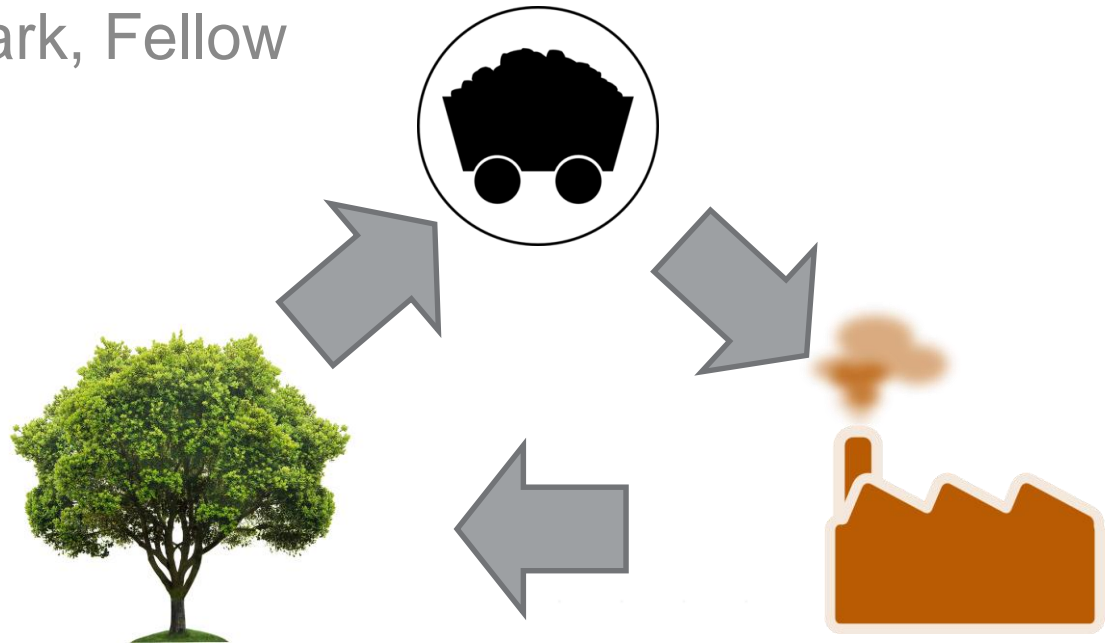


Coal Does Grow on Trees!

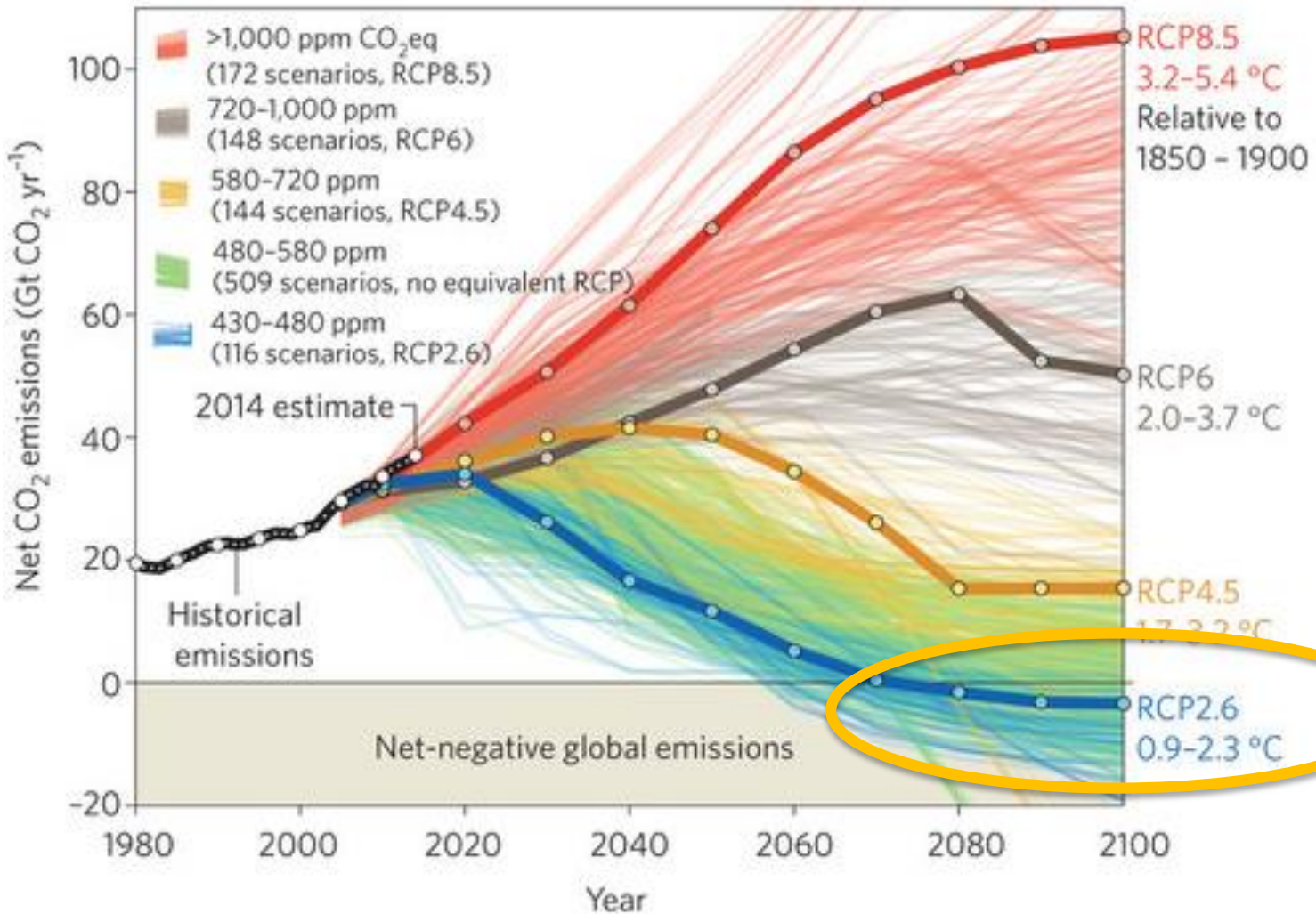
Fuel Switching for Carbon Negative Electric Power

Dr. Addison Killean Stark, Fellow

February 29, 2016

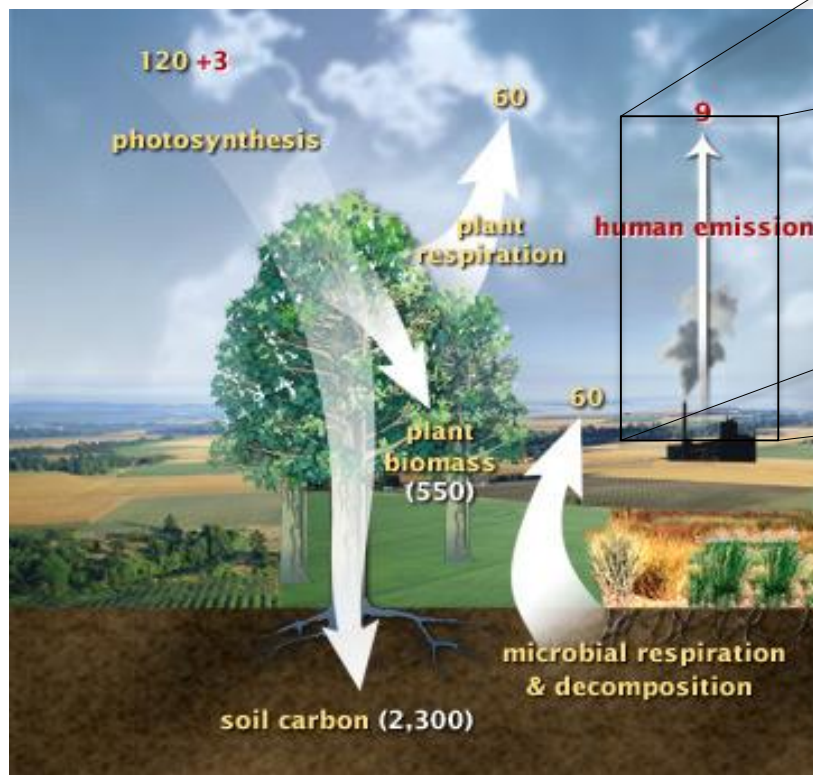


Why Negative Carbon Power?



Closing the Carbon Loop for Power

Units: GigaTon of C



USA: 2 GT emitted. 5-10 GT Cycles

One pathway to Carbon **Neutral** power,
and

the only pathway to Carbon **Negative**
power.

Via **B**io-**E**nergy with **C**arbon **C**apture and **S**equestration (BECCS)

Innovative Strategies

Fuel Pretreatment for Retrofit

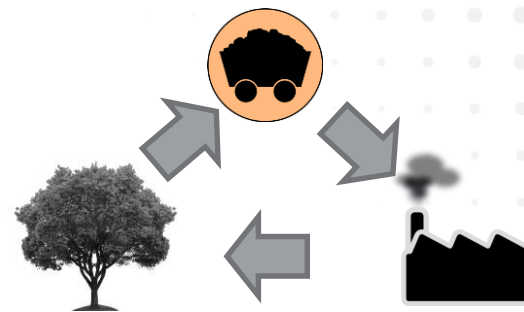


Advanced Plant Design
Or
“Better Plants for Power Plants”

Advanced Plant Design

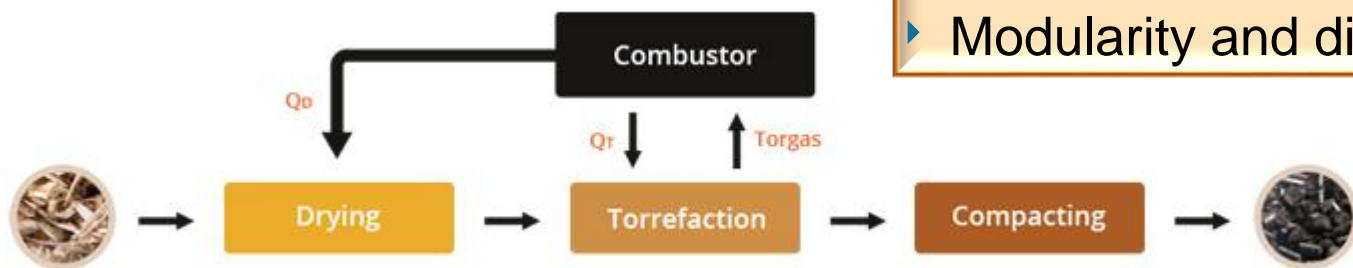
Fuel Pretreatment for Fuel Switch - Torrefaction

Make biomass look and act like coal.



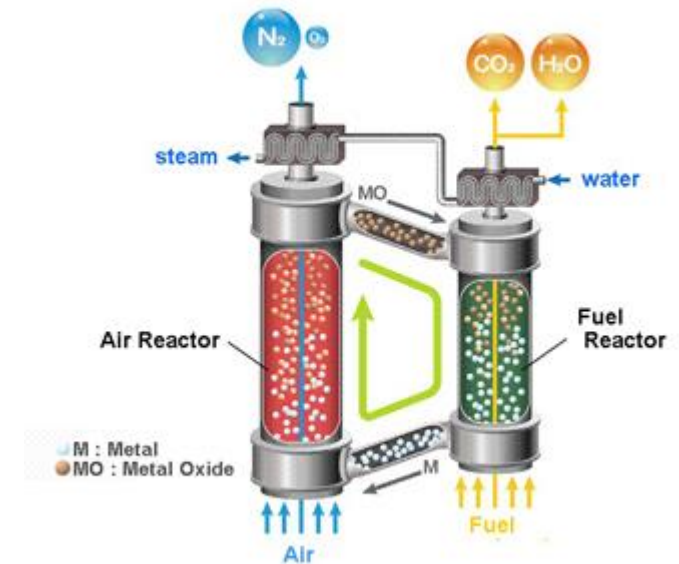
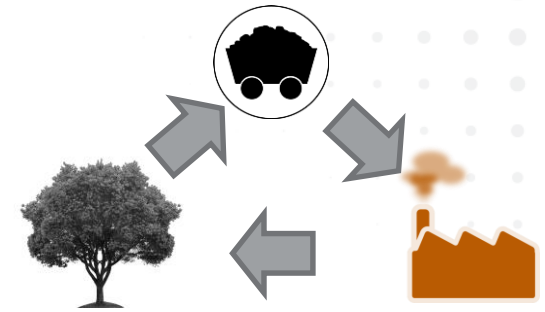
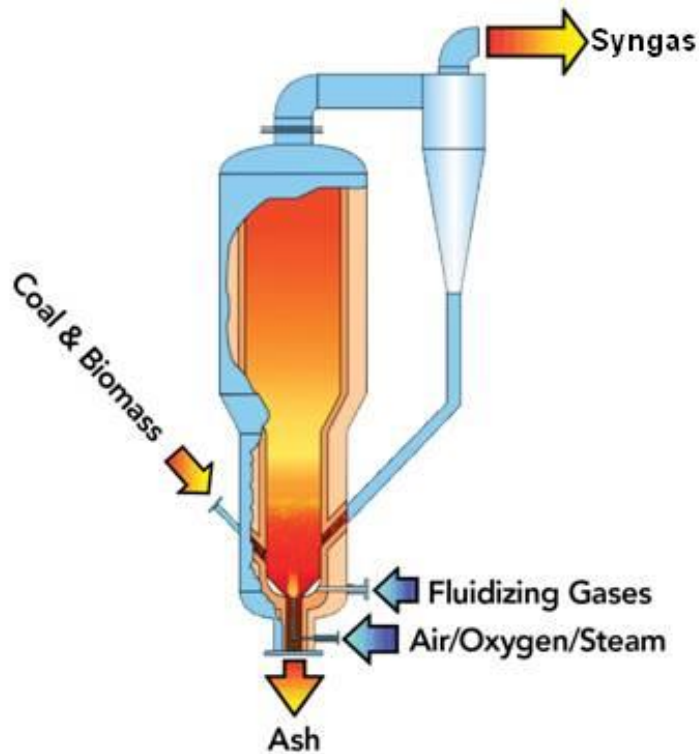
Challenges and Opportunities

- ▶ Scale-up of reactor
- ▶ Heat integration
- ▶ Modularity and distributed production



Advanced Power Plant Design

Integrated (co-)Gasification and Combined Cycle

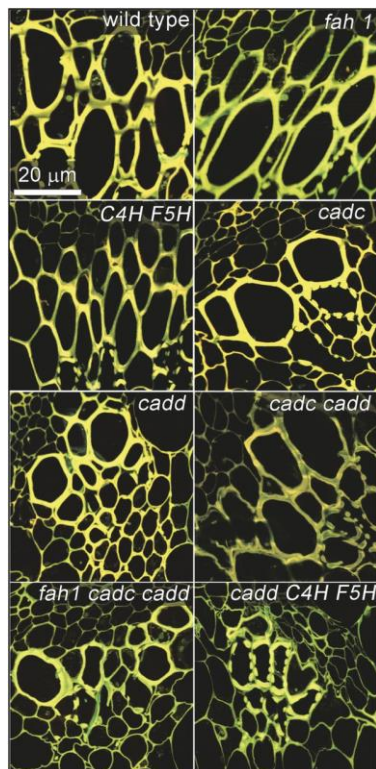
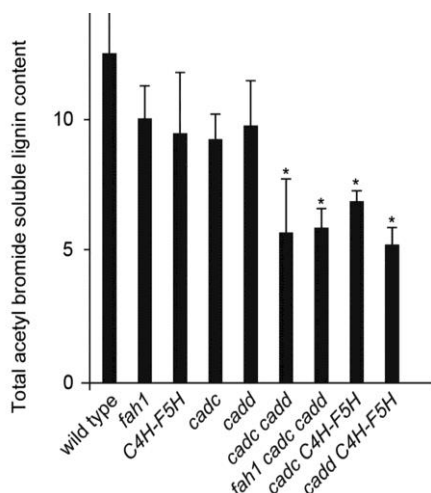


Chemical Looping Combustion

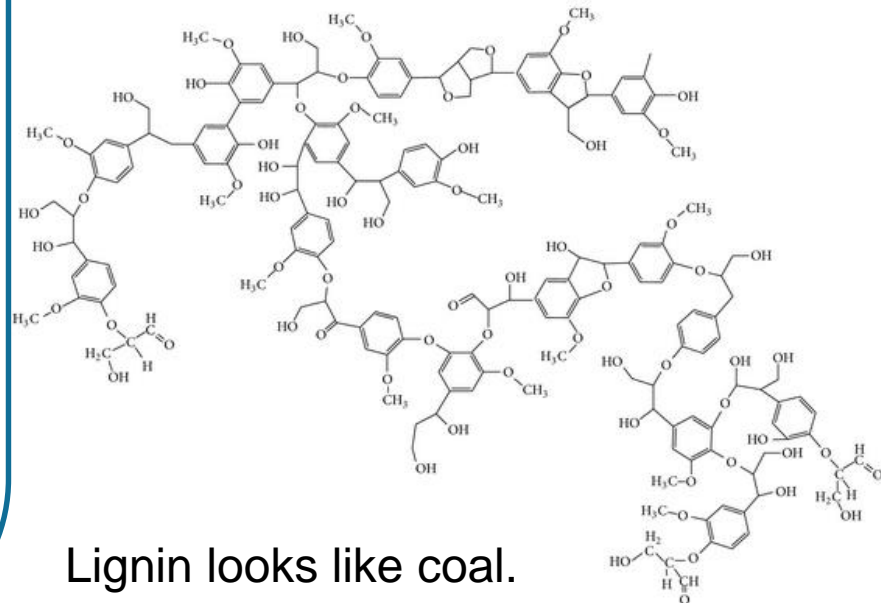
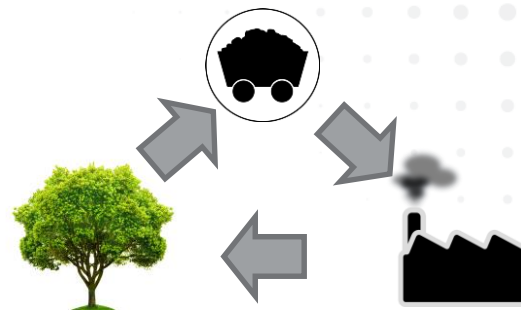
Better Plants for Power Plants!

Breed for More Lignin

Adapt previous work on decreasing lignin?



Anderson et al. *Plant Cell* 2015.



Lignin looks like coal.

In Summary...



Fuel Pretreatment

- + Advanced Power Plants
- + Advanced “Power Plants”
- Carbon electric power