APPENDIX

Broxtowe Borough Council

TRANSITION TO BIODIESEL

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1. INTRODUCTION

The Council's Corporate Plan for the period 2020 to 2024 has an Environmental priority and states that "*the environment in Broxtowe will be protected and enhanced for future generations*". Stemming from this are three corporate environmental objectives one of which details the following: 'develop plans to reduce our carbon emissions to zero and start implementing them'.

The Council has made a commitment to become carbon neutral for its own operations by 31 December 2027. To achieve this, Climate Change Strategy and the Green Futures programme has been developed which aims to leverage the power of the whole organisation for the purpose of reducing the Council's carbon footprint.

The Green Futures programme consists of 15 project strands, one of which covers fuel. In 2020/21, the Council's emissions from transport fuel accounted for 26% of the Council's total own operation emissions. A total of 70% (566 tCO_2e) of emissions were generated by the Councils refuse collection vehicles.

1.1 Decarbonisation of the Fleet

As fleet emissions contribute significantly to the Council's overall Carbon footprint the Council needs to research and then implement actions that will decarbonise its fleet. There are two main ways to decarbonise the fleet, these are either by electrification or looking at alternative low emission fuels.

Whilst electrification may be the long term direction of travel currently this is prohibitive on two counts. Firstly, significant improvements in the infrastructure at Kimberley Depot would be required. Investigations have taken place with Western Power who have indicated that in order to electrify the fleet a new substation would need to be installed on site. Initial indications are that the cost for a new substation would be in excess of £110K. In addition, there would also need to be significant capital investment in infrastructure within the depot, which includes charging points, workshop equipment, as well as investment in employee training.

The second consideration is the capital cost of electric vehicles. Currently the transition to electric is not cost effective in terms of the pay back over the lifetime of the vehicle. The cost of a combustion engine refuse collection vehicle is currently in the region of £185K. The cost of the electric equivalent is in the region of £400/450K. This would total a capital investment requirement in the region of seven million pounds (this is based on current market prices). However, it is envisaged that prices will reduce as the electric vehicle market develops.

A transition to a fully electric fleet at this stage should be considered as a longer term strategic action. In addition, the use of hydrogen as a fuel source is still in its infancy and it may become a more viable longer term option.

An alternative option for decarbonising the fleet and one that can be actioned immediately, is to consider an alternative fuel which can provide a reduction in emissions. Whilst Hydrotreated Vegetable Oil (HVO) is more expensive than diesel, it

produces 98.6% less carbon emissions than diesel (based on BEIS conversion factors published in June 2021). It has the potential to be used in a significant number of the Council vehicles without the need for capital investment in the infrastructure. The use of HVO is therefore considered to be a viable option for the Council to reduce its CO_2 emissions relatively quickly and without the need for major capital investment.

1.2 What is HVO?

Hydrotreated Vegetable Oil (HVO) is a biodiesel which is an alternative fuel similar to conventional or 'fossil' diesel. HVO can be produced straight from vegetable oil, animal oil/fats, tallow and waste cooking oil. The largest possible source of suitable oil comes from oil crops such as rapeseed or soybean. In the UK rapeseed represents the greatest potential for HVO production.

Most HVO produced at present is produced from waste vegetable oil sourced from restaurants, chip shops, and industrial food producers. Oil straight from the agricultural industry represents the greatest potential source but it is not being produced commercially because the raw oil is too expensive. After the cost of converting the raw oil to HVO has been included in the process it is simply too expensive to compete with fossil diesel.

Waste vegetable oil on the other hand can often be sourced for free or sourced already treated for a small price (The waste oil must be treated before conversion to HVO to remove impurities). The result is that HVO produced from waste vegetable oil can compete with fossil diesel in terms of pricing.

2. CURRENT FUEL COST AND USAGE

As shown in Table 1 below there are currently three types of bulk fuel securely stored at Kimberley Depot.

Table 1: Fuel and quantities stored

Fuel	Litres stored on site	Vehicles used
DERV	23,000	All road going vehicles such as Refuse Collection Vehicles, Pick-ups and Vans.
Gas Oil (rebated red diesel)	3,600	All off road vehicles including mowers and secondary engines used in road sweepers (the use of Gas Oil in secondary engines will not be permitted from April 2022, at that point DERV will be used)
Petrol	3,600	Used in mowers and hand held equipment such as strimmer's, leaf blowers.

All of the above fuels are dispensed through electrical fuel pumps and managed through a fuel management system using vehicle ID fobs and driver identification PIN numbers. The system is audited on a regular basis.

At the time of writing this report the full year totals for the amount of fuel used in 2021/22 was not available. Therefore, the totals used in 2020/21 have been used as the baseline figure for calculating any costs associated with a transition to HVO. The amount of fuel used in 2021/22 will be comparable to the amounts used in 2020/21, so any associated costs will be relative.

The amounts of fuel used in 2020/21, together with the associated average cost, is shown in Table 2.

Table 2: Amount of fuel used in 2020/21 and the associated cost

Fuel	**Litres**	**Cost per litre**	**Cost**
DERV	303,908	£1.27	£385,963
Gas Oil (Red Diesel)	4,216	£0.59	£2,487
Petrol	10,210	£1.10	£11,231

The cost of HVO is currently around £15p per litre more expensive than DERV.

3. VEHICLES COMPATIBLE WITH HVO

The Council currently operates 18 Refuse Collection Vehicles all of which can operate effectively on HVO with no conversion requirements and very little difference in maintenance costs. Rushcliffe Borough Council are currently operating two Refuse Collection Vehicles on HVO through a trial programme and early results are proving positive with no issues.

The smaller vans and pick-ups within the fleet are only compatible with HVO where the year of manufacture is from 2019 onwards. This is due to manufacturers engine specifications and there are no retro fit conversion systems available. Out of a fleet of 51 vans and pick-ups, only 15 vehicles are currently compatible with HVO.

As shown in Table 3, out of a fleet of 83 combustion engine vehicles a total of 34 vehicles (41% of the fleet) would be suitable for the use of HVO. This figure will increase annually in line with the vehicle capital replacement programme.

Table 3: Vehicles compatible with HVO

Vehicles	Number in Fleet	Number Compatible with HVO
Refuse Collection Vehicles	18	18
Channel sweepers	2	0
Pavement Sweepers	2	1
Flat back Transits (pick up)	18	7
Transit Vans	33	8
Small vans	8	All electric. Reduced DERV consumption but will increase scope 2 emissions.
Tractors	2	0
Total number of vehicles	**83**	**34**

HVO works more effectively on the hotter engine operating vehicles and equipment. This technology is fitted on the newer vehicles which have Euro 6 specification engines. Most plant and equipment (operated in Grounds Maintenance) have Euro 4 or Euro 5 engines and are therefore not suitable for HVO at this time.

The differences in the engines relates to the legal emissions standards produced from the engine. Table 4 below shows the differences between the engines.

Table 4: Different engine types[1]

Engine Type	Description
Euro 6 implemented 2015	The sixth and current incarnation of the Euro emissions standard was introduced on most new registrations in September 2015. For diesels, the permitted level of NOx has been reduced from 0.18g/km in Euro 5 to 0.08g/km.

[1] https://www.rac.co.uk/drive/advice/emissions/euro-emissions-standards/

Engine Type	Description
	To meet the new targets, some carmakers have introduced Selective Catalytic Reduction (SCR), in which a liquid-reductant agent is injected through a catalyst into the exhaust of a diesel vehicle. A chemical reaction converts the nitrogen oxide into harmless water and nitrogen, which are expelled through the exhaust pipe. The alternative method of meeting Euro 6 standards is Exhaust Gas Recirculation (EGR). A portion of the exhaust gas is mixed with intake air to lower the burning temperature. The vehicle's ECU controls the EGR in accordance with the engine load or speed.
Euro 5 implemented 2011	Euro 5 saw the introduction of particulate filters (DPFs) for diesel vehicles, along with lower limits across the board. For type approvals from September 2011 and new cars from January 2013, diesel vehicles were subject to a new limit on particulate numbers. DPFs capture 99% of all particulate matter and are fitted to every new diesel car. Cars meeting Euro 5 standards emit the equivalent of one grain of sand per kilometre driven.
Euro 4 (implemented 2006)	Reduction on emissions

4. COSTS ASSOCIATED WITH TRANSITIONING TO HVO

As HVO is stored in line with DERV and Gas Oil regulations, the Council has the option to store and issue HVO using the current depot bulk fuel system at no additional cost to the fuel management system. However, due to some of the vans and pick up vehicles not being compatible with HVO the Council would still have to store DERV on site.

In order to accommodate HVO within the existing fuel storage structure changes would be required to the current set up. To operate the Councils fleet effectively on HVO, it is proposed that HVO is stored in the main DERV fuel tank (23,000) for use by the Refuse Collection Vehicles and compatible vans. A photograph showing the DERV tank is shown in **appendix 1.**

The current Gas Oil tank (Red Diesel) would be used to store DERV which will be used by none HVO compliant vehicles. A photograph showing Gas Oil storage is shown in **appendix 2**.

The removal of the Gas Oil storage facility from site would require current vehicles operating on Gas Oil to run on DERV. Operationally this would not be an issue as both fuels are the same with Gas Oil having a red dye to identify rebated fuel. However, there would be an associated cost due to the price difference between the two products.

New regulations came into force in April 2022 regarding the use of rebated fuel (Gas Oil) and fewer vehicles will be permitted to use it. The Council will still be able to continue to use the rebated fuel in mowing equipment as these operations are recognised under the horticultural derogation exemption. However, given the low amount of Gas Oil used, in comparative terms, any investment in terms of additional tanks, pumps and management equipment needed to continue to use Gas Oil is not considered cost effective. It is considered that the most appropriate option would be to cease the use of Gas Oil with all Grounds Maintenance equipment using DERV.

Table 5 below shows the amount of DERV used in 2020/21 by the vehicles which are compatible with converting to HVO.

Table 5: Litres of DERV used in 2020/21 by HVO compatible vehicles

Vehicles compatible with using HVO	Litres of DERV used in 2020/21
Refuse Collection Vehicles	222,296
Flat back Transits (pick up)	9,547
Transit Vans	7,273
Pavement Sweepers	1,326
Total	**240,442**

Whilst only 34 vehicles (41%) can operate on HVO these vehicles equate for 79% (240,442/303,908 litres x 100) of the overall total DERV used each year (based on 2020/21 figures). Based on the fuel and costs for 2020/21, the additional cost and CO_2 savings associated with a transition to HVO is shown in Tables 6 and 7 respectively.

Table 6: Cost associated with transitioning to HVO

Fuel	Litres used per annum	Average pence per litre difference	Additional cost per annum
HVO (instead of DERV)	240,442	+0.15p	£36,066
DERV (instead of Gas Oil)	4,216	+0.68p	£2,866
Total	**308,124**		**£38,952**

Based on 2020/21 figures the total additional cost of transitioning to HVO will be £38,952. It should be noted that this figure will increase each year as the vehicles are replaced through the capital programme.

Table 7: Potential CO_2 savings from transition to HVO based on 2020/21 fuel usage

Fuel Type	tCO_2e
Current fuel usage (DERV, Gas Oil and Petrol)	810
After transition to HVO (HVO, DERV and Petrol)	204
Saving per annum	606 (74.8%)

Based on the amount of fuel used in 2020/21 transitioning to HVO would result in 204 tCO_2e being produced. This equates to a 74.8% reduction in carbon emissions from the Councils fleet.

4.1 Sourcing HVO

HVO can be purchased through the existing ESPO Certas Fuels framework agreement for fuels, currently used by the Nottinghamshire consortium. The framework runs until 30 September 2022 and will be renewed at that point by the Nottingham consortium. This ensures a sustainable supply of HVO.

4.2 Risk

The main risks associated with the use of HVO are shown in the Table 8 below together with their mitigation

Table 8: Risk associated with transition to HVO

Risk	Mitigation
Price of HVO Price increases	Request for revision of budgets
Supply of HVO is restricted	DERV and HVO can be mixed so vehicles

Risk	Mitigation
	can revert to using DERV
Causes maintenance issues within the vehicle	Revert back to using DERV

5. MODELLING TO SHOW IMPACT OF HVO USAGE ON THE COUNCILS TOTAL tCO_2e

Given the significant impact and positive contribution to reducing the Council's emissions a transition to HVO is both economically and environmentally viable. Figures 1 and 2 below shows the effect that transitioning to HVO would have on reducing the Council's overall carbon emissions. The data is based on the figures from 2020/21.

Figure 1: tCO_2e for 2020/21

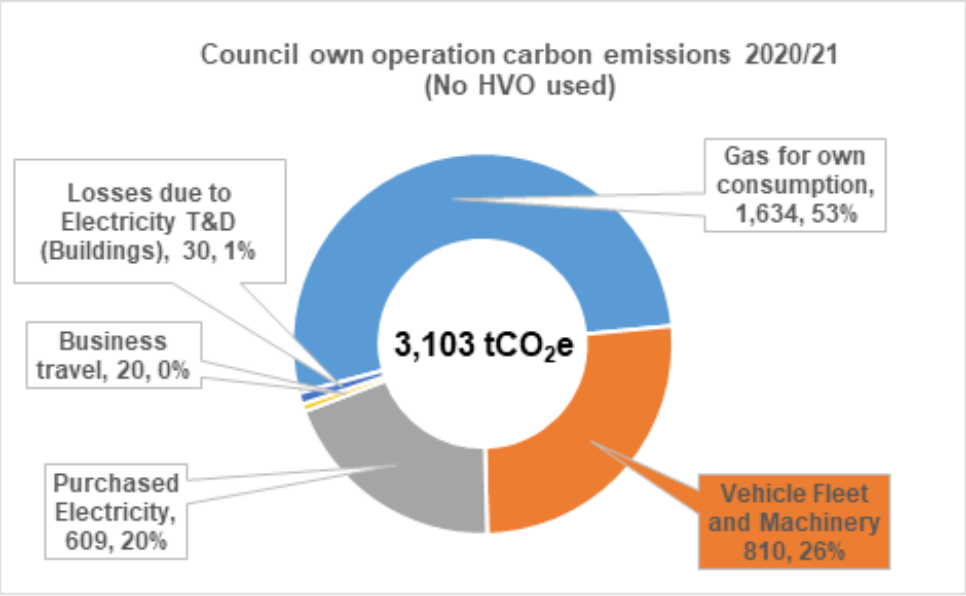
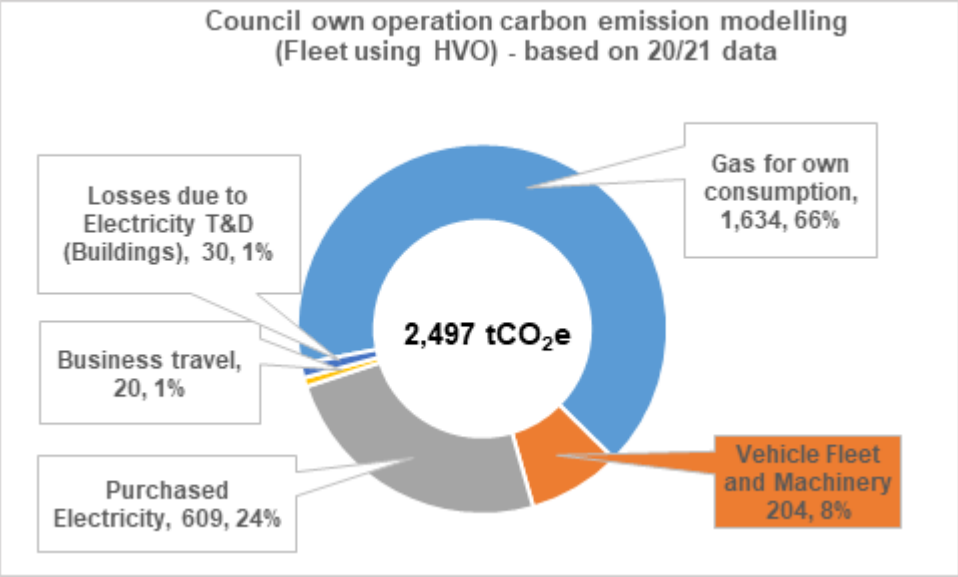


Figure 2: Projected tCO_2e based on transitioning to HVO



As is shown in figures 1 and 2 a transition to HVO at a cost of £38,952 is projected to reduce the Councils carbon emissions by 606 tCO_2e. This equates to a 19.6% reduction in the total Council carbon emissions. Such a transition would set the tone and move the Council in the right direction of travel to becoming carbon neutral by 2027.

Appendix 1

Photograph of DERV storage

Appendix 2

Photograph of Gas Oil Storage