

Using a “producer gas” generator to create electricity

By Gene Townsend

While many people today search for a sensible form of alternative energy to produce electricity, one very old method has been all but overlooked. It is a method especially suitable for people desiring to live in remote areas, beyond the reach of power lines, and it is much less expensive than other forms of alternative energy. It is the conversion of biomass fuels to electricity.

The concept of converting biomass fuels, such as wood, straw, corncobs, coal, peatmoss, etc. into electrical energy is very old. Naturally, one would think of burning these fuels to raise steam for a steam plant, or operate a Stirling or other heat engine.

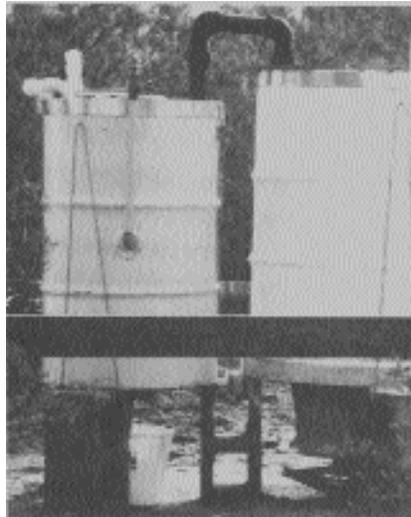
Most people who produce their own home power have need for only a few kilowatts of generated electricity. Steam plants in this size are very inefficient (5 to 10%) as well as dangerous and expensive. Stirling engines are either similarly inefficient or very expensive and nondurable. Take your pick. With either of these, the smoke and soot will coat your equipment and require constant cleaning. There is a better way.

Early days of the gas engine

The gasoline internal combustion engine, known as the S.I. engine, is not normally thought of as burning other fuels, but back in its early days it was operated exclusively on gaseous fuels.

Gasoline was not available before about 1910 when the automobile created a market for it. In that bygone era, coal was the universal fuel, being used for both home heating and early electrical generation plants.

Steam plants during that time—from about 1880 to 1920—were quite inefficient, requiring much precious fuel. In the United States this wasn't a big



Converted oil drums make up the upright gas producer, right, and gas scrubber.

problem due to the abundance of coal, but in Europe where fuel was scarce, a better way was found. It was a simple device known as the gas producer, which had been invented around 1820. The Europeans used it to convert coal into a combustible gas, known as “producer gas,” that could be used to operate the S.I. engine.

These power plants would produce about three or four times the power (for a given amount of coal) as the steam engines of the era. The fuel gas consisted of even volumes of hydrogen (H₂) and carbon monoxide (CO) gasses, as well as “nitrogen”—the nitrogen and other inert gasses that make up most of the atmosphere.

The tars and soot created by the fuel would damage the engine if allowed to enter, so they were filtered from the gas beforehand, resulting in no smoke being released from the plant. Water requirements were much smaller than steam plants as well.

The “producer gas” plants endured for about 30 to 40 years, but the high efficiency of the high pressure steam turbine, developed in the 1920s, caused its demise. In remote areas of the world, where coal transportation

was difficult and expensive, “producer gas” plants that operated on wood or agricultural residue remained through the 1940s.

Any modern gas engine generator can be operated on “producer gas,” whether it is derived from wood or other biomass fuels. The cost of the energy so produced is by far the lowest of all alternative energy sources.

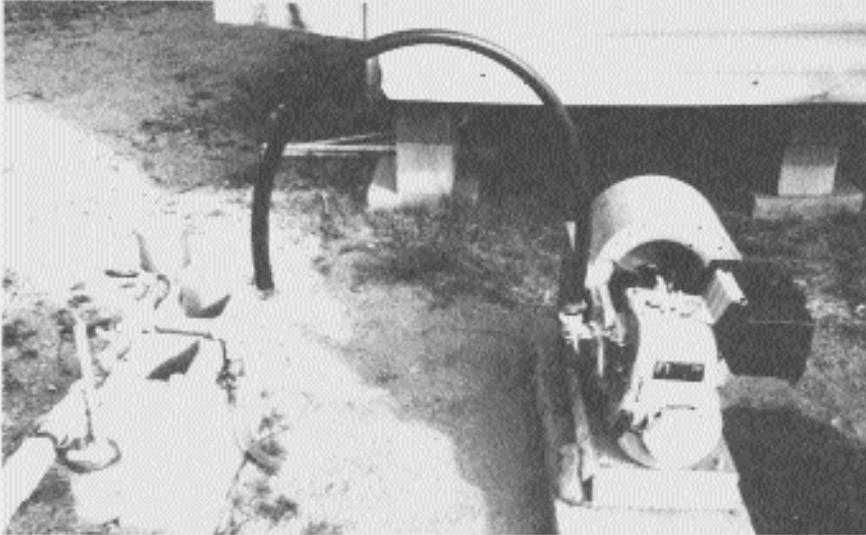
The technique of doing this is very simple, but has been forgotten over the years. In modern times, whenever oil shortages are invoked, interest in the gas producer for automotive use is resurrected. Most modern references to this involve automotive applications to which it is poorly suited due to safety concerns and inconvenience of operation. And producers designed for cars are poor designs for stationary use.

The simplest producer is the **updraft type producer**, so named because of the direction of the motion of the flue gases. It is a high temperature, airtight retort with a vertical stack and grate pad, which is usually a gridwork of iron bars at its bottom upon which the fuel rests.

The fuel is broken into pieces several inches square and fed into the stack from the top, while air enters from the bottom below the grate. The opposite directions taken by the air and fuel cause this to be known as the “counterflow” type, which results in greater efficiency. Air entering from below the grate flows upwards where it burns the carbon fuel that it meets and releases much heat that fuels the action of the producer, which is the reduction of carbon dioxide (CO₂) to carbon monoxide (CO) which absorbs much heat.

About 70% of the carbon fuel is reduced, the balance being burned. Water released by the fuel reacts with carbon to form hydrogen (H₂) gas as well as more CO.

The very hot gases produced in the reduction zone pass upwards through unreacted fuel causing it to heat and



The gas air-mixing manifold at left is attached to a text dynamometer.

release tars and surface moisture through distillation, also called pyrolysis. This action is unavoidable in the updraft type producer, the distillation gases produced being highly undesirable to the engine. They must be removed from the gases by suitable gas conditioning equipment.

The motion of the gases through the system is caused by the intake suction of the engine attached, so the restrictive nature of the filtration equipment must be minimized to avoid power loss. The gas must be cool as well as clean before it enters the engine manifold. Mixture ratio with air is very close to 1 to 1 for "producer gas." The updraft type can work with virtually any fuel containing carbon, and moisture content is non-critical. So this type has great fuel flexibility, but at the cost of relatively dirtier gas.

The **downdraft type producer** was developed to reduce the tar content of the gas when used with high tar fuels such as wood or lignite coals by burning it in the reactor directly, thus avoiding the need for large filtration units. This was a definite advantage in automotive units, which were mostly of this type. However, operation is optimal only for single fuels, and high ash fuels such as manure and crop residues cannot be used.

The **crossdraft producer** was

strictly for use in cars and required charcoal or very high grade anthracite coal fuel. The gas blast velocity is much greater in this type, resulting in much hotter reaction temperatures and faster throttle response—important in traffic conditions. During WW2, Volvo developed trailer-mounted units of this type.

Power output of a gasoline engine will be about half as much with "producer gas," but pollution will be lower due to cooler combustion temperatures. Fuel consumption is about 2.5 lbs. wood per horsepower hour. Compared to other bioconversion processes, such as methane digesters or ethanol stills, a much greater yield results from a lower grade of fuel using simpler equipment. The gas is not stored, but rather produced on demand by the engine as it needs it.

Today, the self sufficient person can produce power at a lower cost than the utilities using this technique—and with very little equipment outlay. It's not nice and clean like PV panels, but it works very well. The gas producer is a carbon-eating animal that needs care and feeding just like any livestock!

(Gene Townsend is the author of the **Townsend Gas Producer Manual**, a construction and operation manual he sells for \$10. If you'd like one, his address is 36515 Twin Hawks Lane, Marana, AZ 85653.)—Editor Δ