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Incentives to Encourage the Adoption of Connected and Automated Vehicles: Lessons Learned from Hybrid-Electric Vehicle Incentive Programs

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Abstract: Connected and Automated Vehicles (CAVs) offer the potential to improve roadway capacity and safety. Thus, improving road infrastructure condition could be prioritized to eliminate further degradation of the transportation infrastructure. In order to foster the adoption of CAVs, incentives can be used; but there is a need to identify what type of incentive would be most effective. To identify effective incentive types, this study uses electric vehicles (EV) and hybrid vehicles as a surrogate to CAVs because of the similarities in obstacles faced for wider adoption. This study then provides some recommendations by examining incentives offered in 15 different countries and by reviewing the literature on the effectiveness of incentive types.

Keywords: incentive; connected vehicles; automated vehicles; electric vehicles

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1. Introduction

Connected and Automated Vehicle (CAV) technologies are rapidly advancing, and they could be operational on our streets and highways within the next decade. These technologies have the potential to improve travel experiences by reducing congestion, travel time, crashes, and potentially energy consumption [1]. In addition, these vehicles can travel at shorter headways, thus improving the capacity of existing roadways [1,2] and stability of the traffic stream [3,4]. However, to achieve significant improvements in road capacity, there needs to be high market penetration of CAVs [5]. For example, Litman [2] estimated that at 50% CAV market penetration, road capacity would increase by 22%.

While studies have demonstrated the potential increases in road capacity with CAV adoption, the literature also documents the obstacles these vehicles face for wider adoption such as higher costs, liability issues, and privacy concerns. In addition to these, public acceptability also plays a major role, as they are the primary end users of CAVs. Research found that three out of four drivers are afraid to ride in AVs [6] because they are concerned about the lack of control and safety [7].

To foster the adoption of CAVs, incentives could be used; but there is a need to identify what type of incentives would be highly effective. Incentives have been proven to be an effective tool to motivate people to do something [8,9] although not all incentives are equally as successful. However, there are currently no such programs on CAVs as they are still in the development stage. Therefore, the objective of this study is to use electric vehicles (EV) and hybrid vehicle incentives as a surrogate to identify effective incentive types for the United States to make recommendations on CAVs. This study uses EV and hybrid vehicles as a surrogate for CAVs because of the many similarities in the obstacles they face/faced for wider adoption: (a) like EVs, CAVs must become cost-competitive; (b) both vehicle types lack trust by the public; and (c) the "chicken and egg" problem—for

the government to provide specific infrastructure, they expect people to buy vehicles, and people do not buy vehicles as there is no supporting infrastructure.

Thus, this study aims to review the literature on the effectiveness of different incentive types and provide recommendations to policy makers. Based on the authors' knowledge, this study is the first of its kind to recommend effective incentive types to promote CAV adoption. The background section provides information on current transportation issues and how CAVs can help address some of them.

2. Materials and Methods

This study examined incentives of a total of 15 different countries across the world (mostly developed countries since the authors aimed to identify effective incentive types for adoption in the US). The authors handpicked two to three countries from each continent. The basis for choosing a specific country is dependent on the availability of incentive and the relevant literature studying the effectiveness of the incentive. Research suggests that countries can learn from each other about incentives [10] but should be adapted to local conditions [11]. An extensive literature search was conducted to identify articles on electric vehicles' incentive effectiveness. The snowball mechanism was adopted to throw a wider net at identifying relevant articles i.e., articles' references were examined to identify relevant literature.

3. Findings

Incentive types can be grouped into three broad categories: fiscal, non-fiscal, and indirect. Fiscal incentives refer to incentives that provide direct monetary benefits such as subsidies and income tax cuts. It is important to note that most incentives target the downstream of the production chain, the customers. Incentives are not unlimited. For example, in Denmark, taxes were to be raised after 5000 new electric car sales or until 1 January 2019 [12]. Table 1 provides a summary of incentives in 15 different countries.

Table 1. Fiscal, Non-Fiscal and Indirect Incentives across 15 countries (including U.S.).

Country	Fiscal Incentive				Non-Fiscal Incentives			Indirect Incentives
	Purchase	Scrappage	Post-Purchase	Income Tax	Free/Reduced Parking Fees	HOV or Bus Lane	Toll/Ferry Fee Exemption	Gas/Carbon Tax
China	✓				✓	✓		
Japan	✓		✓					✓
Singapore	✓							
South Korea	✓		✓		✓			
UAE			✓				✓	
Denmark	✓		✓		✓	✓		
Germany	✓		✓					
Norway	✓		✓		✓	✓	✓	✓
Switzerland			✓					
Netherlands	✓		✓	✓ [2]				✓
UK	✓	✓	✓		✓ [1]			✓
Canada	✓							
U.S.	✓	✓	✓	✓	✓ [1]	✓ [1]	✓ [1]	
Australia	✓ [1]		✓ [1]					
New Zealand			✓					

Note: ✓ implies incentive present in the country; [1] Local incentives—not offered everywhere in the country, [2] for company cars.

The type of incentive, as well as the generosity, could have an influence on the buyer's purchasing decisions. In the following section, the authors conduct a literature review to assess the effectiveness of a given incentive program (in the U.S. and other countries) in attracting the public to buy EV vehicles.

3.1. Effectiveness of Fiscal Incentive Programs

The fiscal incentives discussed in this section are purchase subsidies, accelerated vehicle scrappage programs, post-purchase subsidies, and income tax credits. Table 2 provides an overview of the effectiveness of different fiscal incentives.

Table 2. Effectiveness of Fiscal Incentive Programs.

Fiscal Incentives	Region	Effective	Not Effective
Purchase Subsidies	U.S.	Sullivan et al. [13]; Jin et al. [14]; Yang et al. [15]; Diamond [16]; Gallagher and Muehlegger [17]; Narassimhan and Johnson [18]	Eppstein et al. [19]; Hardman and Tal. [20]
	OC	Yang et al. [15]; Sierzchula et al. [21]; Bjerkan et al. [22]; Shepherd et al. [23]	Antweiler and Gulati [24]
Accelerated Vehicle Retirement/Scrappage Programs	U.S.	Zhang et al. [10]	-
	OC	Brand et al. [25]	-
Post-Purchase Subsidies	U.S.	Gordon et al. [26]	Yang et al. [15]
	OC	-	-
Income Tax Incentives	U.S.	Diamond [16]; Narassimhan and Johnson [18]; Beresteanu and Li [27]; Clinton [28]; Tal and Nicholas [29]	Gallagher and Muehlegger [17]; Eppstein et al. [19]; Skerlos and Winebrake [30];
	OC	Aasness and Odeck [11]; Sierzchula et al. [21]; Zhou et al. [31]; Fearney et al. [32]	-

OC = Other Countries, U.S. = United States.

3.1.1. Purchase Subsidies

Purchase subsidies include, among others, value added tax (VAT) or sales tax exemption, one-time registration tax/fees waivers, and rebates.

USA: According to Sullivan et al. [13], without purchase subsidies the plug-in hybrid electric vehicle (PHEV) fleet penetration will be less than 1% in ten years in the U.S. Nevada and Utah have a similar level of incentives (in terms of dollar value), however, Utah has more EV sales: this could be explained by the fact that Utah relies heavily on purchase subsidies while Nevada relies on free parking [14]. In contrast to Sullivan et al. [13], Eppstein et al. [19] stated that purchase subsidies are ineffective because the consumers have low confidence in EVs or PHEVs.

Other Countries: Across several countries, 78% of the fiscal incentives are purchase subsidies [21]. Many studies suggest that purchase subsidies are the most significant tool to promote EV adoption because the monetary benefit seems higher for consumers as it is provided upfront [15,21,22]. In Norway, a survey revealed that 80% of respondents rated that the exemptions from purchase tax and VAT play a crucial role in the purchase of Battery Electric Vehicle (BEVs) [22]. In the UK, purchase subsidies are helpful to overcome the initial price difference and boost the market; however, it becomes expensive to maintain long-term [23]. Purchase subsidies did not stimulate the sales of EV and hybrid vehicles in Canada because of "free riders", people who would buy the vehicle even without subsidy [24].

3.1.2. Accelerated Vehicle Retirement/Scrappage Programs

In addition to the aforementioned incentive programs, the accelerated vehicle retirement/scrappage program serves a similar purpose by encouraging people to purchase new vehicles. This program is quite common to replace low fuel-efficient older vehicles with newer vehicles. Another motive behind these vehicle scrappage programs is to stimulate economic growth.

USA: The Cars Allowance Rebate System (CARS), also known as Cash for Clunkers, encouraged more customers to purchase more fuel-efficient vehicles. The motive behind this legislation was to stimulate the U.S. economy during recession, as well as support automobile manufactures. After the program ended, the sales of electric vehicles fell, which suggests that the program influenced sales significantly [10].

Other Countries: In the UK, the scrappage program lasted for a year (2009–2010) and generated 400,000 new car registrations. While this program was designed to reduce carbon emissions, it provided a stimulus for the car industry and boosted the market instead [25].

3.1.3. Post-Purchase Subsidies

Post-purchase subsidies include, but are not limited to, exemptions on road tax, ownership tax, environmental tax, and discounted electricity rates.

USA: Gordon et al. [26] suggested that discounting energy rates would be an efficient way to promote Plug-in Electric Vehicles (PEVs). A discount on electricity rates is given by several departments across the U.S. including Los Angeles Department of Water and Power, Georgia Power, Austin Energy, Alabama Power, etc. Even though the post-purchase and purchase subsidy have the same face value, consumers valued post-purchase subsidy low in monetary benefit [15].

Other Countries: Exemption on congestion charge in London (UK), discounts on annual automobile tax in Japan, and exemption on environmental improvement charge in South Korea are some other examples of post-purchase subsidies [33,34]. Even though there are several varieties of post-purchase subsidies in effect across the world, the literature does not document the effectiveness of any of these incentive programs.

3.1.4. Income Tax Incentives

There are two types of income tax incentives: tax credits and tax deductions. Tax credits are a dollar reduction of the income tax liability while tax deductions lower the taxable income and are equal to the marginal tax bracket percentage.

USA: Income tax incentives were found to be effective in attracting the public as they reduce the cost of vehicle ownership [16,18,27–29]. The U.S. government changed to a tax credit system in 2006 which explained 20% of the hybrid sales compared to 5% with tax deduction between 2001 and 2005 [27]. A $1000 rise in tax credit value leads to 2–10% increase in per-capita BEV registrations [28]. On the contrary, federal tax incentives were found ineffective [30] because they require more effort and are difficult to understand [18]. Income tax credits are more generous than sales tax waivers; however, sales tax waivers are associated with a 52% increase in sales while income tax credits lead to a 15% increase [17]. According to Skerlos and Winebrake [30], tax credits would be more effective when offered at different levels based on the consumer's income and location. Higher income level people may buy EVs regardless of the tax credit, and lower income people may not buy due to low tax credit.

Income tax incentives are expensive for the government. Beresteanu and Li [27] found that a flat rebate program (equal monetary benefit to all buyers) is as effective and costs 15% less for the government. Temporary tax credits do not have a lasting effect unless manufacturers lower the prices [19].

Other Countries: In the Netherlands, PEV sales increased months before a tax credit incentive was to expire [31]. Tax incentives are not revenue neutral [11,35]. For example, they have led to a fall in revenue by 30–50% (~€6.4 billion) between 2008 and 2013 in the Netherlands [35]. Therefore, tax incentives should be reduced with time [32].

3.2. Effectiveness of Non-Fiscal Incentive Programs

Non-fiscal incentives are incentives where there is no exchange of money, but the EV owner benefits from these because they save time or reduce the cost of use. Table 3 consolidates the research on the effectiveness of non-fiscal incentive programs.

Table 3. Effectiveness of Non-Fiscal Incentive Programs.

Non-Fiscal Incentives	Region	Effective	Not Effective
Free Parking	U.S.	Zhou et al. [31]	Jin et al. [14]
	OC	Langbroek et al. [36]; Zhou et al. [31]; Zheng [37]	Fearney et al. [32]; Aasness and Odeck [11]
Toll/Ferry fee exemption	U.S.	Zhou et al. [31]	-
	OC	Figenbaum et al. [38]	Sime and Sivertsen [39]; Bakker and Trip [40]
HOV/Bus Lanes access	U.S.	Jin et al. [14]; Narassimhan and Johnson [18]; Tal and Nicholas [41]	Saphores and Dillon [42]
	OC	Zhou et al. [31]; Fearney et al. [32]	Bakker and Trip [40]; Mersky et al. [43]

3.2.1. Free Parking

By offering free parking privileges, the government hopes to promote adoption of EV Vehicles.

USA: In the U.S., Arizona, Connecticut, Hawaii, and Nevada have free parking programs for PEVs. Zhou et al. [31] stated that free parking is an effective incentive, though it is most effective when charging infrastructure is also available. However, purchase incentives are more effective compared to free parking in attracting the public [14].

Other Countries: Free parking has been effective in both densely and sparsely populated countries such as China, Norway, Sweden, and Japan [31,36,37]. Moreover, in Sweden, free parking is the most effective among other incentives such as free charging, access to bus lanes, and purchase subsidies [36]. However, free parking is ineffective because it is not profitable in Norway [11,32]. Furthermore, free parking is a use-based incentive; they do not help the consumers who cannot afford EVs [36]. In fact, free parking reduces the usage cost to the EV owners, which leads to an increase in driving and parking [36]. Since the revenue is affected, these incentives should be phased out with time [38].

3.2.2. Toll/Ferry Fee Exemption

Through exemptions on toll and ferry fees, the government hopes to appeal to those who have to pay these fees frequently.

USA: A few studies discuss the effectiveness of toll or ferry fee exemptions [31]. However, as EVs make up a greater percentage of the fleet, they will affect the revenue generated from toll and ferry operations [44].

Other Countries: Toll exemption played a role in making a decision to purchase an EV in Norway and Austria [38]. Consumers considered the value of toll exemptions higher in areas with expensive toll roads, and the value of ferry fee exemption is more attractive in regions with ferries [32,38]. Aasness and Odeck [11] found that toll and ferry fee exemptions reduce the revenue and will eventually affect the regular maintenance of the infrastructure.

3.2.3. HOV/Bus Lanes

Governments provide access to HOV/bus lanes as an incentive for EV owners.

USA: Geographical differences were found in HOV incentive effectiveness. For example, this incentive was shown ineffective in California [16,42] whereas found effective in Virginia [16,45]. Additionally, within a given region, there are several studies contradicting each other on the incentive's effectiveness. For instance, Diamond [16] said HOV incentive is ineffective in California whereas Tal and Nicholas [41] found through a survey that the primary motivation to buy PEVs was HOV access. The HOV incentive is most valued among higher income people because of the travel time savings [16]. The negative of this incentive is that it could create congestion in HOV lanes and cause additional delays [41].

Other Countries: Similar to the findings in the USA, there were contradicting results in the effectiveness of HOV/bus lane incentive. This incentive was effective in several countries including Norway, Japan, and China [31,32], but found ineffective by Bakker and Trip [40] in European countries. Mersky et al. [43] found that bus lane incentives have

no effect on EV adoption. However, the advantage of this incentive is that government does not have to make any significant additional investments and just needs to leverage the existing facility to be used by the EV owners [29]. The HOV/bus lane will experience greater levels of congestion as the population of EVs increases [11,32,36].

3.3. Effectiveness of Indirect Incentive Programs

Indirect incentives are incentives that do not directly target EV owners. However, ultimately the EV owners benefit from these.

Gas/Carbon Tax

The gas or carbon tax is a user base tax which aims to deter the use of conventionally fueled vehicles. Therefore, it indirectly promotes EV adoption.

USA: Carbon tax makes owning a conventional fuel vehicle (internal combustion engine) more expensive. Most studies point out that there is a positive correlation between fuel prices and adoption of EVs [16,17]. Higher fuel prices lead consumers to buymore fuel-efficient cars. Gallagher and Muehlegger [17] found that an increase in the average gasoline sales price by 20% and a $330 sales tax waiver have a similar effect on hybrid sales. Hybrid vehicle sales in 2006 would have been 37% lower if the gasoline prices were at the same level as that in 1999 ($1.53 instead of $2.60) [27]. Therefore, the rising gasoline price led to an increase in hybrid sales. Compared to purchase subsidies, carbon taxes are more effective as they discourage the use of conventionally fueled vehicles [46]. However, Beresteanu and Li [27] noted that raising gas taxes should be implemented alongside other fiscal incentives.

Other Countries: Due to its effectiveness, increasing gas price (carbon tax) has been used as a policy tool in Europe and Japan [47]. Shepherd et al. [23] discuss that through a levy of fuel duty, the operating cost of a conventional fueled vehicle rises and the market share of the EVs and BEVs increases. However, as the market share of EV and BEVs increases, there will be a loss in revenue from fuel duties [23]. Table 4 summarizes the effectiveness of using gas/carbon tax to promote EV adoption.

Table 4. Effectiveness of Gas/Carbon Tax.

Region	Effective	Not Effective
U.S.	Diamond [16]; Gallagher and Muehlegger [17]; Beresteanu and Li [27]; Fox et al. [46]	-
OC	Lane and Potter [47]	-

4. Discussion

The literature provides a long list of benefits derived from CAVs, which include capacity and safety improvements. Hence, this study recommends the promotion of CAV adoption to address congestion and safety issues so that funds can be allocated to maintain the degrading transportation infrastructure. Encouraging the rapid adoption of CAV technologies could reduce state and federal capital investments in expanding existing roadways as a means to accommodate the increasing vehicle population. Thus, through literature review this study recommends potential effective incentive programs that could be adopted at national, state, or local level to foster the adoption of CAVs. Given that CAVs are not currently in wide circulation in the market, there is the need to develop incentive programs that will increase its adoption. Lessons from the US and other countries on various incentive programs for the adoption of electric vehicles provide useful lessons on what incentives may be rolled out to encourage the adoption of CAVs when they eventually become ubiquitous. To know how incentives have worked out so far in the vehicle acquisition process, various success stories and failed incentive schemes have been explored and presented in this paper. Previous studies have documented mixed results on the effectiveness of incentive programs. Table 5 provides a synthesis of the advantages and disadvantages of the examined incentives. It should be noted that based on the findings,

the success or failure of incentive schemes for vehicle acquisition vary from one country to another. This may perhaps be due to differences in political and economic conditions across the various countries.

Table 5. Advantages and Disadvantages of Different Incentive Types.

Type of Incentive	Advantages	Disadvantages
Purchase Subsidies	Monetary benefit from this subsidy is valued highly Helpful to spur the market	Expensive to run the program long-term. Free riders
Accelerated Vehicle Retirement/ Scrappage Programs	Influence sales of new vehicles Economic stimulus	Free riders
Post-Purchase Subsidies	Discounting energy rates and exemption on travel limits are attractive	Monetary benefit from this subsidy is valued lower than the face value Require effort and understanding.
Income Tax Incentives	Do not require an outlay of cash	Lower income people will not benefit significantly
Free Parking	Effective when parking spaces are limited	Few parking spaces for paying users Do not make EVs affordable
HOV/Bus Lanes	Nominal investment required	Increases EV parking and driving use Causes congestion/delay
Gas/Carbon Tax	Discourage conventionally fueled vehicles	Loss of revenue when number of EV/BEV rises

Several factors play a crucial role in identifying an ideal incentive for a given region because purchase subsidies can be effective but expensive [48]. Hence, states/cities that are economically strong can support such incentives. Some incentives work best when implemented considering the local conditions. For instance, free parking might not be as attractive in Alabama as in New York City. Additionally, certain incentives such as access to HOV/bus lanes, toll/ferry fee exemption, etc. can be better moderated by local authorities rather than by federal authorities.

Many studies identify the ease of implementing subsidies as a significant factor in its effectiveness of the scheme [15–17]. For instance, Colorado has high subsidies, however, the complicated method of indexing (by income and battery size) confuses consumers [15]. Hence, incentives should be designed in such a way that the public can easily estimate and understand the benefits (monetary and otherwise) they would gain.

In general, the government will lose revenue through incentives if they are not implemented well. Any incentive can help reach the short-term goals but it needs a self-enforcing loop or be revenue-neutral to reach the long-term goal. Many studies recommended feebates as an ideal incentive program to implement on long-term basis [17,24,25,35,48,49]. A feebate program is where low-fuel efficient car buyers are penalized by a fee whereas fuel efficient car buyers are rewarded by a subsidy [22,25]. To have an effective feebates program, the revenue generated from fees and money spent on subsidies should be balanced even though the proportions may be unequal. However, the fee on conventional vehicles should be high enough to make owning them unattractive. A similar approach was adopted in France in 2007, and it accelerated the uptake of low emission vehicles [50].

To conclude, purchase subsidies could be very effective in spurring the CAV market. As purchase subsidies are expensive in the long-run, a revenue-neutral incentive such as a feebate can further foster the market adoption of CAVs. Furthermore, it is important to note multiple incentives should be in effect at the same time [21,28,51].

Further, literature suggests that in order to increase the acceptance of AVs, people should be given the opportunity to interact with this technology. Penmetsa et al. [52] found that public interaction with AVs tends to increase acceptance of this technology. Thus, providing facts about the benefits of AVs can reduce the public concerns.

This paper is limited to identifying effective incentives by considering and studying a handful of incentives in developed countries from all across the globe. However, further

studies are required to identify parameters of the incentive program. For example, questions such as those listed below remain unanswered and can be viewed as opportunities for future works:

- How much of a purchase subsidy is good enough to encourage people to buy CAVs?
- How long should the incentive program run?
- Who is eligible for the incentive?
- How can these programs be revenue-neutral?

In a follow-up study, the authors will create, design, and implement effective incentive programs for CAVs, taking into account factors such as local context, cost-effectiveness, and long-term sustainability.

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References

1. Fagnant, D.J.; Kockelman, K. Preparing a nation for autonomous vehicles: Opportunities, barriers and policy recommendations. *Transp. Res. Part A Policy Pract.* **2015**, *77*, 167–181. [CrossRef]
2. Litman, T. *Autonomous Vehicle Implementation Predictions*; Victoria Transport Policy Institute: Victoria, BC, Canada, 2015.
3. Ghiasi, A.; Ma, J.; Zhou, F.; Li, X. Speed harmonization algorithm using connected autonomous vehicles. In Proceedings of the Transportation Research Board 96th Annual Meeting, Washington, DC, USA, 8–12 January 2017.
4. Chen, D.; Ahn, S. Harnessing Connected and Automated Vehicle Technologies to Control Lane Changes at Freeway Merge Bottlenecks. In Proceedings of the Transportation Research Board 97th Annual Meeting, Washington, DC, USA, 7–11 January 2018.
5. Shladover, S.; Su, D.; Lu, X.Y. Impacts of cooperative adaptive cruise control on freeway traffic flow. *Transp. Res. Rec.* **2012**, *2324*, 63–70. [CrossRef]
6. American Automobile Association. Fact-Sheet: Vehicle Technology Survey. Available online: https://newsroom.aaa.com/download/10067/ (accessed on 17 July 2018).
7. Smith, A.; Anderson, M. Automation in Everyday Life. Pew Research Center. Available online: https://www.pewresearch.org/internet/2017/10/04/americans-attitudes-toward-driverless-vehicles/ (accessed on 20 January 2023).
8. Gupta, N.; Shaw, J.D. Let the evidence speak: Financial incentives are effective!! *Compens. Benefits Rev.* **1998**, *30*, 26–32. [CrossRef]
9. James, S. Effectiveness of Tax and Non-Tax Incentives and Investments: Evidence and Policy Implications. *SSRN* **2013**. [CrossRef]
10. Zhang, X.; Xie, J.; Rao, R.; Liang, Y. Policy incentives for the adoption of electric vehicles across countries. *Sustainability* **2014**, *6*, 8056–8078. [CrossRef]
11. Aasness, M.A.; Odeck, J. The increase of electric vehicle usage in Norway—Incentives and adverse effects. *Eur. Transp. Res. Rev.* **2015**, *7*, 34. [CrossRef]
12. Lambert, F. Denmark to Relaunch Its Electric Vehicle Market with Incentives after a Year with Almost No Sales. Available online: https://electrek.co/2017/04/19/denmark-electric-vehicle-incentive/ (accessed on 20 January 2023).
13. Sullivan, J.L.; Salmeen, I.T.; Simon, C.P. PHEV Marketplace Penetration: An Agent Based Simulation. Available online: https://deepblue.lib.umich.edu/handle/2027.42/63507 (accessed on 20 January 2023).
14. Jin, L.; Searle, S.; Lutsey, N. Evaluation of State-Level US Electric Vehicle Incentives. *Int. Counc. Clean Transp.* **2014**. Available online: https://theicct.org/publication/evaluation-of-state-level-u-s-electric-vehicle-incentives/ (accessed on 20 January 2023).
15. Yang, Z.; Slowik, P.; Lutsey, N.; Searle, S. Principles for Effective Electric Vehicle Incentive Design. *Int. Counc. Clean Transp.* **2016**. Available online: https://theicct.org/sites/default/files/publications/ICCT_IZEV-incentives-comp_201606.pdf (accessed on 20 January 2023).
16. Diamond, D. The impact of government incentives for hybrid-electric vehicles: Evidence from US states. *Energy Policy* **2009**, *37*, 972–983. [CrossRef]

17. Gallagher, K.S.; Muehlegger, E. Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology. *J. Environ. Econ. Manag.* **2011**, *61*, 1–15. [CrossRef]
18. Narassimhan, E.; Johnson, C. The Effect of State Incentives on Plug-in Electric Vehicle Purchases. Available online: https://www.nrel.gov/docs/gen/fy15/62884.pdf (accessed on 20 January 2023).
19. Eppstein, M.J.; Grover, D.K.; Marshall, J.S.; Rizzo, D.M. An agent-based model to study market penetration of plug-in hybrid electric vehicles. *Energy Policy* **2011**, *m39*, 3789–3802. [CrossRef]
20. Hardman, S.; Tal, G. Exploring the Decision to Adopt a High-End Battery Electric Vehicle: Role of Financial and Nonfinancial Motivations. *Transp. Res. Rec. J. Transp. Res. Board* **2016**, *2572*, 20–27. [CrossRef]
21. Sierzchula, W.; Bakker, S.; Maat, K.; Van Wee, B. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy* **2014**, *68*, 183–194. [CrossRef]
22. Bjerkan, K.Y.; Nørbech, T.E.; Nordtømme, M.E. Incentives for promoting battery electric vehicle (BEV) adoption in Norway. *Transp. Res. Part D Transp. Environ.* **2016**, *43*, 169–180. [CrossRef]
23. Shepherd, S.; Bonsall, P.; Harrison, G. Factors affecting future demand for electric vehicles: A model based study. *Transp. Policy* **2012**, *20*, 62–74. [CrossRef]
24. Antweiler, W.; Gulati, S. Market-based policies for green motoring in Canada. *Can. Public Policy* **2013**, *39* (Suppl. 2), S81–S94. [CrossRef]
25. Brand, C.; Anable, J.; Tran, M. The transformation to a low carbon passenger transport system: The role of car purchase taxes, feebates, road taxes and scrappage incentives in the UK. *Transp. Res. Part A Policy Pract.* **2013**, *49*, 132–148. [CrossRef]
26. Gordon, D.; Sperling, D.; Livingston, D. Policy Priorities for Advancing the US Electric Vehicle Market. *Carnegie Pap.* **2012**. Available online: https://www.jstor.org/stable/resrep12975 (accessed on 21 June 2023).
27. Beresteanu, A.; Li, S. Gasoline prices, government support, and the demand for hybrid vehicles in the United States. *Int. Econ. Rev.* **2011**, *52*, 161–182. [CrossRef]
28. Clinton, B.; Brown, A.; Davidson, C.; Steinberg, D. Impact of Direct Financial Incentives in the Emerging Battery Electric Vehicle Market: A Preliminary Analysis. Available online: https://www.energy.gov/eere/analysis/downloads/impact-direct-financial-incentives-emerging-battery-electric-vehicle-market (accessed on 20 January 2023).
29. Tal, G.; Nicholas, M. Exploring the impact of the federal tax credit on the plug-in vehicle market. *Transp. Res. Rec. J. Transp. Res. Board* **2016**, *2572*, 95–102. [CrossRef]
30. Skerlos, S.J.; Winebrake, J.J. Targeting plug-in hybrid electric vehicle policies to increase social benefits. *Energy Policy* **2010**, *38*, 705–708. [CrossRef]
31. Zhou, Y.; Wang, M.; Hao, H.; Johnson, L.; Wang, H. Plug-in electric vehicle market penetration and incentives: A global review. *Mitig. Adapt. Strateg. Glob. Chang.* **2015**, *20*, 777–795. [CrossRef]
32. Fearney, N.; Pfaffenbichler, P.; Figenbaum, E.; Jellinek, R. E-Vehicle Policies and Incentives-Assessment and Recommendations. *Compett Deliv. D* **2015**, *5*. Available online: https://www.toi.no/getfile.php?mmfileid=41187 (accessed on 21 June 2023).
33. Western Automation. Government Incentives Encourage Adoption of Electric Vehicles. Available online: https://www.westernautomation.com/technology-innovations/government-incentives-encourage-adoption-of-electric-vehicles/ (accessed on 20 January 2023).
34. Kim, S.; Yang, Z. Promoting Electric Vehicles in Korea. Available online: https://www.theicct.org/blogs/staff/promoting-electric-vehicles-in-korea (accessed on 10 September 2018).
35. Kok, R. Six years of CO_2-based tax incentives for new passenger cars in The Netherlands: Impacts on purchasing behavior trends and CO_2 effectiveness. *Transp. Res. Part A Policy Pract.* **2015**, *77*, 137–153. [CrossRef]
36. Langbroek, J.H.; Franklin, J.P.; Susilo, Y.O. The effect of policy incentives on electric vehicle adoption. *Energy Policy* **2016**, *94*, 94–103. [CrossRef]
37. Zheng, J.; Mehndiratta, S.; Guo, J.Y.; Liu, Z. Strategic policies and demonstration program of electric vehicle in China. *Transp. Policy* **2012**, *19*, 17–25. [CrossRef]
38. Figenbaum, E.; Fearnley, N.; Pfaffenbichler, P.; Hjorthol, R.; Kolbenstvedt, M.; Jellinek, R.; Emmerling, B.; Bonnema, G.M.; Ramjerdi, F.; Vågane, L.; et al. Increasing the competitiveness of e-vehicles in Europe. *Eur. Transp. Res. Rev.* **2015**, *7*, 28. [CrossRef]
39. Sime, A.G.; Sivertsen, E. An Empirical Analysis of Toll Road Exemption as a Determinant for Electric Vehicle Adoption: Norway as a Case Study. Master's Thesis, Norwegian School of Economics, Bergen, Norway, June 2017.
40. Bakker, S.; Trip, J.J. Policy options to support the adoption of electric vehicles in the urban environment. *Transp. Res. Part D Transp. Environ.* **2013**, *25*, 18–23. [CrossRef]
41. Tal, G.; Nicholas, M.A. Exploring the Impact of High Occupancy Vehicle (HOV) Lane Access on Plug-in Vehicle Sales and Usage in California. Available online: https://escholarship.org/uc/item/7hw5899j (accessed on 20 January 2023).
42. Saphores, J.; Dillon, H.S. The Effectiveness of Incentives to Promote the Household Ownership of Alternative Fuel Vehicles in California. Available online: https://escholarship.org/uc/item/29b9t05h (accessed on 20 January 2023).
43. Mersky, A.C.; Sprei, F.; Samaras, C.; Qian, Z.S. Effectiveness of incentives on electric vehicle adoption in Norway. *Transp. Res. Part D Transp. Environ.* **2016**, *46*, 56–68. [CrossRef]
44. Belson, K. Toll Discounts for Going Green. Available online: www.nytimes.com/2008/01/27/automobiles/27GREEN.html (accessed on 8 September 2008).

45. Diamond, D. Impact of high occupancy vehicle (HOV) lane incentives for hybrids in Virginia. *J. Public Transp.* **2008**, *11*, 3. [CrossRef]
46. Fox, J.; Axsen, J.; Jaccard, M. Picking winners: Modelling the costs of technology-specific climate policy in the US passenger vehicle sector. *Ecol. Econ.* **2017**, *137*, 133–147. [CrossRef]
47. Lane, B.; Potter, S. The adoption of cleaner vehicles in the UK: Exploring the consumer attitude–action gap. *J. Clean. Prod.* **2007**, *15*, 1085–1092. [CrossRef]
48. Morrow, W.R.; Gallagher, K.S.; Collantes, G.; Lee, H. Analysis of policies to reduce oil consumption and greenhouse-gas emissions from the US transportation sector. *Energy Policy* **2010**, *38*, 1305–1320. [CrossRef]
49. BenDor, T.; Ford, A. Simulating a combination of feebates and scrappage incentives to reduce automobile emissions. *Energy* **2006**, *31*, 1197–1214. [CrossRef]
50. Schipper, L.; Saenger, C.; Sudardshan, A. Transport and carbon emissions in the United States: The long view. *Energies* **2011**, *4*, 563–581. [CrossRef]
51. Lutsey, N. Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments. Available online: https://theicct.org/publication/transition-to-a-global-zero-emission-vehicle-fleet-a-collaborative-agenda-for-governments/ (accessed on 20 January 2023).
52. Penmetsa, P.; Adanu, E.K.; Wood, D.; Wang, T.; Jones, S.L. Perceptions and expectations of autonomous vehicles–A snapshot of vulnerable road user opinion. *Technol. Forecast. Soc. Chang.* **2019**, *143*, 9–13. [CrossRef]