

# Unlocking the Stored Solar Energy in Wood:

## A Primer on Wood Gasification

Includes:  
**Study Schematic**  
**Tool List**  
**Flow Chart**  
**Resource Links**  
**& more**



Presented by:  
**WoodGasifierPlans.com**

*-What is Wood Gasification?*

*-How Can it Fortify Your Home Energy Needs?*

*-How Much Power Can You Make From Free Wood Waste?*

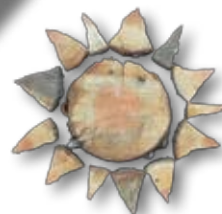
*-How Do You Use the Gas In An Engine?*

*-What are the Benefits of This Improved Design?*

*-How Can it be Used to Replace Petroleum: The WWII Case Study*



Version 1.1





Solar Power Backup

Fuel Trucks & Tractors

Greenhouse Heating

Electrical Generators

Pumps & Equipment

Activated Carbon

## Resources

### Builder Resources

[WoodGasifierPlans.com/builder-resources](http://WoodGasifierPlans.com/builder-resources)

### FAQ

[WoodGasifierPlans.com/faq](http://WoodGasifierPlans.com/faq)

### Videos

[Youtube.com/user/VictoryGasworks](https://www.youtube.com/user/VictoryGasworks)

### Books

[WoodGasifierPlans.com/order](http://WoodGasifierPlans.com/order)

## What is Wood Gasification?

Wood Gasification is the process of using heat to thermally shift solid matter into a gaseous state, sort of like using heat to shift a solid ice cube into a steamy vapor.

It's a thermal chemical phase shifting process that breaks down the structure of wood to release it's most basic elements of hydrogen and carbon, i.e. hydro carbons.

Very similar to what goes on in large scale refineries, just done in a simpler way, on a much smaller scale, without the mess and pollution. And since the wood used is a waste source, it's both free and sustainable.

Wood Gasification is a very clean way to make biogas in mere minutes. The wood is really just a storage battery for solar energy. Wood gas is a form of solar chemistry. The perfect compliment to solar thermal and solar electric because you can tap into the energy day or night and even during the winter.

Most notable it solves a big problem that photovoltaic panels don't. How to fuel existing engines that power much of our society without petroleum.

## Powering Your Home With Distilled Sunlight

More and more people are waking up to the need for personal power production as a hedge against price inflation, storms, grid down scenarios and oil shocks.

A new generation of off grid home owners and home steaders are using distilled wood gas to fuel backup generators, tractors, power equipment and heating barns and green houses too.

The wood is free and the peace of mind is priceless. It's not without some effort to dry and size the wood for use, but it's not any more effort than you would use to dry and store hay.

Efficiency is still the most effective money spent while you prepare to shift to renewable energy. Because the wood can be turned into energy at night, homesteaders can use smaller battery banks for storage.

## How Much Power Can You Make?

Between 3 and 20 kilowatts/ hr are realistic numbers. Each kilowatt hour requires about 2.5 pounds of dry wood.

The gas has some inert elements like nitrogen and CO<sub>2</sub>, so the output is generally 50-60% of the rated output on petroleum fuels, but since the cost of a larger engine or generator is negligible, many folks just size up their equipment a bit.

A 10 kilowatt generator making 5 or 6 kw's is usually the perfect blend of power and efficiency.

To avoid lot's of feed handling costs and expensive automation, the machine is usually run in batch runs of 2-6 hours depending on feedstock capacity. A fill in the morning, solar during the day and a fill at night are easy and cost effective. Trying to run 24/7 is impractical because of engine oil changes and maintenance.



## Quick Conversion

**1 kwh = 2.5 lbs dry wood**

**1 mile driving = 2.25 lbs**

## How do you use the gas in an engine?

You pipe the gas into the engine intake system and provide a smaller air inlet control valve to act as an air-fuel mixer or carburetor.

Simple systems operated on DC power or used in tractors can be as simple as a ball valve controlling air flow at the right setting. Find the sweet spot and make tiny changes to the valve position when needed.

For AC power and variable loads a more dynamic air management system is needed. These can be crafted out of:

- An O2 sensor
- Small micro-processor
- Servo
- Butterfly valve

For a detailed build of this nature and a full engine conversion see the book the Electronic Carburetor Workshop at the end of this report.

## Can you store the gas?

Wood is the primary storage medium. You can store the gas in bags, experts can compress it into cylinders and batteries are a way to store the electricity.

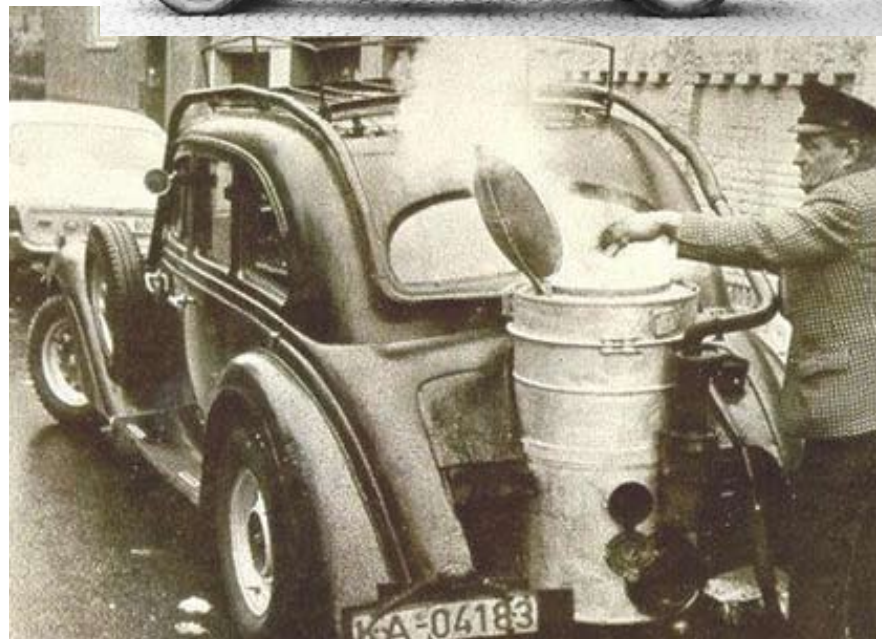
## World War II: A Case Study in Petroleum Replacement

After WWI the countries of Europe embarked on the deployment of renewable fuels, fearing another war.

20 years later much work had gone into evolving earlier gasifier designs. Just in time to be rolled out as oil blockades made fuel a scarce commodity.

With the help of woodgas and producer gas made from charcoal, over 1 million installations (mostly personal scale) fueled everything from trucks and buses to factories and homes. It was the most successful alternative to petroleum.

Unfortunately the knowledge was lost as the generations following switched back to gasoline and diesel. The keepers of the knowledge aged out.





## Benefits of an Advanced DIY Wood Gasifier

Resurrecting and expanding on the early WWII gasifiers has been the passion of Author Ben Peterson. In his new book the **Wood Gasifier Builder's Bible**, he shares a step by step process to build an advanced, **tar cracking wood gasifier** featuring:

- Simple automation for hands free control
- Superior grate system for maximum flow
- Aggressive heat recycling and air preheating for greater efficiency and smoother operation
- High intensity jets and quick change hearth and much more...



## Not all gas is created equal

It's very easy to turn wood into gas. Fill a garbage can with dry wood and place it over a hot fire and soon flammable gases and oils will start escaping.

But to make good engine gas, you need to fully shift the oils to gas or they will burn and make tar which can seize up an intake valve. Not an issue if you are just making heat though.

Many other homemade gasifier designs make some tar and try to filter it out. This can work OK for a while, but eventually your valves will get coated, needing major maintenance with some acetone and an old tooth brush.

## Do it the right way! Crack those oils

This design does an excellent job of cracking oils and tars to make fully distilled gas.

You'll notice the difference. Your engine will be happier too.



## Build Photos Using Mostly Common Parts

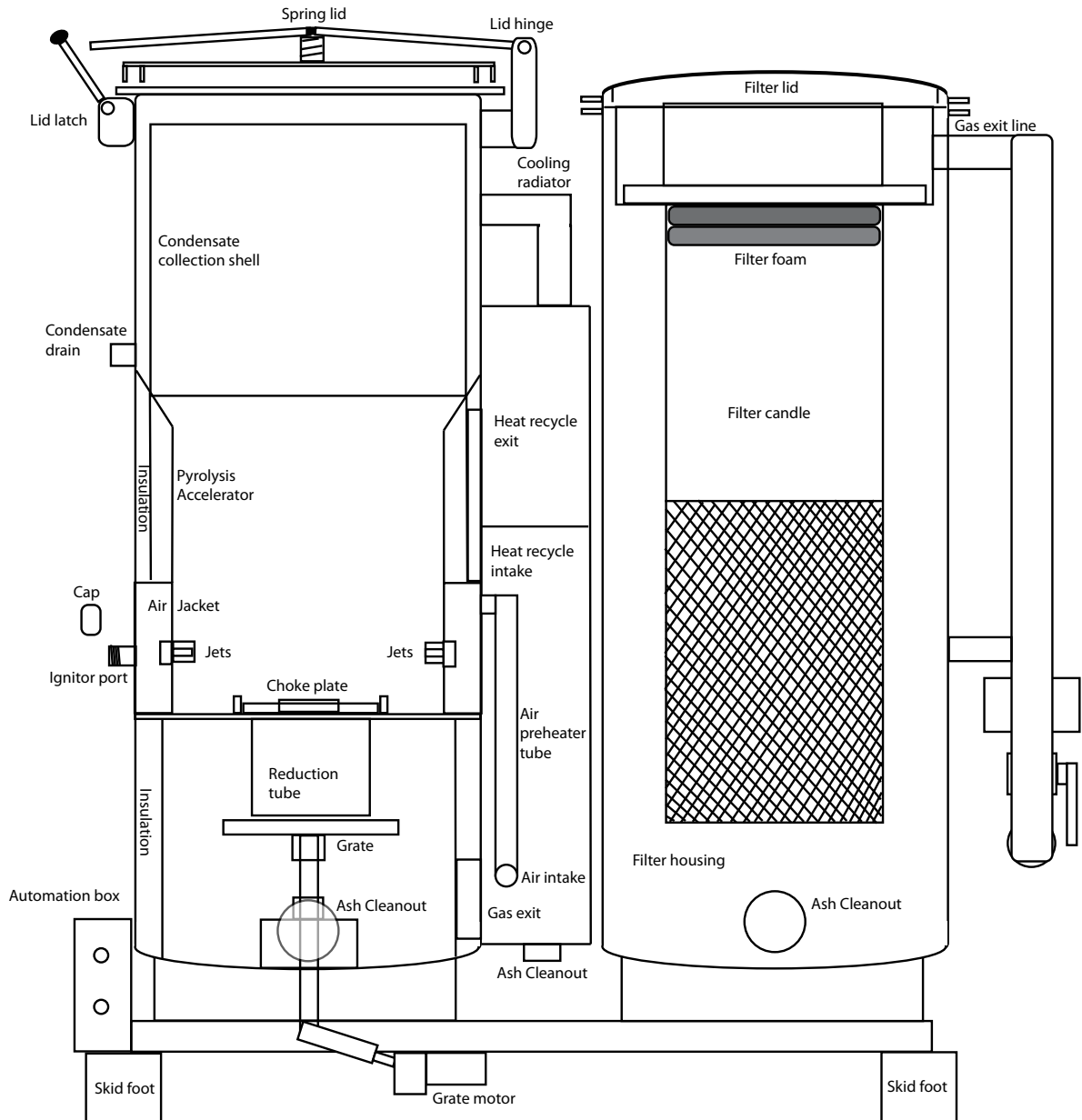
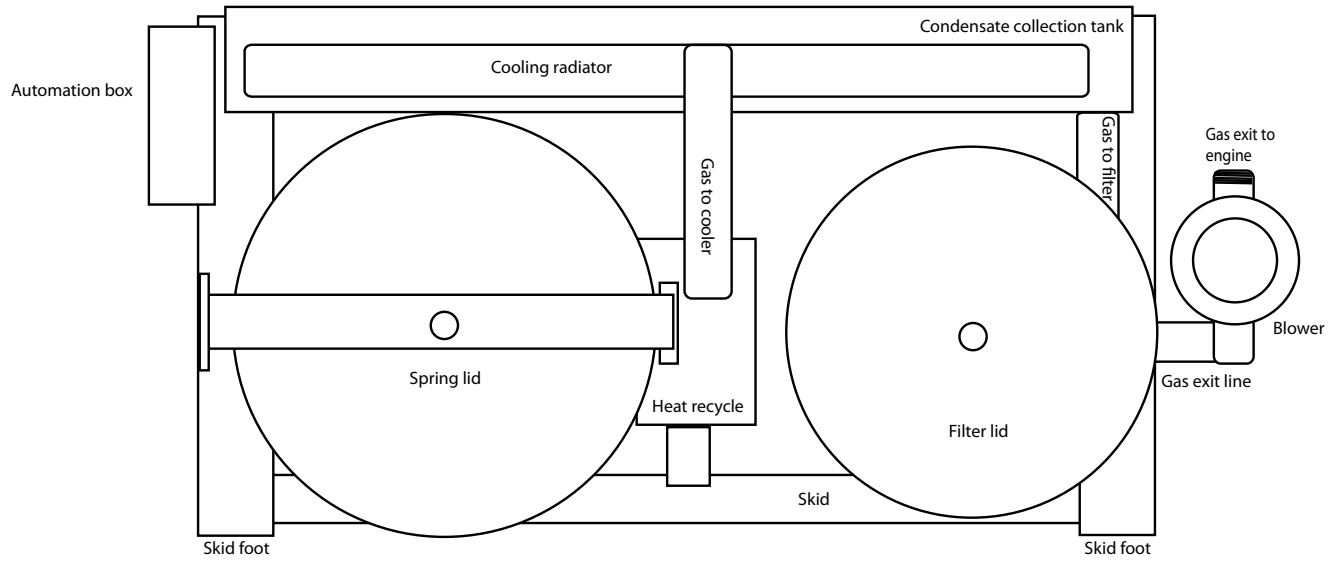
Check out the schematics and flow charts on the following pages.



Ready to learn more? We have a 7 part video series called the **Wood Gas Crash Course** available on our Youtube channel. Definitely check it out. 45 minutes of valuable insight and behind the scenes footage.

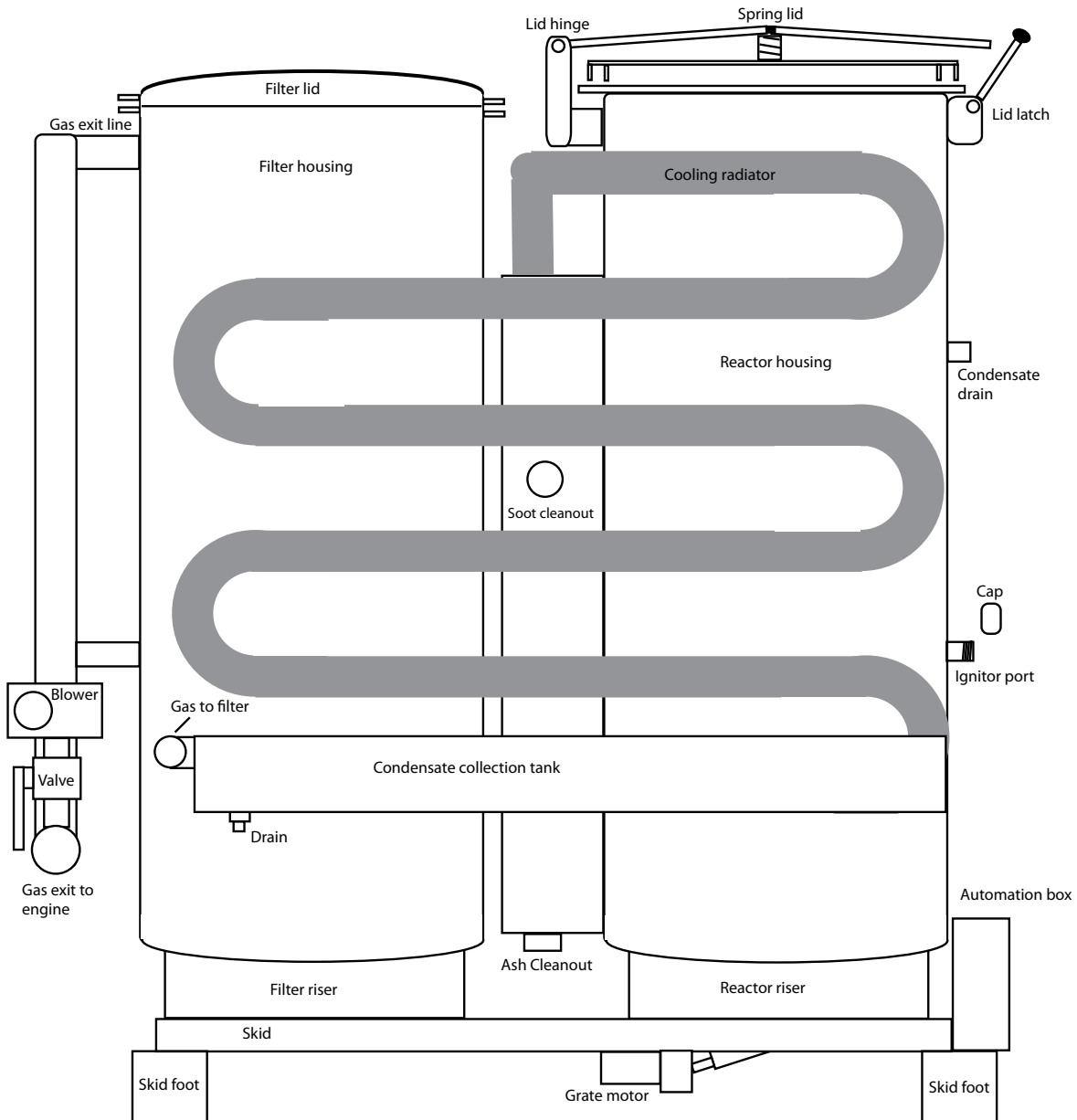
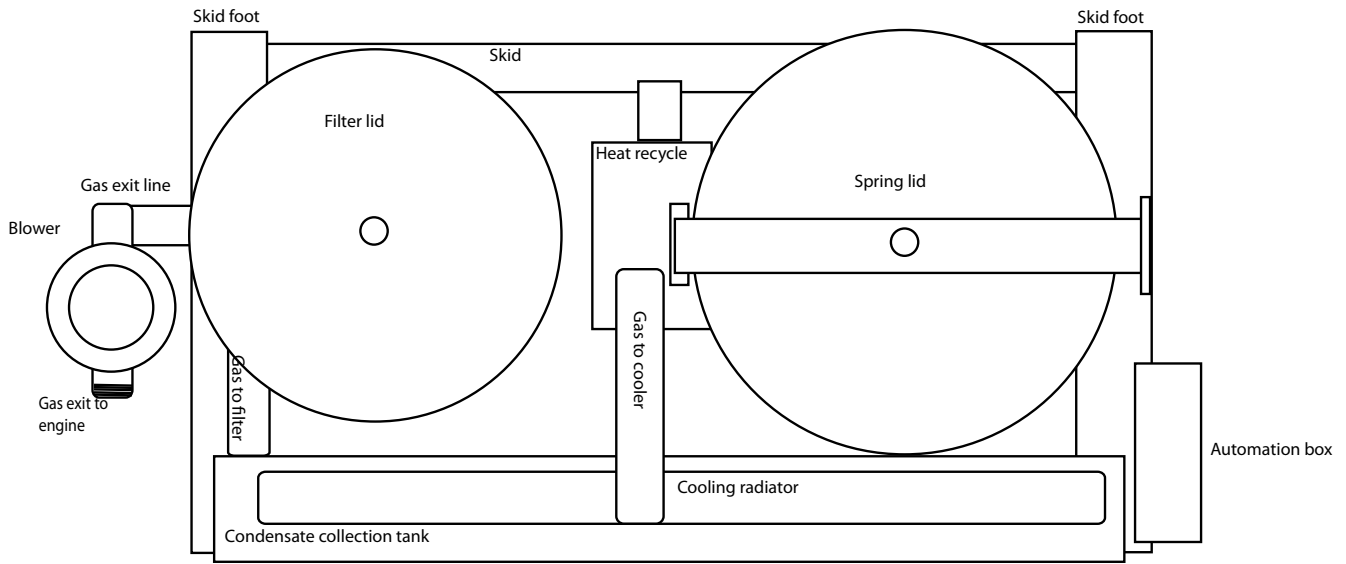
[Youtube.com/user/VictoryGasworks](https://www.youtube.com/user/VictoryGasworks)

# Layout: Front



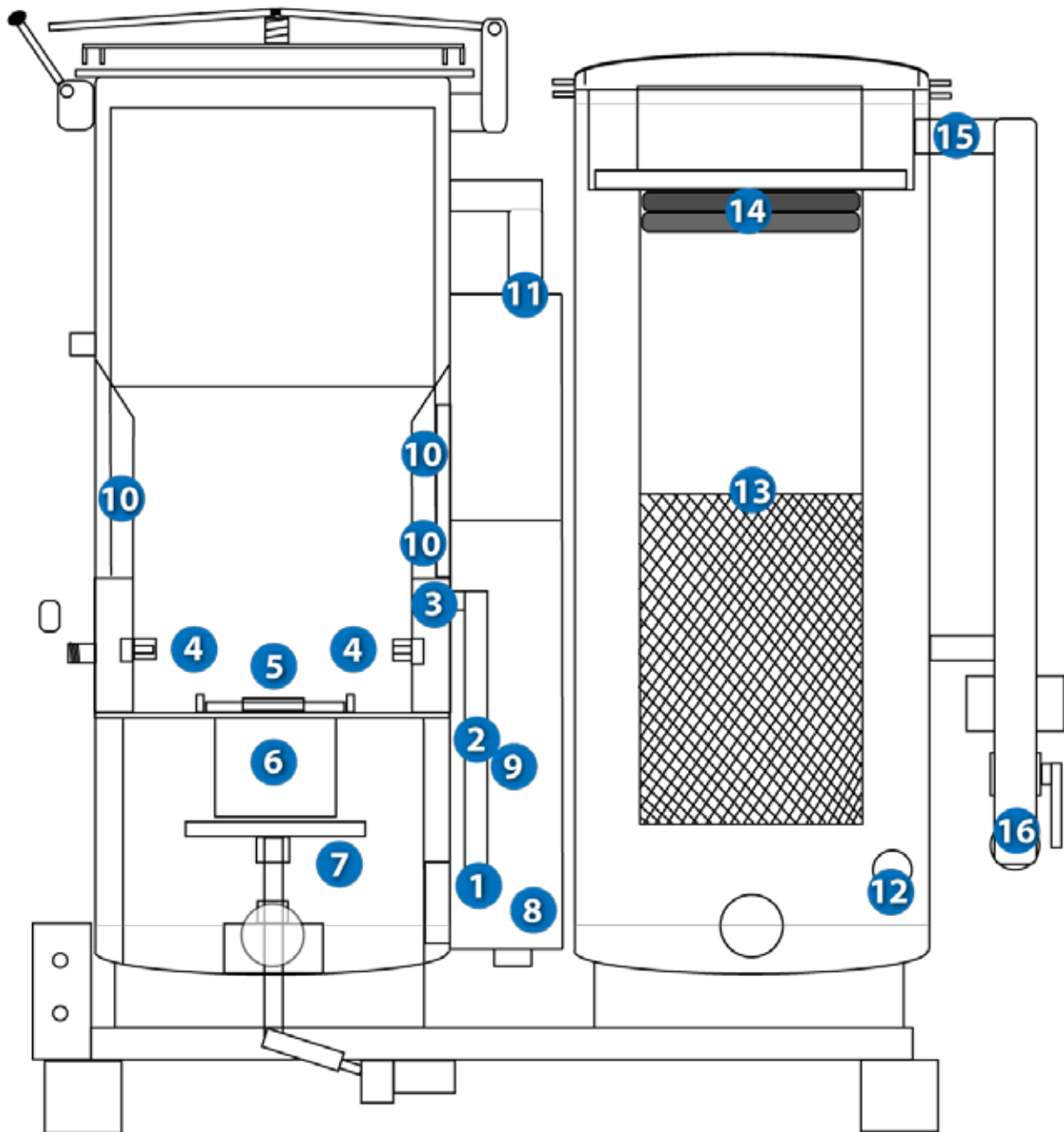
# Layout: Back

<http://WoodGasifierPlans.com>





# Flow Chart



## Wood Gasifier System Flow Chart

1) Cold air enters air inlet check valve

2) Air is pre-heated from post reduction heat

3) Air enter air jacket, cycles around to all jets

4) Air blasts through jets into charcoal

5) Partial oxidation occurs, creating a zone 2000+ degrees that decomposes the wood and charcoal

6) Reduction chemistry, fuel gas is formed in high heat, zero oxygen environment

7) Gas passes through grate

8) Gas reaches expansion chamber, velocity slows, heavy particles drop

9) Heat exchange to air

10) Pyrolysis acceleration

11) Gas to cooler

12) Gas leaves cooler enters filter housing

13) Gas is filtered through organic media

14) Gas is filtered through foam filter

15) Gas exits filter housing

16) Gas exits gas producer

# Terminology

**Woodgas**-Combustible gases made from wood.

**Bio-hydrogen**- Another name for woodgas that highlights it's hydrogen rich composition.

**Wood Gasifier**- The device responsible for phase shifting solid wood into a gaseous state.

**Solar Fuel Distillery**- Another name for a wood gasifier that highlights the stored solar energy in wood and the process of thermal distillation a gasifier employs to make gas.

**Pyrolysis**- A low temperature (400 C) reaction that releases oils and gases from wood, leaving carbon. (charcoal)

**Gasification**- A term that describes the general process of heating solids in an oxygen starved environment to temperatures in excess of 1000 C to make a complete shift of all solids (except minerals, i.e. ash) into a gaseous fuel.

**Reactor**- The core thermal heating portion of the wood gasifier that is responsible for creating the high temperature, low oxygen environment needed for conversion.

**Reduction**- The portion of the gasification process where water and CO<sub>2</sub> are split into hydrogen and burnable single oxide carbon gases. This is an endothermic (heat consuming) reaction affecting molecular chemistry to make fuel.

# Basic Chemistry to Understand:

**#1** The high temperature chemistry at work inside a gasifier requires charcoal. In a wood gasifier the wood is turned into charcoal and the wood oils and light steam are broken down molecularly over the charcoals surface. Nothing happens without charcoal, remember that. The heat from the small oxidation zone (burning) and the recycled heat from the pyrolysis accelerator speed the production of charcoal. An empty gasifier must be primed with small chunks of charcoal that fill it from the grate to about 8" above the jets. After that, the process is self replenishing.

**#2** Combustion requires FUEL, AIR & SPARK. When we are making gas from wood, we don't want to burn up the gas, so we severely limit the intake of oxygen, preventing combustion, thus allowing gas to be formed and not burned up.

**#3** Homogenous phase shifting solids into gases requires 3 things: Temperature, Turbulence & Time.

**Temperatures** need to be high enough to break down the oils and steam. 1000 C minimum.

**Turbulence** means that the air molecules coming through the jets are evenly distributed on the surface of the charcoal, making it incandescent. This is a major contributor to the temperature release.

**Time** is the (residence) time that the wood oils and water vapor are in this hot zone. They need to spend enough time to be broken down completely or they will produce burned oil called tars.

## Dangers:

The gas contains carbon monoxide. Don't breathe it. Don't pump it into your house. It's natural but it's not natural gas. There is no smell added.

The gas is flammable. Keep sparks away!

Surfaces get hot, wear gloves.

## Start-up sequence

- 1) Inspect system seals- No air leaks.
- 2) Check valve positions- Set to flare.
- 3) Inspect air inlet (swing check valve) operation- Oils can cause it to stick.
- 4) Inspect char level- If it's low, fill it to 8" above jets.
- 5) Lightly tamp char bed- Ensure no hollow spaces between char.
- 6) Fill with feedstock- Use properly sized and dried wood.
- 7) Ignite char- Use flame or electric glow plug-30 seconds, then remove.
- 8) Turn on blower- This introduces the draft. Wait 4-8 minutes, then ignite flare. (if desired)
- 9) Choke engine.
- 10) Turn off blower.
- 11) Open valve to engine, close flare valve. Gas is pushed to engine.
- 12) Key start engine, release choke.

## Shut down sequence

- 1) Switch gas flow from engine back to flare. This will starve the engine and evacuate gas from the lines. Engine shuts off. Turn key to off position.
- 2) Turn off gasifier automation. For a short time the residual heat will cause wood to turn into gas, it vents through the flare. Restart within 30 minutes if desired.

## Terminology

**Hearth-** The specific area of the reactor where the air jets and choke plate (gas volume sizing hole) reside. This is the high temperature zone where partial oxidation releases heat to power the conversion process.

**Blower Motor-** The electric fan used to produce the high suction (or pressure) needed to pull air into the hearth to produce gas.

**Monorator hopper-** A feedstock (wood) holding bin that creates a cooling convection current that pulls moisture away from the wood and condenses it as a liquid to be removed. The heat rising from the center drives off the moisture and the cooler outer shell liquifies the water like dew on a window.

**Tar-** Unrefined wood oils are burned and turn into a creosote called tar. This tar can foul engine valves. Its important to fully convert the oils to gas to avoid this using high temperatures and adequate residence time in the combustion zone.

**Start-up time-** The time it takes to get the gasifier lit and into gas production stage. Usually 5 minutes to flarable gas and 10-12 minutes for engine quality gas.

[Facebook.com/WoodGasifierPlans](https://www.facebook.com/WoodGasifierPlans)

# Most Frequently Asked:

## What engine do you recommend?

20 kw natural gas engine with 4 cylinders bought used with low hours on ebay would be a good start.

## Do you sell finished machines?

No we don't.

## Do you offer tech support?

No, visit <http://www.woodgasifierplans.com/builder-resources/> for tutorials and book updates

## Do you do private consulting?

No we don't.

## Should I use a diesel engine?

No, use a spark ignited engine 1-5 liters.

## Can I use pellets, coal, grass, tires, etc.?

NO, use dry wood chunks.

## Other questions?

We probably answered them in our FAQ section.  
<http://www.woodgasifierplans.com/faq/>

# Tool list

## Good

Crescent wrench  
Hammer  
Screw drivers  
Allen wrenches  
Tape measure  
Black marker  
5" angle grinder  
5" cut off blades  
Dust mask  
Safety glasses  
Gloves  
Mig welder .035 weld wire, solid core  
Welding hood, #10 lense  
Drill  
Hole saw blades 1", 1.5", 2", 3.5"  
3/8" drill bit  
Caulking gun  
Hardwood scrap 2" x 6" x 1"  
Scrap pipe lengths for blacksmithing  
Wire stripper/cutter  
Wire crimpers  
Table saw- to cut wood

## Better

Plasma torch or oxy-acetylene torch  
Air compressor

## Best

Roller  
Bender

## Supreme

CNC plasma torch table



## Skills

Basic welding  
Basic grinding/drilling  
Basic hand tools  
Basic cutting  
Basic painting  
Basic 12 volt wiring  
Basic metal forming  
Basic machining - Optional

## General Budget Guidelines

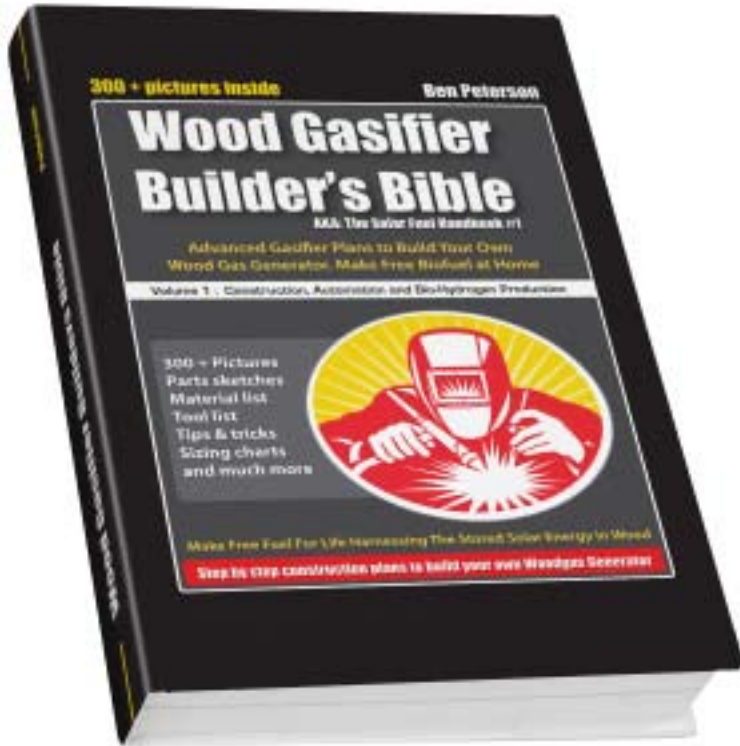
Basic materials, hand cut parts, self welded  
**\$1500**

Basic materials, laser cut parts, self welded  
**\$2500**

Basic materials, laser cut parts, hired welding  
**\$3800**

Turn-key gas production, done for you build  
**\$5800-\$6500 in mild steel.**

*Learn How to Build a Reliable, Powerful Wood Gas Distillery.  
Start Harnessing the Stored Sunlight in Wood Any Time of Year  
+ Convert Your Engine With Simple Automation*



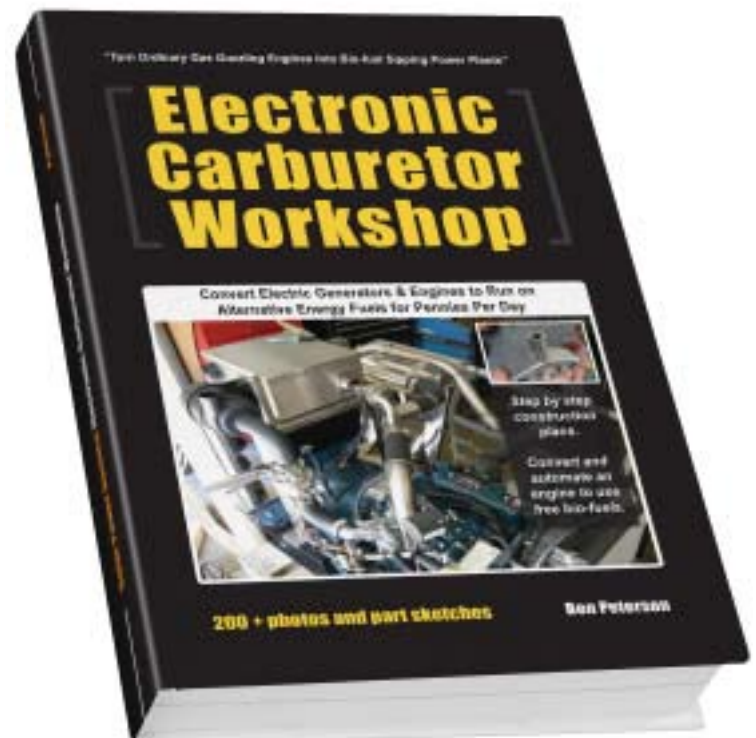
## **A step-by-step construction manual**

Learn how to build an advanced wood gasifier with local parts on a DIY budget.

## **A step-by-step construction manual**

Learn how to convert an engine to run on biogas.

Then learn how to build a simple computer controlled carburetor.



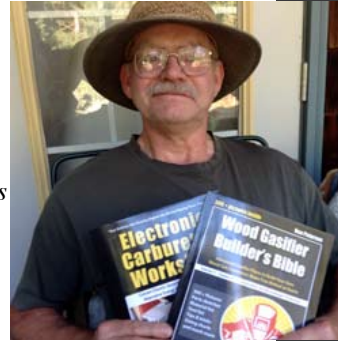
<http://WoodGasifierPlans.com>

# Early Book Reviews

## Now Shipping!

*I see a design that is thermal-chemically very balanced and adaptable for the widest range of engine usages. Home generators, tractor saddle mounted and mid sized power equipment (think sawmill). It is designed to be built in a home garage shop. He gives you a three level tool list and his own proven supplier sources by NAME.*

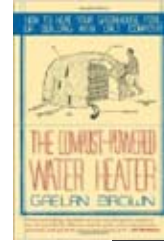
*I am now buying extra copies to gift to all of my true off-grid and solar friends to fill promises I made years ago. That day has finally come thanks to Ben's gift of knowledge and experience in this DIY book system. Thank you for this gift Ben. And to any one reading this...BUY THIS BOOK!*



Washington State Steve Unruh

Woodgas contributor to: Drive On Wood, MicroCogen, the old Victory community site, Lister Engine Group, and GEK Owners forum.

*This is an amazingly valuable book. Ben has boiled down his many years of R&D into a very well written book that makes it clear how anyone can make a wood gasifier. Thank you Ben!*



Gaelan Brown

Author of the Compost Powered Water Heater

<http://compostpower.org>

*I have to say it is an honor and a privilege to able to review Ben's plans... This is a straightforward approach with zero guess work to building a high quality gasifier from what I can see. Not only that but the advanced features and build techniques are the stuff we manufactures are using today. These types of systems are a must and Ben lays all this out for you...*

*Cheers!*

Matt Ryder

CEO Vulcan Gasifier LLC

<http://www.vulcangasifier.com/>



*This is the book I've been waiting for...There is no one I trust more than Ben for this information. Thank you for taking the time to write such a detailed manual. My hats off!"*

David P.

Track Engineer, BN Santa Fe

*Hey Ben I was running the generator today and admiring the electronic carburetor. It was really just ingenious how you set up the whole system... You truly have something special here, I pray others can benefit from your dedication to this underrated technology!*

God bless sir –

David, Victory Owner

*Well done on the book bro! The design is so advanced and yet so simple. You literally spelled out every step.*

Issac S.

Underwater welder, Gulf coast



Thanks for reading