Mobility credits: economic analysis

Executive summary

- The way that we travel is changing. Advancements in vehicle technology and mobile connectivity has spurred the development of a suite of new mobility service offerings to consumers.
- Existing shared vehicle schemes promote lower emission vehicles, reduce the number of cars on the road, lower mileage, and complement public transport and other modes. Therefore, the Government should consider supporting shared vehicle schemes, as part of their actions to address dangerous air pollution and NOx emissions.
- We model the impact of a 2 year scrappage scheme for euro 1-5 diesel cars. The scheme provides mobility credits (to be used for shared vehicle schemes and on public transport) rather than a typical upfront grant in return for the diesel vehicle.
- Our analysis is indicative, but suggests that a mobility credits policy would be both more cost-effective than a scrappage scheme, and provide greater additionality through behavioural change and the promotion of cleaner, alternative modes of transport.
- Indeed, whilst the NPV of DEFRA's scrappage scheme is negative (-£20mn) our modelled mobility credits option provides a net benefit to society (£170mn NPV), whilst reducing NOx emissions by over 1,200 tonnes over a 10-year period.

Context – changing modes of transport

UK cities are growing and evolving. Urbanisation is expected to increase average city density by 30% over the next 15 years, exacerbating congestion, noise pollution and street occupancy. Technological innovations from electrification, to connectivity services, and autonomous vehicles are on the horizon - poised to redefine the way that we travel. Indeed, McKinsey sees future increases in automotive revenues being driven by transport services, such as shared mobility schemes and data-connectivity services.

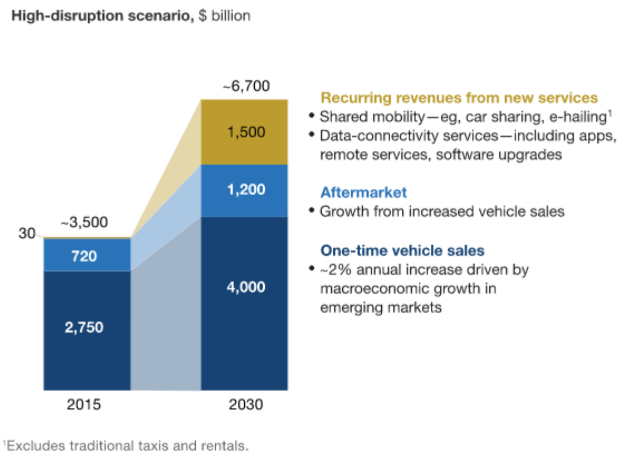

Figure 1 - Global automotive revenue streams (McKinsey & Company, 2017)[1]

Today one of the most prescient policy challenges is how to tackle dangerous levels of NOx emissions in UK urban areas? Diesel cars are responsible for a significant proportion of these

[1] McKinsey & Company (2017) *Disruptive trends that will transform the auto industry*. Available from: http://www.mckinsey.com/

emissions, and policies which support a move away from the oldest and most polluting diesel cars should be considered.

Additionally, good policy should support an orderly transition. It is neither technically feasible nor economically desirable to abruptly switch all vehicle drivetrains to an entirely low emission technology. Indeed, certain market segments such as commercial vehicles are reliant on diesel models in the near term, with few feasible alternatives[2]. Government has a role to play in assessing these costs and benefits, and supporting policies and markets where the transition can bring the highest net benefit to society.

The scrappage scheme analysed in the DEFRA consultation's technical report would certainly contribute to addressing high NOx levels, by targeting the worst performing diesel cars and supporting a switch to newer, cleaner vehicles. However, the DEFRA scrappage scheme still promotes private ownership of vehicles, and does not take advantage of the opportunities presented by new trends in transport, such as the proliferation of shared ownership models.

The UK government must act to curb the high levels of NOx in urban atmospheres. The mobility credits policy proposed here is more cost-effective than a scrappage scheme, and provides greater additionality through behavioural change; which could over time reduce the number of private cars driven on UK roads. Such an incentive is not overly paternalistic, but gives old diesel car users a nudge to change habitual travel behaviours, and provides an attractive incentive to support this shift.

On the benefits of vehicle-sharing: a shift in behaviour

Shared transport models are more efficient economically and more sustainable than older private car ownership models. The average city dweller's car is parked for 97% of the time[3] and can be considered an underutilised asset. Car clubs seek to address this inefficiency.

In 2016, CarPlus automotive trade association, surveyed 186,000 car club members sharing 2,800 cars, and estimated that 25,000 privately-owned cars had been taken off the road as a result of membership[4]. A CarPlus survey of 4,000 London based car club members found that they walked, cycled and used public transport more than the national average (see figure 2 below). In addition, it found members were "increasingly interested in driving electric vehicles.

[2] BVRLA are currently conducting further analysis to consider the appropriate phase-out rates for diesel vehicles, considering the specific alternatives and market conditions of different transport segments (i.e. cars, commercial vehicles etc.). We would be happy to support DEFRA with this research when completed.
[3] Europcar (2010) *Stress and the Chassis – The Cost of Dormant Urban Motors to Our Pockets*.
[4] CarPlus (2016) *CarPlus annual survey of car clubs*. Available from: https://www.carplus.org.uk/

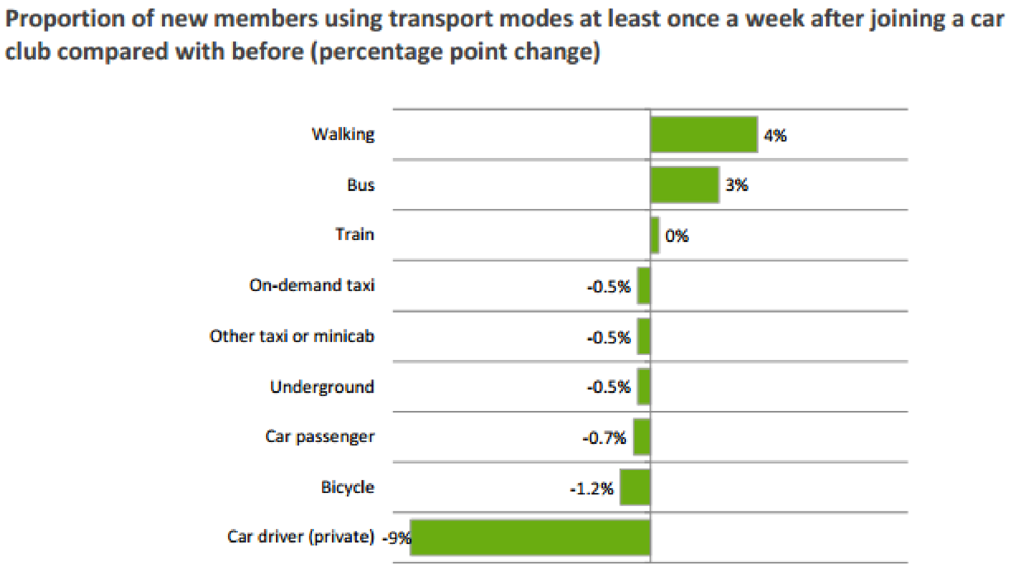

Figure 2 - car club member's use of transport modes (CarPlus, 2016)

Transport behaviour is habitual. Mobility credits therefore provide a compelling alterative to a scrappage scheme as they seek to support lower emission mobility modes and behaviours. For a lower Government cost, this policy can provide greater additionality by promoting a shift in travel behaviours.

Policy: 2-year scrappage scheme for euro 1-5 diesel cars between 2019-2020 which provides an upfront mobility credit rather than a grant as an incentive.

Mobility credit uptake

This analysis assumes that 40,000 diesel car owners will scrap their vehicles in return for mobility credits over a 2-year programme. This is given a pool of around 8 million euro 1-5 diesel cars. The mobility credits (£2,500 worth) can be used to pay for various forms of shared transport. This analysis assumes for simplicity these are either shared car clubs, or public transport (bus and rail).

Whilst some consumers may be attracted to the subsidised car sharing/public transport travel, others will be acting aware that there is a time limited opportunity to access some benefit from scrapping their car. This is while demand for diesel cars, and prices in the resale markets could drop further[5]. For this population of old diesel car owners, the introduction of the mobility credits scheme creates additional opportunity cost of inaction. We estimate that the introduction of a mobility credit incentive (£500 plus the assumed residual value of the vehicle - £2,000) increases the £/mile opportunity cost of running a diesel car by 5%.

Over the 2 years of the policy, our analysis assumes that this incentivises 20,000 diesel car owners a year to scrap their vehicles in return for the mobility credit. Consulting the literature on the measured responsiveness of shared transport demand to car price changes, we think this is a reasonable take up rate. Indeed, using the cross elasticities of demand between car costs and shared transport use (rail and bus) captured in the literature by Toner (1993) and Wardman (1997), the 5% increase in car costs would suggest a take up of 35,000 additional shared transport users a year. This is similar to our assumed take up rate, and close to the assumptions used by DEFRA in the Technical Report.

[5] BBC (2017) *UK car registrations fall 8.5% in May*. Available from: http://www.bbc.co.uk/

Importantly our analysis assumes that the provision of the mobility credit creates behavioural change. Our modelled policy is more cost-effective and provides more additionality than the scrappage scheme proposed.

We assume that:

- The provision of mobility credits creates a behavioural shift from private car ownership towards shared modes of transport i.e. users do not buy an additional vehicle after receiving the mobility credit incentive.
- In line with survey results from CarPlus (2016), ex-diesel car owners reduce their mileage when they join a car club to 4,190 miles a year. Our counterfactual assumption is that the user would drive 7,800 miles, which is the UK's average.
- That total mileage demand is consistent between the 2 scenarios. Individuals therefore use car clubs to service 4,190 miles of their total transport demand (based on CarPlus survey), and the remaining 3,610 miles is serviced by public transport. We assume an equal share between rail, bus and cycling/walking to reflect the diversity in modes (see figure 2), and calculate costs and emissions from this.

Impact on NOx

Our modelled policy reduces NOx emissions by 67 tonnes in the first year of the scheme (2019) and by 1,272 tonnes over the 10-year policy appraisal period. This is equivalent to taking 180,000 euro 5 compliant light commercial vehicles off the road for a year (assuming average mileage of 30,000 miles). This reduction is driven by a shift away from euro 1-5 diesel cars. We calculate NOx savings based on real-world diesel NOx emission levels taken from the European Environment Agency. Participants move to using both car club vehicles and public transport (with their mobility credits).

For the average car club vehicle, we have created a weighted NOx emission factor based on an assumed split between petrol, BEV and petrol hybrid vehicles, and market data on leading models' NOx emissions. This fleet projection is informed by trends in car club fleets and the CarPlus survey (2016). Public transport emissions – both NOx and CO_2e - are derived from a decreasing linear trend based on NAEI[6] and BEIS[7] data.

Monetising the NOx emission reduction based on the Government's damage cost methodology[8], generates health benefits worth a discounted £73.5 million (2017 prices) over the 10-year policy appraisal period.

Social welfare benefit

In line with the methodology and assumptions made in the Technical Report, we have estimated the size of social welfare benefit. This comprises the value of the mobility credits transfer to consumers, as well as the operating cost savings accrued from the shift to car clubs/public transport. The transfer benefit is delivered in 2019 and 2020, whilst the operating cost savings are delivered each of the 10 years for the 20,000 – 40,000 mobility credit recipients. Here we take an average diesel mpg and fuel price, and compare this to a typical car sharing price (£0.1/minute) and public transport price per mile.

In total, this policy delivers £242.7 million worth of social benefit (in 2017 prices).

[6] NAEI (2016) *Emission factors for transport*. Available from: http://naei.defra.gov.uk/data/ef-transport
[7] BEIS (2016) *Greenhouse Gas Reporting*. Available from: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016
[8] Using an urban transport (inner conurbation) damage cost factor of £63,552/tNOx (2017 prices)

GHG benefit

Reducing the number of old euro 1-5 diesel cars on the UK's roads also has a measurable benefit on GHG emissions. This is monetised by talking the Government's 2019 non-traded price of carbon (£65.44 in 2016 prices). Over the 10-year policy appraisal period, this cumulatively brings £19.7 million worth of benefit in present value terms.

Cost to Government

The primary cost to Government is born from the mobility credits transfer. Whilst we would also expect the policy to have some administration and running costs, given a lack of data on this we have not included administration costs in our analysis. In sum and discounted, the cost to Government from providing mobility credits to 40,000 diesel car owners is £91.8 million (2017 prices).

Public cost and economic growth

Public cost is derived from the lost asset value of the cars which are scrapped. Society therefore cannot utilise the useful capital as they would have done. We estimate this by taking the average residual value figure from the technical report (£2,000 per car) in the years the vehicles are scrapped. This accumulates to £73.4 million over the 10-year period.

Additionally, we would expect some deadweight loss from the effective subsidy. In economics, this is an inefficiency caused by society consuming more of a good (shared transport), than their preferences would dictate in a counterfactual perfectly competitive market. We have not estimated this here, but consulting the scrappage scheme deadweight loss figure in the technical report, do not expect this to be substantial.

We see a lot of revenue growth opportunities from new transport services, and this policy would undoubtedly support such industries. Indeed, as shown in figure 1, McKinsey project that shared mobility, connectivity services, and new business models could increase automotive revenues by $1.5 trillion by 2030. However, without further analysis we have not estimated this here.

Results

Our analysis suggests that offering mobility credits to 40,000 owners of old, euro 1-5 diesel cars reduces NOx by over 1,200 tonnes and creates a net benefit for society over a 10-year period. The table and figure below demonstrates our results, and shows an NPV of £170.8 million (2017 prices). This is greater than the NPV for the modelled scrappage scheme in the technical report (which is -£20mn as shown in the table below).

We would argue that the provision of mobility credits can complement the Government's actions on mitigating dangerous air pollution, and provides greater additionality than a scrappage scheme, and at a lower cost to the public purse.

	Mobility credits	***DEFRA scrappage scheme***
First year air quality improvement (t)	66.93	
Total reduction in NOx emissions (t)	1272	*400*
Welfare benefit	£242,731,941	*£120,000,000*
Health impact	£73,499,575	*£10,000,000*
GHG impact	£19,721,120	*£10,000,000*
Government cost	-£91,772,670	*-£110,000,000*

Welfare cost	-£73,418,136	*-£50,000,000*
Economic growth impact	N/A	*Small & positive*
NPV of policy	**£170,761,829**	***-£20,000,000***

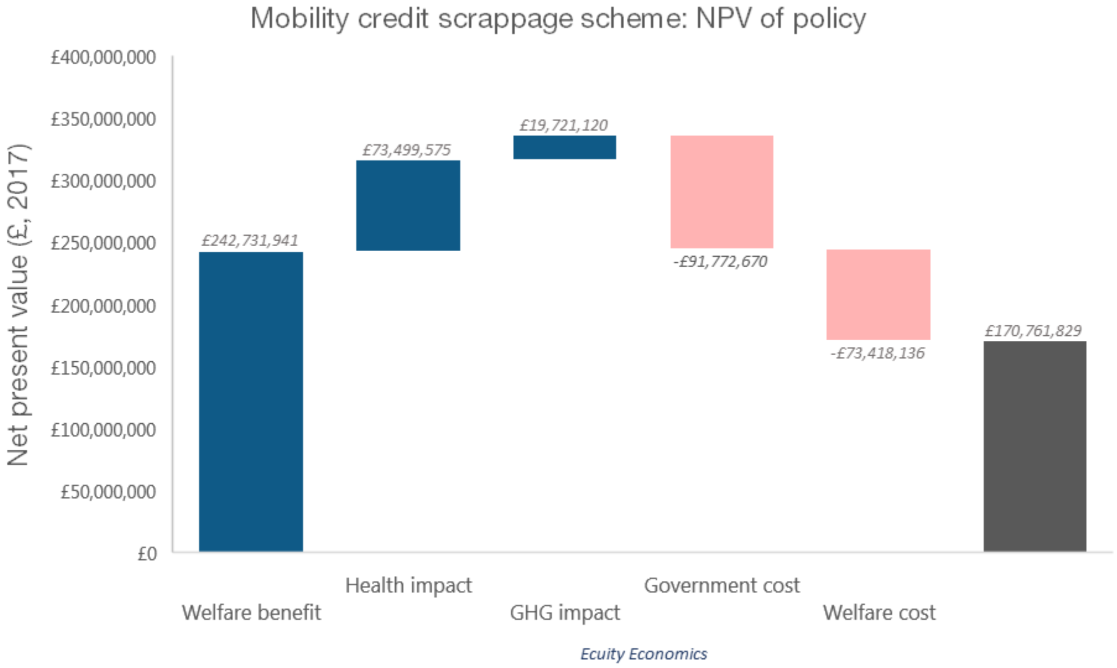

Figure 3 - NPV of the mobility credits policy (2017 prices)

Conclusion

The Government must act on dangerous levels of air pollution and NOx emissions. In this response, we have proposed a policy which lowers NOx emissions and delivers a net benefit to society, by targeting an area (old diesel cars) where the benefits of action are high, and the costs relatively low. A mobility credit scrappage scheme can lower emissions by promoting new travel behaviours in response to new mobility service offerings.

This policy would complement the Government's wider air quality action plan, a plan which should be a mixture of hard regulation and market incentives. It's important that this strategy promotes cleaner technologies, but must not do so without considering infrastructure and production constraints. The transition away from diesel must be orderly, to allow time for the development of clean technology infrastructure, and new product development. This consideration is especially pertinent for certain vehicle types (e.g. commercial vehicles) for which the alternatives are limited, and the impact on business and consumer prices, potentially large. **BVRLA is producing further analysis to consider the appropriate diesel phase-out rates for different vehicle markets. We would be happy to support DEFRA and share this work when the analysis is complete.**

Modelling assumptions, inputs and sources

Baseline scenario – 20,000 in year 1 and 40,000 from year 2 euro 1-5 diesel cars operating for 10 years. Travelling 7,800 miles per year.

Mobility credits scenario – 20,000 individuals in year 1 and 40,000 from year 2 using a mixture (see below) of public transport and car sharing schemes for 10 years. Travelling 7,800 miles per year.

Model parameters	***Baseline scenario***	***Mobility credits scenario***		Source
	Diesel car (a)	**'Shared' car** (b)	**Public transport** (c)	
Fuel Usage Assumptions				
Transport demand	7,800	4,190	3,610	(a) DfT (private car, GB) (b) CarPlus (c) Ecuity calculation
'Typical' vehicle composition	Euro 5 – 49% Euro 4 – 30% Euro 3 – 20% Class 1 & 2 – 1%	Petrol – 40% Petrol Hybrid – 40% BEV – 20%	Rail – 33% Bus – 33% Cycling/walking – 33%	(a) DfT (b) Ecuity assumption. 100% BEV uptake assumed by DEFRA for scrappage scheme. (c) Ecuity assumption.
Vehicle fuel consumption (mpg)	61.3	33.15	N/A	(a) Gov - Vehicle Certification Agency. Typical euro 1-5 (top 3 best-selling cars / year) (b) Vehicle Certification Agency. Modelled on 2017 best-selling vehicle in class. (c) N/A.
Emission Performance Assumptions				
NOx emission factor (g/mile/person)	0.52	0.006	0.197	(a) European Environment Agency (b) Vehicle Certification Agency. Modelled on 2017 best-selling vehicle in class. (c) NAEI data (bus) and Ecuity assumption using rail/bus N_20 emission factors from BEIS (rail).
GHG emission factor (g/mile/person)	203	84.94	70.36	(a) Gov - Vehicle Certification Agency. Typical euro 1-5 (top 3 best-selling cars / year) (b) Vehicle Certification Agency. Modelled on 2017 best-selling vehicle in class. (c) BEIS
Financial Inputs				
Running costs	107.3 p/litre	£0.11/mile	£0.11/mile	a) BEIS

					(b) Market data of £/minute typical cost (~£0.06) & assumed av. speed (~30mph). (c) Ecuity assumption based on newspaper article & adjusted for weighting.
	NOx damage cost (£/tNOx, 2017 prices)	£63,552			DEFRA – transport, inner conurbation. Adjusted to 2017 prices.
	GHG damage cost (£/tCO2e, 2017 prices)	£66.57			BEIS – 2019 non-traded cost of carbon. Adjusted to 2017 prices.
	Other Assumptions				
	Discount rate	3.5%			HM Treasury – Green Book
	Health impact uplift factor	2.0%			HM Treasury – Green Book