CHICHESTER CITY COUNCIL

REPORT OF THE PROPERTY MANAGER

PROPERTY WORKING GROUP MEETING – 8th NOVEMBER 2021

COUNCIL HOUSE

a) **Carbon Neutral Strategy** – a presentation of the 'Carbon Roadmap' **(APPENDIX A)** document will be made to members by Andrew Towch of Save Money Cut Carbon, followed by a brief Q&A session.
The 'Roadmap' report highlights the current difficulty in replacing the existing boilers with a truly green alternative, due to limitations in technology. All the currently available options have significant negative implications, as well as high installation costs. In the short-to-medium term, our focus should be on efficiency and insulation improvements, such as those provided by the heating control upgrade reported on below (item b). An electric van to reduce the use of the diesel truck (see final item below) will be a useful measure in cutting emissions, and a wind turbine at St James Maintenance Compound, to supplement the existing solar PV installation, would be an excellent source of renewable energy for recharging our battery-powered maintenance tools and equipment.

b) **Heating Controls Upgrade** – Saunders Specialised Services has undertaken the agreed works to upgrade the control of the heating and ventilation system. During the works it was discovered that essential safety equipment was missing from the system, such as a gas shut-off valve in the basement linked to the fire alarm, emergency stop button in the boiler room and heat sensors above each boiler. This safety critical work has been instructed (following consultation with Town Clerk, Finance Manager and Chairman of Finance), at the cost of £2788. Additionally, the air handling unit heating pump was found to be inoperative and needs replacing at the cost of £1340. This work will be completed w/c 8th November. Some further efficiency modifications are possible and will be reported on in due course.

c) **Council Chamber** – Archibald Shaw is currently tendering for trial holes to be dug in front of the portico to enable detailed inspection of the foundations.

d) **Damp in Town Clerk's office** – rising damp has become manifest in the Town Clerk's office, on the Lion Street outside wall and the north elevation internal wall. DB Damp Proofing Services will be undertaking remedial works as soon as Listed Building Consent can be obtained. They will remove the plaster on the affected walls up to the height of 1 metre and insert a waterproof membrane prior to replastering and decorating. This will cost £1670 and be funded from the Council House Reserve.

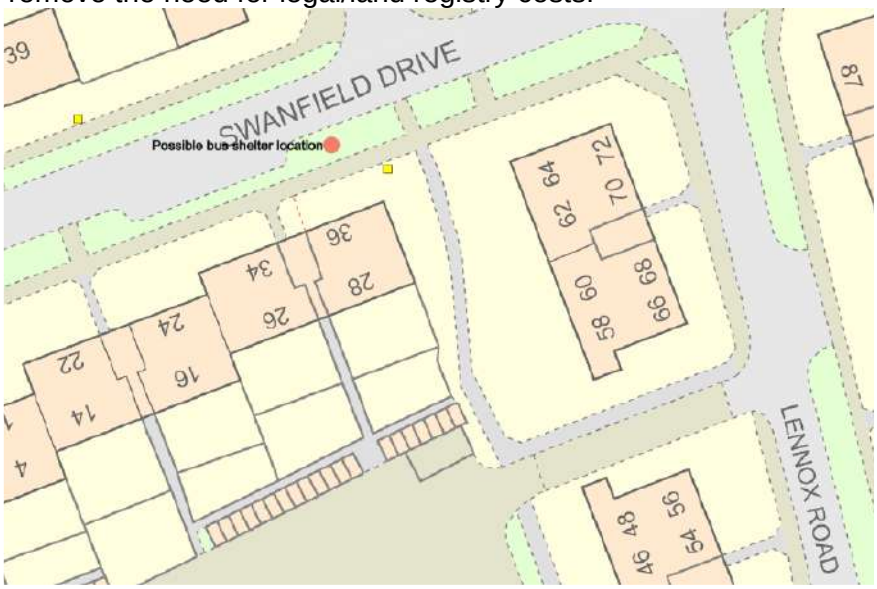
ALLOTMENTS

Update – There are currently 265 people on the waiting list and no vacant plots. Durnford Close allotments have now reverted to Hyde Martlett control, following cessation of the lease on 31st October. The water supply has been turned off and the reading passed to the supplier. Hyde Martlett will now take over the water supply.

BUS STOPS/SHELTERS

Swanfield Drive – confirmation is awaited from CDC and A2 Dominion that the necessary land will be made available for the shelter to be installed. However, the Property Manager has investigated the possibility of placing the shelter further along Swanfield Drive. WSCC

Highways has placed a consultation notice at that bus stop (see location map below) and feedback is awaited as to whether a license will be granted. This location would be a better option and remove the need for legal/land registry costs.



PUBLIC REALM PROJECTS

a) **Wayfinding (finger posts)** – all fingers are now in place, correctly aligned and finials in place.

b) **Precinct Paving** – WSCC are looking into low-cost surfacing options, at the very least as a short to mid-term health & safety intervention whilst a more heritage appropriate solution can be specified and funds (which will be considerable) raised. If a tarmac option is utilised, a sustainable recycled plastic additive product such as MacRebur MR6 could be used to replace part of the virgin bitumen content in the asphalt mix. (see **APPENDIX B** for product details) The manufacturer claims that, for each 1kg of MacRebur product used, 1kg of fossil fuels is saved from extraction, 1kg of waste plastic is saved from incineration or landfill (which is the equivalent weight to 200 single use plastic grocery bags) and up to 3.77kg of CO2e is saved from the project, so on a typical 1000m2 project, 1,440kg of product is used and 5,428kg of CO2e is reduced. This is achieved without increasing the cost over that of traditional tarmacadam.

c) **Lidl to Story Road footpath link** – The Property Manager met with the WSCC's Principal Rights of Way Officer on 1st November to inspect the course of the footpath and discuss the options for improvement. Following that meeting, the WSCC Officer provided the following comments by email;
"*In terms of the public status of the section between the footpath and the Lidl site this is challenging as the section is unregistered so we have no landowner to approach for a dedication as a public footpath which would usually be the mechanism for which a route could gain public status. There is however a legal mechanism under s.26 of the Highways Act that allows an Order to be made proposing public status on land where the owner is not known. Having said this any Order made will be open to public consultation and objection and if objected to the Order would need to be submitted to the Planning Inspectorate for determination. There is no guarantee that any Order would be confirmed and if it is submitted to the Planning Inspectorate for determination the Order making Authority would be expected to cover all the costs of this which can mount up and become expensive. Another issue with getting public status on the link between the footpath and the Lidl site is how far that status runs because to add a new PROW it would require continuity from one highway to another, therefore simply adding the unregistered section as a public access route would not be sufficient. Any new route would need to run across the Lidl site to another route carrying public status of some sort. As far as I am aware the section on the Lidl site is not a PROW or public highway so this would need to be considered carefully as well.*

Further to this we discussed the planning obligations linked to the Graylingwell site. There is a long-term plan to create a cycle route alongside Westhampnett Road which this route would form part of and my personal view is to try to resolve this issue at this time so it can all be done together. If the route were to be a shared footway/cycleway then it may be a case that this route would become publicly maintainable highway and fall under Highways remit rather than PROW however at this time it is too early to say whether this would happen or not."

The Property Manager recommends that this matter remains firmly in the hands of WSCC PROW and Highways teams, with the hope that this section of footpath will be upgraded as parted of a larger cycle route scheme. In the meantime, we could use the City Council's General Power of Competence to lay some additional Type 1 MOT material to provide a reasonably level and firm surface. A temporary path closure order from the PROW team would be required, for public safety reasons, whilst this work was ongoing. The Principal Rights of Way Officer advised that the usual fee would be waived if the City Council chose to carry out this work. The cost of material would be approximately £200, and our maintenance team could undertake the work for a staff cost of approximately £360.

WEST STREET MEMORIAL GARDEN

The Landlord has confirmed, via Marstons, that he is willing in principle to assign the garden and war memorial to Chichester City Council, subject to all legal and land registry costs being met by CCC. The Property Manager has confirmed acceptance of these terms in principle and negotiations are ongoing.

BOARD OF TOWN CLERKS

A quote of £275.00 has been obtained from Acorn Joinery for a wooden board (1800 x 750mm) similar in design to the existing Mayoral Roll board in the Assembly Room anteroom. Derek Pennicott has quoted £350 to paint the board and apply the following gilded lettering;

Clerks of Chichester City Council

William Rowse	*1685*
William Baldwyne	*1688*
James Vavasor	*1709*
Henry Aylward	*1710*
John Dear	*1743*
George Stamper	*1759*
Edward Johnson	*1762*
William Johnson	*1807*
John Price	*1812*
James Powell	*1836*
Edward Arnold	*1869*
J. Loader Cooper	*1899*
Eric Banks	*1936*
Geoffrey Heather	*1965*
Eric Banks	*1974*
Clive Stremes	*1981*
Ian Wilson	*1982*
Fernley Maker	*1983*
Edward Saunders	*1990*
Rodney Duggua	*1998*

ELECTRIC VAN

The sum of £15,000 has been identified from CIL receipts to purchase an electric van. The Property Manager is actively looking for a suitable vehicle with a serviceable battery, similar to those shown below, within that budgetary sum.

Peter Roberts
Property Manager

Appendix A

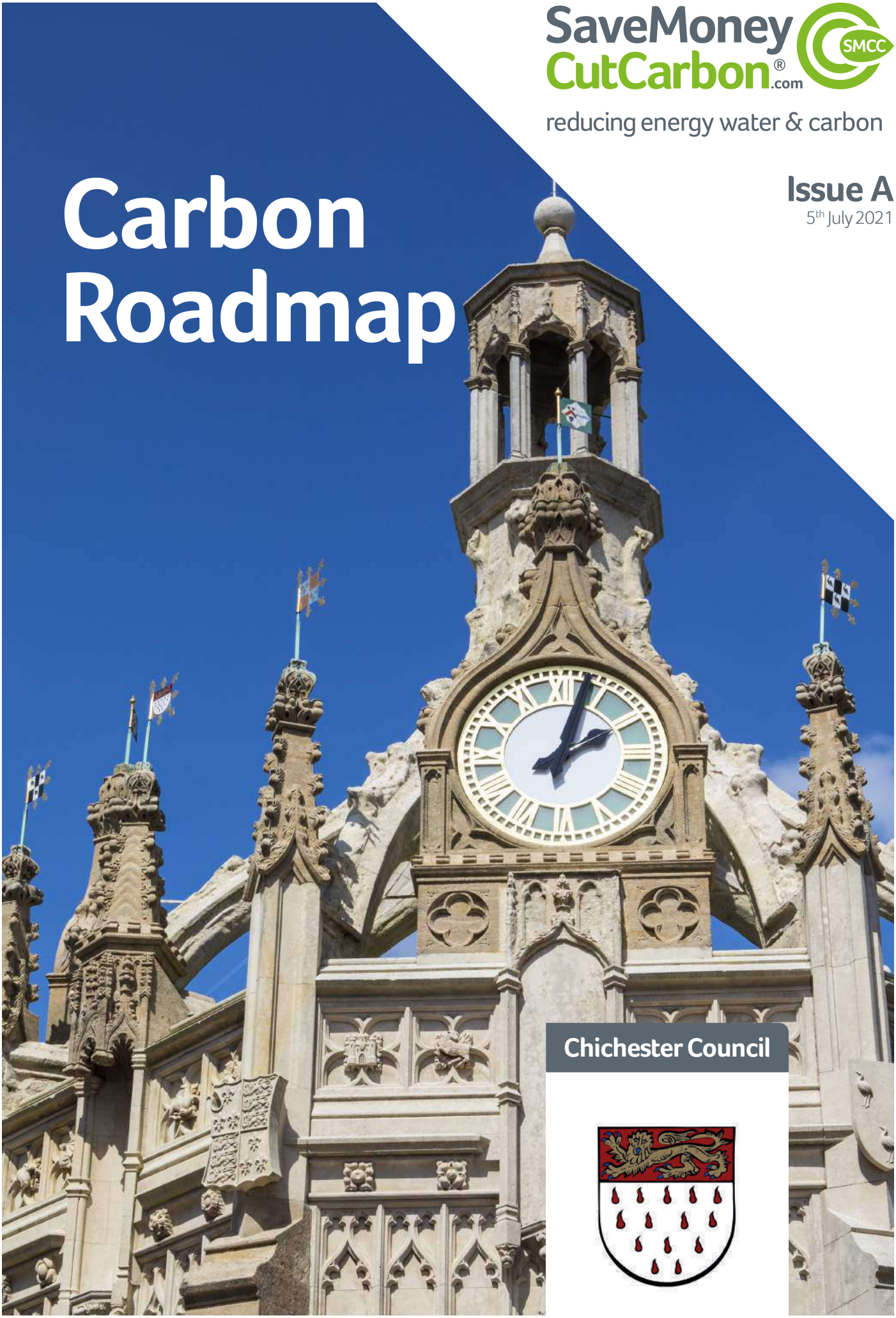
SaveMoney CutCarbon® .com SMCC

reducing energy water & carbon

Carbon Roadmap

Issue A

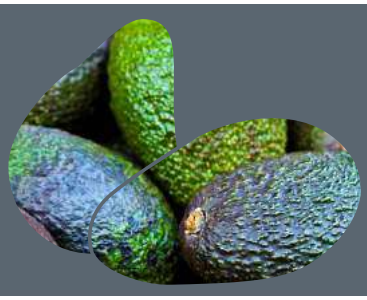
5th July 2021



Chichester Council

The bigger picture

"2000 litres of water is needed to produce 1kg of avocados."



"Human-generated CO_2 accounts for 76% of all greenhouse gas emissions."

"2.1 billion tonnes of waste is generated globally each year. If all this waste was put on lorries, they would go around the world 24 times."

"One football pitch of rainforest is lost every minute."

"By 2025 the ocean is expected to contain 1 tonne of plastic for every 3 tonnes of fish."

UK Fact & Figures

- **UK's 1.8m** non domestic buildings produce almost 17% of the nation's carbon dioxide emissions.

- **UK legislation** drive to achieve net zero carbon emissions by 2035 / 2050 - as much as 18% or £157b of commercial real estate in England and Wales does not meet the minimum standards.

- **Penalty for renting** a property for a period of fewer than three months in breach of the MEES regulations is now equivalent to 10% of the property's rateable value.

- **Government estimates** 18% of commercial properties hold the lowest EPC rating of F or G. Around 230 councils have declared a climate emergency.

- **90%** of S&P 500 Index Companies now publish their sustainability credentials.

Looking at your Emissions

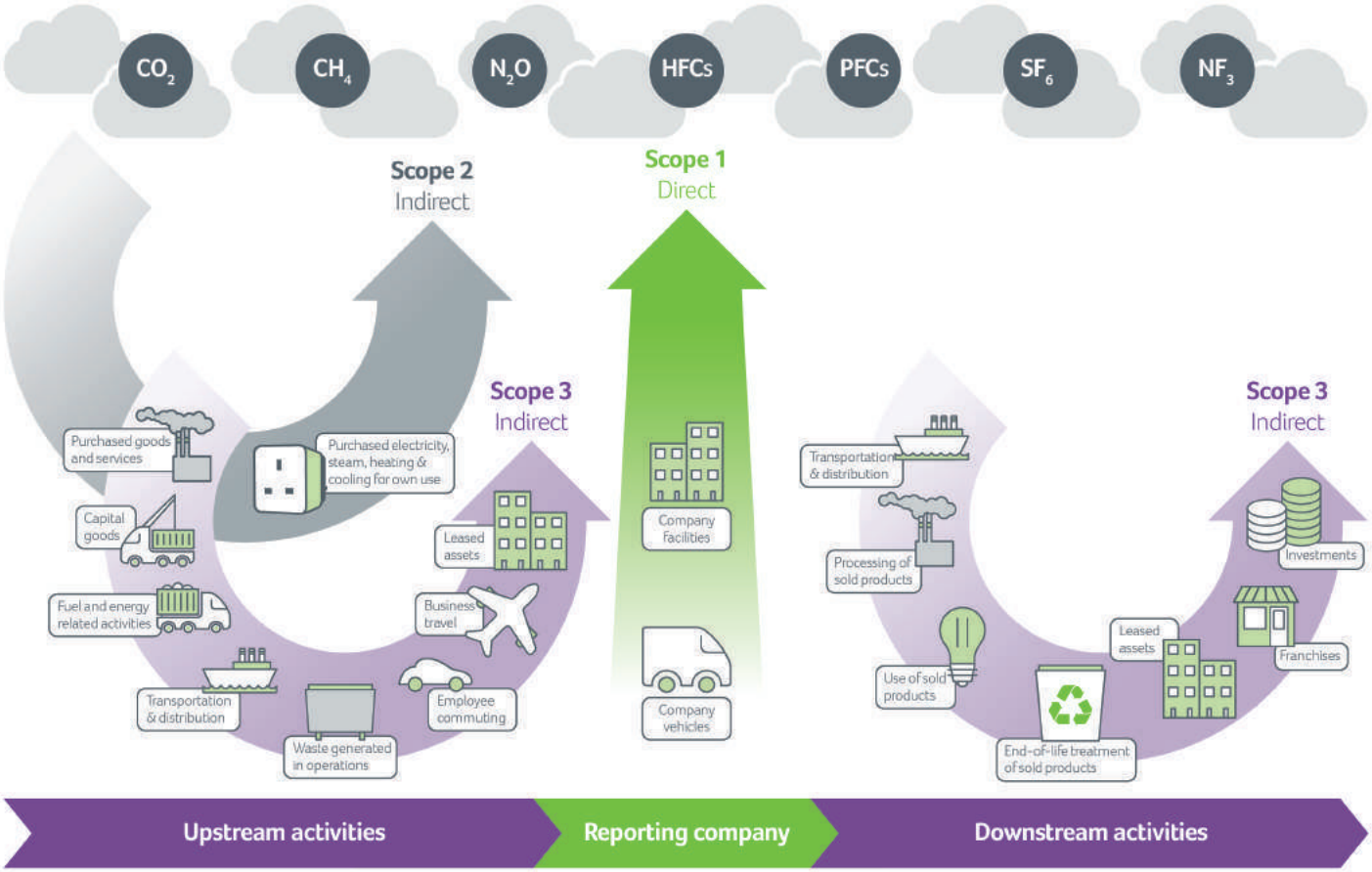


Image source: https://compareyourfootprint.com/difference-scope-1-2-3-emissions/

When reviewing this road map we must consider the difference between scope 1, 2 and 3 emissions

Emissions are broken down into three categories by the Greenhouse Gas Protocol in order to better understand the source.

- **Scope 1 –** All Direct Emissions from the activities of an organisation or under their control. Including fuel combustion on site such as gas boilers, fleet vehicles and air-conditioning leaks.

- **Scope 2 –** Indirect Emissions from electricity purchased and used by the organisation. Emissions are created during the production of the energy and eventually used by the organisation.

- **Scope 3 –** All Other Indirect Emissions from activities of the organisation, occuring from sources that they do not own or control. These are usually the greatest share of the carbon footprint, covering emissions associated with business travel, procurement, waste and water.

  - Purchased goods and service
  - Capital goods
  - Fuel and energy related activities not included in Scope 1 or 2
  - Upstream transportation and distribution
  - Waste generated in operations
  - Business travel
  - Employee commuting
  - Upstream leased assets
  - Downstream transportation and distribution
  - Processing of sold products
  - Use of sold products
  - End-of-life of sold products
  - Downstream leased assets
  - Franchises
  - Investments

Greenhouse Gas Reporting

The Greenhouse Gas (GHG) Protocol defines three categories for the reporting of emissions, these are referred as Scope 1, 2 and 3.

The GHG that are included in the reporting protocol are:
CO_2 – Carbon Dioxide
CH_4 – Methane
N_2O – Nitrous Oxide
HFCs - Hydrofluorocarbons
PFCs – Perfluorocarbons
SF_6 – Sulphur hexafluoride
NF_3 – Nitrogen trifluoride

For reporting, these gases are converted, based upon their Greenhouse Warming Potential (GWP) to a CO_2 equivalence.

For Chichester City Council the emissions assessed, by GHG Scope, were:

		Scope 1	Scope 2	Scope 3
	Location	T CO_2e	T CO_2e	T CO_2e
Electricity	Council House		9.1	See Note 1
Natural Gas		22.1		
Street Lights	Town wide		1.8	
Vehicle		2.7		
Total		**24.8**	**10.9**	

Note 1 – The emissions associated with Scope 3, and the GHG other than CO_2 have not yet been calculated.

Chichester City Council Objective

Although a formal target has not yet been established the council is looking to commit to delivering the Government's objective of being carbon neutral by 2050. This report reviews the CO2 emission baseline for the councils operations and the current technological options that can be considered in the roadmap to achieving this target.

Contents

1. Summary

A number of options have been considered in order for Chichester Council to achieve a Net Zero option for their CO_2 emissions without resorting to offsetting schemes.

The following is a Marginal Abatement Cost (MAC) Curve for the options and schemes identified. This shows the estimated 10yr NPV cost per Tonne of CO_2 saved verses the potential annual CO_2 savings. This has been calculated using:

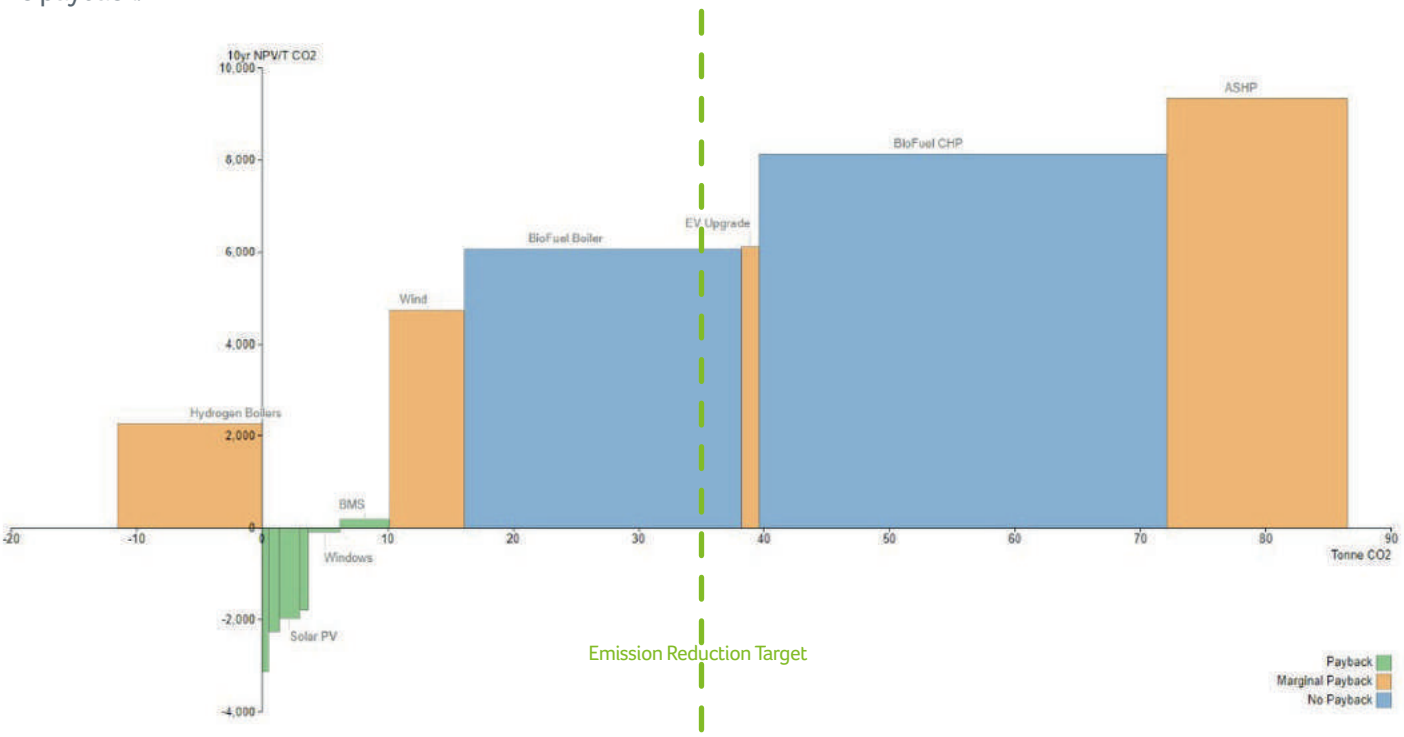
- The indicative Capital cost of the scheme.
- The annual energy saving or cost increase.
- Annual discount rate of 5%.
- Annual energy inflation of 2%.

The Y-Axis is the cost, based upon the 10yr NPV for the specific option, of 1 Tonne of CO_2 saved. Along the X-axis the length of the block indicates the annual amount of CO_2 that could be potentially saved.

Hence, Solar PV over the 10-year period would create an NPV saving of £2,294 per T CO_2 saved, but only deliver 1.6 T CO_2 saving per year. At the other end of the scale replacing the heating with an ASHP system would lead to NPV cost of £8,906 per T CO_2 saved and deliver 14.4 T CO_2 saving per year.

The colour signifies if the scheme has a potential payback, i.e., the operating fuel cost is less than the system replaced or there is no payback and the operating cost is greater. The calculated paybacks are detailed in section 3.

Of these schemes, the Solar PV has a payback within the 10-year period, Wind Turbine and ASHP have a payback but this is potentially beyond the expected life of the unit, or accepted economic viability, and for the other two options there is no payback.



To achieve a zero CO_2 position it is estimated, based upon the current published CO_2 emission factors, that 35.7 Tonnes per year would need to be avoided.

The following table summarises the data presented in the chart above.

Scheme	Payback, Years	Annual CO_2 Saving	10yr NPV	£/T CO_2
Hydrogen Boiler replacement of boilers	>20	-11.5	£26,075	-2,267
Street Light lamps upgraded LED	3.3	0.5	-£1,562	-2,973
Hand Dryers upgrade in Council House	4.8	0.9	-£2,033	-2,298
Solar PV additional panels	8.6	1.6	-£3,156	-1,965
LED Lighting upgrade in Council House	5.5	0.7	-£1,251	-1,858
Improved draft sealing of the Sash windows	7.9	2.5	-£245	-99
Improved zonal heating control	9.4	4.0	£751	189
Wind Turbine	17.6	5.9	£27,911	4,748
Biofuel Boiler replacement of boilers	No Payback	22.1	£134,162	6,066
EV replacement of Transit tipper	>20	1.4	£8,564	6,094
Biofuel CHP replacement of boilers	No Payback	32.5	£264,387	8,127
ASHP replacement of boilers	>20	14.4	£134,584	9,327

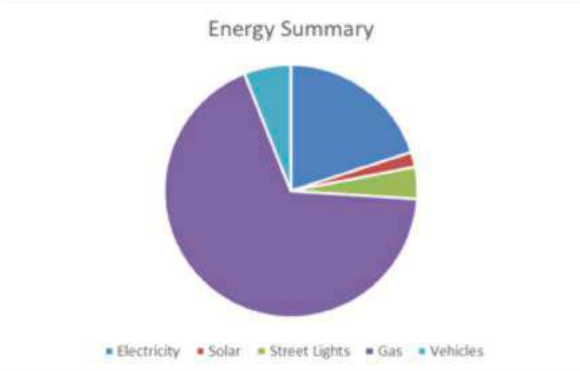
If a renewably generated supply of hydrogen was commercially available, and the storage options could be addressed, this could form a key component of the Chichester Council's strategy of moving to a Net Zero emission position.

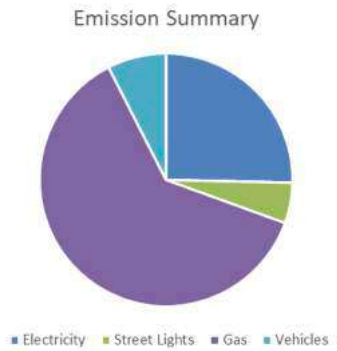
However, based upon currently available technologies the replacement of the boilers with a Bio Fuel alternative is the best economical option and would equate, in conjunction with the other measures highlighted, to a 10yr NPV abatement cost in the order of £4,050 per Tonne of CO_2 avoided.

2. Consumption Review

2.1.1 Energy and Carbon Summary

Due to the exceptional nature of 2020 and 2021, for this exercise, 2019 has been assumed to be a typical year and has been used as the baseline year. The following charts summarise the energy and emission breakdown for the baseline year.





		Energy		Emissions	
	Location	kWh	Proportion	T CO_2	Proportion
Electricity	Council House	35,434	20%	9.1	25%
Natural Gas		120,295	68%	22.1	62%
Solar PV		3,373	2%	0.0	0%
Street Lights	Town wide	7,223	4%	1.8	5%
Vehicle		10,615	6%	2.7	8%
Total		**176,940**		**35.7**	

2.1.2 Emission Factor

The following are the CO_2 emission factors used in this assessment. As can be seen there has been a marked reduction in the Grid electricity factor over the period covered due to the increase in available renewable and Low and Zero carbon generation such as Wind Turbines, Solar Farms and Nuclear balanced by the reduction in operation of the coal fired power stations.

		Reporting Year			
		2018	2019	2020	2021
Natural Gas	$kgCO_2$ per kWh (Gross)	0.18396	0.18385	0.18387	0.18316
Electricity	$kgCO_2$ per kWh	0.28307	0.25560	0.23314	0.21233
Diesel	$kgCO_2$ per kWh (Gross)	0.25296	0.25267	0.25278	0.25338
Vehicle, Class III (1.74 to 3.5 Tonnes)	$kgCO_2$ per mile	0.44243	0.44703	0.43727	0.42695

2.1.2 Electricity

The following chart provides a summary of the electricity consumption for the baseline year. The total consumption was 46,030 kWh of which locally generated renewable energy accounted for just over 7%.

2.1.3.1 The Council House

The following is the energy and carbon profile from August 2017 to April 2021 for the Council House, the 2020 and 2021 are assumed to be exceptions as these reflect the reduced consumption during the Coronavirus lockdown.

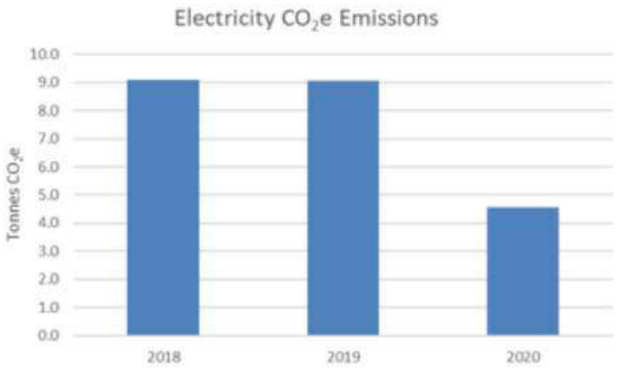
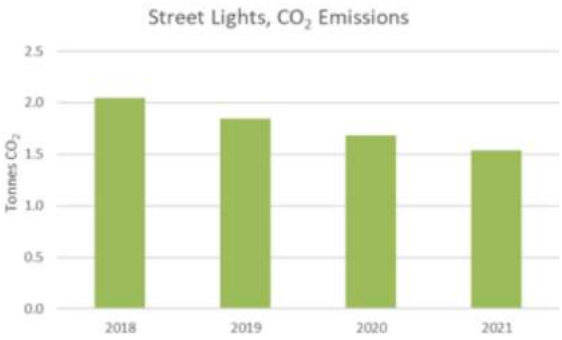


Chart 1 – Total Electrical Demand

2.1.3.2 Street lighting

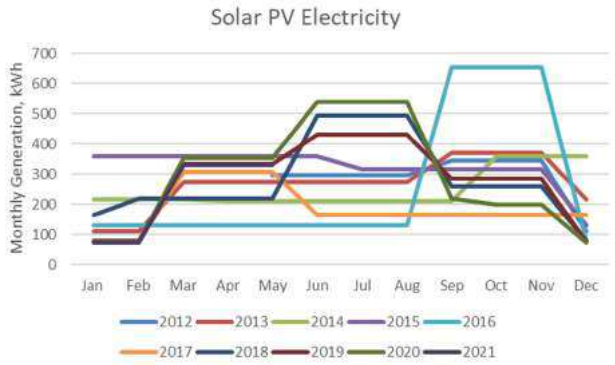
The power for the street lights is not metered but the following is the estimated annual consumption and emissions based upon the lamp rating and the operating hours. The reducing emissions reflects the changes in the grid electricity emission factor rather than improvements in the energy consumption.

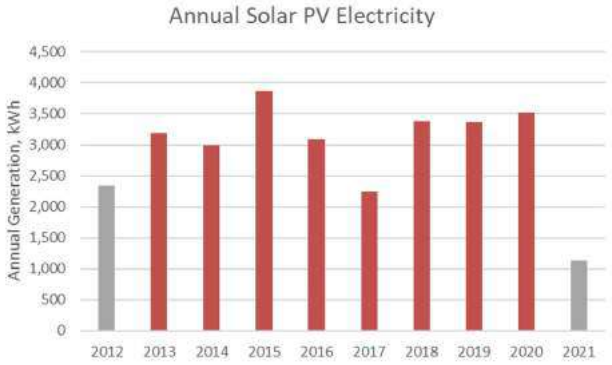
It is estimated that the **annual consumption is 7,223 kWh**



2.1.3.3 Solar PV

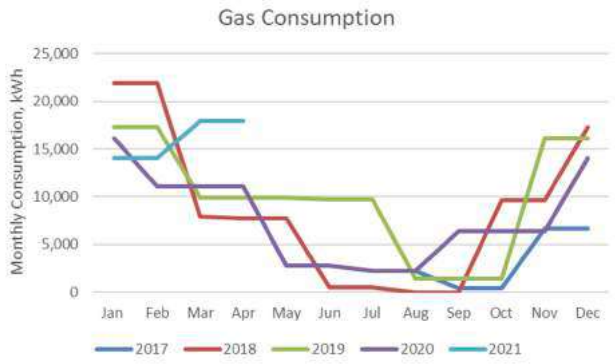
The following is a graphic representation of the available generation data for the Solar PV array, located on the Council House, for the period of May 2012 to May 2021.

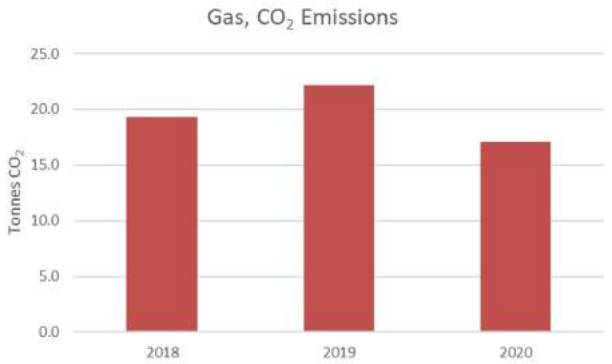




2.1.4 Natural Gas

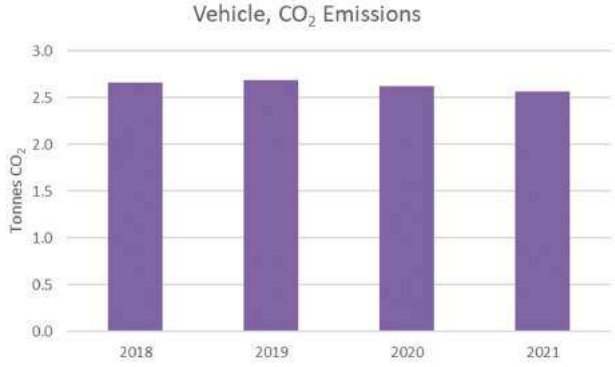
The following is the energy and carbon profile from August 2017 to April 2021 for the Council House, the 2020 and 2021 are assumed to be exceptions as these reflect the reduced consumption during the Coronavirus lockdown.





2.1.5 Transport

The council have a minimal transport related emission impact. The following is the estimated emissions associated with the Transit tipper vehicle which does on average 25 miles per day, 6,000 miles per year. It has been estimated that this equates 10,615 kWh.



2.1.6 Baseline Review – Council House

As displayed by the Display Energy Certificates (DEC), the building has maintained an Energy Performance Operation Rating of B (38) for the past three years. This probably reflects the low energy consumption of the building, compared to the applied benchmark, rather than the efficiency of the building systems.

As stated on the DEC, issued 28th February 2020 and which reflected the pre-Covid 2019 baseline consumption, the following is the actual and benchmark level for the building plus the associated CO_2 emission values.

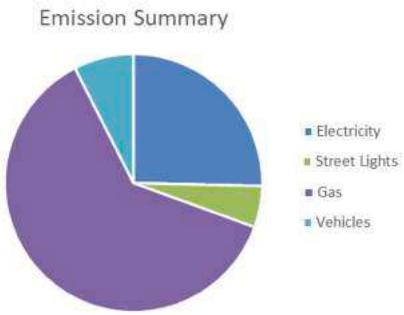
	Electricity	Gas	CO_2 Emission
	kWh/m²/yr.		$kgCO_2/m^2/yr.$
Actual	26	87	22.6
Benchmark	106	122	49.5

What these figures show is that the building is operating at an emission level less than half of that which could be typically be expected for a building of this type.

3. Strategy Areas

3.1 General

The most significant area of emissions is that associate with the natural gas consumption (62%) followed by the electricity (31%), vehicle emissions account for just 7.5% of the total.



3.2 Council House Heating

The Council House Heating is solely responsible for the natural gas related emissions. The current heating is provided by three Rehema Quinta 65 condensing gas fired boilers, located in the roof top plant room. Each of the boilers has a nominal heat input (Gross) of 13.6 to 68.8 kW and seasonal efficiency of 94.4%; they provided the LTHW for just the building radiator system.

It is configured for a flow temperature of 80°C and return temperature of 65°C.

Although they are designed as condensing boilers, operating them at the stated flow and return temperatures will reduce their overall efficiency as it is outside of their ideal condensing operating temperature range.

It has been assumed that the peak winter output is 130 kW and the boiler configuration provides a degree of redundancy.

Photo 1 – Main boilers in Council House

3.2.1 ASHP

The replacement of the boilers with an Air Source Heat Pump (ASHP) which would reduce the overall consumption and associated emissions.

An option that might be considered is the Mitsubishi Ecodan CAHV air source heat pump which is capable of an output water flow temperature of 70°C. Each unit can deliver an output of 43 kW with a Seasonal Coefficient of Performance (SCOP) in the order of 3.2.

Depending on the level of redundancy required, this would be satisfied by four modules.

Image 1 – Mitsubishi Ecodan CAHV image

Space requirements

- This approach would result in the loss of parking space at the rear of the building.
- Due the generally accessibility by the general public of the carpark a protective fence may need to be built around the units.

Operating temperature

- The slightly lower flow temperature may impact the efficiency of the system during the peak winter period but this could be allowed for through the adjustment of the system flow rate.

Option 1	Air Source Heat Pump			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving, £	Indicative Install Cost, £	Payback Period, Years
90,200	14.4	-£360	£140,000	>10

3.2.2 Biofuel CHP

The installation of a CHP module, fuelled by Biodiesel and sized to match the heating demand of the council building. This model assumes that the system will not operate when there is no available thermal load which will minimise the operating hours available and hence the financial benefit.

Assuming the following CHP specification

- Nett Thermal Output.....106 kW
- Average Electrical Output.....63 kW
- Assume meet 75% of the annual heating demand
- Assumed seasonal efficiency of the boilers.....80%
- Assumed thermal demand.....72,000 kWh
- Associated electrical output.....62,000 kWh
- Fuel demand.....18,900 litres

Option 2	Biofuel CHP			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving, £	Indicative Install Cost, £	Payback Period, Years
NA	32.5	-£12,200	£150,000	>10

Space requirements
- This approach would result in the loss of at least one parking space at the rear of the building. A modular plant room containing the CHP unit, fuel tank and thermal store.
- The system pumps could be located in the existing plant room.

Operating temperature
- The existing performance of the heating system could be maintained.

Emissions objective
- This would deliver a significant proportion of the emission reduction required to achieve a nett zero position.

3.2.3 Biofuel Boilers

The replacement of the existing boilers with oil fired boilers supplied with HVO, a biofuel derived replacement for Heating Oil.

The following factors were assumed
- Annual energy requirement.....120,295 kWh
- HVO Cv.....34 MJ/litre, 9.4 kWh/litre
- HVO cost.....£1.30 per litre
- Natural gas unit price.....£0.0341 per kWh

Based upon these figures there would be CO2 reduction of 22 Tonnes per year but the annual fuel cost alone would be in the order of £16,500, and increase of £12,400.

Space requirements
- This approach would result in the loss of parking space at the rear of the building. An external fuel tank would be required.
- The boilers could be located in the existing plant room.

Operating temperature
- The existing performance of the heating system could be maintained.

Option 3	Biofuel Boilers			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving, £	Indicative Install Cost, £	Payback Period, Years
NA	22.1	-£12,400	£25,000	>10

3.2.4 Hydrogen Gas System

There is increased interest in the use of renewably generated hydrogen as an alternative to Natural Gas and there are trials underway where hydrogen, up to 20% by volume, has been injected into the natural gas network. This option has been considered for the operation of the Council House boilers using a dedicated, standalone, hydrogen gas system.

The gas could be supplied as a 15-cylinder Manifolded Cylinder Pallet which would provide sufficient gas for approximately 6 months operation.

Image 2 – Typical Hydrogen Manifold Pallet

The following factors were assumed:
- Annual Natural Gas demand.....120,295 kWh
- Natural Gas Cv.....39.6 MJ/m3 (at standard conditions)
- Hydrogen Cv.....10.8 MJ/m3
- Natural gas Unit price.....£0.0341
- Hydrogen cost .....£1,152 for 108.15 m3 at 175 bar
- Hydrogen generation CO2 footprint.....0.28 kgCO2 per kWh

Based upon these figures the following was calculated:
- Annual Fuel cost.....£2,440 compared to £4,100 for Natural Gas
- Hydrogen production CO2 footprint.....33.6 T CO_2
- Natural Gas CO2 emission.....22.1 T CO_2

Due to it being a pressurised flammable gas there are number of requirements, as defined in BCGA Code of Practice 44, for its safe storage which include:
- At least 3m from site boundary and vehicle parking areas
- Not to be located near a public road
- At least 2m from openings, windows and escape routes from buildings
- Suitably protected to prevent tampering or vandalism

Although manufacturers are developing boilers that are designed for hydrogen, there are no units yet commercially available. However, as with the move from Town Gas, which was approximately 50% Hydrogen, to Natural Gas in the late 60's it is envisaged that existing gas appliances could be modified to accept this new fuel.

If the gas supplied can be shown to be generated via a renewable source, then economically and environmentally it has potential benefits but the use of one of the car parking bays as a storage location would probably make it very difficult to meet the local planning and fire approval necessary.

Option 4	Hydrogen Fuelled boiler			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving, £	Indicative Install Cost, £	Payback Period, Years
NA	-11.5 (increase)	£1,660	£40,000 (1)	>10

Note 1 – Assumed that the boiler, when commercially available would be comparable with an existing Natural Gas Unit but additional cost would be required to safe and compliant gas storage area

3.3 Street Lights

A desk top review of the upgrade of the street lights to an LED equivalent has been completed. Where possible, it has been assumed that the current lamps could be replaced as part of the normal maintenance programme with a LED equivalent.

Option 5	Street Lighting lamp replacement			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving, £	Indicative Install Cost, £	Payback Period, Years
2,056	0.5	£305	£1,000	3.3

Note 1 – These numbers are indicative and based on the information provided. A site visit would need to be undertaken in order to produce an investment ready proposal.

3.4 Renewables

3.4.1 Solar PV

An assessment has identified that it is possible to install an additional 5.52 kWp of Solar PV on the Council House roof. This would generate in the order of an additional 6,238 kWh of electricity per year.

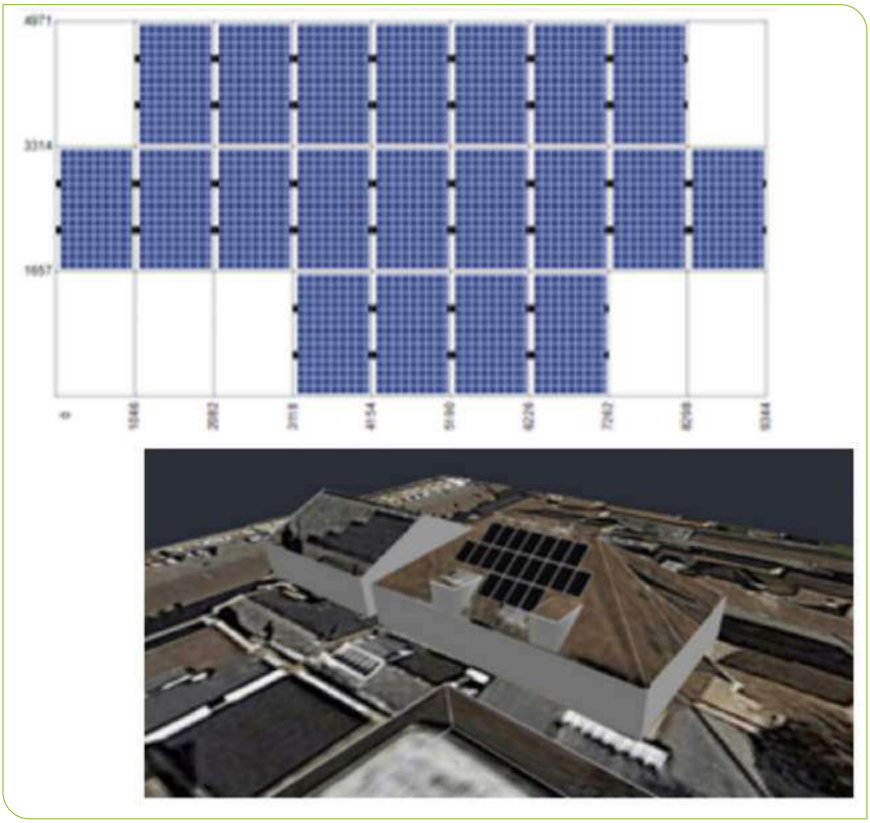


Image 3 and 4 – Solar PV proposed plan and location

Option 6	Solar PV			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving, £	Estimated Install Cost, £	Payback Period, Years
6,283	1.6	£934	£8,000	8.5

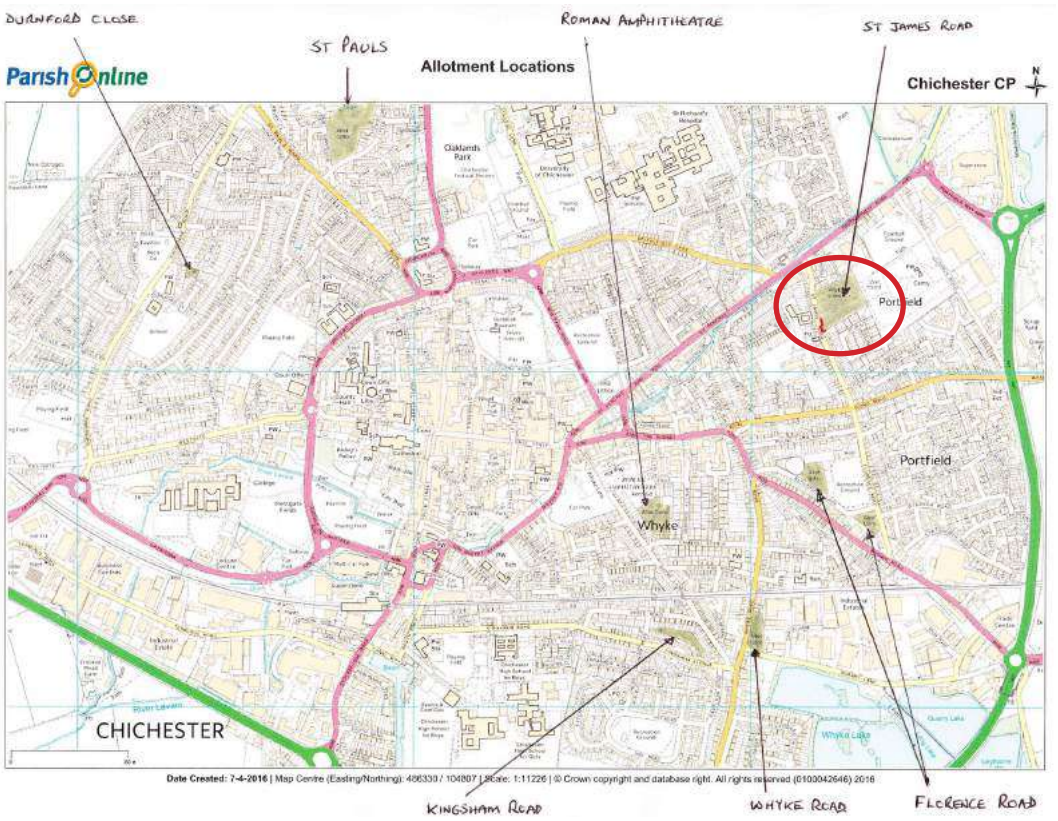
3.4.2 Wind

Introduction

The scope of the project is to outline a proposed installation of a wind turbine at the St James allotment site to provide an off-grid power supply, in conjunction with the solar PV system, to re-charge the maintenance teams power tools.

The address is:
St James Allotment
St James Road
Chichester

3.4.2.1 Location



3.4.2.2 Wind speed

Based upon the available wind speed data that is available it is estimated that a 10m hub height the average wind speed would be in the order of 4.8 m/s.

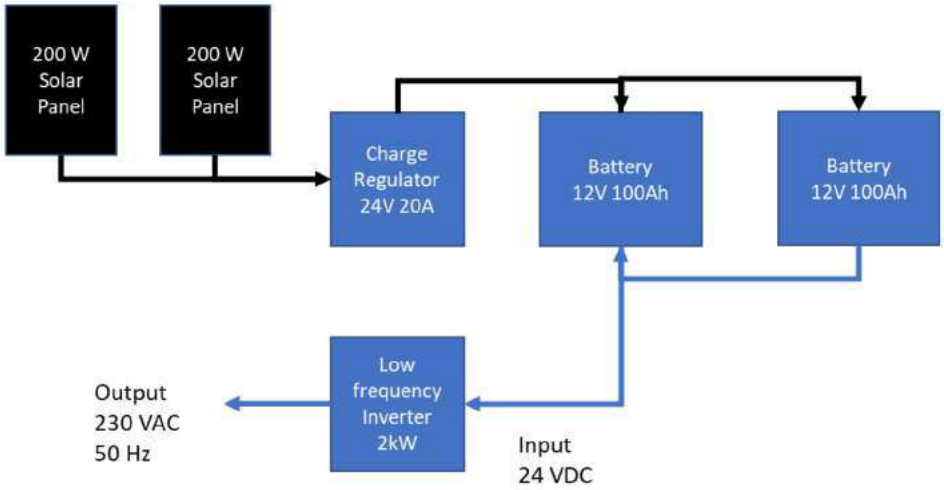
However, the available wind speed will depend on the position of the wind turbine with respect to any neighbouring buildings, trees and other obstructions, all of which will have the effect of reducing the measured wind speed.

Image 1 - Data taken from NOABL windspeed data set

3.4.2.3 Current Renewables

Chichester City Council currently have two 200W solar panels and based upon the location, orientation, it is estimated that these currently generate approximately 390 kWh per year.

The current system is as follows:



3.4.2.4 Proposal

The turbine option considered in this assessment is the Futurenergy AirForce 1, 1 kW micro wind turbine (**https://futurenergy.co.uk/**) which is designed for off-grid, battery charging such as required in this proposed application. Based upon the output performance chart, at the expected average wind speed of 4.8 m/s it is estimated that the system will generate approximately 781 kWh per year which is approximately double that which is currently produced by the Solar PV panels.

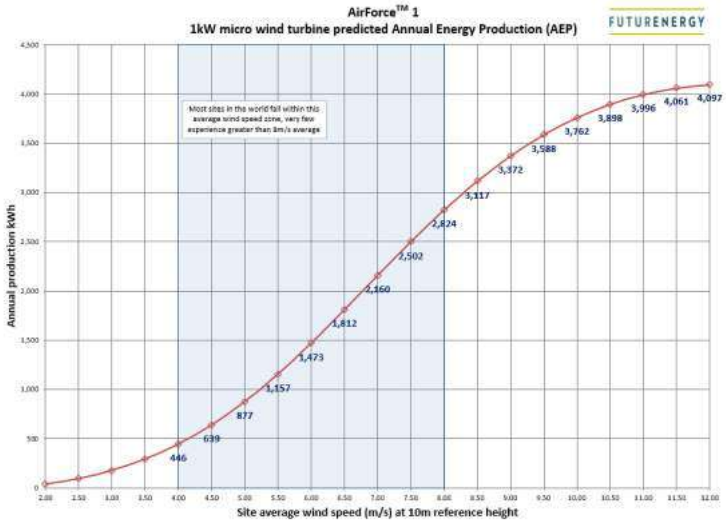
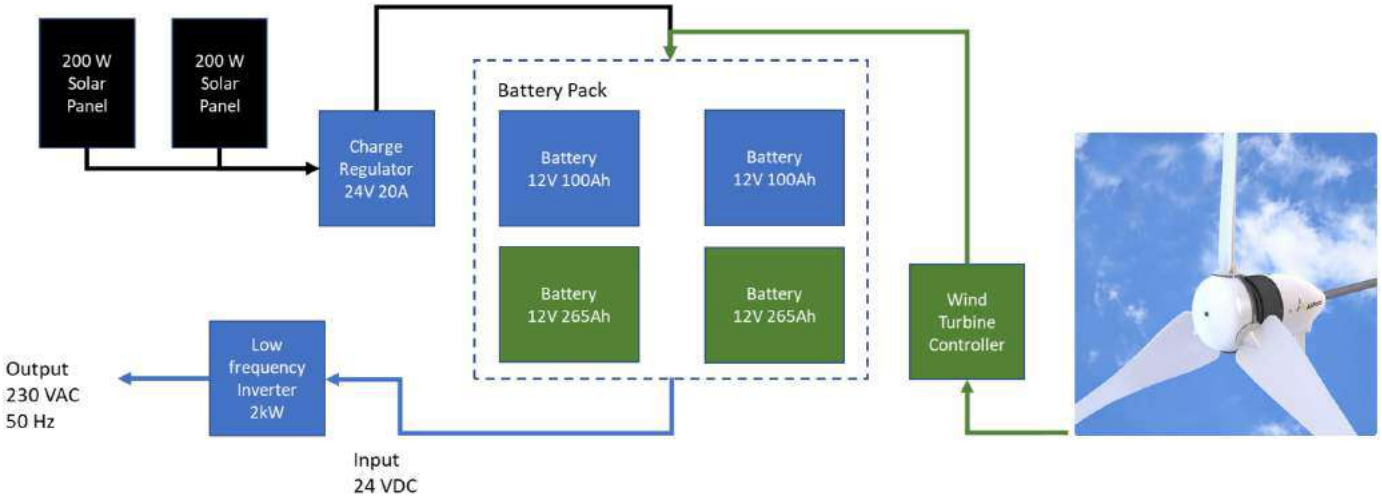


Image 2 - Turbine annual output predictions

3.4.2.5 System Schematic

The system configuration, with the addition of the wind turbine to the existing Solar PV system would be as illustrated below.



3.4.2.6 Advantages

The advantages of this particular option are

- The turbine automatically stops when the attached battery is fully charged which negates the require for dump loads
- Can provide remote WiFi and internet connection so that the system can be configured remotely.
- The start up wind speed is approximately 3.5 m/s

3.4.2.7 Key features

The technical specification for the AirForce 1 Micro wind turbine are:

- Nominal power output: 24V & 48V: 1000W
- Start-up wind speed: 3.5m/s
- Rated wind speed: 12.5m/s
- Survival wind speed: 52m/s
- Total tower-top weight: 19kg
- Number of blades: 3
- Rotor diameter: 1.8m
- Rotor speed (RPM): 200 to 800
- Number of blades: 3
- Generator type: 3-Phase AC
- Turbine mounting: 50mm tube to accept 48.5mm standard scaffold tube
- Noise: LAeq 35dB @ 5m/s wind speed measured behind rotor
  LAeq 54dB @ 7m/s wind speed measured behind rotor

3.4.2.8 Costs

The estimated costs for the required components, excluding the labour costs, are

AirForce 1 Wind Turbine, 48V	£2,250
AirForce 1 Tower kit	£615
Battery pack, 2 x 265AH	£1,400
Scaffold pole, 2 x 5m	£70
Ancillaries/Contingency	£433
Total estimated cost	**£9,103**

3.4.2.9 Planning Requirements

Advice on the requirements for planning permission should be sort.

Although the unit, utilising a 10m pylon would fall within the parameters set by the permitted development rules, these only apply when the turbine is to be positioned within the boundaries of a house or block of flats and if so, not contain any commercial premises.

Although an allotment may not be classed as a commercial property, it is not a residential property and hence the rules may not apply.

3.4.2.10 Permitted Development Constraintsments

- Development is permitted only if the stand-alone wind turbine installation complies with the Microgeneration Certification Scheme Planning Standard (MCS 020) or equivalent.

- The installation must not be sited on safeguarded land.

- Only the first installation of any wind turbine would be permitted development, and only if there is no existing air source heat pump at the property. Additional wind turbines or air source heat pumps at the same property requires an application for planning permission.

- The highest part of the stand-alone wind turbine must not exceed 11.1 metres.

- The distance between ground level and the lowest part of any wind turbine blade must not be less than five metres.

- An installation is not permitted if any part of the stand-alone wind turbine (including blades) would be in a position which is less than a distance equivalent to the overall height of the turbine (including blades) plus 10 per cent of its height when measured from any point along the property boundary.

- The swept area of any standalone wind turbine blade must be no more than 3.8 square metres.

- In Conservation Areas, development would not be permitted if the stand-alone wind turbine would be installed so that it is nearer to any highway which bounds the curtilage (garden or grounds) of the house or block of flats than the part of the house or block of flats which is nearest to that highway.

- Permitted development rights do not apply to a turbine within the curtilage of a Listed Building or within a site designated as a Scheduled Monument or on designated land other than Conservation Areas.

3.5 Vehicles

The principal council vehicle is a Ford Transit with a tipper back that is used by the team that undertakes grounds maintenance. The vehicle travels on average 25 miles per day and is a prime candidate for replacement with a suitably sized electric vehicle.

Currently an EV Ford Transit chassis and tipper option is scheduled to be available in 2022.

Photo 2 – Council transit tipper vehicle

The benefits of moving to an electric vehicle are estimated to be:

Option 8	Electric Vehicle Replacement			
Energy Reduction, kWh	CO_2 Saving, Tonnes	Cost Saving	Estimated Cost	Payback Period, Years
5,620	1.4	£420	£44,000 (1)	>10

Note 1 – Includes the £6-8,000 grant that is currently available.

Due to the high vehicle cost and poor payback this option should be considered when the vehicle is scheduled for replacement. It is estimated that the additional 'premium' cost for the EV option, compared to a current diesel will be in the order of £10,000.

Additional information on the current and future commercial vehicle options can be found at the following link:
https://www.savemoneycutcarbon.com/learn-save/simons-top-10-electric-commercial-vehicles-coming-in-2021/

3.6 Energy Management

As part of the energy survey completed in September 2020 a number of additional improvement measures were identified and which would have an impact on the CO2 emission baseline. These are summarised as follows:

Project Summary	Energy Saving kWh	CO_2 Reduction Tonnes	Cost Saving, £	Est. Install Cost, £	Payback Years
LED lighting upgrade	2,891	0.7	£430	£2,351	5.5
Hand Dryer Replacement	3,796	1.0	£564	£2.697	4.8
Improved zonal heating control	21,659	4.0	£739	£6,934	9.4
Improved draft sealing of the Sash windows	13,537	2.5	£462	£3,630	7.9

3.7 Behavioural Change

From the survey conducted in September 2020 it appeared that there was a good level energy awareness and engagement by the staff. This was demonstrated by the very low Display Energy Certificate rating for the building despite there being very limited use of automated control of the building systems.

However, an ongoing behavioural programme should be considered to maintain, by all the users of the council facilities, an awareness of energy usage. When savings are reliant on staff behaviour 'Spring Back' can rapidly occur without ongoing maintenance due to apathy and the normal changes that occur in the people using the facilities.

From studies over the last decade, IT equipment and other miscellaneous electric loads can be responsible for around a quarter of the total energy consumption in the building. Behaviour change programmes have been shown to achieve energy savings in the workplace of between 4% and 50% and gas from 6% to 10%, although the savings at the top end of the range are exceptional. Generally, depending on the baseline position, a figure in the order of 8% could be considered as achievable through engagement and involvement of people to increase awareness of energy use in the building, promote energy savings and achieve reduction of carbon emissions.

Examples of energy behaviour programmes involve approaches such as:
EDUCATION: Increasing knowledge or understanding, e.g., providing information about the impact of energy use.

PERSUASION & INCENTIVISATION: Using communication to induce positive feelings or stimulate action, e.g., awards publicly given to teams making large energy use reductions.

TRAINING & ENVIRONMENTAL RESTRUCTURING: Changing the physical or social context, e.g., providing on-screen prompts for computer users to turn off their computer at end of day.

RESTRICTION: Using rules to reduce or prevent the unnecessary increase in energy consumption e.g., no more than one desktop monitor or thermostat settings to prevent building users from changing temperature outside of a specific range.

ENABLEMENT: Enabling staff to manage their energy consumption through the reduction of barriers e.g., allowing individuals to access plug sockets to turn them off.

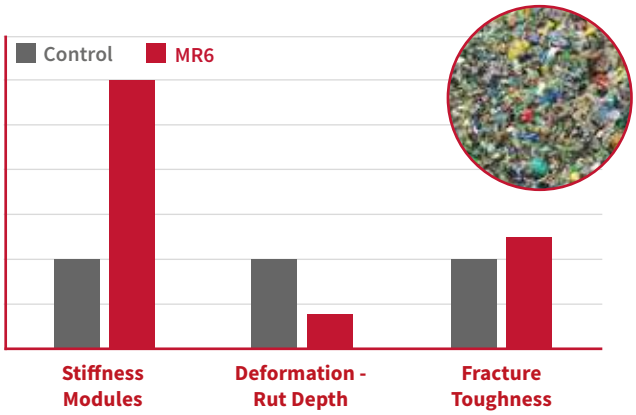
Appendix B

MacRebur Products

MacRebur products are used as binder extenders and /or modifiers to reduce the volume of bitumen required in an asphalt mix, at the same time enhance or maintain asphalt performance.

All products are made from 100% waste plastics that would otherwise go to landfill or incineration. Independent laboratory testing has demonstrated that Macrebur products do not leach plastic or generate toxic fumes.

Macrebur products have been demonstrated by various laboratories across the world to significantly improve the stiffness and deformation resistance of asphalt whilst avoiding the embrittlement of oxidisation, evidenced by increased fracture toughness and fatigue life.



MR6

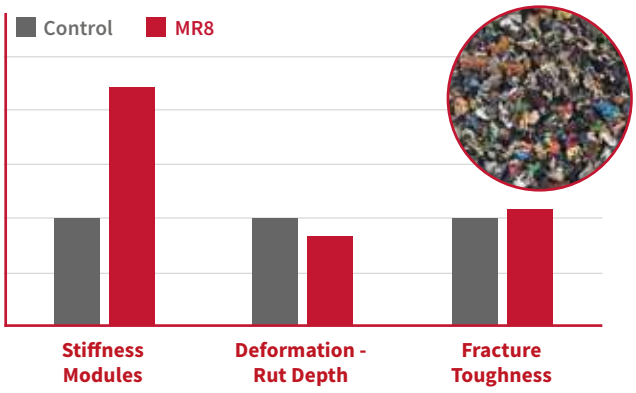
MR6 is a complex arrangement of polymers designed for the extension and enhancement of bituminous binder for asphalt used in road surfaces.

Selected to increase the stiffness and deformation (rutting) resistance of asphalt mixtures without compromising flexibility (crack resistance).

Suited to all asphalt types to be used in all layers of road construction.

Ideally suited to surfacing intersections, roundabouts and slow moving, heavy vehicle areas, where deformation resistance is critical.

Suited to increase the stiffness of binder and base course layers to reduce the overall thickness of pavement required.



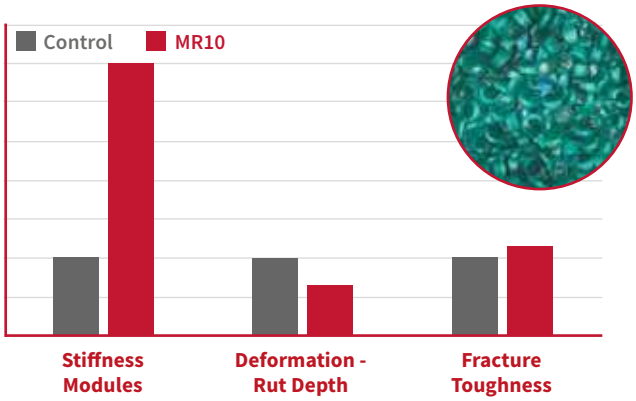
MR8

MR8 is a blend of polymers designed for the extension of bituminous binder for asphalt used in road surfaces.

Selected to extend unmodified bitumen, to maximise environmental and economic benefits without adversely impacting asphalt performance.

Suited to all asphalt types to be used in all layers of road construction.

Ideally suited to surfacing car parks, driveways and local roads, where sustainability and economics are the primary drivers.



MR10

MR10 contains a block co-polymer designed for the extension and enhancement of bituminous binder for asphalt used in road surfaces.

Selected to increase fracture and cracking resistance without compromising deformation (rutting) resistance of asphalt mixtures.

Suited to all asphalt types to be used in all layers of road construction.

Ideally suited to surfacing general trunk roads where stiffness and crack resistance is critical.

Ideal for producing highly crack resistant, but very stiff course layers for overall pavement thickness reduction, similar to EME and other high modulus asphalt mixtures.

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