### The Cost of Electrifying Transport

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#### Background and Motivation

- There is a growing consensus that a low carbon future in the transportation sector will be met through a revolution in the vehicle market.
- Despite the efforts made by many countries, the uptake of alternative fuelled vehicles (AFV) has been low.
- A number of countries have begun to withdraw their current incentives for AFVs, such as Denmark and Ireland, which has already resulted in a decrease in market share (see Figure below).
- This study uses a consumer choice model to:
  i. determine the effect of this withdrawal of incentives on Ireland
  ii. analyse both the cost and effect of increasing incentives on national market share and emissions.

#### Market Segmentation

- The market for private vehicle purchasing is segmented in three ways:
  i. Geographical (Urban/Rural)
  ii. Driving Profile (Modest/Average/Frequent)
  iii. Adopter Profile (Early Adopter/Early Majority/Late Majority)

#### Results

- Scenarios were generated to consider to cost of incentivising transport from a governmental point of view.
- Emissions were generated through linking the consumer choice model with a CarSTOCK model.
- Placing a ban on the sale of vehicles with an internal combustion engine (ICEs) and assuming a market saturation of AFVs had zero cost, but reduced CO\(_2\) emissions by 60% in 2050 relative to 2015.
- A 71% reduction in emissions could be achieved from removing VRT and VAT on new AFV sales at a cost of €532/tonne of CO\(_2\).
- A combination of all scenarios generated a reduction in CO\(_2\) of 73% by the target year.

#### Model Inputs

- Capital costs were collected from the Society of the Irish Motor Industry.
- Stock, efficiency, mileage and fuel costs were collected form the National Car Test and the Vehicle Registration Unit.
- The Intangible cost for model availability was generated using exponential curves calibrated with the number of models available for each year, assuming very high intangible for very low number of models.
- Range anxiety intangible costs were generated from the Oakridge National Laboratory MA\(^c\)T model.

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**Consumer Choice Models**

- Behaviour is an imperative attribute for any model to accurately represent consumer purchasing decisions.
- This study uses a discrete multinomial logit choice model to introduce heterogeneity into a stock simulation model.
- Both ‘tangible’ and ‘intangible’ costs are considered.
- Tangible costs represent the actual costs facing the consumer when purchasing a vehicle.
- Intangible costs represent the unseen costs facing consumer, such as range anxiety.

#### Tangible Costs

- Vehicle Investment Costs, excl. Tax
- Vehicle Registration Tax
- Value Added Tax
- Circulation Tax
- Fuel Costs

#### Intangible Costs

- Model Availability
- Risk Premium
- Range Anxiety
- Refuelling Infrastructure

#### Model Outputs

- A 71% reduction in emissions could be achieved from removing VRT and VAT on new AFV sales at a cost of €532/tonne of CO\(_2\).
- A combination of all scenarios generated a reduction in CO\(_2\) of 73% by the target year.

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