Electric Vehicles: Driving a Revolution

A Private Report for Retainer Clients

ENERGEIA

1.0 Overview

Major manufacturers are planning to introduce three plug-in Electric Vehicles (EVs) into Australia over the next two years in response to changing consumer preferences and expectations of the EV's future role as a major market segment. By 2030, Energeia is forecasting plug-in EV's will account for over a quarter of all cars on the road in Australia.

Customers have yet to be persuaded en-masse of the benefits of EVs, particularly given their limited range, higher upfront costs and unproven resale value, but this has not stopped major manufacturers from announcing plans for 20 EV models by 2014. Customer demand is currently outstripping supply, and Mitsubishi and Nissan have both announced 50%-100% increases in their near-term production capacity. Even so, Energeia's analysis suggests that it may take several years before supply catches up to demand.

In this inaugural Private Report for our Energy Technology research service clients, Energeia examines the emerging EV industry in Australia to identify the market scope, size and complexion, understand the key drivers, trends, issues and outlook. The report also presents findings from Energeia's analysis and modelling of best practice policymaking, consumer take-up timing and suburb level charging profile, comparative EV costs, energy sales and demand for charging infrastructure.

Energeia's model predicts a relatively modest start for EVs across Australia over the next five years, primarily due to limited vehicle supply. However, the nature of technology diffusion, fleet purchasing patterns and the demographics of early adopters suggest that EVs will cluster in niche, largely affluent communities, with implications for electricity network augmentation and public charging infrastructure deployment. Long-term, Energeia expects EV's dominant role in both transport and energy markets to drive a paradigm shift in wholesale energy and network pricing, and electricity network planning.

By 2030, Energeia forecasts EVs will consume over 6 TWh of electricity annually, be capable of delivering up to 12 GW in demand response, and store over 85 GWh of electricity. This represents less than 3% of the total NEM consumption, but over one third of its peak demand. Unless measures are taken to manage EV demand, Energeia's modelling suggest the electricity industry's evening peak could increase by 1.5% per annum over the next 20 years, adding hundreds of millions of dollars in additional network and generation costs.

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2.0 Introduction

2010 has seen the arrival of the first production scale EV and the installation of the first public EV charger in Australia. Significant government and industry activity is underway, including Victoria's major EV trial and Better Place's plans to roll out charging infrastructure in Canberra from 2012. Even so, Australia is trailing global EV market leaders in Asia, Europe and the U.S.

While there are a range of alternative fuel and propulsion systems emerging, this Private Report focuses on Plug-in Hybrid (PHEV) and Battery Electric vehicles (BEV), which are collectively referred to as Electric Vehicles (EVs). The following sections outline the emerging EV industry structure and value chain, highlight international policy trends and emerging best practice, and analyse international and Australian market developments.[1]

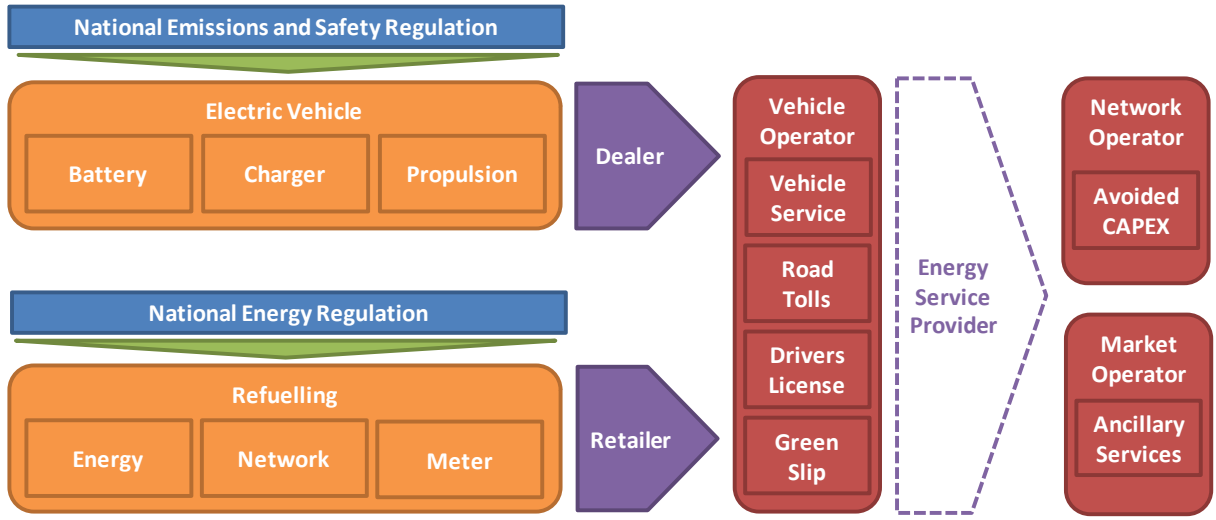
2.1 Industry Structure and Value Chain

The following sections detail Energeia's view of the current EV industry structure and value chains and their evolution over time.

2.1.1 Structure

Energeia's analysis of the EV industry structure is presented in Figure 1. Key regulations are shown as blue squares, industry products and service providers are shown in orange and purple, respectively, with customers shown in red. The structure assumes current conventions around electricity and vehicle supply, though these could change over time through innovation.

Figure 1 – Electric Vehicle Industry Structure



Source: Energeia Research

The energy refuelling segment is largely regulated under the National Electricity Rules (NER), which treat EVs as any other electrical load. While public charging operates on slightly different principles to private charging, electricity metering, pricing and settlement is expected to reflect existing electricity industry standards. EV charging infrastructure includes the refuelling and retailing components.

2.1.2 Issues and Gaps

Although the EV industry is largely based on the existing vehicle manufacturing and electricity value chains, significant development is required to integrate the new fuel, propulsion system and refuelling

[1] EVs include BEVs and PHEVs, but not Hybrid Electric Vehicles (HEVs), which are mainly powered by an Internal Combustion Engine (ICE).

infrastructure into manufacturing supply chains, network infrastructure and energy markets. Energeia's research has identified important gaps in the following main areas:

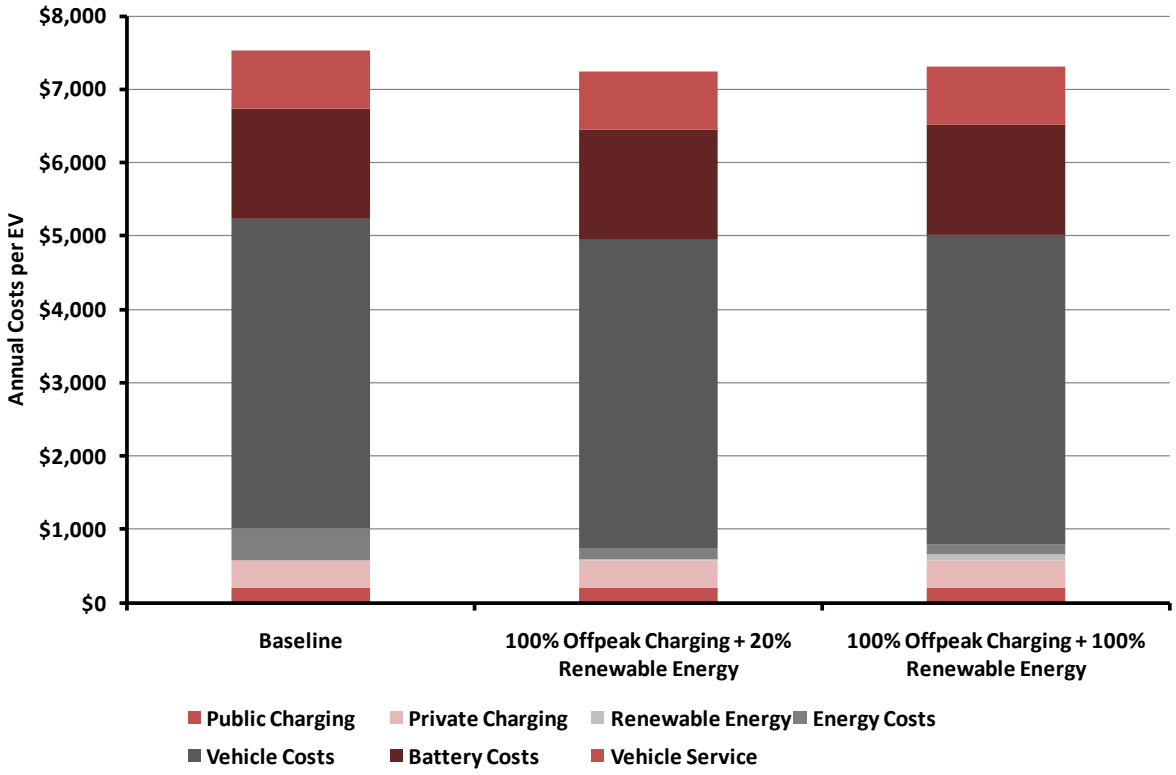
- **Public charging networks** – Public charging is needed to enhance the public profile of EVs, and to provide a convenient, if relatively expensive, option to vehicle drivers.
- **Refuelling plans** – Cost effective and convenient EV operation requires access to off-peak energy and network prices, and roaming access to public charging networks.
- **Demand response incentives** – Minimising the impact from EV charging requires the establishment of demand response incentives by network operators.
- **Vehicle servicing** – EVs are relatively simple, but operators will be locked into dealer service arrangements until independent operators enter the market.

While plans are underway to address the gap in public charging infrastructure, and EV manufacturers are providing vehicle servicing in the near-term, Energeia's research not had identified plans by electricity retailers or networks to introduce EV refuelling plans or incentives, respectively.

2.1.3 Value Chain

Energeia's estimate of Australia's EV industry value chain under three key scenarios is presented in Figure 2. The estimates assume average driving (i.e.1.8MWh of annual energy consumption), a 10 year life for the vehicle, an 8 year life for the battery, and 11% public charging. Energeia has also assumed the installation of private charging driven by demand management and bulk purchasing incentives.

Figure 2 – Electric Vehicle Value Chain (2010)



Source: Energeia Research

What stands out across the scenarios is the relatively minor role played by energy or network costs, the amount of renewable energy used, or charging during peak periods. These costs are almost incidental to the costs associated with purchasing the vehicle, battery and charging infrastructure. Off-peak charging is estimated to save EV drivers around $300 under a Time-of-Use (ToU) tariff, while 100% renewable energy is estimated to add around $80 per year to the average bill.

2.1.4 Cost Evolution

Energeia expects the EV value chain to evolve over time in response to changes in the following key segment costs:

- **Vehicles** – The relative simplicity, economies of scale and reductions in weight are expected to drive down the average costs of EVs over time.
- **Batteries** – Improvements in battery technology and economies of scale are expected to more than halve the costs per kW and kWh over the next decade.
- **Electricity Supply** – The RET and the introduction of a carbon price are expected to more than double the cost of wholesale electricity over the next decade.
- **Electricity Distribution –** Network renewal is expected to double electricity distribution costs over the next decade.
- **Renewables –** Costs are expected to rise as wind is generated on increasingly marginal sites over the next decade.

Overall, the reductions in EV and battery costs are expected to be relatively greater than the increase in wholesale energy and network costs.

2.2 Government Policy and Regulation

Driven by the need for energy security, carbon abatement, new jobs and less urban pollution, most of the world's largest countries have established supportive policies for the accelerated introduction of EVs. These policies are driving many of the near-term EV market trends.

This section examines international trends in EV policymaking, including the development of acceleration programs and the allocation of funds to implement them. Australia's own policy situation is then assessed in light of an emerging best practice framework.

2.2.1 Government Targets

Many of the world's largest and most developed countries have established EV targets supported by development roadmaps, incentive frameworks and substantial government funding. However, as shown in Figure 3, there is wide variation in the target, timeframe and level of financial support pledged by governments. The most aggressive countries are Japan, Israel, Ireland, France, Spain and Germany, with the U.S., China and the U.K. setting what appear to be token targets.

Figure 3 – Government EV Targets and Funding

	Electric Vehicle Targets			Investment	
Country	Vehicles	% of Total	Date	Total ($M)	$ / Capita
U.S.	1,000,000	0.4%	2015	$ 6,000	$ 19.4
China	500,000	0.3%	2012	$ 1,500	$ 1.1
U.K.	100,000	0.4%	-	$ 430	$ 6.9
France	2,000,000	6.2%	2020	$ 2,717	$ 41.5
Germany	1,000,000	2.2%	2020	$ 736	$ 9.0
Spain	1,000,000	4.4%	2014	$ 235	$ 5.0
Israel	500,000	25.0%	-	$ 200	$ 26.3
Japan	34,583,670	50.0%	2020	$ 135	$ 1.1
Denmark	-	-	-	$ 44	$ 8.0
Netherlands	200,000	2.6%	2020	$ 51	$ 3.1
Ireland	250,000	10.3%	2020	-	-
Australia	-	-	-	-	-

Source: Energeia Research

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