

# INTERNATIONAL EV POLICY COUNCIL

## Driving the Market for Plug-in Vehicles - Understanding Financial Purchase Incentives

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### Introduction

Plug-in electric vehicles (PEVs) are more efficient and less polluting than internal combustion engine vehicles (ICEVs). For PEVs to have the most significant impact on urban air pollution, energy consumption, and climate change they need to be deployed in large numbers. For this to happen consumers may need to be incentivized to purchase them.

This policy brief explores financial purchase incentives for plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). Financial purchase incentives are monetary instruments used to attract buyers to PHEVs or BEVs.

PHEVs and BEVs are currently more expensive than ICEVs. Purchase incentives are used to make PHEVs and BEVs more affordable for consumers. Meanwhile costs are reduced through learning and economies of scale, eventually leading to BEV and PHEVs achieving price parity with ICEVs.

This policy brief describes the effectiveness of incentives in increasing PHEV and BEV sales. This brief explores how these incentives should be designed so that they are the most effective.

The evidence presented in this policy brief is taken from a systematic literature review [1].

### Lessons from Academic Research & Empirical Data

#### Research shows that purchase incentives are effective in increasing PEV market shares.

There are more than 30 studies that find purchase incentives to be effective in promoting PEV sales.

#### Purchase incentives increase PEV market shares

Studies using statistical analysis have found that market shares of PHEVs and BEVs are related to purchase incentives being present.

Purchase incentives reduce the overall cost of purchasing a BEV or PHEV and are delivered in multiple ways such as grants, value-added taxes (VAT) or tax exemptions, rebates or income tax credits.

#### The way in which purchase incentives are delivered impacts their effectiveness

Some incentives are provided upfront while others come after consumers buy PEVs. Incentives that come upfront, not afterwards, are more effective.

The following types of incentives are currently in use:

- *Point of Sale Grant Incentives:* These are in the form of a government grants that reduce the upfront purchase price of a BEV or PHEV. The plug-in car grant in the UK offers £4,500 off the purchase

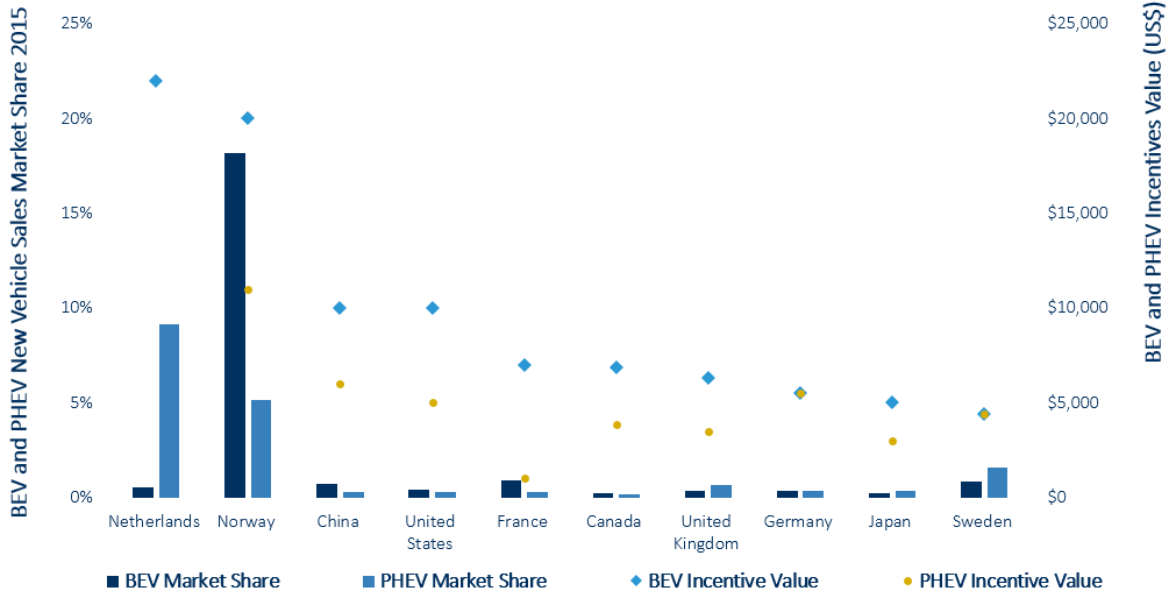


Figure 1: Chart showing the relationship between incentive value for BEVs and PHEVs and the market share of the vehicles [2]. The higher the value of incentives offered, the higher the market for PEVs will be.

price of a BEV and £2,500 off a PHEV.

- **VAT and Purchase Tax Exemptions:** In some markets BEVs do not pay VAT or purchase tax (which ICEVs must pay). This reduces the upfront purchase price. In Norway BEVs do not pay VAT which is 25% and purchase tax which can be an additional 100% of the vehicle value.
- **Post Purchase Rebates:** Consumers receive a check or 'cash back' after they have purchased a PEV. This does not reduce the point of sale price of a PEV. In California buyers of BEVs receive a US\$2,500 rebate.
- **Income Tax Credits:** Consumers receive an income tax reduction at the end of the year. This does not reduce the upfront purchase price of the vehicle. In the US buyers of some PHEVs and all BEVs receive a federal income tax credit of up to US\$7,500.

Of these incentives grants, VAT or tax exemptions and rebates are the most effective. Income tax credits are effective but are inefficient.

### Purchase incentives should be different for BEVs and PHEVs

BEVs offer the greatest environmental benefits and

should receive the highest level of incentive. PHEVs with long electric ranges (>30 miles) can achieve the same number of electric miles as BEVs and should receive a similar incentive. PHEVs with lower electric ranges should receive diminishing incentives based on their range. This is due to them having a poor ratio of electric miles to gasoline miles driven [4,5].

### Purchase incentives should be lower on high-end BEVs or for people with high household incomes

Purchase incentives are less important for buyers of high-end luxury BEVs or for people with very high incomes [7] (See Figure 3). Purchase incentives should have a price eligibility cap (as applied in Germany) or an income eligibility cap.

### Education and awareness campaigns should be used to promote incentives and PEVs

Studies have found that knowledge of PEV incentives and PEVs is low and therefore the impact of the incentives smaller than it should be. Education and awareness campaigns should be used to increase knowledge of PEVs and of incentives [8].

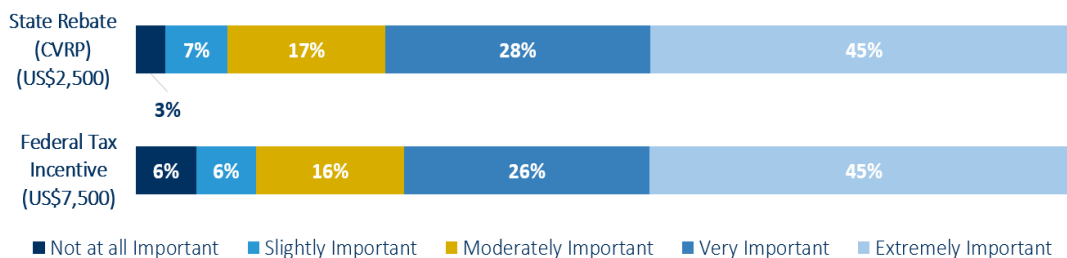


Figure 2: Despite the Federal Income Tax Credit being worth three times more than the State Rebate consumers value the incentives equally [3]. This is due to the rebate being received sooner by vehicle buyers meaning they value it more.

### The premature removal of incentives could negatively impact PEV sales

At present, incentives are very important; around 50% of BEV sales may not occur without the purchase incentives. The removal of purchase incentives too early in the introduction of PEVs will have a negative effect on market growth.

### Incentives should persist until PEVs gain a stable foothold in the market

Rebates and grants may be susceptible to budgetary constraints. In some regions tax and VAT exemptions are paired with high tax or VAT for high CO2 emitting ICEVs. Revenue from ICEVs can be used to fill the gap in revenue caused by PEVs paying no VAT or tax. This effectively creates a revenue source to fund PEV subsidies. This may result in policies that last longer. This is applied in France with the feebate (bonus-malus) system [9].

### Purchase incentives are only one mechanism to incentivize consumers to purchase PEVs

They should be used in combination with other incentives such as free parking, car pool lane access, free tolls and the development of PEV infrastructure. These are explored in additional policy guides (see Further Reading for full list).

## Policy Implications

- Purchase incentives can be used to promote PEV market growth. A well-designed incentive would:
1. Be delivered as a grant, or VAT or purchase tax exemption.
  2. Be combined with high tax, or disincentives, for high CO2 emitting ICEVs.
  3. Offer larger incentives for BEVs and PHEVs with long driving ranges.
  4. Offer smaller incentives for PHEVs with low electric ranges.
  5. Not be applicable to high-end luxury BEVs or to persons of very high income.
  6. Be promoted to consumers through education and outreach campaigns that would also build awareness of PEVs in general. Education and outreach is explored in another policy brief.
  7. Not be removed too early in the market introduction of PEVs. They should persist until PEVs gain a stable foothold in the market.
  8. Financial purchase incentives should be used in combination with other incentives available after PEV purchase (provision of charging stations, free parking, HOV lane access, toll waivers etc.).

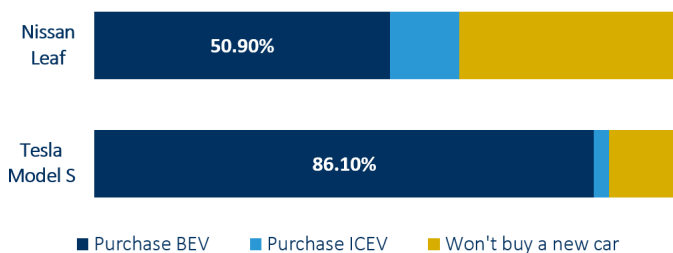


Figure 3: The chart shows consumer behavior if the US federal income tax credit was not available. Most buyers of high-end BEVs (Tesla Model S) would still purchase their vehicle without the incentive [6]. This is related to the high incomes of Tesla buyers meaning they are less price sensitive.

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## Further Reading

This policy brief is part of a series of briefs. Each brief concentrates on a specific aspect of PEVs.

The following briefs are available:

Introduction to PEV Policy Guides

1. Regulatory Mechanisms and Implementation
2. Government and Industry
3. Financial Purchase Incentives
4. Non-financial and in use incentives
5. Information, Education and Outreach
6. Electricity Grids and PEV Infrastructure

## Selected References

[1] Hardman S, Chandan A, Tal G, Turrentine T. The Effectiveness of Financial Purchase Incentives for Battery Electric Vehicles – A Review of the Evidence. *Renew Sustain Energy Rev* 2017;80C:1100–11. doi:10.1016/j.rser.2017.05.255.

[2] International Energy Agency. *Global EV Outlook 2016*.

[3] Center for Sustainable Energy. California Air Resources Board Clean Vehicle Rebate Project, EV Consumer Survey Dataset 2016. <http://cleanvehiclerebate.org/eng/survey-dashboard/ev> (accessed August 12, 2016).

[4] Tal G, Nicholas MA, Davies J, Woodjack J. Charging Behavior Impacts of Electric Vehicle Miles Traveled- Who Is Not Plugging in? *J Transp Res Board* 2014;10.3141/24.

[5] Plötz P, Funke S, Jochem P. Real-world fuel economy and CO2 emissions of plug-in hybrid electric vehicles 2015.

[6] Tal G, Nicholas M. Exploring the federal tax credit impacts on the plug in vehicle market. Transp Res Rec J Transp Res Board 2016.

[7] Hardman S, Tal G. Exploring the decision to adopt a high-end battery electric vehicle: The role of financial and non-financial motivations. Transp Res Rec J Transp Res Board 2016;16–1783.

[8] Kurani KS, Caperello N, TyreeHageman J. New car buyers' valuation of zero-emission vehicles: California 2016.

[9] Rivers N, Schaufele B. New Vehicle Feebates : Theory and Evidence 2014.