Transportation Research Part A 69 (2014) 299–314

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Consumer attitudes about electric cars: Pricing analysis and policy implications

Paul D. Larson [a,*], Jairo Viáfara [b], Robert V. Parsons [c], Arne Elias [d]

[a] CN Professor of SCM, University of Manitoba, 484 Drake Centre, Winnipeg, Manitoba R3T 5V4, Canada
[b] Via < = > Fara Transportation Policy and Planning, Winnipeg, Manitoba, Canada
[c] Centre for Emerging Renewable Energy Inc. (CERE), Canada
[d] Elias Consulting, Victoria, British Columbia, Canada

ARTICLE INFO

Article history:
Received 24 June 2013
Received in revised form 27 August 2014
Accepted 9 September 2014

Keywords:
Electric vehicles
Consumer perceptions
Pricing
Public policy

ABSTRACT

As electric vehicles (EVs) become more readily available, sales will depend on consumers' interest and understanding. A survey of consumer attitudes on electric cars was conducted in Manitoba from late 2011 to early 2012. It utilizes two price assessment methods. The van Westendorp price sensitivity method (PSM) shows the acceptable price range for EVs to be $22,000–27,500. This range closely matches average price range for sales of conventional cars during the same period. The willingness-to-pay method reveals consumers are unwilling to pay large premiums for EVs, even when given information on future fuel savings. A consumer group with experience or exposure to EVs is somewhat different. Nearly 25% of these people are willing to pay a premium of up to $10,000. Different interpretations can be drawn from these responses, calling for further research. An apparent policy opportunity involves consumer education to enhance knowledge and facilitate EV purchase decisions. Survey results also support the hypothesis that EV rollout has focused too much on technology, and not enough on consumers.

1. Introduction

The electric vehicle (EV) is hardly new, first appearing as early as 1834 (Kley et al., 2011). Unfortunately, EVs were quickly eclipsed by fossil-fuel powered competition (Carson and Vaitheeswaran, 2007). By 2011, commercial EVs reappeared (IEA, 2012); their re-emergence facilitated by advances in batteries and motive technologies, including regenerative braking. This revival of the electric car is also driven by global warming and the "sobering prospect of peak oil" (Motavalli, 2012).

EVs are defined as obtaining all or part of the energy for motive operation from the electrical grid. They include battery electric vehicles (BEVs), e.g. the Nissan LEAF or Mitsubishi iMiEV; and plug-in hybrid electric vehicles (PHEVs), e.g. the Chevrolet Volt or Toyota Plug-in Prius.

The road ahead for EVs may be steep and unsure (Elias, 2010). While Brown (2013) forecasts 200% growth over the next ten years, Steinhilber et al. (2013) suggests the promise of EVs has not been realized. Indeed, sales growth has been far short of industry expectations, about one third of anticipated sales (Philip, 2013).

* Corresponding author. Tel.: +1 (204) 474 6054.
E-mail addresses: larson@cc.umanitoba.ca (P.D. Larson), via_fara2@hotmail.com (J. Viáfara), robert.parsons@gov.mb.ca (R.V. Parsons), ael@telus.net (A. Elias).

http://dx.doi.org/10.1016/j.tra.2014.09.002
0965-8564/

Although incentives for buying EVs and the required charging infrastructure have been made available in several jurisdictions, the effectiveness of these incentives has been questioned (Sprei and Bauner, 2011). Several recent studies offer widely varying projections for EV purchases by 2020 (Nemry and Brons, 2010), ranging from 1% to 10% share of the car market. According to Driscoll et al. (2013), environmental incentives and subsidies would have to be raised to "incredible levels" to reach 10% market penetration of EVs by 2020.

EVs offer substantial economic and environmental benefits, by substituting grid-based electricity for fossil fuels. Their operating cost is lower. They also reduce greenhouse gas (GHG) and other emissions, enhance energy security, and promote use of renewable energy (Egbue and Long, 2012). EVs have been identified as an important factor in the move toward sustainability in the automotive industry (Maitin and Lacy, 2011). Given these societal benefits, governments at all levels have good reasons to facilitate uptake of EVs. However, creating effective policy requires understanding consumer perceptions and attitudes toward these vehicles (Schuitema et al., 2013).

In this paper, data from a survey of consumer attitudes in Manitoba, Canada are used to evaluate pricing and identify appropriate policy responses. Two approaches for pricing evaluation are included: (1) the van Westendorp price sensitivity method (PSM), used to define an acceptable price range for consumers; and (2) consumer willingness-to-pay a premium.

1.1. Purchasing processes

Buying and selling an EV involves two inter-related processes. For buyers, the process entails five steps, as follows: (1) need recognition; (2) information search; (3) evaluation of alternatives; (4) purchase decision and (5) post-purchase evaluation. From the seller's view, the *purchasing funnel* also includes five stages: (1) awareness; (2) familiarity; (3) imaging; (4) knowledgeable consideration and (5) purchase decision. The intersection of these two processes is the purchase decision, which is known to be only partly rational, involving a variety of consumer purchasing heuristics (Jansson-Boyd, 2010; Turrentine and Kurani, 2007).

1.2. Manitoba as a location for pricing evaluation

Manitoba is a unique place to assess EV pricing. Winnipeg, its largest city, is an ideal test market for new products, displaying consumer characteristics similar to other larger markets (Onkvisit and Shaw, 2006). Manitoba also features the following advantages for EVs: (1) the lowest electricity rates in North America; (2) lowest GHG electric grid-mix in North America (98% renewable); (3) available plug-in infrastructure for recharging; and (4) population used to "plugging-in" engine block heaters during winter months (IEM, 2011).

Even without incentives, cost evaluation by EVTEC (2012) suggests an EV would eventually pay off and be more economical than a conventional vehicle in Manitoba; though the payback period might be too long for many consumers. This advantage can be expressed by the ratio of retail gasoline price per litre to residential electricity rate per kWh. This is a ratio of purchasing power parity, allowing comparison over time and between jurisdictions, with effects of currency rates removed. The ratio of gas to electricity price varies across North America. As confirmed by EPRI (2013), the price of gasoline is a key variable affecting economic viability of EVs.

In Manitoba, the ratio during 2012 was approximately 17 (gasoline at $1.20 per litre; electricity at $0.07 per kWh). Based on United States Bureau of Labor Statistics (2012a, b) data, the mid-year average ratio in the U.S. was about 7, but only 6 in California and 5 in New York. Similarly, Tseng et al. (2013) use average U.S. prices of $3.68/gallon ($0.97 per litre) and $0.13/kWh., which imply a ratio of 7.46. California is often considered a high priority market for EVs, despite a rather low ratio. The EVTEC (2012) analysis using California cost data suggests EVs would not pay off without purchase incentives, at current battery prices. In the EPRI (2013) analysis, EVs also fail to pay off without incentives. This helps explain the emphasis on purchase incentives in North America. Of course, purchase incentives are not the only policy tool available to accelerate EV adoption. They are also not necessarily the best approach in all jurisdictions.

From late 2011 to early 2012, a consumer survey of attitudes about EVs, including their pricing, was done in conjunction with the Manitoba PHEV Demonstration, a program involving ten converted vehicles monitored for three years (CERE, 2011). This paper focuses on analysis of vehicle pricing, along with policy implications.

2. Relevant literature

The EV literature has grown dramatically in recent years. This selective review focuses on published work dealing with EV market penetration and consumer perceptions of pricing and other car characteristics. Work on technological evolution, comparison and evaluation, as well environmental aspects, is not considered.

Based on their review of EV penetration rate studies, Al-Alawi and Bradley (2013) suggest that three market forecasting techniques are used in the literature: agent-based models (simulation), consumer choice models, and diffusion models (curve-fitting). The relevant agents in market penetration rate studies include: consumers, car manufacturers, policy makers and fuel suppliers. For instance, Driscoll et al. (2013) simulate consumer demand for EVs in Ireland using revealed preference data. Vehicle price, fuel cost, driving range, battery replacement cost, charging time and maintenance cost are among the important attributes used in consumer choice modelling.