Programme Area: Light Duty Vehicles

Project: Consumers and Vehicles

Title: Executive Summary

Abstract:

This project was undertaken and delivered prior to 2012, the results of this project were correct at the time of publication and may contain, or be based on, information or assumptions which have subsequently changed. The Consumers and Vehicle project is comprised of five Work Packages. This Executive Summary covers Work Packages 1.1 and 1.2. The purpose of Work Package 1.1 was to develop a model of future vehicle capability and performance, from which long-term infrastructure needs can be determined and plug-in vehicles1 can be objectively evaluated against conventional vehicles. The purpose of Work Package 1.2 was to determine realistic cost forecasts for plug-in vehicles by conducting a robust analysis of the fundamental cost drivers.

Context:

The Consumer and Vehicles project looked at the potential long-term performance and cost of plug-in vehicles. It examined consumer reactions and behaviours in buying and using them. It explored supporting infrastructure, and included in-depth surveys with 3,000 consumers and real-world testing with 40 drivers.

ETI Executive Summary

Programme: Transport – Plug-in Vehicle Economics and Infrastructure

Project: Consumers and Vehicles (TR1001)

Work Package(s): 1.1 and 1.2 (vehicle technology and cost)

Final Deliverable(s): TR1001/1.1-6 and TR1001/1.2-5

Version: *1.0*

Introduction

The Consumers and Vehicle project is comprised of five Work Packages. This Executive Summary covers Work Packages 1.1 and 1.2.

1.1	Future capability and performance of vehicles
1.2	Vehicle cost driver analysis
1.3	Identifying the relevant consumer segments
1.4	Modelling the consumer response
1.5	Consumer testing framework.

The purpose of Work Package 1.1 was to develop a model of future vehicle capability and performance, from which long-term infrastructure needs can be determined and plug-in vehicles[1] can be objectively evaluated against conventional vehicles. The high-level workflow is presented below.

The full range of vehicle types and sizes were covered, including gasoline, diesel, hydrogen and electric; hybrid combinations were covered as well. The characteristics / attributes data was derived for include:

- Energy consumption
- Acceleration
- Top speed
- Tank-to-wheel CO_2 emissions
- Range (liquid and/or electric)
- Vehicle mass
- Maximum payload
- Luggage capacity

This data is available in MS Excel format. In addition to developing the detailed bottom-up technology roadmaps and deriving the above attributes, the report (ref. 1.1-6) also covers an analysis of the hazards, risks and legislative issues associated with plug-in vehicles.

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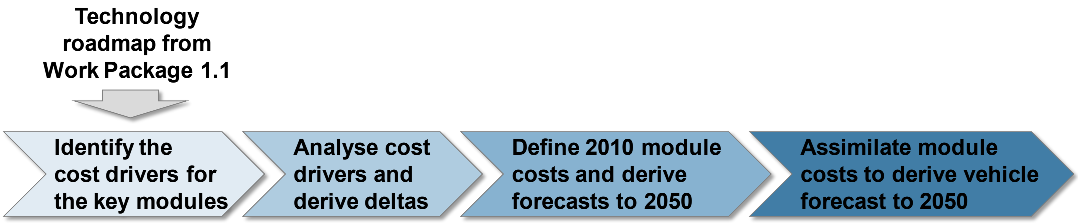
[1] *'Plug-in Vehicle' refers to any vehicle capable of being powered by an external electricity supply. It includes Battery Electric Vehicles (BEVs), which can only be powered by an external electricity supply, and Plug-in Hybrid and Range Extended Electric Vehicles (PHEVs and RE-EVs), which can be powered by either an external electricity supply or petrol/diesel fuel.*

The purpose of Work Package 1.2 was to determine realistic cost forecasts for plug-in vehicles by conducting a robust analysis of the fundamental cost drivers. The high-level workflow is presented below.



The cost driver analysis included:

- Materials consumption
- Material costs
- Efficiency improvements
- Labour cost changes
- Amortisation / CAPEX
- Energy cost changes

The resulting cost data is encapsulated in two separate spreadsheet models:

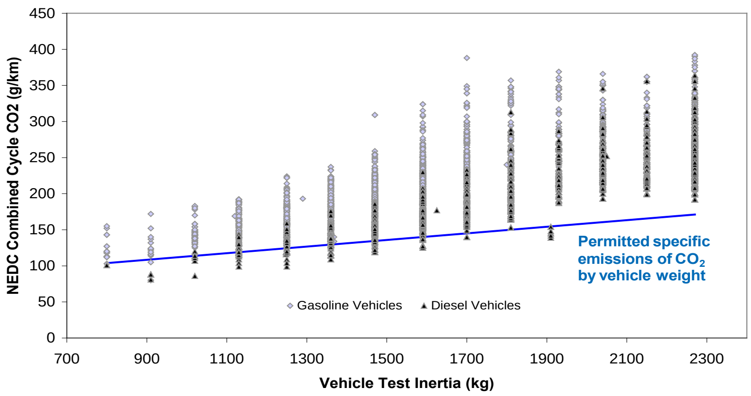
- A component level cost model, presenting the data for the individual modules
- A vehicle level cost model, assembling vehicle costs from the appropriate modules

Key Findings

The automotive industry has made significant progress in recent years to develop and bring to market vehicles with significantly higher fuel efficiencies. This gradual improvement has been brought about by increasing consumer desire for lower running costs and various Government policies.

However, the European automotive industry now has a much larger imperative than ever before to deal with CO_2 emissions; the EU Emissions Regulation for Passenger Cars. This is the most significant market driver; other current governmental measures are complimentary but have relatively small effects.

It is critically important to note that this Regulation is based on tailpipe emissions; energy sector emissions are excluded (e.g. from electricity generation or liquid fuel / hydrogen production).



In response to the strong penalties within this changing environment, the automotive industry is presented with three strategic options:

1. Pay any penalties imposed by the Regulation; and/or

2. Improve the efficiency of vehicles across the product portfolio; and/or

3. Sell a proportion of zero tailpipe emissions vehicles to offset the penalty.

In practice, the scale of penalties due under the Regulation prevents option (1) forming the core of any strategy. It may however form part of a broader strategy.

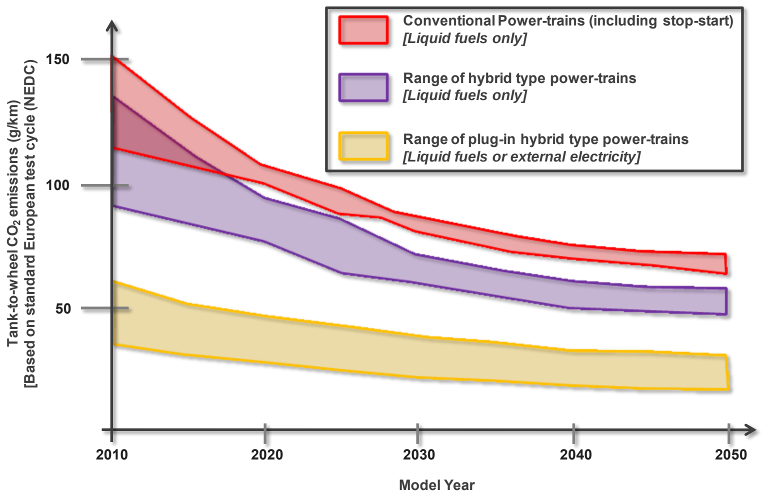
There are a number of low cost technologies, such as stop-start engines, that are easily introduced across the product portfolio to deliver option (2). However, the cost of introducing sufficient technology across the product portfolio to avoid all penalties is significant. Consequently, option (3) becomes increasingly attractive.

Delivering option (3) would primarily require the sale of BEVs or hydrogen vehicles. BEVs are nearer to market than hydrogen vehicles, and are less inhibited by a lack of energy infrastructure.

Automotive industry strategies are likely to involve varying combinations of these three options, depending on the unique position of each individual manufacturer.

Given this strategic context, and assuming increasingly stringent requirements under this Regulation (and/or similarly strong financial drivers), it will become increasingly cost effective to reduce CO_2 emissions from passenger cars.

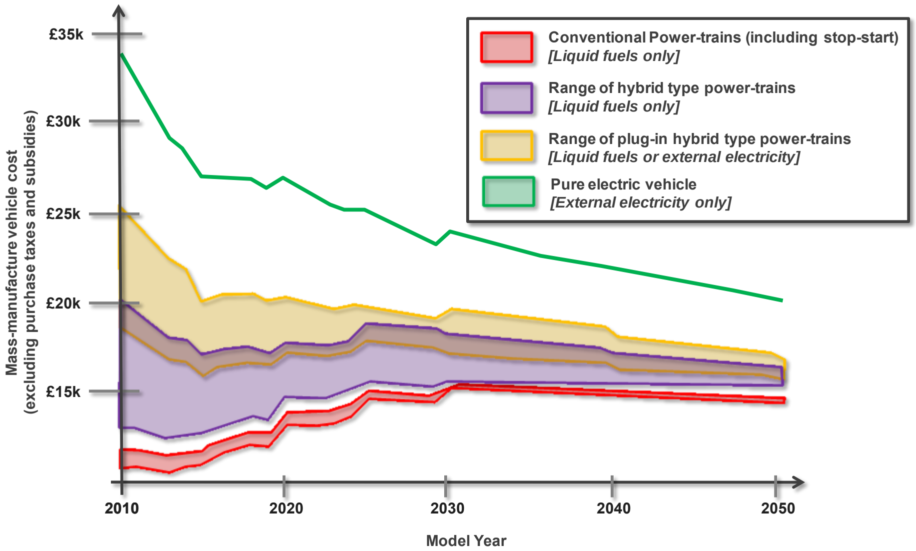
There is significant potential to reduce the emissions from conventionally fuelled vehicles (e.g. power-train efficiency, hybridisation, lightweight structures, improved aerodynamics, etc). This is shown in the diagram below for a typical SMMT Cat. C vehicle (e.g. Ford Focus, VW Golf, etc).



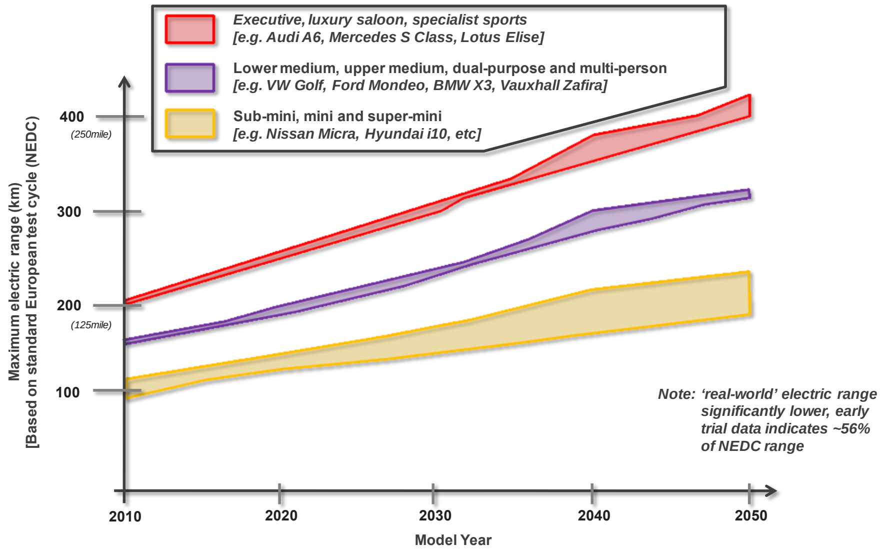
However, this efficiency gain will come at a cost directly linked to the size of the regulatory penalty; currently €95 per g/km reduction. Hence, the cheapest vehicles in the market are likely to increase by ~40% in real terms by 2030.

In parallel to the cheapest vehicles increasing in cost, the cost for alternative power-train options is likely to decrease due to efficiencies of scale and technology learning curves. Consequently, the range of power-train options is likely to converge in cost.

The cost for a typical SMMT Cat. C vehicle (e.g. Ford Focus, VW Golf, etc) is shown in the chart below.



BEVs are anticipated to be the most expensive of the different vehicle power-train types, primarily driven by the cost of batteries. However, the diagram above includes a gradual doubling of electric range by 2050 from the relatively low range of plug-in vehicles today. An alternative approach is to maintain the current range, which would help to bring the cost more in line with other power train options. However, this would further hinder the potential for BEVs to displace other, more versatile, power-train options. The anticipated improvement in BEV range is shown below.



A significant breakthrough in battery technology would enable the cost of BEVs to reduce. However, the timescales for development and integration into a vehicle platform mean that this is unlikely to impact mass-market BEV products until at least 2030.