# BUPA CARE SERVICES

# WILMINGTON MONOR CARE HOME

# DARTFORD

# HEAT DECARBONISATION REPORT

REVISION P01

## Document History

| SUITABILITY | REVISION | DATE | DETAILS | BY | CHKD |
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## EXECUTIVE SUMMARY

KJ Tait were instructed to provide a retrospective Heating Decarbonisation report on behalf of BUPA, in relation to the recent installation of an Air Source Heat Pump at BUPA Wilmington Manor Care Home.

Air source heat pumps were installed to provide for the base heating requirement of the Home as part of a life cycle boiler replacement project which also included the replacement of heat emitters, radiators and primary distribution pipework to maximise efficiencies of the installed heat pumps. 2 No. heat pumps rated at 38kW each were installed and replaced an equal amount of existing gas fired boilers. A replacement gas fired boiler module was installed to cater for Hot Water demand which operates at a higher temperature to minimise risk of legionella.

Air source heat pumps were installed to decarbonise the heating of the home as well as reduction of Nitrous Oxide emissions locally. This was generally in line with local and national objectives to reduce local emissions and utilise the improved, lower carbon, grid supplied electricity.

Of the alternative heat sources and low / zero carbon technologies reviewed, air source heat were the most viable solution.

Location of heat pumps was carefully considered with the optimum location adjacent to the existing boiler plant providing the best solution with respect to proximity to local neighbours, avoiding visual impact on the main elevation and minimising impact on residents.

## 1.0 INTRODUCTION

KJ Tait were instructed to provide a retrospective Heating Decarbonisation report on behalf of BUPA, in relation to the recent installation of an Air Source Heat Pump at BUPA Wilmington Manor Care Home.

The BUPA home is located in Dartford, Kent, providing residential and nursing services for people requiring respite, convalescence and palliative care for people over 65.

Air source heat pumps were installed to provide for the base heating requirement of the Home as part of a life cycle boiler replacement project which also included the replacement of heat emitters, radiators and primary distribution pipework to maximise efficiencies of the installed heat pumps. 2 No. heat pumps rated at 38kW each were installed and replaced an equal amount of existing gas fired boilers. A replacement gas fired boiler module was installed to cater for Hot Water demand which operates at a higher temperature to minimise risk of legionella.

Units were installed within a screened compound close to the main plantroom serving the home.

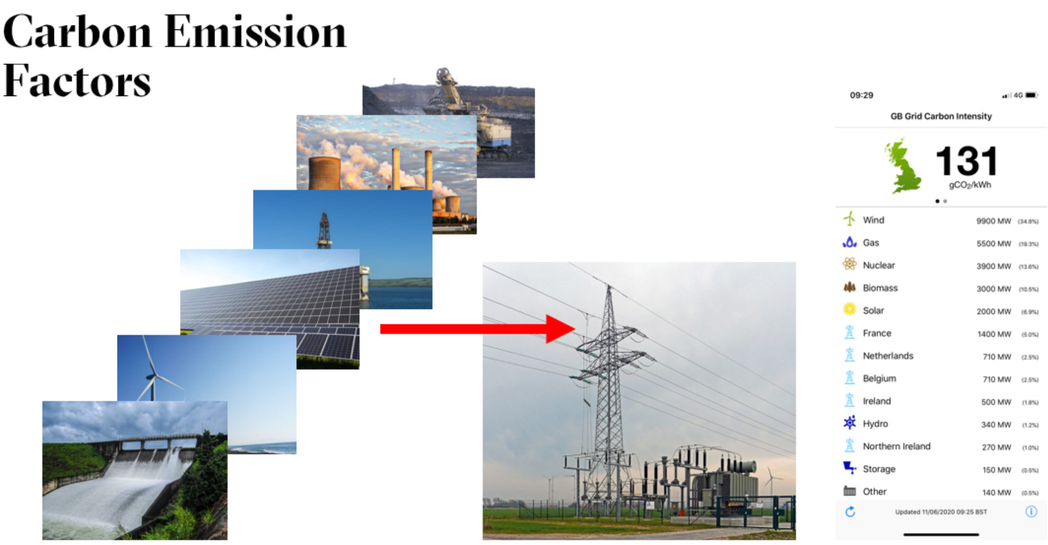
## 2.0 UK BUILDINGS DECARBONISATION

The impact carbon emissions have on the environment and our way of life has been well documented, particularly over the last 5 years with a number of leading global economies declaring a ‘Climate Emergency’. Commitments are being pledged around the world to make changes in an attempt to reduce the devastating effects of global warming.

The building industry, whether through construction, maintenance or operational energy is responsible for approximately half of the UK’s carbon emissions.

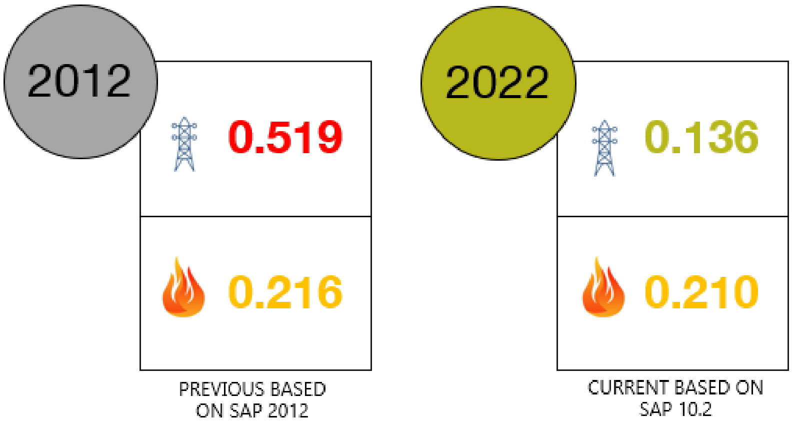
Tackling poorly performing buildings, removing the reliance on fossil fuels and ongoing monitoring is key to success. Every building is complex and bespoke. Even buildings which have been designed to have very low energy consumption will perform just as poorly as an inefficient building if not correctly controlled and managed.

A buildings operational emissions are typically tested and measured against the main fuel carbon emission factors set by the government (measured in $kgCO_2/kWh$). Until recently, these favoured gas as the lower impact of the two primary fuels, however due to the decarbonation of the national grid, electricity has reduced dramatically from a decade ago. This has been achieved primarily through investment of large-scale wind and solar energy.



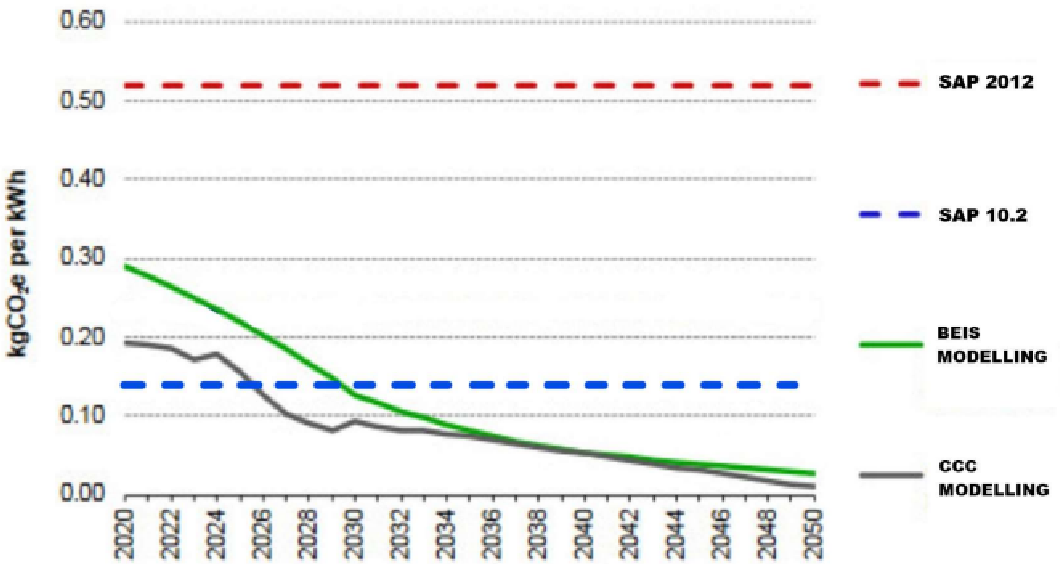
*Graphic showing generator types serving the national grid*

Below is the comparison between the emission factors set in 2012 (which were still being used for compliance until relatively recently) and the new emission factors now in force for new assessments. This shows grid electricity as a much lower carbon fuel source.




The National Grid will continue to decarbonise over-time, predicted to hit 'near-zero' by 2050. This is why buildings which use electricity only as their main fuel are considered to be 'Zero Carbon Ready'.

Gas is also anticipated to reduce over-time with the introduction of blended biogas and hydrogen, however it's unlikely this will happen within the short-term, hence the preference to electrify buildings rather than use 'on site' fossil fuels.




*Decarbonisation trajectory of the National Grid*

## 3.0 LOCAL POLICY

Dartford Council recognised the serious impact of climate change, declaring a 'Climate Emergency' in October 2019. As part of this declaration, on their website the council recommended taking action to reduce carbon by making various changes, including options to decarbonise heat by installing heat-pumps.

The council also submitted the Pre-Submission for the updated Local Dartford Plan on 13th December 2021, including 'Environment and Climate Change Topic Paper'. This is intended to bring together relevant National Planning Policy and local evidence to justify the polices in the Pre-Submission Dartford Local Plan.

In proposed policy 'Climate Change Strategy (S3)' it is noted:

**2.35 -** Climate change is likely to lead to hotter, drier summers, and warmer, wetter winters, with rises in sea levels and an increased frequency of storm events. The Council recognises the serious impact of climate change and the threats posed by rising global temperatures. The Council further recognises that it has a duty to act to ensure that the Borough and its people play a part in securing a sustainable future. It welcomes the Government's commitment to cut greenhouse gas emissions to net zero by 2050 but aspires to go further to tackle the effects of climate change.

**2.36** - The Local Plan has a key role to play in this, and therefore most of the policies of plan include relevant actions. By locating new development in areas well served by facilities and public transport and seeking to improve public transport services as well as walking and cycling routes via the Green Grid network, it will reduce the frequency and duration of private car use and thereby reduce Dartford's carbon emissions. Planning policies can also facilitate measures which encourages the take up of zero or low carbon technology. For instance, through requiring the installation of electric vehicle charging points within new development or promoting domestic renewable energy installations.

## 4.0 WILMINGTON MANOR CARE HOME

The BUPA home is located in Dartford, Kent, providing residential and nursing services for people requiring respite, convalescence and palliative care for people over 65.

Originally built in the Victorian era, the building has been adapted and extended to accommodate 50 residents, plus staff.

The nature of the building restricts certain 'fabric first' improvements, however glazing for example has been upgraded where possible to reduce uncontrolled heat-loss and infiltration. Other improvements such as upgraded high efficiency lighting and controls were also undertaken.

One of the largest sources of energy consumption, and therefore carbon emissions within the building is space heating. As the building is occupied 24 hours a day and vulnerable residents require a slightly warmer environment than considered normal, energy consumption is elevated. Natural gas boilers were originally installed to provide the building with space heating and domestic hot water. As these had reached the end of their economic lifespan, in order to meet their corporate objectives, BUPA wished to explore lower carbon alternatives rather than straightforward like for like replacement.

Decarbonisation of their estate and reduction in energy usage is a key driver for the Client and all new and refurbished schemes have a need to consider the option for potential low carbon alternatives to Gas Fired boilers. This is in line with central government policy where there are phase out dates for gas boilers identified.

## 5.0 ALTERNATIVE HEAT SOURCES

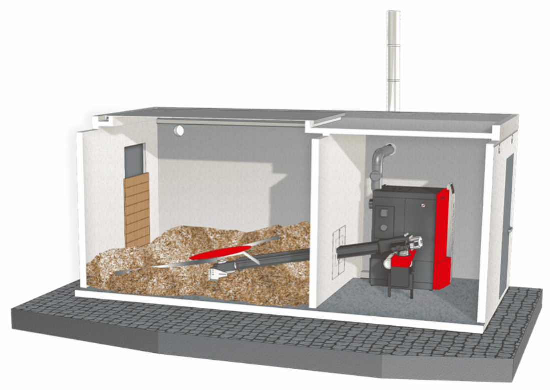
The primary objectives in replacing the heat-source are firstly to replace end of life equipment, but then also attempt to eliminate or reduce the use of on-site natural gas.

There are several potential alternative heat-sources, some of which can be quickly discounted on practical grounds.

5.1 Biomass

Burning wood chip, or pellets to generate heat became more popular on a commercial scale around 10 years ago when the renewable heat inventive was in place. This allowed businesses to install biomass heating plant and effectively be re-imbursed for each kWh produced by the government. When the scheme ended there was decline in uptake. There were also poor installation examples which caused reliability issues and put off many businesses off utilising it.

*Wood Pellets (left) / Wood Chip (right)*



*Typical Biomass Boiler / Feed arrangement*

Interest in biomass has increased recently following turbulent fuel costs and the drive to reduce carbon emissions. Biomass (assuming fuel is sustainably sourced) emits around 75% less CO2 than natural gas and costs approx. 65% less based on current tariffs. Also, unlike a heat-pump solution, it produces high-grade heat meaning the heat is versatile and better suited to large existing buildings which may otherwise struggle to adapt to lower flow temperatures offered by other sustainable sources.

Where a biomass solution might offer a relatively cheap and sustainable source of energy, there are still concerns around reliability of truly sustainable long-term sources of fuel and the argument that particulates produced by burning biomass contribute to air-quality issues.

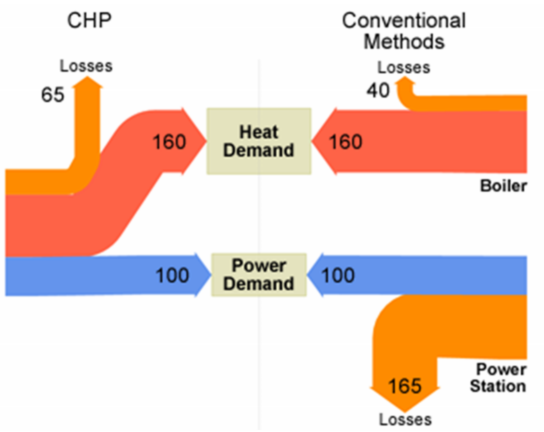
We see the implementation of biomass as a short, to medium-term solution to bridge the gap in carbon emissions on existing sites, allowing building services in older, harder to adapt buildings to be gradually upgraded to low-grade heat solutions. New buildings can be built to operate on low-grade heat from heat-pumps for example, therefore the availability of high-grade heat is less of an issue.

For the reasons above we would not immediately recommend a biomass boiler on this site.

5.2 Combined Heat and Power (CHP)

Combined Heat and Power refers to energy generation equipment that produces both useful heat and power combined. Its most common form is a natural gas engine / turbine which is used to drive an electrical generator, producing heat as a by-product. Typically a CHP engine will produce a 30/60 ratio of electricity/heat, with around 10% losses.

CHP installations are very common in large energy centres and communal heating networks. When they were most common, 1 kWh of electricity taken from the national grid would be responsible for 0.519 $kgCO_2$, however 1 kWh of gas would produce just 0.216. This was due to generation losses suffered by power stations, which rejected waste heat to atmosphere rather than being utilised. CHP's instead burned gas, with a lower carbon emission factor to produce electricity, but also using the waste heat making the process more efficient than grid supplied electricity at the time.





*Tedom CHP engine - credit - Tedom*

As the national grid has continued to decarbonise however, 1 kWh of electricity is now only responsible for 0.136 $kgCO_2$. Therefore when considering generation losses, CHP no longer offers any carbon reduction benefit against an equivalent grid connected power / natural gas installation. It also doesn't align with aspirations to negate the use of on-site fossil fuels.

For these reasons CHP has been discounted.

## 5.3 Solar Thermal

Solar Thermal harnesses energy from the sun similar to photovoltaics, however produces heat rather than electricity. This is a high-grade heat which can be used for domestic hot water storage, or in some cases process heating – i.e. for a swimming pool.

The technology is best suited where a heat-demand is still present during sunny conditions, which does not align with most buildings which have a lower, or almost zero demand during these times. Buildings with a high hot water demand, high dehumidification requirements, or perhaps swimming pools are a good fit for this technology. This system would not necessarily be able to provide the building with a reliable source of hot water for space heating however, so would need be supplemented with another technology. Solar thermal has not been considered at this time, but could potentially be integrated in the future.

*Viessmann Solar Thermal Collector – Roof Mounted Example*

5.4 Ground Source Heat Pumps

The technology behind a ground source heat-pump (GSHP) is essentially the same as an air source heat-pump, with exception to the rejection / absorption medium. Rather than using air, an open, or closed circulation loop is buried underground. This allows the heat-pump to take advantage of a relatively stable ground temperature throughout the year, where an ASHP would need to adapt to the range external ambient temperature experienced in the UK.

However, as this site is unlikely to provide a heating / cooling balance (which is an important factor in GSHP efficiency) it is unlikely to be viable. Also, in the southern parts of the UK the external ambient temperature is relatively close to the ground temperature likely to be experienced, so little or no efficiency benefit can be gained over an ASHP.

For these reasons, as well as the additional capital cost this would likely attract, GSHP's have been discounted.

5.5 Air Source Heat Pumps

An ASAP usually consists of an outdoor unit containing a refrigeration cycle heat-pump and heat exchanger, absorbing, or rejecting energy into external fresh-air via a fan. There are efficiency benefits possible from the high coefficient of performance (COP) of an ASHP, reducing the primary energy use and respective emissions. For example, for every 1 kW of electricity consumed, around 3 or 4 kW of useful heating or cooling energy is provided. This compares to around 0.9kW of useful heat produced by a gas boiler for each kWh consumed. In this instance, a 'heating only' ASAP was considered as no mechanical cooling was required.

One of the shortfalls of an ASHP however is it can only achieve high efficiencies at lower flow and return temperatures. Where a gas boiler will easily produce 80°C flow, a heat-pump may only provide around 50°C. At Wilmington Manor the project included the replacement of all heat emitters and primary distribution pipework to accommodate the reduced flow temperatures and maintain maximum efficiency of the installed heat pumps.

In the case of Wilmington Care Home, based on the average annual gas consumption, we found it would be possible to reduce the buildings annual carbon emissions by 41,727 kg$CO_2$. Nitrous Oxide emissions at the site have also been reduced locally by approximately 2/3rds

## 6.0 HEAT PUMP LOCATION AND DETAILS

Location of heat pump installations was carefully considered in line with the following objectives.

- Proximity to existing service plant to minimise impact and losses of interconnecting pipework.
- Maximise distance and any noise impact to affected neighbours.
- Avoid elevation on front of building visible from drop off point and turning circle.

It should be noted that the Home is surrounded by neighbours on all sides.

Potential locations for the new plant considered as follows.


Discussion on advantages and disadvantages of plant locations as follows.

<u>Option A – Adopted Plant Location</u>

<u>Pros</u>

- Close to existing plant room in basement for easier connection
- Distance from nearest neighbours about as far as possible
- Avoids front elevation and drop off point

<u>Cons</u>

- Visible from access route to nearby neighbours
- Located below resident bedroom on single affected facade

<u>Option B – Rear Garden Area</u>

<u>Pros</u>

- Distance from nearest neighbours although nearest property similar to option A

- Not visible from front of home

Cons

- Long and tortuous route for primary pipework to / from boiler plant. No pipe route available internally and would need to be routed externally on building façade / roof level
- Loss of garden amenity for the residents
- Visible from residents dining room
- Located below resident bedroom on single affected facade

Option C – Front Elevation

Pros

- No benefits identified over alternative locations

Cons

- Long and tortuous route for primary pipework to / from boiler plant. No pipe route available internally and would need to be routed externally on building façade / roof level
- Close to adjacent neighbour
- Located below resident bedroom on two affected facades