San Joaquin Renewables

NATURAL GAS FROM BIOMASS

Transportation Biofuel Project

Cleaning the air in California's San Joaquin Valley

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Carbon Happens!

Sunshine + water + CO_2 = biomass

It is inevitable.

It is nature.

It is… HUGE

Electrifying transportation will not eliminate carbon. (unless renewable fuels made from carbon are used for that end)

Both agriculture and forest growth produce an enormous amount of biomass that is not digestible and is perfect for gasification.

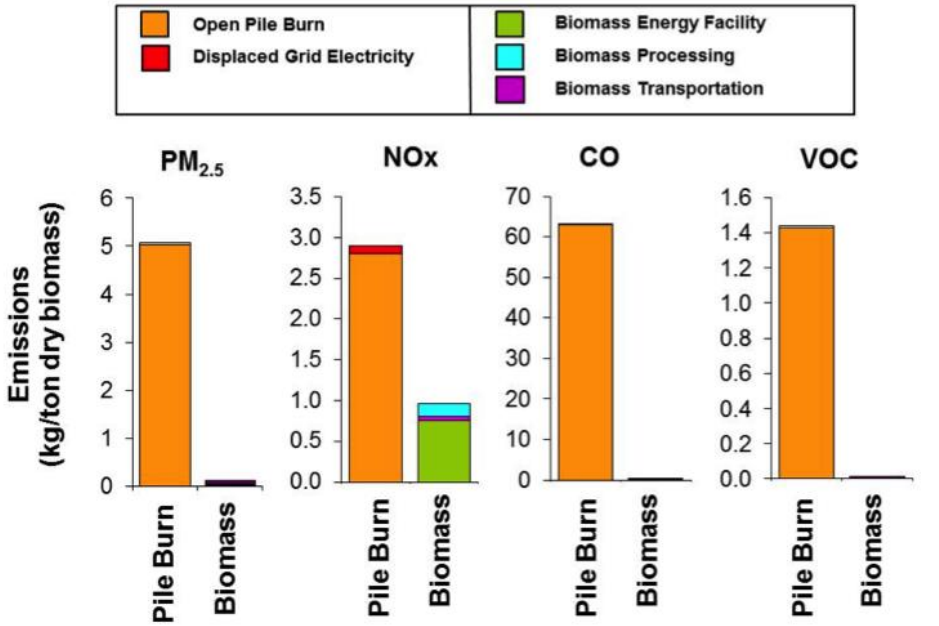
Bioenergy Association of California

Biogas Potential from technically available organic waste, prepared by Rob Williams, UC Davis

Feedstock	Technically Available Amount	Billion Cubic Feet of Methane	Million Gasoline Gallon Equivalents
Landfill Gas	106 BCF	53	457
Animal Manure	3.4 M BDT	19.5	168
Waste Water Treatment Gas	11.8 BCF	7.7	66
Fats, Oils and Greases	207,000 tons	1.9	16
Municipal Solid Waste (food, leaves, grass)	1.2 M BDT	12.7	109
Municipal Solid Waste lignocellulosic fraction)	6.7 BDT	65.9	568
Agricultural Residue (Lignocellulosic)	5.3 M BDT	51.8	446
Forestry and Forest Product Residue	14.2 M BDT	139	1,200
FUEL POTENTIAL		351	3,030

Non-digestible organics

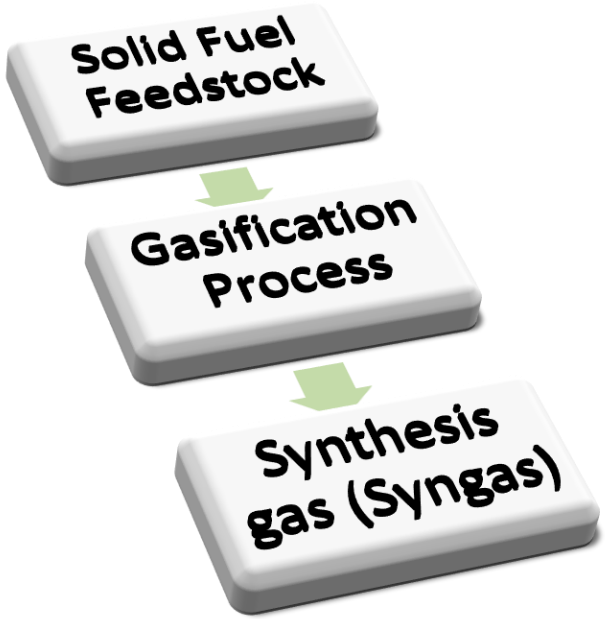
Open burning is a (really bad) option



Source: California Air Pollution Control Officers Association (CAPCOA)

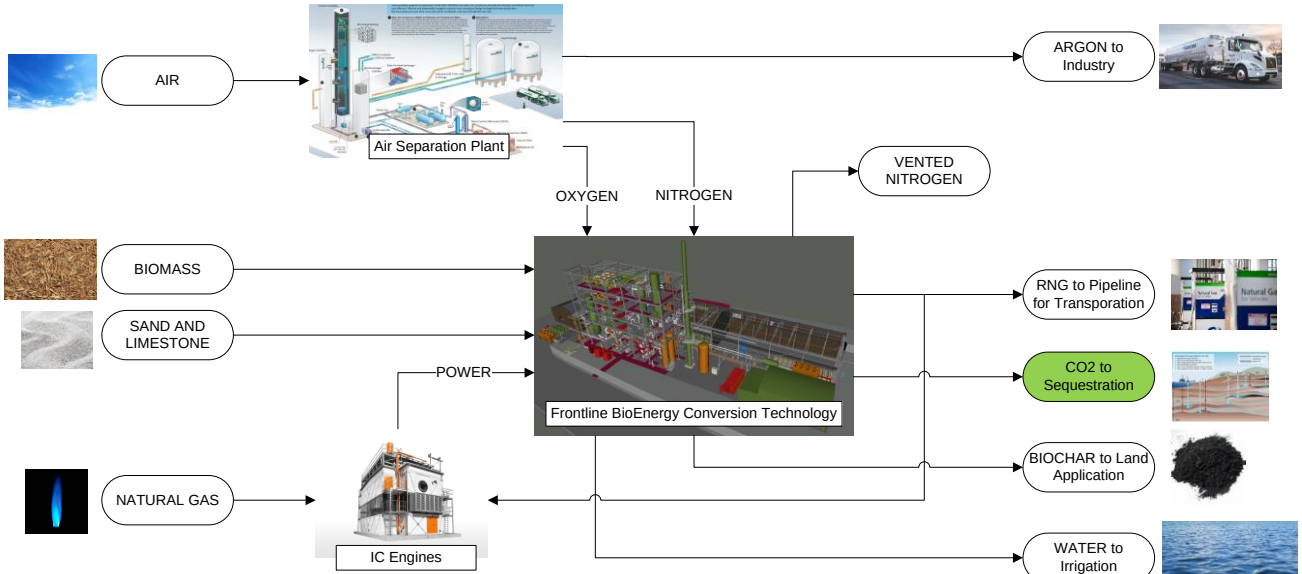
Gasification is a (really good) option

What is gasification?



CO
H2
CO2
H2O
Methane
Light hydrocarbons

Frontline's BING® Process



Gasification, catalytic upgrading, carbon capture

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Project Facts

- One of the first **B**iomass **E**nergy with **C**arbon **C**apture and **S**torage (BECCS) projects in California
- Will create 125 jobs in economically disadvantaged communities
- Air quality benefit equivalent to eliminating the emissions from 2,400 diesel trucks

- Project Status:
  - EPA D3 RIN pathway approved by EPA (May, 2020)
  - Signed feedstock and offtake agreements
  - Currently working through permitting

- Annually, the project will:
  - consume 400,000 tons/year of ag waste
  - produce 29 million gasoline-gallon equivalents of pipeline-quality renewable natural gas (RNG)
  - produce 50,000 tons/year of biochar
  - safely store approximately 400,000 tons/year of CO_2 in a class VI geologic sequestration well

Uses of RNG

RNG as direct transportation fuel
- **Replaces diesel-fueled trucks**

RNG for steam-flood enhanced oil recovery
- **Replacing fossil natural gas lowers CI of produced crude oil**

RNG for traditional and advanced ethanol plants
- **Replacing fossil natural gas lowers CI of produced ethanol**

RNG for petroleum refinery use
- **Used as feedstock for steam-methane reforming (SMR) to produce hydrogen**

RNG for green hydrogen
- **Small SMR's can make renewable hydrogen with negative CI**

RNG for EV charging stations
- **RNG fuels engines or fuel cells**

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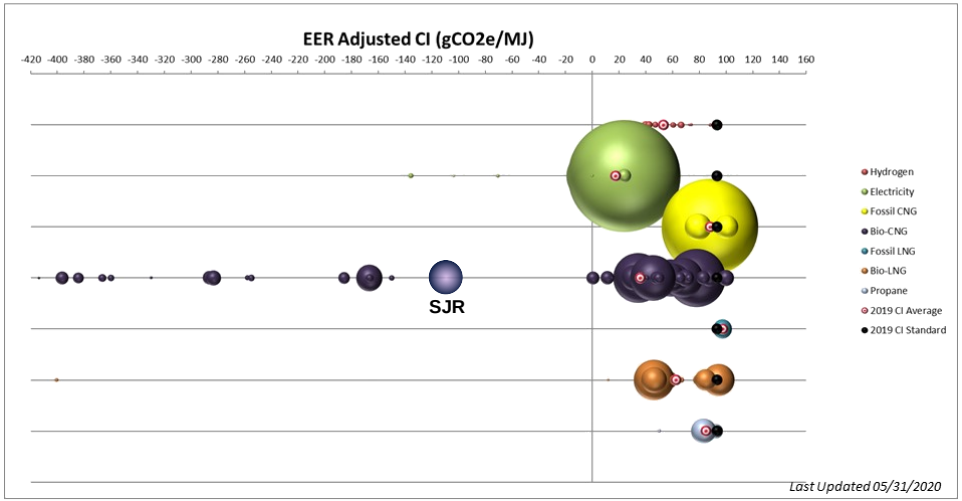
Size and Carbon Intensity Values of Non-Liquid Fuels

2019 Volume-weighted Average Carbon Intensity by Fuel Type for Non-Liquid Fuels



This figure provides perspective on the performance of actual quantities of fuel consumed in California.
Each sphere represents a certified fuel pathway; the size of the sphere represents the reported volume of the fuel in 2019, while its position on the horizontal axis indicates the carbon intensity of that fuel.

The alternative fuel's CI value is divided by its Energy Economy Ratio (EER) in order to obtain the EER-adjusted CI value, representing the emissions which occur from the alternative fuel per MJ of conventional fuel displaced.

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Each marker represents an individual certified fuel pathway carbon intensity (CI), adjusted by the Energy Economy Ratio (EER). The length of each bar indicates the range of carbon intensity that may be achieved by a fuel pathway. The wide range of carbon intensities is due to the lifecycle emissions methodology of the LCFS, variations in feedstock types, origin, raw material production processing efficiencies, and transportation all contribute to an individual producer's fuel pathway CI. All valid CI values shown here are certified including the legacy, Tier 1, Tier 2, and Lookup Table Pathways.

Frontline's BING™ pathway is not yet approved by the California Air Resources Board.

(as of May 31, 2020)

Source: California Air Resources Board:
https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm

More carbon credits generated

Recommendations to Government

LCFS

- We need clarity. What happens to LCFS after 2031?
- Projects that have large impact are large and need a longer time horizon of certainty
- Please prioritize California-based projects over out-of-state projects
- Promote acceptance of CCS in California – simplify CARB CCS protocol
- CARBON HAPPENS!
  - RNG and Electrification of transportation need not be in conflict: EV charging stations can be fueled by RNG from projects like San Joaquin Renewables

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Thank You!

For more info visit:

www.sjrgas.com

www.frontlinebioenergy.com

SJR Feedstocks

Orchard Wood Waste
- 320,000 dry tons/year

Pistachio shells
- 40,000 dry tons/year

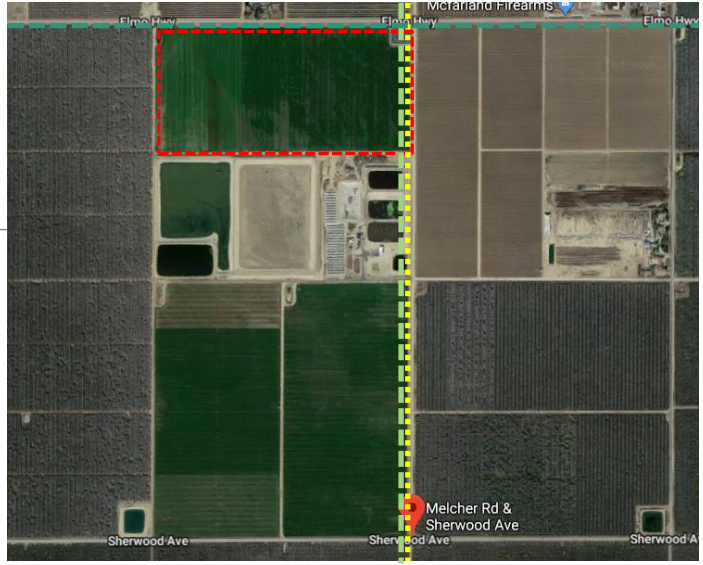
Almond shells
- 40,000 dry tons/year

Project Site

80 acres in the heart of the biomass zone

Directly on Southern California Gas transmission pipeline and lower pressure distribution line

Directly on Pacific Gas and Electric high voltage transmission line



https://earth.google.com/web/@35.68234378,-119.28171747,98.36595892a,3579.2031916d,35y,-0h,0t,0r

San Joaquin Renewables Project Air Quality Impact

by the numbers:

RNG Production

	Pile Burning Emissions		SJR Max Emissions ton pollutant /yr	Reduction	Reduction
	lb pollutant/ dry ton biomass	ton pollutant /yr		tons /yr	
$PM_{2.5}$	10.5	1,670	10	1,660	99%
NOx	3.9	624	10	614	98%
CO	132.6	21,004	100	20,904	99.99%
Non-Methane VOC	3.0	469	10	459	98%
Methane (CH_4)	10.0	1,584	1	1,583	99.9%

RNG Use in Transportation

	Estimated Diesel Tailpipe Emissions		Estimated CNG Tailpipe Emissions		Reduction	Reduction
	lb/ truck•yr	Emissions from fueled trucks ton/yr	lb/ truck•yr	ton/yr	tons /yr	
$PM_{2.5}$	50.1	68	0.5	0.7	67.5	99%
NOx	3751.0	5,064	375	506	4,557	90%
CO	3205.4	4,327	160	216	4,111	95%
NM-VOC	96.8	131	24	33	98	75%

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San Joaquin Renewables Project Potential Air Quality Impact

OVERALL:

	Pile Burning Reduction	Tailpipe Reduction	TOTAL Reduction
	tons /yr	tons /yr	tons /yr
$PM_{2.5}$	1,660	67	1,727
NOx	614	4,557	5,172
CO	20,904	4,111	25,015
NM-VOC	459	98	557
CH_4	1,583	-276	1,307

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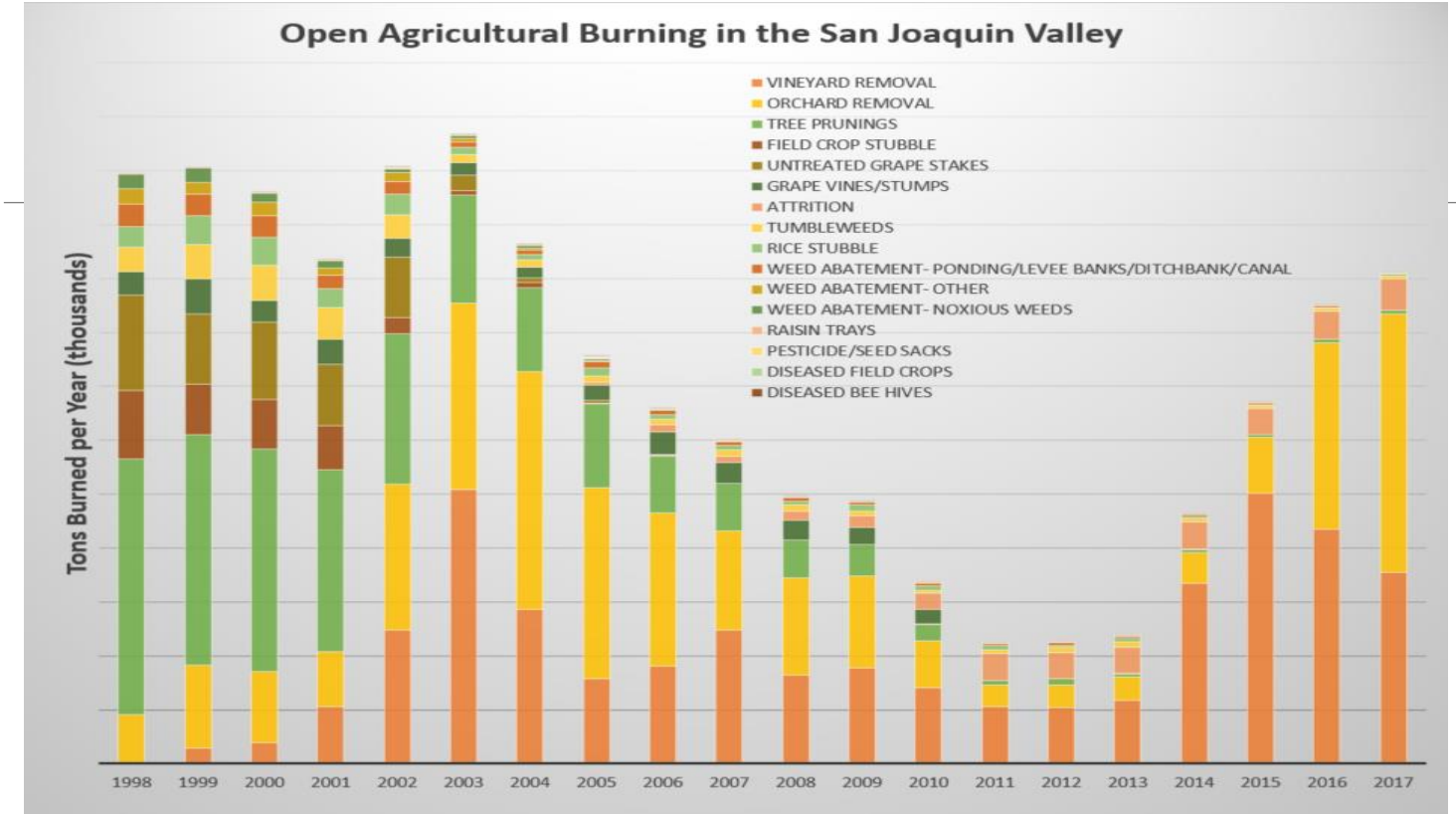

Source: San Joaquin Valley Air Pollution Control District