



Electric Vehicles Opportunities and Challenges for Networks

AIE Sydney EV Event
27th October 2015

Confidential

Energeia – Who are we?

- Founded in 2009 in Sydney, now largest specialist consultancy in Australia
- 15 full-time experts based in Sydney, with network of distinguished experts
- Expanded into California in 2015 to gain greater exposure to transformative trends
- We seek out transformative projects which, by their nature:
 - Are technically high risk
 - Have high strategic value





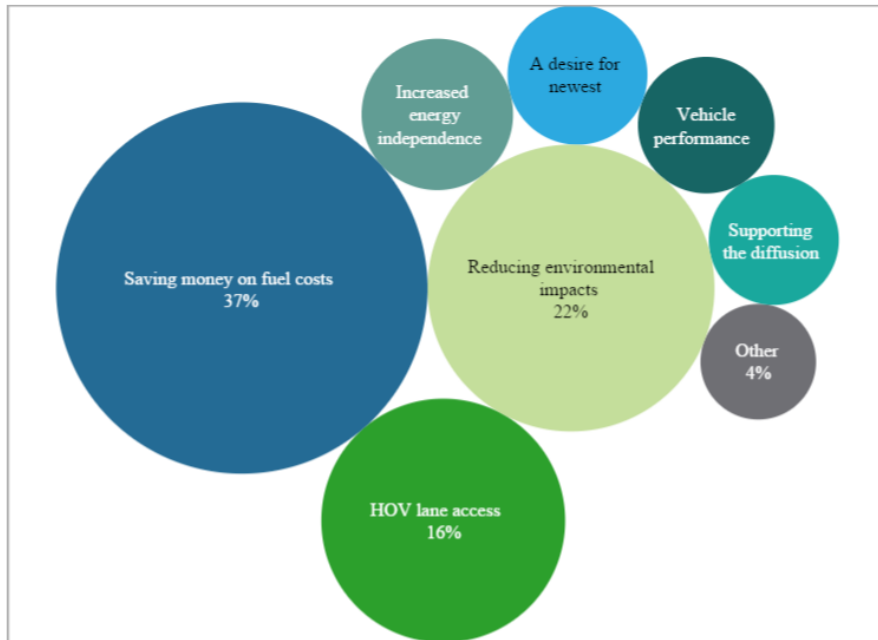
Overview

EV Uptake in Leading Markets

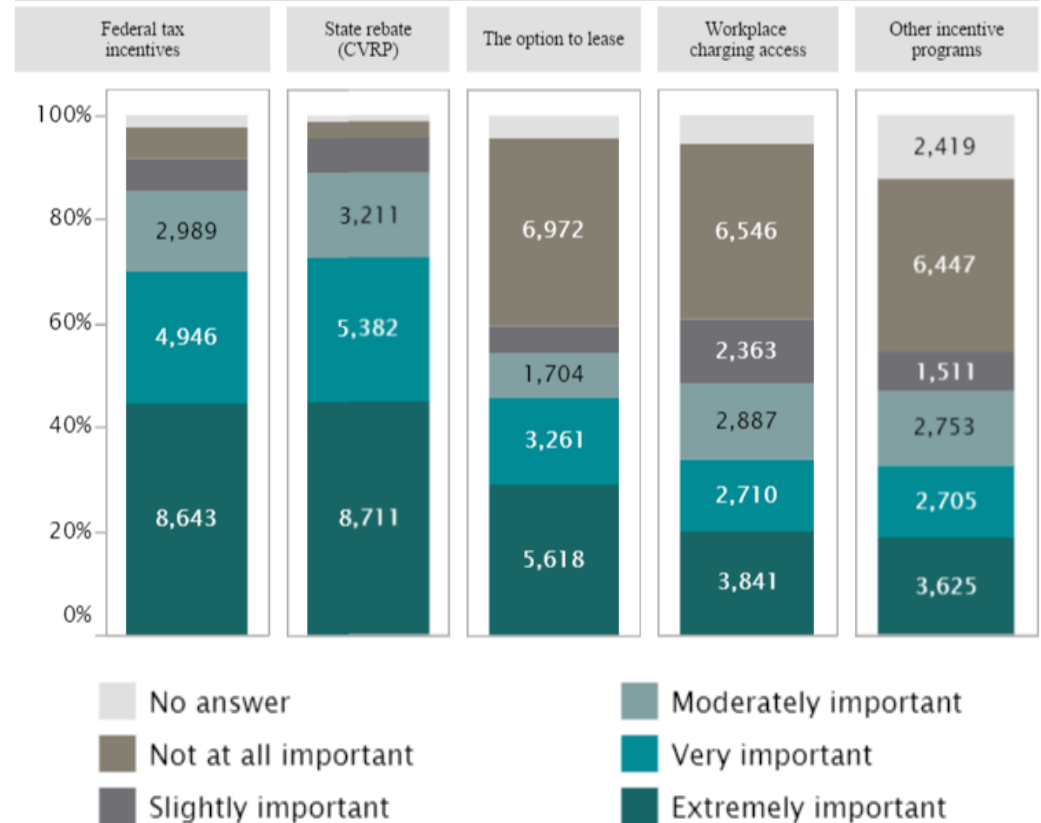


Californian Experience – EV Buyer Motivations and Barriers

Most important reason to acquire an EV



Importance of factors that made it possible to acquire an EV

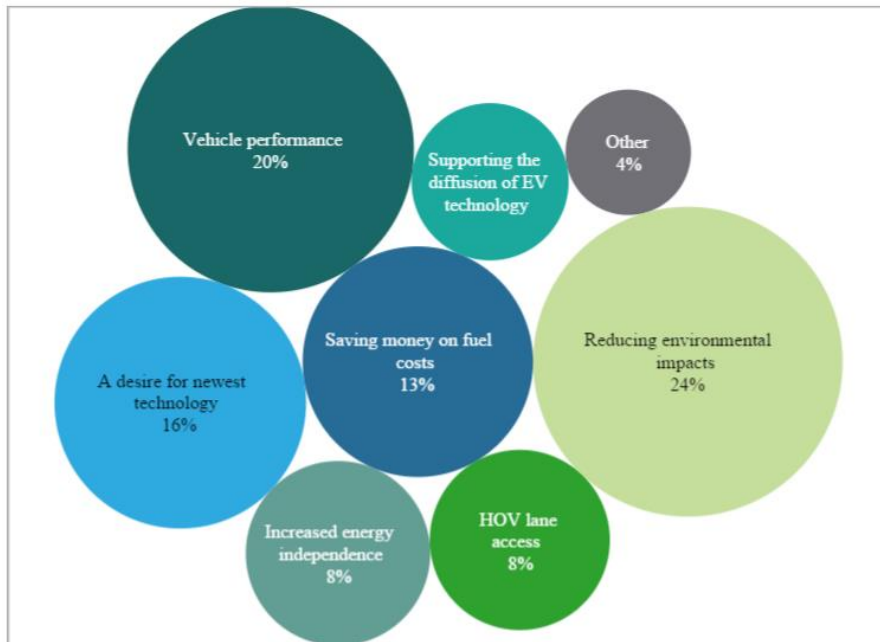


Source: California Clean Vehicle Rebate Project, EV Consumer Survey Dashboard

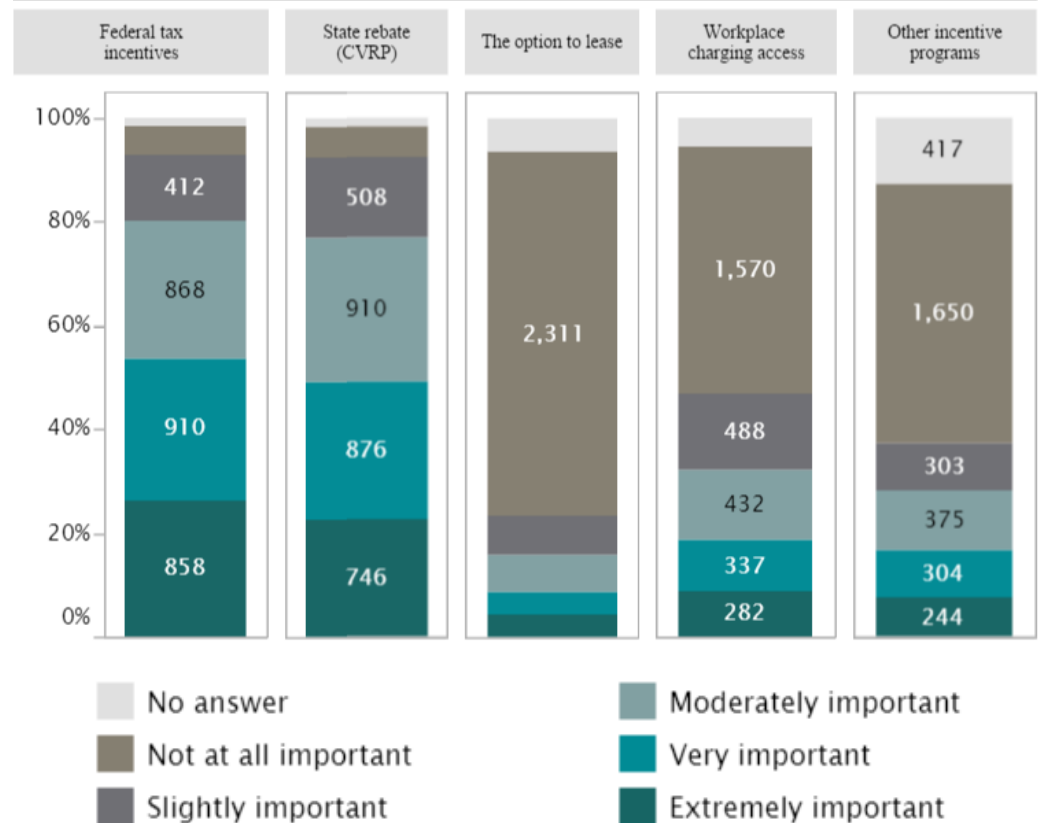
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Californian Experience – Tesla Buyer Motivations and Barriers

Most important reason to acquire an EV



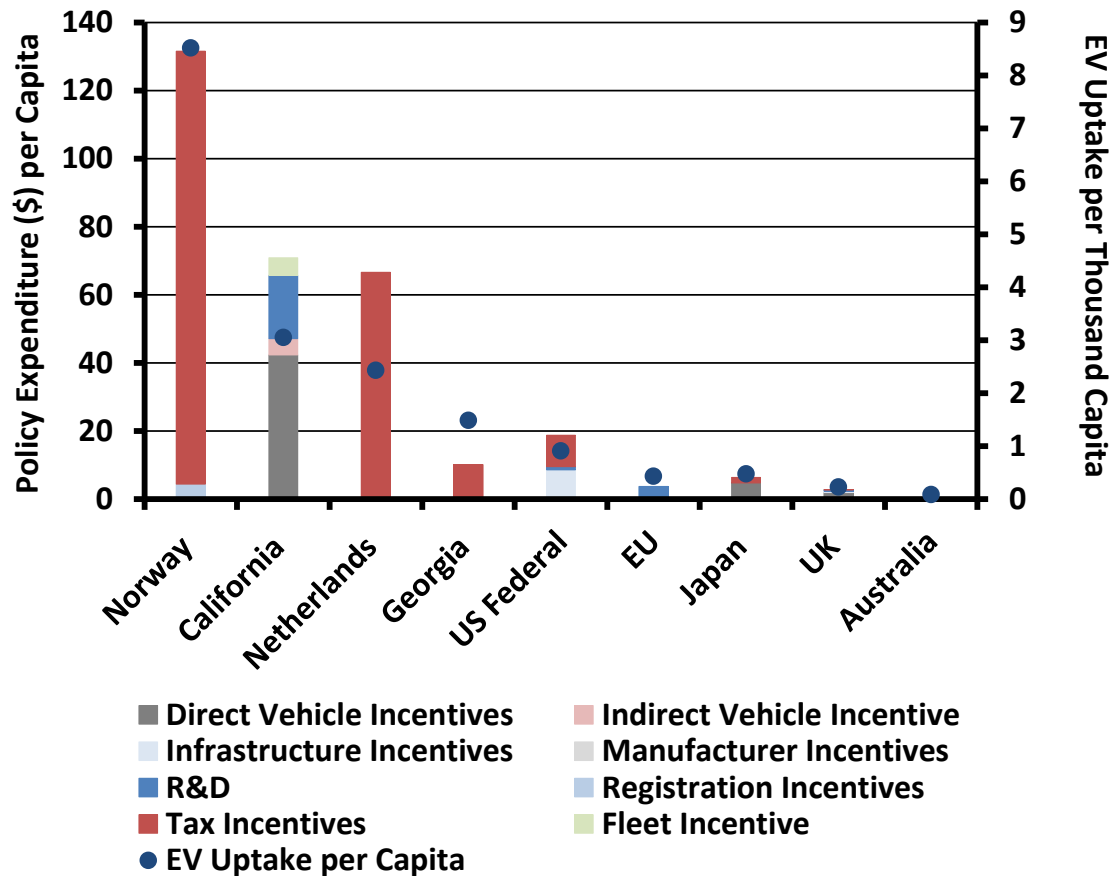
Importance of factors that made it possible to acquire an EV



Source: California Clean Vehicle Rebate Project, EV Consumer Survey Dashboard

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EV Policy Support – Key Driver of Current EV Uptake



Policy support driving uptake

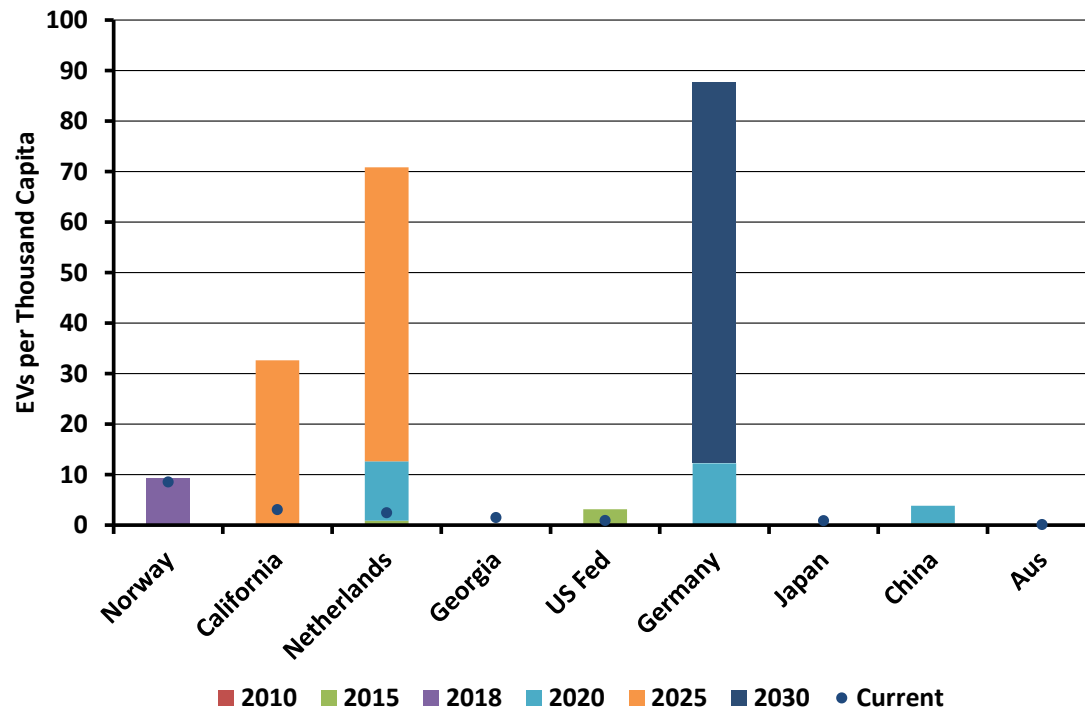
- Large upfront subsidies and tax exemptions assist EVs to achieve purchase price parity with ICEVs
- 92 percent of variation in EV uptake is explained by policy expenditure
- Softer policies – vehicle lane privileges, toll exemptions, ferry toll exemptions – key for EV buyers in CA, Norway

Australia offering little support

- Federal Luxury Car Tax threshold increased to \$75k (~\$5k for Tesla)
- One of few OECD countries without fuel economy or CO₂ fleet standards
- Aligning tailpipe emissions standards with Europe on lagged basis

Source: International Council of Clean Transportation, Inside EVs website

EV Government Targets – Australia to Fall Further Behind



Majority of countries falling behind targets, others overachieving

- Germany aiming for 1 million EVs by 2020, only has 25k EVs
- Norway has already exceeded 2018 target of 50k BEVs
- Netherlands met 2015 target but big jump to 2020 target of 200k
- US only achieved 30% of target of 1 million EVs by 2015
- Japan achieved its 2010 target of 110k in 2015

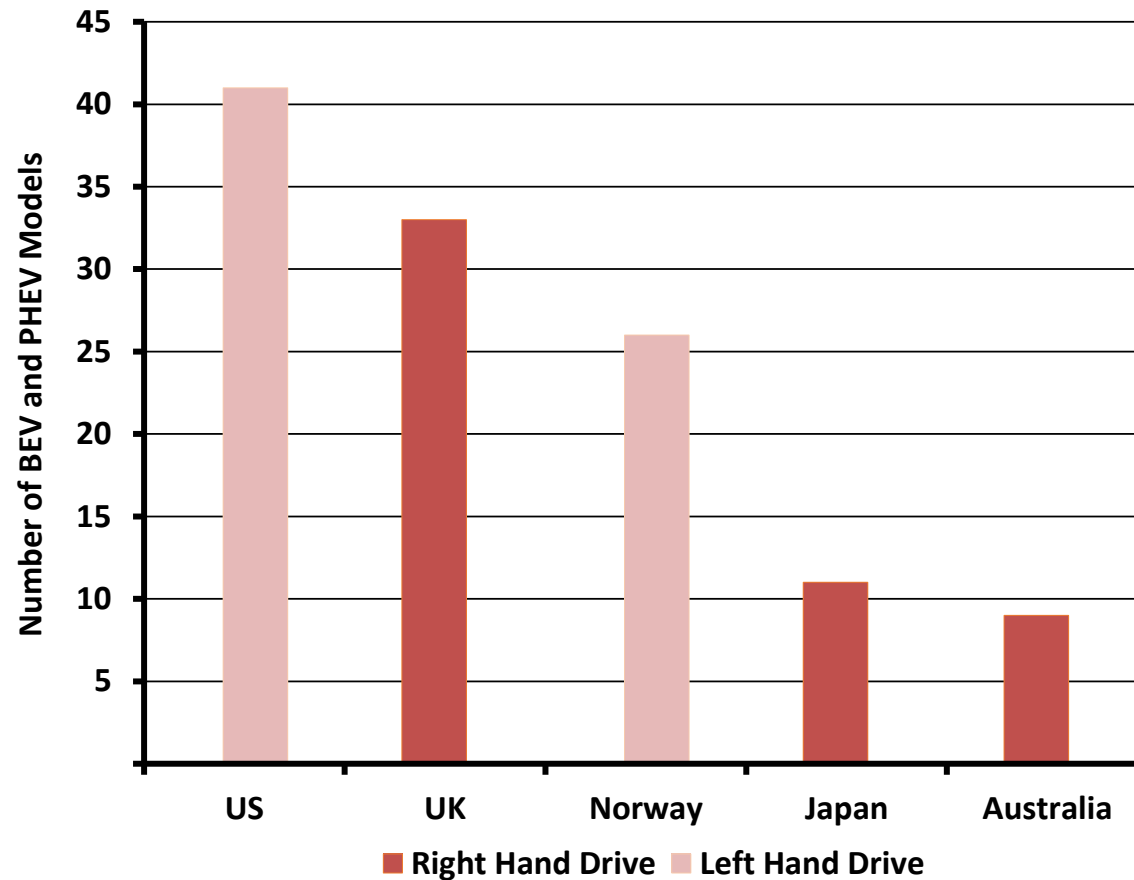
EV target could benefit Australia

- Energeia report for esaa – optimal Australian 2030 target based on low cost policy options is 65-70 EVs per thousand capita

Source: Various government EV program websites, Inside EVs website

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EV Model Availability – Overseas Drivers Have More Choice



Limited model availability is a key barrier

- Large vehicle exporters to Australia (US and UK) have a wider range
- US has 41 models released since 2014, including:
 - 20 compacts/small passenger
 - 7 SUVs
 - 13 luxury sedans
- In Europe 4 OEMs offering light commercial small van models
- Australia has 9 EV models offered by 7 OEMs

Source: US DOE fuel.economy.gov, EV Norway, UK Next Green Car, Australia Green Vehicle Guide

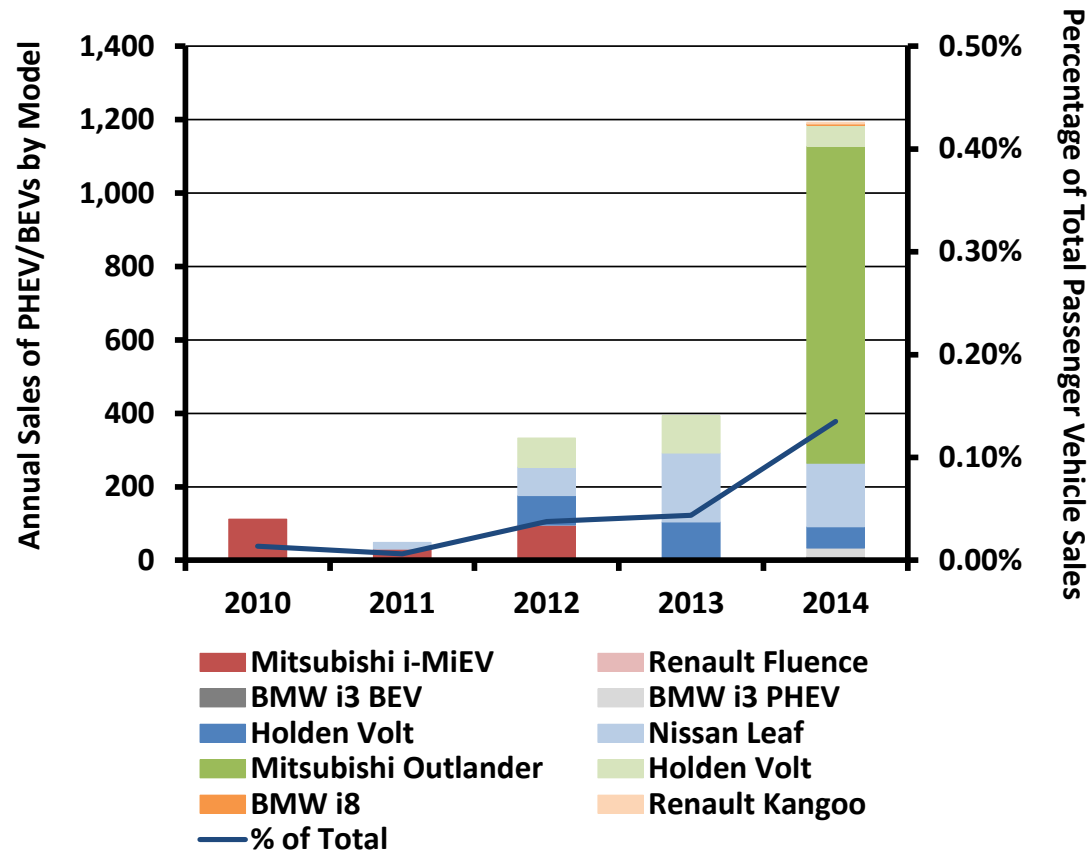
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Overview EV Uptake in Australia



Australian EV Sales to Date – A Drop in the Ocean



A few ripples in the market

- Australian 2014 EV sales quadrupled off very low base
- 22% of new car sales in Norway are EVs (June 2015)
- Commercial sector was largest buyer, attracted by green credentials, O&M savings
- Outlander accounted for 75% of sales in its 1st year of release
- Leaf sales stagnant and Volt has fallen below expectations
- BMW i3 and i8 models made minor sales (36) in 2014
- Tesla sales data not available

Source: Federal Chamber of Automotive Industries VFacts Sales database

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Announced EV Models – The Next Wave to Australia



Tesla Model X (2016)



Audi A3 e-Tron PHEV (2016)



Porsche Cayenne PHEV (2015)



Porsche Panamera PHEV (2015)



Audi Q7 PHEV (2016)



Volvo XC90 PHEV (2016)

The days of the iMiEV are over

- New models will help redefine perceptions of EV performance
- But not mass market models
- Expect moderate sales to niche market – green conscious, technology enthusiasts
- 4 new SUV models
- 5 PHEV variants of existing models
- Q7 diesel PHEV variant may be a tough sell since diesel gate
- A3 e-Tron \$10k less than BMW i3



Outlook

Australian EV Uptake Forecast

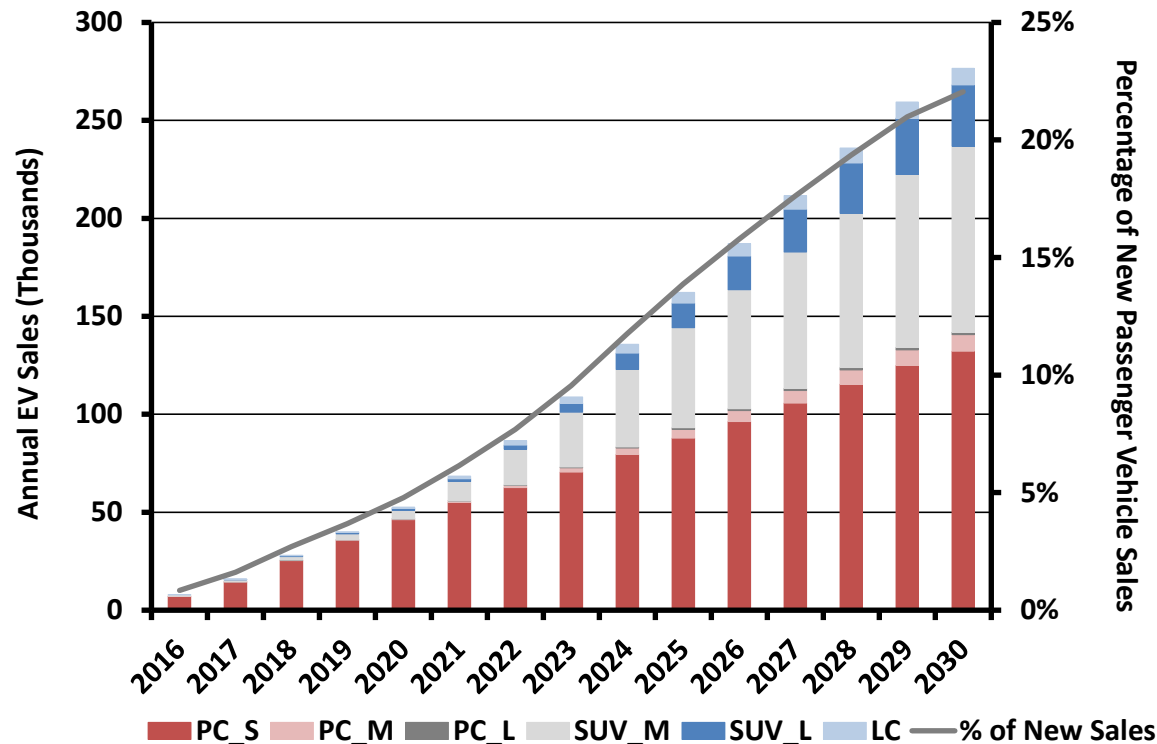


EV Uptake Forecasting – Some Perspective

“There’s a species of crystal-ball gazer making even the most dismal scientists look credible: the electric vehicle sales forecaster.”

- Philip King, Motoring Editor, The Australian

EV Uptake Forecast – Passenger Vehicle Market



23% EV market penetration by 2030

- Uptake strongest in small passenger (PC-S) and SUV medium (SUV-M) vehicle classes
- Driven by stronger fuel savings due to better fuel economy as well as higher underlying growth
- Large sedans struggle to recover upfront cost through fuel savings, as well as declining popularity
- Energeia EV report provides EV uptake forecast by sector:
 - Government
 - Commercial
 - Private

Source: Energeia 2015 EV Report

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Network Impacts

EV Charging Effects



EV Charging Impacts – Increase in Household Bills



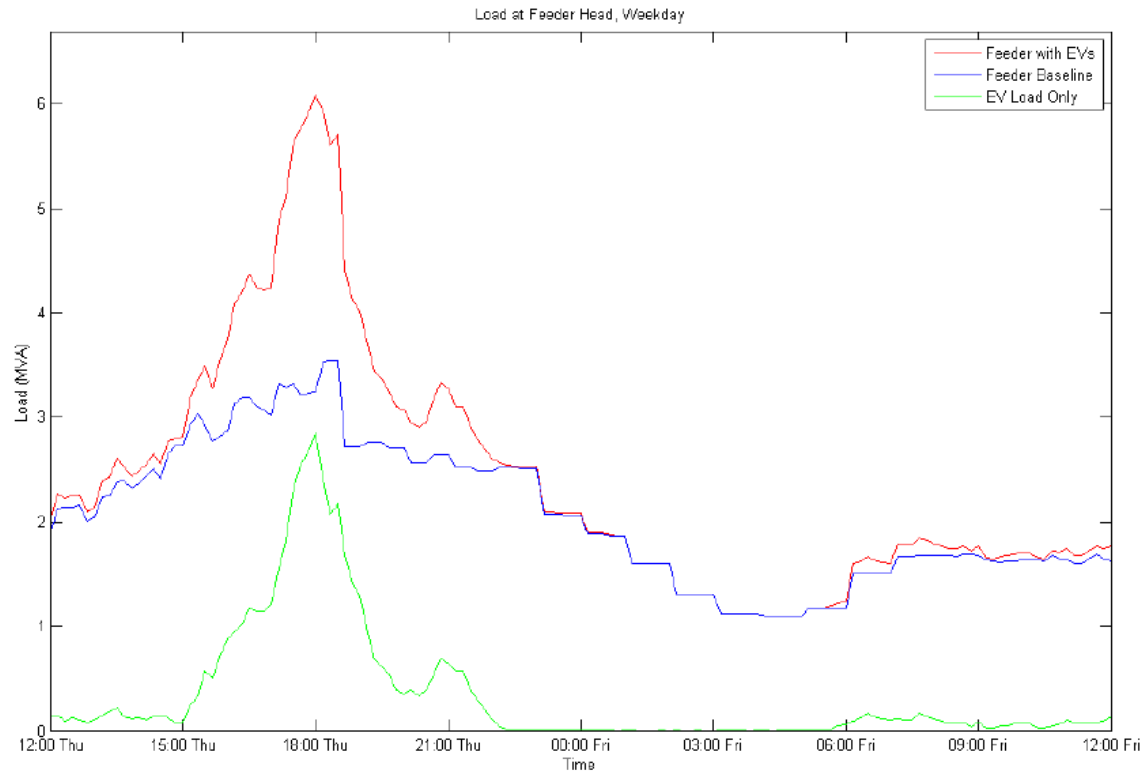
Charging a single EV can increase consumption up to 43%

- Bill impact depends on tariff
- For a QLD household on a flat tariff an extra \$700 pa on bill
- Lower bill impact under demand, time of use tariffs with off-peak charging
- Additional EV consumption offsets displaced consumption from solar PV generation

Source: Energeia report for esaa, ABS, GreenVehicle Guide. Assumes national average vkt and all EV charging at home

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EV Charging Impacts – Asset Load Growth and Augmentation



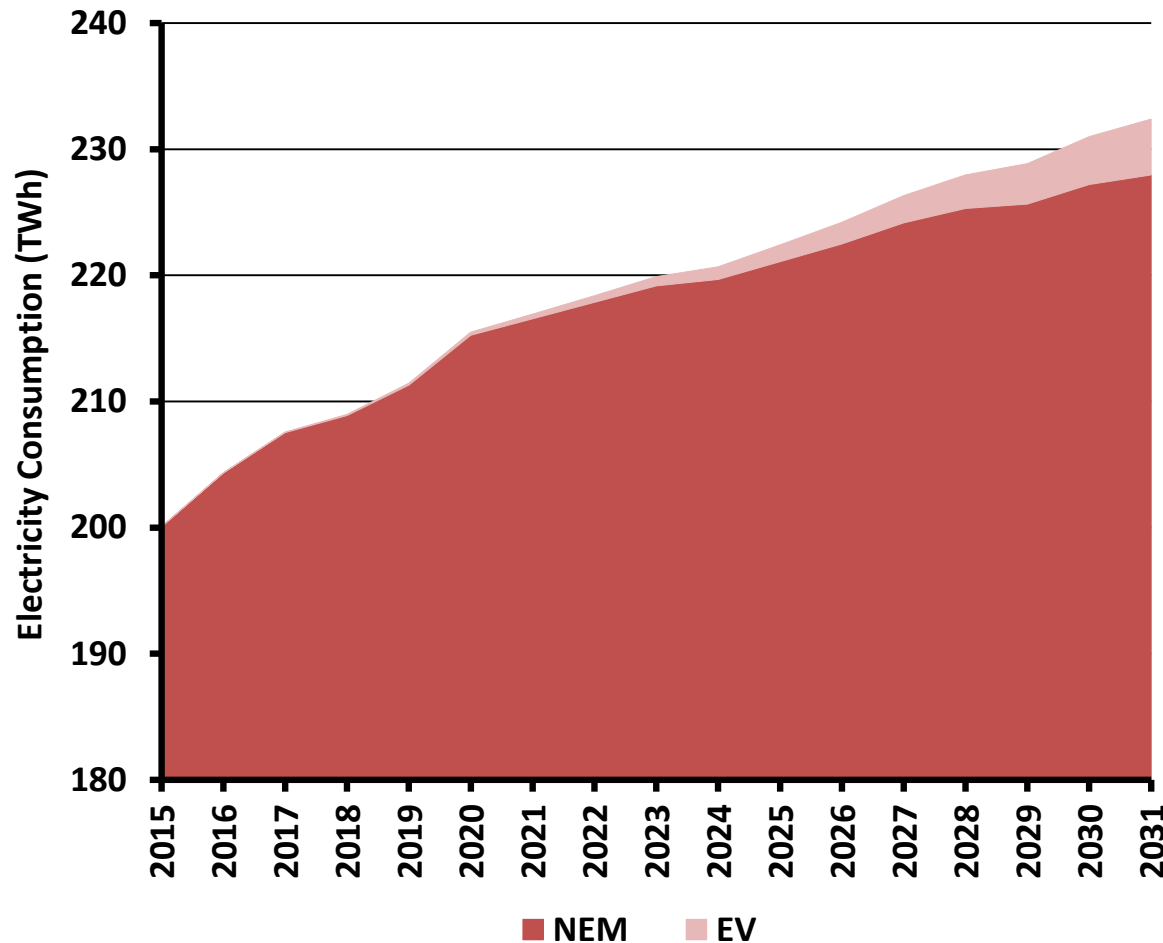
Unconstrained charging can lead to asset augmentation

- Load growth greatest for urban feeders with high density of residential customers (e.g. Elmore Vale)
- Low diversity in arrival home times on weekdays causes feeder load to double at 6pm in this scenario
- EV charging load, highly coincident with peak demand
- Peak demand growth but moderate impact on total energy use, leading to poor load factor
- Feeder head augmentation required due to overloading
- Load growth also experienced at substation level

Source: *Smart Grid, Smart City*, EV Technical Compendium

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EV Charging Impacts – Limited Total System Energy Growth



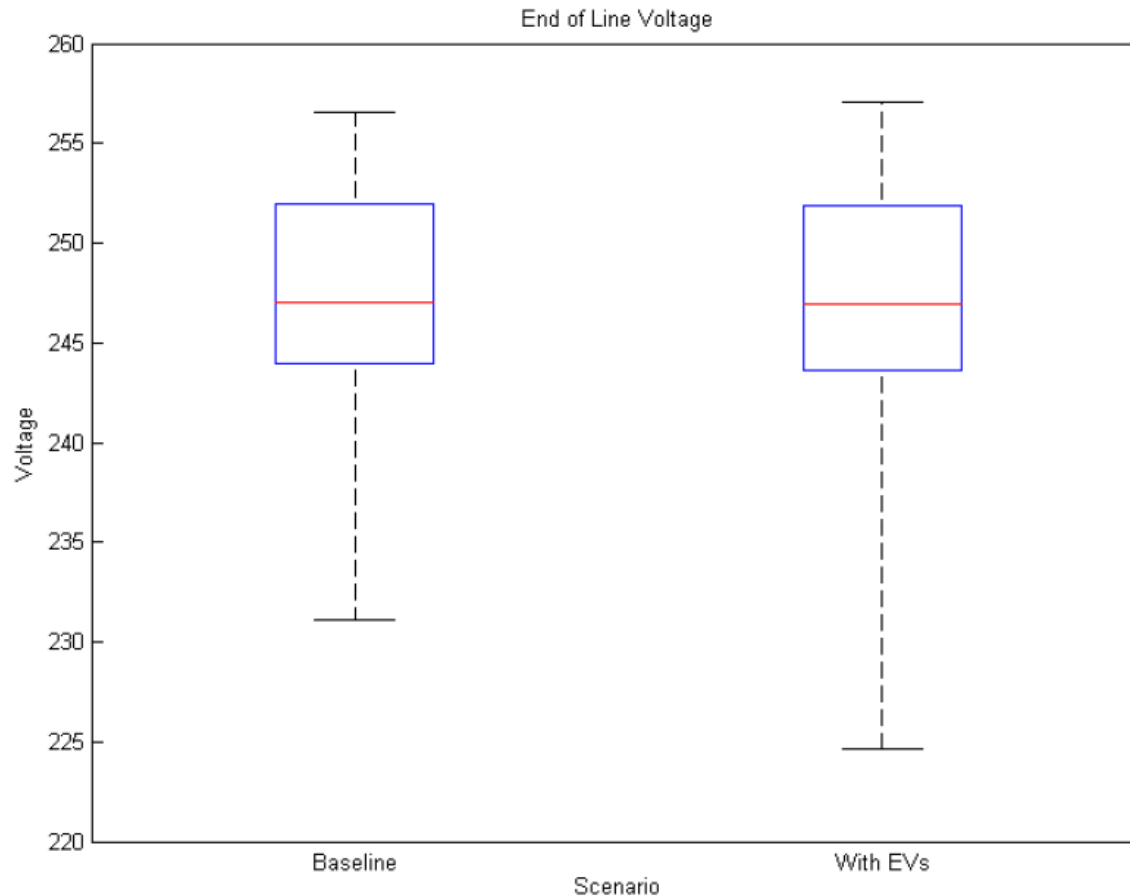
2% increase in NEM consumption by 2030

- Even if whole Australian passenger fleet converted to EVs, additional consumption would only be ~10%
- Therefore value to networks and retailers is not in increased consumption based revenue
- Key value for networks is improved load factor of underutilised assets on urban feeders with high EV uptake, charging load is managed

Source: Energeia, AEMO

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EV Charging Impacts – Voltage Issues

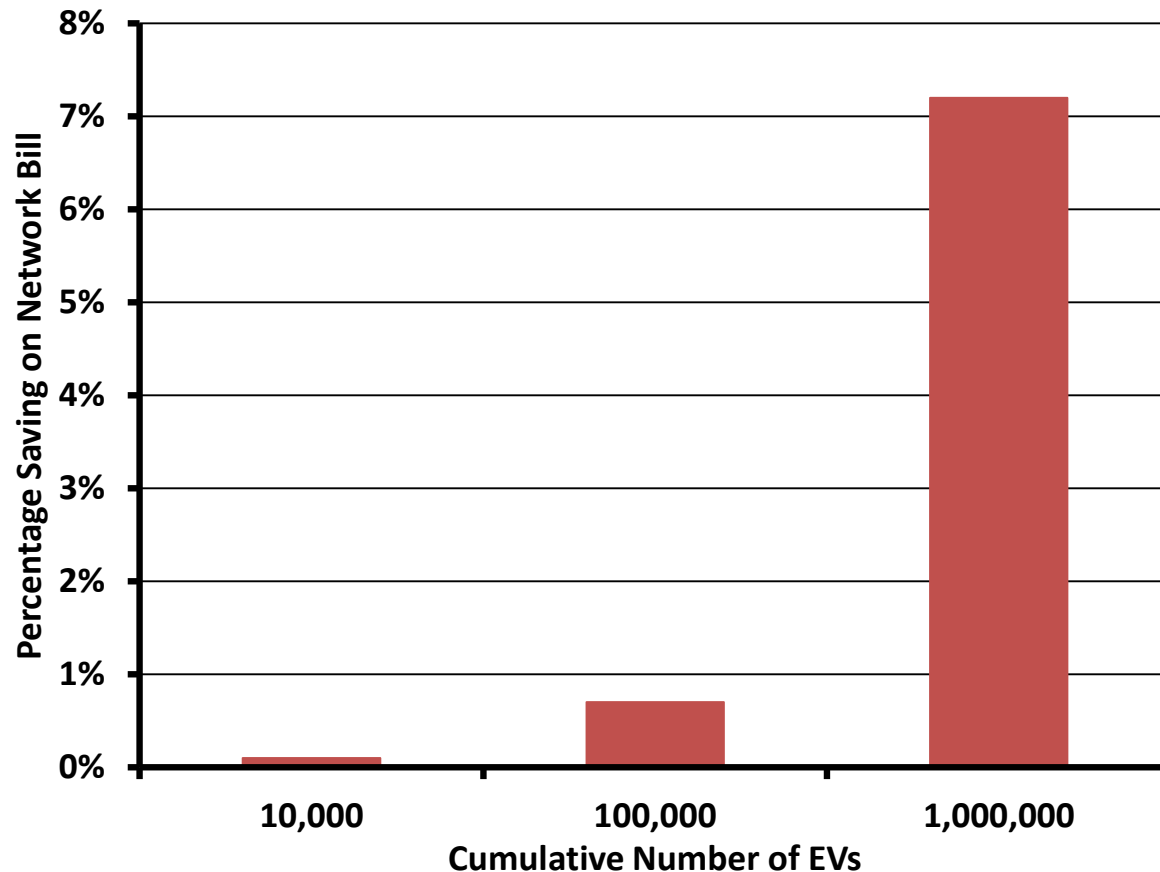


Surge in multiple, simultaneous EV loads can cause voltage drops

- Networks required to maintain voltage between +10 and -6% of 230V at customer premise
- Potential for voltage drops on voltage constrained HV feeders, particularly long feeders
- Large EV loads could drag voltage down at the end of line in LV network, thereby increasing range between min and max voltage
- Poses a challenge for networks to maintain voltage levels
- Difficult to identify optimal configuration for transformer taps

Source: *Smart Grid, Smart City*, EV Technical Compendium

EV Charging Impacts – Residual Cost Sharing Benefits



All customers benefit from increased utilisation due to off peak EV charging, through lower residual network costs

- 1 million EVs in NSW would deliver a 7% saving on the network component of a residential bill
- Equivalent to 20% of NSW fleet
- Assumes that EV charging is managed and does not contribute to peak demand growth and asset augmentation

Source: DNSP Pricing Proposals

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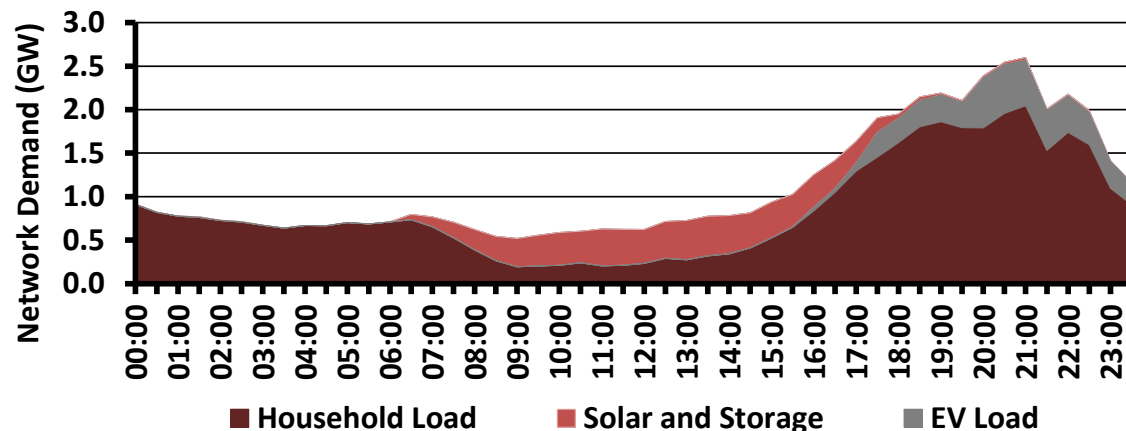
Load Management

Optimizing EV Charging Loads

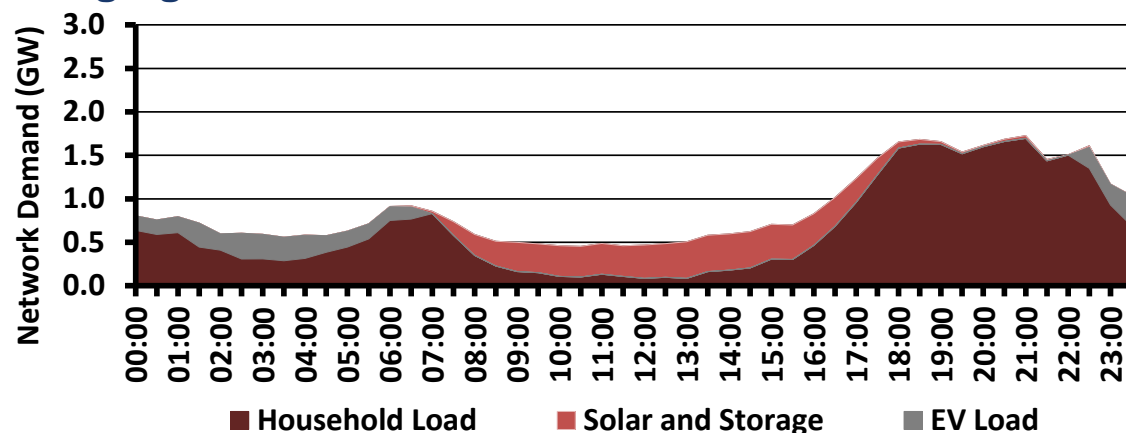


EV Load Management – Tariffs

Unconstrained Charging on Flat Tariff



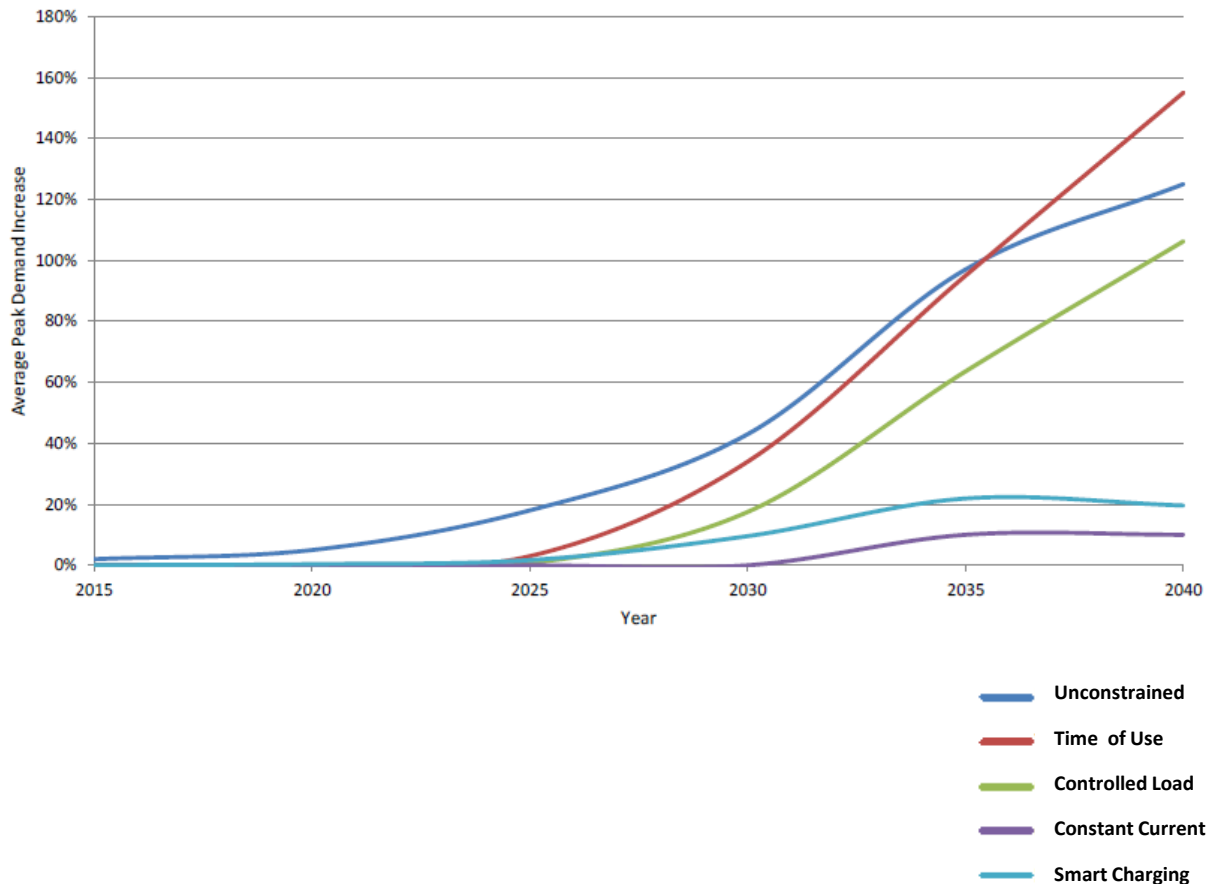
Charging on Controlled Load Tariff



Tariff structure is key to managing EV load, shifting to off peak

- 28 utilities in the US offer EV specific time of use tariffs to incentivize off peak EV charging
- ActewAGL only DNSP or retailer marketing an EV specific tariff
- Existing controlled load and time of use tariffs are well suited to low cost off-peak EV charging
- Importance of staggering on time of channels to ensure EV loads do not create second evening peak
- Common practice to use channels for hot water systems in QLD

EV Load Management – Network Controlled Charging



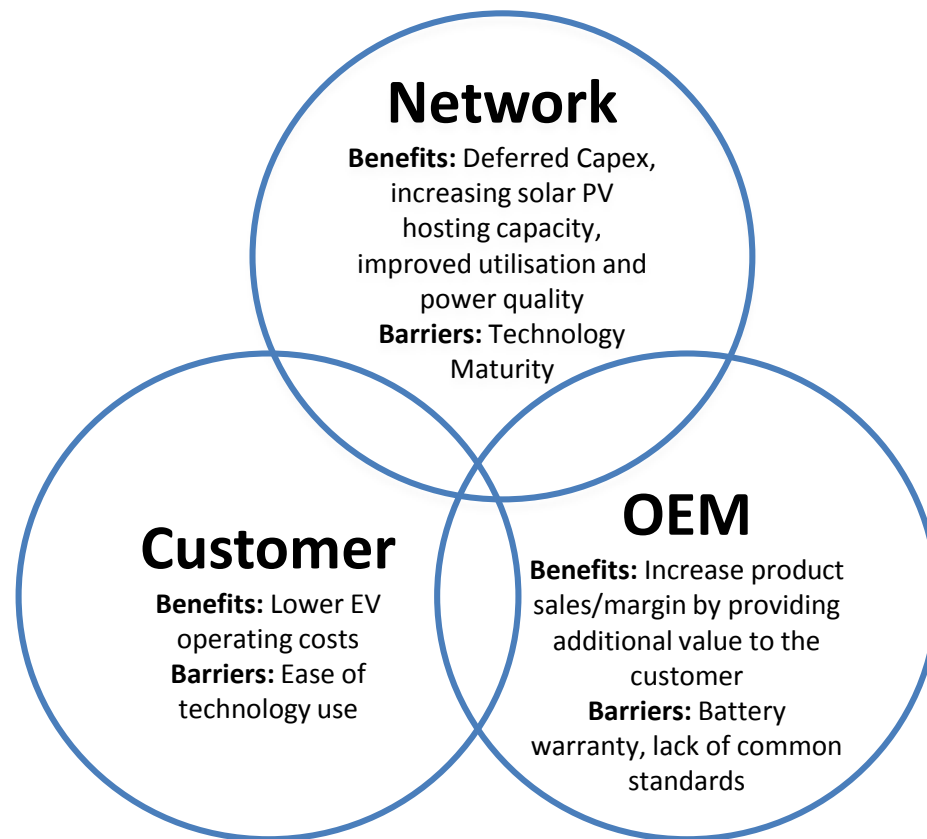
Network controlled charging led to lowest growth in peak demand

- Constant – charge EV at minimum rate to achieve 100% state of charge
- Smart charging – optimal charging rate based on real time feeder load
- Constant and smart charging performed best – least load growth
- Controlled load did not perform well due to sub optimal configuration of channels leading to new 11pm peak
- Time of use also led to new peak due to a lack of charging diversity
- *Smart Grid, Smart City*: if EV charging is managed optimally existing grid infrastructure could accommodate 40% of Australian fleet as EVs without upgrades to network

Source: *Smart Grid, Smart City*, EV Technical Compendium

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EV Load Management – Vehicle to Grid (V2G)



Potential for reduced peak demand and deferred augmentation for network controlled V2G

- Still at demonstration phase
- US Department of Defence trial: V2G could deliver up to \$600/month of ancillary service benefits per EV if available from 7pm-7am
- Benefits for customers, manufacturers and networks need to be demonstrated
- Manufacturer concerns about battery wear and warranty costs a major barrier
- Common standards needed for OEMs to manufacture a V2G compliant vehicle at low cost

Source: Electric Power Research Institute



Supporting EV Uptake

What is the Role of Networks?



Role of Networks – Public Charging Infrastructure

The logo for RWE, consisting of the letters 'RWE' in a bold, blue, sans-serif font.

Overseas utilities providing a range of charging services

- Mostly vertically integrated players
- Potential for Australian networks to play a role in installing, operating and maintaining public charging in strategic locations
- Lack of direct customer relationships a barrier
- However NSPs benefit from:
 - Access to low cost capital
 - State wide operability
 - Experience delivering large scale infrastructure projects

Source: Utility websites

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Role of Networks – Addressing EV Uptake Barriers

Ergon EV Strategy



Removing Barriers

- Quantify the value of EV charging to the Ergon Energy grid
- Develop programs & investigate tariff opportunities that support mutually beneficial EV charging behaviours
- Engage in ongoing sharing of knowledge in order to develop common best practices for industry



Engaging with Stakeholders

- Engage and share knowledge with all stakeholders in order to understand how Ergon Energy can support consumer choices surrounding purchase, ownership and usage of EVs including partnering with key stakeholders where appropriate to demonstrate EV accessibility
- Develop useful impartial information for consumers on considerations when buying an EV and EV charging equipment
- Provide useful tips on good EV usage behaviour, and information on making best use of available electricity tariffs for EV charging



Ensuring Safety

- Work with government to support regulation changes to encourage increased safety of EV charging equipment in line with International and Australian standards
- Establish clear connection requirements for safe interaction between EVs and the grid, for both charging, and exporting (e.g. Vehicle-to-Grid)

Networks have a role to play in overcoming EV uptake barriers

- Providing strategically located public charging e.g. for customers without access to off street parking, fast charging corridors
- Raising customer awareness through championing EV technology via fleet procurement and tariff, charging education campaigns
- Developing charging and V2G connection requirements to ensure safe connections
- Policy advocacy supporting low cost EV policies e.g. fuel economy standards, vehicle lane privileges



The Future of EVs

What is Next?



Diesel Gate – A Game Changer?



Diesel Gate – A Game Changer?



Thank You



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