Advanced Stoves Laboratory at Colorado State University

Peter Letvin , Elisa Guzman
Dr. Bryan Willson

Global Innovation Center for
Energy, Environment & Health

Outline

- Global Innovation Center
- History
- ASL Mission
- Advanced Measurement
- Projects

Global Innovation Center: (1/3) Mission

The Global Innovation Center for Energy, Environment, and Health, is a . . .

. . . partnership between the College of Engineering and College of Business . . .

. . . to develop and disseminate solutions . . .

. . . to global problems . . .

. . . using a self-sustaining, entrepreneurial approach.

Colorado State University

Global Innovation Center: (2/3) History

Engines & Energy Conversion Lab (EECL) 1992

Now one of the world's most active R&D programs for internal combustion engines.

Envirofit International 2003

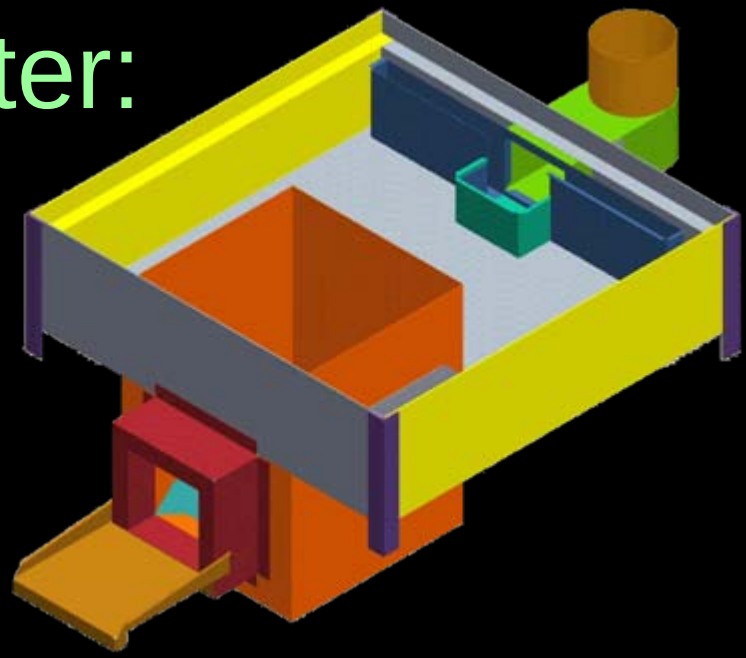
A joint effort of the EECL & College of Business to (initially) disseminate a technology solution to pollution from 2-stroke engines in Asia. Now an independent non-profit 501(c)(3) corporation.

Global Innovation Center 2005

Further EECL / College of Business partnership to promote commercial solutions to large global problems.

Colorado State University

Global Innovation Center: (3/3) Initiatives



Household Energy / Stoves

- Stoves Laboratory
- Stove design (BrightLights)
- High volume stove manufacturing
- Village power
- CEIHD / Shell China Prize for Stoves

Clean Vehicle Technology

- Retrofit solutions for 2-stroke engines
- Retrofit solutions for “dirty diesels”
- “Alternative” fuels: natural gas, “Hythane”
- Biomass fuels: gasification, algae

Colorado State University

Outline

- Global Innovation Center
- History
- ASL Mission
- Advanced Measurement
- Projects

Large Bore Engine Testbed, Founded 1992

Large Engines at the EECL


Colorado State University
CAT
WOODWARD
CATERPILLAR
Colorado State University

Clean Snowmobile Challenge 2000-'02

Clean Snowmobile Challenge 2000-'02

Colorado State University

Colorado State University


TRADING
M. SANTILLAN ST MAKATI CITY
TZ 7404


895


VETERANS
BATOPA
1193
774

EECL Involvement Began through Measurement

Outline

- Global Innovation Center
- History
- ASL Mission
- Advanced Measurement
- Projects

Mission

1. To complement existing stove measurement efforts and ***build knowledge*** by implementing the most advanced measurement techniques available
2. To ***foster innovation*** by promoting the development of new stove technologies
3. To ***maximize impact*** through high-volume dissemination / manufacturing of clean cookstove technology

Colorado State University

Outline

- Global Innovation Center
- History
- ASL Mission
- Advanced Measurement
- Projects

5-Gas Bench for Criteria Pollutants

Hydrocarbons:
- Flame ionization

NOx:
- Chemiluminescence

O_2:
- Paramagnetic

CO:
- Non-dispersive Infrared

CO_2:
- Non-dispersive Infrared

Colorado State University

Detailed Speciation: Fourier Transform Infrared Spectrometer

- Hydrocarbon speciation
- NOx speciation
- Greenhouse gases
- HAPs (hazardous air pollutants)
- Methane, ethane, propane, butane C_5+, ethylene, acetylene, propylene, formaldehyde, acetaldehyde, acrolein, NO, NO_2, N_2O, total HC, CO, CO_2, non-methane HC, non-methane organic gases

Constant Volume Sampling for Mass Flow Measurement

- Positive displacement pump:
  - Controls flow
  - Provides measurement
- Driven by variable speed motor.
- Facilitates real-time variation of dilution ratio for best measurement accuracy

Measure:

- Speed
- Pressure
- Temp
- Composition

$$\text{Mass Flow} = \text{Volumetric Flowrate} \times \text{Density}$$

$$\text{Mass Flow} = \left(\frac{\text{displacement}}{\text{revolution}} \times \frac{\text{revolution}}{\text{minute}} \right) \times \text{Density}$$

$$\text{Mass Flow} = \frac{\text{displacement}}{\text{revolution}} \times \frac{\text{revolution}}{\text{minute}} \times \frac{\text{Pressure} \times \text{MW}}{R_U \times \text{Temp}}$$

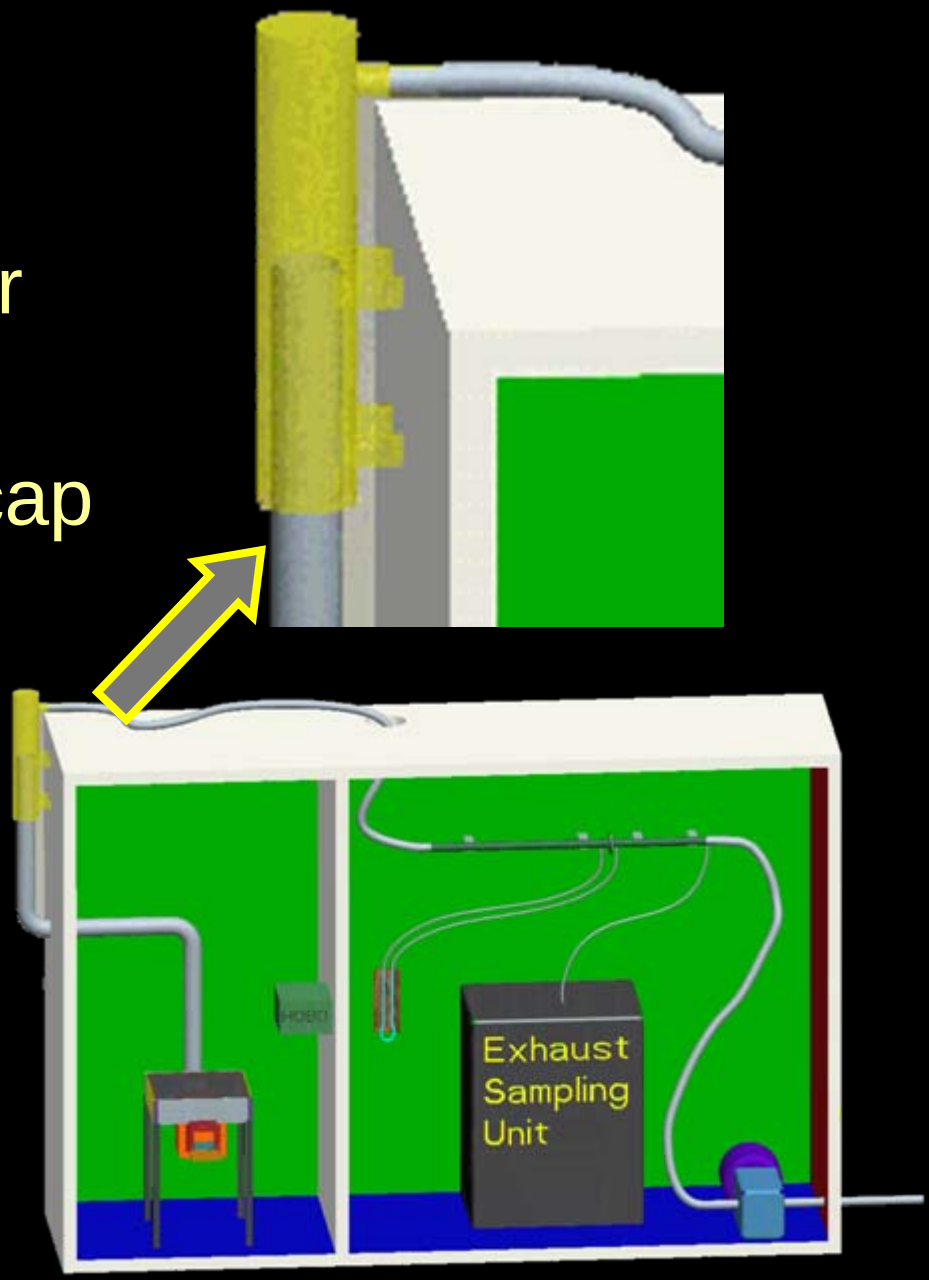
Colorado State University

Sampling Hood

Colorado State University

Dilution Cap

- Sampling hood set up for direct extraction
- Can also use a dilution cap for faster time response for chimney stoves
- Allows simultaneous measurement of stove leakage with chimney stoves



Particulate Measurement Dilution Tunnel

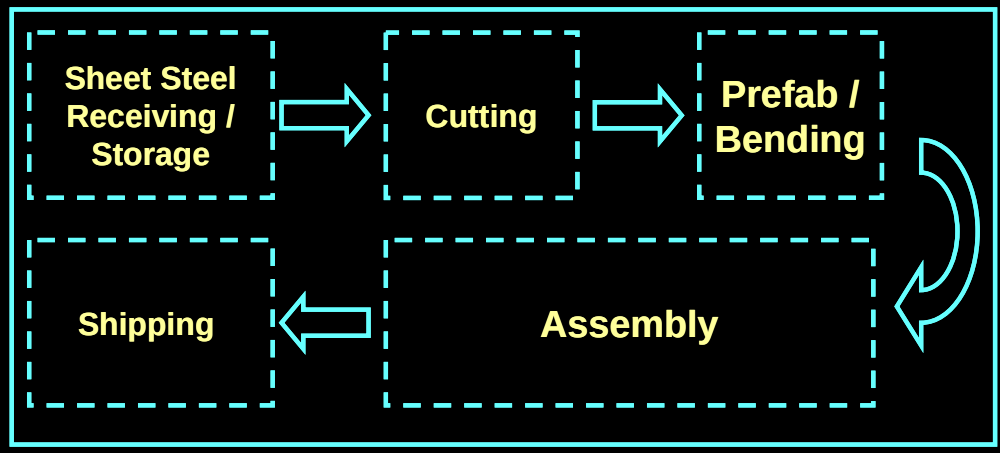
- Variable particulate suspension times, up to 2 minutes
- Will be used for sizing & advanced chemical speciation studies for PM from stoves

Outline

- Global Innovation Center
- History
- ASL Mission
- Advanced Measurement
- Projects

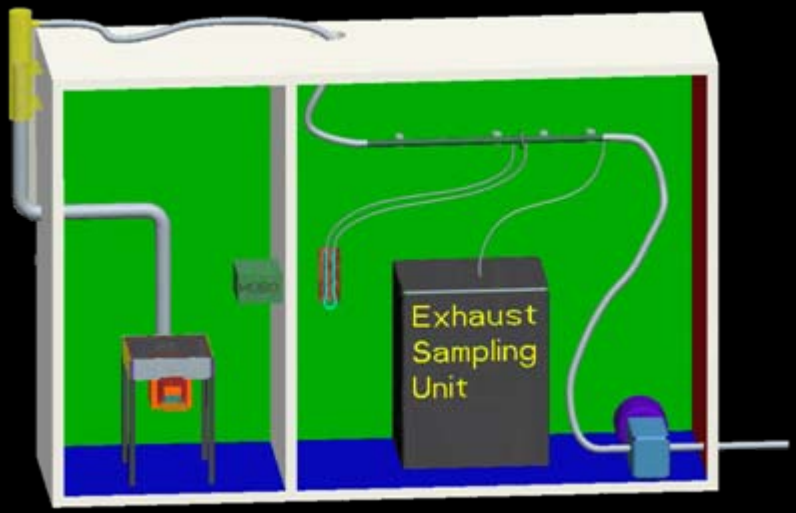
Low-Cost, High-Performance Refractory Ceramics

High Volume Manufacturing



Colorado State University

Support: China Prize For Stoves



Colorado State University

BrightLights: Electricity Generation from Stoves

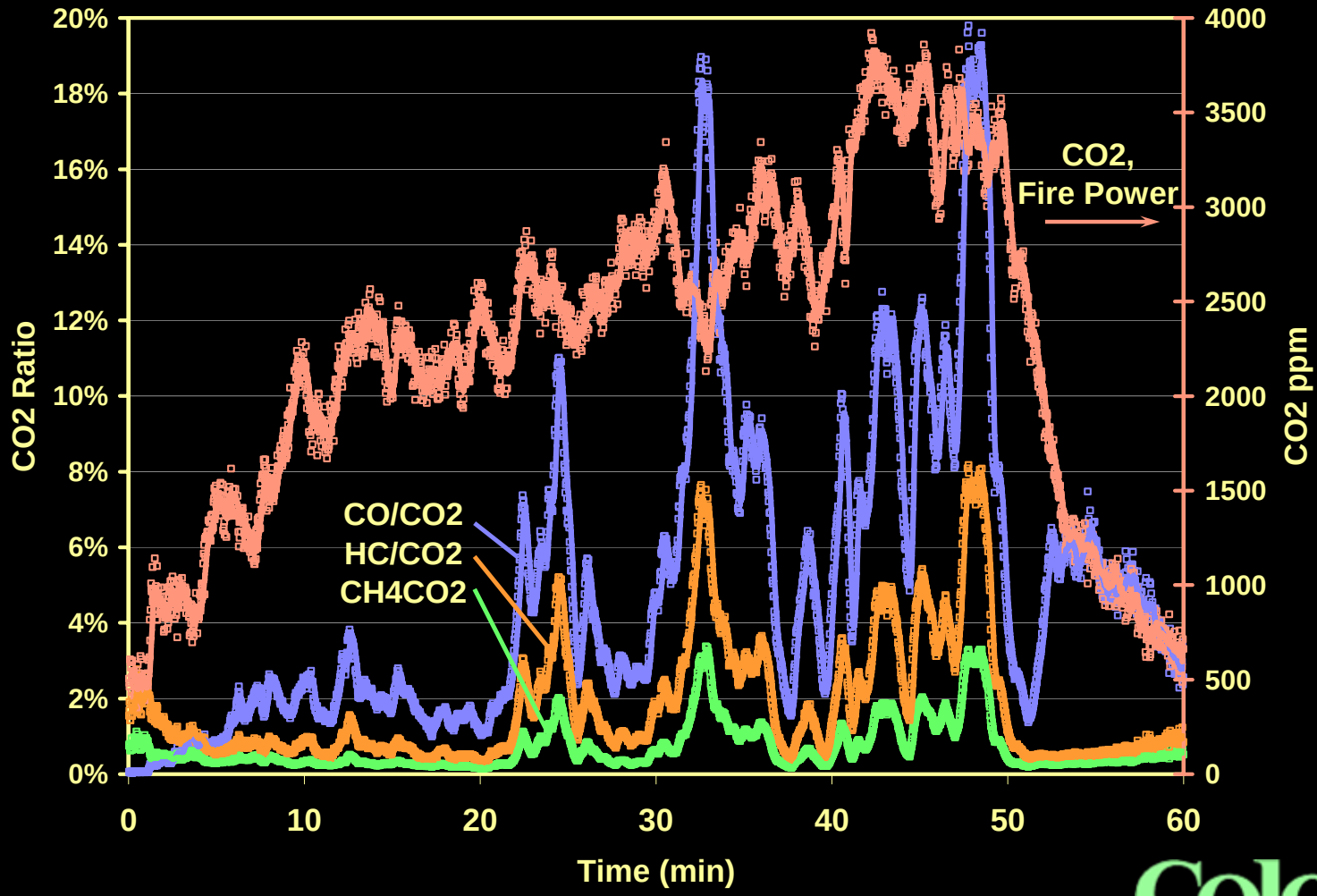
…wood burning stoves…

… with a generator …

… to provide power …

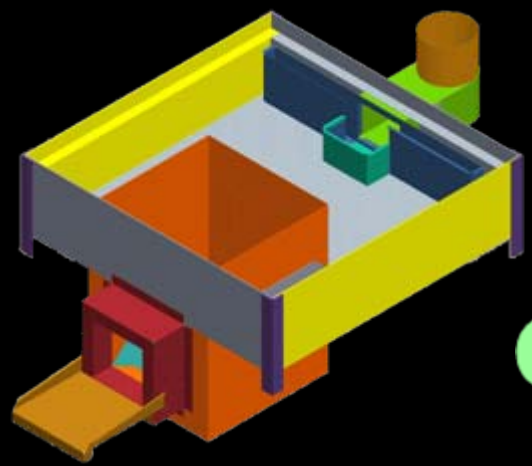
Colorado State University

Greenhouse Gas Studies



Colorado State University

QUESTIONS?



Colorado State University