

Classification of Stove Technologies and Fuels: 1-page version

[This and the full 4-page version 1.0 (2017-04-10) are available at woodgas.com/resources and drtlud.com/resources]

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The classification table below enhances the important “Overview of Improved and Clean Cooking Technologies” from the 2015 joint publication of the Global Alliance for Clean Cookstoves (GACC) and the World Bank’s Energy Sector Management Assistance Program (ESMAP). Three principle groupings are identified [with author’s comments presented in brackets]:

A. (Left) Improved Cooking Solutions (ICS) with direct combustion of solid fuels. [The “old ways.” Largely inadequate to solve the cookstove challenge for clean-burning stoves for 500 million households.]

B. (Right) Non-biomass fuels and stoves. [LPG, NG and electric stoves are used by affluent societies and are aspirational for impoverished people. With current supplies and prices, plus subsidies, LPG could reach perhaps 250 million households that have modest incomes and can be reached by fuel supply chains.]

C. (Center) Three technologies that change biomass into gases or liquids that are then burned cleanly. [Modern woodgas stoves could serve the least accessible and poorest 250 million households using their same currently-used, locally-grown fuels. The Top-Lit UpDraft (TLUD = tee-lud) micro-gasifier stoves are “climate friendly,” earning up to 4 carbon credits per stove per year, sufficient to financially sustain stove maintenance and continual usage. While cooking every meal, these pyrolytic stoves create useful charcoal (or biochar), resulting in potential income for many of the poorest people on Earth.] (Contact the author to become involved.)

Classification of Stove Technologies and Fuels (V. 1.0 – 2017)										
Div	Not-Clean Cooking Solutions (ICS)				Modern Advanced Clean Cooking Solutions (MACCS)					
Fuel	Solid Biomass as Solid Fuel: Wood, dung, agro-refuse, charcoal, (Coal is localized and fossil solid fuel.)				Solid Biomass as Initial Fuel for Creation of Gases & Liquid Fuels			Non-Biomass Fuels		
Cooking technologies	Base-line: Three-stone fire	“Improved Cooking Solutions” (ICS)			Advanced Clean Cooking Solutions (ACCS)			Fossil-Fuel Stoves Processed petroleum to become gases.	Electric Stoves Electricity remotely generated. Much from fossil fuels.	Solar Stoves Dependent on sunlight.
		Legacy & Basic ICS Stoves	Intermediate ICS Stoves	Char-coal ICS stove	Combustible gases and liquids for cooking are created (“refined” or “derived”) from initial biomass that undergoes an intermediate process.					
what is Combusted?	Bio-mass as Solid Fuel	Bio-mass as Solid Fuel	Bio-mass as Solid Fuel	Char-coal has only 30% of energy of wood.	Woodgas from Biomass: Gas-burning with gases from solid dry biomass; makes char.	Biogas from Biomass: Gas-burning with gases from solid wet biomass.	Liquids from Biomass Ethanol, Methanol from biomass.	LPG, NG (nat. gas), DME, (Exclude kerosene) (Coal is solid and seldom clean-burning.)	Electricity Derived from renewable hydroelectric, solar, & (min) biomass. Also from fossil fuels (oil, gas, coal) and nuclear.	No combustion present in solar cook-stove.
Key Features and Stove Types	Three rocks to support a pot; Open fires and sheltered fires. Many supplemental stoves.	ICS Clay, mud, brick, and simple metal to contain fire Artisan produced.	ICS Rocket-style stoves w/ high fuel efficiency and moderately clean burning.	ICS Char-coal stoves cause deformation and high CO emissions.	Pyrolysis in fan-assisted or natural draft TLUD gasifiers produce gases & “C negative” charcoal with re-sale value. TChar stoves can replace charcoal ones.	Anaerobic digestion of biomass decaying in containers yields combustible gases. Always local production; biogas is never transported.	Industrial distillation of biomass yields liquid alcohol to burn in appropriate stoves. Many as supplementary.	Processed fossil fuels, with high fuel and combustion efficiencies; LPG in metal cylinders or NG via pipelines. Subsidized. “C positive”.	No combustion present in the stove; dependent on grid power; batteries are not sufficient. Electric or induction heating elements in a stove structure.	Reflective “dish” or solar-collector box, with need to orient toward the sun. Solar box ovens.

Adapted and expanded from *The State of the Global Clean and Improved Cooking Sector*, ESMAP 2015, Tech Rpt 007/15, Figure 1.1 (p. 13).

<https://openknowledge.worldbank.org/bitstream/handle/10986/21878/96499.pdf>