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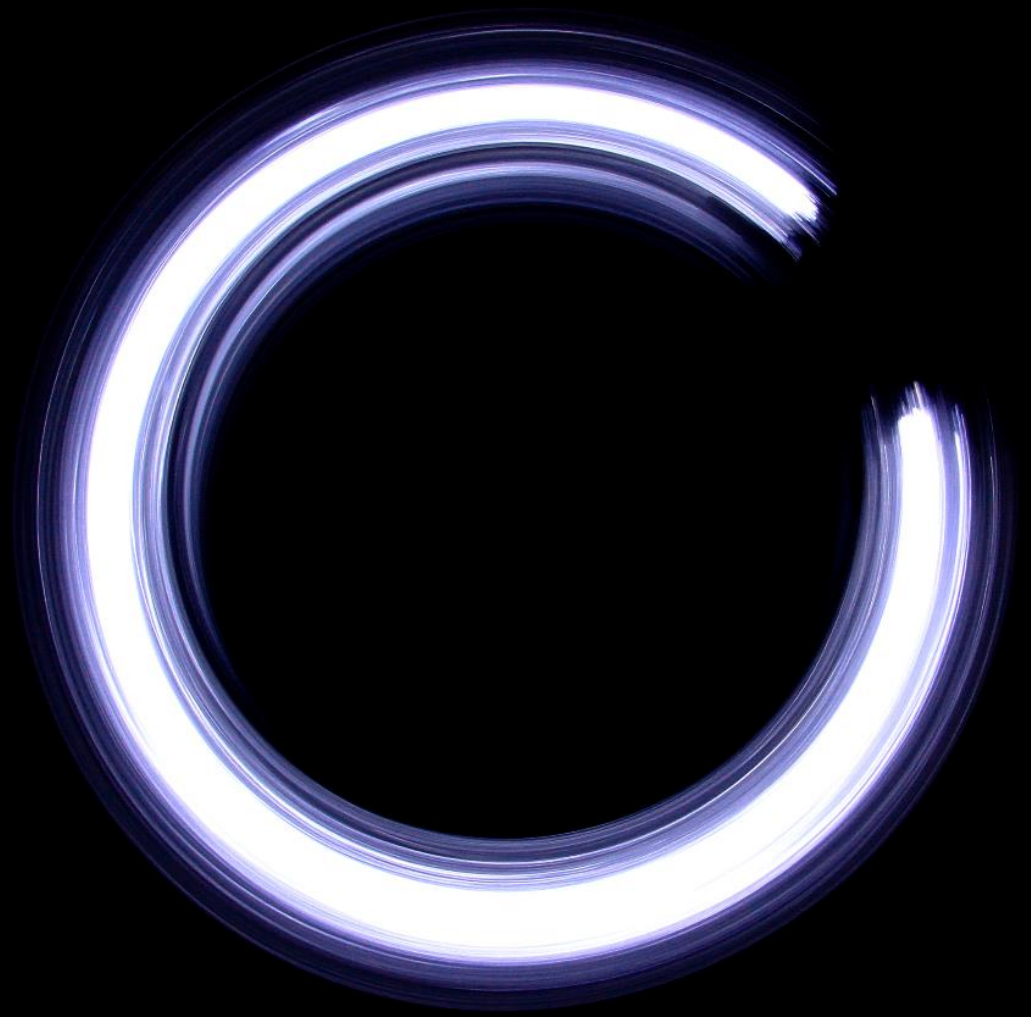

Bang-for-buck:

Australian evidence on the impact of zero emission vehicle purchase incentives

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Deloitte Access Economics

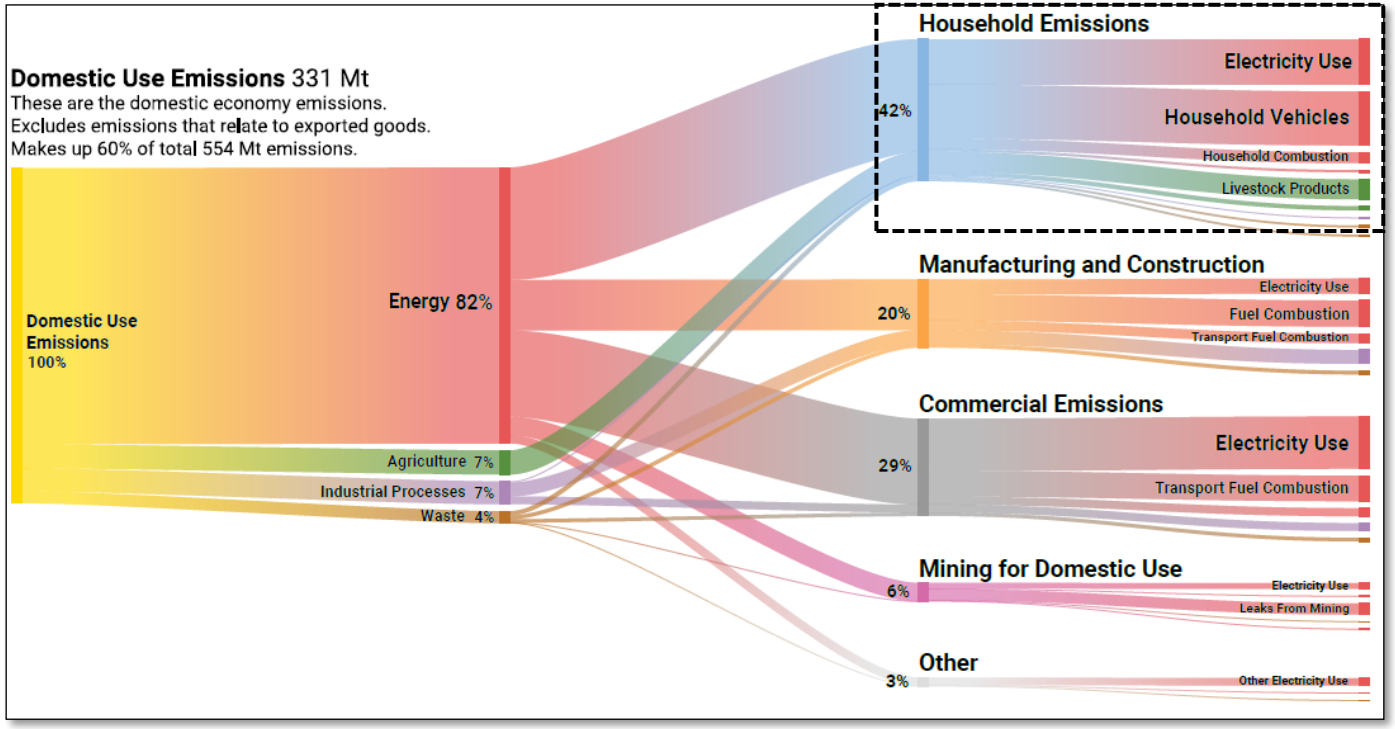
Contents

Background | Household vehicle emissions

Households contribute almost half (42%) of Australia's greenhouse gas emissions, in particular, vehicles represent 30%.

- Australia has set a climate target of net zero by 2050
- Household vehicles represent 30% of total emissions.
- Electric vehicles remain a fraction of overall vehicle sales in Australia
- Very little research exists on which government policies are most effective
- Deloitte was engaged by an Australian jurisdiction to evaluate a shortlist of hypothetical policies
- Deloitte used a survey and econometric analysis
- The policies likely to get the most uptake are also the most expensive, although there are some policies that deliver better bang for buck

Figure 1: Breakdown of domestic emissions by category



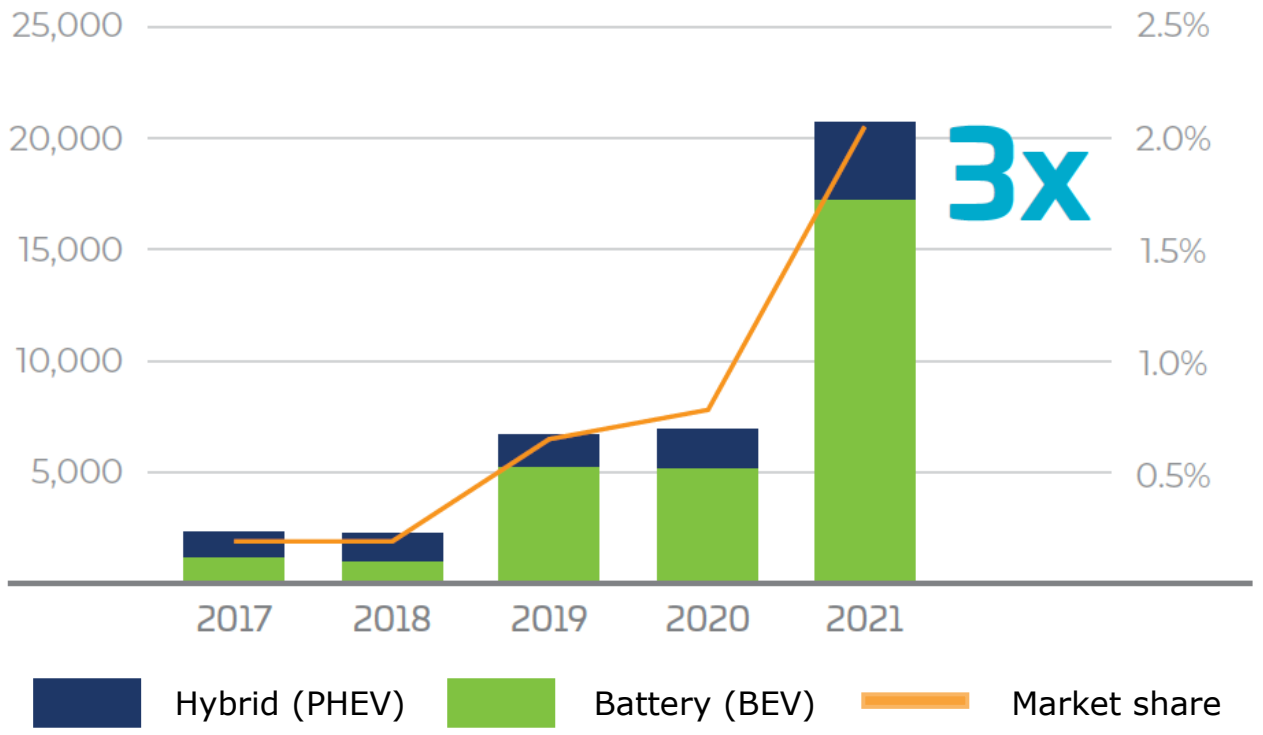
Source: Rewiring Australia (2021)

Introduction | Policies to encourage EV ownership

Electric vehicles represent 2% of total new vehicle sales in Auistralia compared to 9% globally.

- Electric vehicles have been available in Australia since 2011, although have struggled to take off
- 2% of sales across Australia except in ACT (5%)
- Globally, 9% of new car sales are EV with Europe reaching 17%
- Qualitative evidence presents a range of reasons for slow take up including:
  - Upfront cost
  - Range anxiety
  - Charging infrastructure
  - Installation costs
  - "war on the weekend"
  - Limited second hand market
- International experience shows that government policy is critical

Chart 1: Electric vehicle sales, Australia (2017-2021)



Source: Electric vehicle council (2022)

Background | Policy context

All states and territories have policies aimed at improving the affordability and expediting the transition towards ZEVs.

- Each State/Territory currently has its own policy mix to encourage ZEV uptake.
- Policies not only relate to subsidies but can include regulation and other non-financial incentives
- The current evidence base focusses on retrospective policy evaluations
- Most of these policies involve some public funding and investment
- There is limited evidence (domestic or international) that assesses the relative effectiveness of different policy options

Table 1: State-based ZEV policies

	Policy	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Total funding (millions)		10.12	595	4.64	60.25	53.25	6.78	100	21
Financial	Purchase cost	✓	✓	✓	✓	✓	✓	✓	
	Operating cost	✓			✓	✓	✓	✓	✓
	Vehicle fleets		✓	✓	✓			✓	
	Behaviour	✓	✓	✓					
Regulatory	Fuel efficiency standard								
	Sales target		✓		✓	✓		✓	
	Government fleet target	✓	✓	✓	✓	✓	✓	✓	✓
Charging	Public charging	✓	✓	✓	✓	✓	✓	✓	✓
	Smart/home charging	✓		✓		✓			
	Public/private building	✓	✓	✓		✓		✓	✓
Strategy	EV manufacturing								✓
	Electrify truck/HV								
	Public transport	✓	✓		✓			✓	
	Electric micro-mobility	✓				✓			

Note: Education and awareness policies excluded from table for brevity.
Source: Electric Vehicle Council (2022)

Method | Probabilistic expectations

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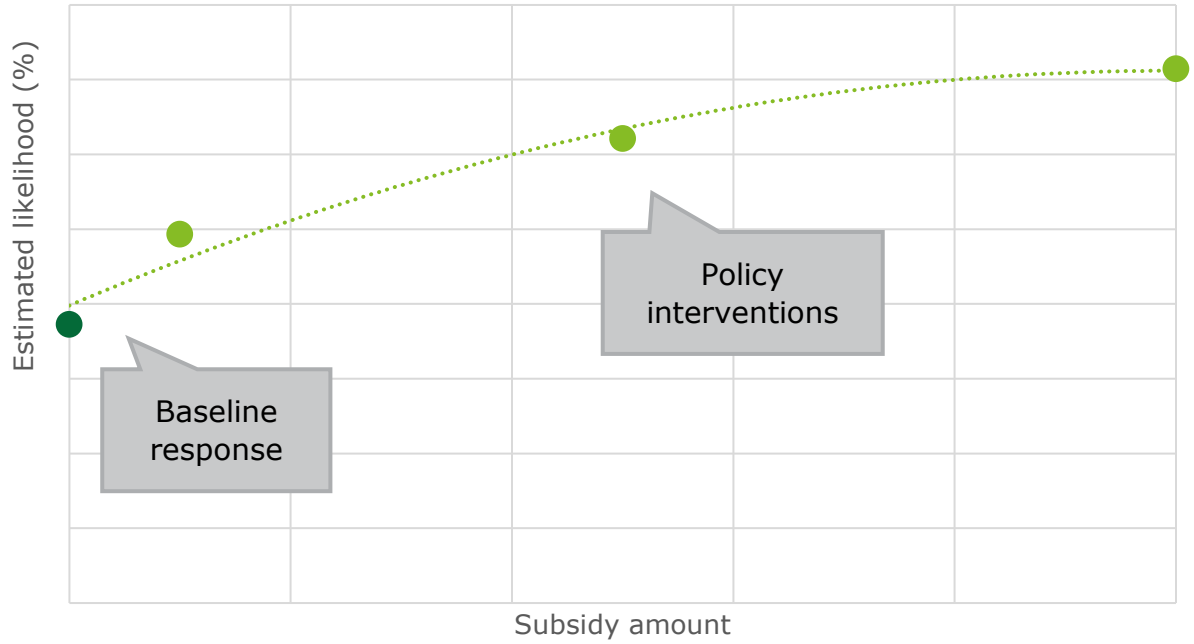
Probabilistic expectations

- *Delavande and Maski (2014)*: studied various hypothetical scenarios and how they would impact the decision to vote or not in the United States.
- *Delavande (2013)*: "Survey respondents can generally understand and answer probabilistic questions, such questions are not prohibitively time-consuming to ask, and the expectations are useful predictors of future behavior and economic decisions."
- **Survey design and data**
- Deloitte survey of 500 residents
- Survey elicited a baseline expected likelihood of purchasing an EV for next vehicle
- Participants are then presented a series of policy questions to see if/how their responsiveness would change

Chart 1: Stylised example of modelling policy impact - Likelihood



Note: Points show average likelihood across sample for each level of subsidy.
Source: Deloitte Access Economics survey (2022)

Method | Probabilistic expectations

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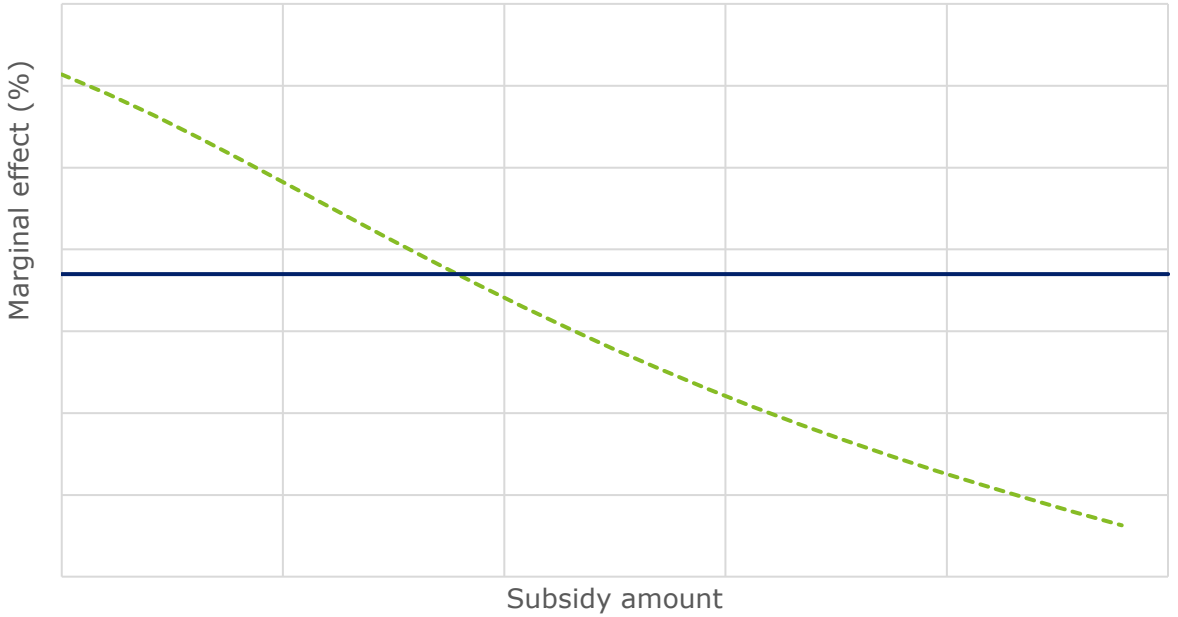
Generalised policy options

Monetised	Non-monetised
Upfront subsidy	Preferential access
Installation costs rebate	Convenient charging
Energy costs rebate	Price competitive EVs
Annual charges rebate	

Assessment criteria

- Deloitte used marginal effects to determine two assessment criteria
  - Prediction (average estimated likelihood): produces the overall increase in likelihood as a result of the policy
  - Average marginal effect: shows the marginal increase in likelihood for a given policy amount or 'bang-for-buck'

Chart 2: Stylised example of modelling policy impact – Marginal effect



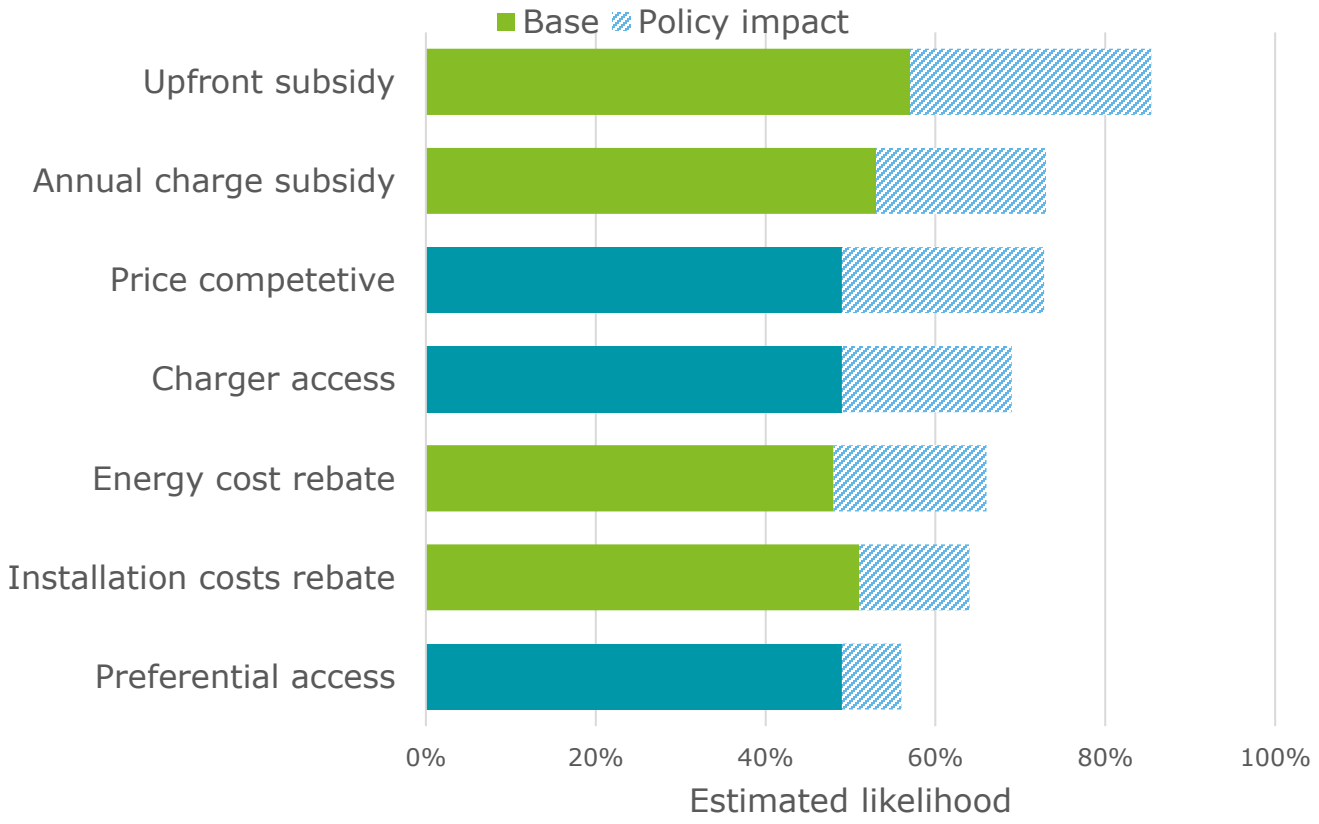
Source: Deloitte Access Economics survey (2022)

Results | Overall

The upfront subsidy has the largest increase in estimated likelihood

- The upfront subsidy has the largest overall impact on a persons likelihood of buying an electric vehicle
  - This is consistent with what we see in other countries and jurisdictions
  - Deloitte did not account for one-off and ongoing costs to government
- Price competitiveness supports the idea that upfront costs still remain the greatest hurdle to adoption
- Charger access indicates that convenience is still an issue for people considering electric vehicles
- Installation costs and energy rebates had the least overall effectiveness of the monetised policies
- Preferential access suggests some relatively cheap options, such as preferential parking, could increase the chance of uptake slightly.

Chart 14: Average estimated likelihood at base and maximum policy amount



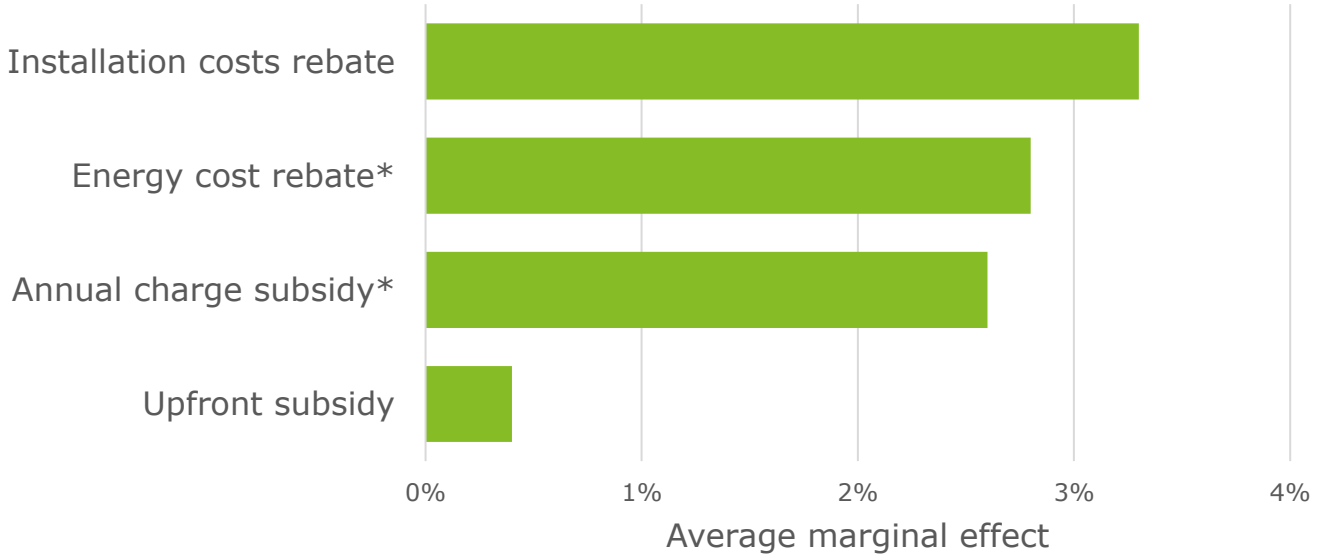
Note: Teal-coloured bars indicate non-unitised policy options. Slight variations in the base are expected with predicted models.
Source: Deloitte Access Economics (2021)

Results | Overall

Installation costs rebate has the highest average marginal effect per $100 of policy value

- The most effective policies are the most expensive
- Upfront subsidy is by far the least cost effective with only an average of 2% increase for each $100
- Energy costs rebate and annual charges subsidies are more cost effective, but represent ongoing liabilities to the government.
- Installation cost deliver the most ‘bang-for-buck’

Chart 15: Average marginal effect – cost effectiveness per $100



Note: Average marginal effects not estimated for static policies. Policies denoted with ‘*’ indicate ongoing cost to government.
Source: Deloitte Access Economics (2021)

Limitations and next steps

Probabilistic expectations is not infallible

Limitations

- Low sample
- The respondents might not represent wider Australia
- Participants expectations about the future could be unrealistic
- Survey responses might be influenced by social norms

Further research

- Further investigation of the impact across wider Australia
- Additional policy option
- Non-financial policies e.g. access to charging
- Further cohort analysis
- Real data on ZEV uptake

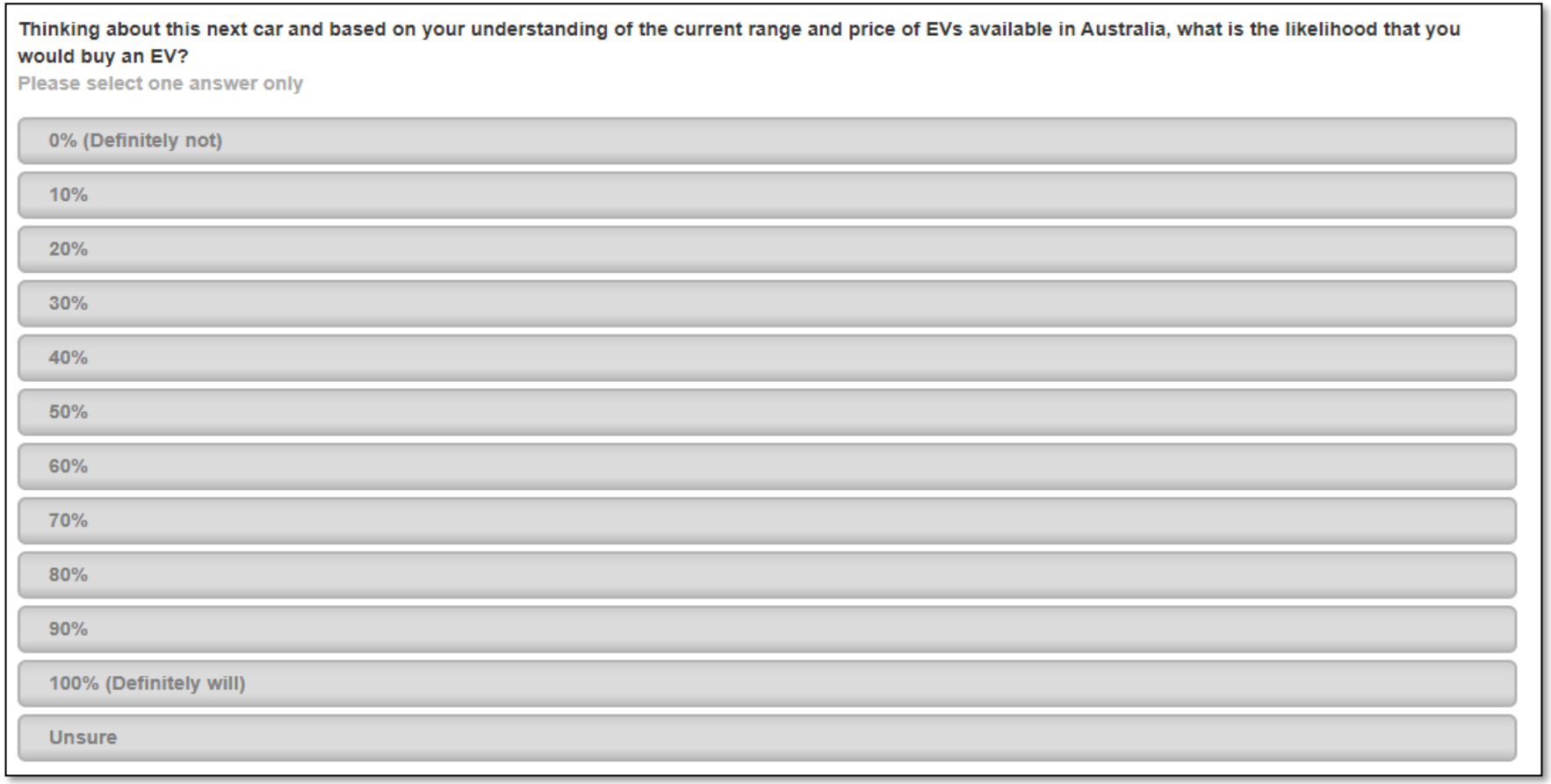
Q&A

Appendices

Survey

Survey questions

Figure A.1: Survey response sample



Source: Deloitte Access Economics (2022)

Survey
Policy question values

Table A.1: Policy values

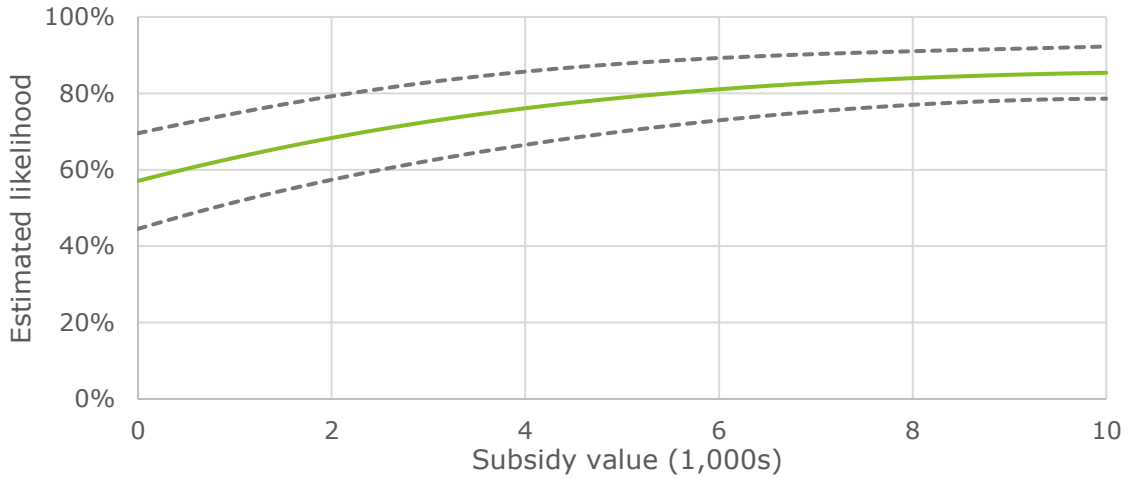
Policy	Type	Amount 1	Amount 2	Amount 3
Upfront subsidy	One-off	$1,000	$5,000	$10,000
Annual charges rebate	Annual	$100	$500	$800
Charger installation rebate	One-off	$100	$300	$500
Electricity costs rebate	Annual	$300	$500	NA

Source: Deloitte Access Economics (2021)

Policy impact

Subsidy: upfront costs

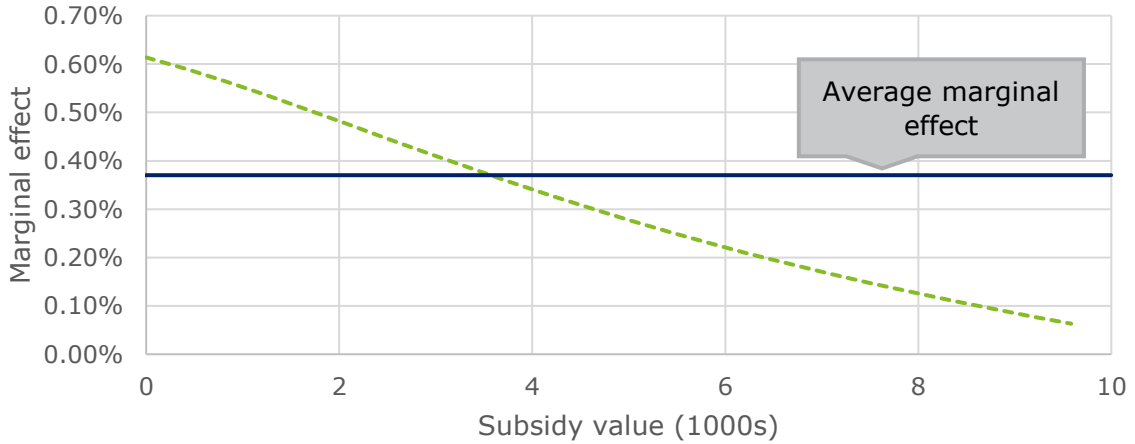
- Across the sample, an additional $100 in subsidies has an average marginal effect of 0.4 percentage points.
- On average, a $10,000 subsidy will increase the likelihood of purchasing an EV from 57% to 85%, controlling for other factors.
- The marginal effect in the case of subsidies is declining over the sample, indicating additional subsidies will be incrementally less effective.
- Per hundred dollar, the subsidy policy has the lowest average marginal effect, although the greatest overall impact.



Note: Dotted lines indicate upper and lower confidence intervals.
Source: Deloitte Access Economics (2021)

Variable	Coefficient
Subsidy amount (hundreds)	0.004*** (0.000)
Intercept	0.351 (0.349)
R^2	0.45
N	1,500

Note: Control variables excluded for brevity. Coefficient on subsidy amount refers to average marginal effect. Standard errors in parentheses
***p<0.001,**p<0.01,*<p<0.05



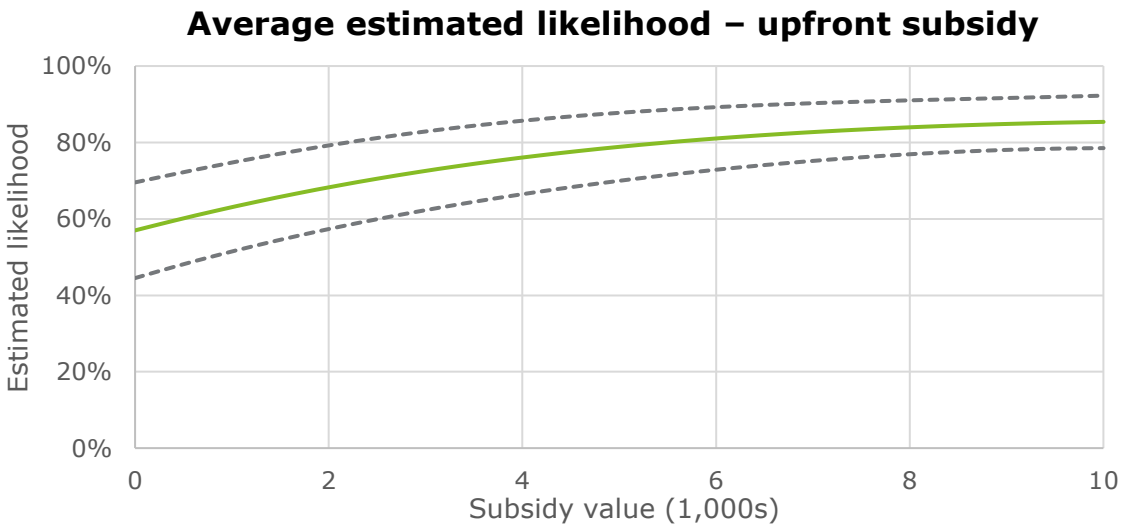
Source: Deloitte Access Economics (2021)

Policy impact

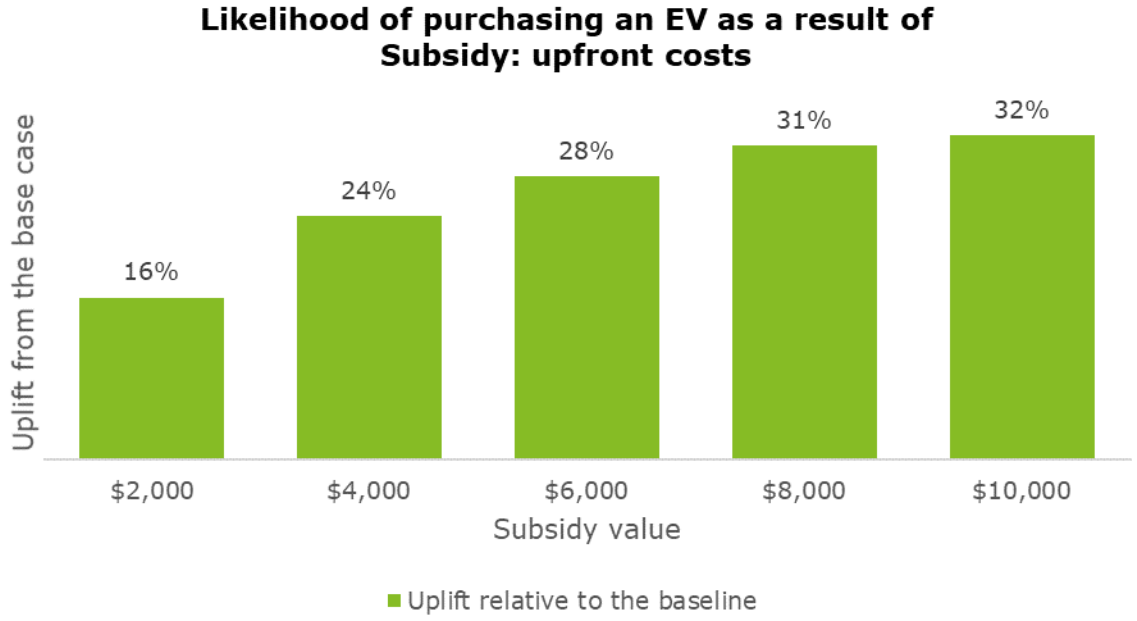
Subsidy: upfront costs

- A maximum of a $10,000 subsidy was tested in the survey, this value **increases the likelihood of purchasing an EV** from 57% to 85%, controlling for other factors.
- On average, an additional $100 in subsidies has an average marginal effect of 0.4 percentage points.
- The marginal effect in the case of subsidies is declining over the sample, indicating additional subsidies will be incrementally less effective.
- Per hundred dollar, the subsidy policy has the lowest average marginal effect (cost effectiveness), although the greatest overall impact.

Subsidy amount	Uplift relative to the baseline	Marginal impact
$2,000	16%	16%
$4,000	24%	8%
$6,000	28%	4%
$8,000	31%	3%
$10,000	32%	1%



Note: Dotted lines indicate upper and lower confidence intervals.
Source: Deloitte Access Economics (2021)



Source: Deloitte Access Economics (2021)

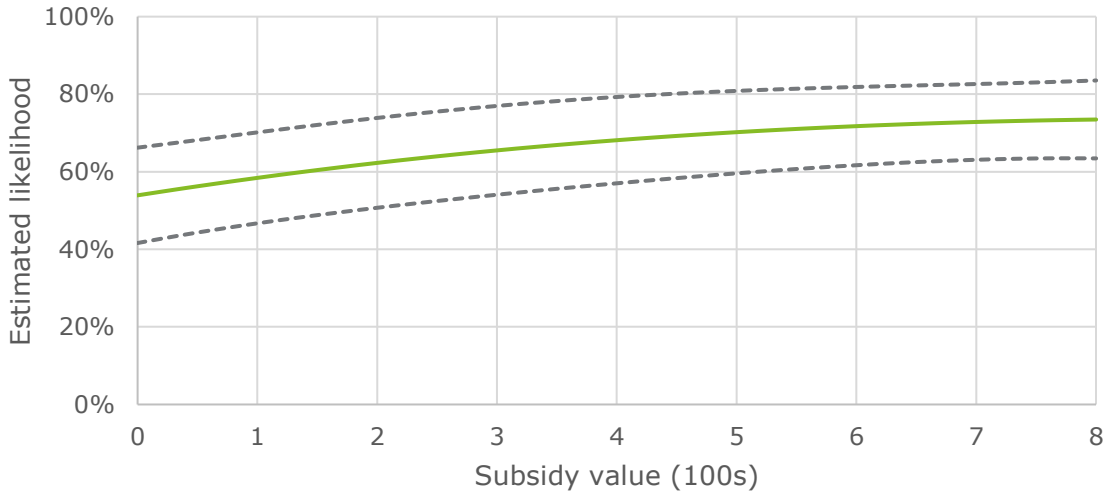
Policy impact

Rebate: annual vehicle charges

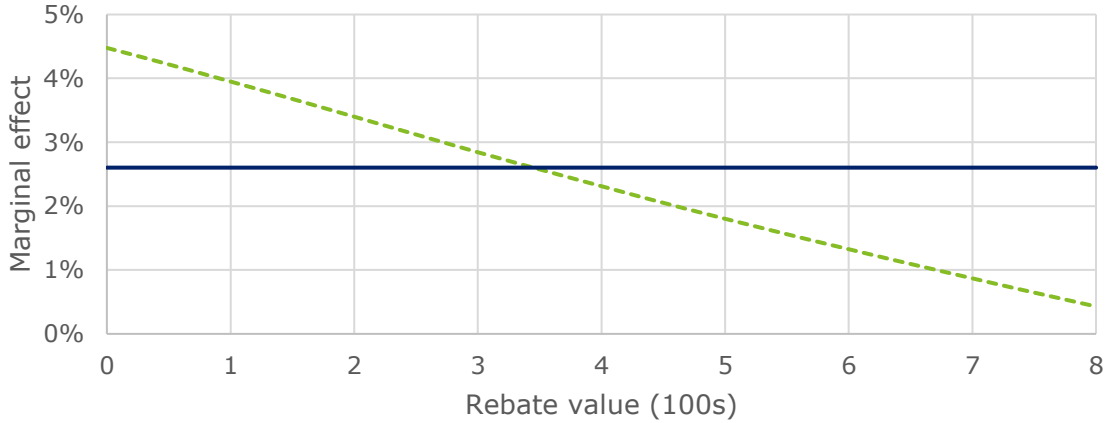
- An additional $100 in subsidies has an average marginal effect of 2.6%, across the sample.
- At the maximum subsidy of $800, the estimated likelihood has increased to from 53% to 70%.
- As in the upfront costs subsidy, the marginal effect is declining, indicating that higher levels of subsidies will have lower overall impact on likelihood.
- Unlike the one-off subsidy, subsidies on annual charges would be an ongoing liability to the ACT government.

Variable	Coefficient
Subsidy amount (hundreds)	0.026*** (0.003)
Intercept	0.310 (0.329)
R^2	0.39
N	1,498

Note: Control variables excluded for brevity. Coefficient on subsidy amount refers to average marginal effect. Standard errors in parentheses
***p<0.001,**p<0.01,*<p<0.05



Note: Dotted lines indicate upper and lower confidence intervals.
Source: Deloitte Access Economics (2021)



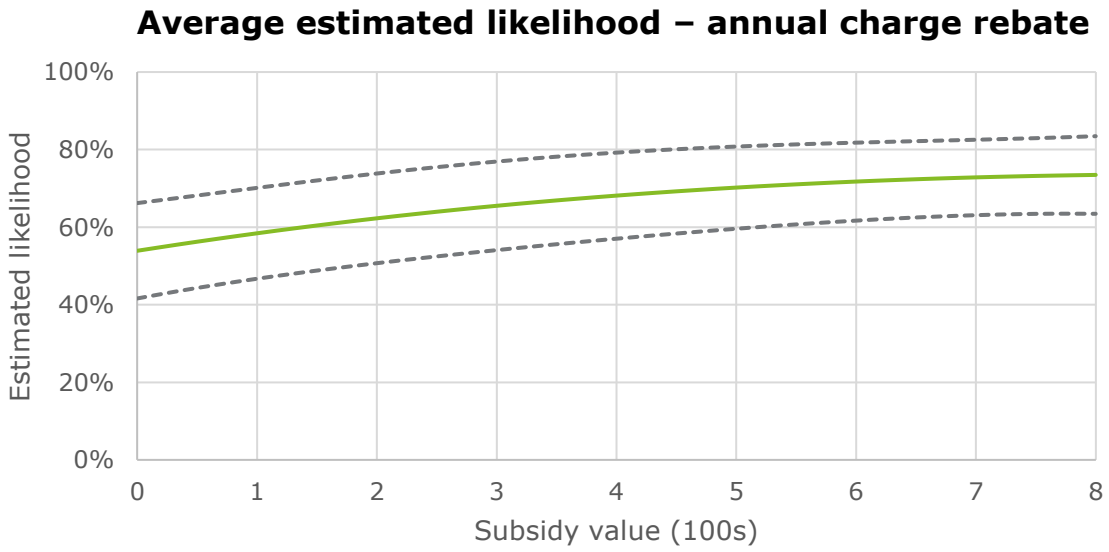
Note: Dotted lines indicate upper and lower confidence intervals.
Source: Deloitte Access Economics (2021)

Policy impact

Rebate: annual vehicle charges

- An additional $100 in subsidies has an average marginal effect of 2.6%, on average.
- At the maximum subsidy of $800, the estimated likelihood increases from 53% to 70%.
- As in the upfront costs subsidy, the marginal effect is declining, indicating that higher levels of subsidies will have lower overall impact on likelihood.
- Unlike the one-off subsidy, subsidies on annual charges would be an ongoing liability to the ACT government.

Rebate amount	Uplift relative to the baseline	Marginal impact
$200	9%	9%
$400	15%	6%
$600	19%	4%
$800	20%	1%



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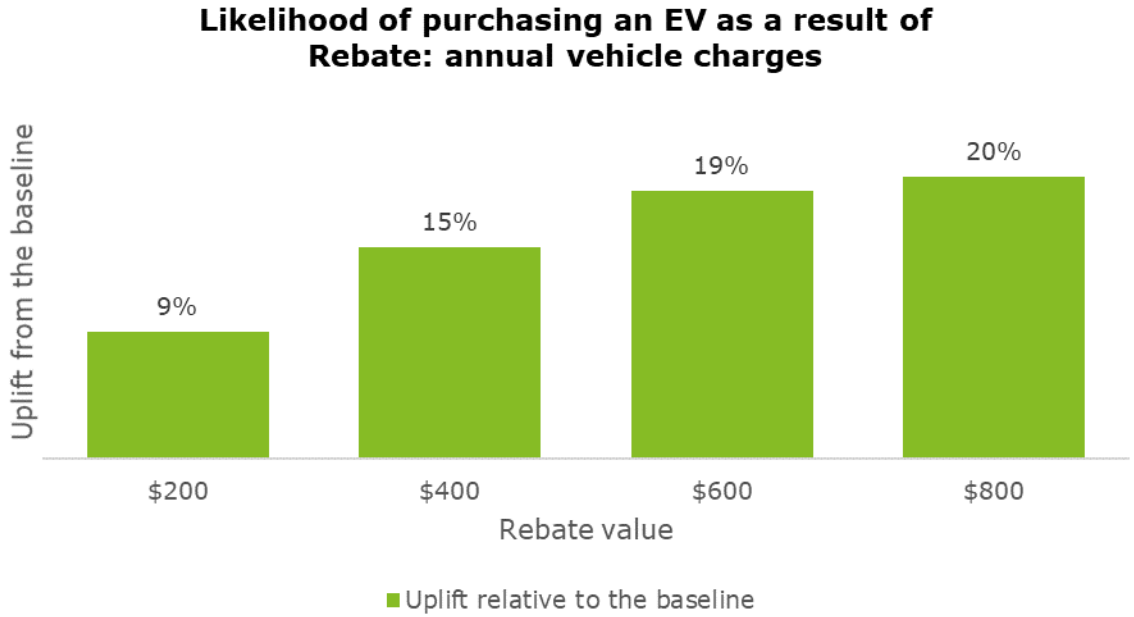
Source: Deloitte Access Economics (2021)



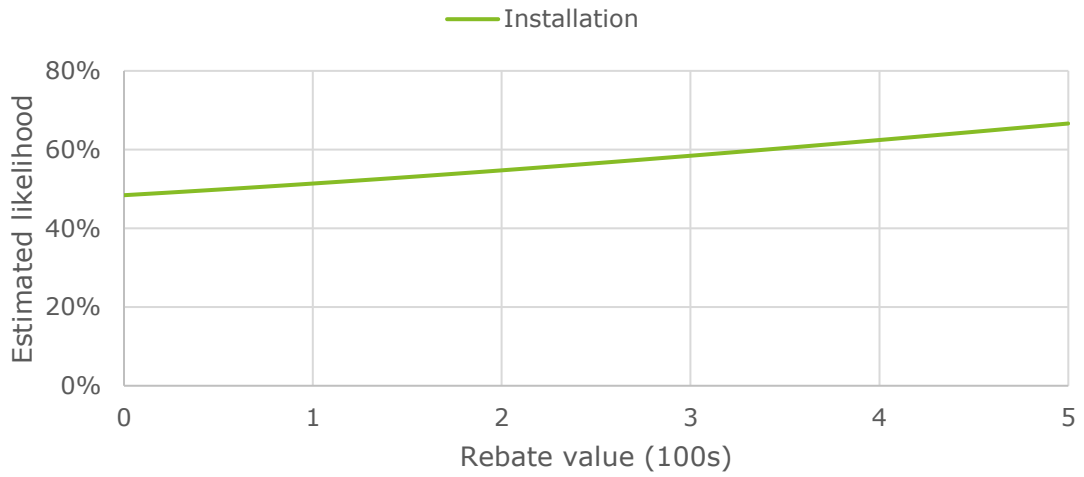
Source: Deloitte Access Economics (2021)

Policy impact
Rebate: installation

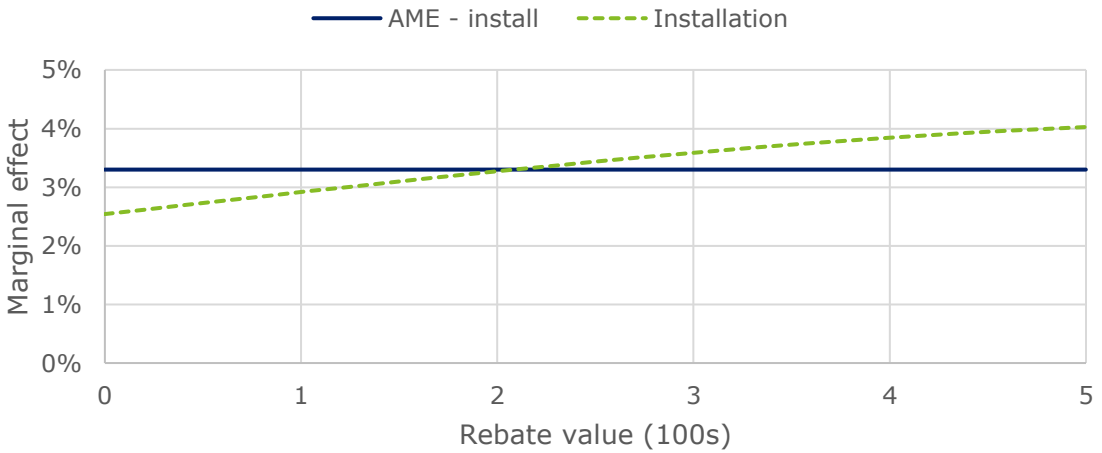
- Per hundred dollar, installation rebates and energy rebates have an average marginal effect of 3.3% and 2.8% respectively.
- Unlike the last two options, the marginal effect on installation and energy rebates is positive across the sample, indicating greater impact with higher levels of subsidy options considered.
- Installation and energy rebates have the highest average marginal effects of the policy options, although the lower value range results in a smaller policy impact.
- Installation rebates have a larger average marginal effect, even though these costs are one off compared to regular energy rebates.

Variable	Coefficient (Install)
Subsidy amount (hundreds)	0.033*** (0.004)
Intercept	0.650* (0.328)
R^2	0.39
N	1,478

Note: Control variables excluded for brevity. Coefficient refers to average marginal effect. Standard errors in parentheses
***p<0.001,**p<0.01,*<p<0.05



Source: Deloitte Access Economics (2021)



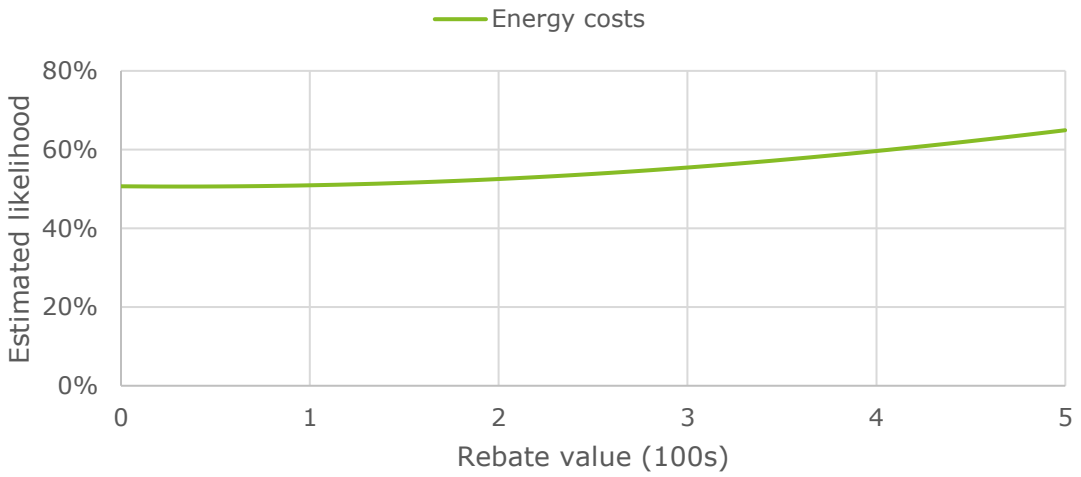
Note: Dotted lines indicate upper and lower confidence intervals.
Source: Deloitte Access Economics (2021)

Policy impact
Rebate: energy costs

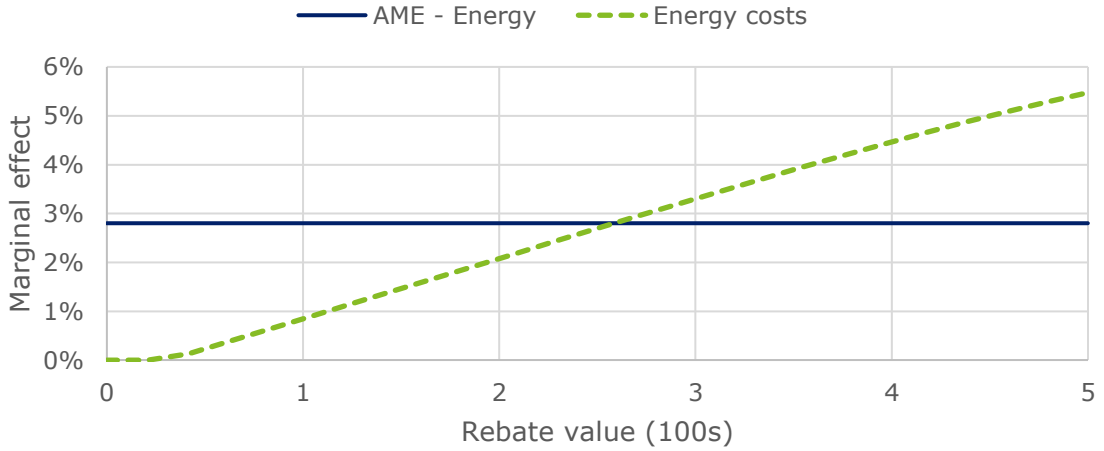
- Per hundred dollar, installation rebates and energy rebates have an average marginal effect of 3.3% and 2.8% respectively.
- Unlike the last two options, the marginal effect on installation and energy rebates is positive across the sample, indicating greater impact with higher levels of subsidy options considered.
- Installation and energy rebates have the highest average marginal effects of the policy options, although the lower value range results in a smaller policy impact.
- Installation rebates have a larger average marginal effect, even though these costs are one off compared to regular energy rebates.

Variable	Coefficient (Energy)
Subsidy amount (hundreds)	0.028*** (0.004)
Intercept	0.717 (0.361)
R^2	0.37
N	1,115

Note: Control variables excluded for brevity. Coefficient refers to average marginal effect. Standard errors in parentheses
***p<0.001,**p<0.01,*<p<0.05



Source: Deloitte Access Economics (2021)



Note: Dotted lines indicate upper and lower confidence intervals.
Source: Deloitte Access Economics (2021)

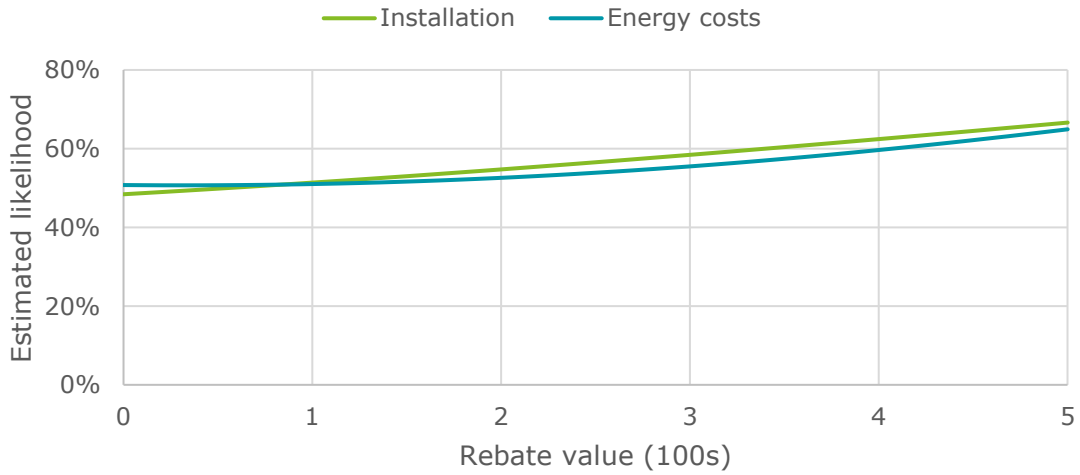
Policy impact

Rebate: installation and energy costs

- Per hundred dollar, installation rebates and energy rebates have an average marginal effect of 3.3% and 2.8% respectively.
- Unlike the last two options, the marginal effect on installation and energy rebates is positive across the sample, indicating greater impact with higher levels of subsidy options considered.
- Installation and energy rebates have the highest average marginal effects of the policy options, although the lower value range results in a smaller policy impact.
- Installation rebates have a larger average marginal effect, even though these costs are one off compared to regular energy rebates.

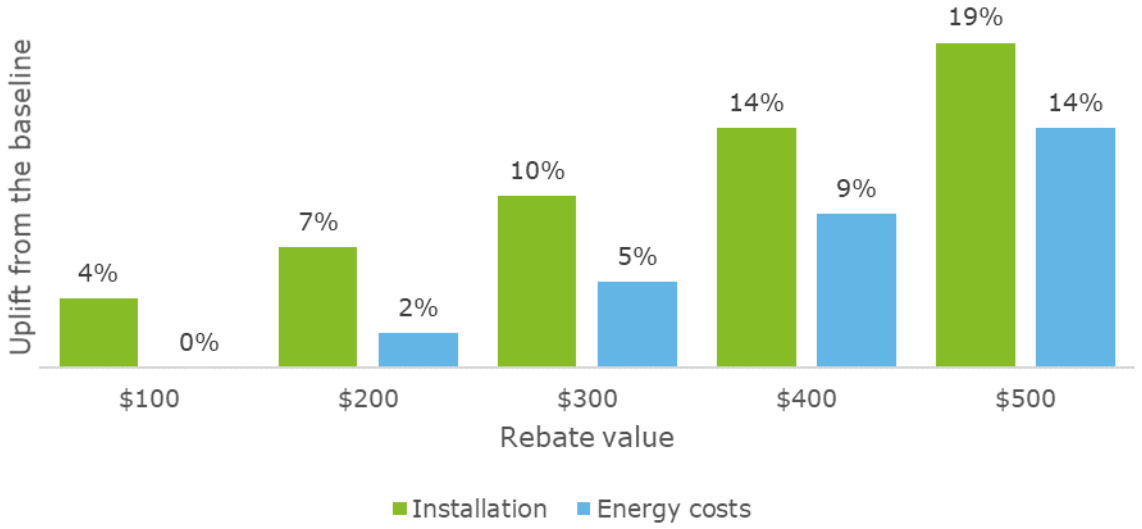
	Installation		Energy costs	
Rebate amount	**Uplift relative to the baseline**	**Marginal impact**	**Uplift relative to the baseline**	**Marginal impact**
$100	4%	4%	0%	0%
$200	7%	3%	2%	2%
$300	10%	3%	5%	3%
$400	14%	4%	9%	4%
$500	19%	5%	14%	5%

Average estimated likelihood – installation and energy



Source: Deloitte Access Economics (2021)

Likelihood of purchasing an EV as a result of Rebate: installation and energy costs



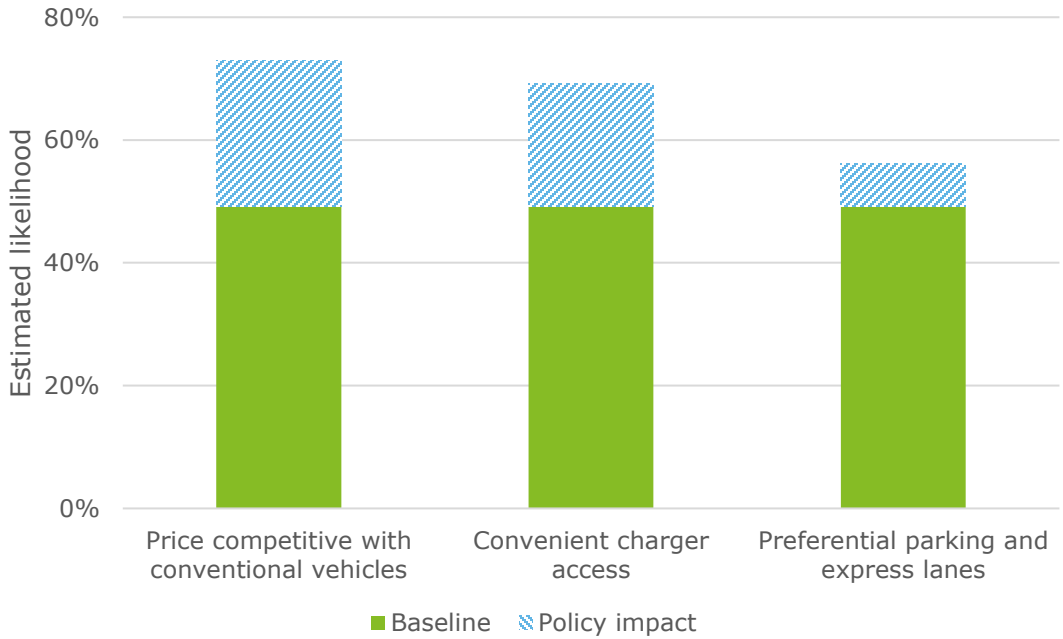
Source: Deloitte Access Economics (2021)

Policy impact
Additional policy considerations

- ACT Residents would be most responsive to a policy that created price competitiveness between EVs and conventional vehicles.
- Providing electric vehicles with preferential parking and express lane access would only increase the average estimated likelihood by 7%, although this represents a relatively inexpensive option.
- Increasing charger availability has an average marginal effect of 19%.

Variable	Coefficient
Static policy	
Preferential parking and express lanes access	0.066** (0.020)
Access to convenient charging facilities	0.189*** (0.020)
EV vehicles are price competitive with conventional vehicles	0.226*** (0.194)
Intercept	0.617 (0.318)
R^2	0.42
N	1,499

Note: Control variables excluded for brevity. Standard errors in parentheses
***p<0.001,**p<0.01,*<p<0.05



Note: These policy options have not been unitised.
Source: Deloitte Access Economics (2021)

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