

# Low Carbon Renewable Gases from Wood Wastes

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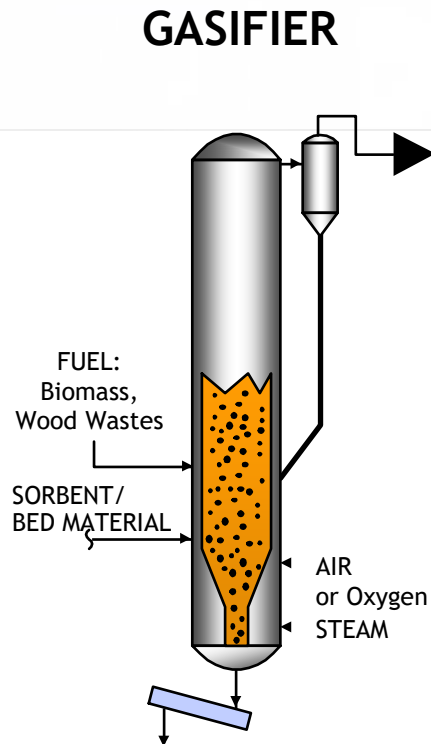
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# Emission Issues Need Solutions

- > Air quality continues to be exacerbated by black carbon and conventional air pollutants produced from open burning of agricultural wastes and from forest fires.
- > Aggressive mandates for GHG and CO2 emission reductions in all energy sectors is creating an expanded need for low and zero carbon fuel for transportation as well as for residential, commercial and industrial energy consumers
- > Dispatchable low carbon power generation is required
- > Reduction of conventional and GHG emissions from the heavy-duty vehicle sector
- > Reduction of conventional pollutants in economically disadvantaged areas
- > More options needed for storable renewable energy – ready when needed

# What is Gasification? How Can it Help!



- > Thermal conversion of wood waste with a limited supply of air or oxygen, into a synthetic gas, or syngas
- > It's not combustion; there's no burning. Gasification uses only a fraction of the oxygen that would be needed to burn the material.
- > An ash/slag remains as a residual – Little to no un-reacted carbon char remains.

## Syngas

CO (carbon monoxide)

H<sub>2</sub> (hydrogen)

Methane

## By-products:

Biogenic CO<sub>2</sub>

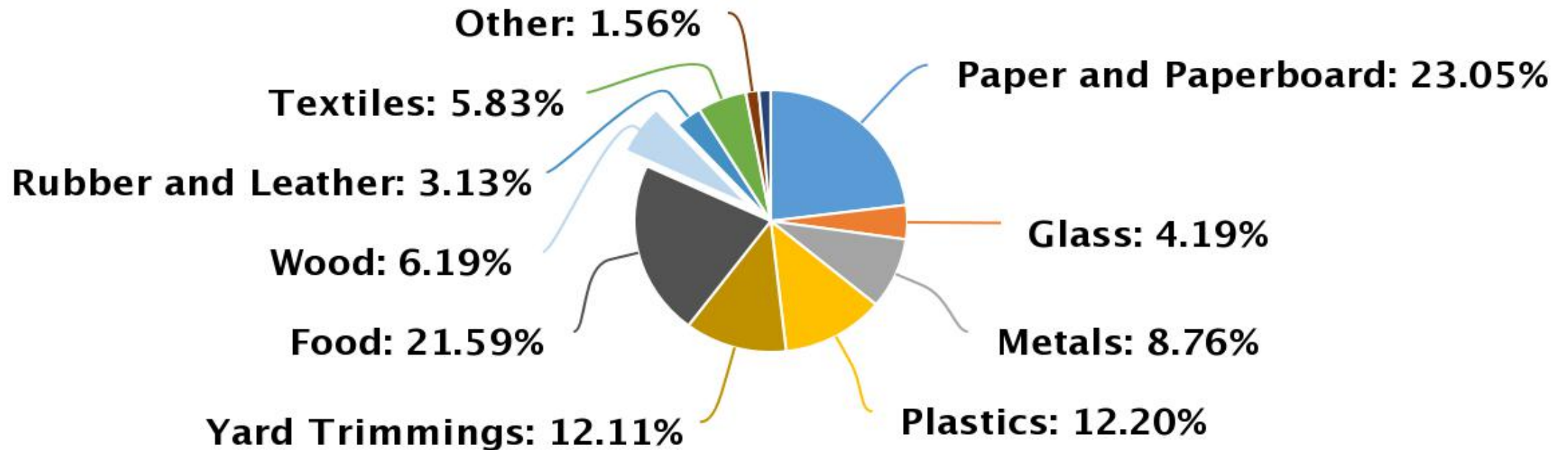
Solids (minerals from fuel)

*Gasification of wood wastes to produce renewable gases can:*

- > *Reduce forest residues that contribute to production of black carbon in fire prone areas*
- > *Produce a very low or negative carbon fuel*
- > *Provide an easy to store energy source*
- > *Produce gases to power dispatchable renewable electricity*
- > *Substantially lower GHG emissions in the heavy-duty transportation sector **today***
- > *Reduce criteria pollutants by 99% (compared to existing biomass power plants)*
- > *Provide processing for millions of tons of wood waste every year*

# Total MSW Generated by Material, 2018

292.4 million tons



Source - <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/national-overview-facts-and-figures-materials>

# SunGas Renewables



*GTI created a for-profit subsidiary called **SunGas Renewables** in 2019*

***SunGas** is working to bring down the cost of a wood waste to renewable fuels production facilities*

***SunGas** is engaged in 6 ongoing projects for the production of low carbon fuels including RNG, hydrogen and liquid transportation fuels. Four additional projects in development*



*SunGas designs, fabricates delivers  
and commissions complete biomass  
gasification systems.*



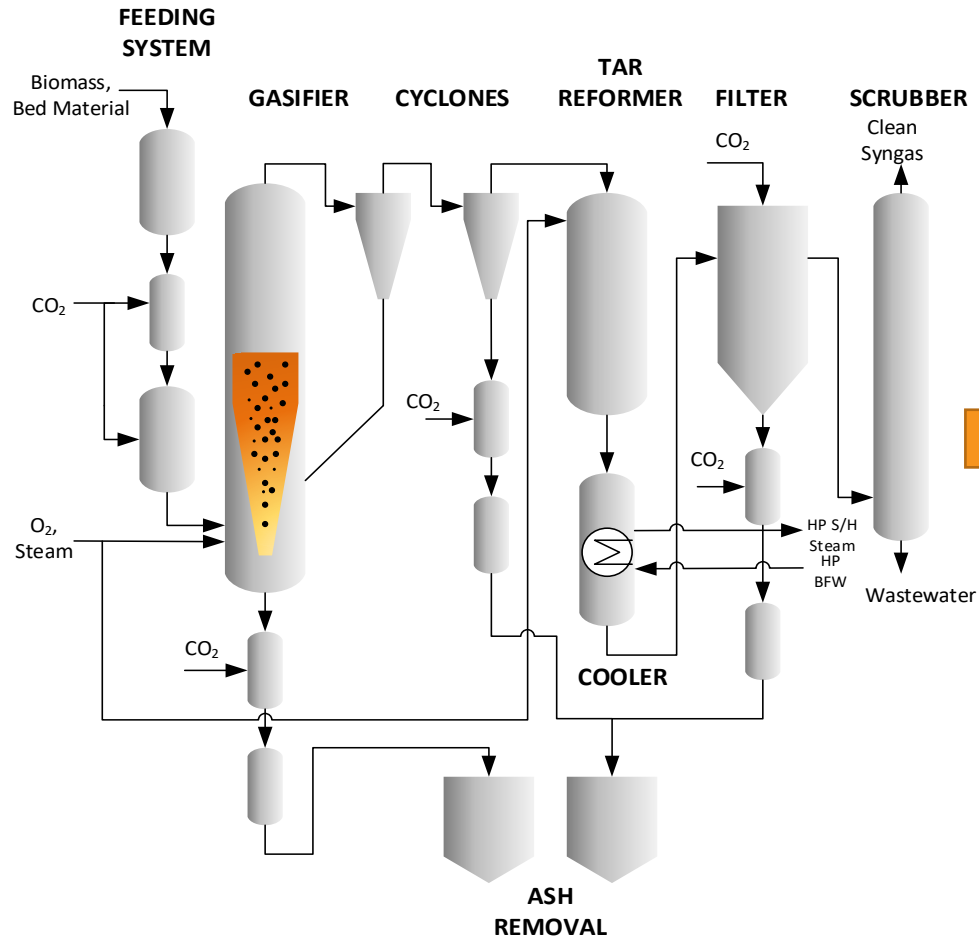


# Proven Biomass Gasification Technology

SunGas Renewables is the sole active commercial supplier of GTI's gasification technology for biomass applications

- > Over the past 40 years, hundreds of millions of dollars, have been applied to develop and perfect GTI's gasification technology
- > Thousands of hours of testing and over a decade of commercial operations
- > Financeable mature technology

# SunGas Gasification Island:



Hydrogen

RNG

Gasoline

Diesel

Methanol

Opportunity to  
**produce low-carbon,  
zero-carbon or  
negative carbon  
fuels** based on  
configuration and  
technologies selected



# SunGas Biomass Gasification System History

13

commercial  
gasification  
systems built

1980 Biomass pilot



1992 Coal & Biomass  
demonstration 80 tpd  
-Finland



2003 GTI's Flex Fuel  
Gasification facility  
opens 20 tpd pilot unit,  
Chicago



2008 Zao Zhuang  
400 tpd oxygen-  
blown, high-ash  
coal



2015-2016 Chalco  
3 sites, 7 gasifiers  
350-550 tpd coal

1995 DOE awarded  
1,250 tpd biomass  
IGCC Plant, not built

2005 High ash  
Indian Coal  
tested for IGCC

1985

1995

2005

2015

2020

1980 Awarded DOE  
grant (Memphis) –  
Scale up technology  
to 1,000 tpd gasifier,  
engineering  
completed

1994 Shanghai  
800 tpd low-rank  
coal



1998 Biomass  
demo plant 100 tpd  
Maui, Hawaii



2006 150 tpd CHP  
Plant Denmark using  
wood



2012 Yima 2,400  
tpd oxygen-blown,  
subbituminous coal



2019 SunGas  
Renewables  
incorporates



SunGas  
RENEWABLES

# Skive Gasification CHP Plant in Denmark

Operating since 2007



# Leveraging Renewable Energy Policy and Incentives

- Produce fuels eligible for RFS, LCFS and other incentive programs
  - Low and negative carbon intensities (CIs) possible
  - Existing GREET model analysis for RNG production shows low, zero and below zero CI scores achievable.
  - Additional analysis ongoing for other fuels like hydrogen, gasoline and diesel



# Summary of SunGas Biomass Gasification Systems



- > SunGas designs, fabricates delivers and commissions complete gasification systems.
  - Market opportunity to process millions of tons of wood waste every year
  - Produces syngas for low carbon renewable fuel production
- > Commercially proven technology ensures financeable renewable fuel production projects
  - SunGas has thousands of hours of testing and over a decade of commercial operations
  - Commercial woody biomass reference in operation since 2007
- > Alliance with Hatch ensures depth of engineering and supply chain experience
- > SunGas gasification technology provides opportunity to produce low carbon, zero carbon or negative carbon fuels
  - Carbon intensity based on technology configuration utilized for renewable fuels production plant design.
  - Produces fuels that can meet RFS and LCFS requirements

# What New Policies are Needed for Wood Waste to gaseous fuel plants to be built

- > The carbon intensity of RNG and hydrogen from forest and agricultural waste should include avoided emissions from wildfires and burning or other means of short-lived climate pollution production
- > Policies that support, encourage and incentivize the sequestration of biogenic carbon so that negative carbon gaseous fuels can be produced from gasification of wood wastes.
- > Definition of available wood wastes to produce near zero, zero or negative carbon gaseous fuels should be reasonable and logical.
- > Ensure that renewable methane and hydrogen production facilities can get approval for connection to the natural gas pipeline system and can receive all the incentives for connection and benefits that biomethane receive now.

## California specific

- > For the LCFS, allow book & claim for renewable electricity to power renewable fuels production. At a minimum for hydrogen production.
- > Pipeline biogas incentives, like the incentives for interconnection adopted pursuant to AB 2313 (Williams, 2016) should also be available for the RNG or hydrogen from gasification of wood waste.
- > Need to revise Public Resources Code section 40117 to clarify that gasification of wood waste and other organic material that would otherwise go to a landfill counts as waste “diversion” – right now, gasification does not qualify as waste diversion unless it is zero emission of any kind. We do not hold anaerobic digestion or any other technology to this standard. It should be revised at least for organic waste gasification.