Error and uncertainty in testing

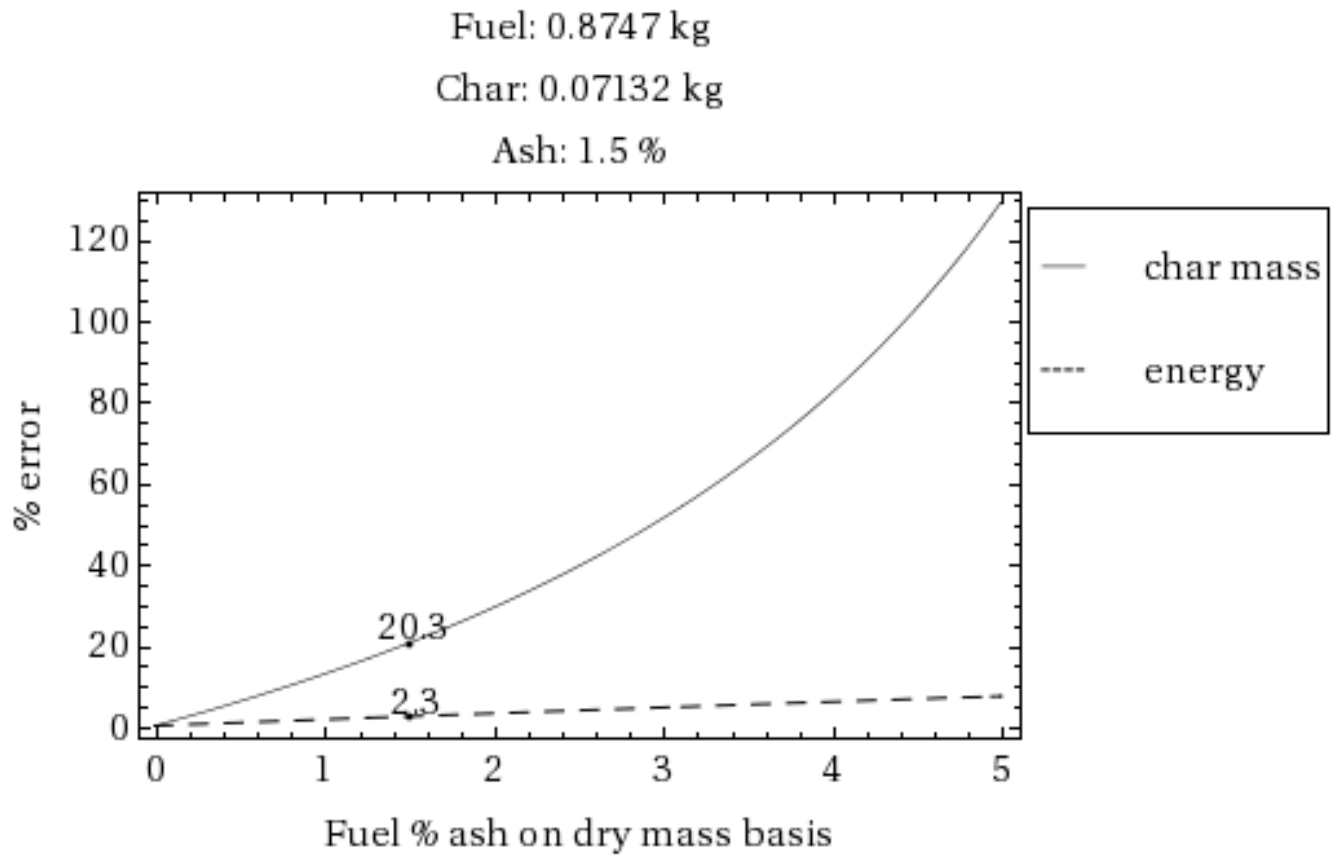
Two types of error common in stove testing

- Calculation and reporting procedures fail to propagate measurement uncertainties of equipment into final result
  - Mass balances
  - Temperature probes
  - Calorimeters or charts of fuel calorific value
  - Emissions detectors
  - Manometers, pitot tubes, etc.
- Analytical bias built into the test procedure

Why is error important?

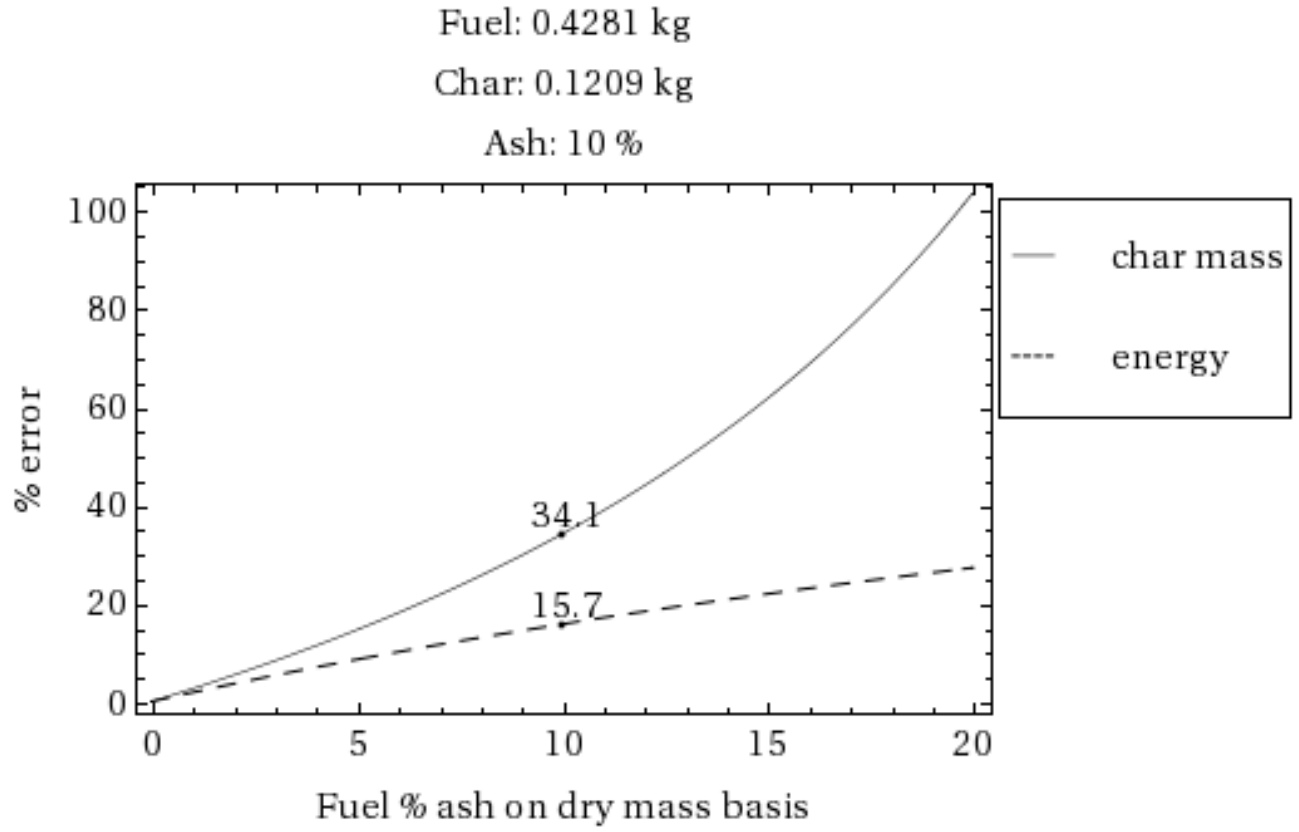
- Comparisons between stoves
  - Many stoves have similar performance. If you have to choose one for your program, which one is really better?
- Nonlinear dose-response curves for emissions
  - Getting a handle on which stoves have a chance of meeting IAP and health outcomes requires accurate tests

Effect of mistreatment of ash: Low ash content fuel (1.5% dry weight)



2.3% Relative error in all quantities involving total energy “used”

Effect of mistreatment of ash: High ash content fuel (10% dry weight)



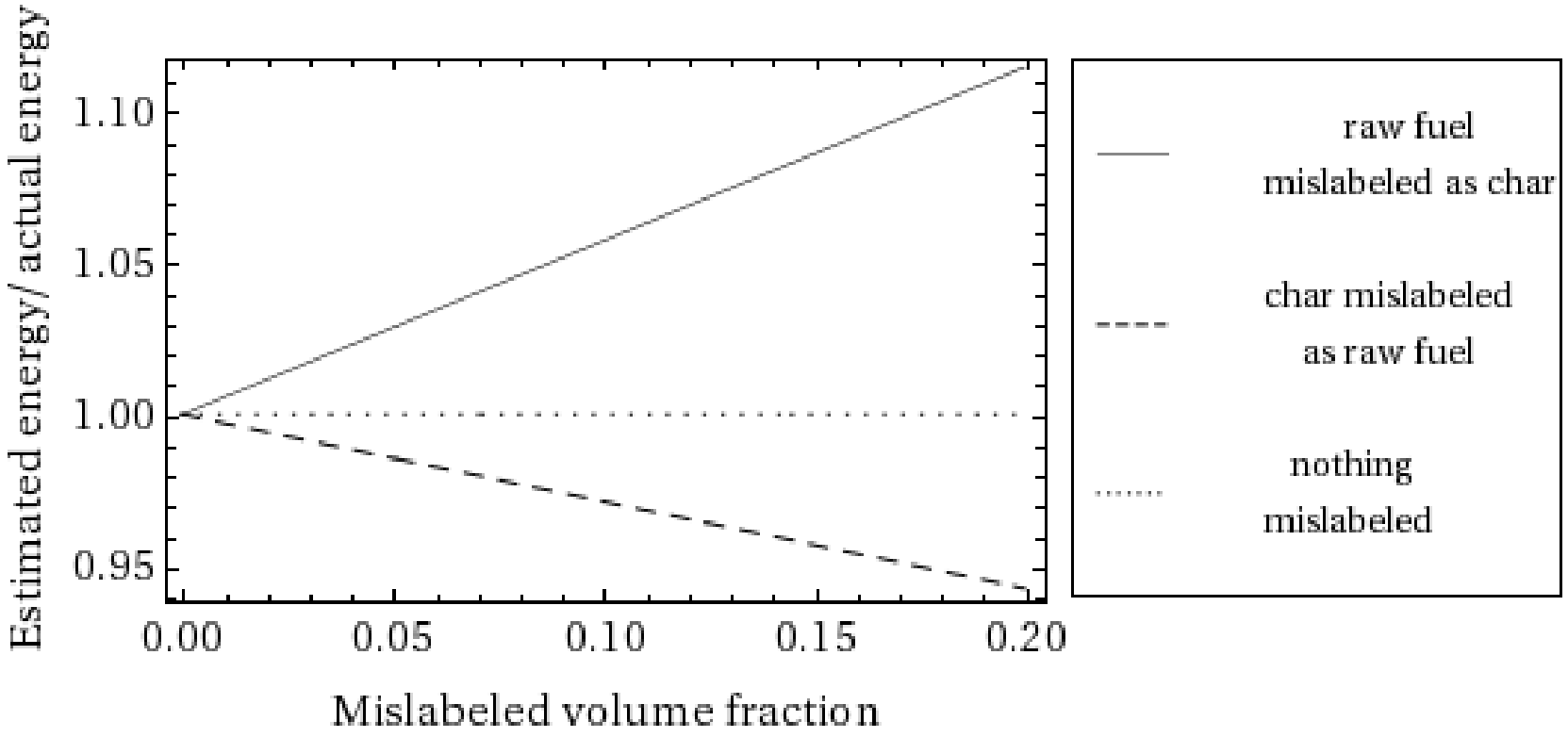
15.7% Relative error in all quantities involving total energy “used”

Fuel left in stove at the end of a boiling test: what is char and what isn't?

Broken piece of fuel shows gradient from unburned to char

How do we assign an energy value to something like this?

Sorting and weighing of char causes bias



Sorting and weighing of char causes bias

- Likely degree of error depends on fuel shape, size, and species
- Fuel in small, discrete chunks is most problematic

How big an issue?

- Analytical bias is most likely on the order of 10% relative error in all quantities involving energy
- Propagated uncertainty between 2% and 5% for energy, ????? For emissions