C
D
S

A Feasibility Review of Cremator Replacement at Poole Crematorium

Bournemouth, Christchurch and Poole (BCP) Council

Date: January 2023

The CDS Group, Building 51, Wrest Park, Silsoe, Bedfordshire, MK45 4HS
W: www.thecdsgroup.co.uk
T: 01525 864387



Table of Contents

List of Figures

List of Tables

1) Introduction and Location

Following a request for a feasibility review on behalf of Bournemouth, Christchurch and Poole (BCP) Council, which manage Poole Crematorium, the CDS Group have the pleasure of presenting a feasibility report exploring various cremation technologies for cremator replacement at Poole Crematorium.

As outlined in the proposal CDS delivered to BCP, the feasibility study will review the following:

- A quantitative review of cremations at Poole Crematorium.
- The installation of new natural gas cremators at Poole Crematorium.
- The installation of new electric cremators at Poole Crematorium.
- A business case and costings analysis for both natural gas and electric cremator installation. (Calculations presented in the accompanying spreadsheet)
- A summary review and breakdown of new cremation technology. (Document attached separately. An NDA needs to be signed to view this document).
- A SWOT analysis of cremator replacement.

Poole Crematorium is located to the north of Poole, Canford Heath Nature Reserve is located to the east of the site. The red line boundary of the site can be found below in Figure 1.

Figure 1. Site Boundary of Poole Crematorium

Poole Crematorium stopped completing cremations in April 2020 at the beginning of the Covid-19 pandemic, due to the age of the gas cremators at the site. Over time the cremators had become uneconomical to repair, due to obsolete replacement parts and mounting concerns regarding the safety of the equipment. Since the decision to discontinue the use of the cremators, Poole Crematorium has been operating as a ceremonial and memorial location only (with a location on site for the scattering or interring of cremated remains within its memorial grounds). Since April 2020 funeral services that have taken place at Poole Crematorium have been conveyed by the Bereavement Care Team at BCP to Bournemouth Crematorium for cremation. As a result, Bournemouth Crematorium completed the second highest number of cremations in the UK (out of all crematoria) in 2021 with a total of 4,446 cremations completed according to the Directory of Crematoria.

The Poole Crematorium site suspended all operations in March 2022 to undertake a refurbishment in the ceremony hall, waiting room and renovation of the office, amongst other works on site. These works were in line with Phase 1 of the Bereavement Services Business Plan. The site re-opened for services at the end of September 2022.

Due to traditions and technology connected to bereavement, the sector has been slow to move towards reducing greenhouse gas emissions associated with cremation. However, the Local Government Association (LGA) state that in order to achieve net zero, decarbonisation has to occur across every economic sector, household and community. To provide some context on emissions associated with bereavement, the amount of CO_2 produced if a gas cremator was completing four cremations per day excluding the cadaver and coffin is approximately 96kg. Therefore, decarbonisation in the bereavement sector is as important as decarbonising other infrastructure that local or national governments operate. Some of the factors that are driving decarbonisation in the sector include: social awareness of the environmental impacts of traditional gas cremation, the advancement in technology to alternative methods of cremation, self-regulation and regulation changes in the industry and economic factors altering the cost of cremation. This feasibility study will address how the industry is evolving whilst providing BCP information on the options available for cremation at Poole Crematorium.

2) A Quantitative Review of Cremations at Poole Crematorium

2.1) A Demographic Analysis of Poole and Dorset

To understand the demographic profile of Poole and the wider Dorset area and to begin to interpret the need for cremator replacement at Poole Crematorium, a review of current and future demographic data has been undertaken.

There are two main sources of population data, the 10-yearly National Census and the annual mid-year population estimates, produced by the ONS. The majority of the data from the March 2021 Census has been published in stages throughout 2022 but some data is still undergoing the process of analysis and ratification and therefore is not yet fully published.

According to data from the ONS Census 2021, the population of Bournemouth, Christchurch and Poole was 400,300 in 2021. This is an increase of approximately 21,400 (5.7%) since the 2011 Census, equating to an increase of approximately 2,140 per year (0.56% increase per annum). In nearby districts over the same time period the New Forest's population shrank by 0.4% and Dorset's population grew by 4%. The average increase in population in the south west region of England was 7.8% which was higher than increase in the Bournemouth, Christchurch and Poole area. The area is now the 14th largest local authority in England by population rank.

According to the Public Health Outcomes Framework 2018 to 2020 the average life expectancy for Bournemouth Christchurch and Poole is 82[1]. Male life expectancy at birth is 80.3 years compared to female life expectancy at birth at 83.7 years, both these life expectancies are above the average for England.

Table 1 on the page below shows the number of BCP residents split into age bands. This data shows the predominant age band is Age 20 to 24 which represents 6.73% of the total district population. The data for England and Wales is also provided for comparison purposes; the most predominant age band is Age 30 to 34 with 6.96% of the population. The percentage of the population aged 65 and above in Bournemouth, Christchurch and Poole is 21.59% and for England and Wales is 18.57%; this implies that the BCP area has an older age profile than England and Wales.

Figure 2 visually represents the population in the BCP district where the ageing profile of the population can be seen in comparison to the population distribution of England and Wales, this is more equally distributed across the age bands. The higher ageing population in BCP is likely to increase the pressure on the capacity of local crematoria.

[1] Public Health Outcomes Framework 2018 to 2020. Available From: Public Health Outcomes Framework

Table 1. Age Bands for Residents of Bournemouth, Christchurch and Poole and England and Wales

Age Band	BCP	% of Population	England & Wales	% of Population
0-4	18,881	4.72	3,232,100	5.42
5-9	21,210	5.30	3,524,600	5.91
10-14	21,342	5.33	3,595,900	6.03
15-19	22,257	5.56	3,394,600	5.70
20-24	26,928	6.73	3,602,100	6.04
25-29	23,842	5.96	3,901,800	6.55
30-34	26,161	6.54	4,148,800	6.96
35-39	26,224	6.55	3,981,600	6.68
40-44	25,414	6.35	3,755,700	6.30
45-49	24,723	6.18	3,788,700	6.36
50-54	26,885	6.72	4,123,400	6.92
55-59	26,526	6.63	4,029,100	6.76
60-64	23,406	5.85	3,455,700	5.80
65-69	20,818	5.20	2,945,100	4.94
70-74	22,596	5.65	2,978,000	5.00
75-79	17,093	4.27	2,170,300	3.64
80-84	12,206	3.05	1,517,000	2.55
85-89	8,261	2.06	925,100	1.55
90+	5,455	1.36	527,900	0.89
Total	**400,196**	**N/A**	**59,597,500**	**N/A**

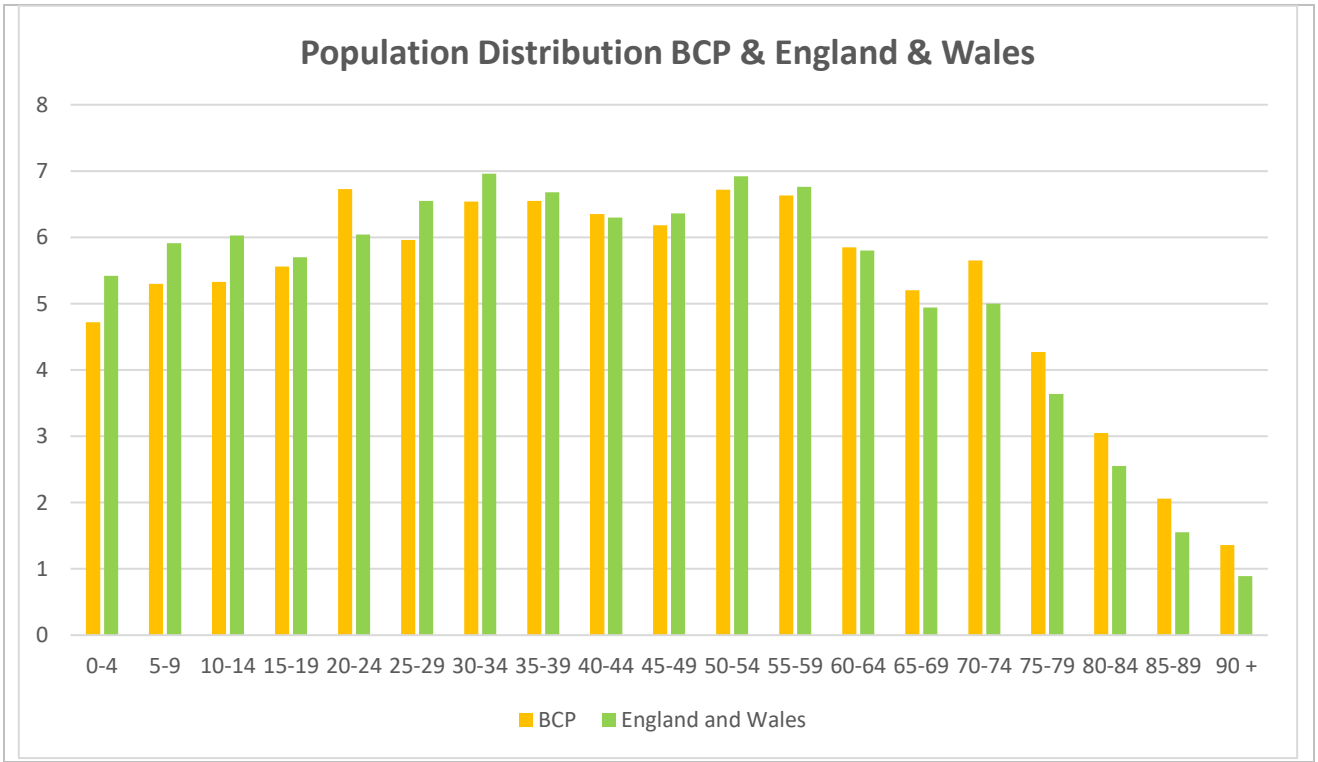


Figure 2. Population Distribution BCP & England & Wales

Table 2. Actual death rates in Bournemouth, Christchurch and Poole

	Basis for average values				For information only	
Location	2016	2017	2018	2019	2020	2021
Population	394,009	395,638	395,784	395,331	396,989	400,300
Total deaths recorded	4,340	4,403	4,298	4,195	4,632	4,766
Death rate	1.101%	1.113%	1.086%	1.061%	1.167%	1.191%
Deaths between age 45-54	143	147	137	138	157	158
Deaths between age 55-64	275	275	293	249	320	300
Deaths between age 65-74	587	605	577	550	630	685
Deaths between age 75-84	1,128	1,150	1,029	1,180	1,225	1,245
Deaths age 85+	2,080	2,115	2,150	1,971	2,205	2,266

The table above demonstrates that the death rate in the BCP area fluctuates yearly across the period between 2016 and 2021. The number of deaths from 2020 and 2021 is higher than previous years as a result of the Covid-19 Pandemic. The pre-covid (2016 to 2019) average death rate in BCP is 1.09% and on average the number of total deaths recorded per annum (2016 to 2019) was 4,309.

The data generally suggests that there is an increasing amount of people and deaths in the BCP area, including amongst the elderly population. An increasingly ageing population is intrinsically linked to increasing death rates due to a larger proportion of deaths occurring. Therefore, regional and national death rates are expected to rise in the future, along with the need for burials and cremations.

2.1.1 Future Population Growth

The data in Table 3 below, was taken from the ONS to show predicted population growth over time in BCP.

Table 3. Population Projections (ONS 2018-2043)

Population predictions				
Location	2018	2028	2038	2043
BCP	395,784	403,611	407,063	408,951
England	55,977,178	58,751,651	60,766,253	61,744,000

Future predictions on population growth can be relevant in relation to need, the catchment population is predicted to rise over the next 20 years, a trend, which can be paralleled by the predicted increase of total deaths, this increase can be seen in Table 4 below.

Table 4. Mortality Rate Predictions Based on Population Projections (2018-2043)

Mortality rate predictions (at 1.09% of population for BCP and 0.9% for England):				
Location	2018	2028	2038	2043
BCP	4,298	4,399	4,437	4,457
England	503,794	528,765	546,896	555,696

The Institute of Cemetery and Crematorium Management (ICCM) publish a Directory of Crematoria each year which states the rate of cremation in England and Wales each year, in 2021 the rate of cremation was 80.93%. The Bereavement Services Manager for BCP stated in the Business Plan Phase One Update Report presented to BCP Council under paragraph 22 that the regional cremation rate for Dorset and West Hampshire is 90% of all deaths in 21/22, this cremation rate will be used to analyse cremations in the region, as it is more accurate to use regional data where available.

Table 5. Cremation Rate Predictions Based on Mortality Predictions

Cremation Rate Predictions (at 90% of mortality rate for BCP and 80% for England)					
Year	2018	2028	2038	2043	Total Increase
BCP					
Cremations	3,868	3,959	3,993	4,011	143
% Increase	N/A	2.35%	0.86%	0.45%	3.7%
England					
Cremations	403,035	423,012	437,517	444,557	41,522
% Increase	N/A	5.0%	3.4%	1.6%	10.3%

The CDS Group acknowledge that there is a difference between the mortality rate in the BCP authority area and the actual number of cremations completed at Poole and Bournemouth Crematorium (in 2018 5281 cremations were completed by Bournemouth and Poole Crematorium). This is higher than the number of deaths in the BCP area, which was 4,298 deaths in 2018, therefore this suggests that people from neighbouring districts travel to Bournemouth and Poole in order to be cremated.

2.2) A Review of Possible Future Pandemics

A pandemic is defined as “an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people”.

The Spanish Flu of 1918-1919 claimed 228,000 lives in the UK alone and 30-50 million people worldwide. The Spanish Flu had a high mortality rate of around 10%. The 1918 flu also had a high infection rate, with a reproduction number between 2 and 3, this is due to the contribution of World War 1 and negligence of governmental control.

On the 31st of December 2019, the World Health Organisation declared several cases of unusual pneumonia in Wuhan in China, the disease was named COVID-19. By August 2020 over 21,500,000

people were reported to have been infected and over 750,000 deaths had been recorded worldwide. The UK has experienced over 177,977 deaths within 28 days of a positive test by date of death as a result of COVID-19 and the pandemic is ongoing (December 2022)[2].

Pandemics such as COVID-19 cause excess deaths in short periods of time and therefore increase stress on the bereavement industry, especially in worst affected areas. In April 2020, the deaths within that month doubled compared to the previous year. As cremation accounts for approximately 80% of UK deaths, crematoria nationwide have been put under serious pressure (Table 6).

Table 6. Deaths by Week in the UK (Apr-19/Apr-20) Coronavirus (ONS 2020)

Week 2019	05-Apr-19	12-Apr-19	19-Apr-19	26-Apr-19	Apr-19 Total	Apr-19 Weekly Average
Deaths	10,126	10,291	9,025	10,059	39,501	**9,875**
Week 2020	**03-Apr-20**	**10-Apr-20**	**17-Apr-20**	**24-Apr-20**	**Apr-20 Total**	**Apr-20 Weekly Average**
Deaths	16,387	18,516	22,351	21,997	79,251	**19,813**

In Table 6 above, the data represents how the COVID-19 pandemic has affected the number of deaths weekly in the UK.

In Table 7 below, based on assumptions at the average amount of cremations per day at the average crematorium, there is an estimated 140% increase in cremations in a single day. A pandemic is an unusual event and therefore cannot be used to base practical capacity off, however if crematoria within the area are working above practical capacity in a normal year, a pandemic can have serious effects on crematoria capacity to cope.

Table 7. Pandemic Impacts on Cremation Numbers in the UK

Week Commencing	19-Apr-19	17-Apr-20
Deaths	9,025	22,351
Cremations (80%)	7,220	17,880
Cremations per day (5 days per week)	1,444	3,576
Average cremations per crematorium, per day	**5**	**12**

There is significant potential for further pandemics to occur in the future, as evidenced by both the historical record and recent research in the field of epidemiology. One of the primary drivers of pandemics is the emergence of new infectious diseases. The globalization of trade and travel has

[2] Gov.UK Available Via: https://coronavirus.data.gov.uk/details/deaths

greatly increased the potential for the spread of infectious diseases, as pathogens can easily be transported to new regions where they may not have previously been present. Pandemics can also be caused by the re-emergence of diseases that were previously controlled or eradicated. This can occur due to a variety of factors, such as the development of drug resistance in pathogens or changes in the environment that allow previously controlled diseases to re-emerge. For example, the recent COVID-19 pandemic was caused by the re-emergence of a previously known coronavirus that had not caused a pandemic in the past.

Overall, the potential for further pandemics is a significant concern, given the significant impact that these events can have on practical capacity at crematoria.

2.3) A Drive Time Analysis (DTA) of Poole Crematorium

2.3.1) DTA Methodology

Drive Time Analysis (DTA) is a quantitative method that can be undertaken using software to estimate the total annual cremations at Poole Crematorium. When assessing the need for a crematorium for planning purposes, drive time catchments are set to 30 minutes at cortege speed (0.6 average driving speed) which is the rule of thumb within the industry and is the methodology which has been used in many successful planning applications. Whilst Poole Crematorium is not a new facility, DTA provides a quantitative methodology to analyse the number of cremations expected at the crematorium, this in turn will help to determine the number of cremators required for installation at Poole.

The population data used in a DTA is derived from two distinct catchments to decipher the population served by a facility. The first is the 'Unique' catchment which is the population/area that is outside of the catchments of alternative facilities but within the catchment of Poole Crematorium. The other is the 'Minimum Drive-time Catchment' (MDC) which is the catchment area based on drive times that would identify Poole Crematorium as its closest crematorium; the drive time influence tool is used to calculate this. Defining the MDC allows for more accurate predictions as to which crematorium people may attend, as areas closer to the site than any other facility, can be ascertained and considered. As a result, this allows for accurate conservative estimations to be made on the total area/population that a given facility serves.

The population data analysed in this section of the report incorporates the latest Office for National Statistics (ONS) mid-year population estimates from 2020. This is because the census data from 2021 is still yet to be fully adopted by third parties like the providers of DTA software.

2020 was a pandemic year associated with coronavirus (COVID-19). As the population estimates are mid-year, the 2020 dataset considers the deaths that were recorded within the first wave of the COVID-19 pandemic[3]. It is also important to note that in the year leading to mid-2020, fewer births were recorded (the lowest number since 2003) whilst international immigration was higher and international emigration was lower.

[3] Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2020. Available from: Population estimates for the UK, England and Wales, Scotland and Northern Ireland - Office for National Statistics (ons.gov.uk)

COVID-19 pandemic years largely include 2020 and 2021 due to the roll out of various vaccinations in the UK. To reduce the forcing of the pandemic in this assessment, pre COVID-19 data will be used for the regional death rate and the regional cremation rate confirmed by BCP Council to calculate predicted cremations.

The average regional death rate for the Bournemouth, Christchurch and Poole District is approximately 1.09% based on ONS data from 2016-2019 (calculated from Table 2). Approximately 90% of deaths per year resulted in cremations in the Dorset and West Hampshire region. If the population of an area is 10,000 for example, the death rate of this population is approximately 109 per year and approximately 98 of these would be cremations: (10,000 x 0.0109) x 0.90.

2.3.2) Results of the DTA

The maps in Figures 3 to 5 demonstrate the existing catchment, unique catchment and MDC catchments to Poole Crematorium with consideration to all other crematoria in the region. A summary table of the population and derived cremation data follows these figures.

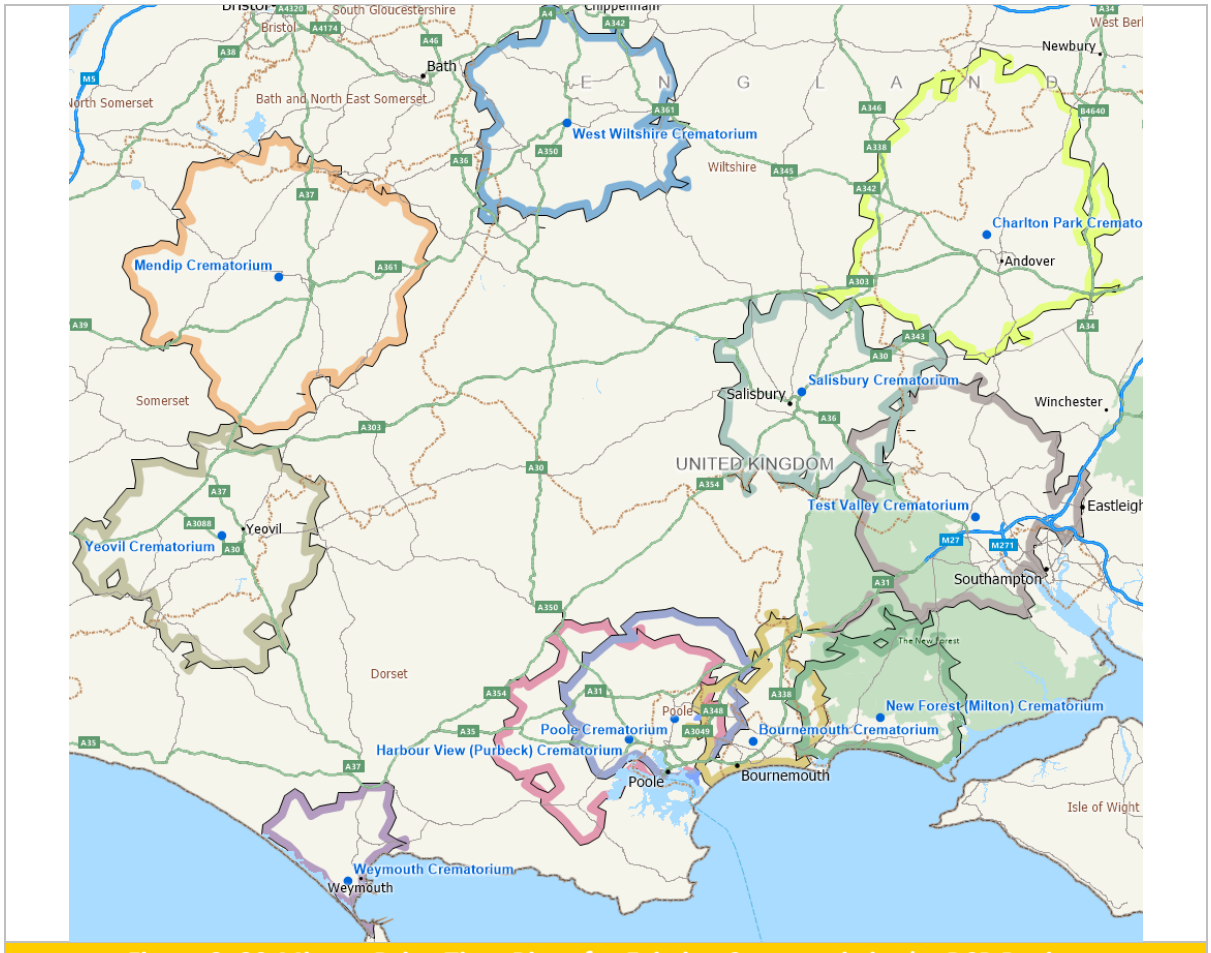


Figure 3. 30-Minute Drive Time Rings for Existing Crematoria in the BCP Region

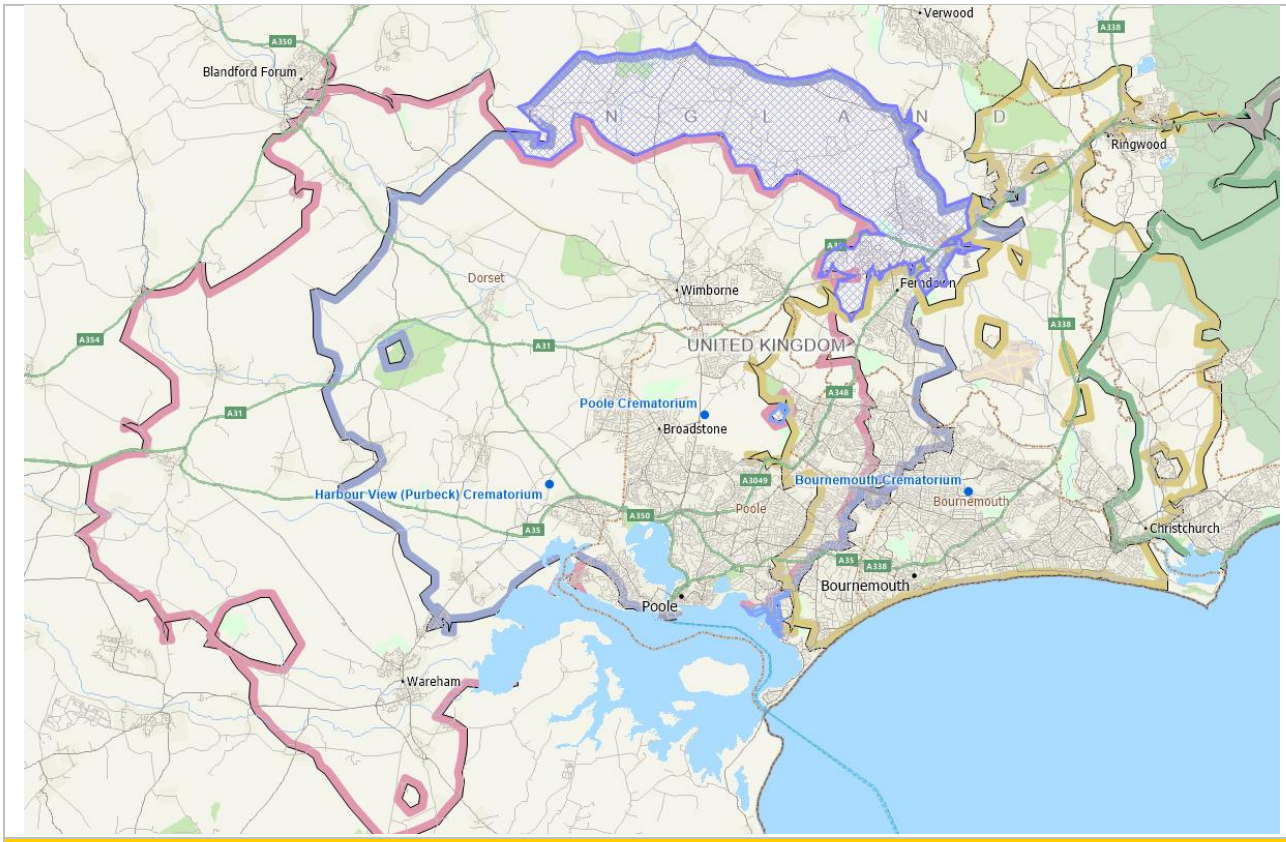


Figure 4. Unique Catchment of Poole Crematorium (Highlighted in Purple Cross-hatch)

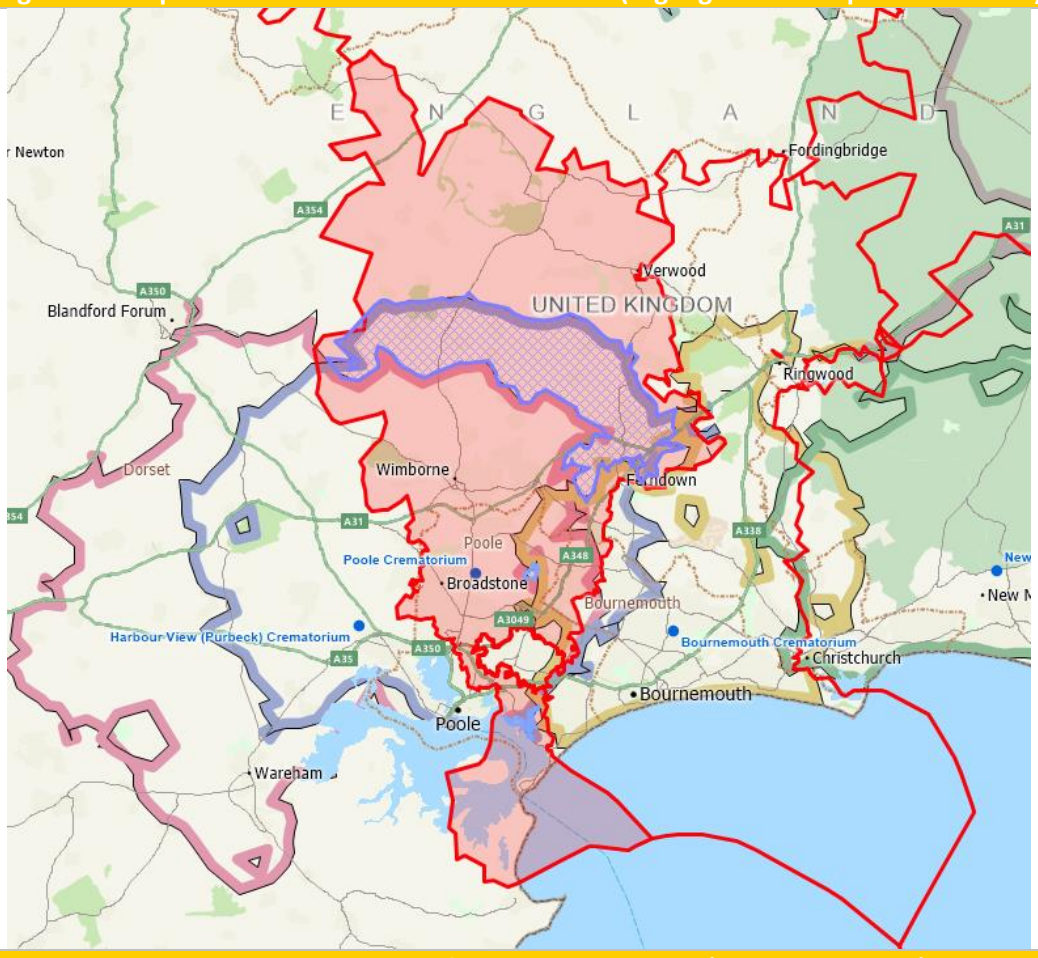


Figure 5. MDC Catchment of Poole Crematorium (Shaded Pale Red)

The DTA shows that there are 3 separate unique catchment areas, which are located within the 30-minute cortege speed catchment of Poole Crematorium but outside of the catchment of alternative facilities. The 3 unique catchment areas are highlighted in purple cross-hatch, with the largest area to the north of Wimborne Minster and Ferndown, the population of these areas is 262 + 14,890 + 751 which totals 15,903. This total can then be multiplied by the regional death rate and the regional cremation rate to get the total number of unique cremations which totals **156 cremations per annum**.

The MDC catchment of Poole Crematorium is shown in Figure 5 highlighted in red, this is the population of the area based on drive times that would identify Poole Crematorium as its closest crematorium. This is calculated by taking the total population of the MDC and then subtracting the unique population (15,903) as to avoid the duplication of people within this area, therefore the MDC Population for Poole Crematorium totals 133,186. By multiplying this figure by the death rate of the region and the cremation rate of the region, this comes to **1307 cremation per annum.**

By adding the calculated unique cremations to the MDC cremations, the DTA methodology calculates that **1,463** cremations would be completed per annum at Poole Crematorium.

The data above is summarised in Table 8.

Table 8. Population Data and Derived Cremations for Drive Time at Poole Crematorium

Location	Unique Population	Calculated Unique Cremations	MDC Population	Calculated MDC Cremations	Total Population	Total Cremations (Per Annum)
Poole Crematorium	15,903	156	133,186	1,307	149,089	**1,463**

According to actual recorded data, Poole Crematorium undertook 2,126 cremations in 2018 and 1,762 cremations in 2019 (the last two years where the cremators were fully operational across the year), an average for the two years is 1,944 cremations. This figure is higher than what is deduced by the quantitative DTA of 1,463 by approximately 481 cremations. This suggests that there are qualitative factors which influence the current performance at Poole Crematorium. This could include the following:

- People currently travel over a 30-minute drive time at cortege speed to use the facility.
- People choose to use the site because of positive attributes such as the appeal of the facility, offering (service times) or experience etc.
- Family allegiance – people use the site to be consistent with family traditions.

In addition, it is important to note that Purbeck Crematorium opened in 2017. Due to the proximity of Purbeck Crematorium to Poole Crematorium, this is likely to reduce the number of total cremations at Poole over time. This is especially relevant as Poole Crematorium was not offering services for a period of time in 2022 due to the refurbishment of the chapel meaning those who would have normally used Poole may have used Purbeck as a closer/ available alternative. This could ultimately lead to permanent loss of those originally with family allegiance to Poole should they have had a positive service experience at Purbeck during this time.

The DTA indicates that 1,463 cremations will be completed per annum at Poole Crematorium, this total largely comprises of the existing services completed at Poole Crematorium. Therefore, this

report suggests there would be a redistribution of the cremations from Bournemouth Crematorium to Poole. If cremators are installed at Poole this may persuade bereaved families and or relatives to return to Poole instead of going to Purbeck crematorium, therefore CDS expect a small increase in Poole Crematorium's market share if cremators are installed at the crematorium.

2.3.3) A Review of Planning Applications in Dorset, Wiltshire and Hampshire for New Crematoria

If a new crematorium was to open in Dorset, Wiltshire or Hampshire this would affect the DTA calculations shown above as the catchment areas for each crematorium would change slightly depending on the location of the new crematorium. Therefore, CDS have completed a review of the planning portals in these areas to understand if there are any new applications that are undergoing review in the planning process. The following planning portals were searched on 16th December 2022:

- Dorset Council.
- New Forest Council.
- Test Valley Council.
- Wiltshire Council.

These searches returned no new results. However, in the future if a new crematorium opens in the region the number of cremations completed at Poole or Bournemouth Crematorium is likely to drop depending on the location of a new crematorium.

2.4) A Practical Capacity Analysis of Poole Crematorium

The Theoretical Capacity of a crematorium is seen as the number of cremation services it could perform if open Monday to Friday throughout the year, excluding bank holidays (giving 252 "Cremation Days") and held cremations from 9:00 am to 5:00 pm (cremations completed on the site on Saturday's are referenced later in this section). Each cremation service would occupy a period of time known as a "slot". The number of cremation services that could theoretically be held each day is therefore dependant on the length of the slot.

In calculating the capacity of a crematorium, we have worked on the basis of 45-minute "slots" as the ICCM recommend this amount of time for a service. Based on a slot length of 45 minutes, a crematorium (with a single chapel) would theoretically be able to fit 11 services between 09:00 and 17:00. However, several of these slots would require the family and friends to travel at inconvenient times, during rush hour, when trying to keep a cortege intact would be stressful. Therefore, it is "Core Hours" which need to be considered when assessing crematorium capacity. This is based on normal operational experiences of crematoria in the UK as in reality funerals are concentrated in the middle of the day, starting between 10:30 and 15:30, rather than between 09:00 and 17:00. There are good reasons for this pattern:

- Funeral Directors need a certain amount of preparation time on the day of the funeral before the cortege can embark on its journey;
- Extended family and other mourners may be travelling from outside the area and will need time to get to the crematorium, especially if it is a journey with which they are not familiar;
- Mourners usually gather afterwards to hold a funeral tea or wake and so need the funeral to take place in the middle part of the day; and

- It would be inappropriate for a funeral cortege to be held up for long periods in rush hour traffic.

Applying these restrictions, the number of cremations that could practically be held a day in a single chapel crematorium is eight, based on 45-minute slots. See table below.

Table 9. Operating Hours and Practical Capacity of a Single Chapel Crematorium

Hours		45 Minute Slots
Non-Core Hours		9:00
		9:45
Core hours		10:30
		11:15
		12:00
		12:45
		13:30
		14:15
		15:00
		15:45
Non-Core hours		16:30
A single chapel crematorium capacity	**Per day**	**Per annum**
Theoretical Capacity	11	2,772
Core-hour Capacity	8	2,016
Practical Capacity	80%	1,613

The relevance of these core hours has been recognised by numerous planning inspectors when considering crematorium capacity, in particular, the appeals at Halstead, Cambourne and Swanwick are pertinent. The appeal inspector in Appeal, APP/M1005/A/2188880 (Swanwick) states the following:

"The four existing crematoria have technical capacity when looking at their operation over any particular year but the fact that Chesterfield crematorium, for example, has plenty of availability in the summer months, or at 16:30 hours on a winter's afternoon is of little comfort or use to those needing to book a funeral at the busiest time of the year at a time of day that would actually allow friends and family to attend. The technical capacity of the 4 crematoria does not bring people who currently live beyond a reasonable distance to a crematorium any closer to that crematorium. Plainly, there is a quantitative and qualitative need in this case."

Further, in appeal case APP/G2245/A/13/2210128 (Halstead) the Inspector states: **"I see no reason to discount the evidence of local funeral directors and clergy who refer to the long waiting times which can be experienced at times, nor the inconvenience and anxiety occasioned by the need for relatives and mourners to travel a considerable distance."**

Memoria's experience (private operator of 11 crematoriums across England and Wales) shows that 90% of funerals occur within the Core Hours. The Core Hour Capacity of a crematorium can be calculated by multiplying the number of Cremation Days by the number of Core Hour Slots i.e. 2,016. However, crematoria cannot work at 100% of their annual Core Hour Capacity because it is impractical to fill every slot in the core hours, every day of the week and every week of the year. Partly, this is because it is difficult to co-ordinate family, funeral director, celebrant and crematorium availability in such a way to fill each slot. In addition, deaths are not spread out uniformly across the year and in winter months can be as much as 40% higher than the average.

This concept has been recognised in a number of appeal hearings and was more recently noted by Mrs Justice Patterson when considering a claim for Judicial Review of permission for a crematorium in Gedling, Nottinghamshire. The judgement confirmed the correct approach taken by planning officers in applying an annualised figure based on a peak month where demand was 20% higher: ***"103 …As the claimant recognises the capacity of a crematorium is fixed. To provide for sufficient capacity in the peak month or months the crematorium required will have the same capacity throughout the year. The use of an uplift figure was appropriate for the reasons set out above. If a figure for a month of lesser demand is used, then there will be insufficient capacity for the peak month of January."***

As such it is recognised that the "Practical Capacity" of a crematorium is around 80% of its Core Hour Capacity. For a single chapel crematorium operating with 45-minute slots this would be 1,613 cremations per annum. The impact of insufficient crematorium capacity could be experienced by the bereaved where crematoria seek to meet needs by:

- Reducing slot lengths – with the consequence that the bereaved may feel rushed, and part of a "conveyor belt" as they see other funeral parties on their arrival or departure; and/or
- Operating outside Core Hours – whilst this may be appropriate for a small number of families, holding well attended funerals outside Core Hours can cause extra distress given the conflict with peak hour traffic; and/or
- Allowing backlogs – delaying funerals during periods of high demand can cause additional distress to the bereaved, who may feel "in limbo" and unable to continue the grieving process whilst waiting two, three or even four weeks for a slot to become available.
- The bereaved may have gathered from long distances to support family members immediately after the death. If the funeral is delayed, they may not be able to stay away from home or work, and therefore miss the funeral, or may have to travel those long distances again.
- Those with cultural or religious needs for a cremation to take place soon after the death may not be met in peak times, resulting in further distress to the bereaved.

Crematoria should not be criticised for having to adjust to the high level of cremation need by taking one or more of the actions listed above. In seeking to serve their communities, they have no choice but to do so. Where such measures are being taken, it is simply a sign that the current provision of cremation is insufficient to serve the local population.

With an ageing population, the number of deaths in the UK is climbing, as is the cremation rate. Combined, these will exert even more pressure on crematoria with a consequential and detrimental increase in impact.

Table 10. Cremations/ Services Completed Per Year

Year	Poole Crematorium	Percentage Change (Year on Year)	Purbeck Crematorium (Opened Sep 2017)	Percentage Change (Year on Year)
2015	2,682	N/A	N/A	N/A
2016	2,610	-2.76%	N/A	N/A
2017	2,408	-8.39%	137	N/A
2018	2,126	-13.26%	755	551.09%
2019	1,762	-20.66%	992	31.39%
2020	1,259*[1]	-28.55%	1,401	41.23%
2021	1,121*[2]	-10.96%	1,414	0.93%

[1] 451 cremations were completed between 1st January and 9th April 2020, after this the cremators were decommissioned, therefore 808 services were completed after 9th April 2020.

[2] No cremations were completed at Poole Crematorium in 2021.

The table above uses data provided by the Cremation Society of Great Britain to show how the number of cremations at Poole Crematorium has reduced over time. This is largely as a result of the opening of Purbeck Crematorium in 2017, which is located only 4.1 miles from Poole Crematorium, other factors such as the decommissioning of the cremators at Poole are likely to have reduced the number of cremations completed.

Table 11. Practical Capacity at Poole Crematorium

Operated by	BCP Council
Built in	1985
Number of chapels	1
Service slot length	45 Minutes
Car park capacity	110
Chapel capacity	120 seats
Practical Capacity	1,613
2016 Cremation Numbers	2,610
2017 Cremation Numbers	2,408
2018 Cremation Numbers	2,126
2019 Cremation Numbers	1,762
Average Cremation Numbers (16-19)	2,227
Practical Capacity Usage Based on Avg Cremation Numbers (16-19)	138%
DTA Calculated Cremations	**1,463**
Practical Capacity Usage Based on DTA	**90.7%**

Comments:

From consultation with the Bereavement, Coroners & Mortuary Manager at BCP it can be confirmed that from April 2023 (if approved) it is likely the crematorium will offer a total of 7, 45-minute services per day between Monday and Friday, additionally a further 3 direct cremations may occur before services commenced. The Institute of Cemetery and Crematorium Management (ICCM) suggest that a crematorium should operate services that are at least 45 minutes, to ensure the bereaved relatives have adequate time to grieve, therefore from April 2023 Poole Crematorium will be innkeeping with these guidelines.

Purbeck Crematorium has led to the reduction in the number of cremations at Poole Crematorium since September 2017 due to the proximity between the two sites, this is demonstrated in Table 10. Based on the calculations above and considering Purbeck Crematorium is likely to continue to affect the annual cremation numbers at Poole, Poole crematorium is likely to be operating under its practical capacity in the future at 90.7% in line with the results of the DTA. It is inaccurate to use the higher practical capacity of 138% as this uses an average of annual cremations between 2016 and 2019 which are trending downwards given Purbeck.

2.4.1) Seasonal Variation Effect on Capacity

Capacity is not only specified over a period of time. It should also be noted that crematoria are particularly busy in winter time. Excess winter deaths cause a heightened need for cremations in a short period of time, local crematoria must have the capacity to cope with this increased need.

Analysis was completed using deaths registered sourced from ONS, see below. The average monthly death rate for the BCP area has been calculated for the months of December, January and February (winter months) from 2013 to 2019, and these numbers have been averaged to provide the average winter monthly death rate which is compared to the average monthly death rate for each calendar year period.

Table 12. Average Monthly Deaths in BCP

Average Monthly Death Rates				
Dec-13	Jan-14	Feb-14	Winter 2013-2014	Cal Year 2013
355	427	366	383	357
Dec-14	Jan-15	Feb-15	Winter 2014-2015	Cal Year 2014
470	568	409	482	349
Dec-15	Jan-16	Feb-16	Winter 2015-2016	Cal Year 2015
349	361	397	369	377
Dec-16	Jan-17	Feb-17	Winter 2016-2017	Cal Year 2016
344	490	417	417	362
Dec-17	Jan-18	Feb-18	Winter 2017-2018	Cal Year 2017
375	510	405	430	367
Dec-18	Jan-19	Feb-19	Winter 2018-2019	Cal Year 2018
295	443	342	360	358

In 83% of the years analysed, the average monthly winter death rate is higher than the monthly average for the calendar year. Between 2013 and 2019, the monthly winter deaths rates averaged at 407 per month compared to 362 deaths per month for the calendar year; demonstrating that winter deaths are approximately 12.4% higher than the calendar year averages. The data suggests that there are more deaths in the winter months, therefore crematoria need to be able to keep abreast of requirements during the winter season, in particular in January, which is typically the busiest month.

Using data from Poole Crematorium in 2020 and 2021 the number of cremations and or services completed over the winter months averaged at 121 per month. Across the 24-month period the average monthly cremations and or services totalled 99 per month, therefore during the winter months there is approximately a 22.2% increase in the number of cremations/ services required and in the future cremations required at the site. The years analysed are Covid years and therefore this total should be taken as a worst-case estimate.

2.4.2) Cremator Requirement

Electric cremators have a longer operating time of 2 hours on average, therefore the likely cremating hours required must be calculated against the existing operational hours. For gas cremations, the typical average time is 1.5 hours per cremation.

As established from the DTA and subsequent analysis, 1,463 cremations are expected to take place yearly at Poole Crematorium. By using the calculation of 252 working days in a year, this means that **6 cremations would be completed per day** on average. By analysing the two most practical sources

of cremation namely electric and gas, the cremator requirement can be analysed to calculate the most efficient possible. Table 13 below is based on the assumption that at least 6 cremations are required to be completed per day. Whilst, Table 14 below is based on the assumption that **7 cremations need to be completed during the busiest possible period** (within the winter months 22.2% higher number of services).

Cremations at Poole could operate across core hours with the possibility of having 3 direct cremations before services began each day, therefore approximately operating between 8:00 and 17:00 which would be across a 9-hour period per day. As the cremators are not currently operational, the operational hours of the cremators could be reviewed once the electric cremators were installed. However, this may be dependent on whether the existing employment contracts of the operators at Bournemouth crematorium could be extended or altered. Tables 13 & 14 demonstrate the number of cremating hours required depending on a range of maximum cremations per day.

The possibility of utilising 'hold over' cremations, where cremations are completed the day after the service is likely to be a cost-effective way of managing cremations during particularly busy periods. The report assumes that any holdover cremations would be completed during the direct cremation slots on the subsequent day.

Electric cremation operation differs from gas cremation in the context that they are 'hot inserts', whereby the electric cremator operates consistently, and the body fuels the cremation, therefore the more cremations processed the less overall energy consumption. This must be considered when considering the number of cremators to install. Practical capacity is the most important consideration as it allows for 15 minutes between each cremation for removal and insertion of the next cremation, which the theoretical capacity does not account for. Theoretical capacity can be calculated by dividing the cremating hours per cremator by the operational hours of the cremator (in this case 9). Similarly, to calculate the practical capacity percentage the cremating hours (practical) is divided by the operational hours of the cremator (9).

The following table represents the estimated cremation capacity based on the operating time of electric cremators and gas cremators, theoretical capacity is the maximum that can be achieved theoretically, whereas practical capacity factors in time for raking out and processing the next cremation (15 minutes):

Table 13. Cremator Capacity at Poole (Annual Average)

Cremators	Maximum Cremations / Day / Cremator	Cremating Hours/ Cremator	Cremating Hours (Practical)	Theoretical Capacity	Practical Capacity
1 Electric	6	12	13.5	133.3%	**150%**
2 Electric	3	6	6.75	66.7%	**75%**
3 Electric	2	4	4.5	44.4%	**50%**
1 Gas	6	9	10.5	100%	**116.7%**
2 Gas	3	4.5	5.25	50%	**58.3%**
3 Gas	2	3	3.5	33.3%	**38.9%**

Table 14. Cremator Capacity at Poole (Winter Average)

Cremators	Maximum Cremations / Day / Cremator	Cremating Hours/ Cremator	Cremating Hours (Practical)	Theoretical Capacity	Practical Capacity
1 Electric	7	14	15.75	155.6%	**175%**
2 Electric	4	8	9	88.9%	**100%**
3 Electric	3	6	6.75	66.7%	**75%**
1 Gas	7	10.5	12.25	116.7%	**136.1%**
2 Gas	4	6	7	66.7%	**77.8%**
3 Gas	3	4.5	5.25	50%	**58.3%**

Table 14 above analyses the cremator capacity in the winter, this is key for analysing the number of cremators required, as in the winter months it is predicted that approximately 7 cremations will be completed at the site per day. Operational risks must be considered in conjunction with the tables above – such as cremator maintenance and how this would reduce the sites practical capacity in the short term. Due to the variance in the number of deaths that occur throughout the year in the BCP region, it would be advisable for any planned maintenance to take place during the summer months (quieter periods).

With the predicted cremator operating hours (9 hours) in the peak winter months the most practical configuration of cremators is:

- 2 electric cremators which would operate for 9 hours to complete 7 cremations.
- 2 gas cremations which would operate for 7 hours to complete 7 cremations.

If the bereavement team were to consider extending their cremating operational hours to 15 hours and 45 minutes per day during the winter months, then a single electric cremator would be feasible on the site. However, to operate the cremators in such a way would be an operational risk, especially if maintenance is required or in the event of a pandemic or inflation in excess winter deaths.

The CDS Group would conclude that based on the DTA completed and a review of the site's capacity over the winter months, 2 **electric cremators would be required to cope suitably with need, especially in peak periods and to allow for maintenance.** Alternatively**, 2 gas cremators would be feasible.**

As Poole crematorium has not had operational cremators in place at the site since April 2020, other crematoria that are competing are now established in the cremation market in the wider BCP area. Therefore, CDS would suggest that once cremators are installed at Poole, a significant public relations campaign occurs to increase public awareness that the site is now 'fully operational' and completing cremations once again. CDS also suggest that BCP build a rapport with the funeral directors in the region to communicate that new cremators have been installed.

2.4.3 A Practical Capacity Analysis of Bournemouth Crematorium

The Bereavement, Coroners & Mortuary Manager at BCP council has stated that the existing gas cremators at Bournemouth Crematorium have a remaining lifespan of approximately 10 years. The

council wish to review the feasibility of installing 2 electric cremators at Bournemouth crematorium to replace the existing 4 gas cremators. These 2 cremators would work with the 2 cremators in place at Poole crematorium to cover current and meet any increases in future demand.

DTA has been completed to understand the population catchment of Bournemouth crematorium, this analysis has been completed using the same methodology as Poole crematorium as explained in chapter 2.3.1 and 2.3.2 of the report.

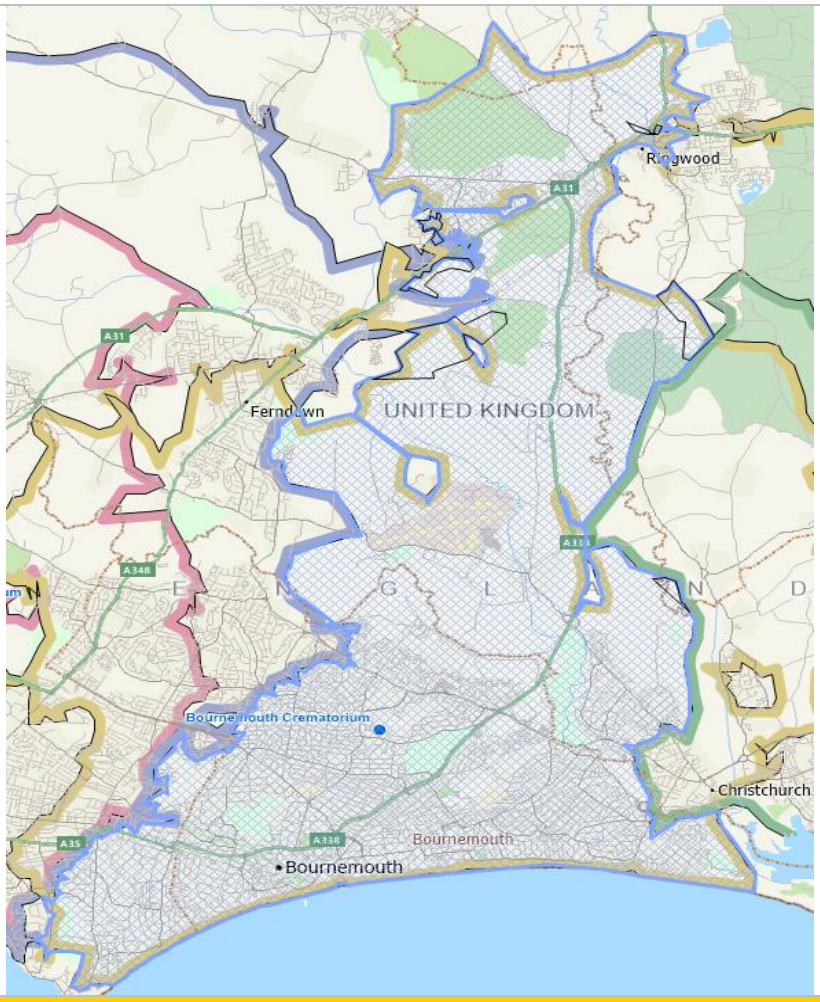


Figure 6. Unique Catchment of Bournemouth Crematorium (Highlighted in Purple Cross-hatch)

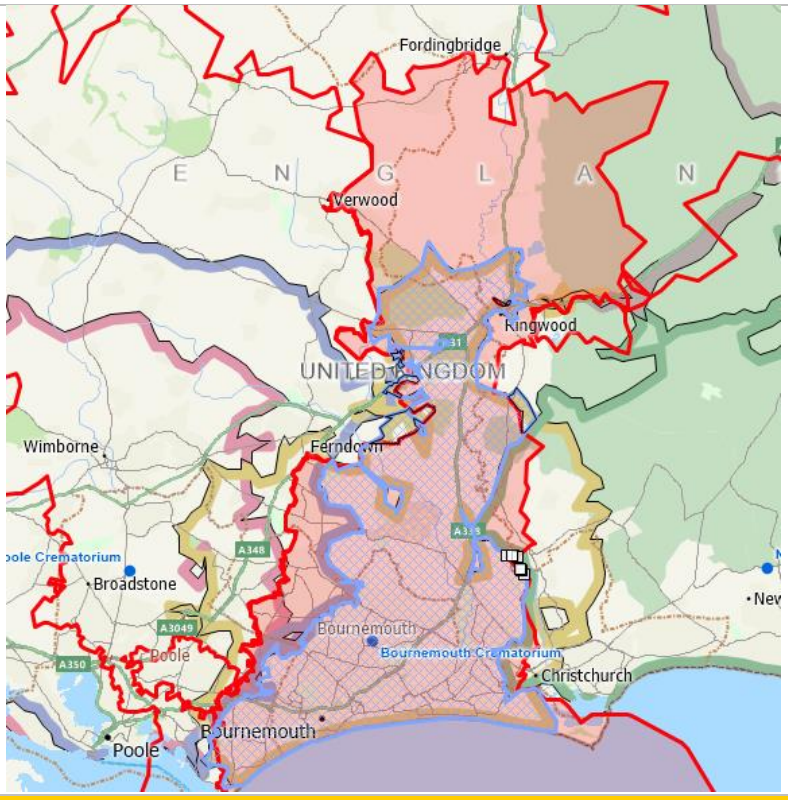


Figure 7. MDC Catchment of Bournemouth Crematorium (Shaded Pale Red)

Table 15. Population Data and Derived Cremations for Drive Time at Bournemouth Crematorium

Location	Unique Population	Calculated Unique Cremations	MDC Population	Calculated MDC Cremations	Total Population	Total Cremations (Per Annum)
Bournemouth Crematorium	187,607	1,840	65,583	643	253,190	**2,483**

By combining the total cremations calculated in table 15 (for Bournemouth crematorium) and table 8 (for Poole crematorium), the DTA estimates that a total of 3,946 cremations will be completed across the two sites. Although Bournemouth is a busier facility (as the site has 2 chapels) than Poole it can be assumed that cremations would be split evenly across the two sites. Therefore, each cremator in theory would be completing 986 cremations per annum. Using this assumption on **average 8 cremations would be completed per day at Bournemouth**. In the winter months at peak times the number of cremations completed per day at Bournemouth would rise to **9 cremations per day.**

Currently on average the cremators at Bournemouth crematorium operate between the hours of 8:30 and 18:30, therefore this means the cremators are operational for a total of 10 hours per day. In peak times in the winter months the cremators can operate for up to 12 hours (between 7:00 and 19:00). However, as this analysis assumes that cremations will be spread evenly across Bournemouth and Poole crematorium it is assumed the cremators will be operational for 10 hours. The tables below demonstrate the theoretical and practical capacity of the cremators based on the opening hours of the site.

The following tables demonstrate that with cremations evenly split across Poole and Bournemouth, on average the site would operate under it's practical capacity with all the configurations of cremators shown in Table 16. However, in the winter months when more cremations are completed per day (9 per day), the site would be operating over its practical capacity by 12.5%. Therefore, to operate successfully in the peak winter months the cremators at Bournemouth would have to be operational for at least 11 hours and 15 minutes.

Table 16. Cremator Capacity at Bournemouth (Annual Average)

Cremators	Maximum Cremations / Day / Cremator	Cremating Hours/ Cremator	Cremating Hours (Practical)	Theoretical Capacity	Practical Capacity
2 Electric	4	8	9	80%	90%
3 Electric	3	6	6.75	60%	67.5%
2 Gas	4	6	7	60%	70%
3 Gas	3	4.5	5.25	45%	52.5%

Table 17. Cremator Capacity at Bournemouth (Winter Average)

Cremators	Maximum Cremations / Day / Cremator	Cremating Hours/ Cremator	Cremating Hours (Practical)	Theoretical Capacity	Practical Capacity
2 Electric	5	10	11.25	100%	112.5%
3 Electric	3	6	6.75	60%	67.5%
2 Gas	5	7.5	8.75	75%	87.5%
3 Gas	3	4.5	5.25	45%	52.5%

The cremator capacity data calculated in the table above requires further investigation to confirm the variation in cremations at Bournemouth crematorium in the winter months, amongst other factors. CDS would be able to provide BCP council with a more in-depth breakdown of expected cremator capacity upon request.

2.5) A Planning Risk Review of Removing and Installing Cremators at Poole Crematorium

Presuming that the electric cremators discussed in section A.11 of the report were installed, it would mean that there would be minimal alterations to the exterior of the building and therefore the cremator installation would have a low planning risk. Changes to any external facia would require planning permission but given the sustainable benefits of electric cremators the planning risk is low. If electric cremators were installed there is potential to explore a reduction in the height of the chimney due to the dispersion of emissions being lower, this would help to reduce the visual impact of the site. Although from a review of satellite imagery the site appears to have some screening from a series of established trees which border the site.

In February 2022 an 'Asbestos Refurbishment/Demolition Survey' reported that asbestos was present in several locations of the building. The Property Services Manager for BCP Council stated that "All Gaskets and Sink Pads were removed as part of the refurbishment project so the only asbestos left is in the Artex in all ceilings (even if they appear to plastered) with the exception of

the new toilets (recently installed new ceiling) also there is Asbestos in the bitumen within the brick damp course."

Therefore, the building should have an asbestos risk register in line with the control of asbestos regulations that were formed in 2012.

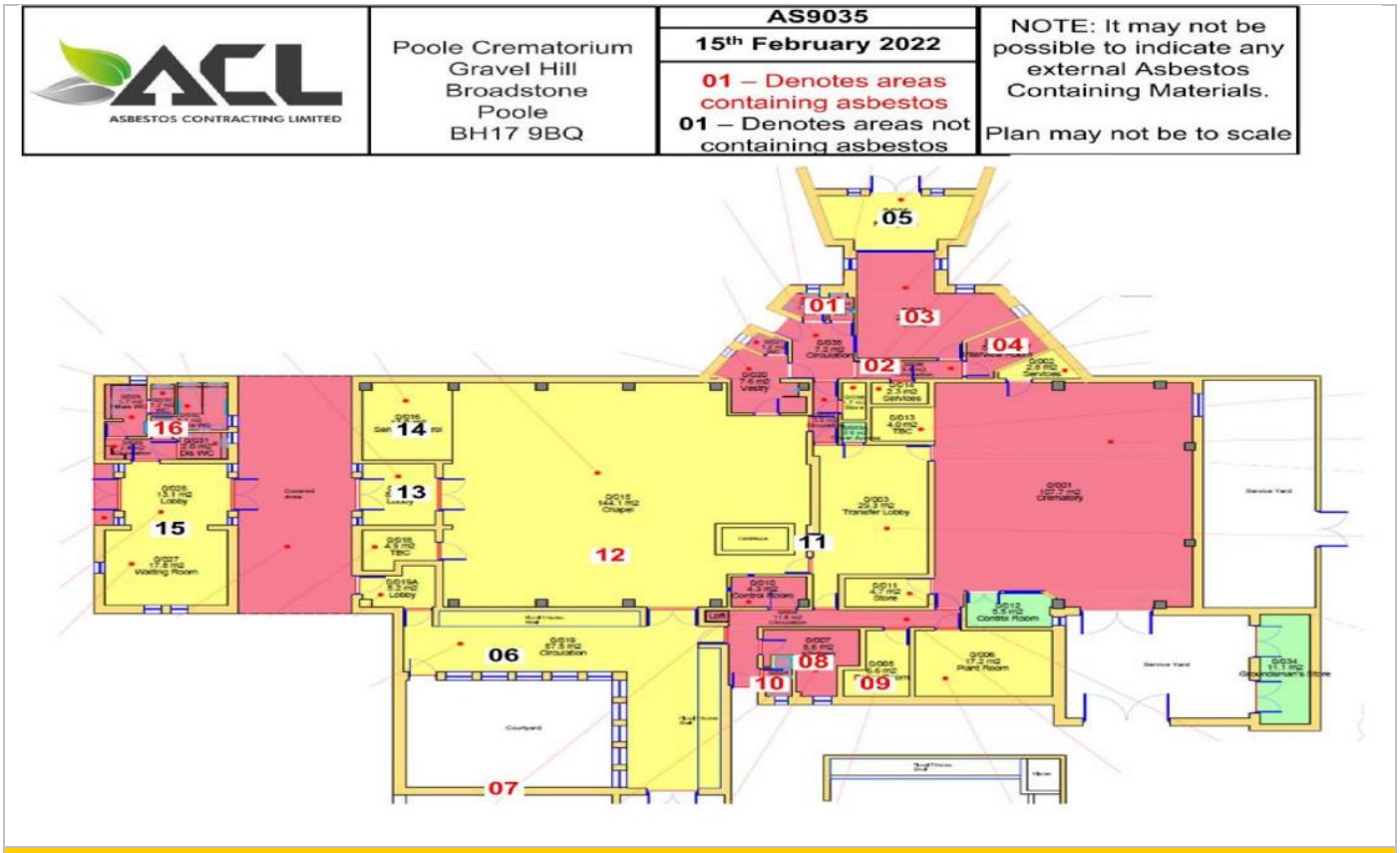


Figure 8. Asbestos Survey of Poole Crematorium

3) Gas Cremator Installation (Natural gas)

3.1) An Outline of the Technology

The current cremators at Poole Crematorium (when operational) utilised natural gas to complete cremations. Gas cremation is used by >95% of existing crematoria in the UK, primarily sourced by natural gas but some crematoria are sourced by LPG tanks due to lack of natural gas supply in the area. Across all the available fuel sources and technologies on the market gas cremation produces the quickest cremation times.

Gas cremation requires a continuous supply of natural gas throughout a cremation, the highest consumption of gas is used at the beginning of each day (when the cremators are turned on) when the machines require higher levels of energy to reach their most efficient temperatures. The most efficient way to run a gas cremator is to reduce the time in between each cremation to reduce the heat loss. If there is consistently a long period of time between cremations, higher maintenance costs can be expected due to the contraction and expansion in the brickwork. This chapter of the report will presume that 1,463 cremations will be completed per year at Poole with 6 cremations completed per day on average.

In the future the government are looking to add hydrogen to the existing gas network, this won't have a considerable effect on cremations, or the time taken to cremate. The table below highlights some of the key considerations for new gas cremators.

Table 18. An Outline of the Latest Gas Cremators Produced

Variable	Result
Capital Cost (Average)	£500,000-£575,000 *(dependant on package and manufacturer, prices of cremators have risen sharply in the last year with higher rates of inflation and supply chain shortages caused by the Covid-19 pandemic) (Average price of £537,500 used in sectionA.9 of this report)*
Maintenance Costs (Average)	£45,000 per 2 cremators per annum
Lifetime	15-20 years
Cremation Time	90 minutes
Lead times from purchase	1-3 months
Manufacturers	Facultatieve Technologies (FT), DFW Europe, IFZW and Matthews Environmental Ltd.

3.2) Financial Cost Implication of Gas Cremators

Several companies manufacture gas cremators in the UK including Facultatieve Technologies and Mathews Environmental Solutions amongst other companies. Although the global market for gas has been in fluctuation in recent months, there is still good availability of natural gas, but the price of natural gas has increased notably since the beginning of 2022. Currently there isn't legislation from the UK government on emissions produced from cremation and therefore the use of the technology would be feasible at Poole Crematorium. The remainder of this chapter will review the costs, consumption and emissions of gas cremators amongst other factors.

If the council choose to install new natural gas cremators the costs outlined in this section are likely to increase in the future due to inflation.

3.2.1) Capital Costs

On average gas cremators cost £500,000-£575,000, the cost is dependent on package and manufacture.

There may be an opportunity to reuse some of the infrastructure already in place at Poole, depending on the age and quality of the infrastructure. Likewise, it may be possible to sell some of the existing equipment for its scrap metal value, which could then offset some of the cost of the new cremators. A full survey of the existing equipment in place would be required to determine the value of the existing equipment.

3.2.2) Operational Costs

The average cost for the maintenance of a gas cremator is approximately £22,500, but this is largely dependent on: its level of use, the breaking of parts and operational difficulties such as complications with the cremation process. CDS would estimate that the cost to maintain 2 new gas cremators per year would be approximately £45,000. Over time the cost to maintain the gas cremators is likely to rise to approximately £60,000 per year (as the cremators reach their operational lifespan).

The Property Services Manager at BCP Council confirmed that the gas supply rate at Poole is 12.495 pence per kWh and as gas cremators use electricity mainly for the control panels, the cost of electricity at the site in Poole is 40 pence per kWh. With 2 natural gas cremators completing a total of 6 cremations per day (3 cremations each), in energy costs, two gas cremators would cost approximately £514.03 per day (a single cremation would cost £85.67). Therefore, in energy costs, two gas cremator on green electricity would cost approximately **£125,337.84 annually** (using 1,463 as the number of expected cremations per annum).

The efficiency of gas cremators is highlighted in the table below, this dataset shows that the more cremations completed per cremator per day the more cost effective the cremation process becomes.

Table 19. Cost per Day and Energy Use for Gas Cremators

Cremations Per Day	Gas Per Cremation (kWh)	Electricity Consumption Per Cremation [inc. rest] (kWh)	Cost per Cremation (to the nearest pound)
1	1359	77	**£201**
2	763	47	**£114**
3	564	38	**£86**
4	483	33	**£74**
5	424	30	**£65**
6	348	28	**£55**

Table 20. Operational Cost per Annum for Gas Cremators (inc. Maintenance)

	Cost Per Annum (£)
2 Gas Cremators	£170,337.84

3.3) The Emissions and Environmental Implications of Natural Gas Cremators

CO_2 emissions from gas cremators are noticeably higher than those from electric cremators. CDS have derived the gas and electricity consumption of gas cremators provided by 2 manufacturers and then this was averaged with consideration to CO_2 production. The data in the table below has been calculated by using the estimated electrical energy usage during use at 12 kWh/hr and during rest at 1.8 kWh/hr. Also, the amount of CO_2 released from the combustion of the body totals 26.9kg. The Carbon intensity values used to work out CO_2 per cremation for natural gas was 0.184kg whilst for electricity 0.231kg was used. Presuming 6 cremations were completed per day at Poole (and evenly split across two cremators), a total of **839.4kg of CO_2 would be released per day**. Over the course of a year **211.5288 tonnes of CO_2** would be produced by the site (including the carbon emissions released by the cadaver and coffin).

Table 21. CO_2 Per Cremation for Gas Cremators

Cremations Per Day	CO_2/Cremation (Inc. Body and Coffin)
1	**294.9kg**
2	**177.9kg**
3	**139.9kg**
4	**122.9kg**
5	**111.9kg**
6	**97.9kg**

NO_x emissions are also a factor when considering the environmental implications of natural gas cremators, Nitrogen Oxide is 300 times more potent than Carbon Dioxide and therefore emissions of this gas must be reduced to meet greenhouse gas emission targets. There are three types of NO_x emissions during combustion (US EPA 1999):

1. Fuel NO_x - resulting from organically bound nitrogen in the fuel (not relevant for natural gas or electricity).

2. Prompt NO_x - resulting from excess air during combustion (negligible for cremation).

3. Thermal NO_x - resulting from high oxygen concentration, high temperatures, and high residence times in the combustion zone (relevant during cremation). High levels of thermal NO_x are dependent on flue gas [oxygen] flow during cremation. Gas flow for a gas cremation is typically 2000mg/m_3 and 1000mg/m_3 for electric cremation; to calculate NO_x concentrations, the length of the cremation process must be considered. The cremation process is a non-homogenous procedure with fluctuating flow values, however, an average value based on typical flow regimes exists.

NO_x emissions have a considerable impact on the environment, the particulates can deplete the ozone causing an increase in ultraviolet radiation at the earth's surface. There is an option for both cremator types to install selective non-catalytic reduction (SNCR), otherwise known as DeNO_x, this process requires ammonia to react with the flue gases to convert the NO_x into water vapour. There are challenges associated with SNCR, ammonia is considered a toxic gas and can harm the environment. The rapid application of urea-water solutions requires an on-site tank, which may not be possible with restricted urban space. Nevertheless, NO_x emissions should be zero, and SNCR should be considered. The electric cremator reduces NO_x emissions by c. 33%, without selective non-catalytic reduction (SNCR).

3.4) Additional Considerations

3.4.1) Green Gas Tariff

The green gas market is only in its infancy. It's difficult and expensive to generate gas from renewable sources, but some suppliers do offer some sort of green gas - this is often made through bio-methane, decaying food, plants and animal waste. It is all but impossible to be "eco-friendly" and use gas. That is why over the long term, the best way to reduce the carbon footprint of our energy supply is by using less and switching from gas to electricity. There is currently insufficient capacity in the UK to supply all of our homes, supply is based around 15 per cent of green gas with the rest offset. The price of green gas is approximately 16% higher than the price of natural gas[4].

[4] Ofgem 2022 Available Via: https://www.ofgem.gov.uk/environmental-and-social-schemes/green-gas-support-scheme-and-green-gas-levy/applicants

3.4.2) International Gas Supply

The international energy supply of natural gas has been the topic of news bulletins across Europe since February 2022 when Russia invaded Ukraine. In 2021 the European Union imported approximately 41 percent of its total natural gas consumption from Russia [5]. Since the conflict began, European countries are no longer buying natural gas from Russia, which has significantly reduced the supply of natural gas to the European market. As the demand for natural gas has stayed constant and is particularly high in the winter months and the aggregate supply of the volume of natural gas has fallen this has led to cost push inflation across the energy sector. In 2021 only 4% of natural gas used in the UK was imported from Russia, but the value of all gas the UK imported in 2021 reached £19.6 billion[6]. The majority of this gas was imported from Norway at 74% and Qatar with 8%. European countries are now purchasing greater levels of natural gas from Norway and Qatar which increases the cost of gas in the UK as well.

According to the Department for Business, Energy and Industrial Strategy non domestic natural gas prices have risen on average by 98%[7] between 2021 quarter 2 and 2022 quarter 2. Because of the reduction in international gas supply the National Grid have warned that British households may face power shortages for hours at a time this winter. This may apply to non-domestic industries such as the cremation industry.

In preparation for the winter, the supply of gas in Germany has somewhat been rationed to ensure there is enough gas for key industrial processes and domestic use. To ration the supply industries have been categorised into various categories depending on their necessity to the German economy and society. Crematoria have been classified in the B category and therefore have not been categorised under the highest priority category. This means that if Germany was to experience a shortage of natural gas, then crematoria across the country would not be at the highest priority level and may not be able to operate (depending on the severity of the rationing). Although the UK is more energy secure than Germany, if the conflict in Ukraine and the subsequent banning of natural gas from Russia continues into 2023, 2024 and 2025 crematoria in the UK may face some rationing of natural gas supply in the future.

---

[5] Eurostat, accessed via: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=EU_imports_of_energy_products_-_recent_developments

[6] Research Briefing to the House of Commons, accessed via: https://researchbriefings.files.parliament.uk/documents/CBP-9523/CBP-9523.pdf

[7] Department for Business, Energy and Industrial Strategy, accessed via: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1107499/quarterly_energy_prices_uk_september_2022.pdf

3.5) SWOT Analysis of Natural Gas Cremation

The following table analyses the suitability of the cremation technology.

Strengths	Weaknesses
Existing technology used for cremation at Bournemouth Crematorium which is operated by BCP; minimal staff training required.	High CO_2 emissions from gas combustion, which would mean that the council missed their carbon emission targets.
Cremation time is consistent and takes 90 minutes.	High NO_x emissions from gas combustion.
The capital cost of the machines is estimated between £500,000 to £575,000.	Maintenance costs for the machines can be costly over time.
Opportunities	**Threats**
Short lead time from purchase to installation.	Uncertainty regarding the future of global gas supply.
Potential to switch to either Hydrogen or Bio LPG as an alternative fuel source on the same cremators in the future.	Uncertainty regarding the future of national gas prices.
There may be potential to retain some of the existing infrastructure from the existing gas cremators, which may lower the cost of the installation.	Threat of future carbon taxes (from national government) on industry's that use natural gas to promote electrification.

4) Electric Cremator Installation

4.1) An Outline of the Technology

European manufacturers (DFW Europe and IFZW) have developed new types of electric cremation plants that remove the requirement for a gas connection and the technology has the potential to decarbonise the cremation industry and reduce Nitrogen Oxide emissions. Cremation equipment has a longevity of 15-20 years; therefore, it is significantly important that the council choose the correct method of cremation as this is a medium to long term investment. Across the UK, there are three crematoria with electric cremators in operation (North Oxfordshire Memorial Park, Huntingdon and Hambleton). CDS have worked on two new-build crematoriums (Huntingdon and Hambleton) and have recently taken a third crematorium successfully through the planning process (construction is beginning in the next few months). By the end of 2022, over 20 electric cremators would have been installed by DFW in Europe.

Research completed by The CDS Group has calculated that electric cremation produces 50-80% less CO_2 emissions than gas, this range is controlled by the energy tariff and number of cremations per day. The electric cremator reduces NO_x emissions by c. 33%, without selective non-catalytic reduction (SNCR). An electric cremator, on a green energy tariff, with SCR installed, would reduce CO_2 emissions by c. 80% and NO_x emissions by >99%. Electric cremation operation differs from gas cremation in the context that they are 'hot inserts', whereby the electric cremator operates consistently, and the body fuels the cremation, therefore the more cremations processed the less overall energy consumption. The electric cremators are larger in size compared to the natural gas cremators, the DFW Electric single ended cremator measures 4.285 x 2.48 x 3.3 meters (lxwxh). The DFW double-end cremator measures 4.185 x 2.5 x 3.3 meters (lxwxh). Additionally, the electric cremators are heavier than gas cremators with the single ended machine from DFW weighing 19,500kg and the double ended cremator weighs 22,000 kg.

This chapter of the report will presume that 1,463 cremations will be completed per year at Poole with 6 cremations completed per day on average.

CDS are aware of new generation technology with electric cremators, this new generation of cremators will focus on the size, installation method and performance of the cremator.

Table 22. An Outline of the Latest Electric Cremators Produced

Variable	Result
Capital Cost (Average)	£800,000 (As of October 2022)
Maintenance Costs (Average)	£45,000 per 2 cremators per annum (estimated)
Lifetime	15-20 years
Cremation Time	120 minutes
Lead times from purchase	9-12 months
Manufacturers	DFW Europe

4.2) The Green Agenda

4.2.1) Green Electricity Tariff

Energy companies have started to offer a 'green' electricity tariff in the UK by:

1) Investing in renewable energy projects such as wind turbines and solar farms. By pumping renewable energy into the grid equivalent to that consumed by green customers, suppliers can legitimately claim they are making a tangible, positive impact on the UK's energy mix.
2) Signing contracts with renewable energy producers, agreeing to buy the power they produce.
3) The suppliers purchase certificates in recognition of renewable energy produced somewhere at some point in the UK. It is this strategy which experts are most critical of.

Certificates, known as Regos (Renewable Energy Guarantee of Origin), are issued every time a unit of renewable energy is produced. One Rego is worth one megawatt-hour of energy. Producers can sell these certificates to anyone. Suppliers buy them to match the energy consumed by their customers on green tariffs. That way, they can say that while their customers may be using non-green energy, they are supporting renewable energy production. Suppliers with green tariffs backed purely by Regos include Outfox the Market and Utility Warehouse. A news article published on BCP Council's website states that all electricity used in council owned buildings is powered on 100% renewable energy as of September 2019[8]. The electricity procured is supplied by energy company Npower and it is a fully audited Renewable Energy Guarantees Origin (REGO) certified product, the energy is generated from wind and hydro sources.

[8] BCP 2019 Available from: https://www.bcpcouncil.gov.uk/News/News-Features/Climate-and-Ecological-Emergency/BCP-Council-electricity-is-going-green.aspx

4.2.2) The Climate Emergency

On 16th July 2019, BCP Council declared a 'climate and ecological emergency' which pledged to make BCP Council and its operations carbon neutral by 2030. This pledge takes into account the council's production and consumption emissions, which is particularly relevant to the operations of a natural gas or electric cremator. The plan states that BCP Council will 'Procure all Council electricity from zero-carbon renewable sources' by 2030.

4.3) Emissions

4.3.1) Carbon Dioxide Emissions

As most types of cremation involve the process of combustion (except Resomation) the process of cremation inherently produces greenhouse gases. Combustion results in a number of products: in the case of organic combustion carbon dioxide, water and energy. Therefore, in this analysis emissions resulting from the combustion of the body and coffin are also included. Emissions are dependent on the size of the body and coffin, with an average of 26.9kg CO_2 released during cremation, as highlighted in Table 19 below. The emissions data includes all variables of energy consumption, for gas, this includes the start-up process of the machine to reach the required cremation temperature (RCT), for electric cremation this includes all energy consumption as the machine uses energy even when non-operational as they maintain their levels of heat. For both crematorium types, the more cremations processed per day, the lower the relative CO_2 emissions per cremation.

Research completed by the CDS Group has calculated that electric cremation produces 50-80% less CO_2 emissions than gas, this range is controlled by the energy tariff and number of cremations per day. Additionally, this produces 33% less NO_x emissions without selective catalytic reduction (SCR).

Table 23. CO_2 Emissions for an Average Cadaver and Chipboard Coffin

Source	Average Weight	Carbon Content	Total CO_2 Emissions
Cadaver	76.5kg	18% of Average Body	12.6kg
Chipboard Coffin	35kg	409g CO_2 e/kg	14.3kg
Total	n/a	n/a	**26.9kg**

CO_2 emissions from electric crematorium are noticeably lower than those from gas crematorium. CDS have derived the electricity consumption of electric crematorium provided by DFW and then this was averaged with consideration to CO_2 production. The data in the table below has been calculated by using the estimated electrical energy Carbon intensity of 0.231kg. Also, the amount of CO_2 released from the combustion of the body totals 26.9kg. From the BCP Council website we know that all electrical energy used in BCP buildings is purchased on a Green Electricity Tariff and therefore the only carbon emissions from each cremation is from the cadaver and the coffin. In the future Poole crematorium and BCP Council could reduce emissions further by working with local funeral directors and coffin suppliers to invest in coffin's which are more environmentally friendly

Table 24. DFW Electric Cremator Estimated CO_2 per Cremation

Cremations Per Day	kWh Per Hour	CO2 Per Cremation (Grid Electricity, inc. Body and Coffin)	CO2 Per Cremation (Green Electricity Tariff, inc. Body and Coffin)
1	20	**137.9kg**	**26.9kg**
2	18	**76.9kg**	**26.9kg**
3	15	**54.9kg**	**26.9kg**
4	14	**45.9kg**	**26.9kg**
5	13	**40.9kg**	**26.9kg**
6	12	**37.9kg**	**26.9kg**

The table above is a theoretical demonstration that as the number of cremations completed per cremator a day increases, the rate of CO_2 produced through the cremation process is significantly reduced for electric cremators. By using an electric cremator which operates on a green energy tariff the amount of CO_2 released stays at a constant rate at 26.9kg as this is the amount of CO_2 released when burning an average cadaver and standard chipboard coffin, no additional CO_2 is produced from the burning of the fuel source. The energy used in the kWh Per Hour column above are much lower those for the gas cremators. But as the machines are always on and kept operational for 24 hours a day, there any energy use per day can be multiplied by a factor of 24.

As the fuel mix for electricity becomes 'greener' due to the prevalence of sustainable technologies such as solar and wind power, there will be a further 44% reduction in CO_2 emissions from an electric cremator connected to the national electricity grid between 2020 and 2050. Fuels, such as hydrogen blend and biogas may be feasible in reducing emissions in certain cases, however, they are not viable solutions for the UK industry due to the number of cremations completed in the country.

Theoretically if 2 gas cremators were fuelled by natural gas and completing 3 cremations per day, this would generate approximately **839.4 of CO_2 per operational day** (inc. cadaver and coffin). Whereas if 2 electric cremators fuelled by green electricity used were completing 3 cremations per day, this would generate approximately **161.4kg of CO_2 per operational day** (inc. cadaver and coffin). **Per working day, a natural gas cremator would release 678kg more CO_2 than a green tariff electric cremator.** If electric cremators were installed on a green tariff this would reduce carbon emissions by **170.86 tonnes annually.**

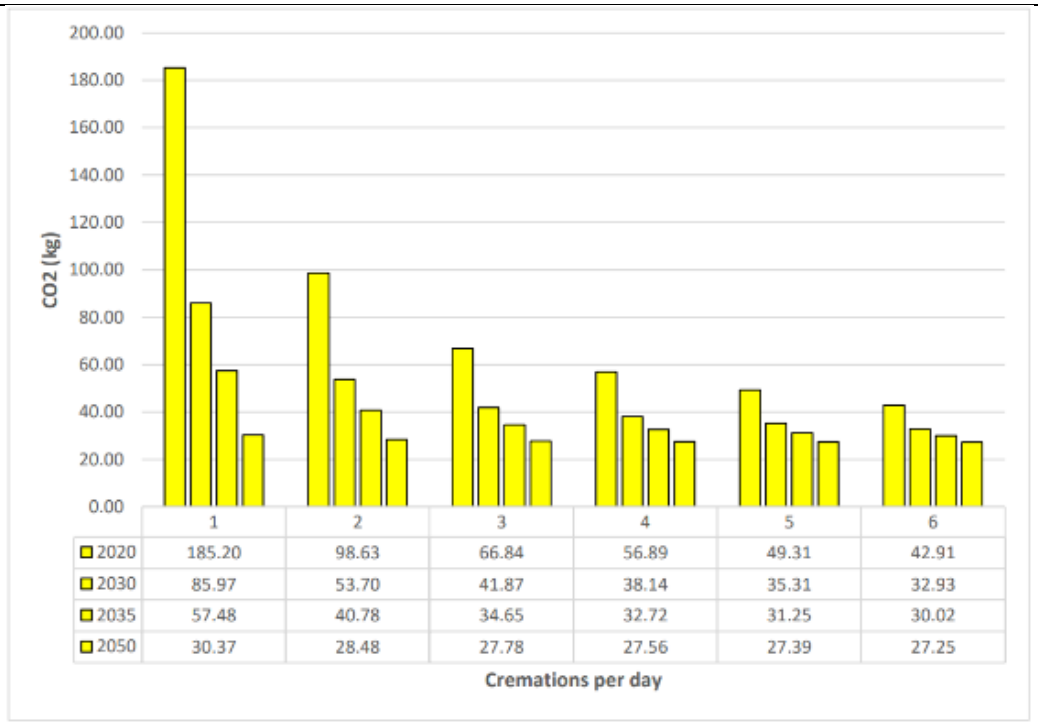
An electric cremator operating on a green energy tariff emits the same amount of CO_2 per cremation regardless of the number of cremations per day. The assertion of '100% renewable electricity' from green electricity tariffs is contested, however, there are energy companies that do generate renewable energy funded by consumer energy tariffs initiating contracts to kickstart new renewable generation, such as Ecotricity and Good Energy (Which 2019).

4.3.2) Future Carbon Dioxide Emissions for Electricity

The Climate Change Committee (2020) determine electrification as a key response required to reach net-zero by 2050 and highlight that low-carbon electricity is now lower-cost than fossil-fuel generated electricity. Furthermore, the UK government, with this focus on a zero-carbon economy, has also banned the sale of new petrol and diesel cars from 2030 (BEIS 2020). Cremation plants last

15-20 years, they have fewer limitations when compared to the electrification of transport, i.e., battery life and charging points.

The carbon intensity of grid electricity is projected to decrease to 44gCO_2/kWh [by 2035], with the further uptake of renewable energy and a reduction in gas generation (BEIS 2018). The carbon intensity from electricity in 2050 may be 5gCO_2/kWh, based on a flexible system including carbon capture, nuclear energy, and green hydrogen power (BEIS 2020). If a crematorium was to install an electric cremator, operating on grid electricity, they should expect, at current projections, for CO_2 emissions to decrease by 1.84% per year.



	1	2	3	4	5	6
2020	185.20	98.63	66.84	56.89	49.31	42.91
2030	85.97	53.70	41.87	38.14	35.31	32.93
2035	57.48	40.78	34.65	32.72	31.25	30.02
2050	30.37	28.48	27.78	27.56	27.39	27.25

Figure 9. Projection of Electric Cremation Emissions [cremations per day] (kg)

As BCP Council utilise a green electricity tariff the 'greening' of grid electricity will mean in time that the price of green electricity tariffs will fall.

4.3.3) Nitrogen Oxide Emissions

The switch to electric cremators also leads to a reduction in nitrogen oxide (NO_x) emissions. The measurement of NO_x emissions is complex as there is not a single conversion factor available to measure NO_x from fuel use. There are three types of NO_x emissions during combustion (US EPA 1999):

1. Prompt NO_x - resulting from excess air during combustion (negligible for cremation).

2. Thermal NO_x - resulting from high oxygen concentration, high temperatures, and high residence times in the combustion zone (relevant during cremation). High levels of thermal NO_x are dependent on flue gas [oxygen] flow during cremation. Gas flow for a gas cremation is typically 2000mg/m_3 and 1000mg/m_3 for electric cremation; to calculate NO_x concentrations, the length of the cremation

process must be considered. The cremation process is a non-homogenous procedure with fluctuating flow values, however, an average value based on typical flow regimes exists.

NO_x emissions have a considerable impact on the environment, the particulates can deplete the ozone causing an increase in ultraviolet radiation at the earth's surface. The electric cremator produces a third-less NO_x than gas; however, a reduced cremation time would also lower NO_x emissions. There is an option for both cremator types to install selective non-catalytic reduction (SNCR), otherwise known as $DeNO_x$, this process requires ammonia to react with the flue gases to convert the NO_x into water vapour. There are challenges associated with SNCR, ammonia is considered a toxic gas and can harm the environment. The rapid application of urea-water solutions requires an on-site tank, which may not be possible with restricted urban space. Nevertheless, NO_x emissions should be zero, and SNCR should be considered.

4.4) Financial Cost Implication of Electric Cremators

4.4.1) Capital Costs

The financial cost of electrification is a critical element in the transition to lower emissions, and levelised cost is an important measure as renewables increase. Thus, it is prudent to analyse the running costs of electric cremators using current business energy costs.

Capital costs are important in decision making, electric cremators are available from two European suppliers [DFW Europe and IFZW] at present (an additional third supplier is discussed under section A.11 of the report). The IFZW cremators were not considered for this report due to the size of the cremators, these cremators are largely used in Europe where cremations are completed off site usually in industrial warehouses (legislation under the 1902 cremation act makes developments like this in the UK more challenging).

The most recent price quoted by DFW for an electric cremator, to The CDS Group's knowledge, was in October 2022 for £800,000. Therefore, the capital cost of an electric cremator is approximately £225,000 to £300,000 more expensive than a gas cremator.

The price of cremators is likely to increase, in the near future, with inflation due to the number of components required to build an electric cremator. Additionally, as a result of supply chain shortages caused by the Covid-19 pandemic and Brexit, some of the parts required to construct the electric cremators are taking additional time to source. Therefore, currently the lead times for an electric cremator from purchase to installation is approximately 9 months to a year for a DFW electric cremator.

4.4.2) Operational and Maintenance Costs

The Property Service Manager was able to provide the current cost of electricity at Poole, which is 40 pence per kWh during standard hours and a night tariff of 38 pence per kWh. The electricity supplied to Poole Crematorium is on a green electricity tariff, therefore to provide a comparison to BCP Council for the cost of grid electricity, a quote was sought to offer a direct comparison of cost per cremation (date of quote was 9/1/2023). The quote shown in the figure below was provided by

E.O.N and was based solely on the postcode of Poole Crematorium and the estimated amount of energy required per annum to operate the cremators to complete 1,463 cremations per annum. The unit rate quoted was 34.28 pence per kWh.

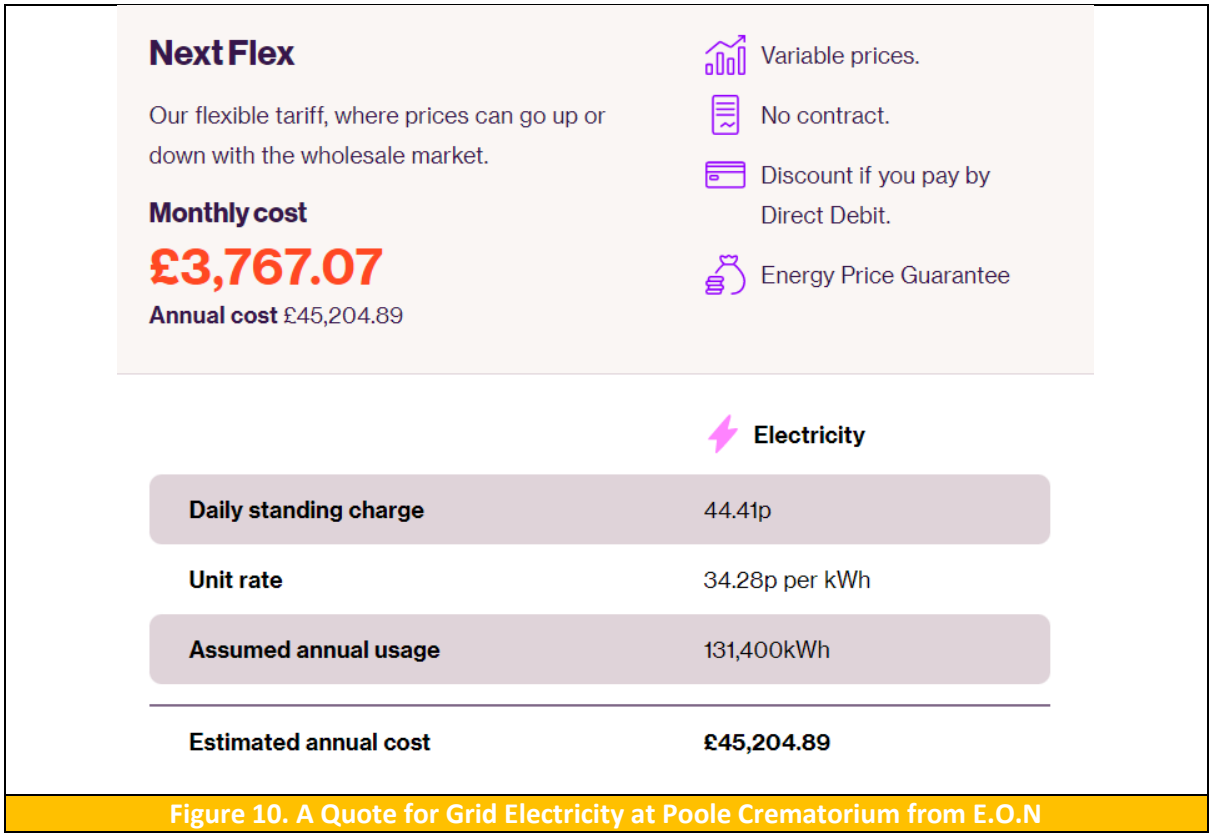


Figure 10. A Quote for Grid Electricity at Poole Crematorium from E.O.N

Table 25. Cost per Cremation for Electric Cremators

Cremations Per Day	kWh/hr	Costs Per Cremation* (Grid Electricity) To the Nearest £	Costs Per Cremation* (Green Electricity) To the Nearest £
1	20	**£238**	**£274**
2	18	**£107**	**£123**
3	15	**£60**	**£69**
4	14	**£42**	**£48**
5	13	**£31**	**£36**
6	12	**£24**	**£27**

The costs provided in the table above are estimated costs, as multiple factors affect the efficiency of electric cremators (based off data provided by DFW and other crematoria in the UK).

The cost of electricity in the table above is analysed by the cost per cremation for both grid and green electricity to highlight the difference in price between grid and green electricity. The cost for the grid electricity is calculated by multiplying kWh per hour (15) by the number of hours in a day and then by the number of days in a year (15 x 24 x 365) as the electric cremators are always active. This total is then divided by the number of working days per year (252) multiplied by the number of

cremations per day (252 x 3), which is then multiplied by the price of the electricity (34.28 pence). The cost of the grid electricity as referenced above is based on a quote provided by E.O.N.

With the green electricity tariff which is used by Poole crematorium, the cost of electricity differs throughout the day, with electricity priced at 40 pence per kWh between 07:00 and 00:00. Between 00:00 and 07:00 a 'Night Tariff', is applied and therefore the cost of the energy is slightly lower at 38 pence per kWh. Therefore, in the column highlighted in green, the difference in price has been factored in and therefore the 40 pence price has been multiplied by 17 hours whilst the 'Night Tariff' has been charged for 7 hours, then multiplied by 365 and divided by the number of cremations and multiplied by the price of the electricity. These totals are then added together to produce the values in the table.

Table 22 shows that the cost effectiveness of electric cremators increases as the number of cremations they perform per day increases. As the number of cremations performed per day increases, the required kWh per hour decreases due to the coffin assisting in fuelling the cremation process, resulting in the need for less electrical energy to maintain the necessary temperature for cremation. Thus, based on the current energy unit prices at Poole crematorium, the cost of each cremation for a cremator performing 3 cremations per day is:

- Natural Gas Cremator – **£85.6718 per cremation**.
- Electric Cremator (Grid Electricity) - **£59.5819 per cremation.**
- Electric Cremator (Green Electricity) – **£68.5099 per cremation**.

These calculations show, if 2 electric cremators (on Poole's existing electricity tariff) would be more cost effective than natural gas cremators by approximately **£17.16** per cremation.

With 1,463 cremations calculated to be completed per annum at Poole, it means that the operational cost of the cremators is:

- Natural Gas Cremator - **£125,338.**
- Electric Cremator (Grid Tariff) **- £87,168.**
- Electric Cremator (Green Tariff) - **£100,230.**

Therefore, on the **current tariff** it is estimated that an electric cremator would be approximately **£25,108** cheaper per annum. CDS estimate for the life span of an electric cremator to be 20 years, therefore a cost saving of approximately **£502,157 is estimated over the cremator's lifetime (for two electric cremators).**

As the electric cremators are always operational there is less fluctuation in the temperature of the brickwork inside the cremator and therefore CDS expect the maintenance costs to be lower compared to the gas cremator. CDS have estimated the annual maintenance cost to maintain two electric cremators is £45,000 per annum.

Table 26. Estimated Operational Cost per Annum for Electric Cremators on a Green Tariff (inc. Maintenance)

	Cost Per Annum (£)
2 Electric Cremators (Green)	£145,230

In conclusion due to the infancy of the electric cremator technology, in the medium to long term, the financial cost savings of this technology compared to traditional natural gas cremation are somewhat unknown.

4.5) External and Indirect Considerations

4.5.1) Structural

Each electrical cremator weighs approximately 20,000kg, where the existing gas cremators are estimated to weigh 17,000kg. Suitable foundations would be required to ensure the electric cremators would be structurally supported by the building. The Property Services Manager at BCP has recommended that if electric cremators were to be installed an intrusive investigation into the ground slab would be advised.

4.5.2) Summary Plant Requirements

The estimated plant requirements to allow for the installation of the proposed electric cremators are as follows:

- New segregated exhaust system for each cremator with new chimneys.
- New mechanical ventilation system providing approx. 30,000m^3/h supply air to cremator hall
- New segregated external condenser for each cremator.
- New incoming electrical supply of 630A TP&N/350kVA with a new local substation rated 500kVA required.
- New 630A TP&N MCCB electrical switchboard with 200A TP&N outgoing supplies to each cremator.

Further:

- Plant space for electric cremators is based on Specialist advice and is assumed as 4000mm long x 2300mm wide x 3400mm high.
- The weight of the electric cremators has been confirmed by specialists to be 20,000kg.
- The chimney and ventilation requirements for the cremator plant have been based on the manufacturer's information and specialist advice and as such no additional requirement other than those identified will be required.

4.5.3) Heat Recovery

As Poole does not use gas in the existing building, The CDS Group have presumed that the crematorium uses electricity for its central heating. As electric cremators are always operational, they are more efficient than gas cremators and therefore less energy can be recovered from the cremation process as less heat is lost between cremations. Gas cremators can recover approximately 250kW of heat per process, whereas electric cremators gather around 150-200kW per process. Although CDS have worked with Huntingdon Crematorium, who operate two electric DFW cremators, to utilise a heat recovery system from their electric cremators to heat two large glasshouses which the Town Council use to grow plants for the town. The opportunity to harness heat recovery technology can be explored at the council's request.

4.5.4) Staff Training for Electric Cremators

The manufacturers of electric cremators would provide the staff with training on all machinery on-site, this includes training for both existing and new staff members. All the relevant health and safety certification still applies for electric cremation, the same as gas cremation. Electric cremation does not require a shutdown the same as gas, as electric cremators operate all the time.

4.5.5) STATS Upgrade Cost

To provide a formal quotation for STATS upgrades for electric cremators, on-site surveys to determine the suitability of sub-stations and viable cable routes, would be required. The location of the nearest substation is unknown, it is unlikely that the existing substation would provide the electrical capacity required to operate the cremators.

CDS have undertaken specialist STATS upgrade surveys for other councils and would be able to complete a survey for Poole Crematorium, once a decision on cremator types has been made.

For two electric cremators a 500kVA sub-station will need to be installed to provide the required 350kVA supply. There will be a requirement to provide a new local transformer and new incoming electrical supply to the building. A new 630A TP&N 12-way switchboard shall be required, also it is recommended electrical distribution equipment that is past its economic life expectancy is replaced with new equipment as part of the upgrade.

For another site which CDS has worked on whom required **two electric cremators for 1,500 cremations a year**, based on existing electrical infrastructure a budget quotation of **£145,000.00** was provided by the local DNO for the installation of the new proposed sub-station. This quote included:

- Offsite works.
- All on and off-site excavation & reinstatement of trenches.
- Provision of HV & LV cabling.
- Provision of sub-station (GRP).
- Provision of sub-station plinth.

Also, additional elements of works were required in this case to permit the upgrade which were completed by the Main and Electrical Contractor. These works included:

- Ducted entry from sub-station to Cremator Hall.
- Modification to ramp between sub-station and Cremator Hall.
- Incoming main MCCB device with CT Chamber.
- New 630A TP&N rated switchboard and associated cabling connections for incoming and outgoing.

Based on a high-level estimation the above works were expected to be in the region of £45,000.00.

Therefore, the estimated allowance for the works required to be completed are:

WPD Budget Estimation - £145,000.00

Contractor Works - £45,000.00

Contingency 10% - £25,000.00

Total - £225,000.00 plus VAT

The cost for electrical infrastructure upgrades is totally dependent on distances for ducting and the capacity of the local network. These calculations were based on prices from the last quarter of 2021 at an alternative site, therefore further consultation will be required with The CDS Group and our Electrical Engineering team to determine updated costs.

4.6) SWOT Analysis of Electric Cremators

Strengths	Weaknesses
Electric cremation on a green energy tariff reduces CO_2 emissions by 80%. Electric cremation releases 33% less NO_x emissions.	Electric cremators have a higher capital cost.
Based on the energy unit prices that Poole operate on electric cremation would be approximately £17 cheaper per cremation than a gas cremation.	Electric cremators require more space due to the requirement for the separate filters and fans and abatement system.
Because of the combustion technique, there is a smaller risk of fires due to the operation of the machine.	The length of cremation times is longer, approximately average 2 hours.
If future legislation is to change where all crematoria must switch away from gas or switch to a greener gas, then Poole would have already overcome this issue by switching to electric.	The lead times for purchasing electric cremators are estimated to be >9 months.
Maintenance costs of electric cremators are thought to be lower in the long term due to the reduction in heat fluctuation which reduces stress on the refractory lining of the brickwork.	Less effective for heat recovery systems to be used in heating the building or heating other buildings due to the efficiency of the electric cremators in retaining heat.
Opportunities	**Threats**
The future UK gas prices are expected to increase due to the reduced availability of gas in global markets. Gas prices are increasing at a higher rate than electricity.	A STATS upgrade may be required, which may require the digging up of roads, causing disruption. The upgrade may also come at a high financial cost – which is currently unknown.
To the knowledge of CDS no crematoria in Dorset offers electric cremation, therefore if marketed suitably to funeral directors, Poole could claim to offer the 'greenest' cremation process in Dorset. This would mean that Poole has a competitive advantage over other crematoria in the area.	Due to the weight of the electric cremators, the foundations of the building may need to be reinforced to withstand the additional weight of the electric cremators.

5) Cost Management Analysis

The following chapter provides BCP Council with a full breakdown of the costs associated with the installation (and operation) of new electric or gas cremators.

After completing the practical capacity calculations and determining the difference in time it takes for a natural gas and electric cremation to be completed, it was determined that the cremator technicians wouldn't be required to work additional hours or complete shift work (at peak periods in the winter months or if nearby facilities cannot complete cremations this may change). Therefore the cremator technician salary wasn't included as part of this cost management analysis.

The energy price tariffs used throughout the report are based on the existing gas and electricity tariff which Poole Crematorium operates on. Therefore the cost of green electricity is 40p per kWh during the day and 38p per kWh between 00:00 and 7:00. The cost of grid electricity would be approximately 34.28p per kWh – this was ascertained by a price E.O.N quoted to CDS. The cost of gas is 12.495p per kWh.

Whilst the options for the development works remain undecided in the detail of the design, the subsequent phasing of works can be structured into the general approach described below.

5.1) Cremator Replacement Costs

5.1.1) Contextual Information

It is the Client's aspiration that the crematorium remains in operation throughout the proposed works, this means that services will still be occurring at Poole. The proposed works would as a minimum, require the existing gas cremators to be decommissioned and removed to allow for a new install of the electric cremators. The logistics of working hours, safe working practices, interfacing with proposed ceremonial services, noise issues, and planned shut down for existing plant alterations/infrastructure upgrade shall need to be agreed with both Contractors and Client. As the width of the doorway to the crematory measures under 3 meters, CDS would recommend that the council ascertain that the existing gas cremators can be removed through this doorway. If the existing gas cremators cannot be removed through this doorway a section of the roof would be required to be removed or a cavity in the wall would need to be created to remove the cremators safely.

5.1.2) Sequence of Works

This section outlines the suggested sequence of works if electrical systems are installed that are deemed to be the least impact on the site and allow for the continued operation of the site.

- Phase 1 – completion of building works to facilitate removal of cremators.
- Phase 2 – decommission and removal of existing gas cremators including removal of gas supplies and any required chimney connections to head end if required. The removal of gas

connection to redundant cremator would require gas isolation until safety is removed and capped.

- Phase 3 – Undertaking of all internal refurbishments works that can be concluded before reinstallation of 2 electric (or 2 gas) cremators.
- Phase 4 – installation of 2 electric (or gas) cremators including new chimneys per cremator, electrical cabling, and 200A TP&N isolator, the connection of new and/or existing associated equipment.
- Phase 5 – installation of new required mechanical ventilation systems.
- Phase 6 – removal of the external condenser and replace for 2 no. smaller units serving each cremator.
- Phase 7 – installation of new 500kVA substation and 630A/350kVA incoming electrical supply from new local sub-station and associated switchboard and metering.
- Phase 8 – test and commission 2 no. new electric cremators for operation once complete.

5.1.3) Initial Structural Review

A structural engineer would be required in the first instance to undertake a detailed review of all elements of the proposed options to determine the extent of any modifications or structural changes that would need to be considered before any installation being undertaken. The Cremator Specialist has confirmed that each electrical cremator weighs approximately 20,000kg, where the existing gas cremators are estimated to weigh 17,000kg. The Structural Engineer will confirm if the proposed plant replacement strategy is feasible and if any structural reinforcement works are required.

5.1.4) Quantifying Downtime

Quantifying downtime is subject to whether the chapel is kept in operation during the refurbishment. Disruption to chapel services could occur on some occasions however proper management could mean that majority of works take place out of service hours.

To complete the entire replacement, The CDS Group predicts the construction period will last an estimated 3-4 months.

5.2) A Breakdown of Cremator Replacement Costs (2-Electric Cremators)

Table 27. A Breakdown of Cremator Replacement (2-Electric Cremators)

Group Elemental Breakdown		Totals
Main Contract Works		
Demolishment of existing cremators		£40,000.00
STATS upgrade		Approx. £196,511.00
Installation and re-build of walls to install cremators		£60,000.00
Attendances / Coordination / Management etc. of Electric Cremator Installations		£7,500.00
Main Contractor OHP @ 15% on above		£45,601.00
Subtotal facilitating		**£349,612.00**
Cremators (elec x 2) inc abatement etc. (based on DFW machines)		£1,600,000.00
Internal structural changes estimate		Approx. £60,000.00
M&E works		£80,000.00
Subtotal facilitating and building works		**£2,089,612.00**
Main Contractor Preliminaries (say 26-week programme)		£234,000.00
Total building works est.		**£2,323,612.00**
Other development costs		
Professional fees inc architect, planning, SE, PM, QS, etc		£98,904.00
Off-site staff allowance		£15,000.00
Construction cost estimate		**£2,437,516.00**
Client Contingency / Risk allowance (12%)		£292,501.92
Inflation allowance (5%)*		£121,875.80
Estimated total project cost		**£2,851,893.72**

5.3) A Breakdown of Cremator Replacement Costs (2-Gas Cremators)

Table 28. A Breakdown of Cremator Replacement (2-Gas Cremators)

Group Elemental Breakdown		Totals
Main Contract Works		
Demolishment of existing cremators		£40,000.00
Installation and re-build of walls to install cremators		£60,000.00
Attendances / Coordination / Management etc. of gas Cremator Installations		£7,500.00
Main Contractor OHP @ 15% on above		£16,125.00
Subtotal facilitating		**£123,625.00**
Cremators (gas x 2) inc abatement etc. (based on Mathews/DFW machines)		£1,075,000.00
M&E works		£40,000.00
Internal structural changes estimate		Approx. £60,000.00
Subtotal facilitating and building works		**£1,298,625.00**
Main Contractor Preliminaries (say 15-week programme)		£120,000.00
Total building works est.		**£1,418,625.00**
Other development costs		
Professional fees inc architect, planning, SE, PM, QS, etc		£65,000.00
Off-site staff allowance		£11,000.00
Construction cost estimate		**£1,494,625.00**
Client Contingency / Risk allowance (12%)		£179,355.00
Inflation allowance (5%)*		£74,731.25
Estimated total project cost		**£1,748,711.25**

*In table 27 and table 28 listed above, CDS have included an inflation allowance to account for inflationary pressures at 5%. For this costing analysis CDS have assumed that the procurement for the electric or gas cremators will occur by January 2024. If the procurement of the cremators occurs after this date a further contingency should be added to the estimated total project cost.

5.4) Cremator Cost Comparison Across Cremator Lifespan

This chapter of the report will draw on information presented in the excel spreadsheet provided to BCP Council in the pack of information submitted to the Bereavement, Coroners & Mortuary Manager.

The calculations presented throughout this report are based on the current tariff price for both natural gas and electricity at Poole Crematorium. To calculate the cost of utility prices in the future The CDS Group have presumed that the unit price per kWh for both gas and electricity will increase by 2% year on year. Table 28 and Figure 11 below do not include the cost of a STATS upgrade that is likely to be required at the site in order to provide the electric cremators with sufficient capacity to operate effectively. Furthermore, this analysis does not include the cost to maintain the cremators.

The high-level costing analysis completed indicates that after **18 years 2 electric cremators are more cost effective than 2 gas cremators** based upon the cumulative capital and operational cost of the cremators.

Table 29. Cumulative Capital and Operational Cost Combined

Cumulative Capital and Utility Cost Combined	2 Gas Cremators	2 Electric Cremators
Year 1	£1,200,338	£1,700,230
Year 2	£1,328,182	£1,802,465
Year 3	£1,458,584	£1,906,744
Year 4	£1,591,593	£2,013,109
Year 5	£1,727,263	£2,121,601
Year 6	£1,865,646	£2,232,263
Year 7	£2,006,797	£2,345,138
Year 8	£2,150,771	£2,460,271
Year 9	£2,297,624	£2,577,707
Year 10	£2,447,414	£2,697,491
Year 11	£2,600,201	£2,819,671
Year 12	£2,756,042	£2,944,294
Year 13	£2,915,001	£3,071,410
Year 14	£3,077,139	£3,201,068
Year 15	£3,242,520	£3,333,319
Year 16	£3,411,208	£3,468,216
Year 17	£3,583,270	£3,605,810
Year 18	**£3,758,773**	**£3,746,156**
Year 19	£3,937,786	£3,889,310
Year 20	£4,120,380	£4,035,326

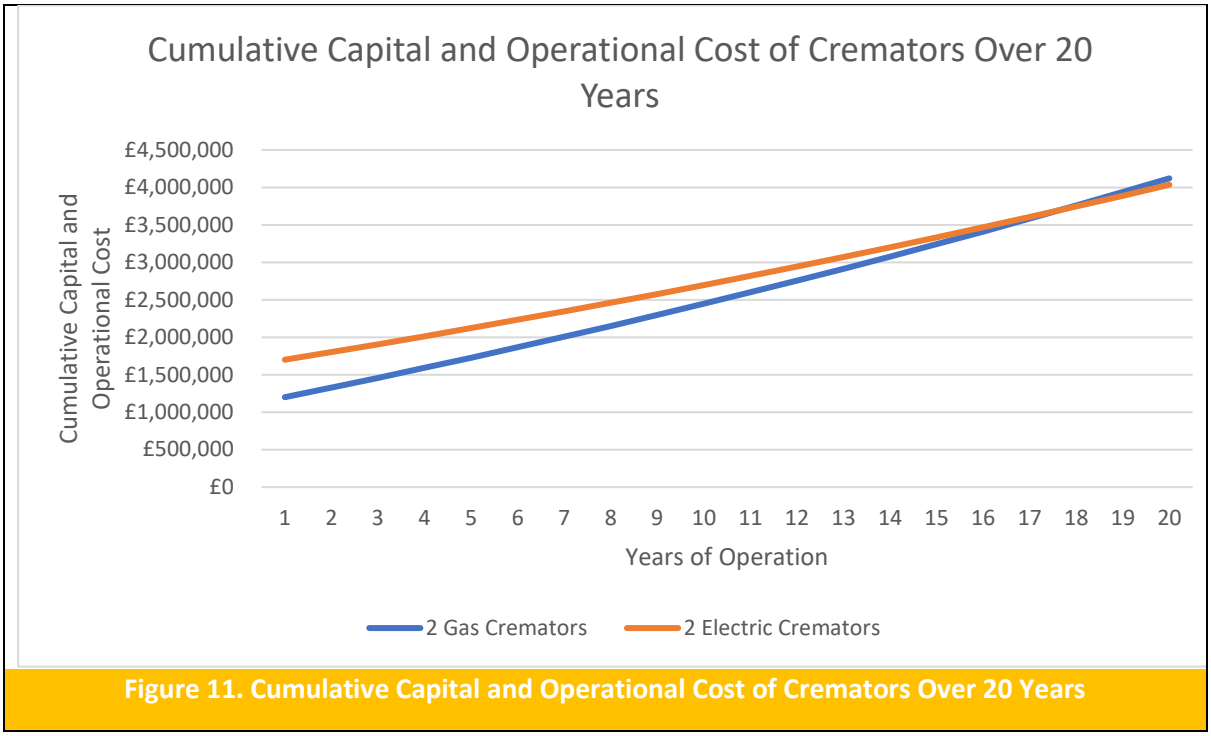


Figure 11. Cumulative Capital and Operational Cost of Cremators Over 20 Years

6) SWOT Analysis of Cremator Replacement

The information in this table has been scored according to the impact of installing cremators at Poole Crematorium. The scoring range for this table is between +3 and -3, with -3 a significant weakness or threat and +3 a significant strength or opportunity. The installation of electric cremators is highlighted in the strengths and opportunities column and the installation of gas cremators is highlighted in the weaknesses and threats column.

Table 30. SWOT Analysis of Installing Electric Cremators

Strengths		Weaknesses	
Electric cremation on a green energy tariff reduces CO_2 emissions by 80%. Electric cremation releases 33% less NO_x emissions.	+3	Existing technology used for cremation at Bournemouth Crematorium is gas which is operated by BCP; minimal staff training required.	-1
Based on the energy unit prices that Poole operate on electric cremation would be approximately £17 cheaper per cremation than a gas cremation.	+3	Cremation time for gas is consistent and takes 90 minutes.	-3
Because of the combustion technique, there is a smaller risk of fires due to the operation of the machine.	+1	The capital cost of the gas cremators is estimated between £500,000 to £575,000.	-3
If future legislation is to change where all crematoria must switch away from gas or switch to a greener gas, then Poole would have already overcome this issue by switching to electric.	+1	Downtime is limited in maintenance periods of gas cremators.	-1
Maintenance costs of electric cremators are thought to be lower in the long term due to the reduction in heat fluctuation which reduces stress on the refractory lining of the brickwork.	+2		
Subtotal	+10	**Subtotal**	-8

Opportunities		Threats	
The future UK gas prices are expected to increase due to the reduced availability of gas in global markets. Gas prices are increasing at a higher rate than electricity.	+2	Short lead time from purchase to installation for gas cremators	-1
To the knowledge of CDS no crematoria in Dorset offers electric cremation, therefore if marketed suitably to funeral directors, Poole could claim to offer the 'greenest' cremation process in Dorset. This would mean that Poole has a competitive advantage over other crematoria in the area.	+3	Potential to switch to either Hydrogen or Bio LPG as an alternative fuel source on the same cremators in the future.	-1
		There may be potential to retain some of the existing infrastructure from the existing gas cremators, which may lower the cost of the installation.	-1
Subtotal	+5	**Subtotal**	-3
Total Strengths and Opportunities	+15	**Total Weaknesses and Threats**	-11
Total SWOT			**+4**

7) Conclusion

CDS have conducted a comprehensive feasibility review of the replacement of the existing gas cremators at Poole crematorium. The opportunity to install electric or gas cremators in the crematory at Poole has been explored in detail.

Practical Capacity

To understand the number of cremators required at Poole crematorium, a comprehensive Drive Time Analysis (DTA) has been completed using industry standard methods. The results state that Poole crematorium is likely to complete 1,463 cremations per annum. This total largely compromises of the existing services completed at Poole Crematorium. Therefore, this report suggests there would be a redistribution of the cremations from Bournemouth Crematorium to Poole. If cremators are installed at Poole this may persuade bereaved families and or relatives to return to Poole instead of going to Purbeck crematorium, therefore CDS expect a small increase in Poole Crematorium's market share if cremators are installed at the crematorium.

With consideration to the time of services at Poole and accounting for a higher rate of deaths in the winter months, the most suitable number of cremators would be two. By assuming there are 252 working days in a year this means that both cremators combined would complete six cremations per day on average and during peak periods seven cremations would be completed per day across the two cremators.

As Poole crematorium has not had operational cremators in place at the site since April 2020, other crematoria that are competing are now established in the cremation market in the wider BCP area. Therefore, CDS would suggest that once cremators are installed at Poole, a significant public relations campaign occurs to increase public awareness that the site is now 'fully operational' and completing cremations once again. CDS also suggest that BCP build a rapport with the funeral directors in the region to communicate that new cremators have been installed.

Natural Gas Cremation

Natural Gas Cremation is proportionately the most popular cremation technology in the UK, with over 95% of UK cremators being fed by natural gas. The capital cost of a gas cremator is approximately £500,000 to £575,000 per cremator. CDS estimate the operational cost of two gas cremators to be £125,337 annually and maintenance to be approximately £45,000 per annum for two gas cremators. There are many benefits to gas cremation, with the largest benefit being its speed of cremation coupled with its consistency. Over the course of a year, 211.5288 tonnes of CO_2 would be produced by two gas cremators (including the carbon emissions released by the cadaver and coffin).

Electric Cremation

The cost of the current generation of a DFW electric cremator is approximately £800,000 which includes the abatement infrastructure required for the electric cremators to operate according to all relevant legislation in the UK. In the coming years CDS are aware that future generations of the electric cremators will be available on the market, the subsequent generations of electric cremators are likely to be able to built inside the crematory and complete cremations on average in under 2 hours.

Electric cremation operation differs from gas cremation in the context that they are 'hot inserts', whereby the electric cremator operates consistently, and the body fuels the cremation, therefore the more cremations processed the less overall energy consumption. CDS estimate the operational cost of 2 electric cremators to be £100,230 annually and the maintenance cost is likely to be lower than the cost to maintain gas cremators. On the current tariffs this means that two electric cremators would be approximately £25,108 cheaper than two gas cremators per annum. On a green electricity tariff only 40.67 tonnes of CO_2 would be released per annum (these emissions would be solely from the cadaver and coffin). **The installation of electric cremators would reduce the councils carbon emissions by 170.86 tonnes annually.**

Conclusion

This report concludes that electric cremation is currently the lowest carbon option for cremation available on the market. BCP Council have declared a 'climate and ecological emergency' in July 2019, which pledged to make the council and its operations carbon neutral by 2030. This pledge takes into account the council's production and consumption emissions, which is particularly relevant to the operations of a cremator.

In conclusion both environmental and economic factors need to be considered when reviewing the technology used for the cremator replacement at Poole. Although electric cremators have a higher initial capital cost, by operating the electric cremators efficiently they can become more cost effective than natural gas cremators (over an 18-year period). The electric cremator is the only technology available on the UK market that would allow the council to meet their carbon emissions targets.

CDS conducted a SWOT analysis in section seven of this report which weighed in the favour of electric cremation at this site by four points, through a semi-qualitative approach. The council could use this as a metric in decision making.