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Campfire Experiment

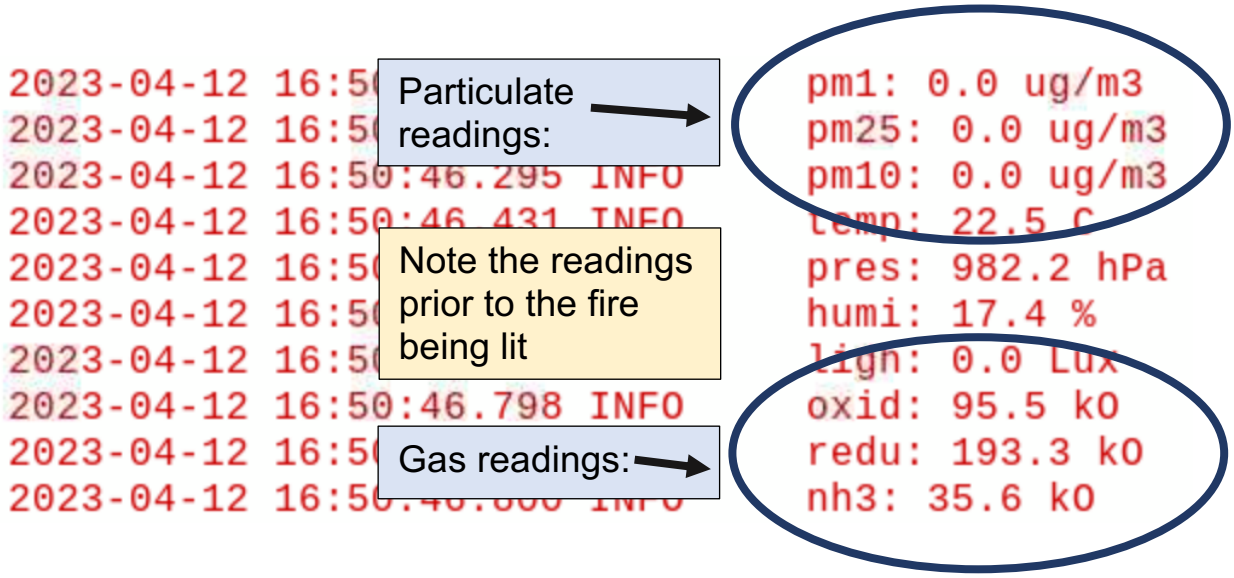
On the afternoon of 12th April 2023 we lit a campfire in the woods. There were three reasons for this:

- To provide heat and light for a night of family camping under the stars
- As a means of disposing of ivy and brambles that had been cleared earlier in the day
- For cooking marshmallows on!

The fire roared into life at 5 pm. Some of the ivy was composed of thick and dry branches which helped to get the fire going. Other parts of the ivy was made up of damp green leaves.

The Particle Sensor was running throughout. The tree on which it is mounted is 40m from where the campfire was lit. These are screengrabs taken throughout the afternoon and late into the evening. I have highlighted the points of interest!

The Particulate Sensor, mounted on a nearby tree



The fire is lit

Particulate matter beginning to register

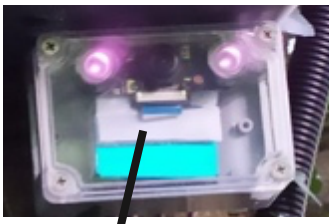
Nitrogen Dioxide: (oxid)

Carbon Monoxide: (redu)

Ammonia (NH3)

```
2023-04-12 17:51:51.654 INFO
2023-04-12 17:51:51.760 INFO
2023-04-12 17:51:51.861 INFO
2023-04-12 17:51:52.012 INFO
2023-04-12 17:51:52.017 INFO
pm1: 1.0 ug/m3
pm25: 1.0 ug/m3
pm10: 1.0 ug/m3
temp: 19.6 C
pres: 983.7 hPa
humi: 20.0 %
ligh: 0.0 Lux
oxid: 97.9 kO
redu: 264.7 kO
nh3: 64.6 kO
```

Smoke rises and spreads quickly



View from the sensor cam

```
2023-04-12 19:22:
2023-04-12 19:22:
2023-04-12 19:22:
2023-04-12 19:22:02.017 INFO
2023-04-12 19:22:02.124 INFO
2023-04-12 19:22:02.222 INFO
2023-04-12 19:22:02.229 INFO
2023-04-12 19:22:02.379 INFO
2023-04
2023-04-12
```

Particulate matter rising

```
pm1: 3.0 ug/m3
pm25: 3.0 ug/m3
pm10: 3.0 ug/m3
temp: 20.0 C
pres: 985.7 hPa
humi: 21.6 %
ligh: 0.0 lux
oxid: 113.8 kO
redu: 227.1 kO
nh3: 78.4 kO
```

Nitrogen Dioxide: (oxid)

rising

Ammonia (NH3)

```
2023-04-12 19:2                                    O    pm1: 4.0 ug/m3
2023-04-12 19:2                                    O    pm25: 4.0 ug/m3
2023-04-12 19:2                                    O    pm10: 4.0 ug/m3
2023-04-12 19:22:04.775 INFO                            temp: 19.9 C
2023-04-12 19:22:04.884 INFO                            pres: 985.7 hPa
2023-04-12 19:22:04.980 INFO                            humi: 21.6 %
2023-04-12 19:22:04.986 INFO                            ligh: 0.0 Lux
2023-04-12 19:22:05.126 INFO                            oxid: 110.8 kO
2023-                                                   redu: 244.3 kO
2023-04-12 19:22:05.128 INFO                            nh3: 77.0 kO
```

Particulate matter continues to rise

Carbon Monoxide: (redu) rising

```
2023-04-12 19:22:32.384 INFO    pm1: 3.0 ug/m3
2023-04-12 19:22:32.386 INFO    pm25: 5.0 ug/m3
2023-04-12 19:22:32.387 INFO    pm10: 5.0 ug/m3
2023-04-12 19:22:32.519 INFO    temp: 19.6 C
2023-04-12 19:22:32.624 INFO    pres: 985.8 hPa
2023-04-12 19:22:32.718 INFO    humi: 21.5 %
2023-04-12 19:22:32.725 INFO    ligh: 0.0 Lux
2023-04-12 19:22:32.873 INFO    oxid: 101.0 kO
2023-04-12 19:22:32.874 INFO    redu: 259.8 kO
2023-04-12 19:22:32.876 INFO    nh3: 71.5 kO
```

```
2023-04-12 19:2                                    pm1: 4.0 ug/m3
2023-04-12 19:2                                    pm25: 4.0 ug/m3
2023-04-12 19:2                                    pm10: 5.0 ug/m3
2023-04-12 19:22:09.360 INFO                       temp: 19.7 C
2023-04-12 19:22:09.462 INFO                       pres: 985.7 hPa
2023-04-12 19:22:09.559 INFO                       humi: 21.6 %
2023-04-12 19:22:09.570 INFO                       ligh: 0.0 Lux
2023-04-12 19:22:09.713 INFO                       oxid: 107.5 kO
2023-04-                F0                         redu: 253.7 kO
2023-04-12 19:22:09.714 INFO                       nh3: 75.4 kO
```

Particulate matter continues to rise

Peak Carbon Monoxide: (redu)

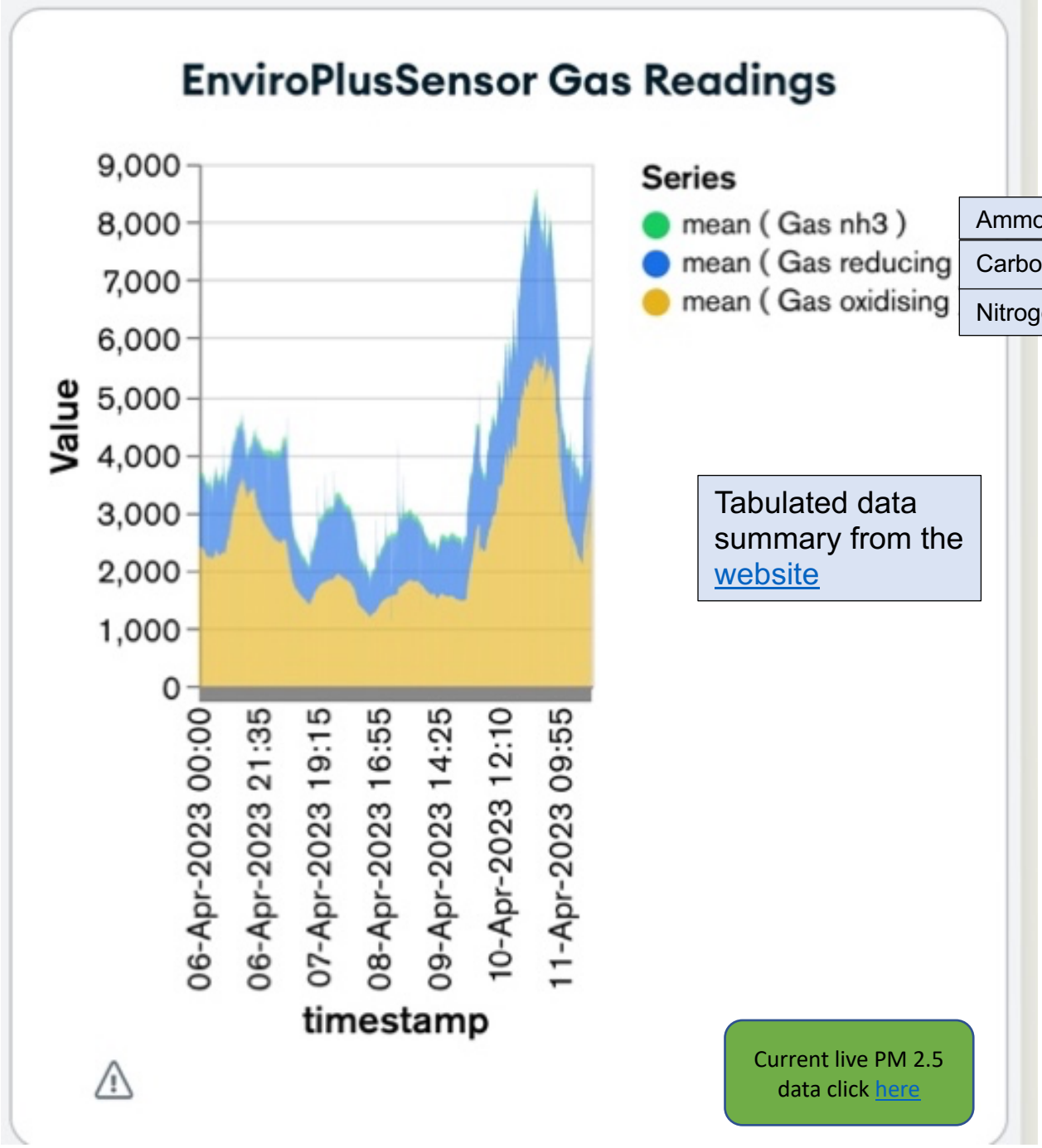
Fire gradually burns down to embers

```
2023-04-12 21:20:0
2023-04-12 21:20:0
2023-04-12 21:20:0
2023-04-12 21:20:08.058 INFO
2023-04-12 21:20:08.158 INFO
2023-04-12 21:20:0
2023-04-12 21:20:0
2023-04-12 21:20:08.401 INFO
2023-04-12 21:20:08.402 INFO
2023-04-12 21:20:08.403 INFO
```

Particulate matter falling

Humidity much higher

```
pm1: 1.0 ug/m3
pm25: 2.0 ug/m3
pm10: 4.0 ug/m3
temp: 15.1 C
pres: 716.8 hPa
humi: 87.0 %
ligh: 0.0 Lux
oxid: 116.2 kO
redu: 250.8 kO
nh3: 77.3 kO
```



Ammonia (NH3)

Carbon Monoxide: (redu)

Nitrogen Dioxide: (oxid)

Tabulated data summary from the website

Current live PM 2.5 data click here

Size Guide:

Particles of dust very small

The symbol for a micron is μm

Most dust particles are 5 microns or less, which are so small that they can't be seen and tend to remain suspended in air

5 microns = 0.005 mm

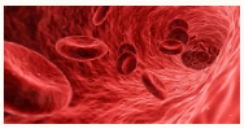
Also called PM 5

(5 μm)

PM2.5 tiny

This is a dangerous size of particle. PM2. 5 kills the most people worldwide. It consists of particles smaller than approximately 2.5 microns – so small that **billions of them can fit inside a red blood cell**.

2.5 microns = 0.0025 mm



Also called PM 2.5

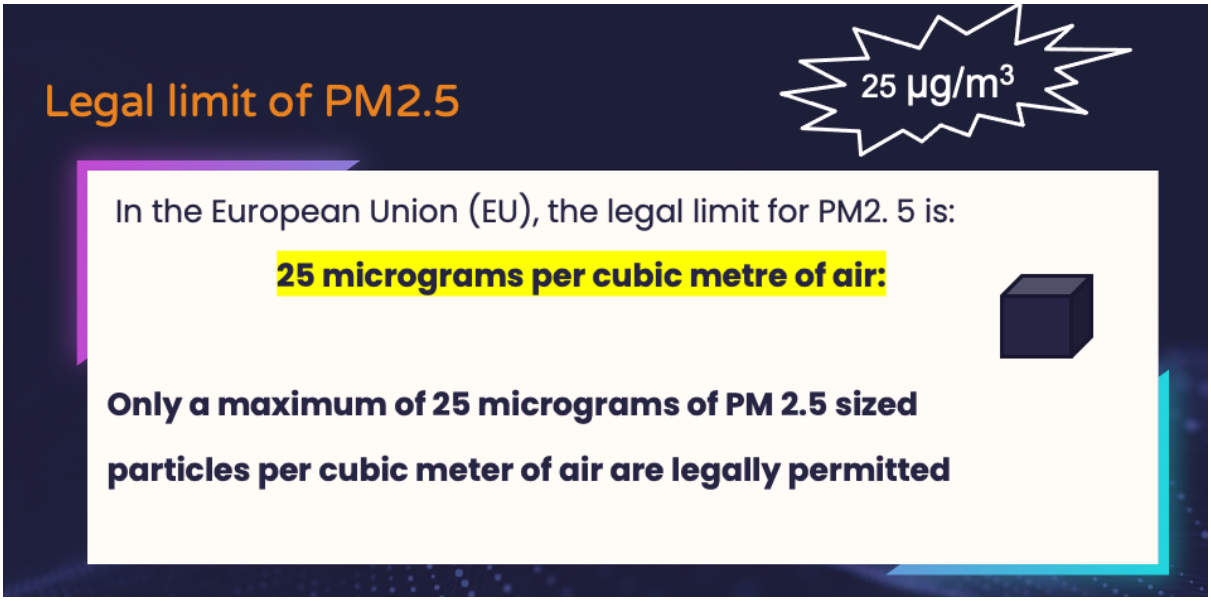
(2.5 μm)

PM2.5

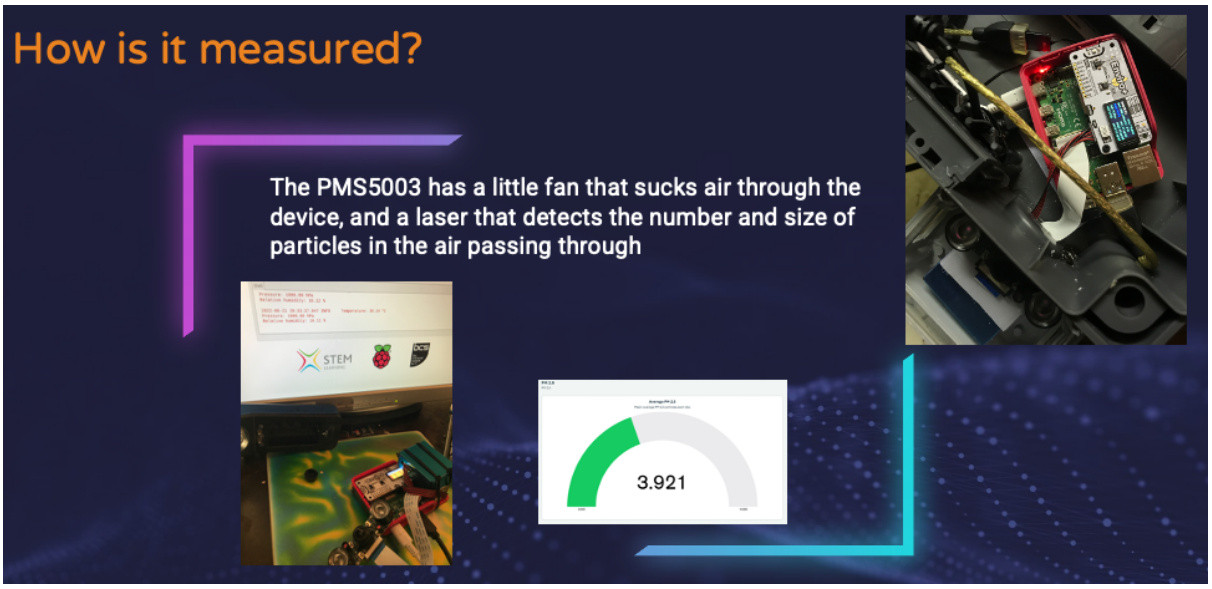
PM 2.5 are very small particles usually found in smoke

Millions of people die prematurely every year from diseases and cancer caused by air pollution. The first line of defence against this carnage is ambient air quality standards. Yet, according to researchers from McGill University, over half of the world's population lives without the protection of adequate air quality standards.

PM2.5 is responsible for an estimated 4.2 million premature deaths every year globally. This includes over a million deaths in China, over half a million in India, almost 200,000 in Europe, and over 50,000 in the United States.



The max PM 25 reading was 4 ug / m3 which did not exceed the EU legal limit.



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This sensor forms part of the *Space To Learn* initiative which operates a woodland based outdoor learning test bed facility in Northern Ireland. For more information, please click here.

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Conclusions

A bonfire can be seen to raise the level of particulates, including the most dangerous PM2.5 size.

On this occasion the quantity of PM2.5 measured did not exceed the legal limit.

Nitrogen, Carbon Monoxide and Ammonia levels of gas were raised.

The other sensor readings were of limited value for this experiment, however the background humidity increased markedly at nightfall.

Particulate and gas levels remained raised five hours later.