



Assessment of the impact of open fires and solid-fuel-burning heaters on Air Quality in Bishop's Castle

Summary

The results of our study assume the major source of particulate pollution is open fires and wood-burning stoves.

We analysed data from the last year (winter 2024-winter-2025) from an air-quality sensor in Bishop's Castle, along with similar data from sensors in other towns in the UK which likely have mains-gas-based heating.

- The air quality in Bishop's Castle is overwhelmingly safe. The data showed good or acceptable air quality in over 99% of hours in the winter 24-25, and in only just over 0.1% of the time (5 hours) did air quality reach a level that even "might" cause any harmful effects.
- The air quality in Bishop's Castle is similar to or better than locations in other towns we looked at across the UK served by gas mains.
- Air quality is generally even better in summer than in winter (about half the levels of microparticles). This is likely due to atmospheric differences between winter and summer which tend to trap particles nearer to the ground in winter.
- There is no evidence from our sensor to suggest that solid-fuel burners and stoves in Bishop's Castle cause unhealthy levels of particulates in the air in the town.

Report

It is well-known that solid fuel burners like wood-burning stoves emit much more polluting particulates and chemicals than gas- or oil-burning heaters, especially if the wood-burners are used incorrectly or with unsuitable fuel like damp wood. Bishop's Castle has many households that use solid fuel burners some or all of the time for heating, so we set out to check whether this in practice leads to noticeably poor air quality in the town.

It is quite easy to get reliable air quality data from sensors such as those connected to the Purple Air data platform, and we used such a sensor located in a back garden on the High Street. However, it is much more difficult to know when and how many wood-burners are being used at any time in town, in order to try to correlate measured air quality with burner-emissions.

Of course, burners are typically used much more in winter than summer, and it is very tempting to use the outside air temperature as a proxy for intensity of wood burning (i.e. a lot of burning when the outside temperature is 0C, little or none when it is 20C, and in-between when it is 10C outside).

We analysed a lot of data using the proxy of air temperature, and we did find weak evidence for more polluting particles in the air as temperature drops: giving roughly twice as much particulates on average in winter compared to summer. **See Charts 1 and 2.**

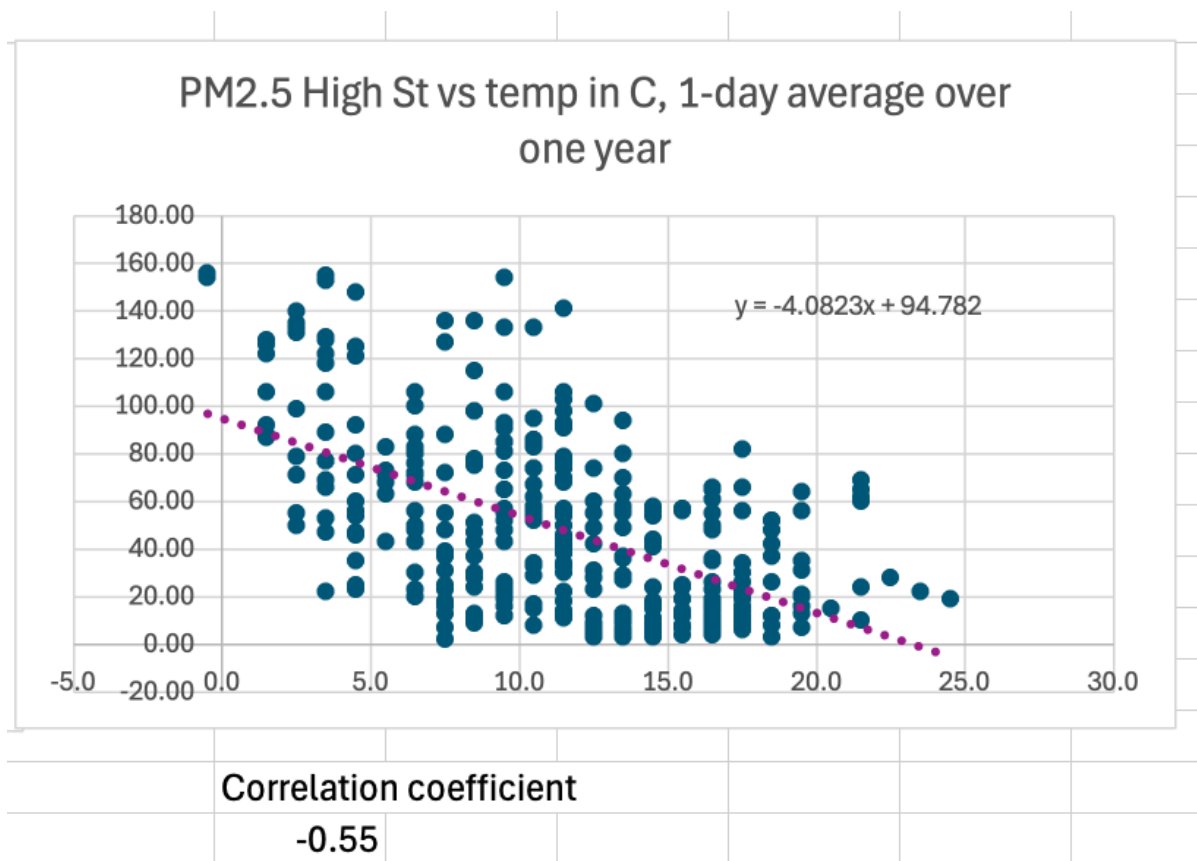


Chart 1: daily average daily reading of PM2.5 measurement vs air temperature

Recognising that burning is mostly during the waking day, we isolated the data for 10am to 10pm for a particularly cold period in January '25, and found a weak relationship, though actually with weaker correlation than the year-long data above.

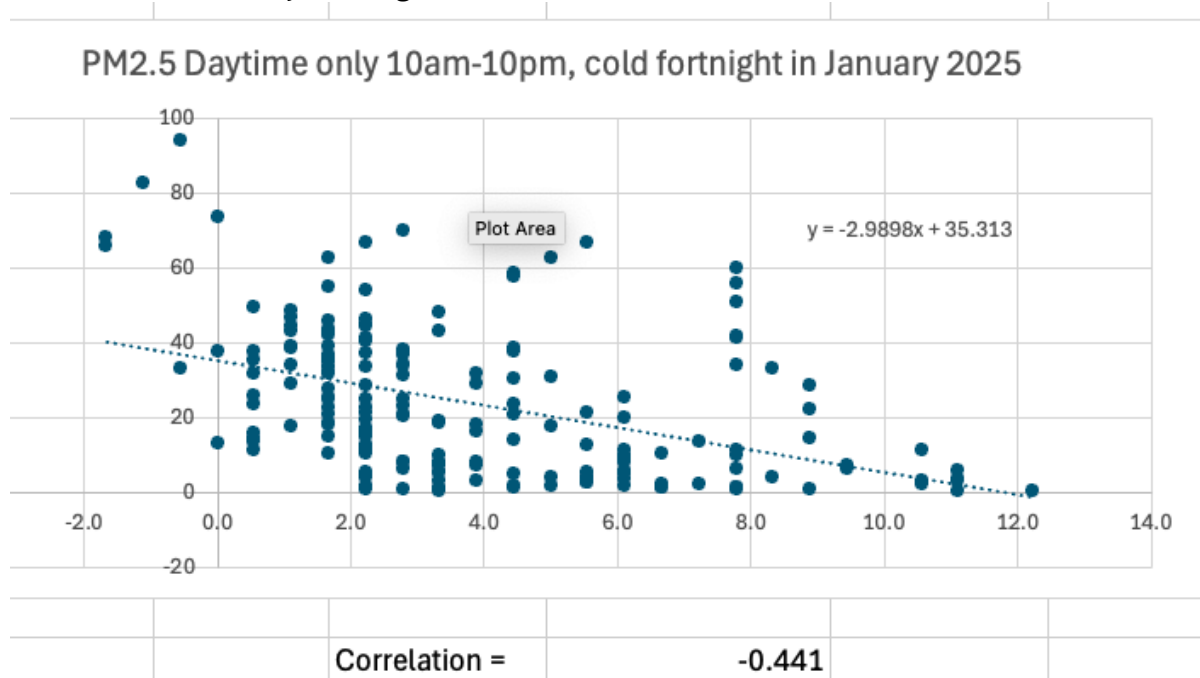
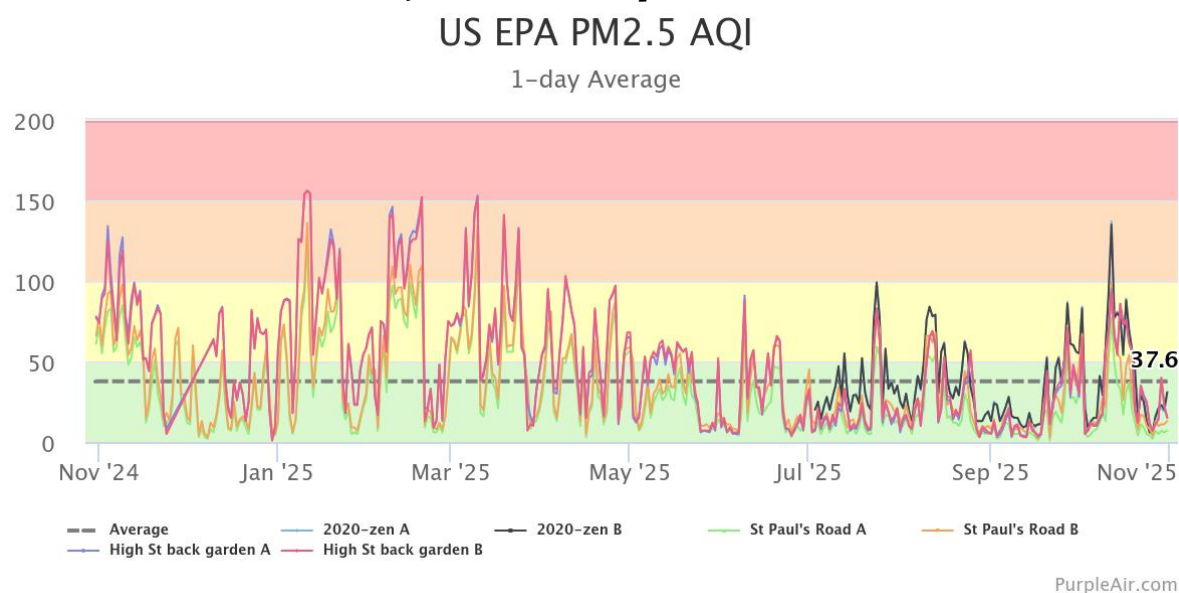


Chart 2: Hourly average PM 2.5 over a cold period, during waking hours

However, it is well-known that winter makes air quality worse anyway, through winter effects like low-moisture air and “inversion layers” that trap particles near to the ground. So it’s not really possible to tell the difference between natural effects and the effects of more wood-burning.

The strongest evidence comes from comparing Bishop’s Castle data throughout the year with data from major towns around the UK which almost certainly have gas heating. **See Chart 3** which shows the very similar patterns of readings for BC (red), Cheltenham (green), Birmingham (black). [There was a fault with the BC sensor in early December 2024]



The similarity is even more striking when comparing the numerical values across towns, as shown in **Chart 4**, which compares **Nottingham readings (vertical axis) with BC (horiz.)**

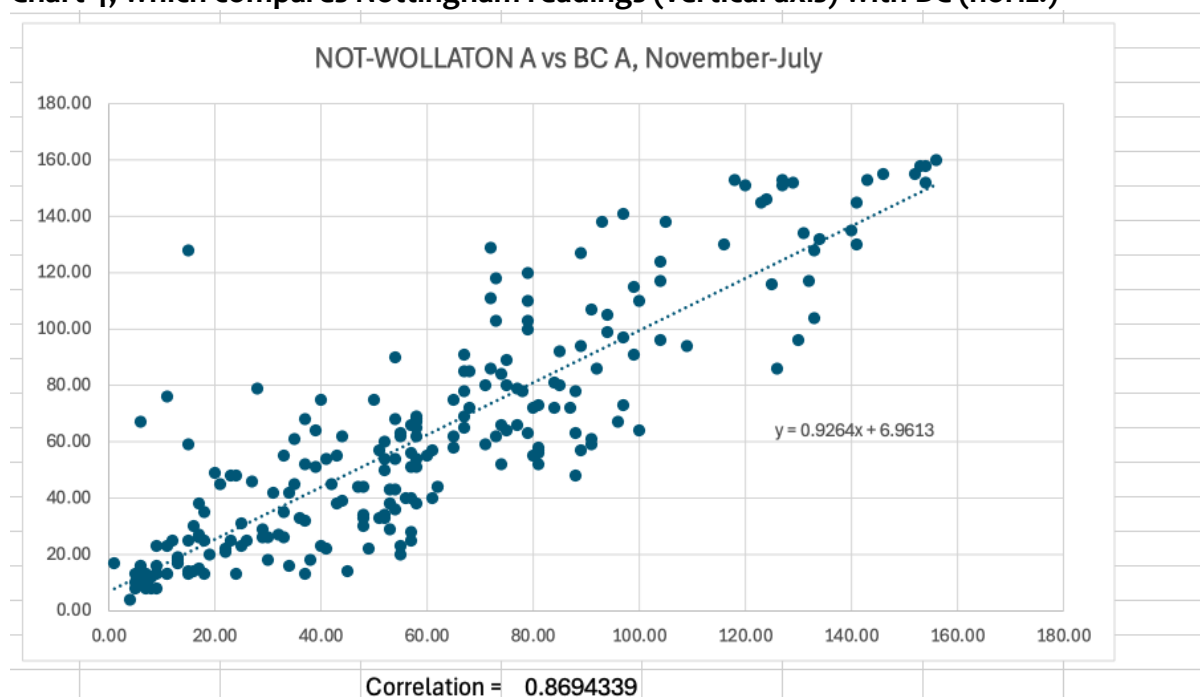


Chart 4: Daily measurement in Nottingham compared to reading in Bishop’s Castle

Note that Chart 4 has the highest correlation coefficient of any comparison we plotted (0.87, which indicates a very high correlation, i.e. the Nottingham readings on any given day are very similar to what we see in Bishop’s Castle). This indicates that **fluctuations in air quality from day to day are mostly due to national-scale effects which affect most of the UK, not local effects in any given town.**

In fact as we looked at other towns, we often saw periods of a few days when particle measurements spiked much higher than normal (400 or above). They were in different periods in different towns, so they are very likely due to local incidents like a serious fire or some substantial construction work causing dust. **There were no such anomalous incidents in Bishop’s Castle** in the year that we have been taking measurements.

The air quality in general in Bishop’s Castle is anyway at a good level (low levels of particulates.
See Chart 5

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

Chart 5: The air quality index measured in Bishops Castle between 26 September 2024 and 8 April 2025 (no data 24 November to 10 December)

Key for air quality readings:

Conclusions

There is very little evidence to suggest that wood-burners are in practice noticeably affecting the air quality in Bishop’s Castle.

Although there is a weak correlation between air temperature and air quality (worse air quality in winter than summer), there is a very similar effect in other big towns which probably have mains gas and so don’t have the density of wood burners as in Bishop’s Castle. And there are known explanations for the winter-summer difference.

If we wanted better information we would need some way of gathering hourly data on how many

	1 - 50	Air quality is satisfactory, and air pollution poses little or no risk.
	51 - 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
	101 - 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
	151 - 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
	201 - 300	Health alert: The risk of health effects is increased for everyone.
	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

wood-burners were being used throughout Bishop’s Castle.

Instead, the evidence shows that most of the daily variation in

BC air quality is due to large-scale effects outside of Bishop’s Castle, and which affect other major UK towns very similarly.

Air quality in Bishop’s Castle is very similar to or better than places which have gas-powered burners. Other towns have occasional high-pollution events, while Bishop’s Castle does not.

November 2025. Geraint Davies for Lightfoot