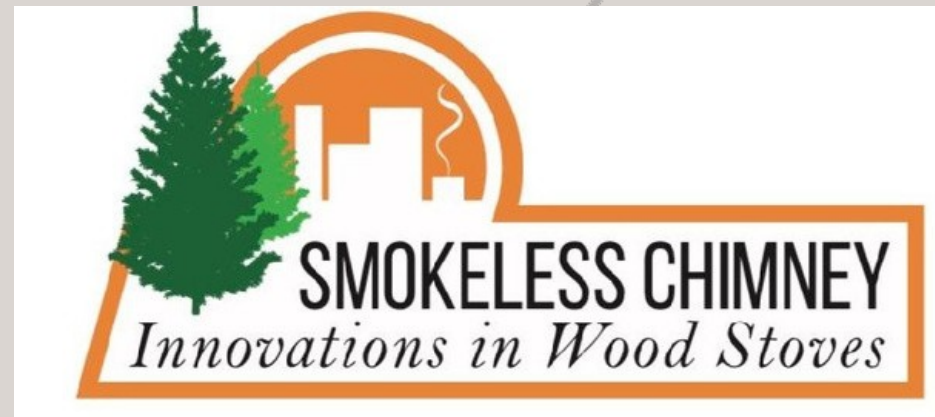




ETHOS 2025

Presented by Noel Putaansuu
January 2025



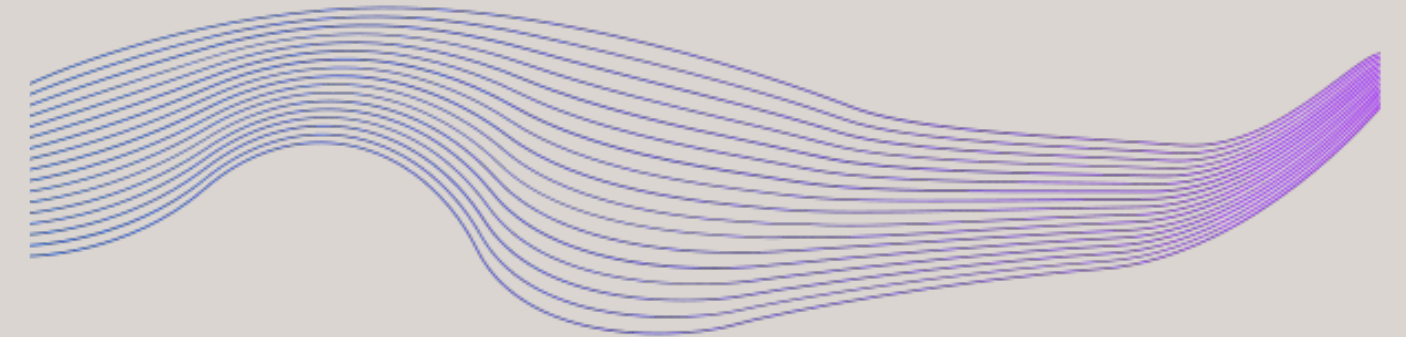
Smokeless Chimney

Combustion Automation

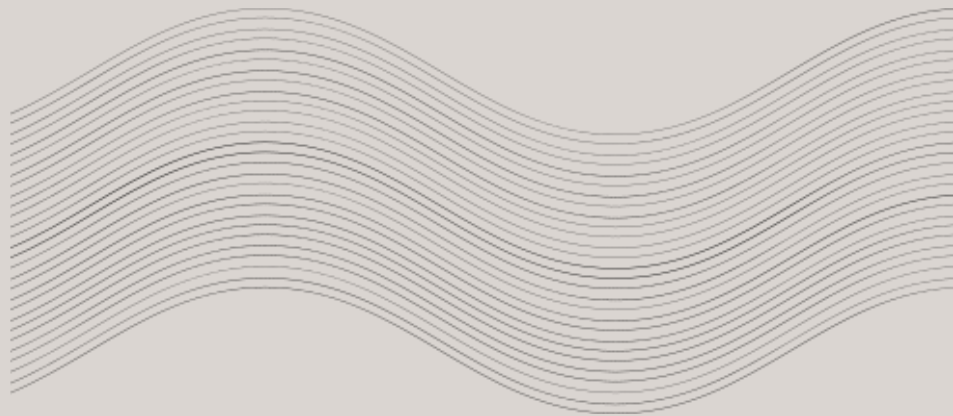
Presented by Noel Putaansuu

Smokeless Chimney

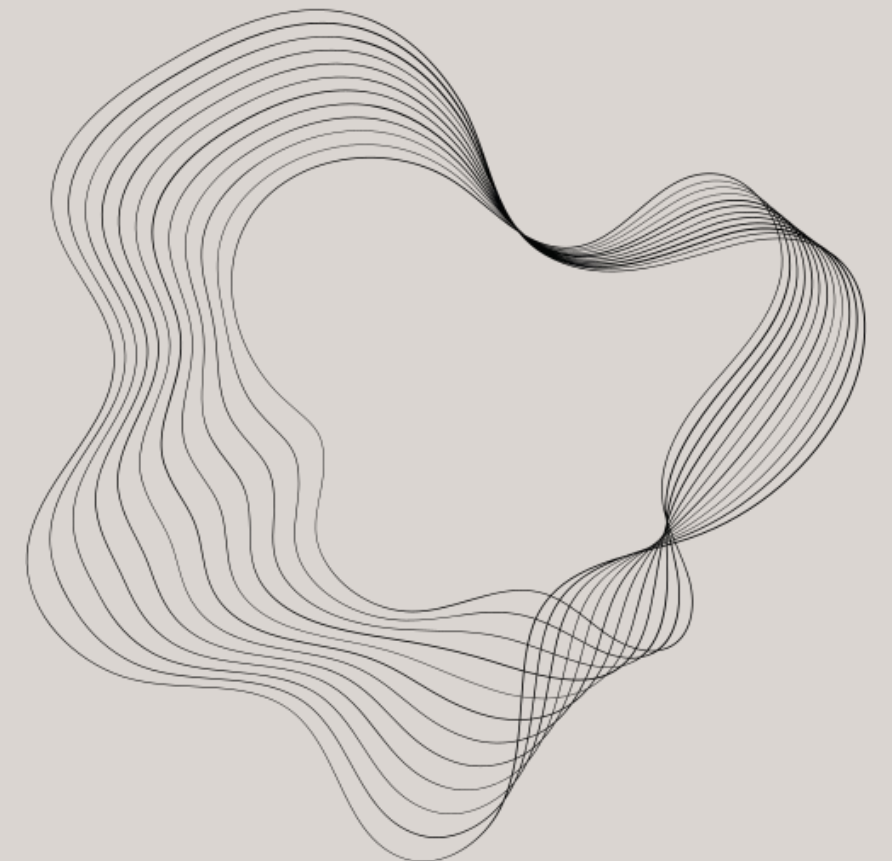
Emissions monitoring and control systems for wood
heat and cook stoves.



This is specific to solid fuel heating systems
Wood Stove and Pellet or Chip Stoves



13 million wood stove in the USA
1 billion people heat or cook with solid fuel (WHO)



Smokeless Chimney Looking Ahead

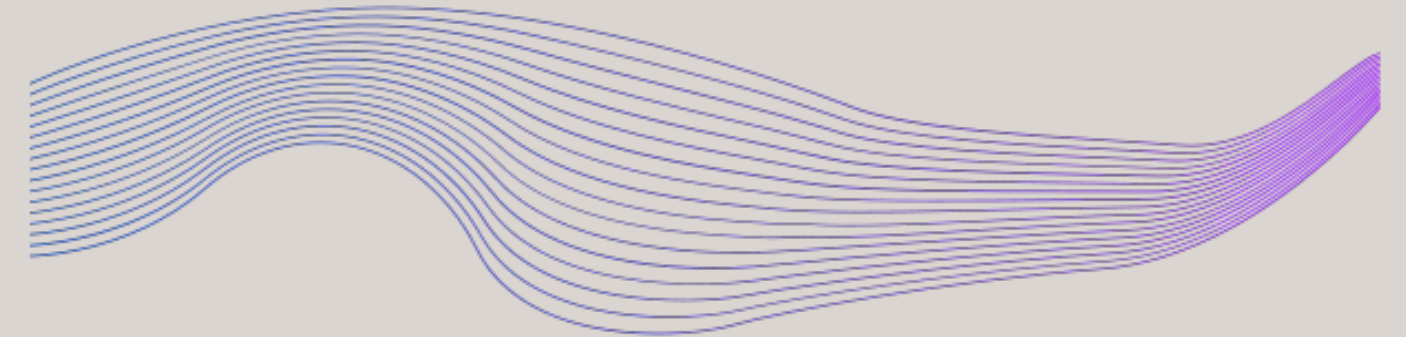
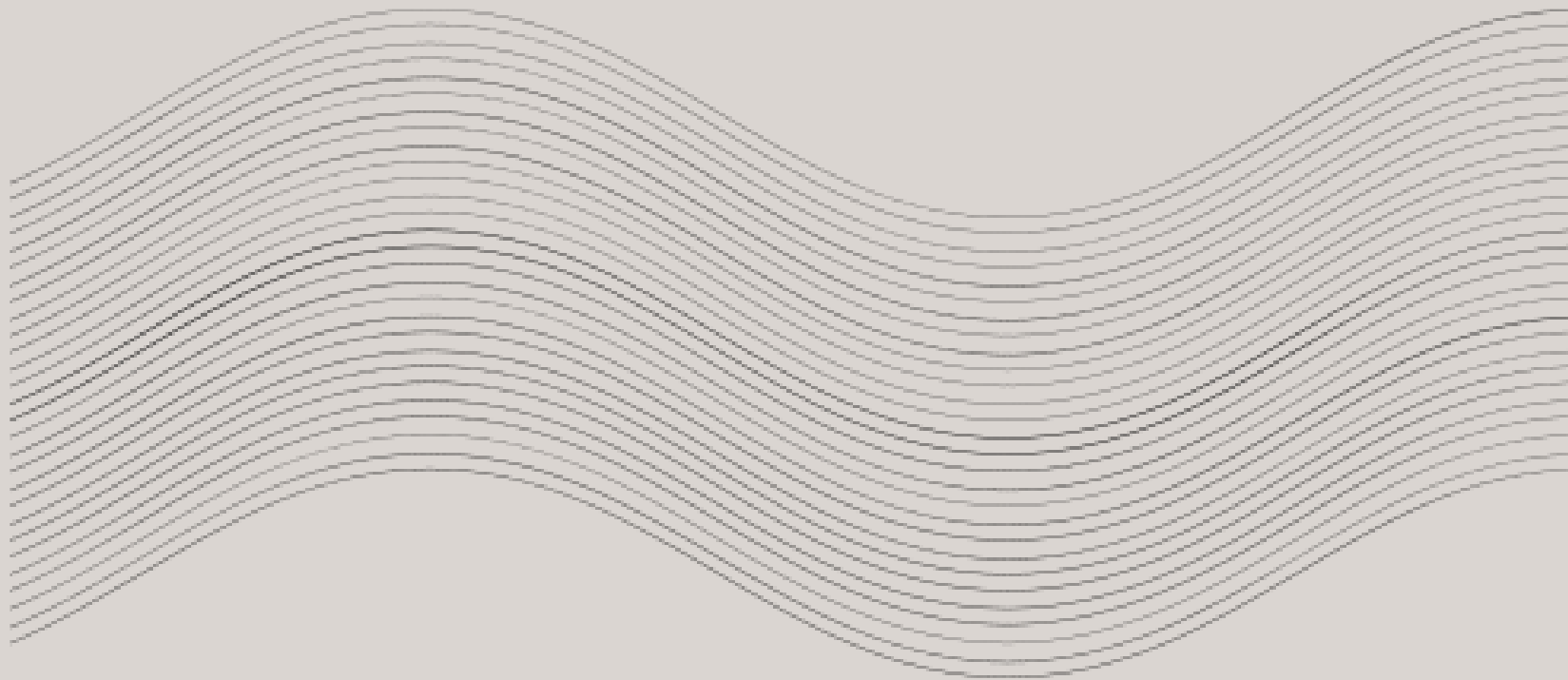
Air Quality is
and will be a
major issue

Wood Stoves will need to be
monitored and controlled
for clean burning

Monitoring: CO₂, CO, PM 2.5, Volatile Organic Compounds (VOC)
will be a health upgrade to any home.

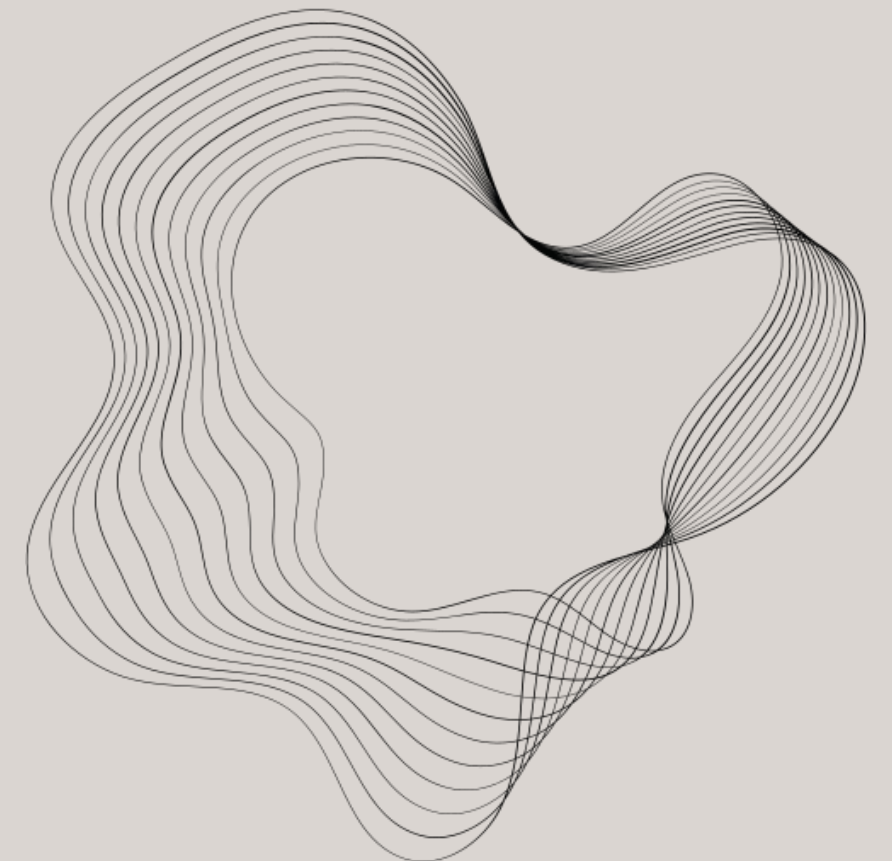
Smokeless Chimney

We are leader in smoke measurement technology



3 Patents

We have earned a grant from the DOE to work with 3
scientists at Berkeley

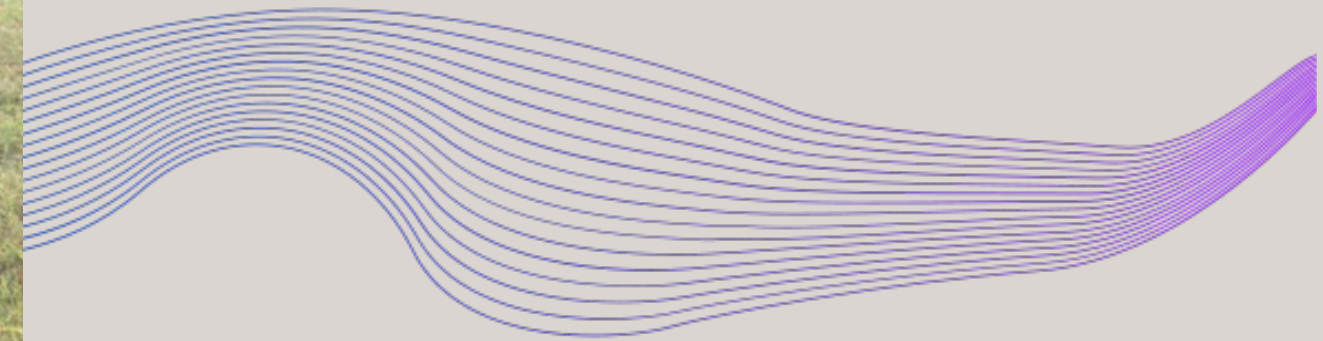
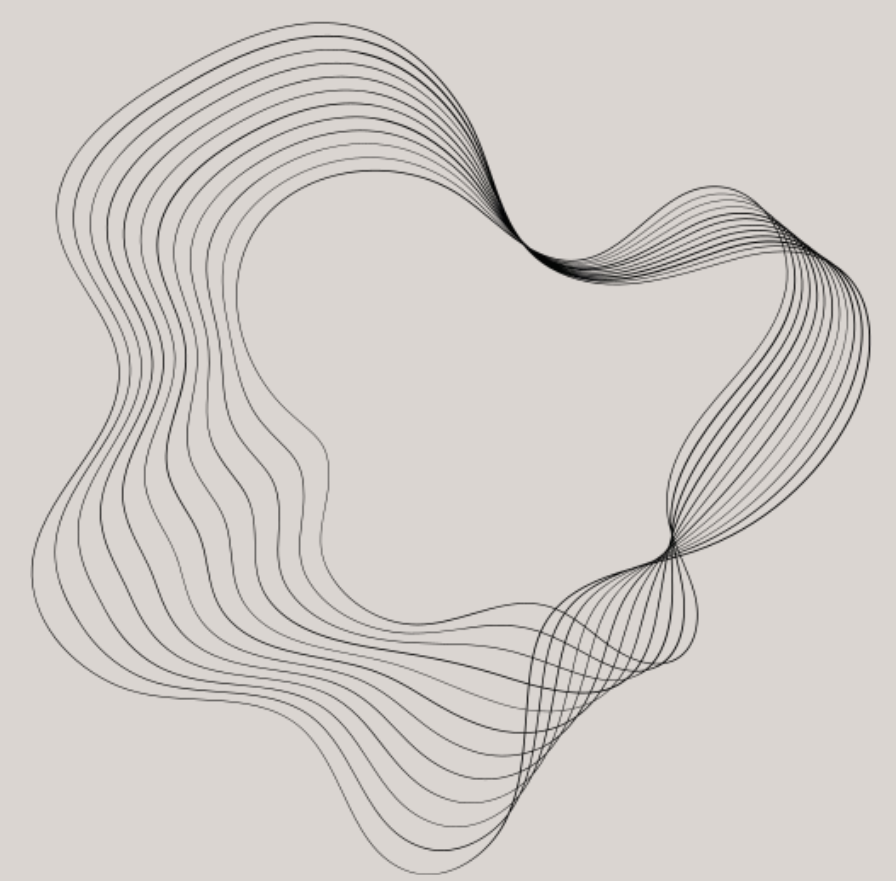


Smokeless Chimney

Smoke is a problem. There are laws regarding Opacity
of Emissions

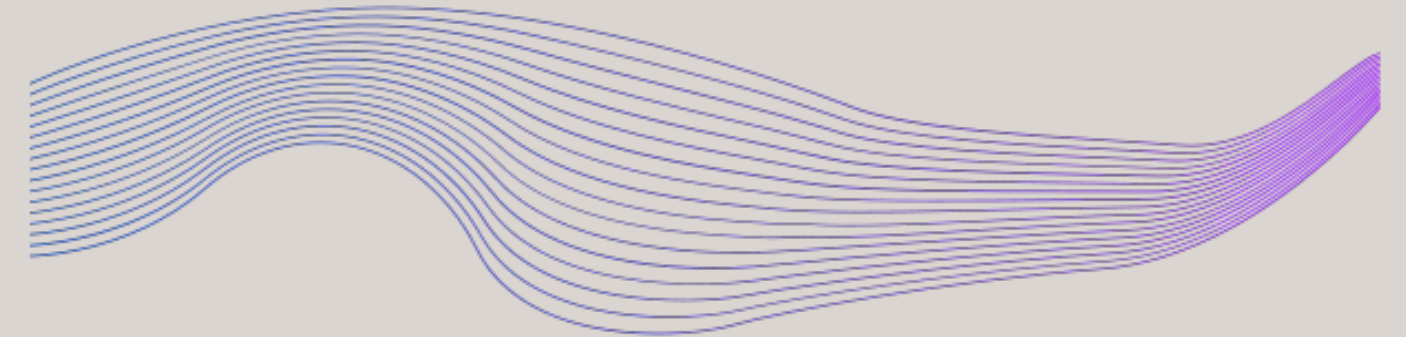
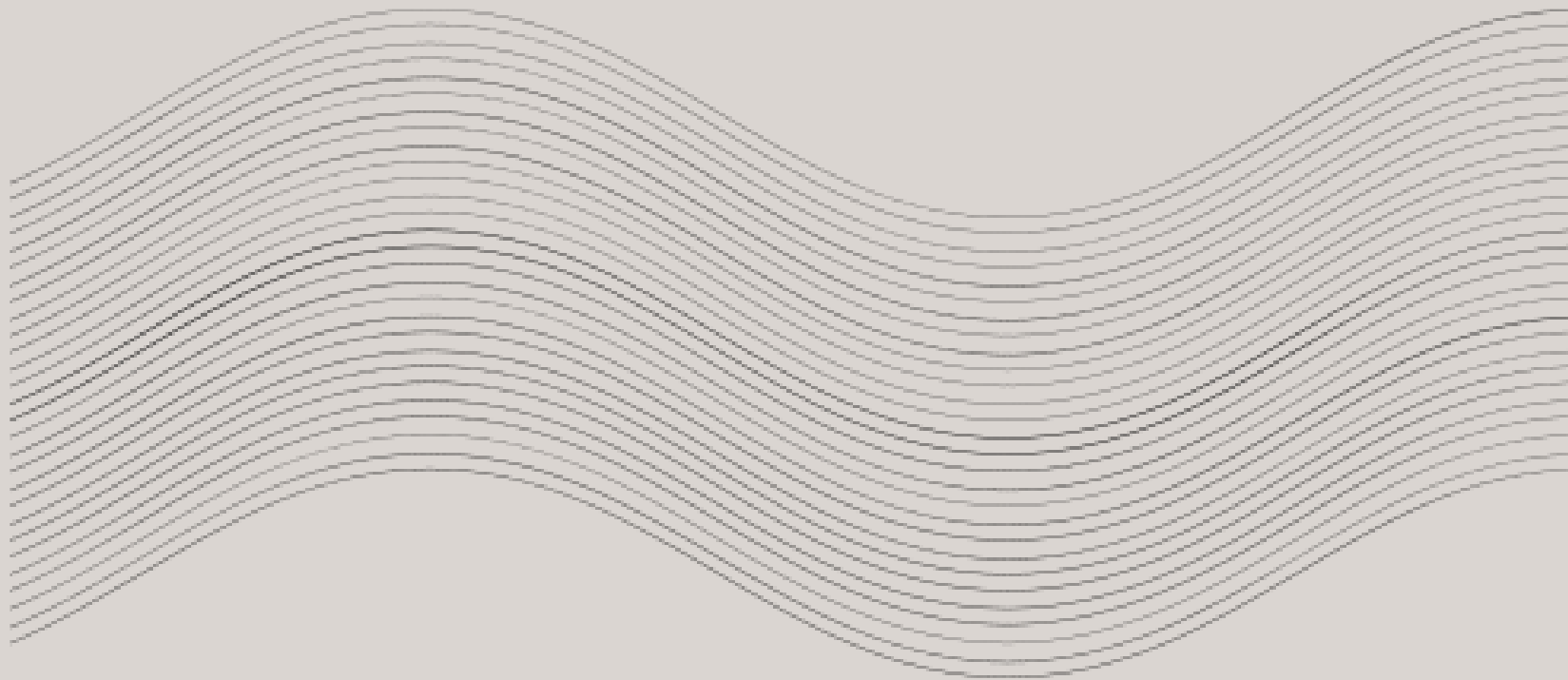
Method 28

Ringleman



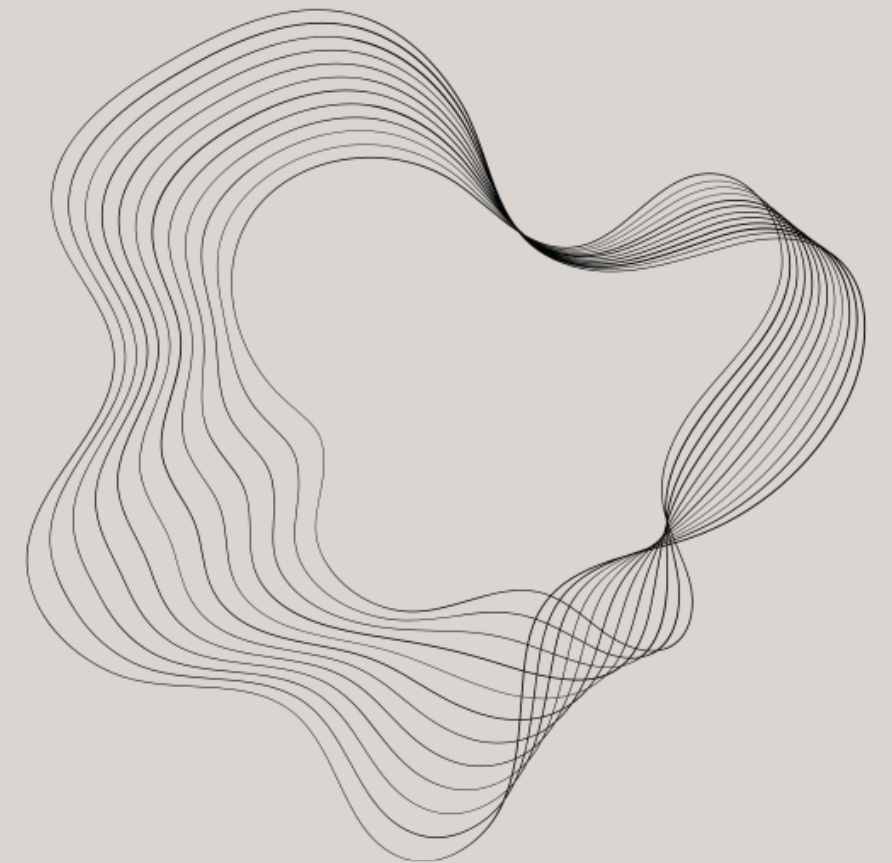
Smokeless Chimney

Our Solution



- Combustion Air Flow
- Smoke Measurement

These devices work together or separately
There are many options for each device





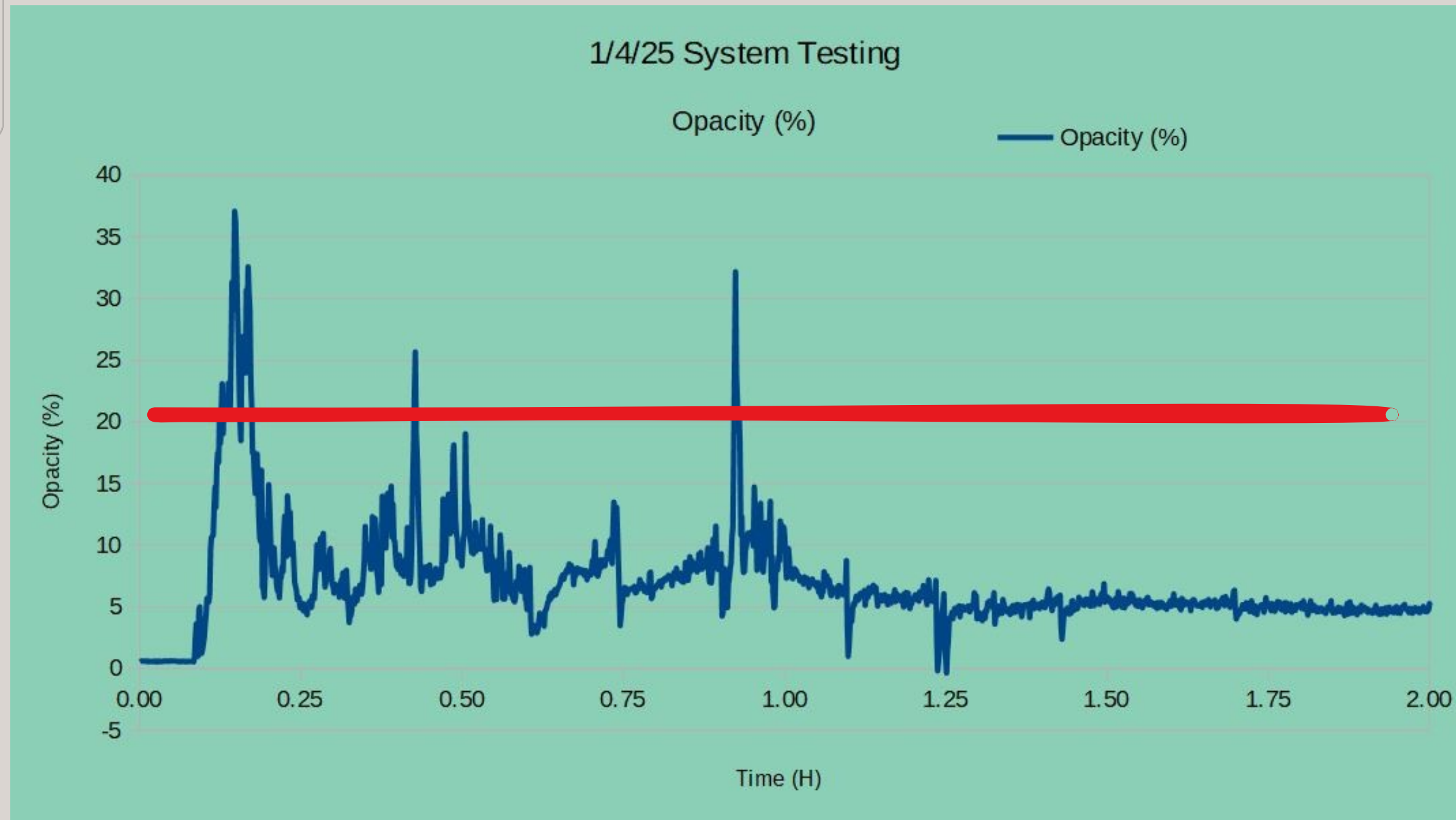
Smokeless Chimney Smoke Measurement



- Experience since 1982
- Smoke Measurement
- 1982-2005 Incandescent light and photoresistor
- 2018 Digital Light sensor using photodiodes
- 2024 Multiband digital light sensors
 - White LEDs

Smokeless Chimney

Smoke Measurement



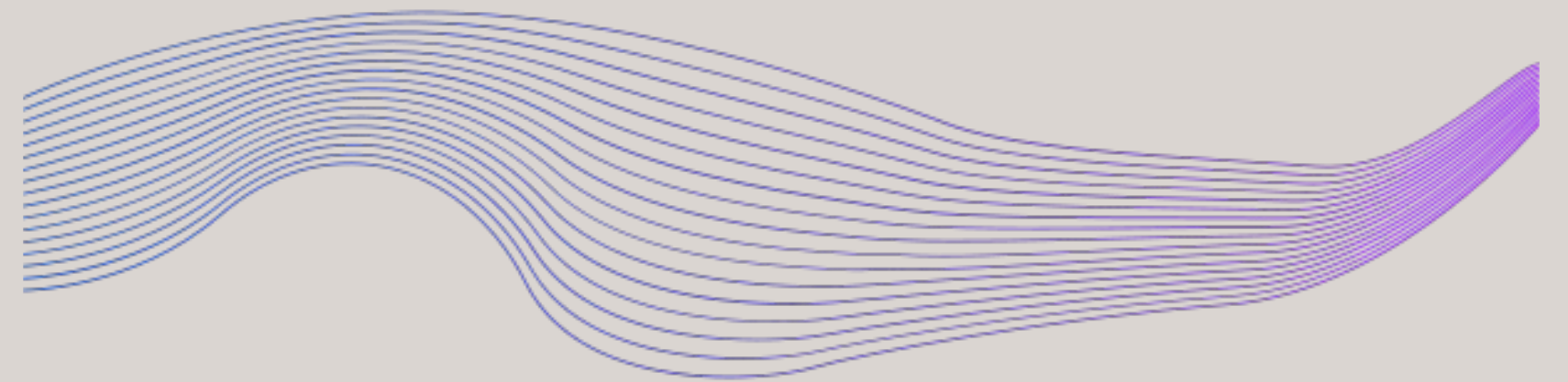
Smokeless Chimney

Principles of Light Scatter

1. Rayleigh

2. Mie

3. Tyndall

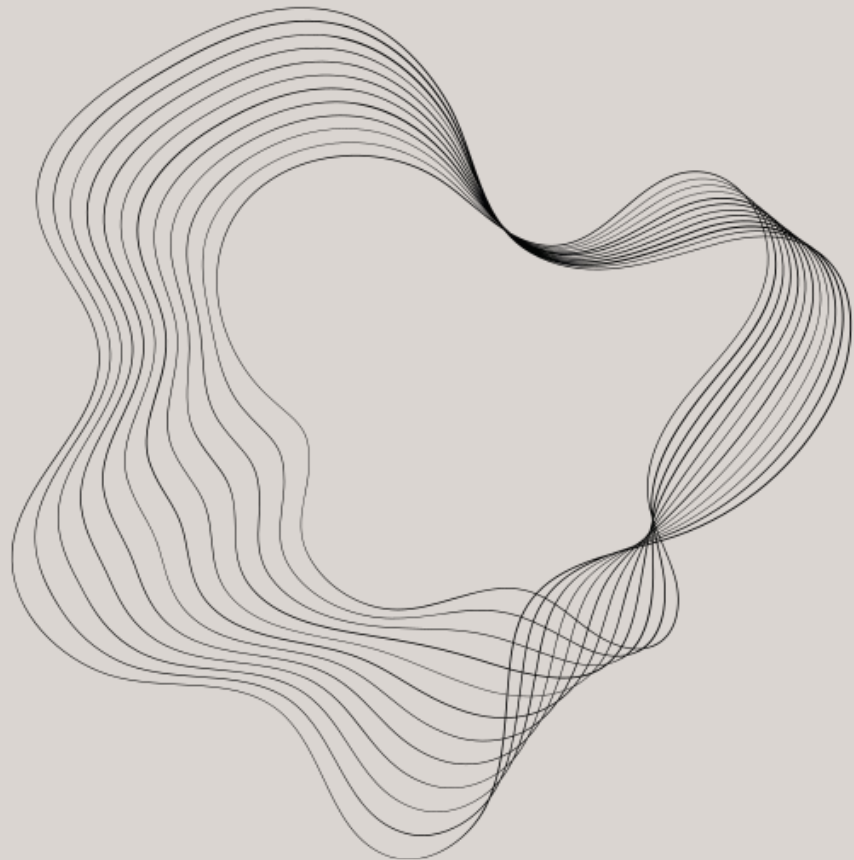


Smokeless Chimney

Working with Light Scatter

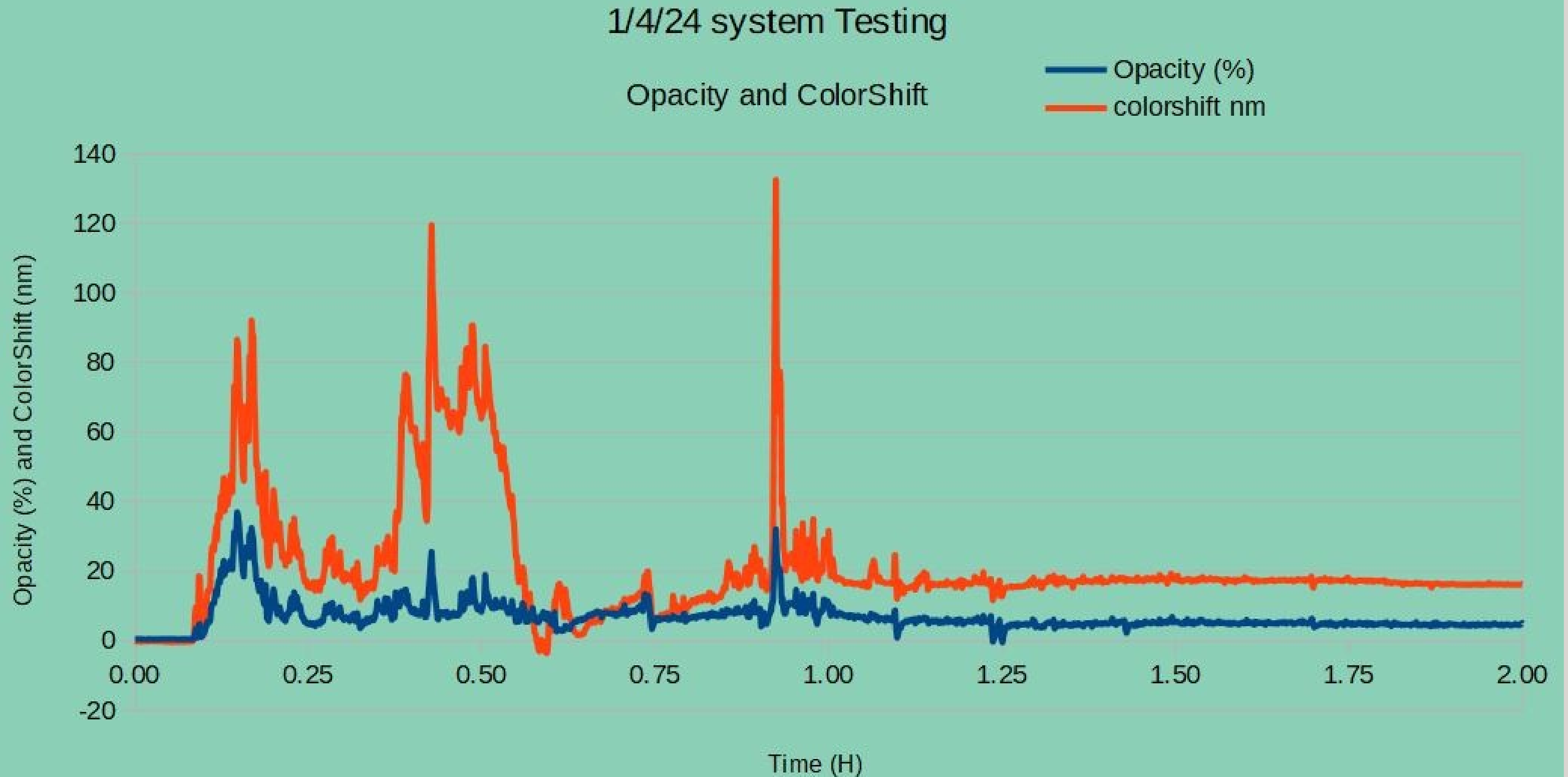
Company metric

Normalized Change in Peak Wavelength



ColorShift

Smokeless Chimney Smoke Measurement



Smokeless Chimney

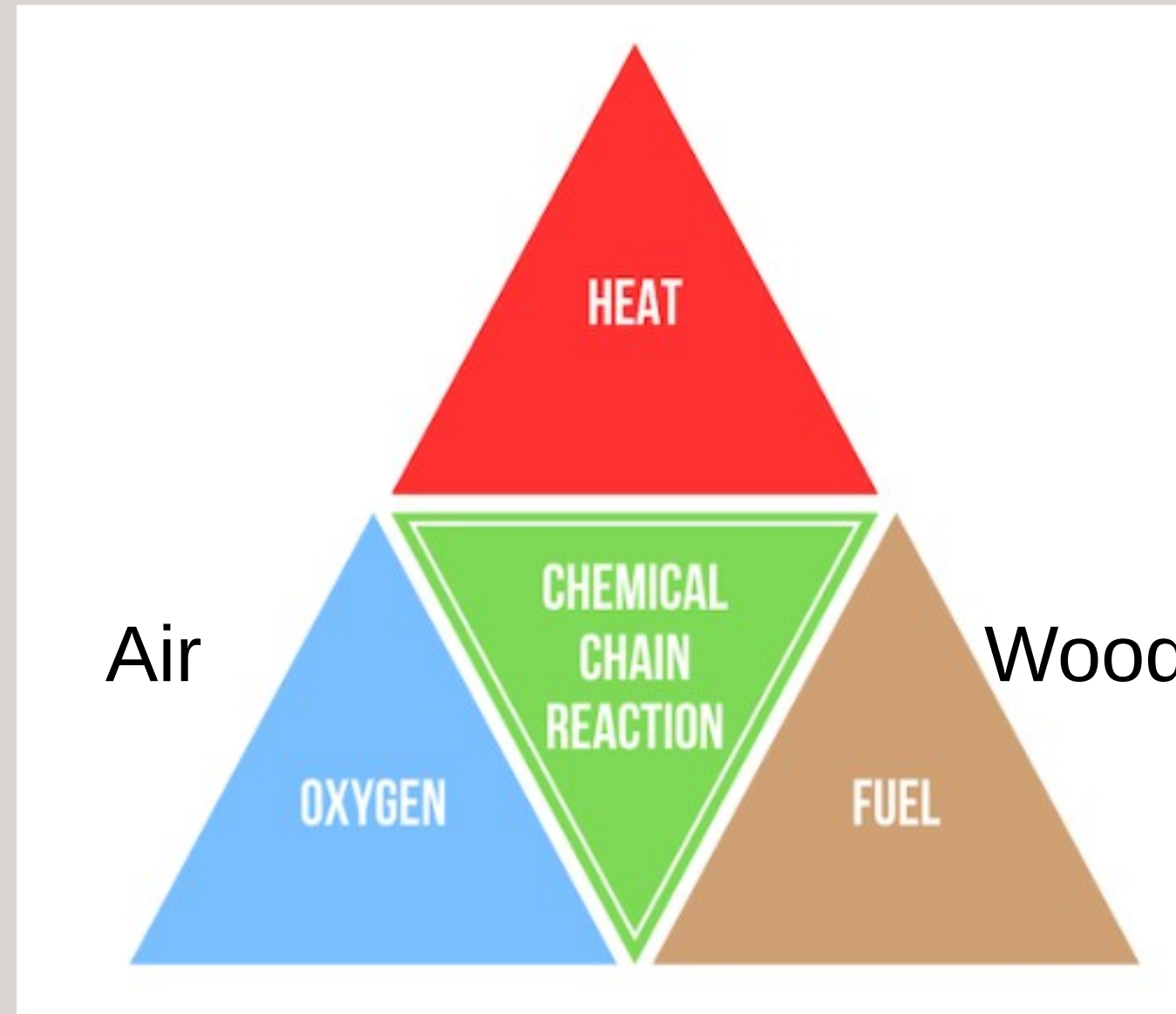
Combustion Control

Design Parameters

1. Safety
2. Efficiency
3. Emissions

Air Flow

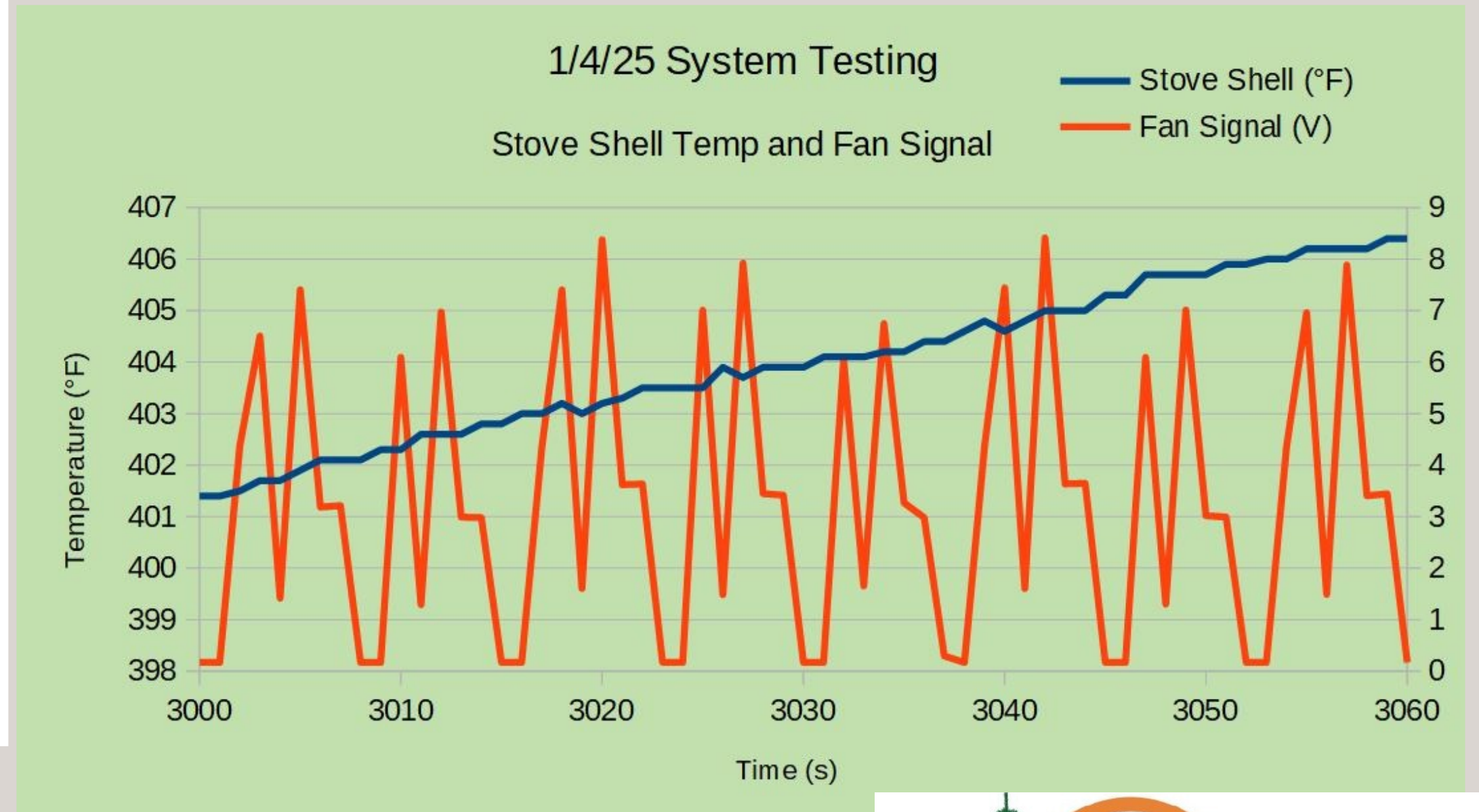
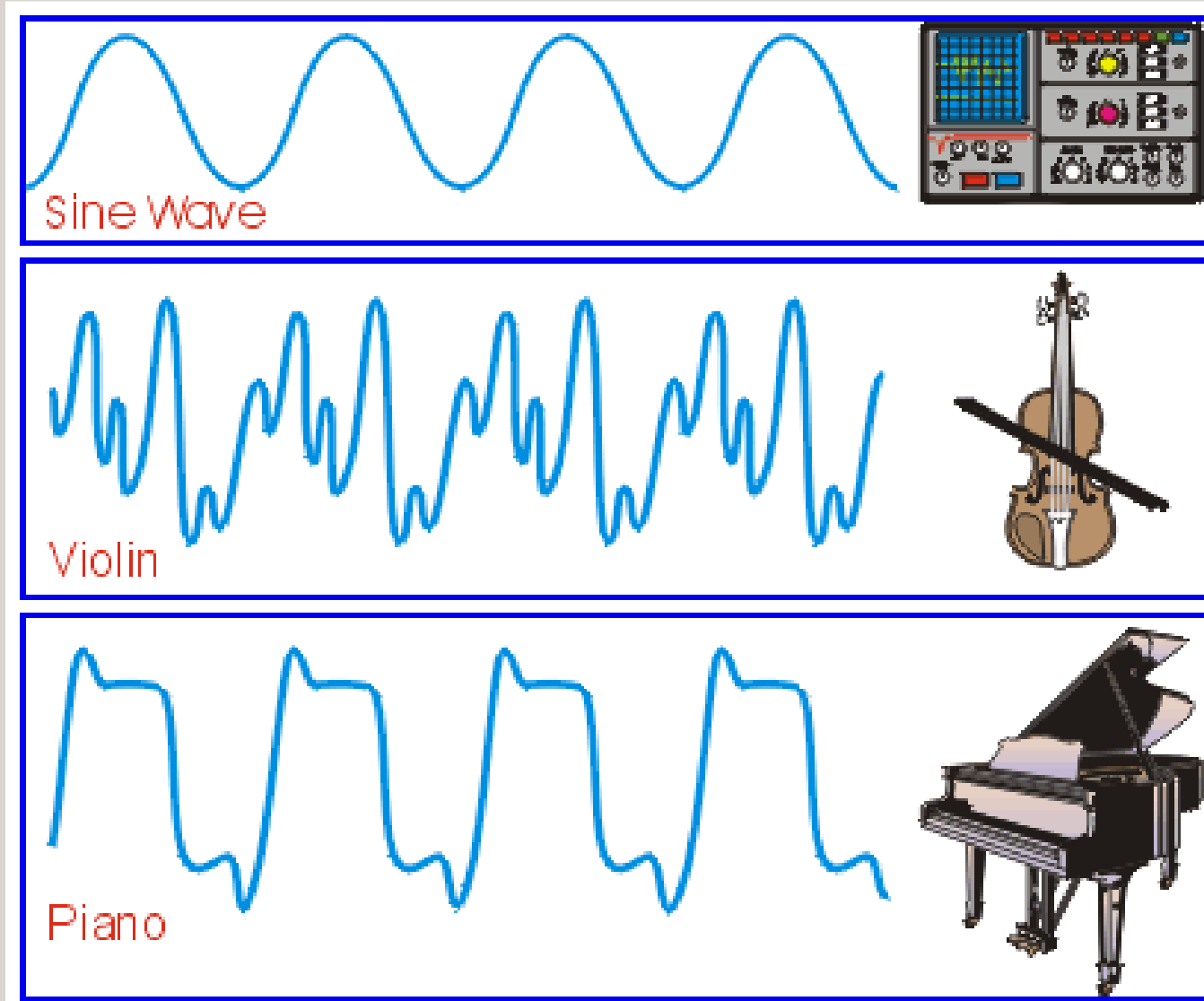
Mass flow rate
Air flow pattern



Wood burning phases

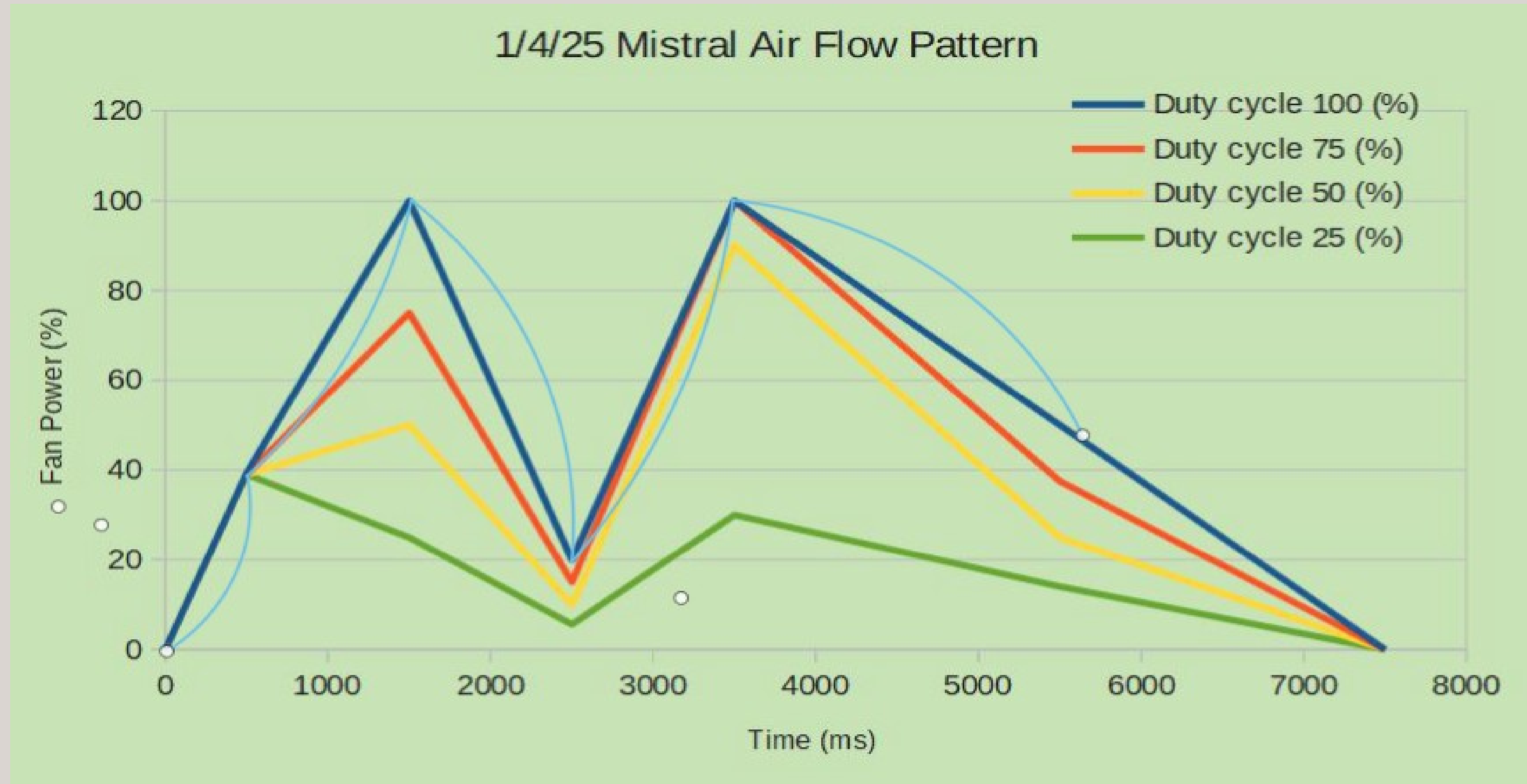
New Fuel Insertion
Endothermic
Peak Heat
Embers

Smokeless Chimney Combustion Control





Smokeless Chimney



Smokeless Chimney

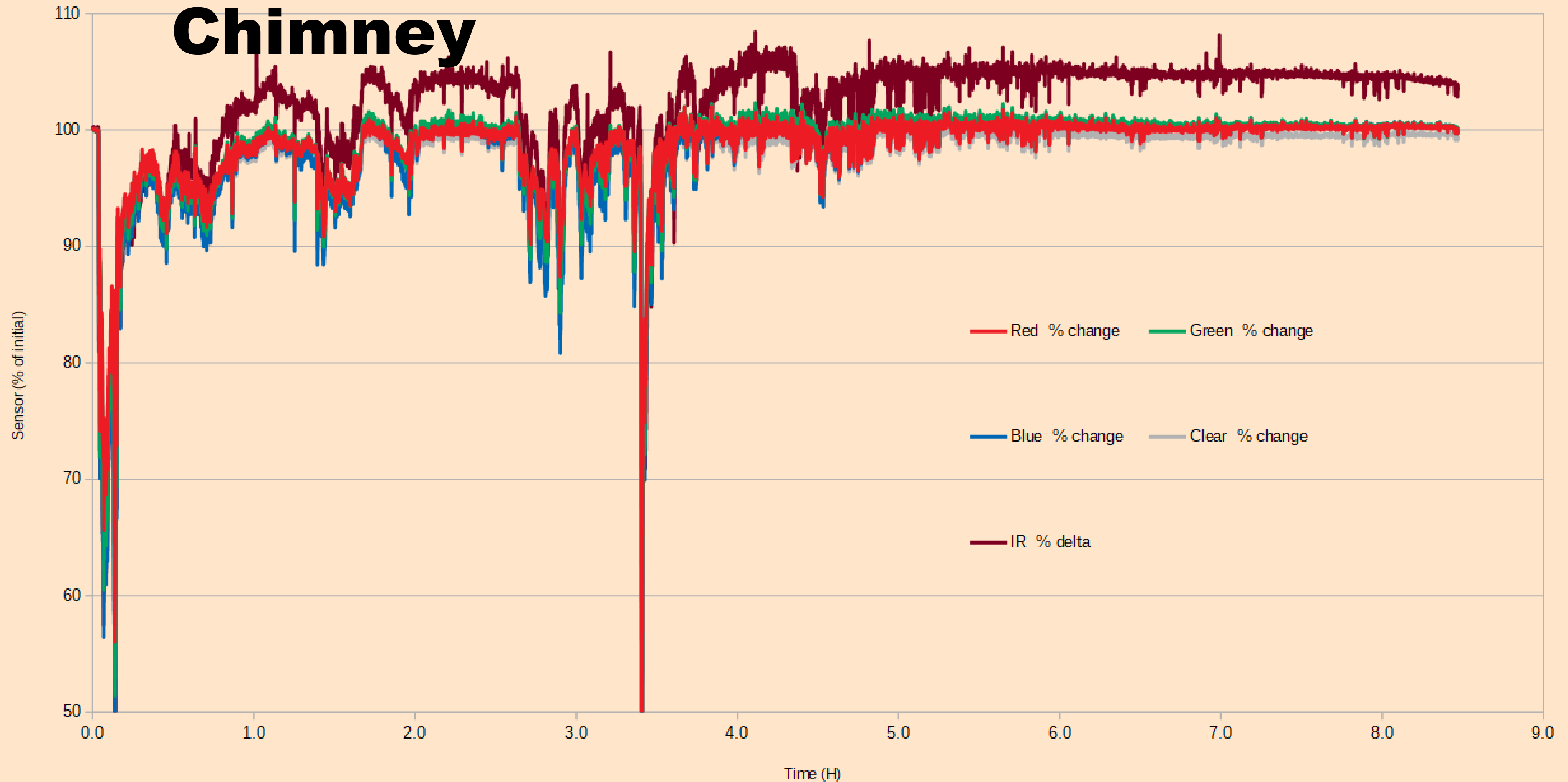
Octoring - Smoke Measurement



Smokeless Chimney

1/12/25 Octoring Testing

Sensor Channels Normalized



Smokeless Chimney Receiver / Control



Smokeless Chimney

Summary / Takeaways

- Safety First
- Every Wood Stove is Unique
- Fire is controlled with small air adjustments or patterns
- There are 13 million Wood/Pellet Stoves in the USA alone
- 1 Billion people heat or cook with biomass





Smokeless Chimney

Contact

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