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Government of Ireland

Spending Review 2019

Incentives for personal Electric Vehicle purchase

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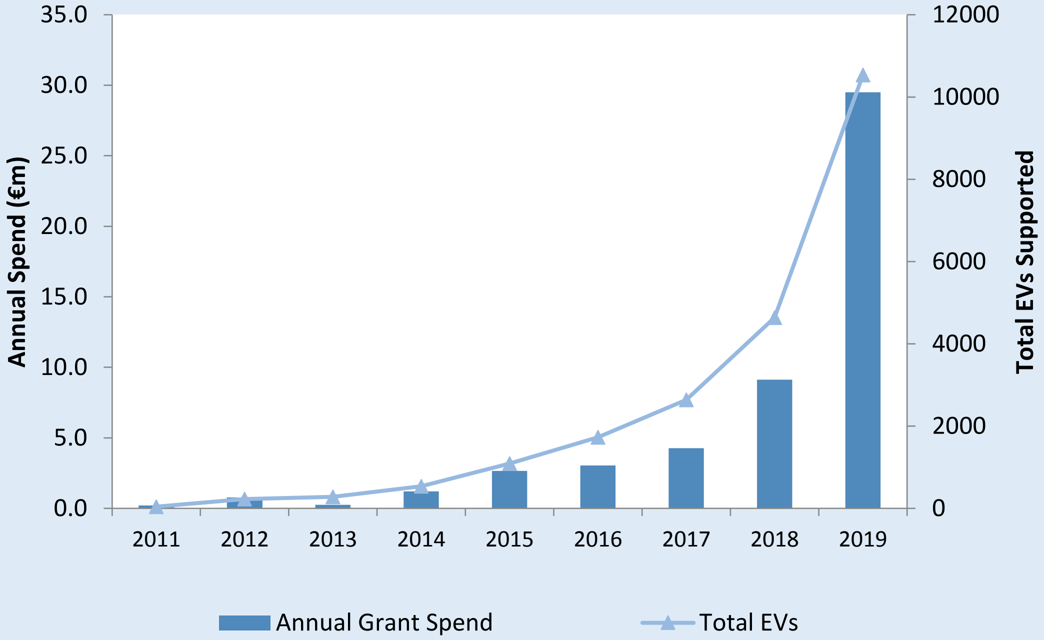
Executive Summary

Key Trends and Features of Electric Vehicle Incentive Expenditure

- Ireland has some of the most generous supports in the world for Electric Vehicle purchase. These include: a purchase grant, vehicle registration tax (VRT) relief, a toll incentive, a home charger installation grant and reduced motor tax rates. Expenditure on all of these schemes is rapidly accelerating and the pace of this acceleration is rising.

- Spend on the Sustainable Energy Authority Electric Vehicle grant has been increasing since 2013. This growth has been particularly pronounced over the last three years. Year on year, spend increased by 40% in 2017, 114% in 2018 and is expected to reach 223% in 2019.

SEAI Electric Vehicle Purchase Grant Expenditure 2011-2019



- Similarly, the cost of the Vehicle Registration Tax (VRT) relief for Electric Vehicles has grown at a fast pace during this period. Year on year, 2017 saw a 77% increase and 2018 a 75% increase. By April 2019 the cost of the relief for the year already reached the total cost of this measure in 2018, reflecting the rapid growth in Electric Vehicle sales this year.

- This growth in Electric Vehicle sales is a very positive development but poses challenges for the sustainability of the existing supports and, over the longer term, the income the State receives from motor taxation.

Key Findings

- The Government's Climate Action Plan sets a target of reaching 840,000 passenger electric vehicles (EVs) on the road by 2030. This target will be achieved through a combination of Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). €200m has been allocated in Project Ireland to support the achievement of this target.

- Until they become cost competitive with ICE vehicles, Government supports can boost take-up of EVs and address the market failure that would otherwise see EV levels remain below optimum levels. In total, the average EV purchaser receives a direct subsidy from the State of between €10,141 (PHEV) and €13,616 (BEV). This suggests that if the current supports are continued, every 100,000 new EVs (combination of BEVs & PHEV deployment) will cost the Exchequer between €1.14 billion and €1.36 billion. The growth in EVs will also reduce Exchequer revenues, with €1.5 billion less revenue from motor tax, VAT and fuel oil tax between now and 2030, reaching €500 million in annual losses by 2030, if the Climate Plan targets are reached.

- On balance, the evidence suggests that financial incentives do impact on EV adoption rates and that increasing exposure to EVs has a corresponding effect on consumer interest in EVs. EV take-up also appears to be strongly influenced by model availability and the availability of charging infrastructure.

- When compared to the cost of reducing greenhouse gas emissions through other mechanisms, the cost to the Exchequer of the current range of EV supports appears quite high. The benefits are also regressive in nature, in that they tend to benefit the wealthier in society.

- Theoretical and empirical evidence suggests that the countries' most successful at boosting EV adoption rates combine subsidies for EVs with higher taxes on ICE vehicles.

Points for Further Consideration

- While the current EV supports have proven effective at increasing EV take-up, at the current growth rates and absent reform, the Project Ireland 2040 allocation will be exhausted by 2021. It is worth considering whether this represents the optimal use of the allocated Project Ireland 2040 funds to reach the target articulated in the Climate Action Plan. A schedule of declining supports for EV take-up which would end when the gap between EVs and ICE vehicles is equalised may offer a more sustainable pathway of incentives.

- The policy mix has the potential to enhance the EV offering. While at present Ireland charges both motor tax and vehicle registration tax (VRT) based on CO2 emissions, some countries use more holistic systems that impose heavier costs on vehicles with high CO2 emissions or fuel consumption alongside incentives for vehicles with low CO2 emissions or fuel consumption.

- The greenhouse gas emissions and air pollution savings associated with a Plug-in Hybrid Electric Vehicle (PHEV) are lower than those of a Battery Electric Vehicle (BEV). PHEVS also have a narrower affordability gap relative to ICE Vehicles. On this basis, there may be a case for reducing incentives for PHEVs at a faster rate than BEVs.

- Over the next decade, EV take-up will lead to significant declines in Exchequer revenues from motor and fuel taxation, which could pose a substantial risk to the stability of the State's finances. Balancing the achievement of the Climate Action Plan's targets on EV deployment with maintaining revenues will require careful consideration and alternative taxation models will need to be considered.

- Given that the levers for influencing EV take-up are split between several Government Departments (DPER, DFIN, DTTAS & DCCAE), a cross-Departmental group to consider a more holistic approach to EV incentivisation, as recommended in the Government's Climate Action Plan, should be prioritised.

Section 1. Introduction

The Programme for Partnership Government outlines the Government's intention 'to become a leader in the take-up of electric vehicles.'[1] *Project Ireland 2040* built on this commitment by pledging to have at least 500,000 electric vehicles (EVs) on Irish roads by 2030. The *Climate Action Plan 2019* has increased the ambition on electrical vehicle (EV) numbers with a goal of 936,000 EVs (including 840,000 passenger EVs) on the road by 2030. These targets are underpinned by a range of incentives to stimulate consumer EV purchase.

The term EV in this paper refers to Battery Electric Vehicles (BEVs) and Plug-in Hybrid Vehicles (PHEVs). A BEV is a vehicle that uses a battery as the sole means of energy storage for the propulsion of the vehicle. A BEV does not have a fossil fuel engine or generator. It is driven purely by an electric motor with battery energy storage[2]. PHEVs use an internal combustion engine (ICE) and an electric motor which can be charged from an electricity source. The battery's energy is recharged by the ICE, wheel motion, or by plugging into a charge point. Non plug-in EVs are not supported through the grant schemes discussed in this paper.

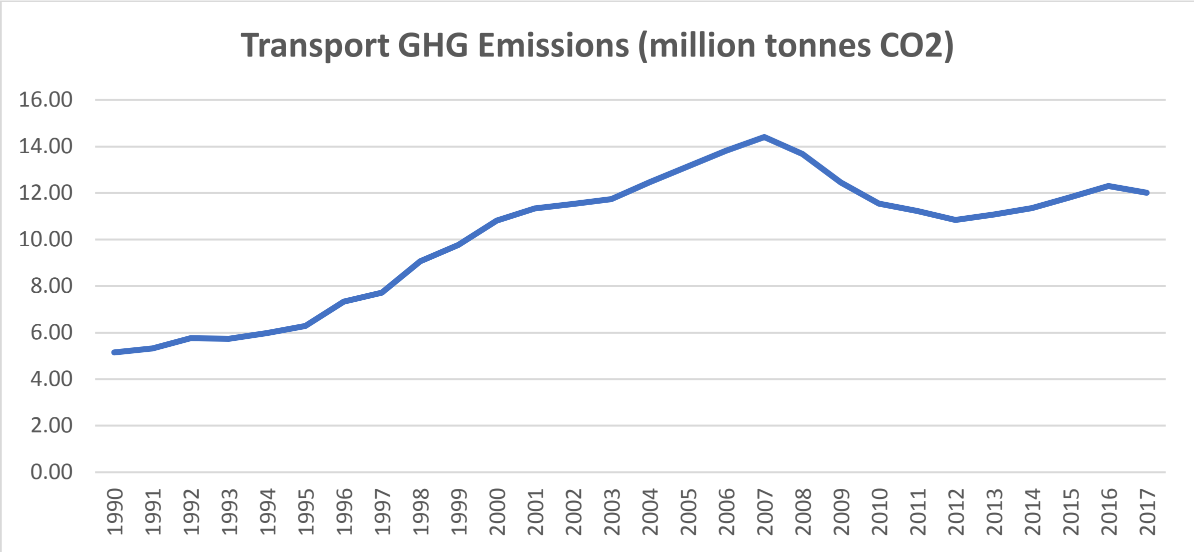
This paper has been completed as part of the 2019 Spending Review process. The Spending Review aims to create a body of evidence on the efficiency and effectiveness of existing areas of expenditure that can be used to inform the budgetary process. The paper has been drafted by IGEES staff within the Department of Public Expenditure and Reform, in conjunction with staff from the relevant Departments and Governmental Agencies, who supplied relevant data and information. The development of the report was overseen by a Steering Group containing representatives from the Department of Public Expenditure and Reform, the Department of Communications, Climate Action and Environment and the Department of Transport, Tourism and Sport.

The majority of greenhouse gas emissions from the transport sector are attributable to road transport. In particular, 96% of the transport emissions that count towards Ireland's non-ETS[3] greenhouse gas emissions targets (i.e. those emissions for which the State is liable), are caused by road transport. Cars are the largest source of transport greenhouse gas emissions, accounting for 52% of these emissions in 2017 (6 million tonnes). The transport sector also accounted for 12% of all air pollutant emissions in 2015 and is one of the largest contributors to NOx emissions pollution in cities. The diesel car fleet

[1] https://assets.gov.ie/3221/231118100655-5c803e6351b84155a21ca9fe4e64ce5a.pdf
[2] https://www.seai.ie/sustainable-solutions/electric-vehicles/what-is-an-electric-vehicle/types-of-electric-vehicle/
[3] The ETS refers to the Emissions Trading System.

is a key source of this particulate pollution. Significant human health impacts can arise from particulate matter (PM) and nitrogen oxides (NOx) emissions, which include cardiovascular disease, lung disease and heart attacks. Increasingly, court decisions are requiring European urban areas[4] to limit diesel car use to protect human health.

Figure 1: Transport Greenhouse Gas Emissions 1990 – 2017



Car ownership is influenced by geography. In 2016, 76.6 per cent of households in urban areas owned at least one car. This compares with 91.0%of households in rural areas. Of those households indicating they had a car, 54.5% in rural areas had two cars or more, in contrast to 33.0% in urban areas.[5]

The use of policy support mechanisms has been a key feature of electric vehicle market development globally. The deployment of such measures has been used in order to overcome or alleviate some of the barriers to EV adoption which include range limitations and vehicle costs, as well as other challenges such as the lack of awareness or confidence in the technology.

Battery costs are currently the main reason for the higher upfront costs of EVs in comparison with incumbent technologies. Battery cost reductions hold significant promise for lowering the cost of an EV. Average prices hit $209/kWh at the end of 2017. Research has found that battery costs must fall

[4] Most western and northern German cities have outright banned older diesel vehicles with Madrid, Paris and Milan among other cities expected to follow suit.
[5] https://www.cso.ie/en/media/csoie/newsevents/documents/census2016summaryresultspart2/Chapter_8_Travel_patterns_and_car_ownership.pdf

to around $100/kWh for EVs to reach parity with ICEVs on a Total Cost of Ownership[6] (TCO) basis. Although it is expected that EV costs and other market barriers will reduce over time, until then a supporting policy environment will be key in stimulating the early market development.

In Ireland, EV purchase is incentivised through both tax expenditures and direct grant supports. A Low Emission Vehicle (LEV) Taskforce, led by the Department of Communications, Climate Action and Environment and the Department of Transport, Tourism and Sport, was established in December 2016 to consider the range of measures and options available to Government to accelerate the take-up of low carbon technologies in the road transport sector. The taskforce convened an interdepartmental group and consulted with relevant stakeholders. The Government, on foot of the LEV Taskforce's interim recommendations in advance of Budget 2018, expanded the suite of supports available for EVs in Ireland. This included the introduction of Benefit-in-Kind tax relief, a grant for the installation of home chargers, a grant for the use of EVs in the taxi/hackney/limousine sector, a reduction in tolls for electric vehicles and a public awareness programme[7].

The goal of this paper is to examine the incentives for personal electric vehicle purchase in Ireland, to attempt to gauge the effectiveness of these supports and consider their sustainability. The paper is laid out as follows: Section 2 details the level of state intervention in this policy area and examines expenditure and take-up trends across the various EV incentives; Section 3 assesses the effectiveness of these incentives relative to their stated objectives by looking at the extent to which supports have influenced purchasing decisions; Section 4 assesses the impact of these policies on wider decarbonisation objectives; Section 5 looks at the distributional effects of EV incentive policies; Section 6 considers the sustainability of the incentives over the medium term, evaluates options to improve their cost effectiveness and provides some areas for consideration.

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[6] This is defined as the upfront capital cost of the vehicle as well as the estimated lifetime fuel costs associated with the vehicle

[7] https://www.dccae.gov.ie/en-ie/energy/publications/Documents/21/LEV%20Taskforce%20Phase1%20Progress%20Report.pdf

Section 2. Incentives for private purchase of Electric Vehicles

The positive externalities associated with pollution abatement result in suboptimal levels of both EV development and adoption. In other words, since EVs have environmental benefits that can't be captured by any one individual and greenhouse gas emissions are insufficiently priced by the market, rates of EV adoption fall below the optimal level from a societal perspective. This is a clear market failure. Economic theory indicates that government policy should be employed to help correct for such situations. A number of personal incentives exist for Battery Electric Vehicles (BEVs) and Plug-in Hybrid Vehicles (PHEVs) (table) in Ireland[8]. Other non-personal Government initiatives that impact the electric vehicle market can be found in Appendix 1.

Table 1. Personal Incentives for Electric Vehicle Purchase (2019)	
Sustainable Energy Authority of Ireland (SEAI) Grant Scheme	A grant of up to €5,000 towards the purchase of a new BEV or PHEV (launched 2011)
VRT Relief	- Up to €5,000 for new BEVs until end 2021; and - Up to €2,500 for new PHEVs until end 2019.
Charging Supports	A grant of up to €600 is available to support installation of home charger points for buyers of new and second-hand EVs.
Toll Incentive Regime	Under the Electric Vehicle Toll Incentive Scheme BEVs and PHEVs qualify for 50% and 25% toll reductions respectively up to a maximum €500 annual threshold for private vehicles and €1,000 for commercial vehicles. A higher incentive rate of 75% discount for BEVs and 50% discount for PHEVs applies for off-peak travel on the M50.
Low Motor Tax	Electric vehicles qualify for the lowest motor tax band available. [9]
Fuel Excise / Carbon Tax	There are no fuel excise duties applied to electricity consumption, whereas these duties represent a significant proportion of diesel and petrol prices.

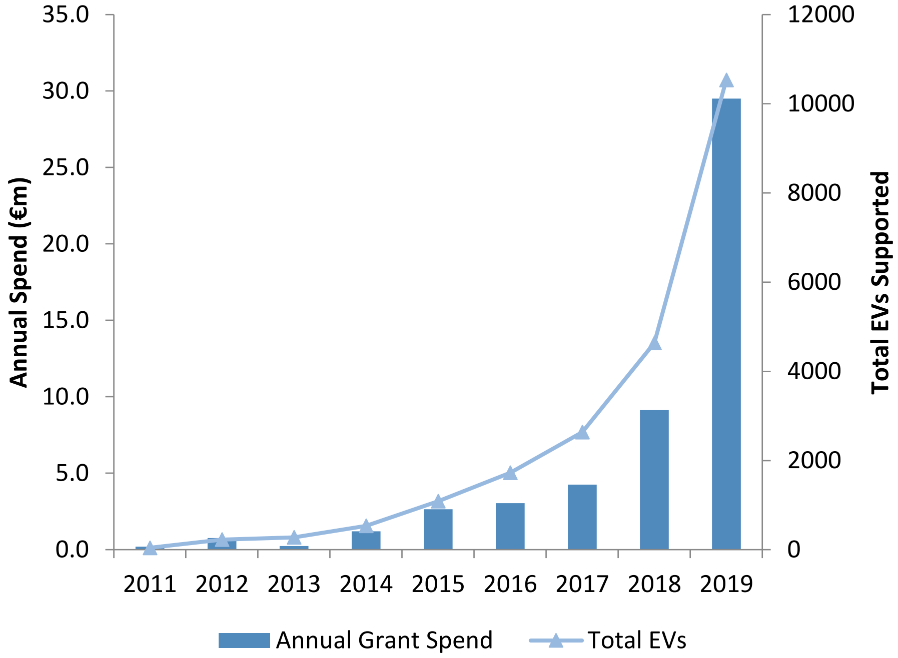
[8] This paper covers central Government incentives only. Local Authorities also provide incentives, including free parking, in certain instances.
[9] https://www.motortax.ie/OMT/pdf/co2_emissions_rates_en.pdf

Schemes under Review

1. Sustainable Energy Authority of Ireland (SEAI) Grant Scheme

Of the policies and measures that can be employed to overcome the barriers to adoption, consumer subsidies are viewed as being of particular importance during the years before ownership becomes economical (IEA, 2013). A Sustainable Energy Authority (SEAI) of Ireland-run grant scheme was introduced in April 2011[10]. The grant level depends on the list price of the vehicle. Qualifying vehicles with a list price of between €14,000 euro and €20,000 receive grants between €2,000 and €4,500. Those with a list price above €20,000 receive a grant of €5,000. Both BEVs and PHEVs qualify for the scheme.

Figure 2. SEAI Grant Expenditure



**2019 based on predicted spend*

The purchase grant can be drawn down for both personal and commercial purchase. The scheme is demand led and it is therefore difficult to predict future spend with a high degree of certainty. The trend however over the last number of years shows increasing numbers of new electric vehicles purchased year on year. 2019 has seen a particularly sharp increase in the level of EV purchases and it is expected that the total number purchased this year will be considerably in excess of previous

[10] https://www.oireachtas.ie/en/debates/question/2018-07-24/2110/

years. Grant expenditure in 2019 is likely to equal nearly 90% of the schemes total spend to date. Spend increased by 114% in 2018 relative to 2017 and is expected to increase by 223% in 2019. In June 2019 the scheme has supported 1,057 private BEVs and 681 private PHEVs this year. At a €5,000 cost per grant this works out as an €8.7 million spend on private vehicles. Up to the end of July 2019 the scheme expenditure totalled €35 million[11].

Table 2. SEAI Total Expenditure on Electric Vehicle Purchase Grant

Year	No of Grants	Amount (Euro)
2011	42	198,000
2012	183	767,400
2013	53	242,200
2014	257	1,203,400
2015	555	2,647,800
2016	638	3,038,800
2017	908	4,262,000
2018	1,999	9,133,600
2019 (to end July)	2,992	13,615,800
Total	7,627	35,109,000[12]

2. Charging supports

The SEAI Electric Vehicle Home Charger Grant scheme was introduced in January 2018. The scheme supports the cost of installing a home charger up to a maximum of €600. Prior to the introduction of the scheme, the ESB, through its eCars programme, had provided free home charge points to qualifying parties at the end of 2017. This scheme was exclusively aimed at vehicles purchased under the SEAI Electric Vehicle Grant Scheme. Given the importance of home charging, it was considered important that a replacement incentive was provided. This scheme is different to the SEAI purchase grant in that both purchasers of new and second hand EVs are eligible. The scheme has supported 2,290 charger installations at a cost of €1.37 million up to June 2019.

[11] This covers both commercial and private spend.
[12] SEAI Internal data

3. Toll incentive

The Electric Vehicle (EV) Toll Incentive Scheme was launched in July 2018. It provides toll rebates of up to €500 a year for EV users. It was introduced to encourage private car commuters who regularly use tolled roads to consider switching to EVs. It is estimated that there are approximately 400,000 heavy toll users in Ireland and so reduced tolls act as a meaningful incentive for a large number of vehicle owners. The scheme is administered by Transport Infrastructure Ireland on behalf of the Department of Transport, Tourism and Sport. It is expected that the scheme will run until the end of 2022 (or up to a maximum of 50,000 EVs), with the level of incentives reducing in-line with the uptake of EVs. Under the scheme, battery electric vehicles and plug-in hybrid electric vehicles qualify for 50% and 25% toll reduction respectively, up to a maximum annual threshold of €500 for private vehicles and €1,000 for commercial vehicles. Greater off-peak reductions also apply to the M50 toll.

Since its introduction 53% of all EVs in the national fleet have registered to avail of the incentive[13]. The total number of private vehicles registered to the end of May 2019 was 6,076. As of April 2019 the average cost per vehicle was €47.84. On an annual basis this results in a cost of €63.50 per vehicle. The total cost of the scheme as of May 2019 was €353,561. However, the number of registrations for the scheme has increased monthly and so average figures are not representative of cost per vehicle. Table 3 gives a monthly breakdown of the cost per car within the scheme. As the scheme is relatively new, it is difficult to determine the likely cost of a car for an entire year.

Given that the incentive is free to avail of and is available to all EV owners, it can be expected that the average cost per vehicle will increase over time, as awareness of the rebate increases. This is consistent with the number of vehicle registrations in the scheme increasing at a faster rate than vehicle purchases.

[13] https://www.kildarestreet.com/debates/?id=2019-02-07a.555&s=speaker%3A244

Table 3. The Electric Vehicle Toll Incentive Scheme			
Month	**Vehicle Registrations**	**Total Expenditure €**	**Expenditure per vehicle €**
Jul-18	2,415	16,265	6.73
Aug-18	3,159	21,795	6.90
Sep-18	3,578	25,509	7.13
Oct-18	3,816	28,602	7.50
Nov-18	3,949	27,087	6.86
Dec-18	4,135	26,879	6.50
Jan-19	4,621	29,185	6.32
Feb-19	4,870	30,550	6.27
Mar-19	5,246	35,929	6.85
Apr-19	5,845	37,874	6.48
May-19	6,076	73,886	12.16
Total	6,076	353,561	58.16

DTTAS/ TII Data

4. Vehicle Registration Tax (VRT)

Vehicle Registration Tax (VRT) is a tax chargeable on the first registration of vehicles in the State and is levied as a percentage of the open market selling price (OMSP) of the vehicle. The OMSP depends on the market value, engine size, year, model and the roadworthiness condition of the vehicle. Since 1 July 2008, the rate of VRT on private motor cars has been calculated on the basis of CO2 emissions, so that cars with higher CO2 emissions attract a higher tax liability. In Budget 2013, the emissions bands were adjusted to increase the incentive to purchase less environmentally harmful motor cars. These rates can be found in Appendix 2. Battery Electric Vehicles (BEV) have no tail pipe emissions of CO2. Plug-in Hybrid Electric Vehicles (PHEV) are estimated to have CO2 emissions circa 60g/km on average.

Reliefs from Vehicle Registration Tax were first introduced in Finance Act 2008 for EVs and electric motor cycles. The Finance Act 2010 extended the relief to plug-in electric hybrids in order to encourage their entry onto the Irish car market. In Finance Act 2011, the VRT relief in respect of EVs was also limited to a maximum of €5,000. In Budget 2015, reliefs for BEVs, PHEVs and hybrids were extended to 31 December 2016 and subsequently extended again to 31 December 2021 in the case of electric vehicles and electric motorcycles and 31 December 2018 in the case of hybrid and plug-in hybrid vehicles.

Relief for BEVs is in place until the end of 2021 and for PHEVs until end of 2019. BEVs qualify for relief from VRT up to a maximum amount of €5,000. Appendix 2 gives the applicable relief rates for hybrids and plug-in hybrids. Table 4 shows relief rates based on the 2017 average emissions of the EV category.

Table 4. VRT Reliefs for Less Environmentally Harmful Vehicles

Type of vehicle	**Maximum Relief**	**Average tailpipe CO2 emissions (2017)**
Hybrid Electric Vehicles	€1,500	92g/km*
Plug-in Hybrid Electric Vehicles	€2,500	25.5g/km*
Electric Vehicles	€5,000	0g/km
Electric Motorcycles	Exempt	0g/km

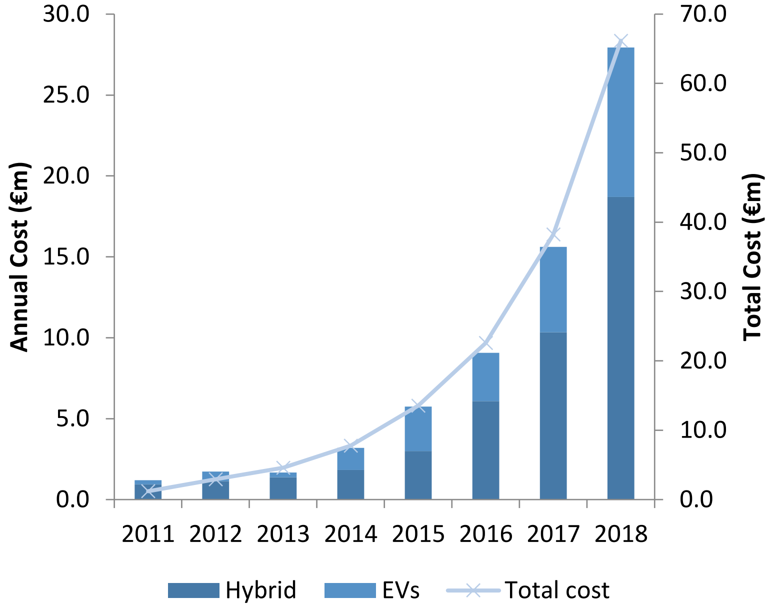
*These values will increase significantly under WLTP testing

The Department of Finance has estimated the total cost of this VRT relief from its introduction to April 2019 at €88.4 million. This compares to a figure of €66.2 million at end 2018. This breaks down into a total cost since 2011 of €57 million for PHEVs and conventional hybrids and a cost of €31.4 million for BEVs. For 2017-2019 a more explicit breakdown is available by vehicle type in Table 5. It is notable that a large proportion of this relief is going towards electric hybrid models.

Table 5. Cost of VRT Reliefs for Less Environmentally Harmful Vehicles

	2017	**2018**	**2019 (Jan to Apr)**
Total cost of relief BEVs	€5,283,500	€9,233,000	€8,632,500
Number of vehicles	1,106	1,930	1,935
Total cost of relief PHEVs	€1,294,300	€3,848,300	€3,015,900
Number of vehicles	625	1,994	1,494
Total cost of relief electric hybrids	€9,045,100	€14,861,050	€10,557,900
Number of vehicles	7,056	11,788	7,736

Figure 3. VRT Relief Expenditure on Less Environmentally Harmful Vehicles



5. Motor Tax

Since 1 July 2008, the rate of Motor Tax on private motor cars has also been calculated on the basis of CO2 emissions, so that cars with higher CO2 emissions attract a higher tax liability. Motor Tax for a BEV is €120 per annum and typically €170 per annum for a PHEV. The rate for a typical new diesel car is €170 and a typical new petrol car is €180. As the proportion of BEV sales rise, this will lead to a reduction in the motor tax revenues. See Appendix 3 for motor tax rates.

6. Excise / Carbon Tax relief

The rise in the number of EVs on the roads will lead to revenues forgone from fuel taxation. Total taxes on a litre of petrol and diesel are currently about 55% and 61% of the average retail price, respectively. The majority of this revenue is attributable to the excise charged on fuel. The Carbon Tax, at the current rate, typically forms only a very small proportion of the retail price for auto fuels (currently around 3-4% of the retail price of a litre of petrol and diesel).

BEVs are currently not subject to excise duty with domestic users exempt from paying the electricity tax. PHEVs do pay some excise on transport fuels depending on the amount driven in non-electric mode. The cost of this revenue foregone to the end of 2018 has been estimated by the Department of Transport, Tourism and Sport at €5.74m[14]. However, similarly to motor taxation, as the proportion

[14] This is based on the cost of the excise revenue foregone from displaced petrol and diesel fuel sales.

of BEVs and PHEVs in the total Irish vehicle fleet rises, these excise and carbon tax losses will increase. These taxes represent a significant proportion of total Irish Government revenues. Carbon tax (VAT exclusive) receipts in 2018 were approximately €431 million. Fuel excise receipts in 2017 were approximately €2 billion[15].

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[15] https://www.oireachtas.ie/en/debates/question/2018-01-16/229/

Section 3. How effective have State supports been in encouraging Electric Vehicle adoption?

The Programme for Partnership Government states the Government's intention 'to become a leader in the take-up of electric vehicles'. Further to this, *Project Ireland 2040* explicitly states the intention to have 500,000 EVs on the road by 2030. This has been superseded by the new targets set out in the *All of Government Climate Action Plan 2019*. There are currently 125,000[16] new vehicle sales a year in Ireland. At this purchase rate, the proportion of new vehicle sales that are EVs will need to rise aggressively to reach the target in the Climate Plan. Market analysis conducted in the development of the Climate Action Plan suggests that rapid falls in the purchase price of EVs will make EVs an increasingly attractive option for motorists when examined on a total cost of ownership (purchase price, maintenance and fuel consumption) basis.

The objective of introducing fiscal incentives for electric vehicles was to increase early uptake by lowering the total cost of ownership (TCO) and in particular, the upfront capital cost of purchase. This increases the cost competitiveness of an EV compared to traditional Internal Combustion Engine (ICE) models. Boosting early adoption has the added benefit of facilitating investment in charging infrastructure so that once EVs reach price parity this is not a barrier to take-up. Furthermore, there are likely externalities to putting additional EVs on the road in that it exposes consumers to the technology and normalises it.

2.1 What influences Electric Vehicle uptake?

To accurately model vehicle choice consumer specific data is required (Daziano and Chiew, 2012[17]). Generally, this data is not available. Much of our knowledge about consumer vehicle choice comes from surveys on stated preferences. There is relatively little information of this nature available based on Irish consumers. However SEAI's Behavioural Economics Unit (BEU) conducted a survey of 387 participants to investigate the impact of an online tool which allows people to enter the details of their commute and see how much money they could save by switching to an electric vehicle. As part of this process, a number of questions about attitudes towards electric vehicles were asked. Range anxiety was identified as an issue, particularly amongst males and those living in rural areas. If journey

[16] https://www.simi.ie/en/news/191-registrations-further-dampened-by-brexit

[17] Daziano, R.A., Chiew, E., 2012. Electric vehicles rising from the dead: Data needs for forecasting consumer response toward sustainable energy sources in personal transportation. Energy Pol. 51, 876–894.

distance is long enough, range anxiety seems to become a big enough dissuading factor that cost savings are not sufficient to overcome it.

Given the lack of data on Irish consumers, some insight can be gained from looking at international studies on the factors that influence EV uptake. Based on a survey of consumer attitudes to electric cars, Larson et al., 2014[18] note that a high purchase price appeared to be the strongest barrier toward EV purchase in a study of Canadian consumers. The willingness-to-pay method used revealed that consumers were unwilling to pay large premiums for EVs, even when provided with information on expected fuel savings. However, the authors also found that consumer groups with experience or exposure to EVs behaved differently. Nearly 25% of this cohort were willing to pay a premium of up to $10,000 for an EV. Fiscal incentives, if sufficiently high to offset cost differences between EV and conventional cars, are the most important reason to buy an EV, according to a survey made among Norwegian BEV owners (Bjerkan et al., 2016). There can, however, be an "attitude-action gap" from survey to action (Lane and Potter, 2007)[19][20]. Similarly, an early Norwegian study noted the difficulty of determining the significance of incentives, as EV owners might state their importance in order to maintain their availability (Econ Analyse, 2006[21]). This study had EV owners rate the importance of selected incentives for their choice of purchasing an EV. Exemption from road tolling, vehicle license fee reduction and reduced purchase costs were considered most important.

There are studies that look to overcome the consumer survey issues by looking directly at market shares and incentives. Given the relatively low levels of EV adoption even in the countries with the highest market shares, most studies that focus on the role of incentives have been based on hybrid-electric vehicles (HEVs). However, EVs represent a much larger departure than HEVs from ICEVs and consumers face considerably more uncertainty when choosing to purchase an EV. There are a more limited number of studies that focus on EV adoption specifically. Brand et al. (2013) explore the effects of three fiscal incentives: vehicle purchase taxes, graduated vehicle road taxes and scrappage schemes. According to their study, car purchases taxes and feebate policies are most effective in accelerating low carbon vehicle adoption.

[18] Larson, P.D., Viáfara, J., Parsons, R.V. and Elias, A., 2014. Consumer attitudes about electric cars: Pricing analysis and policy implications. *Transportation Research Part A: Policy and Practice*, *69*, pp.299-314.
[19] The majority of consumers report positive attitudes toward the environment and yet this results in a limited purchase of environmentally friendlier cars.
[20] Lane, B. and Potter, S., 2007. The adoption of cleaner vehicles in the UK: exploring the consumer attitude–action gap. *Journal of cleaner production*, *15*(11-12), pp.1085-1092.
[21] Analyse, E.C.O.N., 2006. Elbileiernes reisevaner. *Econ analyse*, *40*.

Hidrue et al., (2011)[22] and Eppstein et al., (2011)[23] recognised the role of consumer subsidies in ensuring in the initial stages EVs reach a critical mass. Sierzchula et al. (2014)[24] look explicitly at the role of incentives in EV adoption using market share data from 30 countries. They attempt to examine the role financial incentives and other socio-economic factors have on EV take-up. They find that financial incentives do impact on EV adoption rates. However, there is considerable variation in the degree to which they matter. High financial incentives in Norway and Estonia result in increased EV adoption. Denmark and Belgium, on the other hand, saw low adoption levels despite high incentives during the period of analysis. However, the study provides evidence that incentives may initially be necessary to encourage take-up, despite not always being sufficient. Nations with financial incentives of less than $2000 generally had lower total EV shares. This study provides evidence that the effect of fiscal incentives depends on demand elasticities and that vehicle choice is not only a factor of economic considerations, but a number of personal attributes that affect behaviour. The authors' results also indicate that it is total incentive value, rather than a specific policy type, that impacted levels of EV adoption. However, some studies do find that up-front costs have a higher weighting than reductions in variable costs (Jin et al., 2014)[25].

Even in cases where fiscal incentives are considered generous, take up levels have often failed to reach desired levels. This is because different consumers face different barriers to switching to an EV and these are not always related to cost. Sierzchula et al. (2014)[26] describe three different groups of factors that influence consumer vehicle choice:

- Technological aspects including battery costs;
- Consumer characteristics and context factors: this includes fuel prices, electricity costs and availability of charging stations;
- Intangible costs: these are the non-monetary perceived costs a consumer faces in operating a vehicle.

[22] Hidrue, M., Parsons, G., Kempton, W., Gardner, M., 2011. Willingness to pay for electric vehicles and their attributes. Resour. Energy Econ.33, 686–705.
[23] Eppstein, M., Grover, D., Marshall, J., Rizzo, D., 2011. An agent-based model to study market penetration of plug-in hybrid electric vehicles. Energy Policy 39, 3789–3802.
[24] Sierzchula, W., Bakker, S., Maat, K., van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183–194.
[25] Jin, L., Searle, S. and Lutsey, N., 2014. Evaluation of state-level US electric vehicle incentives. *The International Council on Clean Transportation*.
[26] Sierzchula, W., Bakker, S., Maat, K., van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183–194.

Consumers often suffer from bounded rationality when making purchasing decisions. They do not always have enough information about potential cost savings, leading to suboptimal decision making. Targeted education and experience programmes, such as those operated by SEAI, aim to overcome these information gaps.

While costs and cost perceptions are important, it has been argued that the effect of intangible costs on the EV market represent the most difficult barrier to overcome. These costs are typically difficult to quantify as they are particularly consumer specific and affect different individuals to different degrees. It is, however, vital for policymakers to engage with these issues if they are to ensure effective removal of these barriers. Aspects such as vehicle range and a limited charging network, social norms and social validation, unfamiliarity and lack of knowledge, willingness to accept new and uncertain technologies, as well as less choice in terms of vehicles' specification, all effect adoption rates. Sierzchula et al. (2014)[27] found that the national market share of EVs is well explained by the number of charging stations. This is in line with the results of Lieven (2015)[28]. Country specific factors such as public procurement plans also influenced adoption rates (Sierzchula et al., 2014)[29].

Lévay et al. (2017)[30] used pairwise comparisons between EV and ICE cars using data from 8 countries. The authors group the 8 countries into 3 groups based on incentive levels and their impact on TCO.

1. In Norway, incentives led to the lowest TCO for the EVs;
2. In the Netherlands, France, and the UK the TCO of EVs is close to the TCO of the ICE pairs;
3. In the other countries the TCO of EVs exceeds that of the ICE vehicles. This includes Poland, Hungary, Germany and Italy.

For the period from 2010-2015, where incentives remained stable in Norway, the Netherlands, the UK and France, their study shows that incentives became effective when model availability increased.[31] They also found that while the total cost of ownership (TCO)-sales relationship was negative, it varied

[27] Sierzchula, W., Bakker, S., Maat, K., Wee, B. v., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183–194. http://dx.doi.org/10.1016/j.enpol.2014.01.043.
[28] Lieven, T., 2015. Policy measures to promote electric mobility – A global perspective. Transp. Res. Part A 82, 78–93. http://dx.doi.org/10.1016/j.tra.2015.09.008.
[29] Sierzchula, W., Bakker, S., Maat, K., van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183–194.
[30] Lévay, P.Z., Drossinos, Y. and Thiel, C., 2017. The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership. *Energy Policy*, *105*, pp.524-533.
[31] Figenbaum, E., Fearnley, N., Pfaffenbichler, P., Hjorthol, R., Kolbenstvedt, M., Jellinek, R., Emmerling, B., Bonnema, G.M., Ramjerdi, F., Vågane, L., Iversen, L.M., 2015b. Increasing the competitiveness of e-vehicles in Europe. Eur. Transp. Res. Rev. 7, 28. http://dx.doi.org/10.1007/s12544-015-0177-1.

by car segment. Compared to their ICE vehicle pair, larger EVs have lower TCO, higher sales, and seem to be less price responsive than small EVs. They find that exemptions from flat taxes favour larger EVs, while lump-sum subsidies favour small EVs. While the countries with incentives all had median or above GDP per capita levels, some of the countries with no incentives had similar levels of GDP. The countries with the lowest incentives had the smallest share of EVs as part of new car sales over the period of analysis. The authors conclude that *"Incentives can play a crucial role in the market breakthrough of EVs, but larger market penetration can only be achieved if EVs become price competitive."*

In summary, up to this point in the development of the EV market, subsidies appear to have been necessary to overcome other barriers to take-up. They are not always sufficient and even where they are available, while market shares of EVs are higher, EVs still only make up a small share of total new vehicle sales. The next section will look in further detail at the policy contexts in a number of countries and attempt to determine where policy has been most effective.

2.2 Electric Vehicle Markets Globally

In 2018, the stock of global electric cars reached 5.1 million vehicles, having increased by 2 million throughout the course of the year[32]. China accounted for the largest quantity at nearly 50% of the global total stock[33]. A multi-government policy forum dedicated to accelerating the introduction and adoption of electric vehicles worldwide, known as the Electric Vehicles Initiative (EVI), was launched in 2010 under the Clean Energy Ministerial (CEM). There are 16 countries involved in the EVI at present. Globally, more than two-thirds of electric car sales in 2018 were BEVs. This share has been increasing steadily, from 50% in 2012 to 68% in 2018. This is due to the dominance of BEVs in the Chinese market (76%).

[32] https://www.iea.org/publications/reports/globalevoutlook2019/
[33] https://www.iea.org/publications/reports/globalevoutlook2019/

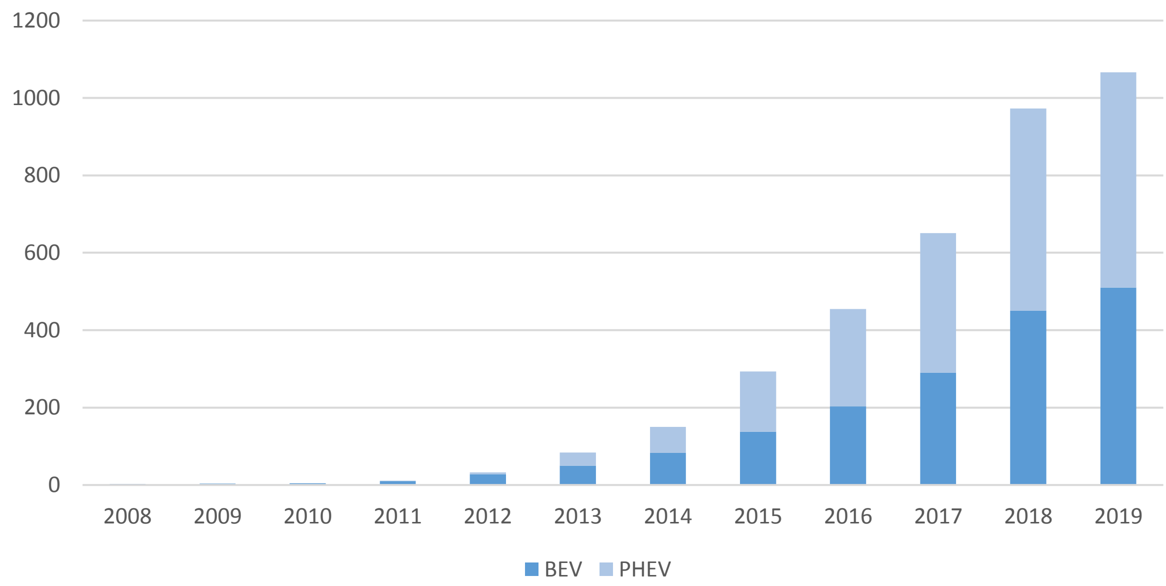
Table 6. Top 10 countries for electric car sales worldwide (2018)		
Country	**New electric car sales**	**Market share of electric cars**
China	1,078,530	4.48%
USA	361,320	2.45%
Norway	72,690	46.42%
Germany	67,500	1.96%
Japan	49,750	1.13%
UK	50,360	2.10%
France	46,700	2.15%
Sweden	28,960	7.92%
Canada	44,150	2.32%
Netherlands	29,160	6.57%

*Data from the IEA's Global EV Outlook 2019 – *includes BEVs and PHEVs*.

EU

In Europe, the increase in electric car sales in 2018 was 31%. This is a slower rate of growth than in the previous 12 months (41%) and below the global average. However, Europe hosts the countries with the largest penetration of electric car sales. The total number of EVs in Europe is expected to reach over 1 million vehicles in 2019.

Figure 4. EU 28 Total Electric Vehicle Stock (thousands)



(Source: EAFO. 2018/2019 based on extrapolated data)

The role of incentives

In order to overcome barriers toward adoption of EVs many countries have developed policies to encourage uptake. Beyond direct purchase subsidies, complementary measures that enhance the value proposition of an electric vehicle including taxation benefits, reduced or exempted parking fees, the use of congestion charging and access to bus or car pool lanes[34] are used. A number of countries also penalise the use of ICE vehicles and use some of the resulting revenue to incentivise low carbon alternatives, otherwise known as a "feebate" system. While at present Ireland charges both motor tax and vehicle registration tax (VRT) based on CO2 emissions, these countries use much more holistic feebate systems that tend to impose significantly higher taxes or fees on vehicles with high CO2 emissions or fuel consumption alongside the provision of incentives to vehicles with low CO2 emissions or fuel consumption.

In order to determine the success of these incentives it is necessary to know how much policy has influenced uptake. Factors that influence take up are changing at a fast pace as the market develops rapidly. This means the exact impact of incentives is difficult to distinguish. However, the OECD & IEA[35] believe that policy has provided the push necessary to ensure take up in an environment where ICE vehicles have a significantly lower up front capital cost. There is some evidence to support this. The main markets for light duty electric vehicles by volume and sales share, China and Norway respectively, have what is considered to be the strongest policy push. By far, Norway has the world's highest share at 10% of electric cars in its vehicle stock. 46% of new car sales in Norway are electric[36]. The feebate system, combing incentives for EV take-up with punitive taxation of ICEs, has been particularly effective in Norway where it has encouraged a movement away from ICE vehicles due to the growing relative costs of ownership. Norway is followed by Iceland with a share of 17% and Sweden at 8%[37]. In terms of sales volumes, Norway is followed by Germany, the UK and France. Denmark and the Netherlands, where sales had declined in 2017, saw strong growth in 2018[38]. The PHEV share in electric vehicles (EV) sales significantly decreased in 2018 compared to 2017 in Japan (47% versus 67%) and the Netherlands (14% versus 22%).

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[34] Bjerkan, K.Y., Nørbech, T.E., Nordtømme, M.E., 2016. Incentives for promoting Battery Electric Vehicle (BEV) adoption in Norway. Transp. Res. Part D 43, 169–180. http:// dx.doi.org/10.1016/j.trd.2015.12.002.

[35] https://www.oecd-ilibrary.org/deliver/fulltext?itemId=/content/publication/9789264302365-en&mimeType=freepreview&redirecturl=http://www.keepeek.com/Digital-Asset-Management/oecd/energy/global-ev-outlook-2018_9789264302365-en&isPreview=true

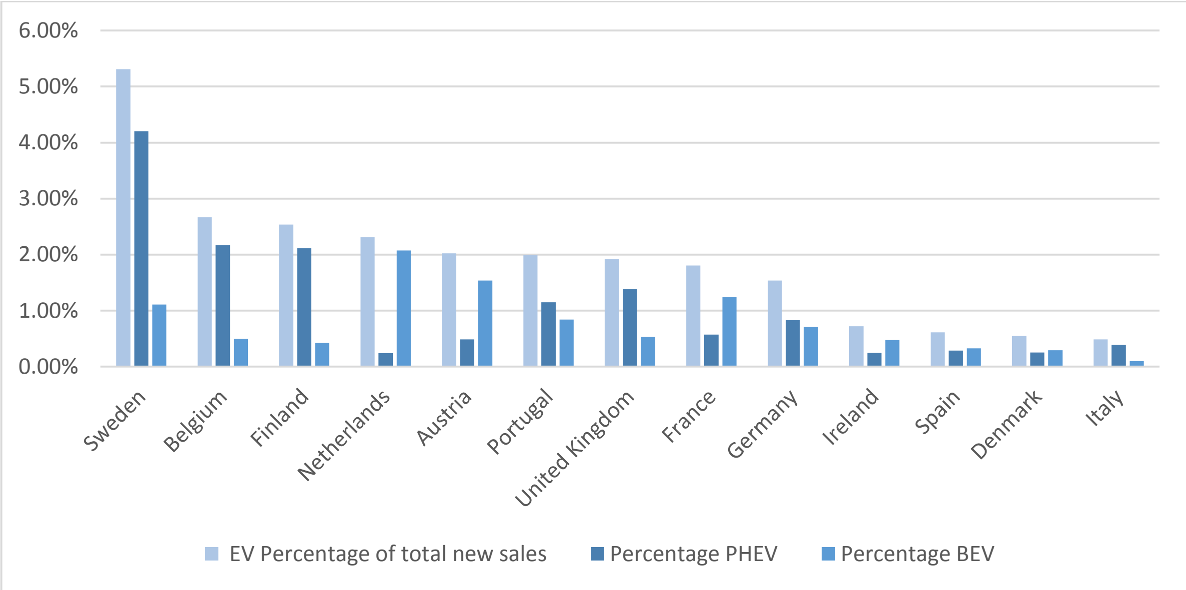
[36] https://www.iea.org/publications/reports/globalevoutlook2019/

[37] https://www.iea.org/publications/reports/globalevoutlook2019/

[38] https://www.iea.org/publications/reports/globalevoutlook2019/

A study by the European Commission's science and knowledge service, the Joint Research Centre (JRC), found a high correlation between financial inducement and the purchase of an electric vehicle[39]. On the contrary, countries without incentives have negligible shares of EVs on their roads. In Poland there are no incentives resulting in a market share that is close to zero (0.2%). In order to determine the role of incentives in EV adoption, this paper will attempt to look at the policy contexts in a number of these countries in further depth.

Figure 5. New electric vehicles by country (2017)



Data: Organisation Internationale des Constructeurs d'Automobiles, EEA and SEAI

Italy

In Italy EV numbers have been negligible as EVs were merely exempt from the annual circulation tax, which is not high. The Italian Government has, however, introduced much improved EV incentives since April 2019. New EVs with CO2 emissions below 70 g/km between March 1, 2019 and the end of 2021, and cost less than €50,000 including VAT, will now qualify for subsidies. Plug-in buyers in Italy can count on up to €4,000 incentives to purchase BEVs and €1,500 for PHEVs, which can increase to €6,000 and €2,500 respectively if an old car is scrapped[40]. The impact has been notable. In April 2019, 1,661 new plug-ins were registered, which is 271% more than April 2018, at a market share of 0.95%. Battery electric vehicle (EV) sales increased 355.9% (0.7% share) to 1,190 and PHEVs to 471 (up 152%)[41].

[39] Lévay, P.Z., Drossinos, Y. and Thiel, C., 2017. The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership. *Energy Policy*, *105*, pp.524-533.
[40] https://insideevs.com/news/349102/april-2019-plugin-sales-italy/
[41] https://insideevs.com/news/349102/april-2019-plugin-sales-italy/

Norway

The Norwegian parliament has set 2025 as the goal for all new cars to have zero emissions. Norway uses a feebate system to encourage uptake. Their fiscal incentives are some of the most generous in the world (see Table 7) and it is normal for an EV version of a car to reach at least price parity with the ICE version. Alongside this, the Norwegian vehicle taxation system heavily taxes ICE vehicles based on curb weight, engine power, CO2 and NOx emissions. EVs are also exempt from the 25% VAT rate. BEVs are fully exempt from both taxes and partly exempt from annual circulation taxes. PHEVs are not exempt from these taxes, but, due to their low type-approval CO2 emissions, their owners still pay less than owners of ICE vehicles. Several non-fiscal and non-monetary incentives exist, such as access to bus lanes, free parking, road toll exemption, and reduced rates on ferries.

To give a practical illustration of the feebate system in action, according to a 2018 analysis, a Volkswagen Golf costs a Norwegian the equivalent of €31,000 including €11,000 in taxes and fees. By comparison, the fully electric e-Golf sold for €27,000[42]. This has led to the highest take-up rates in the world.

[42] https://www.citylab.com/environment/2018/12/norway-electric-vehicle-models-incentives-car-free-oslo/578932/

Table 7. The Norwegian EV incentives[43]:

- No purchase/import taxes (1990-)
- Exemption from 25% VAT on purchase (2001-)
- No annual road tax (1996-)
- No charges on toll roads or ferries (1997- 2017).
- Maximum 50% of the total amount on ferry fares for electric vehicles (2018-)
- Maximum 50% of the total amount on toll roads (2019)
- Free municipal parking (1999- 2017)
- Parking fee for EVs was introduced locally with an upper limit of a maximum 50% of the full price (2018-)
- Access to bus lanes (2005-).
- New rules allow local authorities to limit the access to only include EVs that carry one or more passengers (2016)
- 50 % reduced company car tax (2000-2018).
- Company car tax reduction reduced to 40% (2018-)
- Exemption from 25% VAT on leasing (2015)
- Fiscal compensation for the scrapping of fossil vans when converting to a zero-emission van (2018)
- Allowing holders of driver licence class B to drive electric vans class C1 (light lorries) up to 2450 kg (2019)

Germany

A German subsidy scheme for EVs was introduced in 2016. The initiative was partly financed by the German car industry, to boost electric car usage.[44] Germany saw one of the biggest jumps in sales in 2017 globally, following the introduction of these incentives. There were 55,000 new electric car sales in Germany in 2017 and the market share of electric cars jumped from 0.7% to 1.6%[45].

43 https://elbil.no/english/norwegian-ev-policy/
44 https://www.reuters.com/article/us-germany-autos/germany-to-reach-target-of-1-million-electric-cars-later-than-planned-idUSKCN1LZ29E
45 http://www.oecd.org/about/publishing/Corrigendum_GEVO2018.pdf

Sweden

The growth rate of EVs has been consistently increasing in Sweden since 2011. Up to 2011 the subsidy was approximately €3,760 for a BEV and €1,900 for a PHEV that met the emission requirement of a maximum of 50 grams of carbon dioxide per kilometre. In 2018 the Swedish Government introduced a new system where new low carbon vehicles will qualify for a bonus at purchase, while new vehicles with high emissions will be taxed at a higher rate for the first three years. Purchasers of new EVs receive a rebate between approximately €705 up to €5,640 for new cars, depending on their CO2 output. Vehicles that emit a maximum of 60 grams of carbon dioxide will qualify for the minimum bonus. Vehicle tax was increased for the first three years for light vehicles that run on petrol or diesel. This has had a huge impact on uptake levels and sales of electric cars increased by 253% in the first five months of 2019[46].

The Netherlands

Even though the Netherlands has the world's second-highest stock share of electric cars, it is the only member of the 16 countries involved in the Electric Vehicles Initiative (EVI) where the annual sales volume and market share declined at certain points over the last few years. The small decrease in EV registrations in 2014 and 2016 could be attributed to public debates in both 2013 and 2015 on the phasing-out of incentives for PHEVs. The anticipated decrease of incentives most likely led to increased sales in 2013 and 2015 (Thiel et al., 2015)[47]. Eventually, the PHEV incentives remained in 2014; they were reduced only in 2016. Electric car sales in the Netherlands were largely PHEVs before this point, but PHEV sales nearly came to a halt in 2017. The tax incentive for BEVs has remained and their sales continue to grow.[48]

France

In France, a type of feebate system known as a "bonus-malus" system based on CO2 emissions was introduced in 2008. The scheme uses revenues from fees for emission-intensive vehicles to finance bonus payments for electric vehicles (EVs) to incentivise the car purchase decision. Various modifications over the years have helped to ensure the scheme's effectiveness and balance the revenue stream. A fee must be paid for vehicles with CO2 emissions equal to or above 120 g/km. At

[46] https://www.bloomberg.com/news/articles/2019-06-12/sweden-s-electric-car-boom-is-under-threat-from-power-crunch

[47] Thiel, C., Krause, J., Dilara, P., 2015. Electric vehicles in the EU from 2010 to 2014 – is full scale commercialisation near?. Publications Office of the European Union, Luxemburg. http://dx.doi.org/10.2790/921495.

[48] This policy change is in line with the Netherland's strategy to phase out the sales of PHEVs and promote sales of BEVs in order to facilitate a move to zero-emission transport that is needed to reach the national GHG reduction ambitions and its climate pledges in the Paris Agreement.

the threshold the fee is €50, but the continuous fee function rises steeply, rising to €10,500 for vehicles with CO_2 emissions greater than or equal to 185 g/km. The bonus for EVs is currently at €6,000, granted for electric vehicles emitting less than 20g CO_2/km.

Hybrid vehicles with emissions between 20g and 60g CO_2/km are no longer eligible for a €1,000 bonus payment. Initially, the fee (malus) was charged to new vehicles with CO_2 emissions over 160 g/km, while a rebate (bonus) was provided to vehicles with CO_2 emissions below 130 g/km. In the initial phase of the scheme, the bonus threshold was high enough for efficient fossil fuel cars to benefit from the scheme. However, the CO_2 emission levels at which the Government starts to impose fees and provide rebates have decreased over the years, as have the CO_2 'steps' between each category. Since 2017 a continuous function has been used to set the fee part of the scheme to provide an uninterrupted incentive to improve vehicle efficiency.

Both fully electric and plug-in hybrid vehicles are eligible for either a 50% discount or are exempt from the license plate tax depending on the region. EVs are also exempt from the company car tax. Hybrid vehicles emitting less than 110 g/km are exempt during the first two years after registration. An additional bonus of €1,000 (or €2,000 for non-taxable households) is provided when a diesel or petrol car is scrapped and a used electric or a more efficient internal combustion engine vehicle is purchased. For new electric and plug-in hybrid vehicles the bonus is €2,500. The market share of EVs in France, while not at Norwegian or Swedish levels, is one of the highest in Europe.

Denmark

Denmark provides a particularly useful example of the impact of incentives. A phasing out of tax breaks, starting in 2015, saw sales of EVs plummet. In 2017 the Government announced a delay in these changes. Rather than an increase to 40% of the full tax rate on ICEVs the tax on EVs has remained at 20% and is now fixed at that rate until end 2021 for cars with a purchase price below approx. €53,600. Above this purchase price the taxation rate is 40%. 2018 saw an increase in demand once again in the Danish EV market. In 2018 4,583 PHEVs were sold, which is 261% more than 2017. The market share also improved to 2.0%, close to the record of 2.3% in 2015[49].

[49] https://insideevs.com/news/342230/in-2018-denmark-returned-to-strong-growth-of-plug-in-car-sales/

Electric Vehicle uptake in Ireland

Despite the relatively generous level of supports available in Ireland for purchasing and operating an EV, the pace of EV adoption has heretofore generally been behind the level of ambition set out in Government targets. Since 2008, there have been a number of targets setting out the Governments ambition on electric vehicles:

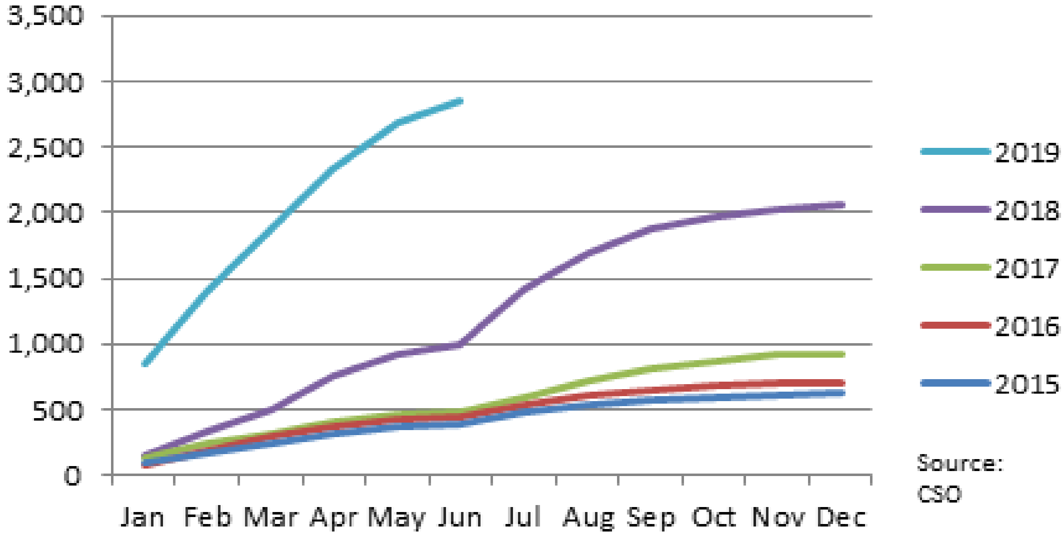
- In 2008, the aim was that EVs would make up 10% of the national car fleet — equivalent to 200,000 vehicles — by 2020.
- In 2014, that target was downsized to 50,000.
- In 2017, it was further reduced to 20,000.

Even with rapidly increasing sales, at a combined passenger car level of 7,218 Battery Electric Vehicles and 4,953 Plug-in Hybrid Electric Vehicles on the road at end July 2019[50], whether we will reach this target is not clear. Despite generous incentives, Ireland has not reached the levels of France or the Netherlands, for instance. A possible reason for this is that while our VRT and motor tax rates are based on CO2 emissions, the overall level of taxation on the sale of new ICE vehicles is below that applied in these countries[51]. High taxation of combustion-engine vehicles with relatively high emission levels and low taxation or exemptions for low-emissions can combine to act as a powerful purchasing incentive. Evidence suggests that EV take-up is higher in countries such as the Netherlands and Norway where taxation for high emission cars is significantly higher than for low-emission cars, while tax differences are not as substantial in countries with lower EV take-ups such as Germany and the United Kingdom.[52]

The relatively slow pace of EV take-up is not unique to Ireland. The overall market share of EVs is generally low across countries. Engagement with the Department of Transport, Tourism and Sport and the Department of Communications, Climate Action and Environment suggested that there have been a number of reasons why take up in Ireland has been lower than desired. The availability of vehicles, the limited choice of models, range anxiety, the availability of charging infrastructure and low levels of consumer awareness have all had considerable impacts. However, disaggregating the degree to which each of these factors has influenced vehicle purchase is difficult.

[50] Electric Vehicles under current taxation. Source: National Vehicle and Driver File.
[51] https://theicct.org/sites/default/files/publications/EU_vehicle_taxation_Report_20181214_0.pdf
[52] https://theicct.org/sites/default/files/publications/EU_vehicle_taxation_Report_20181214_0.pdf

Figure 6. Cumulative Sale of new Electric Vehicle per annum



Supply issues have certainly played a role. Transport & Environment (T&E)[53] recently released a study underlining what they believe to be an important cause of the lower EV sales numbers in Europe. By 2020, car manufacturers in the EU are required to be 95% compliant with a 95g CO2/km target for new car sales, and fully compliant in 2021. The report suggests that the 2020/2021 CO2 emissions standards are suppressing EV sales in advance of this point as manufacturers seem to be delaying costly switchovers of production lines in advance of this date. The report found supporting evidence of this in model launch delays and the long lead times for vehicles. It also made claims about the low levels of money invested in EV marketing and the use of pricing to steer buyers towards more profitable models of vehicle.

Transport & Environment have, however, expressed optimism about the future of the EV market in Europe. In 2019 the EU Parliament and the Council agreed on a mechanism to encourage the sale of more zero- and low-emission vehicles such as fully electric cars or plug-in hybrid vehicles based on the approach proposed by the Commission. If a manufacturer meets certain benchmarks, it will be rewarded with less strict CO2 targets. The benchmark levels for 2025 will be 15% for cars and vans, and for 2030 35% for cars and 30% for vans. T&E expect sales to rise as car manufacturers will be required to market them to meet tightened regulations[54]. This does however suggest that the total supply of EVs available from European manufacturers will remain constrained until these dates are

[53] https://www.globalfleet.com/en/taxation-and-legislation/europe/analysis/us-overtake-eu-ev-sales-and-why?t%5B0%5D=Tesla&t%5B1%5D=Electrification&t%5B2%5D=New%20car%20sales&curl=1
[54] https://www.consilium.europa.eu/en/press/press-releases/2019/01/16/co2-emission-standards-for-cars-and-vans-council-confirms-agreement-on-stricter-limits/

passes. With a limited total pool of vehicles available, it may imply that continued high EV subsidies will benefit vehicle manufacturers more than individual consumers.

Limited model choice has impacted EV sales also. Having a wide range of models and styles of vehicles is important for the EV market to fully take off. The choice of models has, however, grown significantly. The number of new EVs on the European market was 7 in 2018, and will rise to 20 in 2019, 33 in 2020 and 45 in 2021[55]. This has likely played a role in the recent growth in uptake levels. In Q1 2019 uptake levels were much greater than in previous years. In 2018 there were approximately 37 EV models available in Ireland[56]. With a growing number of brands entering the market, there will be more model choice, allowing EVs to reach a broader consumer base. The pace of technology has also increased, with battery range increasing dramatically and costs of production falling. Collectively these changes appear to be spurring the market on and should continue to do so as the market for EVs moves towards cost competitiveness with ICEVs.

The Department of Communications, Climate Action and Environment has projected a continuation of the take-up levels experienced in the first half of the year for the rest of 2019. This is likely to be attributable to falling EV costs and generous grants, leading to a narrowing total cost of ownership of EVs and ICEVs, combined with greater model availability and EVs becoming more familiar. It is likely this trend will accelerate as the market moves towards cost parity.

[55] https://www.globalfleet.com/en/taxation-and-legislation/europe/analysis/us-overtake-eu-ev-sales-and-why?t%5B0%5D=Tesla&t%5B1%5D=Electrification&t%5B2%5D=New%20car%20sales&curl=1

[56] SIMI (Society of the Irish Motor Industry)

Section 4. Assessing the impact of these policies on wider decarbonisation objectives

The overriding objective of incentivising electric vehicle uptake is to reduce greenhouse gas emissions and mitigate the effects of climate change. EVs, in concert with a low-carbon power generation mix, provide a key means of decarbonising private transport and hence reducing transport related greenhouse gas emissions. Modal shift to sustainable transport and public transport, will deliver the added benefit of reducing congestion but for a large proportion of people, private car usage will remain their primary means of transportation.

Battery electric vehicles require no direct fuel combustion and rely on electricity. As the electricity supply becomes increasingly decarbonised over time, EVs offer the prospect of an entirely emissions-free transport sector. Plug-in Hybrid electric vehicles combine a petrol or diesel engine with an electric motor and a battery.

While the impact of both BEVs and PHEVs on greenhouse gas emissions is dependent on the electricity generation mix, the impact of PHEVs is less clear. A PHEV can be driven in electric or diesel/petrol mode. Consumers that charge their PHEV adequately and drive in electric mode will see a reduction in the emissions from journeys.

There is some limited research on consumer charging behaviour. A study carried out by Mitsubishi suggested that owners of its Outlander Plug-in Hybrid Electric Vehicle (PHEV) averaged a weekly mileage of 288.3km, with an average of 145.8km of this being driven in electric vehicle (EV) mode. This is a figure of 50.51%[57]. As this study was led by a manufacturer, others may provide greater insight. Another study of Ford plug-in electric vehicle owners in California gave a figure of 33.3% for the average percentage of miles travelled in electric vehicle mode[58]. The results of a Norwegian study by the Institute of Transport Economics showed that PHEVs were driven 55% of total km in E-mode and 63% on work trips[59]. Further to this, a study done on behalf of the BBC in the UK suggested that PHEVs averaged just 40 miles per gallon (mpg), when they could have done 130 mpg[60]. This, however, was based on the corporate fleet. Studies of corporate vehicles are likely to reflect different incentives than that of the private consumer who is personally covering operating costs. Nonetheless, based on

[57] https://mitsubishi-media.co.uk/en-gb/releases/1476
[58] https://www.mdpi.com/2032-6653/8/4/926
[59] https://www.toi.no/getfile.php?mmfileid=43161
[60] https://www.bbc.com/news/business-46152853

these concerns and the high corporate uptake in the UK, subsidisation of PHEVs in the UK ended in 2018. While a fall in PHEV sales of 34% occurred year-on-year, sales of BEVs increased from 929 in April 2017 to 1,517 in April 2019, although this still only accounts for less than 1 per cent of new sales[61].

In addition to reducing fossil fuel usage and emissions from the transport sector, the fact that BEVs also have zero tailpipe emissions means there are none of the local air quality impacts that arise from ICE vehicles. This will help to achieve Ireland's air quality obligations between 2017 and 2030 and reduce noise levels, leading to improved health outcomes. EV deployment also assists Ireland in meeting its 10% minimum renewable energy target in the transport sector by 2020, helps to achieve Ireland's 2030 climate and energy targets, Ireland's 2050 decarbonisation goals and finally reduces fossil fuel import dependency.

4.1 The Environmental Outcome of Electric Vehicles

As mentioned, switching a vehicle, whether car, LGV or HGV, from an Internal Combustion Engine (ICE) variant to an Electric Vehicle (EV) delivers a number of benefits to wider society. The analysis undertaken in this review attempts to breakdown the costs and benefits of incentivising private EV ownership in Ireland, from the Exchequer's perspective. This involves placing a value on the air quality and greenhouse gas emissions benefits of switching from a diesel or petrol car to an EV. These values are per the values in the updated Public Spending Code issued in 2019[62]. In order to value these benefits it is also necessary to establish a counterfactual. According to a US study, EVs replace relatively fuel-efficient vehicles.[63][64] It is assumed in this case that a BEV or PHEV is replacing either a Euro 6 petrol or diesel car, on the basis that all new passenger cars sold in the EU should conform to this standard from 1 September 2014. This analysis does not include the emissions associated with the energy mix of electricity generation as this is beyond the scope of this paper, nor the sustainability or environmental impacts of the EV manufacturing process[65]. However, it should be noted that EVs only become carbon neutral when the electricity mix is fully decarbonised and hence the benefit

[61] https://www.ft.com/content/e58b168c-70a4-11e9-bbfb-5c68069fbd15
[62] The shadow price of public funds and the discount rate are also taken from the revisions to the Code.
[63] EVs replace gasoline vehicles with an average fuel economy of 4.2 mpg above the fleet-wide average. Xing, J., Leard, B. and Li, S., 2019. What Does an Electric Vehicle Replace?. *Available at SSRN 3333188*.
[64] Xing, J., Leard, B. and Li, S., 2019. What Does an Electric Vehicle Replace?. Available at SSRN 3333188.
[65] An adjustment is made to vehicle emissions to ensure the analysis is based on the on road actual fuel use for new cars, based on the following report: https://theicct.org/news/real-world-vehicle-fuel-consumption-gap-europe-stabilizing

values included in this paper are somewhat overstated. The analysis is carried out over a 12 year time period as this is the average vehicle lifetime in the State.

Table 8. Vehicle EU Emissions Standards[66]
Euro 6 emissions standards (petrol) CO: 1.0g/km NOx: 0.06g/km PM: 0.005g/km (direct injection only) **Euro 6 emissions standards (diesel)** CO: 0.50g/km NOx: 0.08g/km PM: 0.005g/km

The costs involved in this analysis relate to direct Exchequer outlays: the SEAI grant; the charging grant; the toll incentive and the VRT relief. Table's 9 and 10 show the breakdown of costs to the State of incentivising EVs. Table 9 is based on the removal of emissions associated with a petrol car from the atmosphere, while Table 10 is based on replacing a diesel[67].

When analysed in this fashion, the upfront costs of subsidising the adoption of both BEVs and PHEVs greatly outweigh the projected benefits. The weighting of the VRT and SEAI Grant, given that these Exchequer outlays are in year one, while the emissions savings are over twelve years, plays a role in this outcome. However, even the undiscounted total benefits do not come close to competing with the total costs.

Each vehicle converted saves between 33 and 45 tonnes of CO2 over its lifetime. Even assuming very high carbon costs, the level of incentivisation greatly outweighs the direct benefits. However, there is a caveat here in that the goal of providing incentives in the early stages of EV market development is to provide the leadership required so that consumers become more familiar with the product. As previously discussed, social norms play an important role in vehicle choice. There may be externalities associated with getting one additional EV on the road that justifies a cost to the Exchequer beyond the value of the direct quantifiable benefits associated.

Given the generosity of the subsidies in year one in the BEV analysis, the significant reduction in the VRT relief for a PHEV means it has a higher net present value (NPV). The assumption included in this paper's analysis is based on a PHEV that is driven 50% of the time in battery mode. This has an impact

[66] https://www.rac.co.uk/drive/advice/know-how/euro-emissions-standards/

[67] On road factors have been applied to the CO2 savings using weighted average of petrol and diesel factors from: https://www.theicct.org/sites/default/files/publications/Lab_to_Road_2018_fv_20190110.pdf

on the outcome of the vehicle cost-benefit analysis. The benefit cost ratio is more positive for a BEV given that it does not rely on any direct fossil fuel use. The benefits are greater for replacing a typical diesel car as the average diesel driver travels further annually (24,000km vs a petrol car distance of 17,000km[68]).

Table 9. Exchequer CBA Summary per vehicle: Based on replacing a Petrol Euro 6 ICE			
PVs over 12 years		**BEV**	**PHEV**
Costs*	Grant	€6,500	€6,500
	Charging point	€780	€780
	VRT	€6,054	€2,579
	Toll Exemption	€282	€282
	Total	**€13,616**	**€10,141**
Benefits	CO_2	€1,735	€868
	PM	€172	€86
	NOx	€60	€30
	Total	**€1,967**	**€984**
NPV		-€11,648	-€9,157
BCR		0.144	0.097

*Includes shadow price of public funds at 130%

Table 10. Exchequer CBA Summary per vehicle: Based on replacing a Diesel Euro 6 ICE			
PVs over 12 years		**BEV**	**PHEV**
Costs*	Grant	€6,500	€6,500
	Charging point	€780	€780
	VRT	€6,054	€2,579
	Toll exemption	€282	€282
	Total	**€13,616**	**€10,141**
Benefits	CO_2	€2,402	€1,201
	PM	€243	€121
	NOx	€113	€57
	Total	**€2,758**	**€1,379**
NPV		-€10,856	-€8,762
BCR		0.203	0.136

*Includes shadow price of public funds at 130%

The cost of subsidisation for a Battery Electric Vehicle (BEV) between now and 2030 works out between €254 and €351 per tonne of CO2 saved. This cost rises to between €492 and €681 for a Plug-in Hybrid Electric Vehicle (PHEV)[69]. This is because, based on the charging assumptions in this paper and its continued use of fossil fuels, the greenhouse gas emissions and air pollution savings associated

[68] https://www.ccpc.ie/consumers/cars/car-clocking/
[69] Based on 50% use in battery mode.

with a Plug-in Hybrid Electric Vehicle (PHEV) are lower than those of a Battery Electric Vehicle (BEV). It should be noted that PHEVS also have a narrower TCO gap relative to ICEVs than BEVs.

4.2 Exchequer Revenue Losses and the Transition to Electric Vehicles

There are additional costs associated with incentivising EVs from the Exchequer's perspective. The taxation of fossil fuels is a significant income source to the Irish Exchequer. Government must be aware of the severity of these revenue losses if EV penetration grows to the levels set out in the Climate Action Plan 2019. In both Norway and the Netherlands, these losses have been significant[70][71]. For this reason, the widespread diffusion of EVs will necessitate considerations of the sustainability of the current vehicle taxation model and the sustainability of public finances.

Table's 11 and 12 show the net present values of the expected tax losses associated with replacing both a petrol and diesel car with an EV over the 12 year period. Again, losses are based on a twelve year lifespan of the vehicle and on the basis that the EV replaces either a euro 6 petrol or diesel car. This is equal to an annualised cost of €616-618 for a BEV and €286-€292 for a PHEV. Based on the euro 6 maximum emissions standard a 6 diesel vehicle has lower carbon emissions than the petrol equivalent. For this reason the motor tax losses included are lower for a diesel. The other differences result from a difference in the average driving distance between diesel and petrol vehicles. The VAT losses are based on the VAT differential between petrol/diesel and electricity per km.

The impact of the switch to EVs on Exchequer revenues will depend on when the majority of take up takes place but it is likely that once EVs reach cost parity that revenues will decline at a greater rate. Based on the figures in the Climate Plan, the 2030 target will result in approximately €1.5 billion less revenue from motor tax, VAT and excise (mineral oil tax) between now and 2030, reaching €500 million in annual losses by 2030.

[70] Lévay, P.Z., Drossinos, Y. and Thiel, C., 2017. The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership. *Energy Policy*, *105*, pp.524-533.

[71] An intermediate evaluation of CO2-based vehicle tax policies in the Netherlands in 2011 resulted in a tightening of CO2-based limits to avoid future revenue loss.

Table 11. Tax Revenue foregone per vehicle (relative to a euro 6 Petrol) (Net Present Values)		
PVs over 12 years	**BEV**	**PHEV**
Motor Tax	€623	€104
Fuel VAT	€1,575	€787
Excise + Carbon tax	€5,219	€2,610
Total	€7,417	€3,501

Table 12. Tax Revenue foregone per vehicle (relative to a euro 6 Diesel) (Net Present Values)		
PVs over 12 years	**BEV**	**PHEV**
Motor Tax	€519	€0
Fuel VAT	€1,713	€856
Excise + Carbon tax	€5,158	€2,579
Total	€7,390	€3,435

Section 5. The distributional effects of Electric Vehicle incentivisation policies

Understanding who is buying these EVs and to what extent these policies are benefiting different socioeconomic groups is important for establishing the fairness of the schemes under review. Whilst car ownership was once a sign of wealth in itself, cars are now more common amongst households of all income levels. However, there are still marked differences in vehicle ownership rates linked to socio-economic characteristics and in particular, the value of cars varies considerably as does the rate of purchase of new vehicles.

Low carbon investment subsidies are often found to be regressive as higher income households tend to have more capital to invest in low-carbon assets. These effects are particularly pronounced in the new car market. Availing of the SEAI Electric Vehicle grant is only possible for purchasers of new cars with a value above €14,000.[72] Those with lower disposable incomes are more likely to purchase previously owned vehicles. Furthermore, the majority of EVs in the new car market are still significantly more expensive than the average car. This means that the grant availability is limited to those who are most able to bridge the affordability gap. In the US the average buyer of a new car, in 2015, earned about $80,000 per year[73]. This suggests that high income buyers capture a disproportionately large share of EV incentives. In 2016, Germany implemented a €4,000 subsidy for the purchase of EVs, financed through an increase in fuel prices. In their study Reaños and Sommerfeld[74] gave evidence this subsidy was regressive, leaving lower income households, who weren't purchasing EVs, worse off.

There is limited research on the types of individuals who buy EVs in Ireland. There are, however, some studies available from other jurisdictions. An early study of Norwegian EV owners found that a typical owner was usually a male between 30 and 60 years old, with both a high education and high income, living in a multi-person household with multiple cars (Econ Analyse, 2006[75]). Figenbaum et al.[76] confirmed these results. Figenbaum and Kolbenstvedt[77] found that electric vehicle ownership in

[72] http://discovery.ucl.ac.uk/1493270/1/Cars%20and%20socio%20economics%20understanding%20neighbourhood%20variations%20in%20car%20characteristics%20from%20administrative%20data.pdf
[73] https://www.autonews.com/article/20150804/RETAIL03/150809938/car-buyers-getting-older-richer-nada-economist-says
[74] Reanos, M.A.T. and Sommerfeld, K., 2018. Fuel for inequality: Distributional effects of environmental reforms on private transport. *Resource and Energy Economics*, *51*, pp.28-43.
[75] Econ Analyse, 2006. Elbileiernes reisevaner (Travel behaviour of EV owners). Oslo.
[76] E. Figenbaum, M. Kolbenstvedt, B. Elvebakk Electric Vehicles – Environmental, Economic and Practical Aspects. As Seen by Current and Potential Users.Institute of Transport Economics, Oslo (2014)
[77] Figenbaum, E. and Kolbenstvedt, M., 2013. *Electromobility in Norway-experiences and opportunities with Electric Vehicles*(No. 1281/2013).

Norway, however, was no more socially skewed than owning multiple cars. Based on a survey of over 5000 respondents in Denmark, Finland, Iceland, Norway and Sweden, Sovacool et al (2018) predict that predominantly men, those with higher levels of education in fulltime employment, are the most likely to buy EVs[78]. Hjorthol (2013) reviewed the literature on EV use and attitudes in Europe and the U.S. and found that early adopters of EVs are typically male, middle aged, have a high educational attainment and a high income, have multiple cars and live near cities. Using detailed micro-level data on Californian car purchasers Muehlegger and Rapson[79] (2018) compare EV households to new car buyers. They find EV households are more affluent and purchased more new vehicles in the last year[80]. In particular, individuals with an income over $150,000 per year purchased a third of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs). According to the U.S. Department of Energy's Vehicle technologies Office (2018) *"Early adopters are generally wealthier, more educated, more comfortable with technology, and have a stronger environmental attitude … (than) the rest of society"*[81].

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[78] https://www.sciencedirect.com/science/article/pii/S095937801830030X?via%3Dihub

[79] Muehlegger, E. and Rapson, D.S., 2018. *Subsidizing Mass Adoption of Electric Vehicles: Quasi-Experimental Evidence from California* (No. w25359). National Bureau of Economic Research.

[80] https://merritt.cdlib.org/d/ark:%252F13030%252Fm56692z3/1/producer%252F2013-UCD-ITS-RR-13-02.pdf

[81] The U.S. Department of Energy's Vehicle Technologies Office. (2018). Alternative Fuels Data Center. Retrieved from AFDC: https://www.afdc.energy.gov/fuels/electricity_charging_home.htm

Section 6. Conclusions

Given the level of transport emissions caused by the passenger car, it is clear that the State must make efforts to tackle the carbon intensity of the sector. Transport emissions represented 27% of Irish emissions in the non-ETS sector in 2017. The EPA predict that even with 250,000 electric vehicles on the road by 2030, emissions from the sector will increase by 8% from 2018 – 2020 and 11% from 2018-2030 in the absence of additional measures[82].

Most EVs remain more expensive than the Internal Combustion Engine equivalent even when the total cost of ownership over the lifetime of the vehicle is considered. Research suggests that TCO parity "could be achieved by the middle of the next decade or earlier"[83]. This suggests that there is a case for continued Government intervention in the interim to overcome the market failure that would otherwise lead to a sub-optimum level of EV take-up

The lack of domestic data makes it difficult to disaggregate the impact the various Government subsidies are having on EV purchase rates. However, international evidence tends to suggest that financial incentives do impact on EV adoption rates and that increasing exposure to EVs has a corresponding effect on consumer interest in EVs. However, EV take-up also appears to be strongly influenced by model availability and the availability of charging infrastructure.

Ireland currently offers some of the most generous supports in the world for EV purchase. These include: a purchase grant, vehicle registration tax relief, a toll incentive, a charger installation grant and reduced motor tax rates. Even when accounting for the greenhouse gas emission and air quality benefits, the cost to the State of maintaining the current level of EV supports is very significant. In total, the average EV purchaser receives a direct subsidy from the State of between €10,141 and €13,616. As well as this direct expenditure liability, the State's finances are also impacted over time through reduced excise receipts, as excise is not currently levied on domestic electricity usage.

Balancing the achievement of the Climate Action Plan's targets on EV deployment, with affordability will require careful consideration and alternative options will need to be considered. On the basis of

[82] https://www.epa.ie/pubs/reports/air/airemissions/ghgprojections2018-2040/Greenhouse_Gas_Projections.pdf
[83] https://www.jpmorgan.com/global/research/electric-vehicles

the current supports each 100,000 new vehicles will cost the Exchequer between €1.14 billion and €1.36 billion [84]. This is a strawman figure as achieving the 2030 target will also include vehicles sold on the second hand market and EV subsidies are designed to expire. It does, however, provide some insight into the scale of the challenge. The achievement of the 2030 target will also result in approximately €1.5 billion[85] less revenue from motor tax, VAT and excise (mineral oil tax) between now and 2030, reaching €500 million in annual losses by 2030.

The affordability challenge poses an immediate problem. Demand for EVs has grown rapidly in 2019. The SEAI grant and VRT costs for the first six months of the year have been greater than the entire 2018 spend. While the current EV supports have proven effective at increasing EV take-up, at the current growth rates and absent reform, the €200m committed to EV deployment in Project Ireland 2040 will be exhausted by 2021. Maintaining the current level of supports, providing a very high level of support to a very few early adopters, would be a very regressive policy choice. It is worth asking whether this is the optimal use of the allocated Project Ireland 2040 funds in order to reach the target articulated in the Climate Action Plan. When compared to the cost of reducing greenhouse gas emissions through other mechanisms, such as investment in energy efficiency which has the potential to have less adverse distributional impacts, the cost to the Exchequer of the current range of EV supports appears quite high in comparison. A schedule of declining supports for EV take-up, which would end when the total cost of ownership gap between EVs and ICEs is equalised, may provide a more sustainable pathway for Government incentives moving forward, while providing certainty to vehicle purchasers, dealers and manufacturers.

The OECD & IEA[86] believe supportive policies will play a role alongside cost reductions in ensuring EV take-up in the period to 2030. However, supportive policies come in a number of guises and are not limited to subsidisation. Those countries which have been most successful in promoting EV take-up have used measures such as congestion charging and low emission zones to complement subsidies, in tandem with a punitive taxation regime for ICEVs. Through State intervention in the form of a feebate model other countries have narrowed the TCO gap between EVs and ICEVs by increasing taxation on ICE vehicles and using this to fund EV rebates. While at present Ireland charges both motor tax and vehicle registration tax (VRT) based on CO_2 emissions, these countries use much more holistic feebate

[84] Based on the cost of the VRT relief, SEAI grant, home charger grant and toll incentive.
[85] Net Present Values using discount rate as per CBA analysis.
[86] https://www.oecd-ilibrary.org/deliver/fulltext?itemId=/content/publication/9789264302365-en&mimeType=freepreview&redirecturl=http://www.keepeek.com/Digital-Asset-Management/oecd/energy/global-ev-outlook-2018_9789264302365-en&isPreview=true

systems that impose significantly higher fees on vehicles with high CO2 emissions or fuel consumption which gives those Governments a greater capacity to provide rebates to vehicles with low CO2 emissions or fuel consumption.

The cost of subsidisation for a Battery Electric Vehicle (BEV) between now and 2030 works out between €254 and €351 per tonne of CO2 saved. This cost rises to between €492 and €681 for a Plug-in Hybrid Electric Vehicle (PHEV)[87]. The greenhouse gas emissions and air pollution savings associated with a Plug-in Hybrid Electric Vehicle (PHEV) are lower than those of a Battery Electric Vehicle (BEV). PHEVS also have a narrower TCO gap relative to ICEVs. On this basis, there may be a case for reducing incentives for Plug-in Hybrid Electric Vehicles (PHEVs) at a faster rate than Battery Electric Vehicles (BEVs).

With a low density rural population, public transport options are limited and hence private car usage remains the only choice for a large majority of rural dwellers. This can only be addressed over the long term as greater density is encouraged through better spatial planning. For these individuals, transitioning to an electric fleet appears to be the only medium term option for reducing their carbon footprint. The difficulty of this transition is further impacted by the need for sufficient charging infrastructure in rural Ireland to encourage EV usage, where BEVs are currently a less viable option.

Alternatives are, however, an option in urban areas. Currently, Irish cities have some of the highest private car usage for commuting journeys in the developed world. Ireland's sustainable mobility usage, on the other hand, is relatively low. For example, just 2,330 people cycled to work in Cork city and suburbs, 1,874 in Galway, 968 in Limerick, and 395 in Waterford[88]. Public transport as a modal share is also low. This suggests that there is a significant opportunity to incentivise and support more sustainable transport options, particularly in urban areas. This has the added benefit of reducing congestion.

The Climate Action Plan requires the development of a Roadmap on the optimum mix of regulatory, taxation and subsidy policies to drive significant ramp-up in passenger EVs and electric van sales from very early in the next decade. Given that the levers for influencing EV take-up are split between several

[87] Based on 50% use in battery mode.
[88] https://www.cso.ie/en/csolatestnews/pressreleases/2017pressreleases/pressstatementcensus2016resultsprofile6-commutinginireland/

Government Departments (DPER, DFIN, DTTAS & DCCAE), a cross-Departmental group to consider a more holistic approach to EV incentivisation should be prioritised.

Appendix 1

Table 13. Other non-Personal EV Incentives	
Public Body Procurement	National Procurement Service is to introduce a new public procurement framework contract for EVs to allow public bodies to buy EVs with reduced administrative burden.
0% Benefit-in-Kind (BIK)	A 0% rate of benefit-in-kind (BIK) applies to EVs when provided by an employer to an employee.[89] (budget 2019- 3 years)
SPSV Grant Scheme	The electric Small Public Service Vehicle (SPSV) Scheme offers a grant of up to €7,000 or €3,500 towards a BEV or PHEV respectively for vehicles in the taxi, hackney or limousine sector.
Accelerated Capital Allowance (ACA)	EVs are on the list of products qualifying for accelerated capital allowances which allows for the write off of the capital cost in year 1 rather than over the traditional 8 year period.

Appendix 2

Table 14. VRT rates for Category A vehicles

	CO2 emissions levels	VRT rates
Band A1	0 - 80 grams per kilometre	14% of OMSP (minimum €280)
Band A2	81 – 100 grams per kilometre	15% of OMSP (minimum €300)
Band A3	101 – 110 grams per kilometre	16% of OMSP (minimum €320)
Band A4	111 – 120 grams per kilometre	17% of OMSP (minimum €340)
Band B1	121 – 130 grams per kilometre	18% of OMSP (minimum €360)
Band B2	131 – 140 grams per kilometre	19% of OMSP (minimum €380)
Band C	141 – 155 grams per kilometre	23% of OMSP (minimum €460)
Band D	156 – 170 grams per kilometre	27% of OMSP (minimum €540)
Band E	171 – 190 grams per kilometre	30% of OMSP (minimum €600)
Band F	191 – 225 grams per kilometre	34% of OMSP (minimum €680)
Band G	over 225 grams per kilometre	36% of OMSP (minimum €720)

[89] However, in Budget 2019, the Minister put a cap of €50,000 on the original market value of a vehicle that qualifies for this tax rate. Any amount over the €50,000 limit will incur BIK.

The following table sets out the remission or repayment amount based on the age of the vehicle being first registered:

Table 15. Remission or repayment amount based on the age of the vehicle being first registered		
Age of hybrid electric vehicle	**Maximum amount which may be remitted or repaid (hybrid electric)**	**Maximum amount which may be remitted or repaid (plug-in hybrid electric)**
New vehicle, first registration	€1,500	€2,500
Not a new vehicle, but less than 2 years	€1,350	€2,250
2 years or over, but less than 3 years	€1,200	€2,000
3 years or over, but less than 4 years	€1,050	€1,750
4 years or over, but less than 5 years	€900	€1,500
5 years or over, but less than 6 years	€750	€1,250
6 years or over, but less than 7 years	€600	€1,000
7 years or over, but less than 8 years	€450	€750
8 years or over, but less than 9 years	€300	€500
9 years or over, but less than 10 years	€150	€250
10 years or over	Nil	Nil

Appendix 3

Table 16. Irish Motor Tax rates				
Co2 Emissions Output (grams per km)	**12 Months Tax**	**6 Months Tax**	**3 Months Tax**	**Arrears Per Month If You Pay Late**
0 - 1	€120	€66	€33	€12

1 - 80	€170	€94	€48	€14
2 - 80	€170	€94	€48	€17
81 - 100	€180	€99	€50	€18
101 - 110	€190	€105	€53	€19
111 - 120	€200	€111	€56	€20
121 - 130	€270	€149	€76	€27
131 - 140	€280	€155	€79	€28
141 - 155	€390	€216	€110	€39
156 - 170	€570	€316	€161	€57
171 - 190	€750	€416	€211	€75
191 - 225	€1200	€666	€339	€120
226 - 999	€2350	€1304	€663	€235

Quality Assurance

Quality Assurance Process

To ensure accuracy and methodological rigour, the author engaged in the following quality assurance process.

- ✓ Internal/Departmental
  - ✓ Line management
  - ✓ Spending Review Sub-group and Steering group
  - ☐ Other divisions/sections – Central Votes Section and the Public Service Reform and Delivery Office.
  - ✓ Peer review (IGEES network, seminars, conferences etc.)
- ✓ External
  - ✓ Other Government Department
  - ☐ Advisory group
  - ☐ Quality Assurance Group (QAG)
  - ☐ Peer review (IGEES network, seminars, conferences etc.)
  - ☐ External expert(s)
- ☐ Other (relevant details) – INSERT