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Programme Area: Light Duty Vehicles

Project: Economics and Carbon Benefits

Title: New Revenue Opportunities within Plug-in Vehicle Environment

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. This report provides an in-depth qualitative viability analysis (supported by initial quantitative estimates) of the complimentary revenue streams (to the core business models) that may emerge within the plug-in vehicle environment and their potential contribution to the overall economic viability of plug-in vehicles in the UK. This report should be read in conjunction with the 'Generic Business Models for Plug-in Vehicle Environment' report. These two reports precede the in-depth quantitative viability analysis in the Economics and Carbon Benefits project. The key insights are captured in the Executive Summary on pages 6 to 10.

Context:

A strategic level analysis of the potential size of the market for plug-in vehicles, the total level of investment needed and the total carbon offset for the UK.

ETI Plug-in vehicles project

WP 3.2.1 New Revenue Streams

19 November 2010

Final Report

Deliverable No: WS3/ARUP/13

ARUP

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		Name	Guri Neote, Zoe Jankel, Jac Cross	Jac Cross / Peter Young	Peter Young
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		Description	Final Report including changes in response to feedback from ETI reviewers.		
			Prepared by	Checked by	Approved by
		Name	Jac Cross	Peter Young	Peter Young
		Signature			

Basis of Preparation

General

- Our work has combined desktop research, interviews with industry specialists (both internal and external), and cost-modelling. We have undertaken the following activities:
    - Desktop research, which has included review of research papers, industry journals, government reports and other PIV industry related publications;
    - Informational interviews with internal Arup staff who specialise in the communications industry;
    - Informational interviews with stakeholders throughout the PIV industry and public sector specialists to verify and supplement information collected during the desktop study; and
    - High-level cost-modelling for business models with a 'Potentially Viable' business case (criteria defined on Page 13).
- A complete list of publications reviewed is given in Appendix B and a list of interviews conducted is given in Appendix C.
- Publicly available data sources are referenced directly in this report. Interviews were conducted on the understanding that opinions, data or information obtained from interviews would not be directly referenced in this report. However, on each page a list of the relevant interviews is provided in the footer and information taken from interviews is indicated with a [†] in the main text.
- Our analysis and opinions have been based on our technical knowledge and, where indicated, discussions with industry stakeholders.
- We have not sought to establish the reliability of the sources of information used, but we have satisfied ourselves, so far as possible, that the information used is consistent with industry opinions.
- This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Assumptions

- A major feature of new revenue streams is their reliance on communications infrastructure. Therefore we assume that charge infrastructure associated with PIVs will comprise as a minimum of:
    - Electricity power supply, and
    - IT communications link (standard copper / fibre optic link)

Economic Boundary

- For the purposes of this report we do **not** consider any of the revenue streams listed below as new, and categorise these as existing business models or generic business models in the plug-in vehicle market:
    - Maintenance of PIVs
    - Payment for in car infotainment / entertainment systems
    - Payment / fees for electricity used for charging PIVs at charge posts
    - Payment / fees for parking PIVs at charge posts / bays
    - Payment for charge posts / infrastructure installation
    - Maintenance of charge posts / infrastructure
- As such these revenue streams have been considered in WS3/ARUP/06 and are beyond the scope of this report.

Glossary

BEV	Battery Electric Vehicle, a plug-in vehicle with no internal combustion engine
Business Model	A collection of transactions that form part of the plug-in vehicle industry supply chain
Charge post	A stationary unit that supplies electricity for the recharging of PIVs also referred to as charge points or charge stations in the PIV industry
Charging	PIV battery charging
Chassis	A vehicle without a battery
Consumer	The user of a vehicle, may be an individual or an organisation
Conventional Charging	Charging of PIVs using 3kW or 7kW plug-in charge posts (3-8 hour charge time)
ICE	Internal Combustion Engine
ICEV	Internal Combustion Engine Vehicle
Infotainment System	In vehicle systems that combine both content that is both informational and entertaining, e.g. satellite navigation and music systems
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle, a parallel hybrid
PIV	Plug in Vehicle
IRR	Internal Rate of Return
R&D	Research and Development
Range	Electric only range of BEV, REEV or PHEV
REEV	Range Extended Electric Vehicle, a series hybrid
Rapid Charging	Charging of PIVs using 50kW plug in charge posts (10-30 minute charge time)
Revenue Stream	A transaction between any two stakeholders that results in there being income to either party
Running costs	The annual costs of using a vehicle excluding depreciation, for the purpose of this report taken as maintenance and fuel
Total cost of ownership	The total cost of using a vehicle, for the purpose of this report taken as depreciation, maintenance and fuel
Wi-Fi	Wireless local area network (WLAN) internet connectivity
WAP	Wireless Access Point
SMS	Short Message Service

Contents

New revenue streams arising from the integration of vehicles and charging infrastructure could affect the development of the PIV market

Introduction

This work considers new revenue streams that may arise in the PIV market in the UK due to the integration of vehicles and charging infrastructure. Seven potential new services are considered. The viability of these services is assessed using information from interviews with PIV industry stakeholders and desktop research. For those services that are potentially viable, their impact on the PIV market and the Treasury is assessed.

Deliverable outline

This report is split into the following sections:

2. Methodology	this section describes the methodology and the new revenue streams considered, and outlines the scenarios used in assessing business models consisting of one or more new revenue streams.
3. Summary analysis	this section describes the business models and new revenue streams assessed, outlines their viability and, for those that are potentially viable, summarises their impact on the Plug-In Vehicle (PIV) market.
4. Detailed analysis	this section contains detailed analysis of each business model in a consistent format that covers technology requirements, current experience, market demand, barriers, enablers, risks and competition. For those business models found to be potentially viable, their attractiveness in four scenarios and their impact on the PIV market is assessed.
5. Appendices	the appendices include details of scenarios, sources, a list of interviewees, the initial list of sectors and potential services identified in our workshops, and deliverables **WS3/ARUP/12** – Agreed list of organisations to be contacted, **WS3/ARUP/14** – Computer model to forecast future revenues, **WS3/ARUP/15** - Input to the development of the Consumer Testing Framework and **WS3/ARUP/16** - Non-confidential data gathered during Work Package 3.2

Overview of new revenue streams

Revenue streams outside the core revenue streams of a business model can be important to incentivising infrastructure investment or technology take-up. For example, advertising, infrastructure hosting, and smartphone applications are non-core products and services that have significantly affected development of the mobile telecoms industry.

In this work we do **not** consider any of the revenue streams below because they are either existing business models or are generic plug-in vehicle business models and are discussed in WS/ARUP/06:

- Maintenance of plug-in vehicles
- Payment for in-car infotainment and entertainment hardware
- Payment for electricity used for charging electric vehicles at charge posts
- Payment for parking electric vehicles at charge posts
- Payment for charge post installation
- Maintenance of charge posts

Desktop research and information from interviews with industry stakeholders informs the assessment of new revenue streams

Methodology

This report describes potential new revenue streams that may become viable following the deployment of PIVs and assesses their impact on the economic and carbon benefits of the PIV market. To do this we:

- **Step 1:** Identify sectors relevant to the PIV market
- **Step 2:** Identify potential services that may result in new revenue streams
- **Step 3:** Consolidate and derive the specific new revenue streams and associated business models
- **Step 4:** Carry out an initial business model viability assessment
- **Step 5:** Assess business model viability in four scenarios and assess the impact of the business model on: PIV take-up, rate of charging infrastructure deployment, Treasury costs, and Treasury revenues.

Industry interviews

We spoke to specialists in the following industry sectors and organisations to inform our identification of new revenue streams and our business model analysis:

- Automotive
  - Nissan
  - Mitsubishi
  - Nudge Advisory (Mercedes-Benz)
  - Lotus Engineering
  - Siemens
- Vehicle info/entertainment
  - Alpine
- Vehicle recovery
  - theAA
- Car parking
  - Network Rail (Station Team)
- Public sector
  - Transport for London (TfL)
  - London Borough of Hackney
- Telecommunications
  - O_2
  - BT Openzone
  - The Cloud
  - Cobalt Telephone Technologies
  - IBM
  - Siemens e-mobility
- Charge posts
  - ChargeMaster
- Electricity
  - E.ON
- Energy
  - Shell

Only one new revenue stream, infrastructure hosting, is likely to significantly impact the development of the PIV market

New revenue streams analysis outcome

Seven potential new services are assessed as listed below. One of these, infrastructure hosting, could potentially have an impact on the PIV industry.

1. Information services
2. Car parking
3. **Infrastructure hosting**
4. Multi-media retail
5. Capture and exploitation of user travel data
6. Incremental retail revenues
7. Sponsorship of charging infrastructure

Infrastructure hosting is the strongest new revenue stream business model

Infrastructure hosting is an established practice in the telecoms industry involving a service provider paying a fee to a site owner for hosting equipment. Typical hosted equipment includes public Wi-Fi access points, mobile network micro cells, or CCTV cameras, which require electrical power and a hardwired telecoms connection. Charge posts meeting these requirements could be attractive infrastructure hosting sites.

Infrastructure hosting is a promising new revenue stream for three main reasons.

- Demand for hosting sites is largely independent of the PIV market. Additional mobile and Wi-Fi network capacity is required to meet increased demand for these services from rising 3G handset use, which can be handled by reinforcing the mobile network or by offloading data traffic onto public Wi-Fi networks. CCTV hosting is most likely to be attractive to local authorities, who could save money by combining CCTV and charge posts in a single unit.
- Infrastructure hosting can be viable at any level of infrastructure deployment, although its attractiveness is likely to be greater for owners of larger charge post networks, because this could enable a service provider to cover a large area under a single agreement.
- Hosting revenues can be significant compared to the costs of installing charge posts. Revenues will depend on the attractiveness of the site to the service provider, which will affect the fee for each piece of equipment, and also on the amount of hosted equipment compared to the number of charge posts in an area.

Consequently, infrastructure hosting can help to increase the rate of charge post deployment and reduce the need for government to subsidise this deployment at any level of PIV take-up and any level of existing charge post deployment. The effect of this revenue stream on carbon abatement and Treasury revenue will be secondary, due mainly to any additional PIV take-up encouraged by more widespread charging infrastructure.

The main threat to the viability of infrastructure hosting is if static or moving induction charging displaces charge posts, as the lack of significant above-ground structure makes it less suited to Wi-Fi, micro cell, and CCTV hosting. Induction charging is not expected to be available for large-scale deployment for around 10years.

Strong substitutes and legislative barriers make four of the business models unviable

Legislative restrictions limit the current viability of user travel data exploitation and charging infrastructure sponsorship

The **capture and exploitation of user travel data**, for example travel patterns, vehicle condition, and charging patterns, would be useful to a wide range of organisations such as vehicle manufactures, charge post providers, and energy companies. Organisations able to capture and analyse data could generate revenue from it.

The main barrier to the viability of exploiting user data is the Data Protection Act and consumer concern about privacy resulting in low levels of consumer consent for data collection. Examples of successful exploitation of consumer data are store loyalty schemes, which compensate for concerns about privacy by providing consumers with incentives. A further barrier is that OEMs are well placed to collect data but generally unwilling to share it widely, instead retaining it to inform the future development of vehicles.

The consensus of industry experts consulted was that the privacy barrier to data exploitation was sufficiently strong to make this model unviable.

Sponsorship of charging infrastructure in return for branding charge posts corporate organisations could subsidise the capital cost of infrastructure installation. Given high concern for the environment in the UK population and particularly amongst higher earners, charge post sponsorship could be an attractive way of associating an organisation with an issue with wide appeal. Sponsorship could consist of a small number of agreements covering large charging infrastructure networks, similar to Barclay's sponsorship of the London Cycle Hire scheme, or a large number of small sponsorship agreements, similar to local authority schemes offering sponsorship of roundabouts and other public areas.

An advantage of sponsorship is that its value would be dependent on the profile of the charge post as much as its utilisation, so it could be suited to the early stages of the PIV market when vehicle take-up is low. However, advertising consent would currently be required for each charge post site in each local authority. This may not be granted as local authorities generally seek to restrict on-street advertising, and even if successful would add significantly to the cost of installation due to planning and legal fees. The Barclay's Cycle Hire scheme avoided this problem by branding the bicycles not the docking stations, an option that is unavailable to the PIV market.

Currently restrictive advertising regulation makes charge post sponsorship unviable. It is conceivable that advertising regulations for charging infrastructure could be relaxed in order to encourage charge post deployment, in which case this model could become more attractive.

Strong substitutes make information services and multi-media retail unviable

Information services are provided to PIV drivers for a fee by an organisation coordinating data from a number of sources. Drivers access data through an in-car unit which receives information in real time in a similar way to traffic updates received by existing satellite navigation systems. Information services will be important, particularly to BEV drivers, to reduce range anxiety by assisting with battery management and locating recharging facilities by providing and integrating information such as: distance on current charge, available charge post locations, real-time traffic information, parking space booking, and adverse weather and air quality updates.

Expected low demand for public charging makes two of the business models unviable

Multi-media retail involves PIV drivers paying a fee to download music or video to their vehicle during recharging, taking advantage of the telecoms connection of the charge post. Digital sale is a rapidly growing segment of the multi-media market.

Both these revenue streams face extremely high levels of competition facilitated by smartphones that enable consumers to access the internet on the move. The data sources making up the information services are likely to be available free online, for example charge post owners will provide online availability information to maximise charge post utilisation, so consumer willingness to pay will be low. Multi-media is already available for download from a large number of sites that can be accessed using smartphones, which can often be sychronised with vehicle entertainment systems, so there is little reason to pay for these services through a charge post.

Pressure from alternative providers of information services and multi-media retail means both of these new revenue streams are unviable for any level of PIV take-up and infrastructure deployment.

Demand for public charging in the future

Incremental retail revenues are earned when the presence of charge posts in a retail car park increases revenues in the core business. For example consumers are attracted to shop in a supermarket with charge posts rather than one without. Such an advantage is only available to early movers, providing a competitive advantage that is unsustainable.

The **car parking** model is based on a conventional car park business model augmented with services related to PIVs: charging facilities, advertising in PIV bays, and premium parking spaces available to book. Current experience indicates that advertising in car parks and premium spaces are not widespread and it is unlikely that the presence of charge posts will change this significantly.

The viability of both these models is correlated with demand for public recharging, which depends on the following factors:

- PIV take-up, the proportion of BEVs, which need to recharge to extend range, and the proportion of REEVs and PHEVs, which can extend their range using their internal combustion engine.
- BEVs are expected to fulfill only a small part of their recharging needs in public locations and REEVs and PHEVs have no need to recharge in public.
- The requirement for public recharging will depend on battery technology improvement and associated increase in PIV range, but this is subject to considerable uncertainty.

As a result of the above factors it is expected that demand for public charging during the initial lauch of the PIV market will be low, limiting the viability of incremental retail revenues and car parking.

Introduction

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Report Scope

This report is the main deliverable of WP3.2.1 “New Revenue Streams”

The scope for this work package is summarised below.

> ***“Given the integration of the vehicle and infrastructure, there are potentially new revenue streams (e.g. targeted marketing). Identify what revenue streams may be accessible within plug-in vehicles.***
>
> ***“These revenue streams fall into a number of categories, principally:***
>
> - ***those that are exclusively connected to plug-in vehicles and support these vehicles; and***
> - ***those whose development and deployment will be aided by the development of infrastructure surrounding plug-in vehicles but can equally be utilised by conventional vehicles.”***

This work follows from and builds on the work on Generic Business Models carried out in WS3/ARUP/6. The executive summary of the Generic Business Models work is provided in Appendix I as background to this report.

The technology assessment included in this work covers the following criteria from the contract scope:

- Intended capability of the possible communication systems.
- What attributes are probable?
- What measures are being taken to ensure compatibility with competitors?
- What are the potential packages?
- Who are the communication system owners?
- Identify any novel features if possible.

For new revenue streams assessed to be potentially viable open format forecast models have been created to fulfill the following criteria from the scope of WP 3.2.2:

- Cost models have been created for the different new revenue streams using data procured as part of the WP 3.2.1 process.
- An open format forecast model has been built for the new revenue streams. This will predict future revenues based on the outputs of the vehicle and consumer models in Sub-Project 1.

Introduction

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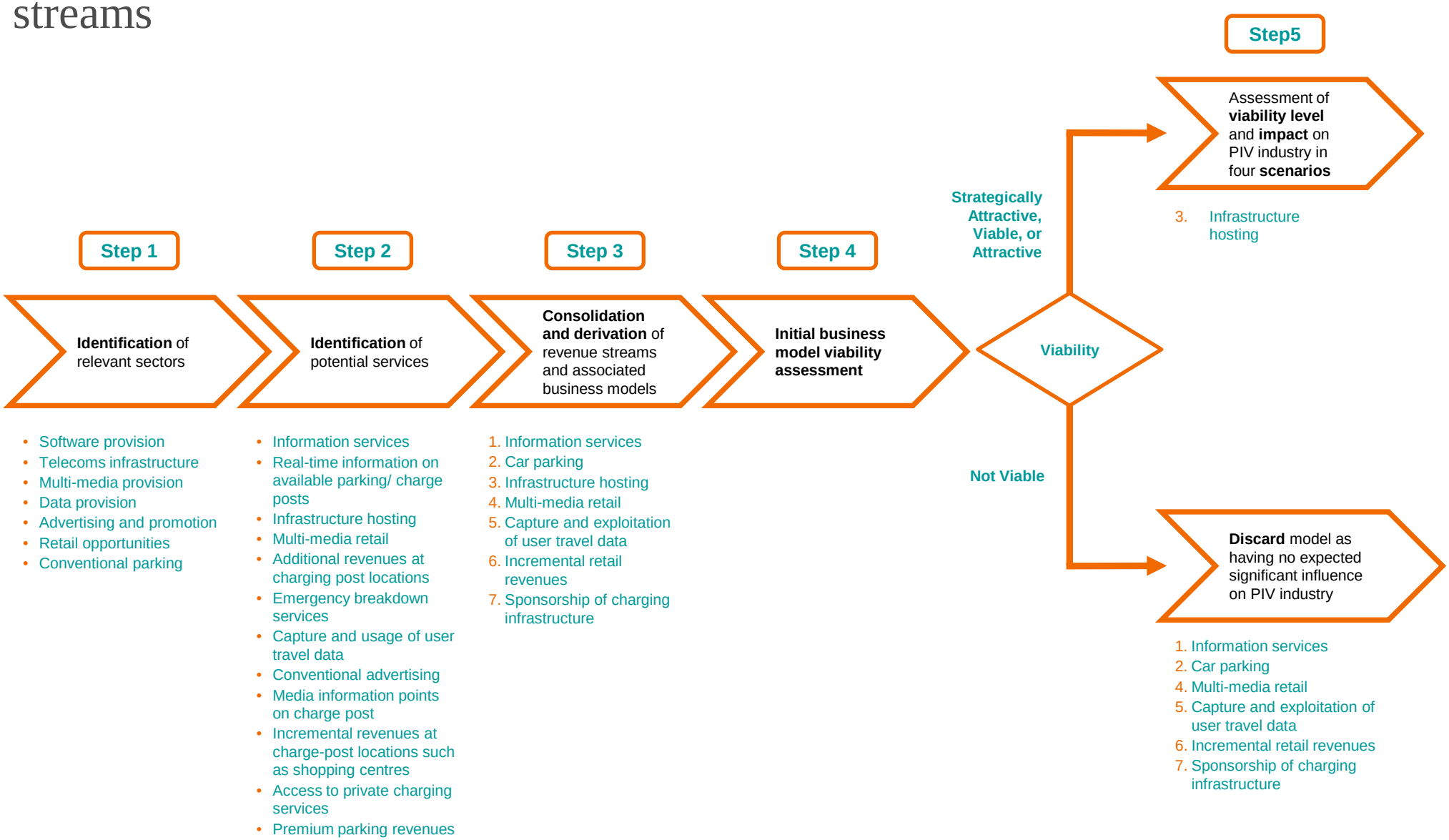
A structured process is used to assess viability and impact of new revenue streams



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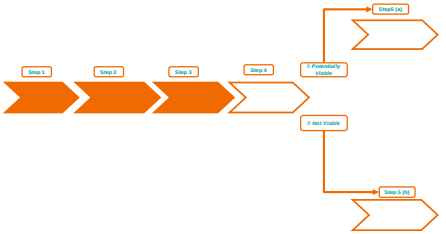
Desktop research and stakeholder interviews were used to verify the list of new revenue streams at each stage



Step 1: Identification of sectors relevant to the PIV market

We identified industry sectors relevant to the PIV market using internal workshops. We reviewed these sectors on an ongoing basis in the light of information from subsequent desktop research and stakeholder interviews.

Step 2: Identification of potential services

We used a combination of desktop research and meetings with internal industry specialists to identify 12 services that could generate new revenue streams associated with the PIV market (see Appendix C).

Step3: Consolidation and derivation of revenue streams and associated business models

Using desktop research, stakeholder interviews, and workshops with internal industry specialists we consolidated the 12 services from Step 2 into seven business models, which could be assessed for viability. Each business model includes one or more new revenue streams.

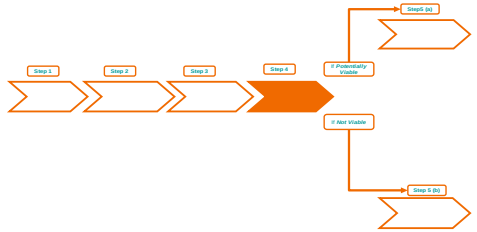
Step 4: Initial business model viability assessment

We made an initial assessment of the viability of each business model from Step 3 by considering: technology requirements, current experience, market demand, barriers, enablers, risks and competition.

Step 5: Assess detailed business viability and impact

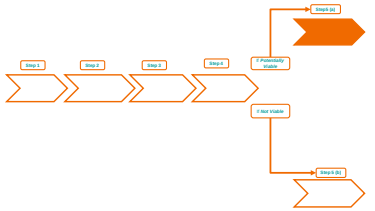
For potentially viable business models from Step 4 we:
a) built a cost model;
b) assessed attractiveness on a consistent scale in four scenarios;
c) assessed impact on infrastructure deployment, carbon abatement, treasury costs & revenues.

Business model viability is assessed using a consistent scale



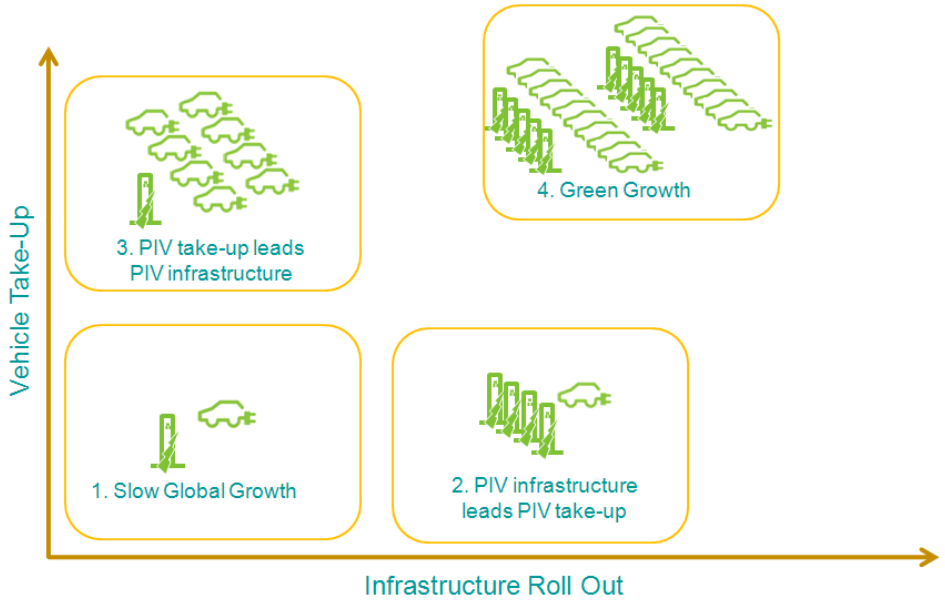
Not Viable (NV)	• No viable investment opportunities • Significant risks and barriers with few compensating enablers • Need/demand for service is weak
Strategically Attractive (SA)	• Not currently profitable • Investment opportunities have insignificant (and potentially negative) net present value at conventional discount rates (<15%) • Potential strategic benefits for market entrants such as first mover advantage, early market share, brand credibility, technology development, ability to shape standards, possible access to third party funding
Viable (V)	• Positive net present value investment opportunities with reasonable (less than five years) pay back periods • Market place may be competitive and not necessarily highly profitable • Viability may rely on access to third party funding or public subsidy
Attractive (A)	• Attractive investment opportunities with significant net present value and high internal rate of return • Potentially low risk and highly scalable • Potential for high profitability, perhaps due to high barriers to entry or some other sustainable competitive advantage • Viability not dependent on third party funding or public subsidy

Business models with potential revenues are assessed in four scenarios …

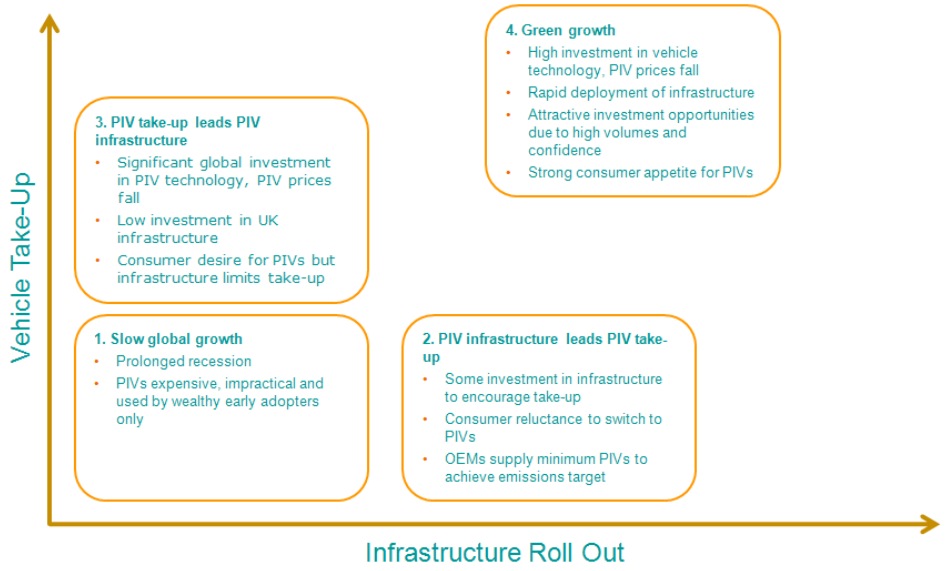


- Business model viability is assessed in detail to 2020. To provide a context within which to assess the business models and recognising that the future of the PIV market over the next 10 years is uncertain, a scenario approach is used
- How this business viability changes in the longer run 2021 to 2050 is also considered for each business model listed
- Four scenarios are summarised below, and are consistent with the scenarios used in our Generic Business Models work in WP 3.1.1. A detailed analysis and description of these scenarios can be found in Appendix A.

Four scenarios of different levels of vehicle take-up and infrastructure development



Consistent trends characterise each scenario



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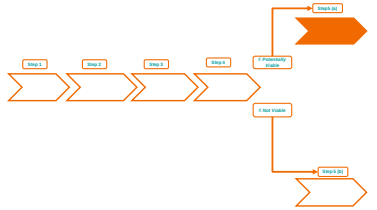
Assessment considers impact on PIV take-up, carbon abatement, infrastructure deployment and Treasury revenues



We have assessed the impact of the potentially viable new revenue streams on the following areas:

1. Rate of charging infrastructure deployment
   - Will the presence of the new revenue stream substantially increase the rate of charging infrastructure deployment?
2. Carbon abatement
   - The new revenue streams only affect carbon abatement to the extent to which they increase the number of ICEVs replaced by PIVs. Therefore PIV take-up is taken as a proxy for carbon abatement.
   - Will the presence of the new revenue stream substantially increase the rate of PIV take-up?
3. Treasury costs
   - Owning charging infrastructure is not currently profitable, so the deployment of charging infrastructure is subsidised by the government.
   - Likewise, PIVs are not currently price competitive with ICEVs, so they will be subsidised by the government.
   - Will the presence of the new revenue stream substantially reduce the required government investment in charging infrastructure and/or PIV subsidies?
4. Treasury income
   - Will the presence of the new revenue stream substantially reduce government tax revenues through decreased vehicle excise duty VED, fuel tax and other vehicle taxes?

Level of Impact	Rate of Charging Infrastructure Deployment	PIV Take-up (proxy for Carbon Abatement)	Treasury Costs	Treasury Revenues
HIGH	• New revenue stream has potential to substantially increase rate of charging infrastructure deployment	• New revenue stream has potential to increase PIV take-up to a higher take-up scenario, eg from Scenario 2 (300,000 in 2020) to Scenario 3 (600,000 in 2020)	• New revenue stream has potential to substantially reduce required government investment in the PIV market for a given scenario	• Significant loss of tax revenue due to high take-up of new revenue stream
MED	• New revenue stream has potential to moderately increase rate of charging infrastructure deployment	• New revenue stream has potential to increase PIV take-up halfway to a higher scenario, eg in Scenario 2 from 300,000 to 450,000 in 2020	• New revenue stream has potential to make some reduction to required government investment in the PIV market for a given scenario	• Some loss of tax revenue due to switch to PIVs over ICEVs
LOW	• New revenue stream has little potential to affect rate of charging infrastructure deployment	• New revenue stream has little potential to increase PIV take-up.	• New revenue stream has little potential to reduce government subsidy of the PIV market	• Little impact to current levels of tax revenue due low levels of PIV take-up

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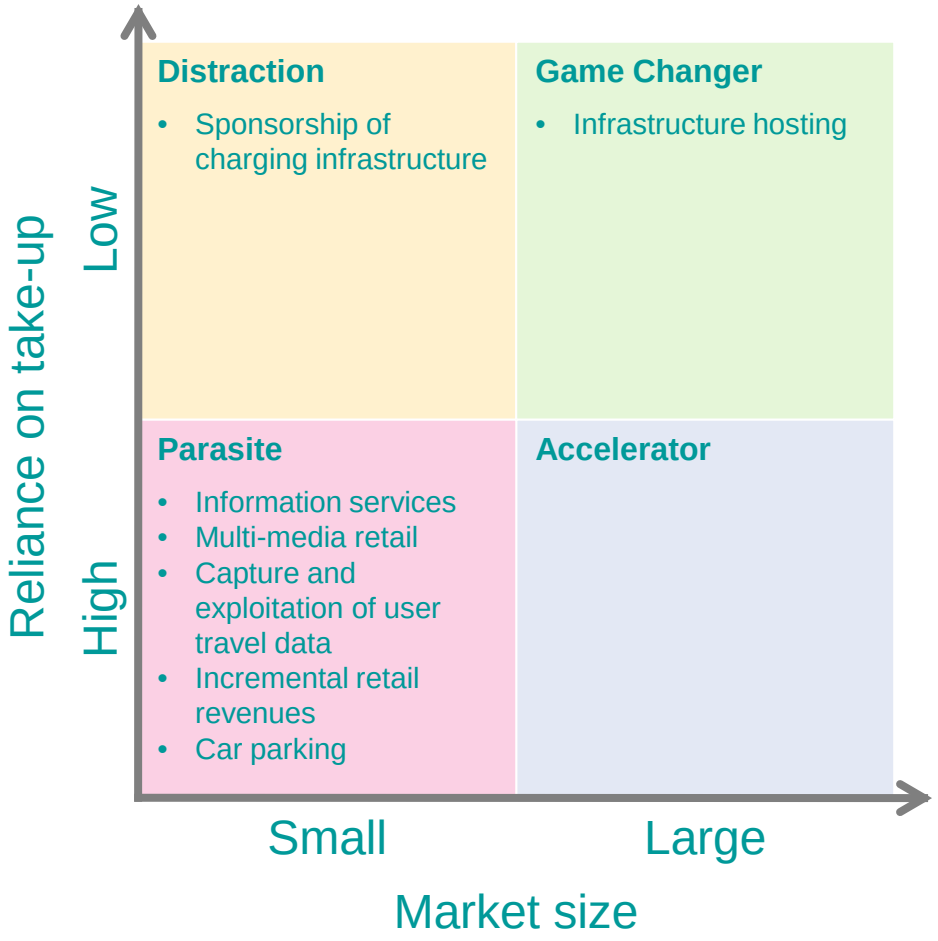
Summary Analysis

1. Executive summary
2. Introduction
3. Summary analysis
4. Detailed analysis of each business model
5. Appendices

Seven business models have been considered

Ref.	New revenue stream	Description
1	Information services	A third party coordinating centre collates information relevant to PIV drivers who access it in-car through a hardware unit. Information potentially available through this unit includes: distance on current charge, available charge post locations, real-time traffic information, parking space booking, and adverse weather and air quality updates.
2	Car parking	This model augments a conventional car park with PIV specific services including: • Charge posts, so PIVs can recharge whilst parked, the costs of which are recovered through a payment from the electricity supplier. • Premium space booking where, for example, a driver can prebook a space on the ground floor or near the lift. • Advertising targeted at PIV drivers.
3	Infrastructure hosting	Public charge posts could host other infrastructure that relies on electrical power and a telecoms connection, eg public Wi-Fi, mobile network micro cells, or CCTV. The operator of the hosted infrastructure would pay a rental fee to the charge post owner. The operator of hosted equipment would typically own, install, operate, maintain and decommission their services on the charge post.
4	Multi-media retail	PIV charging infrastructure could provide a channel through which to enable consumers to purchase and download music, video, movies and other media to their vehicle. Downloaded media could either be used in the vehicle or at home following the journey.
5	Capture and exploitation of user travel data	PIVs are likely to record and store substantial data on travel patterns, vehicle condition, and charging patterns, which would be useful to a wide range of service providers. These may include vehicle manufactures, charge-post providers, and energy companies. The sale of data could generate revenue for organisations able to capture, analyse and sell PIV user data.
6	Incremental retail revenues	By providing public charge posts in their car parks, retail outlets may generate incremental revenues from PIV drivers making extra visits, spending more, or choosing a retail outlet with charge posts rather than one without. There may be “first mover” advantage for some retailers, until the introduction of charge posts becomes widespread.
7	Sponsorship of charging infrastructure	A charge post provider would permit charging infrastructure to be branded by one or more corporate sponsors in order to subsidise the capital cost of infrastructure installation. Sponsorship of charging infrastructure of PIV charging infrastructure could be an attractive proposition given its popular, environmentally friendly image.

In summary: only one business model has the potential to make a significant difference to the PIV market…



Game changer
With its low reliance on take-up and strong market potential, infrastructure hosting has the potential to significantly affect the development of charging infrastructure.

Distraction
Although it has low reliance on take-up making it look attractive in the early stages, sponsorship of charging infrastructure has low market potential, so it is unlikely to have a significant impact.

Accelerator
No models fit this category.

Parasite
With a dependence on take-up and a weak market potential the remaining models feed off the market, but will never drive it.

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…and only one business model is considered to have potentially viable new revenue streams

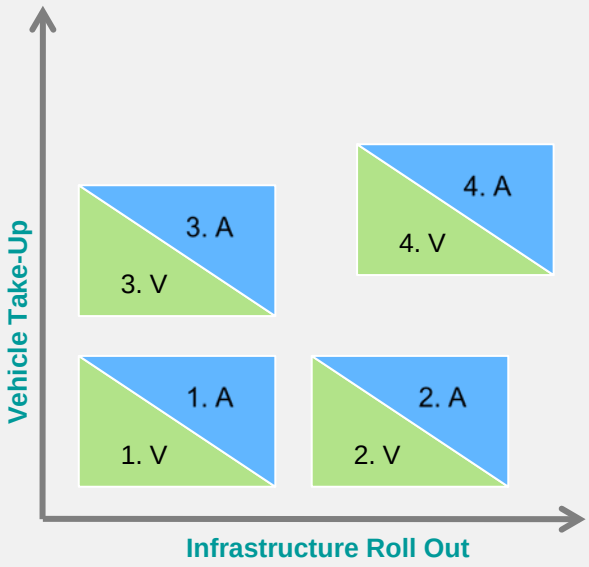
New Revenue Stream	Summary of Viability	Is revenue stream viable?
Information services	• Current experience shows a feasible revenue stream from subscription services but these are under strong pressure from free services provided through smartphones. • Information services will be important to reduce range anxiety, but this is likely to reduce with increased familiarity with vehicles and with more widespread charging infrastructure. • The threat from free substitute services is high, resulting in low consumer willingness to pay for services, making this model unviable for direct revenue generation.	**NV**
Car parking	• Viability of this model depends on a number of uncertain factors including the growth and composition of the PIV parc, recharging behaviour, technology development and the willingness of electricity suppliers to pay rebates, which is currently viewed as being unlikely. • The substantial risk and low market size associated with this model makes it not viable.	**NV**
Infrastructure hosting	• Current experience shows there is a clear revenue stream for hosting telecoms equipment. • Future demand for hosted services is likely to be strong and independent of PIV take-up, so this business model can generate revenue at any stage of the PIV market. • Competition from other locations suitable for hosting infrastructure is likely to be strong, which may limit the fees that can be charged for hosting. • This business model has potential to be viable or attractive so its attractiveness in four scenarios and its impact on the PIV industry and the Treasury are assessed in Section 4.	**SA, or V, or A**
Multi-media retail	• Digital multi-media retail is a simple, established business model. • Demand is strong and growth potential is good. • However, there are strong alternative means of accessing digital multi-media, such as smartphones and home PCs and no compelling reason to switch to charge post to PIV downloading. • It is unlikely that the multi-media retail business model would yield significant additional revenue under any likely future circumstances, so this model is unviable.	**NV**

…continued

New Revenue Stream	Summary of Viability	Is revenue stream viable?
Capture and exploitation of user travel data	• There is a clear demand for appropriately collated data on PIV usage. • However, there are significant legal and consumer perception barriers to commercially exploiting data. • OEMs are best placed to collect data, have the greatest use for it and are also typically unwilling to share it. • Overall, this business model is unviable in all likely future circumstances.	**NV**
Incremental retail revenues	• The viability of this model is closely linked to a number of uncertain factors (PIV take-up, recharge behaviour, charging infrastructure distribution). • Incremental revenues are likely to be small and capital costs of charging infrastructure are high. • In most cases only possible for the first mover – a competitive advantage that is unsustainable. • This model is unviable in all future circumstances.	**NV**
Sponsorship of charging infrastructure	• The public are sympathetic to green issues and sponsorship of PIV charging infrastructure offers a means to tap into this sentiment. • Difficulties obtaining advertising consent presents overwhelming barriers to sponsorship of on-street charge posts in the current climate. • This model is currently unviable, and expected to remain so for the early stages of the PIV market. • However, if legislation were changed to permit charge post advertising this model could become viable.	**NV**

Infrastructure hosting is an attractive business model at all levels of PIV take-up and could have “medium” impact on the PIV market

Viability in 2020



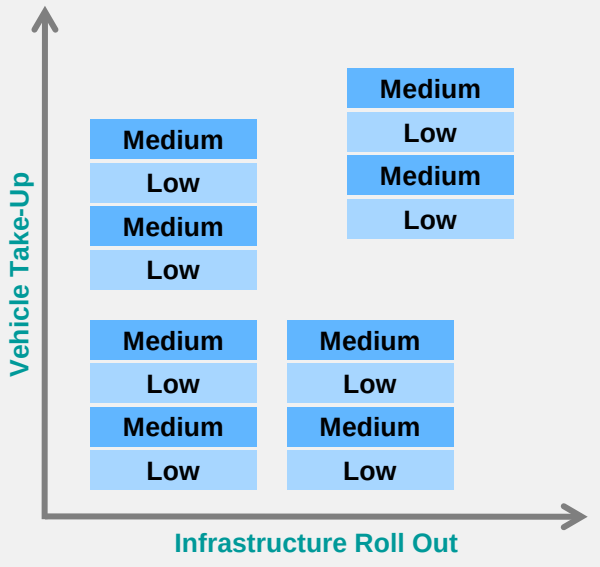
Viability assessment for charging infrastructure as not regulated asset

Viability assessment for charging infrastructure as regulated asset

Summary

- Hosting revenues are only weakly linked with charge post utilisation (to the extent that PIVs use the hosted service while parked).
- Therefore the viability of the business model is independent of many of the uncertain factors that make other new revenue streams risky.
- Hosting is viable at all levels of PIV take-up and at all levels of infrastructure roll-out.
- It is likely that larger, more geographically spread charge post networks will be more attractive. If charging infrastructure is regulated DNOs will probably own extensive networks, making the business model attractive in this case.
- The impact of infrastructure hosting will primarily be on the rate of charging infrastructure deployment and consequently on Treasury costs, as it becomes less necessary for government to subsidise infrastructure.
- There may be a secondary effect on PIV take-up as the presence of charging infrastructure helps to address range anxiety, but this will be secondary to the cost of PIVs, which is unaffected by this model.

Impact



ARUP

Detailed analysis of each business model

ARUP

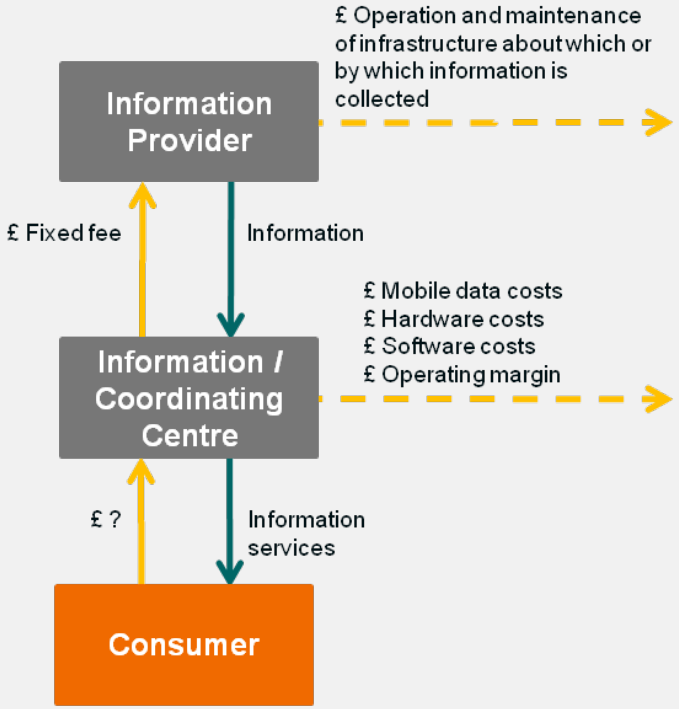
Analysis : Information services

Information services are feasible and established…

Description

A third party coordinating centre collates information relevant to PIV drivers who access it in-car through a hardware unit. Information potentially available through this unit includes: distance on current charge, available charge post locations, real-time traffic information, parking space booking, and adverse weather and air quality updates.

Much of the technology and services are not exclusive to PIVs but their development will be enhanced by the advanced information and communications technology in PIVs.



Technology Requirements

This business model relies on existing communications infrastructure (GPRS and radio). However, for a full range of services the PIV system would need to meet the following requirements:

- In-car hardware unit (through which consumer accesses information) can communicate with the PIV computer, which provides data related to state-of-charge, usage, etc.
- Charge posts include the necessary hardware and communications to allow availability information to be provided and to allow spaces to be booked.
- Standardisation would be essential so that software and technology is compatible between the different entities, eg vehicle computers, hardware units, charge posts and coordinating centre [†].

Current Experience

- Real-time information services, provided via GPS and integrated SIM cards for GPRS comms, are offered by existing satellite navigation manufacturers for an annual subscription, eg automatic routing to points of interest [1, 2]. However, fee-based services are under pressure from free, smartphone services [29].
- Some charge posts already integrate additional services including a site locator with ‘dynamic availability reporting’ via a mobile interface [14].
- The Nissan Leaf BEV sale price will include a standard Nissan Connect package providing information on charge post type and location and the vehicle charge status [3].
- RingGo (Cobalt Telephone Technologies) enable users to pay for parking using their mobile. They provide a free smartphone application that allows users to view and edit account details and find car parks with the RingGo service [†].
- The London Cycle Hire scheme provides real-time data on docking station availability accessible online, eg through a smartphone [40].

Sources: i, ii, iii, vii, xi, xii

ARUP

Analysis : Information services

…but despite demand, free services will limit revenues…

Market Overview

The OEMs we consulted believe that information services are more important to PIV drivers, and particularly BEV drivers, than they are to ICEV drivers [†]. The main reason is the potential of information services to reduce range anxiety by assisting with battery management and locating recharging facilities.

The fee for information services is likely to be similar to existing packages for additional services integrated with vehicle satellite navigation systems; approximately £45 annual subscription [1, 2].

The take-up of satellite navigation amongst ICEV drivers is around 28% [28] with far fewer of these paying annual subscriptions for additional services. Although it is likely that take-up amongst PIV drivers would be higher these figures suggest it would still be far lower than 100%, unless provided as standard by OEMs.

Furthermore, the importance of information services is likely to decrease with time as consumers become more familiar with and more confident in their vehicle's range, as battery technology improves, and as charging posts become more widely available.

The market for information services is capped at a subscription for each PIVs in the UK parc. Even in this optimistic case, the revenues (£45/vehicle/yr [1, 2]) would be small compared to the cost of vehicles (£15,000 or more).

Competition

- Fee based information services are significantly threatened by organisations willing to offer similar services for free.
    - OEMs may include information services in a vehicle's purchase price, because of their importance to drivers, particularly BEVs [†, 3, 18, 27]. In this case there may still be a opportunity for a third party to provide these services and receive payments from OEMs, but in this case the additional revenue would not help to reduce PIV cost.
    - Most of the data making up the information service is likely to be made freely available online [†]. For example charge post location, availability and booking likely to be made available by charge post operators aiming to increase utilisation of their network.
    - Smartphones with 3G subscriptions will be capable of accessing this free online data [†], although unless integrated with the vehicle computer coordination of, for example, navigation to an available charge post with range remaining would not be possible.
    - PIV infotainment systems will be integrated with smartphone technology in many cases [8] in which case they will be capable of accessing free online information directly.
- An integrated service would have an ease of use advantage over these alternatives and may provide greater peace of mind with regards to range anxiety.

Sources: i, ii, iii, vii, xi, xv, 1, 2, 3, 8, 18, 27

ARUP

Analysis : Information services

…making this model unviable for revenue generation.

Barriers

- In many cases consumers expect to and can access data for free through open-source software, which is likely to reduce the potential revenue from this model [†].
- Vehicle range depends on factors such as average speed, incline, and remaining battery life, and is currently too complex to estimate accurately [†]. This could substantially reduce the capability of information services to mitigate range anxiety amongst PIV drivers making the services less attractive.

Risks

- The usefulness of information services is highest when range anxiety is high and charging infrastructure is scarce. Therefore the viability of this model is sensitive to:
  - The proportion of BEVs vs REEVs/PHEVs, as range anxiety will not significantly affect REEV/PHEV drivers;
  - Increased consumer confidence in range through familiarity and increased charge post availability as the PIV market becomes established; and
  - Increased PIV range as battery technology improves.

Enablers

- All the vehicle manufacturers interviewed will integrate an LCD screen in the centre console of PIVs [†]. This will display an indication of range and could provide an interface for other information services.

Summary

- Current experience shows a feasible revenue stream from subscription services but these are under strong pressure from free services provided through smartphones.
- Information services will be important to reduce range anxiety, but their importance is likely to reduce with increased familiarity with vehicles, with more widespread charging infrastructure and with improvements in battery technology.
- The threat from free substitute services is high, resulting in low consumer willingness to pay for services, making this model unviable for direct revenue generation.

Sources: ii, iii, vii, xi

ARUP

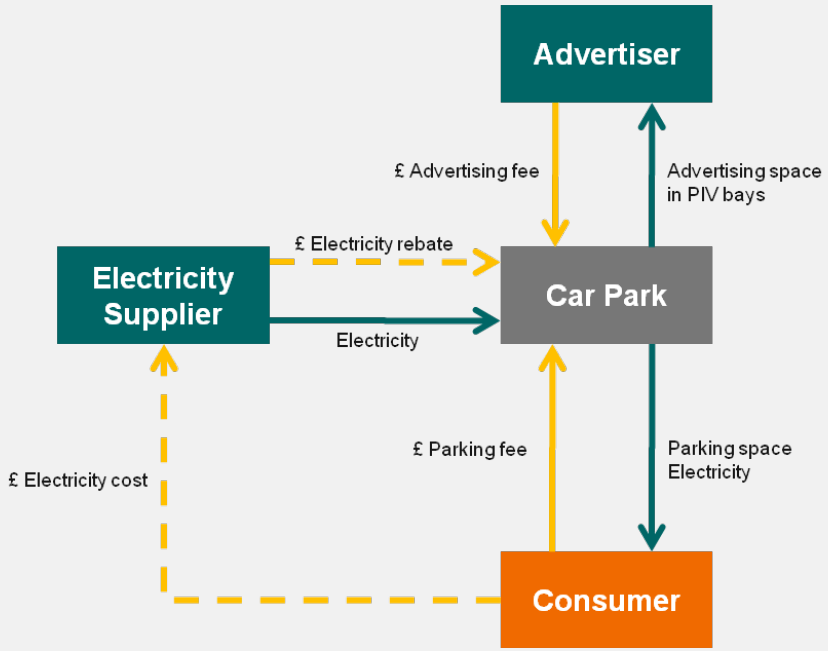
Analysis : Car parking

Model relies on a number of untested revenue streams...

Description

This model augments a conventional car park with PIV specific services including:

- Charge posts, so PIVs can recharge whilst parked. The car park operator would recover the cost of installation either through a payment from the electricity supplier or from charging a premium on the parking fee.
- Premium space booking where, for example, a driver can prebook a space on the ground floor or near the lift.
- Advertising targeted at PIV drivers.



Technology Requirements

The following technology is required for this business model:

- Model is reliant on standardisation of charge post interfaces.
- To enable direct billing of the consumer by their domestic electricity supplier, communication is needed between the charge post in the car park and electricity suppliers.
- Premium space booking could be enabled by a variety of existing technology (for example online or by telephone).
- For targeted advertising a screen will be needed on the charge posts.

Current Experience

- NCP currently allows PIV drivers to bid for one of 50 charge post spaces in the London area with the space being allocated to the highest bidder for 12 months. The roll out of this business model will depend on the amount that PIV drivers are willing to pay for charge post spaces [25].
- As part of its 10-year sustainability plan, Gatwick Airport is considering installing a PIV recharge network and introducing a vehicle low emission zone [26].
- EDF offered a discount on their Green tariff to the Barclays Cycle Hire scheme in return for the EDF brand appearing on the terminals. This suggests that electricity providers may be interested in subsidising PIV charging infrastructure, either directly or indirectly.

Sources: v, 25, 26

ARUP

Analysis : Car parking

…with revenue potential dependent on uncertain factors…

Market Overview

Commercial Recharging

Revenues from recharging depend on the utilisation of charge posts in public car parks. Utilisation is uncertain and likely to be low during the initial take-off of the market for the following reasons:

- BEVs expected to fulfil only a small part of their recharging needs in public locations, eg EDF forecast 15% at commercial private charge posts [30].
- REEVs and PHEVs have less need to recharge in public, so are likely to use public charge posts less than 15% [†].
- Requirement for public recharging depends on range, which depends on the development of battery technology – subject to uncertainty.

Consequently the market for public charging is expected to be small during the initial launch of the PIV market.

Advertising

The scale of retail advertising in car parks currently is low, suggesting there is little demand for it. The presence of charge posts is unlikely to significantly change this, although opportunistic retailers targeting a “green” image may advertise. Any revenue will be closely linked to the utilisation of the charge post, which for the reasons given above is expected to be low in most cases. Consequently the market is expected to be small.

Premium Parking

The premium parking market depends on consumer willingness to pay extra for premium spaces and the convenience of being able to book them. The lack of differential pricing in current car parks suggests this is not a significant effect, although a car park offering preferential parking to PIV drivers may increase custom from these drivers. The market for this revenue stream is small.

Competition

- There are various alternative locations for recharging that provide significant competition to recharging in car parks and are likely to restrict profit levels:
  - Home and workplace charging, which will fulfil most of the recharging needs of typical PIV drivers [†].
  - Retail organisations offering low cost recharging as a means to attract customers.
  - On-street charge posts and parking would compete directly with nearby car park parking and charging.
    - It is likely to be cheaper to install charge posts in a car park than on the street, so the car park model may have a cost advantage.
    - Local authorities face an increasing challenge balancing the needs of residents for private parking with charge post rollout, which may restrict the scale of on-street charge post rollout [†].
    - There is a drive to reduce street clutter that may restrict the extent of on-street charge post deployment [41].

Sources: i, ii, iii, vii, viii, xi, xviii, 12

Analysis : Car parking

…but model may be viable under certain circumstances.

Barriers

- The main barrier to entry is low PIV take-up, as demand for this model correlates closely with take-up. With low take-up utilisation of PIV enabled spaces would be insufficient to recover capital investment in charge posts.
- Industry experts have indicated that car parking revenue is often driven by turnover. Therefore private car park operators may be reluctant to install charge posts as it may encourage consumers to stay for longer, reducing turnover [†].
- The current prevalence of free or annual membership based recharging is a significant barrier to an additional recharging service priced by usage [42].

Risks

- PHEVs and REEVs have much less requirement for recharging in public, so viability of this model is sensitive to the proportion of the PIV parc made up of these vehicle types [†].
- Battery improvements and consequent increased range of BEVs could reduce public charging by those with access to home or workplace charging to close to zero within 5 years [†].

Enablers

- Car parking is an existing model with a number of large incumbents (NCP, Eurocarparks, BCP, Pink Elephant). Facilitating the PIV specific services would require an investment in charge posts, but there are no major technical obstacles to overcome.

Summary

- Viability of this model depends on a number of uncertain factors including the growth and composition of the PIV parc, recharging behaviour, technology development and the willingness of electricity suppliers to pay rebates (which is currently viewed as being unlikely).
- The small size of the market makes the advertising revenue stream unviable.
- The lack of current demand for premium parking spaces within car parks indicates that this revenue stream is unviable.
- The viability of charging a premium for recharging is discussed in WS/ARUP/06. Recovering the installation costs of charge posts from the electricity supplier is not viable beyond isolated projects during the development of the PIV market.

Sources: ii, x, xi, xii, xvii, 20

ARUP

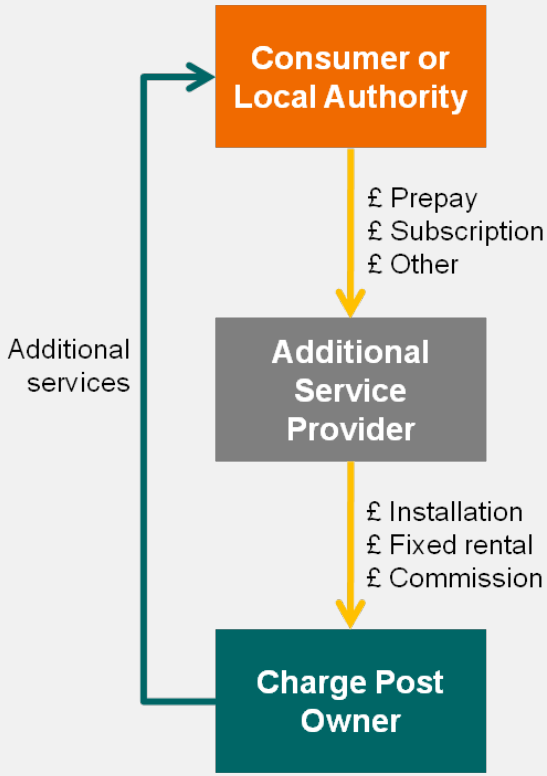
Analysis : Infrastructure hosting

Infrastructure hosting is a simple, well established revenue stream…

Description

Public charge posts could host other infrastructure that relies on electrical power and a telecoms connection, eg public Wi-Fi, mobile network micro cells, or CCTV. The operator of the hosted infrastructure would pay a rental fee to the charge post owner [†].

The operator of hosted equipment would typically own, install, operate, maintain and decommission their services on the charge post [†].



Technology Requirements

For this business model to be feasible the following requirements must be met:

- Charge posts have a physical telecoms connection (copper wire or fibre optic) of sufficient bandwidth for the hosted infrastructure.
- Charge posts can physically accommodate the hosted infrastructure.

Current Experience

- Hosting of Wi-Fi and mobile network micro cell equipment on or in shops, restaurants and other locations is an established practice [†]. For example, BT Openzone and The Cloud provide Wi-Fi hotspots in locations such as hotels, bars, restaurants, shopping centres, and car parks [43, 44].
- The operator of the hosted infrastructure typically pays a fixed rental charge and sometimes also a usage based fee to the host location owner, suggesting there could be a viable revenue stream for hosting infrastructure in charge posts [†].
- To reduce data traffic on mobile networks, mobile network operators have agreements with Wi-Fi hotspot providers to allow mobile users free access to Wi-Fi hotspots [†]. There is scope to enhance these relationships.

Sources: iv, vi, ix

ARUP

Analysis : Infrastructure hosting

…with a strong, but competitive, market outlook…

Market Overview

Three types of hosted infrastructure are considered in this business model, but this does not preclude others:

- Mobile network micro cells;
- Wi-Fi access points; and
- CCTV.

Mobile network micro cells and Wi-Fi access points

Mobile network capacity increase is essential to maintain current service standards for customers. Capacity can be increased by installing more network cells, by offloading data traffic onto public wireless networks, or both in combination. The demand for public internet access is also expected to grow strongly, partly driven by mobile data traffic offloading, increasing the requirement for public Wi-Fi access points. Charge post operators could tap into this market by integrating mobile network micro cells and Wi-Fi access points in charge posts [10].

Two important factors in selecting mobile and Wi-Fi infrastructure locations are:

- Footfall, because higher footfall means higher demand [†]; and
- Spacing, where micro cells are typically 300m to 1km apart [37] and Wi-Fi access points 100m to 300m.

The proportion of charge posts hosting infrastructure will depend on whether they are in areas of high demand for hosted services and how clustered they are, as only some of the charge posts in the cluster would be required for hosting. Therefore a charge post operator's hosting revenue would depend on the geographic spread of their charge posts and footfall across that area.

CCTV

CCTV is most likely to be installed by local authorities in charge posts owned by them [16]. Charge post hosted CCTV could give wide coverage and be less obtrusive than existing arrangements. Revenue would through saving the costs of installing separate CCTV points, rather than additional income.

Competition

- The main competitors to charge posts for hosting Wi-Fi or mobile network micro cells are alternative locations, for example, nearby coffee shops, restaurants or bars. These have the advantage that users are likely to spend longer there and are therefore more likely to use the services.
- Other public infrastructure technologies such as lamp posts, street lights, car park pay machines can also be used for infrastructure hosting activities in preference to charge posts [†]. The Mayor of London has a vision to integrate Wi-Fi hotspots in lamp posts.
- If charge post owners choose to offer services, eg Wi-Fi access, rather than just host infrastructure, they will be in direct competition with current Wi-Fi network providers.

Sources: i, iii, iv, vi, ix, xii, 10, 16, 37

Analysis : Infrastructure hosting

…barriers and risks are not insurmountable, so model has potential

Barriers

- There are concerns that Wi-Fi and mobile network micro cells will not provide adequate coverage if mounted at the height of a typical charge post [†].
- Retrofit may not be feasible as a basic telecoms connection is necessary. Co-ordination and pre-installation contracts between the manufacturer, the operator of the hosted infrastructure may be required to successfully integrate third party equipment on charge posts [†]. Telecoms stakeholders interviewed wanted involvement in a project from planning stage to provide a solution customised to the location, that would allow economical maintenance and future replacement [†].
- Difficulty negotiating contracts with local authorities may obstruct hosting in local authority owned charge posts [†].

Risks

- Although charge posts are not currently owned as regulated assets by DNOs, it is Conservative policy to change this. Providing un-regulated services from a regulated asset could be difficult [19], although mobile base stations are currently hosted on electricity pylons [38].
- Charge post communications are currently GPRS enabled for communications [†]. The requirement for a hard-wired telecoms connection may not be satisfied.
- Inductive charging could become a viable technology, making charge posts obsolete and other “host” infrastructure would be required such as lamp posts.
- Most industry specialists expect that consumers will prefer to charge their PIVs at home [†]. This may limit the usage of public charge posts and reduce the component of demand that is related to PIVs.
- Public charging may become redundant within 5 years due to improvements in BEV range [†].

Enablers

- The GLA and other government bodies have already discussed the potential to integrate Wi-Fi with charge posts [†].
- Wi-Fi operators see Wi-Fi as a supplement to 3G network capability rather than a complete substitute [†].
- Hosting mobile and Wi-Fi services in charge posts could benefit the PIV system:
  - SMS is currently preferred for PIV to charge post communications, so integrating SMS enabling hardware in charge posts is desirable [†];
  - PIVs will use internet communication as in-car technology improves, eg to pass telemetry to OEMs while recharging, increasing demand for Wi-Fi in charge posts [†].
- Because the hosted infrastructure operator typically owns, installs, operates and decommissions, there is little requirement for additional investment on the part of the charge post operator to enable this revenue stream.

Summary

- Current experience shows there is a clear revenue stream for hosting telecoms equipment.
- Future demand for hosted services is likely to be strong and independent of PIV take-up, so hosting revenues are available at any stage of the PIV market.
- The risks associated with this business model are reasonably quantifiable and some will be passed onto the operator of the hosted infrastructure.
- Competition from other locations suitable for hosting infrastructure is likely to be strong, which may limit the fees that can be charged for hosting.
- This business model has potential to be viable or attractive and it is assessed for the four scenarios given in Section 2.

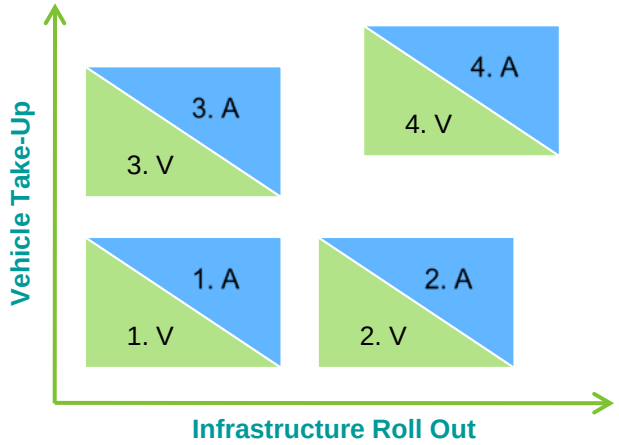
Sources: i, iii, iv, vi, ix, x, xii, xiii, 19, 38

ARUP

Analysis : Infrastructure hosting

Potentially viable for all levels of PIV take-up and infrastructure roll-out

Initial Take-up Business Viability (2010 – 2020)



Viability assessment for charging infrastructure as not regulated asset

Viability assessment for charging infrastructure as regulated asset

- In general users of the hosted infrastructure are different to users of the charge post for PIV charging, so hosting revenue streams are independent of charge post use.
- Therefore even at low levels of PIV take-up and infrastructure rollout there is potential for additional revenues for charge post owners from hosting rental fees.
- There is little requirement for investment by the charging post operator, so this additional revenue stream is likely to be profitable making the additional revenue stream viable.
- Increased levels of infrastructure rollout will improve the geographical coverage of charge post hosted infrastructure, but operators of hosted infrastructure will have to deal with multiple owners. Attractiveness of business model likely to be related to size of an owner's charge post network and so to the number of organisations that own charge posts.
- In some cases hosted services will also be used by PIV drivers while they are recharging. In this case business model viability will be improved with increased levels of PIV take-up and will be affected by the rate of charging, which will determine how long PIV drivers remain at a charge post.
- If infrastructure is regulated there are concerns over whether hosted services could be provided from these assets [19]. However, because DNOs would be likely to operate more extensive networks than private companies, it could be more attractive to operators of hosted infrastructure as they need to deal with fewer organisations.

Future Business Viability (2021 to 2050)

- Technological improvements in PIV charging infrastructure may represent a Capex risk if existing charge posts and/or the services provided are made redundant
- The business prospect of receiving revenues from hosting telecommunication infrastructure is still a robust one in the longer term PIV industry view. Even a shift to rapid charging or induction charging [17] would provide a level of physical infrastructure within which other services could be "hosted", and the business model and opportunities would be unlikely to change significantly

Sources: 17

ARUP

Analysis: Infrastructure hosting

Is there a significant revenue stream based on cost model?

New revenue streams:

The following hosting revenues are based on interviews and discussions with internal experts in the field of communications. To assess the significance of the revenue stream the lower bound values have been used.

- Wi-Fi access point = £300 - £400 per month
- Mobile micro cell = £500 - £600 per month
- CCTV = £0 - £100 per month

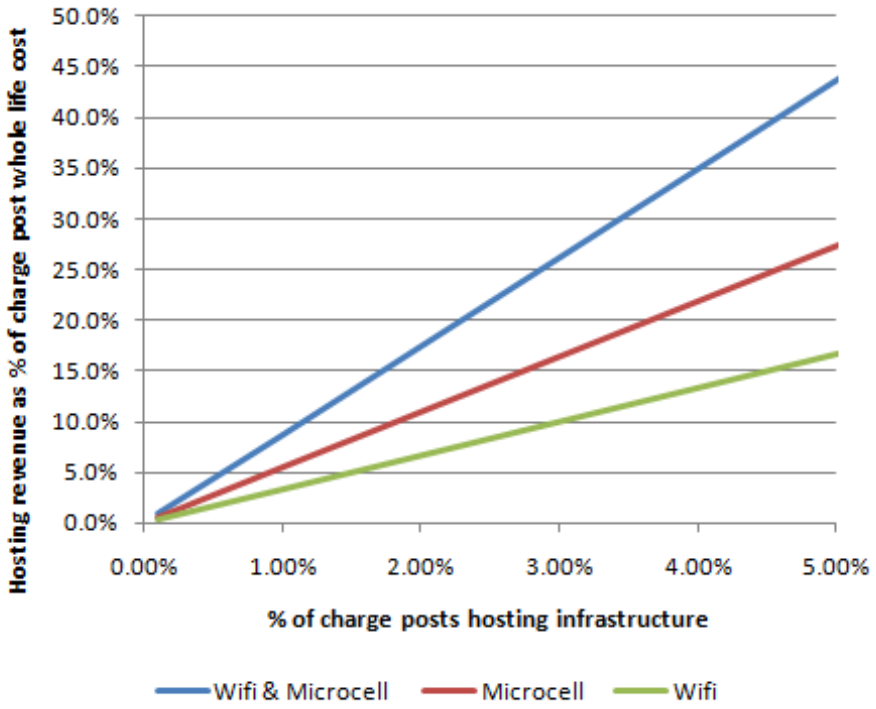
Charge post installation costs are taken to be consistent with the generic business models work **WS3/ARUP/06** and are based on interviews with charge post manufacturers.

- Installed Cost = £5,000
- Maintenance Cost = £100 per month

The significance of the hosting revenue is calculated assuming a network of charge posts in which only a small percentage of charge posts actually host infrastructure, because:

- Charge posts are likely to be clustered, whereas only one wifi access point or microcell per operator is required in each location;
- Not all charge posts will be in areas where additional network capacity is required.

The variation of hosting revenue as a proportion of charge post installation and operating cost with the percentage of charge posts containing infrastructure is shown in the graph on the right.



Based on the cost model, infrastructure hosting can make a meaningful contribution to charge post costs even at low levels of penetration

- If other infrastructure can be hosted, this would increase the available revenues.
- The infrastructure hosting model is largely independent of charge post use for PIV charging.
- Charge post owners can pass through the capital cost of installation and maintenance of hosted services reducing the risk of high operating costs.

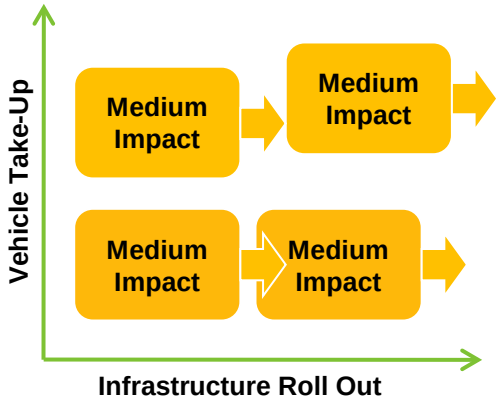
* The cost of installation is higher than in the Generic Business Models Report due to consideration of the additional complexities of installing an integrated charge post

ARUP

Analysis : Infrastructure hosting

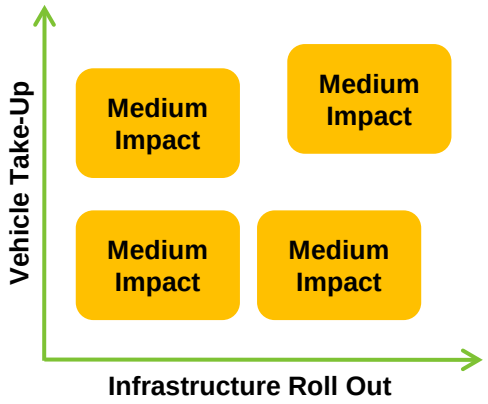
Potential for moderate effect on charge post roll out rate and Treasury costs

Impact on Rate of Charging Infrastructure Deployment



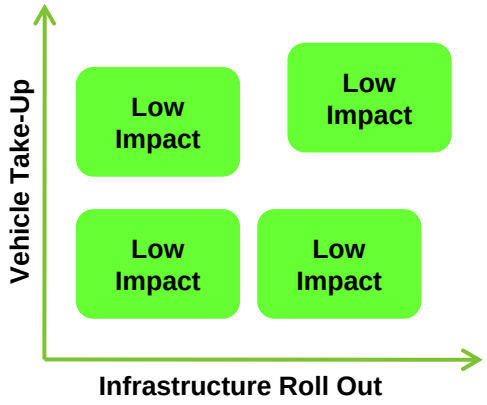
- At all levels of PIV take-up and infrastructure roll-out additional revenues from hosting infrastructure will improve the financial case for further charge post installation.
- The impact will be moderate as not all charge post sites will be in areas of high demand for hosted services.

Impact on Treasury Costs



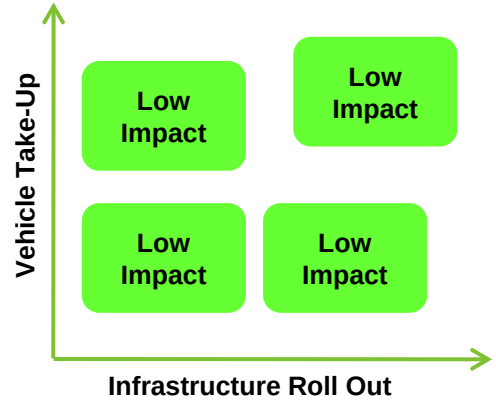
- In all scenarios high demand for Wi-Fi & micro network hosts brings revenue to charge posts in high demand areas, reducing required government charge post investment.
- To ensure appropriate charge post distribution government may still need to invest in low demand areas.

Impact on PIV Take-up (proxy for Carbon Abatement)



- A faster charge post deployment has the secondary effect of reducing range anxiety, which will have some positive effect on BEV take-up.
- The presence of services in charge posts may encourage some early adopters.
- Together these will have a low impact on PIV take-up, ie much less than 50% increase.

Impact on Treasury Revenues



- Infrastructure Hosting could subsidise charge post roll out, with a secondary effect on PIV take-up and consequent impact on Treasury revenues, however this effect is likely to be low.

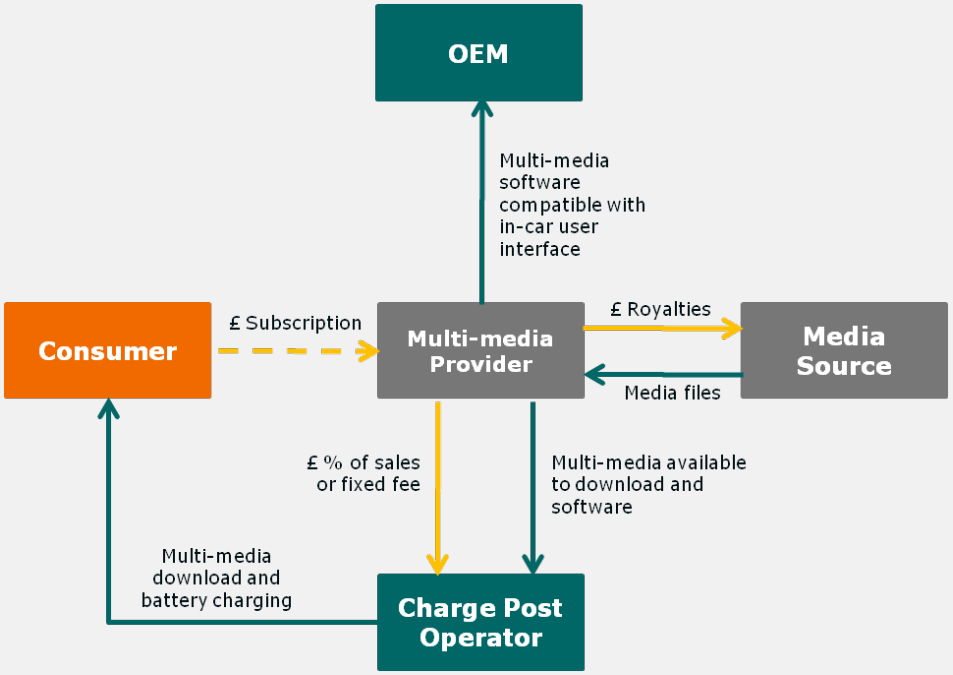
ARUP

Analysis : Multi-media retail

Digital multi-media retail is a simple and established business model…

Description

PIV charging infrastructure could provide a channel through which to enable consumers to purchase and download music, video, movies and other media to their vehicle. Downloaded media could either be used in the vehicle or at home following the journey.



Technology Requirements

For this business model to be feasible the following requirements must be met:

- Charge posts have a telecoms connection of sufficient bandwidth for downloading multi-media.
- Charge post to PIV communications must be standardised to a specification with sufficient bandwidth to support multi-media download. Connection could be wireless or physical.

Current Experience

- Similar services are offered in the existing media download industry. For example iTunes, Amazon, and Napster offer music and video downloads:
  - Consumers register an account and download multi-media from an online store.
  - Consumers pay per download or pay a subscription for access to a catalogue.

ARUP

Analysis : Multi-media retail

…the market is strong and growing, but competition is fierce…

Market Overview

Digital multi-media retail is a growing market. For example, in 2009 digital music album sales increased by over 50% to 1/8th of total sales, while singles sales are dominated by downloads (98%) [31].

The download market is currently dominated by a few large providers, notably iTunes with around a 70% market share for music downloading [32]. It is likely that a charge post provider would team with an established provider and receive a transport fee for providing the data connection although a customised multi-media database could be provided directly.

There are two main limitations of the market potential of downloading at a charge post to a PIV:

- First is the lack of a compelling reason why consumers would choose to download to their PIV rather than use an existing channel, eg at home on a PC or through a 3G mobile phone.
- Potential revenues are closely correlated to public charge post utilisation, which is likely to initially be limited by PIV take-up and the domination of home and workplace recharging.

Competition

- There are a number of substitute channels to downloading to a PIV at a charge post:
  - Download to smartphone through 3G or Wi-Fi connection. It is likely to be possible to synchronise smartphones with PIV entertainment systems eliminating the need to download to the vehicle [†].
  - Download to laptops or home entertainment systems at home, where consumers are more relaxed and inclined to think about doing this [†].
  - PIVs will also contain conventional entertainment interfaces, such as CD players and USB ports [†].
- Furthermore the potential to generate revenue from multi-media download is threatened by advertisement supported content that is provided free to the user. Examples include services such as Spotify and Deezer [6, 7].

Sources: ii, xi, xiii, 6, 7, 31, 32

ARUP

Analysis : Multi-media retail

…combined with barriers and risks, this model is unviable.

Barriers

- Standardisation between different OEMs and software developers may be difficult to achieve.
- Legislation preventing video being in the driver's line-of-sight, ie on the main console may reduce the demand for in-car video to those vehicles with additional screens reducing the market for multi-media.
- BEVs, the anticipated main users of public charge posts, are currently used for short journeys, so demand for in-car entertainment may be limited [†, 15].
- Consumer willingness to pay for in-car infotainment systems varies widely and may reduce demand for such systems and consequently for multi-media [†].

Risks

- Consumers may be unwilling to change their behaviour to download to their vehicles [†].
- Inductive charging could become dominant, making charge posts obsolete, and there may be no communications link suitable for downloading multi-media.
- Infotainment systems are likely to be integrated with smartphone devices, undermining the business case for a dedicated vehicle download system [8]. Industrial co-operation to achieve this exists between GM & Google, and Microsoft, Fiat, Ford & Kia [4].

Enablers

- Dual view LCD screen technology could overcome legislation prohibiting video being shown on the main console in the driver's line of sight [21].
- Early adopting "technophiles" may have a high willingness to pay for "surprise and delight features" such as multi-media download [†].

Summary

- Digital multi-media retail is a simple, established business model.
- Demand is strong and growth potential is good.
- However, there are strong alternative means of accessing digital multi-media, such as smartphones and home PCs and no compelling reason to switch to downloading from charge post to PIV.
- It is unlikely that the multi-media retail business model would yield significant additional revenue under any likely future circumstances, so this model is unviable.
- Even if this business model were viable its impact on the PIV market would likely be minor.

Sources: ii, iii, vii, xi, xiii, 4, 8, 15, 21

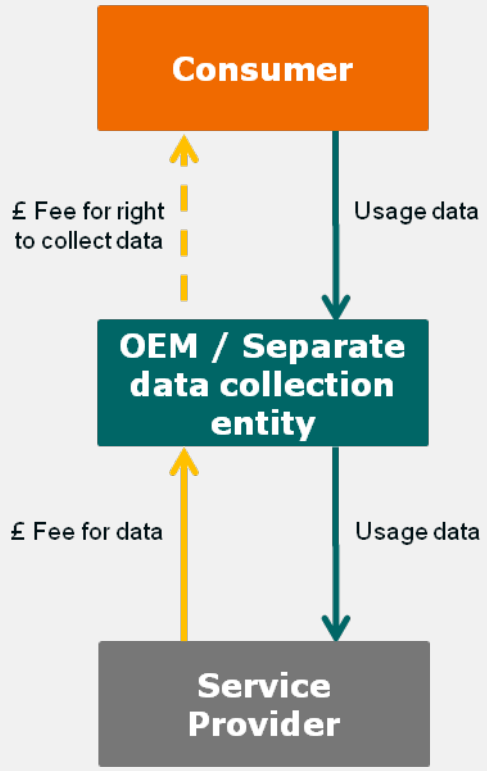
ARUP

Analysis : Capture and exploitation of user travel data

PIVs will generate massive quantities of data…

Description

PIVs are likely to record and store substantial data on travel patterns, vehicle condition, and charging patterns, which would be useful to a wide range of service providers. These may include vehicle manufactures, charge-post providers, and energy companies. The sale of data could generate revenue for organisations able to capture, analyse and sell PIV user data.



Technology Requirements

For this business model to be feasible the following requirements must be met:

- The PIV has appropriate software installed for data acquisition and storage.
- A means for collecting the data is required, for example it could be transmitted wirelessly or when the PIV is using a charge post with a communications link.

Current Experience

- Transport for London keep comprehensive records of journeys completed by Oyster card holders. To date this data has not been commercially exploited.
- Tesco capture data from Club Card holders and use it to significant effect through targeted 'relevance marketing' [5, 13].
- Data on PIV usage currently recorded from PIV trials includes: journey time of day; journey duration; journey distance; energy transferred during charging; charging time duration and time of day; ambient temperature; and vehicle charging [†].
- Data on PIV usage is already gathered / sold by electricity companies and other organisations.

Sources: i, vii, xvii, 5, 13

ARUP

Analysis : Capture and exploitation of user travel data

…data that will be of use to many organisations in the PIV market…

Market Overview

Data relating to PIV usage, such as trends of when, where and for how long users charge has clear value to a number of organisations. All the industry specialists interviewed stated that data on PIV usage patterns would be valuable and relevant to third parties if appropriately interpreted.

- OEMs may gain usage data and use this to influence design (eg battery capacity in different vehicles). They may also gain diagnostic data to identify issues with PIVs or batteries, sharing this data only with their suppliers [†].
- Usage data may be sold to companies with PIV fleets. This would enable them to asses pricing strategies [†].
- Data on usage would be particularly valuable to companies with vehicle fleets e.g. vehicle rental companies [†].

These organisations are likely to be interested in more comprehensive PIV usage data. Relevant data sets could be sold for a fixed fee to third parties.

Organisations with access to PIV users would be best placed to set-up the necessary data collection consent with consumers. For example:

- OEMs could do this at the point of purchase of the PIV;
- Electricity suppliers could do this through the relationship they already have with consumers to supply domestic electricity.

The consumer may not play a role in the model other than giving consent for data collection, probably at purchase.

Competition

- Although some organisations specialise in capturing data on consumer activities, for example Tesco, TfL and Experian, the comprehensive and specific data recorded by PIVs is not matched by any current competitor.

Sources: vii, xi, xiii

ARUP

Analysis : Capture and exploitation of user travel data

…but legal and consumer perception barriers make this model unviable.

Barriers

- The overwhelming quantity of recorded data associated with a large PIV roll-out would make it difficult to interpret and collate. New data mining techniques would need to be developed [†].
- Issues of privacy are a significant obstacle to exploiting user data:
  - The Data Protection Act would require consent from the PIV user before data could be sold to a third party and would require the data to be anonymous and generic, reducing its value [†].
  - Consumers' consent for data collection is likely to be difficult to obtain due to concerns about invasion of privacy [†]. Consumers are generally wary of targeted marketing, with successful examples such as loyalty cards relying on offers to gain consumer support.
- OEMs are protective of their data and unwilling to share it with third parties [†].

Risks

- Consumer concerns about invasion of privacy could result in very low levels of consent for data collection reducing the value of any data that could be collected [†].

Enablers

- OEMs already record data from ICEVs which is currently downloaded from the vehicle during servicing [†].
- PIVs will record more data than ICEVs [†].
- Current PIV trials across the UK are recording usage data for research purposes [†].
- Public Wi-Fi networks, such as The Cloud, could be used for the transfer of PIV data from onboard storage.

Summary

- There is a clear demand for appropriately collated data on PIV usage.
- However, there are significant legal and consumer perception barriers to commercially exploiting data.
- OEMs are best placed to collect data and have the greatest use for it, but are also typically unwilling to share it.
- Due to the barriers to data exploitation and the unwillingness of OEMs to share data, this business model is judged unviable.

Sources: i, ii, iii, vii, x, xi, xii, xiii

ARUP

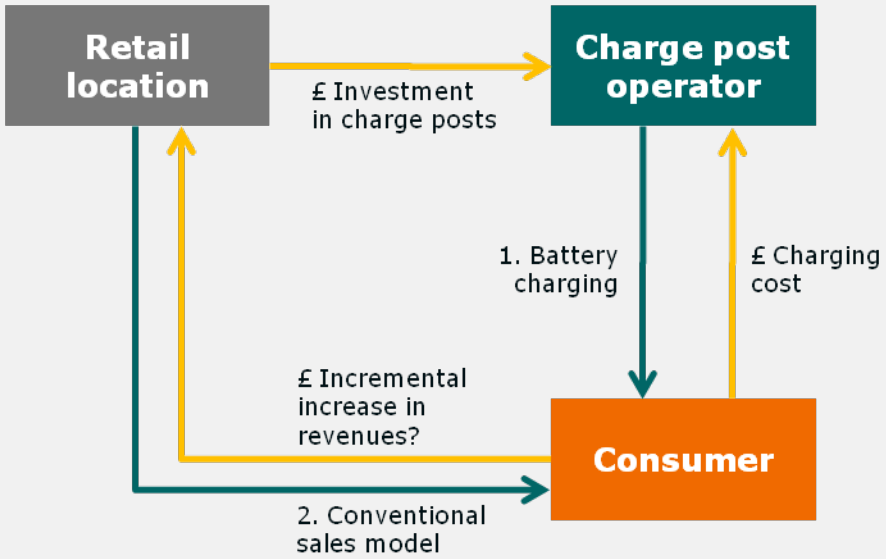
Analysis : Incremental retail revenues

Charge posts could attract PIV drivers to retail locations…

Description

By providing public charge posts in their car parks, retail outlets may generate incremental revenues from PIV drivers making extra visits, spending more, or choosing a retail outlet with charge posts rather than one without.

There may be “first mover” advantage for some retailers, until the introduction of charge posts becomes widespread.



Technology Requirements

This business model is only weakly dependent on technology developments.

It will be more attractive if charging infrastructure is standardised, so charging posts can be used by all PIV drivers.

Current Experience

- Some retail locations already operate a similar model providing conventional car parking for free subject to a minimum spend in-store, eg Tesco.
- Some retail locations offer free PIV charge posts [33, 34]. The reasons behind such locations offering this service are not stated, but are likely to be for marketing purposes, rather than for incremental revenue generation.

Sources: 33, 34

ARUP

Analysis : Incremental retail revenues

…and if take-up is high, incremental revenues may be generated…

Market Overview

The market potential of incremental revenues depends on a number of characteristics of the PIV market. Incremental revenues are likely to be correlated:

- Positively with the number of BEVs, REEVs and PHEVs in the UK parc;
- Positively with public recharging as a proportion of overall recharging, which will depend partly on vehicle type (BEV, REEV or PHEV);
- Negatively with the availability of public charging infrastructure;
- Negatively with market maturity.

At low levels of take-up retailers are only likely to install charge posts for CSR or publicity purposes, to make a 'green' statement, as charge post utilisation would be low and corresponding incremental revenues also low.

With increased roll-out of PIVs and if fees are introduced for most public charge posts, offering deals for free or discounted charging could generate incremental revenues for retailers.

At the current typical rate of charging (3kW) this model may be limited as consumers only spend significant amounts of time (similar to recharge times) at a few retail locations, for example shopping centres [†]. Rapid charge may make this model more viable for other retail locations, for example DIY stores.

Competition

- The main competitors to this business model are alternative means for recharging.
    - Home charging is likely to be far more convenient [†] and anchor expectations of the cost of recharging in all locations. This means that for discounted public charging to be perceived as a benefit it would need to be cheaper than domestic recharging, ie lower than the cost of domestic electricity.
    - Workplace charging is also likely to be more convenient [†] and, at most, be charged at the cost of electricity to business.
    - Currently on-street charging is either free or available on payment of an annual fee.

Sources: xiii

ARUP

Analysis : Incremental retail revenues

…but model unviable due to high costs and infrequent public charging.

Barriers

- The capital cost of charge posts means incremental revenues must be significant in order to justify the cost. It is unlikely that this will be the case in most locations.
- Home and workplace charging are expected to dominate the PIV recharging, in which case demand for charging in retail locations would be limited [†].
- The capacity of PIV batteries is expected to double in the next 5 years, which would reduce range anxiety and the consumer incentive to shop where there are charge posts [†].

Risks

- Low recharge power resulting in long recharge times means PIV spaces may be occupied for longer, reducing consumer turnover, and consequently reducing total revenue in that location [†]. There is a risk that PIV charging in retail car parks could have a negative impact on incremental revenues earned.
- Charging infrastructure likely to have a long payback period over which its effectiveness will depend on a lot of factors that are difficult to predict and outside the control of the retail location. For example, PIV take-up, proportion of REEVs and PHEVs, distribution of other public charging infrastructure.

Enablers

- Trials in Japan have indicated that range anxiety encourages consumers to seek locations with charge posts, supporting the first-mover advantage hypothesis [†].
- Consumers in the Japanese trial referred to above frequented locations with charge posts but did not charge at them [†]. This could enhance the viability of the incremental revenue model, as it would reduce operating costs of these charge posts.

Summary

- The viability of this model is closely linked to a number of uncertain factors (PIV take-up, recharge behaviour, charging infrastructure distribution).
- Incremental revenues are likely to be small and capital costs of charging infrastructure are high.
- This model is not viable.
- Retail locations will continue to install charge posts in order to demonstrate their commitment to promoting sustainable transport solutions such as PIVs. Therefore although this model may not generate substantial incremental revenue streams, it does align itself with corporate social requirements and we will continue to see some commitment to installing charge posts in public retail locations for strategic reasons.

Sources: ii, vii, x, xii

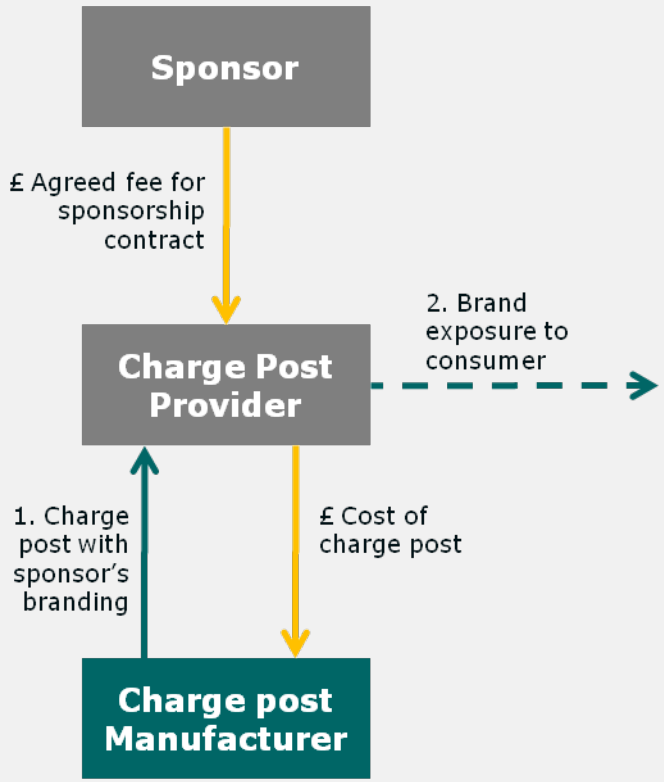
ARUP

Analysis : Sponsorship of charging infrastructure

Sponsorship is a simple revenue stream…

Description

A charge post provider would permit charging infrastructure to be branded by one or more corporate sponsors in order to subsidise the capital cost of infrastructure installation. Sponsorship of charging infrastructure of PIV charging infrastructure could be an attractive proposition given its popular, environmentally friendly image.



Technology Requirements

This business model has no technology requirements.

Current Experience

- The TfL Cycle Hire Scheme in London is sponsored by Barclays, following direct negotiation between the London Mayor and Barclay's Chief Executive [†]. The 5yr, £25million deal (more than other offers) was considered more than the value of the branding itself, so TfL Cycle Superhighways sponsorship was also included [†]. This demonstrates the difficulty of "pricing" the intangible gain to an industry sponsor.
- Smaller scale infrastructure sponsorship is used by many local authorities to subsidise activities such as roundabout landscaping [35]. Luton council give guide prices for roundabout sponsorship between £2,000 and £5,000 per annum [39].

Sources: v, viii, xiv, 35

ARUP

Analysis : Sponsorship of charging infrastructure

…and the public are sympathetic to green issues…

Market Overview

The market potential of the sponsorship model is closely linked to public perception of environmental issues and PIVs in particular, but need not be directly linked to PIV take-up, perhaps making it suitable in the early stages of the market.

In 2009 around three-quarters of UK adults were fairly or very concerned about climate change, with the proportion being higher amongst better educated, better paid groups [36]. Therefore, there is a large part of the UK population who are likely to look favourably on sponsorship of green initiatives such as charging infrastructure.

If an extensive charging infrastructure network is rolled out by a single provider or a consortium of providers, for example local authorities across a large region, sponsorship of the whole network may be attractive to a large company. If charging infrastructure networks are fragmented small scale sponsorship of individual posts or groups of posts will be more likely.

The value of the sponsorship depends on the extent to which posts can be branded, which is discussed in more detail in the 'Barriers' section. Restrictions on branding mean the most realistic sponsorship opportunity is likely to be for electricity providers [†].

Competition

- Sponsorship of charging infrastructure must demonstrate value for money over conventional advertising. Currently this seems unlikely given the significant barriers to entry experienced on the TfL Cycle Hire project, discussed in the "Barriers" section.

Sources: v, viii, xiii

Analysis : Sponsorship of charging infrastructure

…but advertising on-street is difficult, so model is unviable.

Barriers

- For on-street locations, displaying branding requires advertising consent for each charge post site [†].
  - Applying for this consent is expensive due to the associated planning and legal fees [†].
  - There is no guarantee that consent will be granted [†].
  - It should be noted that because of these issues only the Barclays cycle hire scheme bicycles are branded, not the docking stations [†].
- Advertising can be regarded as street clutter, which local authorities are generally opposed to.
- In the absence of charge post branding, publicity would be limited to any associated promotion or advertising. This would be of more value to a single large sponsor than many small sponsors, but is unlikely to be of sufficient value to raise significant sponsorship.

Risks

- No risks have been identified.

Enablers

- A CLG review of permitted development for charging posts for electric cars [11] recommends that:

  "advertising regulations relating to charging points should be reviewed. There is a case for [...permitting...] the un-illuminated display of the logo of the electricity supplier with a maximum size of about 70cm^2."
  - This remains a suggestion and, if implemented, would limit any sponsorship revenue to the electricity supplier.
  - Legislation of this nature is likely only when there is significant take-up of PIVs and associated infrastructure.
  - More significant legislative change to permit charging post advertising by any organisation would significantly increase the viability of this revenue stream.
- It would be possible to provide charge posts in "company colours" however this is of reduced value to a corporate sponsor [†].

Summary

- The public are sympathetic to green issues and sponsorship of PIV charging infrastructure offers a means to tap into this sentiment.
- Difficulties obtaining advertising consent currently gives rise to overwhelming barriers to sponsorship of on-street charge posts.
- This model is currently unviable, and expected to remain so for the early stages of the PIV market.
- However, if legislation were changed to permit charge post advertising this model could become viable.

Sources: v, 11

ARUP

Appendices

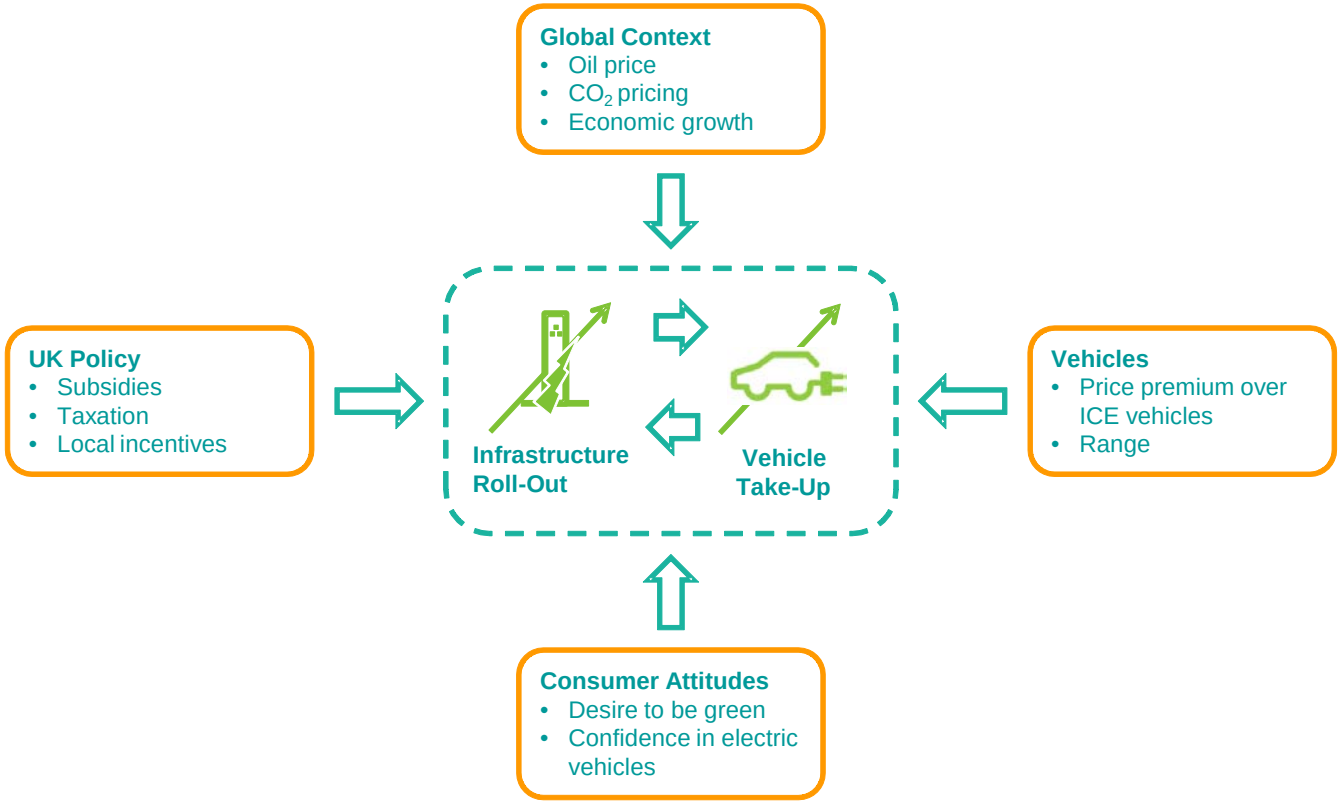
1. Executive summary
2. Methodology
3. Summary analysis
4. Detailed analysis of each business model
5. Appendices

Appendix A: Further Details on Scenarios (1/3)

For potentially viable business models viability is assessed in detail to 2020. To provide a context within which to assess the business models and recognising that the future of the PIV market over the next 10 years is uncertain, a scenario approach is used. An informed view of how this viability changes in the longer run 2021 – 2050 is also given for each potentially viable business model.

Variables

Drivers of PIV take-up were used as variables, based on the outcomes of the variables workshop, and consistent with the early scenarios work



ARUP

Appendix A: Further Details on Scenarios (2/3)

Variable	Slow Global Growth	PIV Infrastructure Leads PIV Take-up	PIV Take-up Leads PIV Infrastructure	Green Growth
Global Context	• Oil price returns to $50/barrel long term trend • Prolonged recession • ICE running costs reduce relative to PIVs • No global agreement on CO_2 price	• Oil price remains at current levels • World and UK emerges from recession as expected • ICE running costs unchanged relative to PIVs • No global agreement on CO_2 price	• Oil price remains at current levels • World emerges from recession faster than UK • ICE running costs increase relative to PIVs • Global CO_2 price agreement increases fuel cost	• Oil price rises quickly • ICE running costs increase relative to PIVs • Global CO_2 price agreement increases fuel cost
UK Policy	• Cost saving measures limit subsidies for PIV industry • Tax incentives and measures with little impact on government revenues for low take-up remain	• PIV industry subsidies limited, government focuses on PIV infrastructure investment which has a greater direct benefit to UK businesses and stimulating growth • Tax incentives and measures with little impact on government revenues for low take-up remain • UK expects to meet 2020 CO_2 targets	• Cost saving measures limit subsidies for PIV industry • Tax incentives and measures with little impact on government revenues for low take-up remain • UK unlikely to meet 2020 CO_2 targets	• Significant subsidies for PIV industry • Increased PIV take-up puts pressure on the government to limit tax incentives and other measures to maintain revenues • UK invests to meet 2020 CO_2 targets
UK Subsidy	• £250m to encourage low carbon vehicles reduced as part of cost cutting measures • Vehicle excise duty CO2 bands remain constant enabling efficient diesels to achieve lowest band	• £250m to encourage low carbon vehicles reduced as part of cost cutting measures. • Vehicle excise duty CO2 bands made more stringent to encourage PIV take-up over efficient diesel	• £250m to encourage low carbon vehicles remains. • Vehicle excise duty CO2 bands made more stringent to encourage PIV take-up over efficient diesel	• £250m to encourage low carbon vehicles supplemented by additional government money to make PIV financially comparable to ICE from 2015 onwards and to encourage infrastructure installation. • Vehicle excise duty CO2 bands made more stringent to encourage alternative fuel vehicles
UK Legislation Prevailing	• European emissions legislation incentivises OEMs to pursue super-credits via PIV • Battery legislation leads to high levels of recycling • Charging infrastructure not a regulated asset	• European emissions legislation incentivises OEMs to pursue super-credits via PIV • Charging infrastructure not a regulated asset	• European emissions legislation incentivises OEMs to pursue super-credits via PIV • Charging infrastructure not a regulated asset	• European emissions legislation incentivises OEMs to pursue super-credits via PIV • Charging infrastructure not a regulated asset
Alternative UK Legislation	• Charging infrastructure is a regulated asset	• Charging infrastructure is a regulated asset	• Charging infrastructure is a regulated asset	• Charging infrastructure is a regulated asset

Appendix A: Further Details on Scenarios (3/3)

Variable	Slow Global Growth	PIV Infrastructure Leads PIV Take-up	PIV Take-up Leads PIV Infrastructure	Green Growth
Vehicles	• OEMs and suppliers invest cautiously in R&D • PIV performance stagnates • Production volumes below efficient level • Vehicle prices remain high	• OEMs and suppliers invest cautiously in R&D • PIV performance stagnates • Production volumes below efficient level • Vehicle prices remain high	• OEMs and suppliers invest confidently in R&D • PIV performance improves significantly • Production volumes approach efficient level • Vehicle prices reduce	• OEMs and suppliers invest confidently in R&D • PIV performance improves significantly • Production volumes reach efficient level • Vehicle prices reduce
Consumer Attitudes	• Concern for CO_2 slips down consumer agenda due to financial pressures • Confidence in buying an PIV low due to cost of vehicles, range anxiety, unproven technology, low level of infrastructure	• Confidence in buying an PIV low due to cost of vehicles, range anxiety, unproven technology	• Concern for CO_2 significant among better off but generally moderated due to financial pressures • Confidence in buying an PIV restrained by low level of infrastructure • Incentive to buy an PIV increased by more favourable total cost of ownership vs ICEs	• Consumer concern for CO_2 fashionable and an important purchasing criterion • Confidence in buying an PIV increased by familiarity and proven performance in use • Incentive to buy an PIV high due to subsidised costs, infrastructure availability, high cost of ICE
Vehicle Usage Trends	• PIVs primarily used as second vehicles for short journeys due to range anxiety resulting from lack of infrastructure • REEV/PHEVs used as main vehicle for all journey types	• PIVs primarily used as second vehicle for short journeys due to range anxiety and lack of experience of longer journeys • REEV/PHEVs used as main vehicle for all journey types	• PIVs primarily used as second vehicles for short journeys due to range anxiety resulting from lack of infrastructure • REEV/PHEVs used as main vehicle for all journey types	• PIVs primarily used as second vehicles but some use on longer journeys supported by appropriate charging infrastructure on trunk roads • REEV/PHEVs used as main vehicle for all journey types
Infrastructure Deployment	• Limited or reduced government subsidy limits development and roll-out of infrastructure • Existing free government infrastructure disincentivises private investment	• Aggressive government subsidy facilitates roll out of charging infrastructure capable of supporting high levels of PIV take-up • Private investment in infrastructure limited due to low levels of vehicle take-up	• Limited or reduced government subsidy limits development and roll-out of infrastructure • Existing free government infrastructure disincentivises private investment	• Aggressive government subsidy facilitates roll out of charging infrastructure capable of supporting high levels of PIV take-up • Private investment in infrastructure encouraged
Vehicle Take-Up	• Low (300,000) • Restricted to wealthy early adopters and those in areas with strong local incentives, e.g. London	• Low (300,000) • Restricted to wealthy early adopters and those in areas with strong local incentives, egg London	• Medium (600,000) • Fleet buyers purchase based on low total cost of ownership for high mileage, low range use, predictable usage pattern	• High (1,200,000) • Fleet buyers with suitable usage patterns buy PIVs for cost saving and PR reasons • Retail customers buy PIVs for cost saving and to demonstrate green credentials

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Appendix C: Interviews

No.	Company	Sector	Location	Date
i	Cobalt Telephone Technologies	Automated Parking Payments	London	July 2010
ii	Nudge Advisory (Smartcar – Mercedes / Daimler)	OEM PIV Manufacturer	London	July 2010
iii	Lotus Engineering	OEM PIV Manufacturer	London	August 2010
iv	BT Openzone	Telecoms	London	August 2010
v	Transport for London	Public Sector	London	August 2010
vi	O2	Mobile Networks Telecoms	London	August 2010
vii	Nissan	OEM PIV Manufacturer	Cranfield	August 2010
viii	London Borough of Hackney	Public	Hackney	August 2010
ix	The Cloud	Telecoms	London	August 2010
x	Shell	Oil and Gas	London	August 2010
xi	Mitsubishi Corporation Automobile Europe N.V.	OEM PIV Manufacturer	Amsterdam	August 2010
xii	Siemens e-mobility	Charge post infrastructure provider and manufacturer	Southampton	August 2010
xiii	IBM	IT	London	August 2010
xiv	ChargeMaster	Charge post infrastructure	London	September 2010
xv	Alpine	In car entertainment	London	September 2010
xvi	theAA	Vehicle Breakdown	Teleconference	September 2010
xvii	E.ON	Electricity Utility	Teleconference	September 2010
xviii	Network Rail Stations Team	Private sector stations / car park	Teleconference	September 2010

Appendix D: Identification of potential services (1/2)

No.	Description of the potential revenue	Commentary
1	Provision of real-time route planning information services	This service integrates information such as range on current charge, location of available charge posts, real-time traffic data, congestion charging, to provide smart route planning and assistance with battery management. The technology may not be directly linked to PIVs, but its development will be enhanced by the information and communications technology in PIVs.
2	Real-time information on parking and charge post availability	To mitigate range anxiety a service to find and book a parking space with a charge post would be valuable for BEV owners. Consumers could be charged a fee for use or service providers (car parks and charge post operators) could pay for advertising through the service.
3	Infrastructure hosting on public charge posts	Public charge posts would provide an ideal platform for hosting other telecoms infrastructure such as public Wi-Fi access points or CCTV, which rely on availability of a power supply and telecoms connection. Hosting revenues could be used to subsidise the installation of the charging posts.
4	Purchase of multi-media services whilst PIV charging	Through the PIV charging infrastructure (of any type), customers could be provided with an option to purchase and download music, video, or movies to their PIVs, either for use in the vehicle, or for downloading to a home entertainment system on return. These services provide a potential revenue stream for providing the service and content.
5	Additional revenues at charging post locations	Whilst PIV owners are waiting for their vehicles to charge they are more likely to leave their vehicle for 20-30 minutes. There could be increased advertising and retail revenues at these locations, for example increased use of local amenities such as cafés and shops. Local businesses may advertise at charge posts or through an integrated system directly into the vehicle to inform customers of local services.
6	Emergency breakdown services	Potentially increased demand for breakdown services to provide emergency battery recharging or other PIV services. This may be a marginal increase over current revenues for these companies.

Appendix D: Identification of potential services (2/2)

No.	Description of the potential revenue	Commentary
7	Capture and exploitation of user travel data through customer loyalty programmes	PIVs are likely to record and store substantially more data on travel patterns, vehicle condition, etc, which would be useful to a wide range of service providers. These may include vehicle manufactures, charge-post providers, energy companies, etc.
8	Conventional advertising	Advertising (sponsorship) on the public charging post may be possible, depending on local planning regulations.
9	Media information points on the charge post	A public charging post would provide an ideal location for local information services, perhaps on an interactive screen; providing local information and advertising that would be useful for the general public (not just PIV users). Service providers may pay to advertise their services through this outlet, thereby partly subsidising the cost of the infrastructure.
10	Incremental revenues at charge-post locations such as shopping centres	Investigate whether locations such as supermarkets may see some incremental increase in revenues from providing public charge posts in their car parks. There may be “first mover” advantage for some supermarkets, until the introduction of charge posts becomes widespread.
11	Access to private charging services	The general public could offer to provide charging facilities (on their driveways) on an open-market or integrated bidding platform. Theoretically, users could advertise their availability of charge locations and pricing using a bidding model similar to eBay or Amazon Marketplace. If PIVs were enabled with a unique ID, the owner of the PIV could be charged by their own electricity company, perhaps with an additional premium for the person offering the public (driveway) service.
12	Premium parking revenues	With an “intelligent” PIV users may be able to “book” their parking space in advance, to secure a charging location (perhaps linked to on-line diaries). In a model similar to airline seat booking, nearer the time, the value of that parking space would increase and therefore a PIV owner may then choose to divert to an alternative parking space (aided by their vehicle) and “sell” the existing space on the market.

Appendix I: WS3/ARUP/6 Executive Summary (1/4)

Introduction

This work considers **"the generic business models which may be effective during the initial launch / take-off of the [plug-in vehicle] market, in order to inform scenario development and system architecture definition"** in the UK.

14 business models have been considered: 12 from the vehicle provision, after sales service, and charging infrastructure sectors; and a further two that integrate vehicle provision and charging infrastructure provision. A scenario approach is used in the assessment of business model viability using four scenarios defined in terms of different levels of Plug-In Vehicle (PIV) take-up and charging infrastructure roll out in 2020. The business models are assessed for each scenario.

Overview of the PIV Market

The PIV market can be split into two interrelated components, vehicles and charging infrastructure, which must function together as a system. Developments in vehicles affect the requirements of charging infrastructure and vice versa.

PIVs are of three main types. Battery Electric Vehicles (BEVs), draw their power only from a battery and depend on publicly accessible charging infrastructure to extend their range. Range Extended Electric Vehicles (REEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) carry an Internal Combustion Engine (ICE), which they can use to extend their range without relying on charging infrastructure. These differences mean demand for charging infrastructure depends not just on PIV take-up, but also on the proportions of BEVs, REEVs and PHEVs, bringing significant uncertainty to payback and return on investment in charging infrastructure.

It is useful to consider charging infrastructure in three categories: home, workplace, and publicly accessible. Most PIV charging is expected to take place overnight at home, some at workplaces and a small proportion at publicly accessible charge posts. All PIV owners with appropriate parking are expected to install a home charge post. Workplace car parks are expected to be appropriate locations for charge post and their provision can be matched to demand reasonably well. In contrast publicly accessible charging infrastructure is subject to significant uncertainty over demand, appropriate geographic distribution, and consumer willingness to pay, with implications on the risks involved in investment in businesses associated with this type of infrastructure.

Appendix I: WS3/ARUP/6 Executive Summary (2/4)

Vehicle Provision

The success of PIVs depends on a combination of positive consumer attitudes, investment in developing vehicles by manufacturers and investment in charging infrastructure. Consumer attitudes towards PIVs are driven by vehicle cost, concerns about the reliability of the new technology, and, in the case of BEVs, range anxiety. In the early stages of the PIV market manufacturers are driven by emissions legislation and the need to develop technology.

European fleet average emissions legislation is a primary driver of PIV development. To avoid paying emissions premiums PIVs may be priced below cost by manufacturers in order to make them sufficiently attractive to consumers to achieve sales volumes that reduce their fleet average emissions below the target. However, in this case supply of PIVs is likely to be limited to that required to achieve the emissions target, to minimise incurred losses.

In scenarios where the cost of vehicles remains high in 2020 PIVs are not attractive to consumers, so the viability of vehicle provision is driven by manufacturers' strategic aims to establish brand, develop technology and meet emissions targets. In scenarios where PIV costs have reduced in 2020, in combination with extensive infrastructure roll out, PIVs are attractive to consumers and manufacturers have attractive opportunities to sell vehicles through their conventional channels.

Battery leasing is proposed as a way of making the cost structure and risk of PIVs more acceptable to consumers, by selling a chassis and leasing the battery, reducing the upfront vehicle cost and removing the main technology risk from the consumer. This model faces significant barriers to adoption, including unfamiliarity to consumers, and the complications in selling vehicles second hand. Although these barriers can be overcome, it is expected that in situations where this occurs the cost barriers to more conventional ownership models (buy or lease) will have been overcome, reducing the need for battery lease.

BEVs present operational problems for car clubs unless rapid charging infrastructure is widely available, but REEVs and PHEVs will be attractive to car clubs when their costs become competitive with ICEVs.

The interaction between consumer acceptance of business models and concern about technology risk is uncertain. For example, buying a PIV is familiar, but carries with it all the technology risk. Battery leasing is an unfamiliar business model, but helps to reduce exposure to technology risk. OEMs we have spoken to have questioned the willingness of consumers to accept novel business, but this should be tested.

After Sales Service

PIVs are a new technology in mass market vehicles, which has a number of implications on maintenance. Consumers are likely to seek the reassurance of branded garages for their PIV maintenance needs. Garages will require a significant investment in training to become capable of servicing PIVs, but maintenance volumes are likely to be low because PIVs are predicted to require considerably less routine maintenance than ICEVs and during initial take-up they will only be present in small numbers. It is therefore uncertain who will make this investment.

In all scenarios main dealers will be able to leverage the value of their brands for competitive advantage in the maintenance market, but the low volumes and the need to keep overall PIV costs down to make them attractive to consumers will restrict profit maximising pricing policies.

At the end of their useful life, European legislation prevents PIV batteries being disposed of in landfill and places financial responsibility for recycling them on the organisations that brings them to market. Consequently battery recycling will be viable for any level of PIV take-up. Economies of scale are likely to be available from growth in portable battery recycling also required by European legislation, which in the UK must increase from 3% to 45% by 2016.

If a second life market for PIV batteries can be developed there may be greater opportunities for profit. The value of second life PIV batteries will be restricted by: the cost of reconfiguration; cheap alternative storage, such as lead-acid batteries; and the value of energy storage. It is only likely to be worth investing in developing the market and setting up reconfiguration facilities for scenarios where battery volumes are high.

Appendix I: WS3/ARUP/6 Executive Summary (3/4)

Charging Infrastructure

Alongside vehicles charging infrastructure is a critical part of the PIV system.

The rollout of charging infrastructure will be strongly affected by the mix of BEVs, REEVs and PHEVs and legislation governing whether DNOs can invest in charging infrastructure and include it in their regulated asset bases. Uncertainties in these areas mean there is currently considerable risk associated with charging infrastructure investment and this risk is likely to remain during the initial take-off of the PIV market.

BEVs, REEVs and PHEVs will all generally require a home charging facility, so demand is closely correlated with overall PIV take-up. Manufacturing such posts will be viable in all scenarios, but low barriers to entry mean profits will be low. It is expected that the consumer will own and operate their home charge post.

Workplace charge posts are likely to be important to a number of consumer groups. It will be essential to BEV drivers with a round trip commute further than their range. For PIV drivers without off-street parking at home it is likely to be the most convenient option for charging. For REEV and PHEV drivers keen to maximise their electric only miles workplace charging will provide an opportunity to top-up. The main business opportunities in this space are likely to be manufacture, installation and maintenance of posts. Operation is unlikely to generate significant revenue during initial take-off of the PIV market as it is expected that workplace charging will not require significant administration or billing.

Publicly accessible charging infrastructure is necessary for BEVs to extend their range beyond a single charge, so demand for it depends on the take-up of BEVs. Consumer willingness to pay for public recharging is likely to be restricted by the price of alternatives, such as REEVs, PHEVs and ICEVs, which do not need to charge to extend their range. Combined with the high cost of installing public charging infrastructure this presents significant challenges to operating profitably in this market. For all but the most optimistic scenario charging infrastructure is unlikely to be directly profitable and will be installed by local authorities for environmental reasons, or by private companies for indirect benefits, for example marketing.

One proposed solution to this investment challenge is to change legislation to enable DNOs to invest in charging infrastructure and include it in their regulated asset base. DNOs could then adjust their network charges to earn a regulated return on this investment and electricity suppliers would sell electricity to PIV drivers through the charge posts. This change would affect workplace and publicly accessible charging infrastructure, but it is expected that home charge posts would continue to be installed by home owners. There are difficult practical issues with the regulated asset approach. For example where should charge posts be installed? Car parks of shopping centres and supermarkets may be suitable locations but there would then be issues of those businesses attracting indirect benefits, such as increased business from PIV drivers. A potentially complex regulatory framework would need to be established.

Integrated Business Models

In this report integrated business models are defined to be those that combine activities from the vehicle provision and charging infrastructure parts of the PIV system into a single business. Such business models are likely to appeal primarily to BEV drivers, as they are reliant on publicly accessible charging infrastructure to extend their range. Consequently the prices of vehicle and charging packages will be limited by substitutes such as REEVs, PHEVs or ICEVs that do not require access to public charging infrastructure.

The cost to the consumer of an integrated package is likely to be dominated by the cost of the vehicle, during initial take-off of the market. Therefore in scenarios where PIV costs remain high packages from integrated providers will remain unattractive to consumers in comparison to buying or leasing an ICEV.

In scenarios where PIV costs become competitive with ICEVs, integrated providers offer an innovative ownership model for consumers. Battery swap offers a differentiated service that could be attractive to consumers, but technical issues and barriers to battery standardisation by manufacturers make it unlikely to be viable. Without battery swapping stations, integrated models do not offer a sufficiently differentiated service to persuade consumers to risk a novel ownership model.

Appendix I: WS3/ARUP/6 Executive Summary (4/4)

Barriers and Enablers

During the initial take-off of the PIV market the main driver of vehicle rollout in Europe will be the European fleet average emissions legislation. Under this legislation OEMs will be fined if their average fleet emissions are above a target level. PIVs offer OEMs a means to reduce the average emissions of their fleets, particularly in the years to 2015 when the legislation incentivises such vehicles.

However, as PIVs are expensive to develop, require batteries that are expensive, and are produced in small volumes OEMs may have to price them below cost to make them attractive to consumers. Consequently there is a risk that the supply of PIVs will be restricted to that required for OEMs to achieve their fleet average emissions target to minimise losses.

With a restricted supply of PIVs, and BEVs in particular, it will take much longer for there to be sufficient demand to support a widespread charging infrastructure rollout. This will reduce the utility of BEVs to consumers and could be a vicious circle obstructing BEV take-up.

A further issue with charging infrastructure is the need for standards to enable PIV drivers to use any publicly accessible charge post. If standards are not set early in the launch of the PIV market, there is a risk of competing standards and under-specified charge posts, in particular charge posts with inadequate communications to facilitate billing and demand management (if required).

Many studies indicate that the main obstacles to consumers considering PIVs are the high cost of the vehicles, concern about the reliability of the new technology and, in the case of BEVs, range anxiety. Vehicle cost is expected to reduce as battery prices drop and vehicle production volumes increase. In the short term, government subsidies will help to mitigate the cost barrier, although initially even subsidised PIVs will be expensive compared to ICEVs. Technology concerns will be mitigated as PIVs driven by early adopters are proved in use. Range anxiety can be reduced by providing charging infrastructure, selling BEVs with larger batteries or consumers gaining experience of their true journey patterns.

For businesses considering entering the PIV market the main barrier is risk. Risk comes from a number of sources: the reliability of current technology; the rate at which technology will improve; government policy is changeable in timescales over which investment decisions must be made; and there is a great deal of uncertainty in demand, particularly for public charging infrastructure.