

# Measuring Emissions & Exposure

**Important:**

Emissions and Exposure are not the same!

- **Emission** = what comes out of the stove
- **Exposure** = what people breathe



# Emissions vs Exposure

## Exposure

- must be measured in the field
- is related to people's habits as well as stove characteristics
- affect personal health in many ways
- ...*immediate problem*

## Emissions

- can be measured in the lab (maybe)
- are related to exposure if stove is not vented
- affect
  - neighborhood AQ
  - regional AQ
  - global air chemistry
- ...*longer-term problem*



# Emissions *and* Exposure

STOP!

Exposure must be  
reduced  
immediately

but...

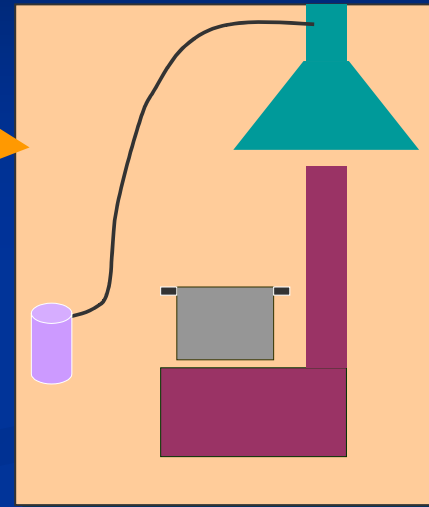
Emissions become  
important as population  
densities increase

- Both require similar measurements (add CO<sub>2</sub> to get emissions)
- Emissions are the link with laboratory development
- If possible, measurements of both *might* demonstrate multiple benefits



# Emission measurement

- Converging on recommendations!
- Collection method: *Hood*
- Pollutants to measure: *CO and PM*  
(and more in testing lab)
- Data acquisition: *Real-time when possible*



# Measurement scenarios



increasing quantity needed  
increasing time commitment



increasing complexity  
increasing expense

## I. In-field monitoring

- confirm improvements
- rapid feedback to stove artisans

## II. Stove design lab

- evaluate design choices
- demonstrate emission improvements

## III. High-end (university) testing

- validate less-expensive measurements
- understand nature of emissions



## II. Test case at Aprovecho Research

- Hood (developed & delivered by Dale Andreatta)
- Pollutants:
  - CO via NDIR
  - PM via light scattering (not perfect)
  - Emissions inferred using CO<sub>2</sub>
  - Also measuring O<sub>2</sub> to assess combustion
- Data Acquisition:
  - Computerized with LabView
- Status: Funded by Murdoch

Plan: Take same measurements to field (TamiCart) & compare with exposures



# III. University backup

In addition to the “basics”

- Colorado State (Bryan Willson)
  - Gas composition
- University of Illinois (Tami Bond)
  - Particle characterization: chemical & physical
- Outreach & integration with other universities abroad



Emission only; others are working on efficiency, etc.



# Outstanding questions

Amazing that these still exist!

- The **chimney** question
  - What's quickest, broadest, most feasible way to reduce *exposure* over the long term?
- The **representativeness** question
  - To what extent do lab measurements look like field measurements?
  - Can we design improvements in the lab that affect real stoves?
- The **confirmation** question
  - What *minimum* amount of measurement ensures that a new stove is effective?

