Using Standard Calibrations and CO_2 Recoveries to Calculate Emissions

Calculating g/day from Sensor Values

- Sensors give a voltage value output - not meant to be interpreted other than qualitatively.
- They must be converted to human-readable units by applying an equation.
- In the case of CO_2, CH_4, O_2, H_2, and H_2S, this means applying the calibration factors.

Mass Flow Rate (g / sec): $\dot{m} = \rho \cdot V \cdot A$

(Density x Velocity x Area)

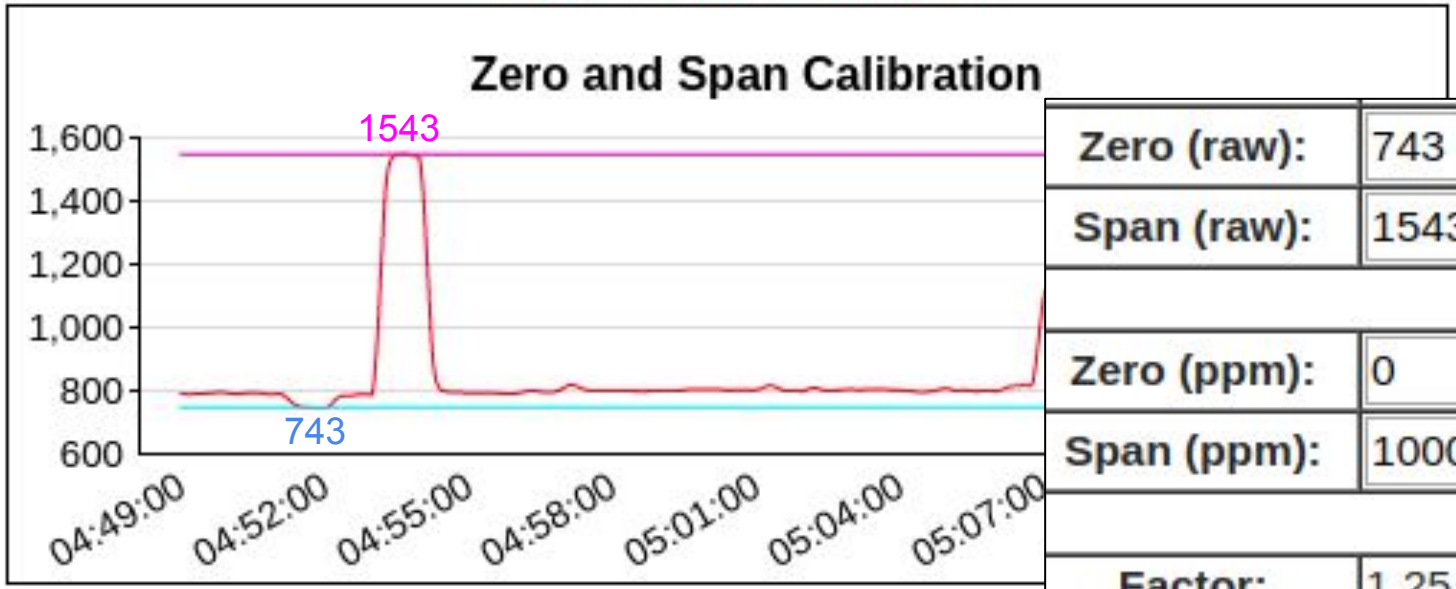
= Concentration x Airflow x C x Coeff

Measuring/Calculating Concentration

Remember - sensors output as voltages, not as ppm or L/s. So we must convert them using equations.

In the case of CH_4 and CO_2, we use calibration factors.

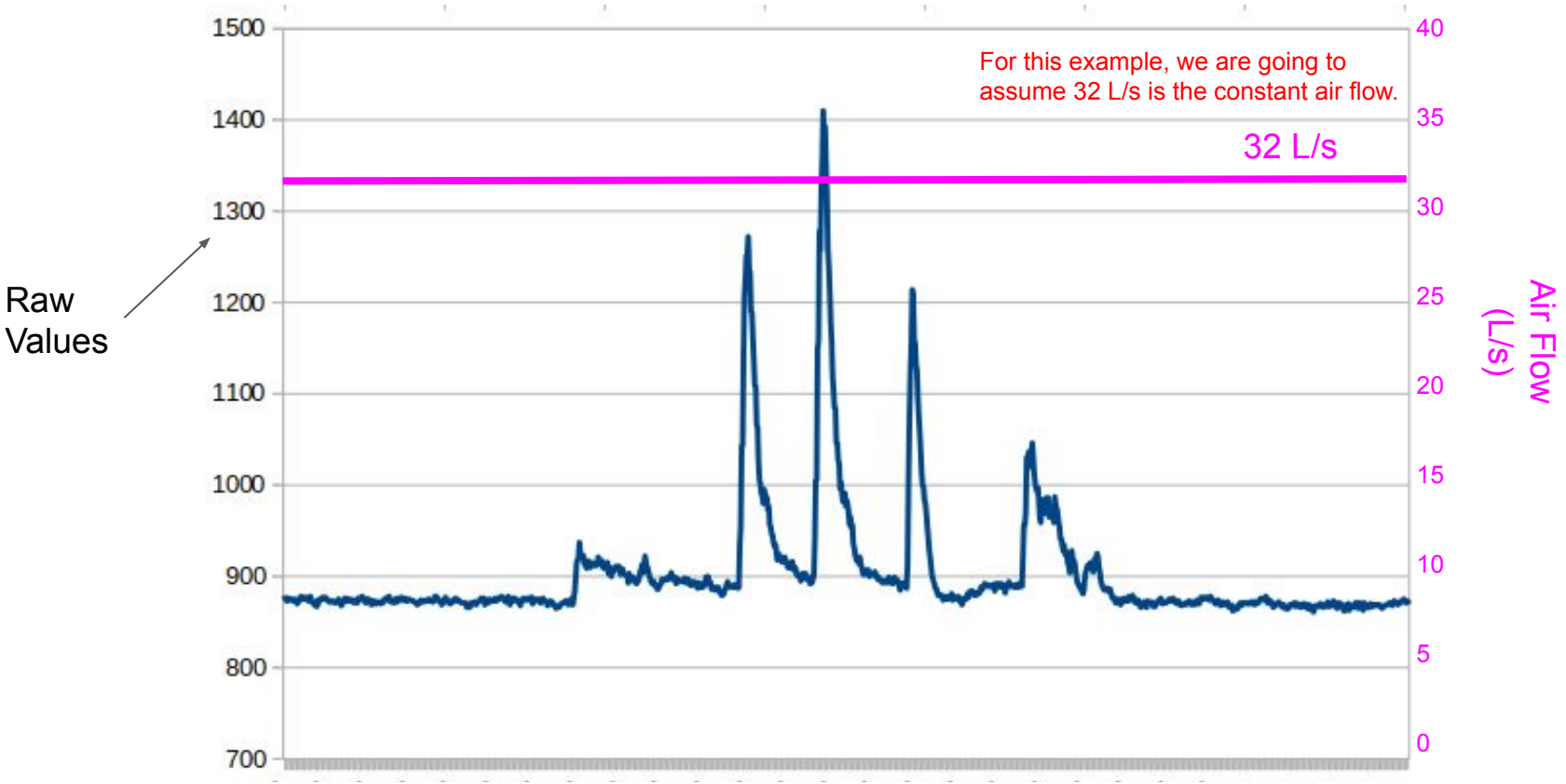
Calculating g/day from Sensor Values



Zero (raw):	743	O
Span (raw):	1543	O
Zero (ppm):	0	
Span (ppm):	1000	
Factor:	1.25	

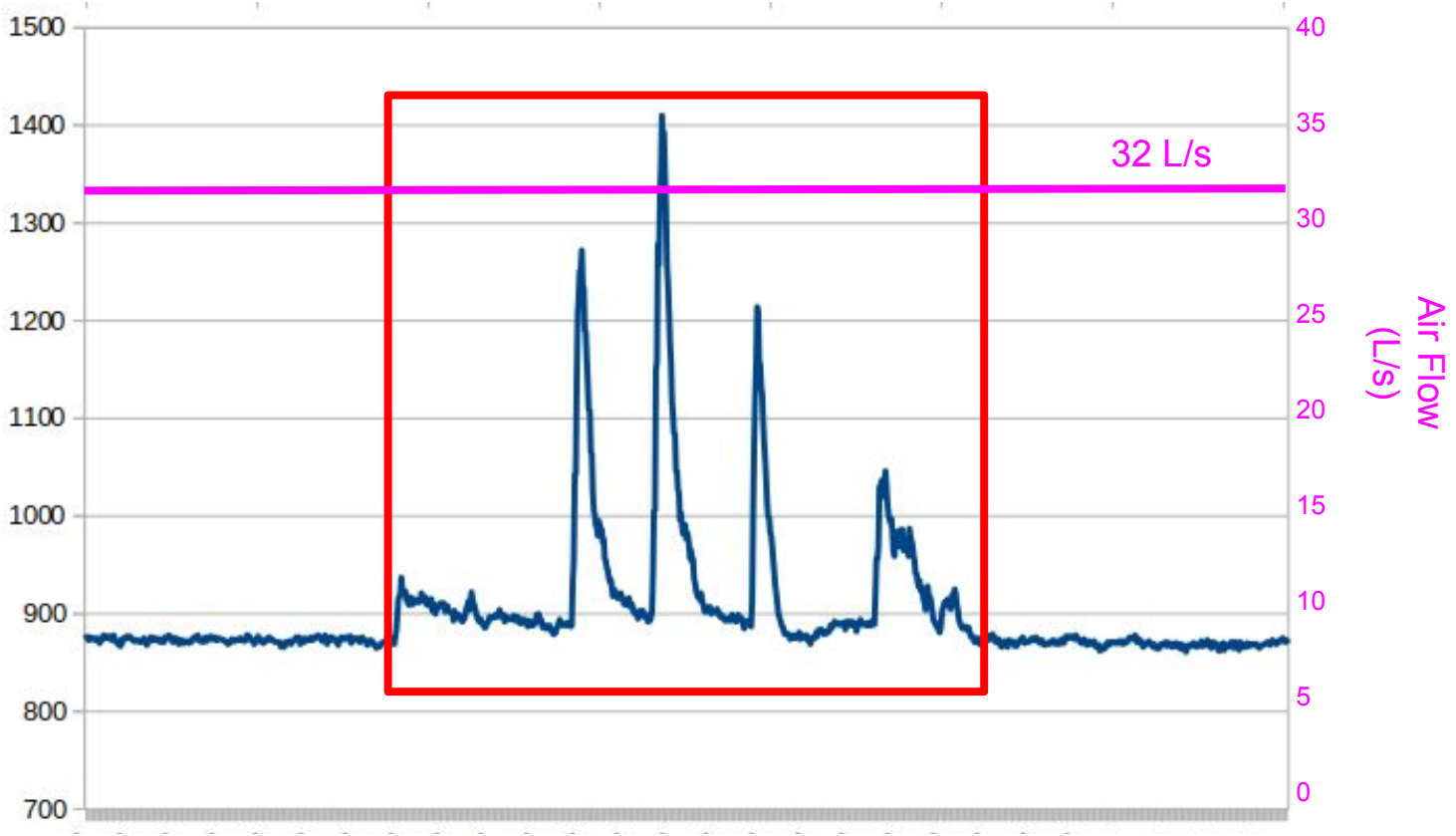
$$\textbf{Factor (Cg)} = \frac{\text{SpanPPM - ZeroPPM}}{\text{SpanRaw - ZeroRaw}} = \frac{1000 - 0}{1543 - 743} = \textbf{1.25 [ppm per raw]}$$

Calculating g/day from Sensor Values



Mass Flux (grams / day) = Concentration x Airflow x C x Coeff

Calculating g/day from Sensor Values



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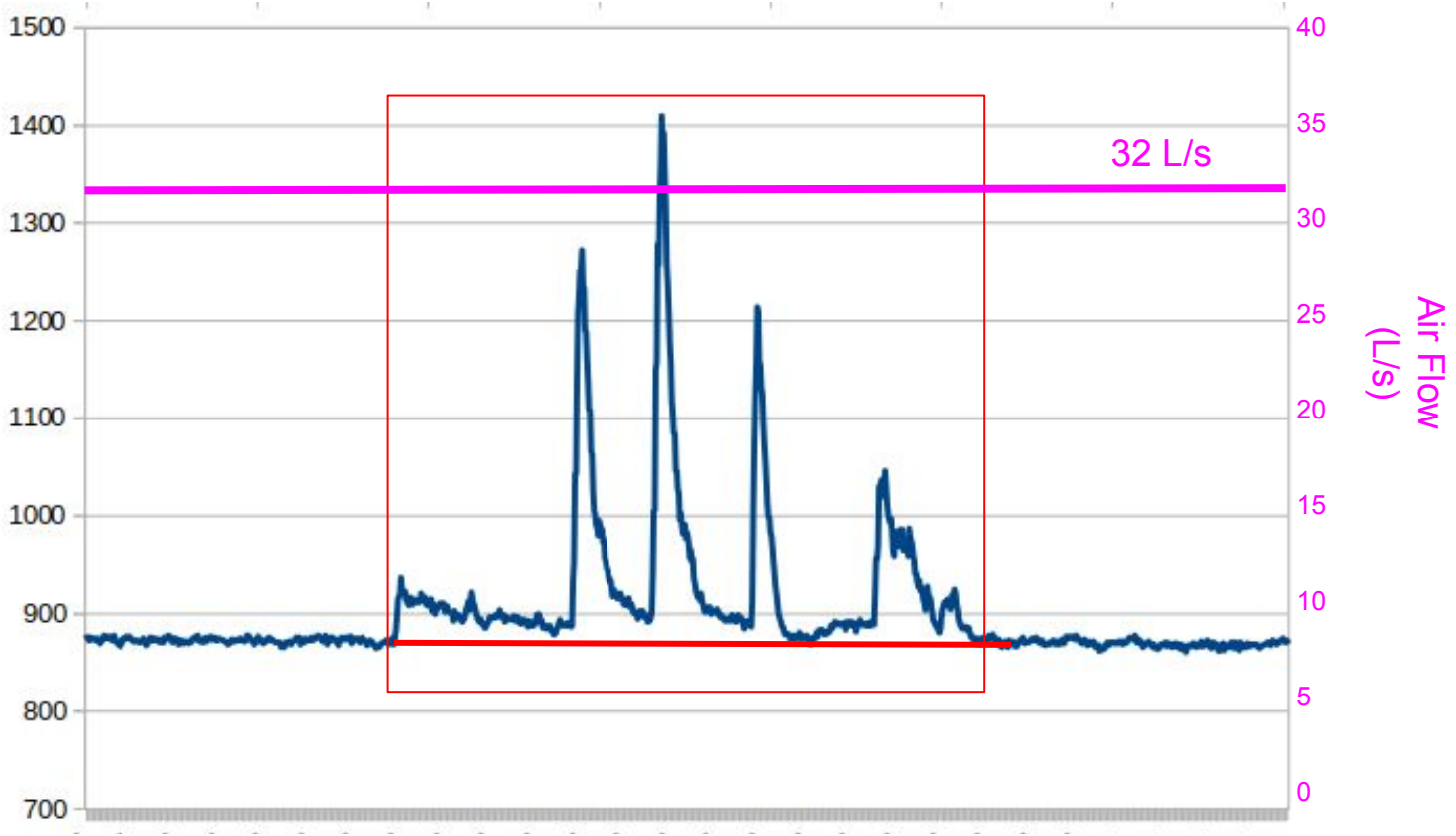

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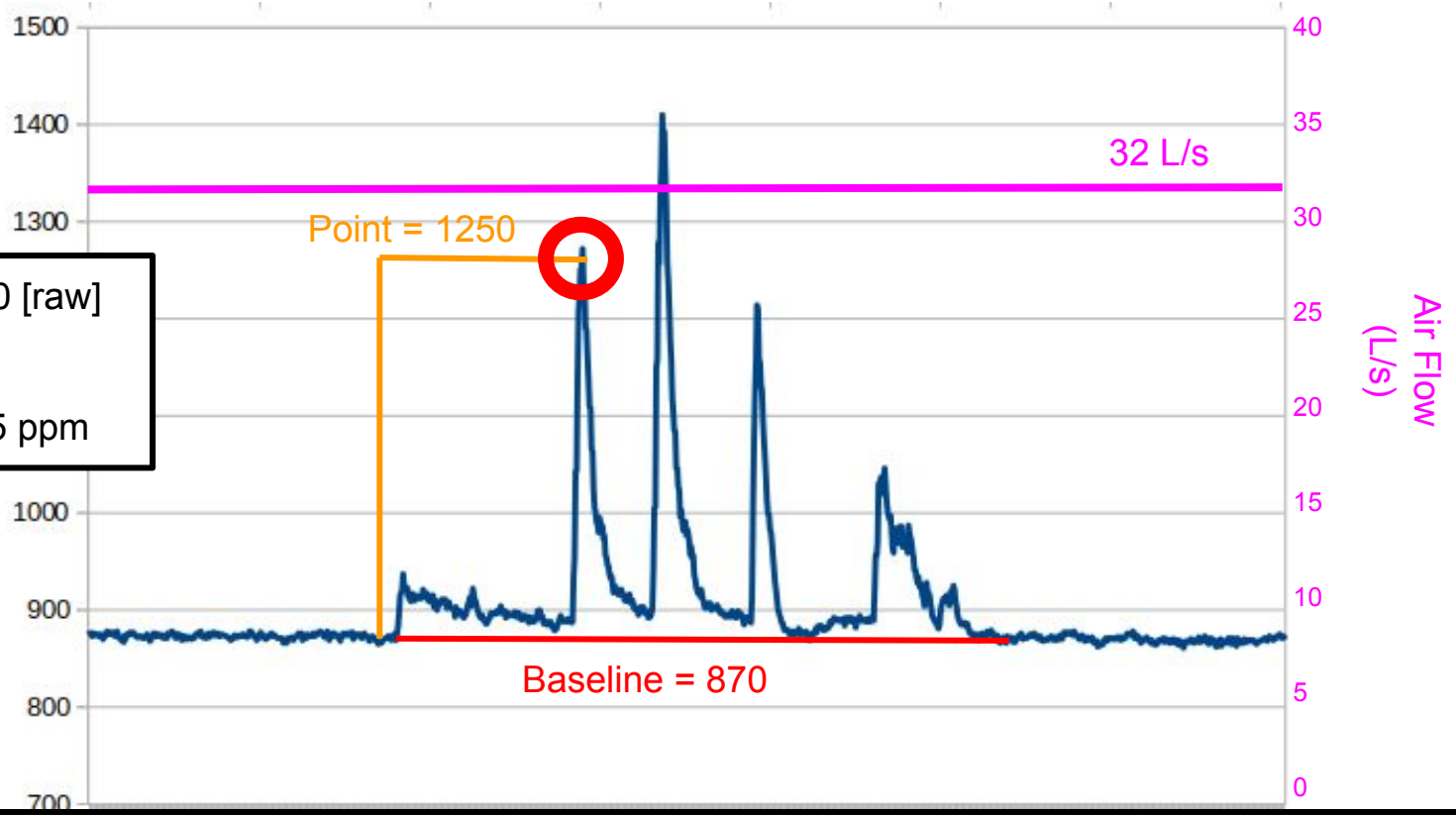


1250 - 870 = 380 [raw]

380 x Cg =
380 x 1.25 = 475 ppm

Mass Flux (grams / day) = Concentration x Airflow x C x Coeff 475 ppm **x** 32 L/s **x** Cross Area of pipe **x** Coeff

How Do We Know the Air Flow Rate? (32 L/s in our example)

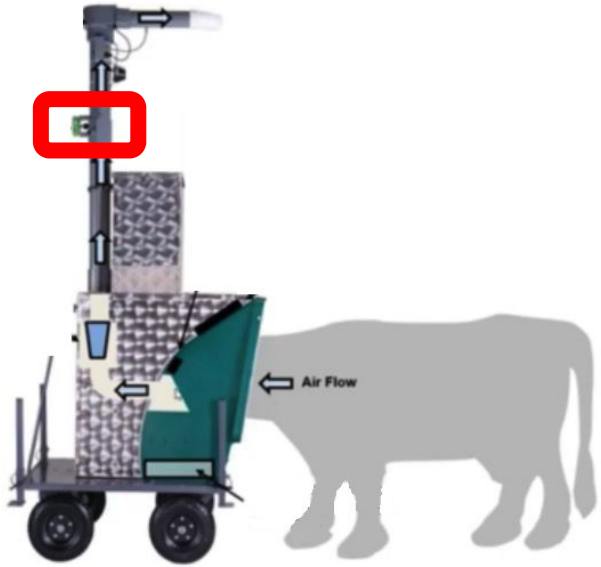
GreenFeed measures the air flow through the “chimney” (pipe) at the central location.

This sensor also reports the flow in voltages

So the sensor must be calibrated/checked.

The CO_2 Recovery serves two purposes:

1) Check that the whole system is working correctly
2) Calibrate the flow coefficient



CO_2 Recoveries Process

GreenFeed Calculates Mass Flow Rates (Mass Flux) using: $\dot{m} = \rho \cdot V \cdot A$

But mass flow rate can also be measured completely independently with a mass balance (scale).

So we can:

1) Weigh a cylinder of CO_2
2) Release some CO_2 from it into GreenFeed
3) Weigh the cylinder again

And the difference in the weights of the CO_2 should equal the amount of mass that GreenFeed calculated.

$$\frac{\text{Mass}_{\text{Initial}} - \text{Mass}_{\text{Final}}}{\text{Time}_{\text{Release}}} = \underset{\text{(in ppm)}}{\Delta\text{Conc}_{CO2}} \times \underset{\text{(in "raw")}}{\text{FlowRate}} \times \underset{\text{(in L/s per raw)}}{C_{AF}} \times \underset{\text{(in m}^2\text{)}}{\text{Area}} \quad [\times \textit{Temp Coeff} \times \ldots \times \ldots]$$

Temperature Factor, Dimensional Analysis Conversion, and Density @ STP