TLUD: (*Top-Lit Up-Draft*) Gasifiers: *One of many backyard biochar designs*

See back of page for "Champion" TLUD design

Pros	**Cons**
Easily adapted as clean cooking stove	Fuel size and shape dependent. Requires "chunky" biomass w/ good airflow
Steady, gentle, predictable heat output	Fuel source must be very dry
Can use wood chips as fuel, or other small, chunky biomass	Slightly more complicated DIY build than other 'drum in a drum' biochar designs
Easily adapted with air control for metered flame	Must be present to extinguish in order to yield biochar
Commercial and very low cost versions available for home or developing nations	
Works off natural draft - no electricity required	

Biomass: Actually the sum total of all carbon based organisms in a given space. For our purposes it's refuse plant material used as fuel, usually wood chips, or something that's a similar size and shape.

Gasifier: Household or industrial scale appliance where limited oxygen is supplied to smoldering biomass, facilitating pyrolysis, where volatile gases are liberated and burned in another location.

Syngas: Mixture of gases that are released in the pyrolysis of biomass. Mainly CO, H and Co2

Pyrolysis: Process where syngas is liberated from biomass by the application of heat in a limited oxygen environment. Byproducts of process are syngas and charcoal.

Combustion: Process where gas, oxygen and spark combine to create flame. Clean combustion is dependent on heat, and a proper ratio of gas and oxygen. Complete combustion of wood theoretically yields only CO2 and Water Vapor.

Primary air: The air (oxygen) that is used to initiate pyrolysis

Secondary air: The air (again, oxygen) that is mixed with syngas for combustion

Biochar: Charcoal, usually made in a higher temperature process than typical lump charcoal. Biochar has many applications, but ultimately serves as a powerful soil amendment that is highly resistant to microbial degradation and 'sequesters' carbon for hundreds of years.

Carbon Sequestration: Any process where CO2 is removed from atmosphere and stored indefinitely. In the case of Biochar, waste wood (that would otherwise be burned or left to rot) is carbonized via pyrolysis, where a portion of the greenhouse gases that would be released are stored as biochar. All other factors aside, for every 1 lb of biochar made, roughly 3.67 lbs of carbon dioxide is sequestered.

Dan Hettinger, Living Web Farms Biochar, 2018

If you've researched backyard biochar on your own, then you'll recognize this as another cylinder inside a cylinder system, like many of the other DIY designs available. Understanding it's operation reveals a few things that set this apart from other designs. Start with this champion design, and modify as you become familiar with its operation. As with all these passive designs, hole sizes and dimensions are dependent on fuel source and moisture content. This one works well with dry hardwood chips.

- With the concentrator lid removed and set aside, start by loading dry, chunky biomass into the fuel cylinder to just below the top.
- Using a torch or match, carefully light the column of biomass **on top**. This may take some practice.
- Once it's well lit, place the concentrator lid back on. Watch as gas is liberated from the smoldering biomass, and mixes with secondary air through the small gap between the inside and outside cylinder.
- There's just enough oxygen in the primary air to keep the biomass smoldering, TLUD relies on preheated secondary air for complete combustion.
- The concentrator lid constricts the flame and then allows it to expand again in the riser. This subtle change in pressure helps swirl air and gas around to facilitate mixing of air and fuel.
- Gases are steadily liberated and Biochar remains as the 'pyrolysis front' continues downward.
- Eventually, all that's left is biochar, and the flame will become noticeably weaker and you'll smell that familiar charcoal grill scent. Carefully pour it out into a sealed metal container, or quench if you want to keep the valuable biochar as carbon negative soil amendment.

Image Source: Biochar-International.org and "Dr. TLUD"