Extract from BC Community Heat Network Feasibility Study

1. Air quality improvements

As part of the recent studies a pollution monitor that measures the particulates in the air was installed. In off gas grid areas, such as Bishops Castle, there has continued to be a wider range of heating fuels compared to areas with gas. Some of these fuels and the appliances they are used in generate a range of pollutants that are detrimental to urban air quality. The other main source of urban pollutants has been road vehicles, but these have reduced significantly over recent years. Air quality has been improving over recent decades as heating has moved from coal, oil boilers have become cleaner and there have been large reductions from road vehicles. Now wood, coal, smokeless fuel and older oil boilers are the main sources of particulate pollution. Table 5 below indicates how much worse coal is in comparison with oil and LPG for all pollutant types. Recent research has been highlighting that the health impacts of particulates is greater than has been previously acknowledged. Particulates are abbreviated to PM_{10} the 10 being the particle size being measured. The smaller the particle size the greater the concern. $PM_{2.5}$ is the measurement that is the default display on the Purple Air website. Particulates are probably the local air quality pollutant that is of greatest concern to health.

The monitoring of particles in Bishop's Castle shows that during the winter the air can be poor. The installed PurpleAir monitor can be seen on-line at www.purpleair.com and reports the particulate pollution levels using the US EPA Air Quality Index (AQI). This is an air quality index created by the United States Environmental Protection Agency, and its goal is to convey health-based air quality information to the public.

Figure 12 air quality index explanation

The air quality index measured in Bishops Castle between 26 September 2024 and 8 April 2025 (no data 24 November to 10 December) was:

Air quality index	*hours*
Below 50	*3474*
51-100	*721*
101-150	*31*
151-200	*5*

Table 4 Measured air quality index in Bishops Castle

The lifecycle GHG emissions for traditional fossil fuels, as shown in Table 3, are taken from the HMT Green Book [19], which are the same as the Government emission conversion factors for greenhouse gas company reporting.

Emissions grams per GJ	Coal	Smokeless fuel	Wood	Oil	LPG	Natural gas
Benzene	22	7	58	0.05	0.3	0.2
CO	4600	4600	2900	54	24	23
NOx	118	127	63	48	48	18
NMVOC	490	150	390	1	4	2
SO2	810	490	10	8	0.3	0.3
PM_{10}	307	55	455	2	1	1
CO2 (g/kWh heat)	350	350	15	268	214	184

Table 5 Pollutants from different heating fuels

The precise numbers and pollutant type as shown in Table 5 is not too important, the main purpose of presenting it here is to show how much worse wood, coal, and 'smokeless' fuels are than oil and LPG. Each coal fire or wood burning stove has an impact equivalent to hundreds of oil or LPG boilers for most of the pollutant types.

The figures for natural gas are also presented as gas is the UK's predominant heating fuel which being far cleaner that coal and wood is also significantly cleaner than oil. The pollution impacts of gas set the general national discussion on air quality impacts from heating as gas is the most common fuel. The cleanness of gas has resulted in little attention being paid to the air quality impacts of heating.

Table 5 simplifies the actual situation as the appliance the fuel is burnt has a large impact on the actual emissions in use. Table 6 indicate the range of particulate emissions from wood buring in different appliaces.

Wood burning emissions	Range of $PM_{2.5}$ grams/GJ	Notes
Open fireplace	440-1760	
Conventional stove	370-1480	
High-efficiency stoves	285-740	
Advanced/ ecolabelled stoves & boilers <50 kWth	19-233	
Wood / woodchip boilers < 50 kWth	235-940	Data from 2003-2008 so probable improvement since then
Pellet stoves and boilers <50 kWth	30-120	

Table 6 impact of appliance type on particle emissions from wood burning.

The emission limit for boilers receiving the RHI is 30g/GJ, so the wood pellet boiler at the community hospital will be much cleaner than most other wood burning appliances in

Table 6 is data from testing, most typically under optimum combustion conditions. It is highly likely that actual emission in use will be higher. Damp wood will significantly increase emissions. More processed fuels such as wood chip and especially wood pellet will have lower emission and lower variability as the fuel is more consistent in size, moisture and quality all which allow the boilers to be designed achieve much greater control of the combustion process to enable optimum combustion conditions.

In summary combustion is very variable process leading to wide range of emission levels. Woodchip and pellet boilers are cleaner, woodboring stoves that are 'Clean Air Act Approved' or the newer 'Eco design' certified will be less polluting, but still many times worse than oil or LPG for all but CO_2.

There is similar, but much smaller variation in emissions outputs from oil and LPG boilers, over time regulation has resulted in lower NOx outputs from boilers and for oil boilers a reduction in particulates. Older oil boilers can be problematic as they have very long lives and so may not get replaced, despite newer boilers being significantly more efficient and cleaner burning.

The heat network allowing the removal of wood and coal burning and older oil boilers in many houses would bring improved local air quality to Bishops Castle in the winter months. This should benefit the health all of residents of Bishops Castle and especially those who stop using wood and coal as often in air quality in homes with stoves and open fireplaces can be far worse than the external air quality.