Investment Decision Pack

NGET A11.10 EV Fleet

December 2019

As a part of the NGET Business Plan Submission

nationalgrid

Justification Paper Non-Operational Property Capex EV Fleet Justification Report			
Asset Family	Fleet Vehicles		
Primary Investment Driver	Environment		
Reference	A11.10		
Output Asset Types	N/A		
Cost	£47.49		
Delivery Year(s)	2021-2026		
Reporting Table	D4.3a and D4.5 CAI		
Outputs included in T1 Business Plan	100% transition to EV fleet (where alternatives are available today, 2019)		
Spend Apportionment	**T1**	**T2**	**T3**
	£59.30	£47.49	Unknown

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Executive Summary

In line with our stakeholder desires, the CCC report and our ambition to accelerate a clean future, we want to transition to a 100% alternative fuel fleet by 2026. Due to operational requirements for 4x4 and HGVs, as well as our panel van vehicles, which are currently not available as a market alternatives today, this commitment translates in to a 60% replacement for electric vehicles. This paper outlines the detailed justification behind the expenditure of £47.49m to transition the ET operational fleet to 60% low carbon alternatives and to install and maintain the charging infrastructure which will enable it. This provides the societal benefit of a 40%-60% reduction in CO_2 emissions and a reduction in air pollutants, by 2026, estimated to give a societal benefit of £1.24m. This investment also provides benefit in to T3, with our estimated minimum greenhouse gas emission reduction at ~10,000tCO_2e with a saving of 250kg of air particulates and just under 4000kg of NOx over the same period, significantly contributing to cleaner air within cities.

Introduction

Britain is leading the way to becoming the world's first clean economy. In June, the UK became the first major economy to legislate for net-zero emissions by 2050. Transport is the largest single sector contributing to Britain's emissions, with surface transport accounting for 23% of 2018 greenhouse gas emissions *[source: CCC 2019 Parliamentary Report].* Transport is also a major contributor to poor air quality in many of our cities, which per the Royal College of Physicians, is responsible for 40,000 early deaths per year.

The need to rapidly decarbonise the transport sector is recognised. In the Government's 'Road to Zero' strategy, all new vans are to be zero tailpipe emissions from 2040. The Committee on Climate Change stated that this switch needs to happen even earlier – with no new petrol & diesel sales called for by ideally 2030, and 2035 at the latest – to meet legislated net-zero ambitions.

We as National Grid are in complete support of the net-zero commitment and seek to play our critical role enabling this transition to happen in the best way for consumers. This also includes making our own contribution and demonstrating leadership by reducing our own controllable emissions. Electricity Transmission stakeholders have consistently highlighted environment and sustainability as a key issue through our regulatory engagement programmes and the expectation of our stakeholders is that we account for the environmental impact of all our investment decisions and operations.

As Electricity Transmission has a significant van fleet of 836 commercial vehicles, decarbonising our fleet is important to reducing our environmental impact in line with our stakeholder priorities, as well as setting an example for other companies and wider UK society around the need to transition to achieve net-zero. Many other companies are making this move, including energy industry peers such as SSE, EDF and Centrica. This is increasingly achievable, with the costs of low emission alternatives, such as electric vehicles falling and more models coming to market.

Our ambition is to replace as many of our ICE vehicles with zero-emissions alternatives such as EVs where the cost-benefit analysis is justified and it is efficient for consumers. There is a proportion of our fleet however where zero-emissions alternatives are not yet available on the market. For 60% of Electricity Transmission's fleet, alternatives (EVs) are available on the market today. This 60% is composed of 33% small-panel vans, 25% medium-panel vans, 2% large-panel vans. For the remaining 40%, no alternatives are available on the market today. This 40% is composed: 26% 4x4 vehicles, 7% large <3.5 tonne drop-side/tippers, 4% Heavy Goods Vehicles between 4.6 tonnes and 16+ tonnes, 2% medium-panel vans with all-wheel-drive, and 1% large-panel vans with on-board power.

This composition of our fleet naturally limits our ability to predict when we'll be able to convert anywhere beyond 60% of our fleet. We do continue to engage with vehicle manufacturers and the wider industry to keep pace of developments, so that we can assess when it's efficient to convert further vehicles in line with our ambition to enable net-zero, and play our own part towards it too.

Electric Transmission's current vehicles replacement policy is 6 Years for LCV and 8 Years for HGV, due to none existent or very little discounts currently available on EV technology when compared to the mainstream discounts on offer for ICE technology we anticipate no payback on an EV fleet within our current replacement cycle and lower annual mileage when

compared against a logistics provider with higher annual mileage, however this may be mitigated by extending the EV asset life.

When considering converting our fleet to electric vehicle alternatives, it is important that the requisite charging infrastructure is available. The deployment of charging infrastructure across Britain will occur as EV uptake grows in the 2020s, and this infrastructure is likely to be spread across a range of locations e.g. home, work, destination, fleet, motorway. We will need to consider, for converting our own fleet, whether suitable charging infrastructure for our drivers to use will be deployed at the right location, speed and accessibility near our sites, or whether we need to provide charging infrastructure ourselves. This will be critical to enabling our vehicles to convert to EVs and reduce our environmental impact in line with stakeholder priorities. This paper explores costed options for vehicles, and makes a proposal, for [1] converting our commercial vehicles to zero-emissions alternatives, and [2] the charging infrastructure required to enable this conversion.

Vehicles

We are proposing converting 60% of our fleet, amounting to 499 vehicles, in the T2 time period, to electric vehicle (EV) alternatives, with the remaining 40% to remain as internal combustion engine (ICE) vehicles. This proposed 60% accounts for where models are currently available on the market. This proposition is also in line with reducing our environmental impact per our stakeholder priorities.

To deliver this and the charging infrastructure, we are requesting £47.49m in Totex (vs £59.30m in T1) over the course of T2 if we were to retain a 100% ICE fleet), which will also deliver significant environmental benefits with a reduction of 45%-60% in greenhouse gas emissions[1] and a reduction in air pollution of 60% (vs 100% ICE fleet). We therefore believe this Totex proposal efficiently delivers wider UK environmental value, whilst remaining efficient for consumers.

As the EV market continues to expand in the 2020s, we will naturally seek further opportunities to convert our remaining ICE vehicles, and ensure we're making the most efficient choices for consumers and the environment in our vehicle replacement year-on-year.

Charging Infrastructure

Suitable charging infrastructure is required so that our fleet can carry out its operational duties efficiently. Our ICE vehicle fleet is currently able to refuel at a wide range of petrol/diesel stations spread across the UK, whereas the development of electric vehicle charging infrastructure during the T2 timeframe and beyond remains uncertain – in terms of charging speed, location and access.

There are likely to be cases where local public charging is available, or drivers can charge at home, but there are also likely to be cases where this is not available, and thus at least some level of on-site (e.g. substation) charging is needed for our fleet to perform its operational duties. Battery range developments in the 2020s may also reduce charging requirements. Costs of on-site charging infrastructure have also been estimated through numerous surveys at our sites by a third party, but these may have some variability site-by-site and may evolve as infrastructure technology develops.

This is clearly an inherently uncertain space, but we do not want to be in a place where our vehicles are unable to perform their operational duties, so we will be requesting a price-control deliverable (PCD) for this in December's plan, with a size of £11.43m (£9.30m capex and £2.13m 5-year opex), based on cost estimates for charging infrastructure needed at 234 of our sites.

To ensure this is an efficient cost, we will work with the DNOs to ensure that there is no infrastructure duplication where it can be avoided. We will also build in learnings and savings from our trial of 30 small electric vans being conducted in 2019/20 and indeed as we take up further EVs during the T2 period, assuring that any costs borne by consumers on this aspect of reducing our own emissions are efficient. These costs have been included in the baseline for the December 2019 T2 submission.

[1] The is dependent on the energy used to charge the EV's, if we procure renewable energy for onsite charging then overall emissions from EV fleet would be zero.

Optioneering and Cost Benefit Analysis – Vehicles

Summary - Options considered:

1. Maintain a 100% ICE fleet and don't purchase EVs

2. Convert vehicles where an efficient alternative is available today i.e. 60%c

3. Lease EVs instead of purchase them outright (up to 60%)

We assessed the first two options on a total cost of ownership basis to ensure like-for-like comparison of the two options, and to determine the required Totex to fund the desired option. We also considered the environmental impact of these two options, to help guide this cost-benefit analysis in line with our stakeholder priority to reduce our environmental impact.

Options 3 has been discounted due the financing costs applicable to leasing vehicles via vehicle hire companies. The finance cost that they offer is more expensive than what National Grid can get on the corporate bond market, as we have a good credit rating (from rating agencies) which means our interest cost is low. Leasing vehicles would ignore that credit rating advantage and pay additional financing costs through a lease agreement. Therefore, leasing is not an efficient way to manage our fleet.

To summarise:

Option 1: Maintain ICE-only vehicles: £30.54m totex and £1.60 cumulative (5 year) environmental societal impact.

Option 2: Convert vehicles to 60%: £36.05m totex and £1.24 cumulative (5 year) environmental societal impact with £11.43m of vehicle charging infrastructure installation and maintenance costs.

Cost Benefit Analyses – Methodology used

A total cost of ownership basis was used in the cost benefit analysis, to enable a like-for-like comparison between ICE and EV options, and to determine the required Totex to fund each option. Both options laid out a replacement trajectory in each year of T2 to achieve the desired end-states (retain 100% ICE for option 1; 60% EVs for option 2), from which the vehicle purchase (capex) and ongoing vehicle costs (opex) were calculated, which together form the total cost of ownership of vehicles in that year. Summing this up across the 5 years of T2 achieves the T2 total Totex requirement for that option. In addition, to assess the environmental societal impact of our vehicles, we monetise the tailpipe emissions of our fleet in each year.

- Vehicle purchase of new vehicles (capex): The number of ICE vehicles and EVs purchased in that year, multiplied by the vehicle purchase price
- Ongoing vehicle costs of entire fleet (opex): the cost of running each vehicle owned within that year, which is divided into vehicle fuel, vehicle hire (hiring an alternative when our owned vehicle is in for repairs), vehicle maintenance and vehicle other costs. These costs are naturally different for ICE vehicles when compared to EVs
- Environmental benefit: the monetised value of emissions from vehicles in our fleet that year, looking at the NOx pollutant. With EVs having zero tailpipe emissions, but using the BEIS electricity data for EV vans.

Option 1: 0% EV & 100% ICE Costs

		2021/22	2022/23	2023/24	2024/25	2025/26	T2 total
EV	# bought	0	0	0	0	0	
	# cumulative	37	37	37	37	37	0
	Purchase cost		-	-	-	-	-
	Ongoing costs	-	-	-	-	-	-
ICE	# bought	115	74	25	150	280	644
	# cumulative	836	836	836	836	836	836
	Purchase cost	£3.75	£1.41	£0.76	£3.19	£4.93	**£14.04**
	Ongoing costs	£3.30	£3.30	£3.30	£3.30	£3.30	**£16.50**
	TOTAL	**£7.05**	**£4.71**	**£4.06**	**£6.49**	**£3.68**	**£30.54**

Throughout the course of T2, this will require £30.54m Totex for ICE vehicle purchasing and ongoing costs.

The environmental impact of this option is shown in the table below.

Environmental Impact	FY21/22	FY22/23	FY23/24	FY24/25	FY25/26	T2 Total
tonnes CO_2e	4,173	4,173	4,173	4,173	4,173	**20,864**
kg NOx	1,324	1,324	1,324	1,324	1,324	**6,620**
kg PM	83	83	83	83	83	**414**

The total societal cost of these environmental impacts, based on the non-traded price of carbon and air pollution damage costs (BEIS, 2019) are £1,602,544 over the T2 period. The cost to society in the final year of T2 is £330,145, with no improvement from the start of the T2 period.

Option 2: 60% EV & 40% ICE Costs

		2021/22	2022/23	2023/24	2024/25	2025/26	T2 total
EV	# bought	26	68	1	133	271	499
	# cumulative	63	131	132	265	536	536
	Purchase cost	£0.95	£2.40	£0.07	£4.49	£7.41	£15.32
	Ongoing costs	£0.18	£0.37	£0.37	£0.73	£1.47	£3.12
ICE	# bought	89	6	24	17	9	145
	# cumulative	773	705	704	571	301	301
	Purchase cost	£3.27	£0.17	£0.72	£0.79	£0.34	£5.29
	Ongoing costs	£3.08	£2.85	£2.85	£2.32	£1.22	£12.32
EV & ICE	**OPEX Only**	**£3.26**	**£3.22**	**£3.22**	**£3.05**	**£2.69**	**£15.44**
EV & ICE	**CAPEX Only**	**£4.22**	**£2.57**	**£0.79**	**£5.28**	**£7.75**	**£20.61**
EV & ICE	**TOTEX**	**£7.48**	**£5.79**	**£4.01**	**£8.33**	**£10.44**	**£36.05**

[1]: Note all EVs purchased are small panel vans (499 purchased), except in 2025/26 where 17 of the 104 vehicles bought account for all of ET's 17 large panel vans

Throughout the course of T2, this option will purchase 499 EVs to take the total to 536 EVs out of ET's 836 total vehicles, taking us to 60% EV. This will require a £36.05m Totex (EV and ICE purchasing & ongoing costs).

The environmental impact of this option is shown in the table below:

Environmental Impact	FY21/22	FY22/23	FY23/24	FY24/25	FY25/26	T2 Total
tonnes CO_2e	3,924	3,676	3,672	2,674	2,294	**16,240**
tonnes CO_2e renewable	3,842	3,511	3,506	2,176	1,670	**14,705**
kg Nox	1,219	1,114	1,112	691	530	**5,386**
kg PM	76	70	70	43	33	**337**

The total societal cost of these environmental impacts, based on the non-traded price of carbon and air pollution damage costs (BEIS, 2019) are either £1,236,219 or £1,122,892. The lower cost is based on charging of the vehicles on our own sites in which case we can procure renewable energy (making EV's emissions zero). The cost to society in the final year of T2 is significantly reduced compared to the beginning of T2, seeing a reduction of almost 40% over the period.

Comparing to option 1 the societal benefits from choosing option 2 would equate to up to almost £480,00 in environmental value to consumers. This is both from a reduction in greenhouse gas emission and reduction in air pollutants that are known to damage human health. The overall emissions reduction by 2026 for option 2 is between 45% - 60%. Once we have converted 60% of our fleet to EV we would aim to maintain this as a minimum, however as the market evolves in future we are likely to be able to convert even more of our fleet. One of the key benefits of making the transition to EVs in T2 is the environmental benefits achieved by 2026 will then continue in perpetuity. Therefore, our overall emissions reduction in T3 could be estimated at around 10,000tCO_2e with a saving of 250kg of particulates and just under 4000kg of NOx over the same period.

Assumptions in vehicle profile

Vehicle Purchase Costs:

Purchase costs are outlined below, full detail given in appendix 2.

- ICE: £16,000-16,500 for a small panel van vehicle, £19,500-20,500 for a medium panel van and £28,500 for a large panel van.
- EV: £25,000 for a small panel EV (based on Nissan Tekna 40kW)
    - £29,750 basic price + £55 first registration fee - £7,140 plug-in vehicle grant + £4,000 fit-out costs = £27,165
- EV: £71,000 for a large panel EV (of which ET has 17 in total, compared to 498 small/medium panel vans)
    - £62,000 purchase price (for an LDV EV80 56kW) with £9,000 vehicle conversion cost
- Assumes EV purchase price stays the same (which has potential to change with EV technology maturity)
- Assumes a £7,140 Plug-In Vehicle Grant (PIVG) remains in place (risk of removal)
- Assumes we replace all medium & small panel ICE vehicles with small panel EVs, in line with current fleet strategy

Ongoing vehicle costs:

This is broken down into four components: vehicle fuel, vehicle hire (hiring a vehicle temporarily when one's vehicle is in repairs/maintenance), vehicle maintenance & other vehicle costs.

- Vehicle fuel assumed 43% cheaper for an EV (£390/y) compared to an ICE vehicle (£1,368/y)
    - ICE: 12,000 miles per year assumed, which at 35MPG means 1300 litres of fuel consumed per year, at a cost of ~£1.06/l. Total fuel cost £1,368 per year, 12.2p/mile.
    - Total cost of ownership is 50p/mile for small panel van and 60p/mile for medium panel van
    - EV: 12,000 miles per year assumed. 15p/kWh electricity price (assuming a mix of charging used) is 3.1p/mile. Adding 25% contingency/error is 4.8p/mile. Total fuel cost therefore £576/y.
    - Total cost of ownership for EV small panel van is 52p/mile
- Vehicle hire assumed 10% more for an EV compared to an ICE vehicle
    - 10% is an assumption based on [1] EV technology is new and commercial know-how may be lower than for ICE vehicles, meaning vehicles spend longer off the road, and [2] whereas previously some repairs we could diagnose and fix ourselves, we may not yet know how to do this for EVs, meaning more garage visits hence hire
- Vehicle maintenance assumed to remain flat, as EVs need to be maintained less frequently, but when they do the costs may be slightly higher due to developing commercial know-how
- Vehicle other costs also to remain flat
- Road fund license has been removed from the opex for EVs

Note this ongoing cost also assumes that no penalties for use of ICE vehicles emerge over the course of T2 e.g. zero emissions zones within cities not rolled out (where any ICE vehicles that enter these zones would be subject to fees not accounted for in this CBA)

Optioneering – Charging Infrastructure

The EVs we are proposing to convert to in our vehicle proposal will need to charge, with suitable charging infrastructure required so that our fleet can carry out its operational duties efficiently. Our ICE vehicle fleet is currently able to refuel at a wide range of petrol/diesel stations spread across the UK, whereas the development of electric vehicle charging infrastructure during the T2 timeframe and beyond remains uncertain – in terms of charging speed, location and access. In the context of this uncertainty, there are three options we have for charging infrastructure:

1. Utilise public charging (e.g. at nearby motorways, supermarkets etc)

2. Home charging installed at our drivers' homes

3. On-site charging infrastructure provision

There are likely to be cases where options 1 and/or 2 are viable for some of our EVs. However, vehicle users may have no access to off-road parking, live in flats or rented accommodation, may need to drive longer distances than enabled by home-charging alone, and will leave a stranded National Grid asset at their home if they change role or company. Relying on option 1 alone is high risk, as public infrastructure (of appropriate speed, location & access) is currently uncertain, and may limit our operational fleet's ability to perform their required duties.

As such, relying on options 1 and 2 alone is unlikely to meet the entirety of our charging needs, therefore there is some requirement for on-site (e.g. substation) charging to enable our fleet to perform its operational duties – per option 3. As we cannot predict the extent to which options 1 and 2 will cover our needs, we will be requesting a Price Control Deliverable (PCD) in December's plan based on relying on option 3 alone. We outline the scale of this ask below.

To identify the amount of charging infrastructure needed, a survey of the number of charge-points needed per site was conducted across our 290 operational sites spread across the country, which yielded a need for a total of 1430 charge-points spread across 234 sites. This is less than 290 as some sites are very close to other National Grid sites and can use the same charging facilities, or are too small to accommodate many vehicles. We have also calculated that for every 6 sites, a fast (DC) charging unit would be required for the case where the teams have a multi-site meeting and need the ability to rapidly charge vehicles during that meeting. This number of charge-points ensures our teams (which carry out work across multiple sites) can access any given site and have sufficient charging infrastructure in place to carry out their duties.

The costs of charging infrastructure per site are also being estimated through numerous surveys at our sites by a third party. These costs may have variability site-by-site, as some sites may require longer cable runs, additional earthing etc., and these costs may also evolve as infrastructure technology develops.

From our London site surveys and supplier quotations to date we have derived the below average cost per charge-point. The key difference in our London sites however are that we have not needed to perform an LVAC earthing study and also, as a result we do not envisage that the LVAC boards require upgrading to accommodate the infrastructure. This is because of the existing adequate access to the required LVAC network in London. It is also possible that a larger overall distribution network, connection capacity is needed at a site where the LVAC supply is inadequate and therefore we have assumed that this is required at 10% of the sites, along with a standard LVAC upgrade. Looking at all these possible variables we have calculated an average charge-point unit cost of £6,500 as outlined below.

Charge-point – Item Description	**Charge-point Capex Unit Cost (£m)**
Capex hardware and labour for install per charge-point	£ 0.0050
DNO upgrade (10% or 23 of the sites @ £20k each)	£ 0.0005
LVAC upgrade (10% or 23 of the sites @ £30k each)	£ 0.0003

Earthing studies @ £2k per site	£ 0.0003
Cost for DC charge-points, 4 times the speed (£10k capex and £4k install - assumed for 1/6 of site numbers or 40 of 234 sites)	£ 0.0004
TOTAL capex/charge-point	**£ 0.0065**

As we are currently undertaking the trials in London to ascertain the exact cost and O&M model required to ensure that we have adequate operational access to all the required charge points to order to perform our duties. We have at present been quoted £38 per month per charge-point to allow for licence costs for the back-office software management platform, customer service, warranty, telecommunications, repairs and upgrades to be undertaken by a competent person.

Annual Opex Costs - Description	**Cost per charge-point (£m)**
Annual Opex O&M for 95% availability of each charge-point (@£38/charge point/month)	£ 0.0005

Charging Infrastructure – T2 costs (£m)	**21/22**	**22/23**	**23/24**	**24/25**	**25/26**	**TOTAL**
CAPEX - Installation	1.86	1.86	1.86	1.86	1.86	**£9.30**
OPEX – charging infrastructure maintenance, new charge-points (3rd party)	0.13	0.26	0.39	0.52	0.66	**£1.97**
OPEX - charging infrastructure maintenance, 74 legacy London charge-points (3rd party)	0.03	0.03	0.03	0.03	0.03	**£0.17**
OPEX TOTAL	0.17	0.30	0.42	0.55	0.69	**£2.13**
TOTEX	**2.03**	**2.16**	**2.28**	**2.42**	**2.55**	**£11.43**
# standard T2 installed charge-points	286	572	858	1144	1430	**1430**
The **opex** numbers transposed in to the business plan were phased incorrectly and the phasing appears in BPDT # D4.5 CAI as follows	0.38	0.42	0.55	0.50	0.28	**£2.13**

For 1430 standard (and 40 DC charge-points, spread over the cost of the standard charge points) at £6,500 (capex) each across 234 sites, the total capex in T2 is £9.30m, and for 1430 charge points, 5-year opex is £2.13m. This amounts to a Totex request for the outlined PCD of £11.43m taking in to account the £0.17m opex for the 74 legacy charge points which will have been installed in T1. We have not included provision for the additional 40DC charge points as we have assumed the cost can be absorbed within the contract for the 1430 standard charge points.

Note that these costs are drawn from several site surveys and supplier quotations. There is potential for the cost per site to be higher, if LVAC board upgrades are needed, or more major civil works are needed. There is also potential for the cost per site to be lower e.g. with limited civils, earthing and shorter cable run requirements. Regarding LVAC boards, the need and cost of upgrades will be considered site-by-site for existing substations when assessing the efficient option for charging infrastructure. For new substations, we're adapting our technical specifications to reflect & consider the implications of potential EV uptake, to minimise the need for future reinforcement.

Overall, any unspent funding against the outlined Price Control Deliverable will be returned to consumers as per our usual totex sharing mechanism, as suitable public charging near our sites emerges (option 1), home charging alternatives open up (option 2) and as we refine the costs of charging infrastructure. We will also build in learnings and savings from our 30 EV trial being conducted in 2019/20 and indeed as we take up further EVs during the T2 period, assuring that any costs borne by consumers on this aspect of reducing our own emissions are efficient.

Environmental and societal impact:

- The BEIS conversion factors 2019 have been used for all CO_2e calculations, taking average values from the freighting goods table, 0.40576kgCO_2e/mile for diesel and 0.10115k gCO_2e/mile for battery electric vehicle. This factor has been used for all years of T2. However, in reality the grid electricity carbon factor will decrease so the carbon emissions should fall.
- It is assumed for the Option 2 renewable data that fleet will be charged on our own sites with renewable energy therefore greenhouse gas emissions are taken as zero.
- The Governments non-traded price of carbon, central scenario, has been used to calculate the societal impact costs from expected greenhouse emissions. This increases from £70 to £75 over the T2 period.
- The Government damage costs for air pollution have been used calculate the societal impact costs from expected air pollution of NOx (£6/kg) and Particulates (£106/kg).
- The NOx and Particulate emissions from ICE vehicles has been estimated based on the assumption that all fleet will be Euro 6 standard. The emissions limits for euro 6 has then been used to estimate future emissions.

Risks and opportunities

- Charging infrastructure, and the best way of delivering this to users is not yet fully mature. There is a risk of charging/vehicle availability issues, see next section for further details –
    - *We will assume a requirement for on-site charging at all relevant sites and work with the DNOs to build an efficient network of vehicle charging infrastructure by avoiding duplication.*
- The types of electric vehicles available and the current mileage range means certain vehicles may not be suitable at more remote locations.
    - We will learn more through our imminent 30 vehicle trial in London
- Costs of technology are likely to drop therefore purchasing earlier may result in higher overall costs.
    - We consider this is a cost that is required to stimulate the market and provide cleaner air in built-up areas and given government grants may also be removed, purchasing earlier might save money in this respect.
- Emissions limits on new ICE vehicles may become stricter therefore the savings in air pollution or and greenhouse gas emissions may become lower than currently estimated
    - We believe electric vehicle are still the longer-term solution to meet net-zero.
- Our network is growing with an increased demand for clean energy connections; therefore, our fleet may need to grow.
    - This has not been considered in this report
- There is a high risk that the current government grant available for electric vehicles will be removed before 2021
    - We have included this benefit in our calculations – therefore our costs may increase in the future.
- There is a risk that the cost of Diesel will increase as usage decreases
    - We have not included any provision for this in our calculations

Opportunities

- Reductions in air pollution, especially in built up areas, will be beneficial for local communities and aligns to both government and local authority strategies around air quality improvement.
- Transitioning to a low carbon fleet will help the UK in its ambition to Net Zero, supporting the CCC's statement on transitioning from diesel in 2030.
- Fuel costs are lower and in future it is expected that EV's will achieve price parity with ICE, therefore there is a future (past T2) opportunity for cost savings for both National Grid and the end consumer.
- There is significant reputational value for National Grid to be seen leading on the transition to the low carbon economy, which converted significant proportions of our Fleet to EV's would achieve.

Conclusion

We have considered continuing with Diesel vehicles throughout the T2 period and although ~£5.60m additional investment is needed for the EV switch, plus £11.43m in charging infrastructure, this investment will achieve a ~50% reduction in GHG emissions and a ~60% reduction in air pollutants by 2026. This will then be the starting point for T3. The calculated societal benefit for improved air quality and climate mitigation is ~£0.5m, however there are additional unquantifiable benefits which include EV market stimulation, leadership and reputational advantage.

We also expect cost parity between ICE and Electric vehicles during the T3 period, once EV technology has further matured. We believe option 2, switching to 60% EVs (or other low carbon alternative) is the best option for wider society and progressing with our net-zero targets. The total cost for this investment is £47.49m over the 5 year T2 period.

Taking the annual mileage of 12,000 miles and the CO2/mile for diesels as 0.41kgCO2e/mile and an EV as 0.10kgCO2e/mile then there is a saving of 0.31kgCo2e/mile and over 12,000 miles for 6 years this works out as £11,137tCO2e for 499 exchanged vehicles. Taking the non-traded cost of carbon for the vehicle lifetime to be £73, this indicates a value of £812, 050 of the CO2e saved over the life of the vehicles. If we wanted to ensure this investment was cost neutral before proceeding, we would need the cost of carbon to be £1,535/tCO_2e.

Total Proposed Investment Costs

Total T2 vehicle and infrastructure cost request	21/22	22/23	23/24	24/25	25/26	TOTAL	BPDT Ref #
Capex - vehicle purchases	£4.10	£2.57	£0.71	£5.21	£8.02	**£20.61**	D4.3a Row 27
Opex - vehicle maintenance	£3.09	£3.09	£3.09	£3.09	£3.09	**£15.44**	D4.5 CAI Row 36
Capex - charging infrastructure install	£1.86	£1.86	£1.86	£1.86	£1.86	**£9.30**	D4.3a Row 29
Opex - charging infrastructure maintenance	£0.38	£0.42	£0.55	£0.50	£0.28	**£2.13**	D4.5 CAI Row 36
TOTAL	£9.43	£7.94	£6.21	£10.66	£13.25	**£47.49**	N/A

Appendix1: Breakdown of ongoing costs

Option 1: 0% EV & 100% ICE Costs

		2021/22	2022/23	2023/24	2024/25	2025/26	T2 total
	# bought	0	0	0	0	0	0
	# cumulative	0	0	0	0	0	0
	Ongoing costs	-	-	-	-	-	-
	Fuel costs	-	-	-	-	-	-
	Hire costs	-	-	-	-	-	-
	Maintenance	-	-	-	-	-	-
0% EV	Other costs	-	-	-	-	-	-
	# bought	115	74	25	150	280	644
	# cumulative	836	836	836	836	836	836
	Ongoing costs	£3.30	£3.30	£3.30	£3.30	£3.30	**£16.50**
	Fuel costs	£1.50	£1.50	£1.50	£1.50	£1.50	**£7.50**
	Hire costs	£0.18	£0.18	£0.18	£0.18	£0.18	**£0.90**
	Maintenance	£1.26	£1.26	£1.26	£1.26	£1.26	**£6.30**
100% ICE	Other costs	£0.36	£0.36	£0.36	£0.36	£0.36	**£1.80**
	TOTAL	**£6.60**	**£6.60**	**£6.60**	**£6.60**	**£6.60**	**£16.50**

Option 2: 60% EV & 40% ICE Costs

		2021/22	2022/23	2023/24	2024/25	2025/26	T2 total
	# bought	26	68	1	133	271	499
	# cumulative	63	131	132	265	536	536
	Fuel costs	£0.03	£0.07	£0.07	£0.13	£0.27	**£0.57**
	Hire costs	£0.02	£0.03	£0.03	£0.06	£0.12	**£0.26**
	Maintenance	£0.10	£0.21	£0.21	£0.42	£0.85	**£1.79**
	Other costs	£0.03	£0.06	£0.06	£0.12	£0.23	**£0.50**
60% EV	Ongoing costs	**£0.18**	**£0.37**	**£0.37**	**£0.73**	**£1.47**	**£3.12**
40% ICE	# bought	89	6	24	17	9	145
	# cumulative	773	705	704	571	301	301

	Fuel costs	£1.33	£1.26	£1.26	£1.02	£0.54	**£5.47**
	Hire costs	£0.19	£0.17	£0.17	£0.14	£0.07	**£0.74**
	Maintenance	£1.23	£1.12	£1.12	£0.91	£0.48	**£4.86**
	Other costs	£0.33	£0.30	£0.30	£0.25	£0.13	**£1.31**
	Ongoing costs	**£3.08**	**£2.85**	**£2.85**	**£2.32**	**£1.22**	**£12.38**
	TOTAL	**£3.26**	**£3.22**	**£3.22**	**£3.05**	**£2.69**	**£15.44**
This cost was transposed in flat profile - BPDT# D4.5 CAI		**£3.09**	**£3.09**	**£3.09**	**£3.09**	**£3.09**	**£15.44**

Appendix 2: Vehicle Types

Vehicle	Diesel	Electric
SPV Vehicle	Ford Connect 240 L2 FWD 1.5TDCi 100ps (EU6)	Nissan e-NV200 Tekna 40kW
MPV Vehicle	Transit Custom 300 L1 H1 FWD 2.0 TDCi 105ps	Nissan e-NV200 Tekna 40kW
PV Vehicle	Ford Transit 350 L2 H3 RWD 2.0 TDCI 170ps	LDV EV80 56kW