Decarbonizing The Gas Sector: Why California Needs A Renewable Gas Standard

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Bioenergy Association of California

Authors: Julia Levin, Katherine Mitchell, and Henry Swisher

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Except where otherwise noted, the authors are solely responsible for the content of this paper.

About the Bioenergy Association of California

The Bioenergy Association of California (BAC) is a non-profit association of more than 50 public agencies, private companies, local governments, environmental groups and others working to promote sustainable bioenergy development. BAC focuses on community-scale projects that convert organic waste to energy, including renewable electricity, transportation fuels and pipeline gas. For more information about BAC, visit: *www.bioenergyca.org*.

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Executive Summary

California uses more than 2 trillion cubic feet of natural gas per year and that amount is going up.[1] Natural gas provides more than half of the state's electricity, heating and cooling, and a growing share of transportation fuels. Although cleaner and cheaper than other fossil fuels, natural gas is a major source of greenhouse gas emissions, air and water pollution. In addition, California imports 91 percent of its gas, making the state vulnerable to supply and price fluctuations and costing more than $9 billion per year in lost revenues and jobs.[2]

Natural gas causes more than a quarter of all greenhouse gas emissions in California.

Renewable gas provides a cleaner, safer and more sustainable alternative to fossil fuel gas. Made from organic waste, renewable gas can replace fossil fuel gas and provide many other benefits. Most importantly, renewable gas can:

- Cut greenhouse gas emissions by millions of tons per year;
- Produce renewable electricity that is available 24/7;
- Provide the lowest carbon transportation fuels;[3]
- Cut fossil fuel use, air and water pollution;
- Reduce landfilling by millions of tons per year;
- Reduce catastrophic wildfire;
- Protect ratepayers by diversifying California's gas supply; and
- Produce two to six times as many jobs as fossil fuel power.

California could produce almost 300 billion cubic feet of renewable gas per year just from organic waste --the waste from food and food processing, livestock, agriculture, yard waste, construction debris and other wood waste, soiled paper and forest biomass. Instead of landfilling or burning that waste, California could use it to generate enough renewable electricity to power 2 to 3 million homes or to generate 2.4 billion gallons of clean, ultra-low carbon transportation fuels.

Organic waste can produce enough renewable gas to replace ¾ of all the diesel used by motor vehicles in California.

California has adopted several policies to promote biogas, but their implementation has

1 California Energy Commission (CEC), 2014, Overview of Natural Gas in California. *CEC Energy Almanac*. http://energyalmanac.ca.gov/naturalgas/overview.html.

2 Based on $4 per MMBtu x 2,405,520,000 MMBtu (2,313 billion scf of natural gas).

3 California Air Resources Board, 2014 Look-Up Table, available at: http://www.arb.ca.gov/fuels/lcfs/2a2b/2a-2b-apps.htm.

Biogas generates 2 to 6 times as many jobs per megawatt as fossil fuel gas.

been slow and they do not provide the long-term certainty needed for biogas to compete with the historically low cost of natural gas. In order to capture the many benefits of biogas, California needs a statewide policy to expand the biogas market enough to drive down costs and become self-sustaining.

California needs a Renewable Gas Standard (RGS). An RGS would require a small but increasing percentage of the state's gas to be renewable. Modeled after the state's Renewable Portfolio Standard, which has doubled renewable electricity in just over a decade, the RGS would require an increasing percentage of renewable gas, beginning with just 1 percent in 2020 and gradually increasing to 10 percent in 2030. This modest but steady increase in the renewable gas market will provide enormous benefits to public health and safety, the environment and the economy.

It is time for California to diversify and decarbonize its gas supply. It is time for a Renewable Gas Standard.

Los Angeles County Sanitation Districts produce 80 MW of renewable electricity from wastewater and landfill biogas, saving $19 million in electricity costs and cutting GHG emissions by about 325,000 metric tons per year.

I. Introduction

California is a global leader in the fight against climate change. The state has adopted dozens of policies to increase renewable energy, energy efficiency, recycling, carbon sequestration and more. In the electricity sector, California has adopted a Renewable Portfolio Standard (RPS) to increase renewable energy and decrease greenhouse gas emissions. In the transportation sector, California has adopted a Low Carbon Fuel Standard (LCFS) to reduce greenhouse gas emissions and diversify fuel supplies. Surprisingly, however, California has not adopted a policy to decarbonize or diversify the gas sector, which causes more than one-quarter of all greenhouse gas emissions in the state.[4]

> Nearly half of all new natural gas fired power plants built in the U.S. in 2013 were built in California.

California will not be able to meet its long-term greenhouse gas reduction goals without reducing emissions from the gas sector. Yet California's natural gas use has been increasing in recent years and is likely to continue to do so given the rapid increase in gas fired power plants and the historically low price of natural gas.

Reducing emissions from California's gas sector will require a comprehensive statewide policy focused on decarbonizing and diversifying California's gas supply. This paper presents the rationale for a statewide gas strategy, beginning with an overview of the natural gas sector in California, then presenting the potential production and benefits of renewable gas – especially biogas generated from organic waste – and proposing the framework for a Renewable Gas Standard that would require a gradual but increasing percentage of California's gas to be renewable gas.

II. The Natural Gas Sector In California

California uses more than two trillion cubic feet of natural gas per year and gas use continues to increase (Table 1).[5] Most natural gas is used in the residential, industrial, commercial and electric sectors, with just a small fraction used as transportation fuel.

Natural gas is used to generate more than half of California's electricity supply[6] and the majority

4 Based on 2012 usage of natural gas, 2.313 trillion cubic feet emits 125.8 million metric tons of CO_2 equivalent emissions (based on the US Energy Information Agency conversion factor of 54.4 kg CO_2e / 1,000 cf of natural gas). http://www.eia.gov/environment/emissions/co2_vol_mass.cfm. California's total GHG emissions are 458 MMT CO_2e. California Air Resources Board, "Greenhouse Gas Inventory for 2000-2012 – by Category as Defined in the 2008 Scoping Plan," available at: www.arb.ca.gov/cc/inventory/inventory.htm.

5 CEC, footnote 1.

6 U.S. Energy Information Administration (US EIA). California generates 8115 GWh from natural gas out of a total of 15,083 GWh used in 2014. http://www.eia.gov/state/?sid=CA#tabs-4.

of its home heating and hot water.[7] It is also used for cooking and various industrial purposes. Natural gas use in California is highly seasonal, increasing in the winter for space heating and in the summer to generate electricity for air conditioning.[8]

Table 1 – Natural Gas Use in California (2010-2012)

Natural Gas End Use (billion cubic feet/year)	**2010**	**2011**	**2012**
Electricity Generation	922	796	1032
Industrial	548	559	577
Residential	509	518	485
Commercial	199	201	201
Natural Gas Vehicles	18	16	17
Total Natural Gas Demand	**2,196**	**2,091**	**2,313**

Source: California Energy Commission, 2014

California continues to add new natural gas fired power plants at a fast pace. In 2013, nearly half of all new natural gas power generation in the United States was built in California.[9] And more than half of new power generation in California came from natural gas, more than all new renewable energy sources combined.[10]

The California Public Utilities Commission has jurisdiction over 150,000 miles of utility-owned natural gas pipelines, which transported 82 percent of the total amount of natural gas delivered to California's gas consumers in 2012[11]. Residential and small commercial customers, referred to as "core" customers, account for

Sierra Energy's gasification facility on Fort Hunter Liggett will help the U.S. Army to meet its energy security and military preparedness goals.

7 CEC, footnote 1.

8 CEC, footnote 1.

9 US EIA, http://www.eia.gov/todayinenergy/detail.cfm?id=15751.

10 Id.

11 California Public Utilities Commission (CPUC), Overview of Natural Gas Sector. http://www.cpuc.ca.gov/PUC/energy/Gas/natgasandCA.htm.

approximately a third of the natural gas delivered by California utilities in 2012.[12] Large consumers, like electricity generators and industrial customers, referred to as "noncore" customers, accounted for two-thirds of the natural gas delivered by California utilities in 2012.[13] Most of California's small customers purchase natural gas from the utilities, while most large consumers purchase natural gas directly from producers and natural gas marketers.[14]

California imports 91% of the gas that it uses, costing the state more than $9 billion per year.

As a transportation fuel, natural gas is cleaner than diesel or gasoline. It is an important means to reduce air pollution and greenhouse gas emissions, especially from heavy duty vehicles such as trucks, buses, construction equipment and off-road vehicles. In the South Coast Air District, for example, vehicle emissions are the largest source of smog-forming NOx emissions, constituting seven of the ten largest sources of NOx emissions in the region.[15] In fact, more than 90 percent of Southern California's NOx emissions are from the combustion of gasoline and diesel by motor vehicles.[16] Replacing those petroleum fuels with natural gas can reduce NOx emissions by 50 percent and may be able to reduce NOx emissions as much as 90 percent in the future.[17] Natural gas can also reduce greenhouse gas emissions by 23 percent from diesel powered vehicles and by 28 percent from gasoline powered vehicles.[18]

Natural gas is cleaner and cheaper than petroleum based fuels, but it is still a fossil fuel with a number of economic and environmental drawbacks. On the economic side, California has to import 91 percent of the natural gas that it uses from other states and Canada (Table 2).[19] This means that California is sending nearly $9 billion per year out of state to purchase natural gas.[20] The loss to California's economy is much greater than that because California is also losing the

12 Id.

13 Id.

14 Id.

15 Henry Hugo, Assistant Deputy Executive Officer, South Coast Air Quality Management District, June 23, 2014 Presentation to the CEC, slides 3 and 4.

16 Gladstein, Neandross & Associates, Pathways to Near-Zero-Emission Natural Gas Heavy-Duty Vehicles, May 19, 2014, at p. 16. http://www.gladstein.org/pdfs/On-Road_Pathways.PDF.

17 Id at p. 9.

18 Todd Campbell, Clean Energy, June 23, 2014 Presentation to the California Energy Commission, slide 3.

19 California Gas and Electric Utilities' California Gas Report: Issues 2004-2013. http://www.pge.com/pipeline/library/regulatory/cgr_index.shtml; CEC Energy Almanac, Table 2, http://energyalmanac.ca.gov/naturalgas/natural_gas_supply.html.

20 Based on $4 per MMBtu x 2,405,520,000 MMBtu (2,313 billion scf of natural gas).

jobs, economic development, tax revenues and other economic multipliers that go with dollars spent on energy production. Importing 91 percent of California's gas supply, which is used to produce the majority of California's electricity supply, also leaves California vulnerable to market manipulation. California paid heavily for this vulnerability in the 2001-2002 energy crisis, when out-of-state gas traders manipulated the market and cost California ratepayers billions of dollars.

Table 2 - California Natural Gas Supply
Percentage of Supply by Region

	2008	2009	2010	2011	2012
California	13	12	12	11	9
Canada	19	21	23	19	16
Southwest US	46	43	41	32	35
Rocky Mountains	22	22	24	38	40
TOTAL	**100**	**100**	**100**	**100**	**100**

Source: California Energy Commission, 2014

Public health and environmental impacts add to the costs of natural gas. Natural gas is responsible for more than one-quarter of all greenhouse gas emissions in California – about 125 million tons of carbon dioxide equivalent emissions per year.[21] Natural gas is responsible for 90 percent of the greenhouse gas emissions from California's electricity sector.[22] Natural gas exploration, drilling and combustion have additional environmental and public health impacts.

While natural gas is cleaner and less expensive than diesel and gasoline, it provides far fewer benefits than renewable gas.

III. Renewable Gas Potential And Benefits

California can generate substantial quantities of renewable gas to reduce greenhouse gas emissions, diversify the gas sector and provide many other benefits. Renewable gas made from organic waste in California can provide more than 10 percent of the state's total gas supply

21 Based on California's 2012 gas consumption of 2.313 trillion cubic feet of gas and US EIA's emissions conversion factor of 54.5 kg of CO_2 per 1,000 scf of natural gas, emissions from California's gas sector were 125.8 MMT CO_2e in 2012. www.eia.gov/environment/emissions/CO2_vol_mass.cfm. California's total GHG emissions in 2012 were 458.7 MMT CO_2e. California Air Resources Board (CARB), "Greenhouse Gas Inventory for 2000-2012 – by Category as Defined in the 2008 Scoping Plan," available at: www.arb.ca.gov/cc/inventory/inventory.htm.
22 Id.

with technologies that are proven and widely deployed. In the future, renewable gas may also be generated from renewable power, further expanding renewable gas supplies.

This CR&R facility in Southern California will produce 4 million diesel gallons per year from 320,000 tons of organic waste, the largest project of its kind in the U.S.

What is Renewable Gas?

Renewable gas can be produced from biological (organic) material or renewable electricity.

Biogas

The California Energy Commission defines biogas as anaerobic digester gas, landfill gas and any other gas derived from an eligible biomass feedstock.[23] Biogas can be produced from anaerobic digestion (the decomposition of organic material in the absence of oxygen) or biomass conversion. Organic waste sources include food and food processing waste; fats, oils and grease (FOG); yard and other green waste; forest and wood waste; dairy and agricultural waste; biosolids and gas from wastewater treatment; and landfill gas.

Biomass conversion is defined by California law as "the production of heat, fuels, or electricity by the controlled combustion of, or the use of other noncombustion thermal conversion technologies on, the following materials, when separated from other solid waste:

(1) Agricultural crop residues.
(2) Bark, lawn, yard, and garden clippings.
(3) Leaves, silvicultural residue, and tree and brush pruning.
(4) Wood, wood chips, and wood waste.
(5) Nonrecyclable pulp or nonrecyclable paper materials."[24]

Noncombustion thermal conversion technologies such as gasification and pyrolosis use direct or indirect heat in a controlled oxygen environment to convert biomass materials into biogas. In addition to thermal conversion there are also chemical and biological conversion methods for creating biogas from biomass.

Gas Produced From Renewable Electricity

In addition to biogas, renewable gas can be produced from renewable electricity, converting intermittent renewables like wind and solar to baseload, renewable power. This form of renewable gas is created by using wind or solar power to split water into hydrogen and oxygen, and then combining CO_2 with the hydrogen to create methane.[25] Although not yet deployed in California,

23 "*Renewables Portfolio Standard Eligibility, Seventh Edition,*" at page 116, adopted by the California Energy Commission, April 2013. Publication number CEC-300-2013-005-ED7-CMF

24 California Public Resources Code section 40106(a), enacted by Senate Bill 498 (Lara, 2014).

25 http://www.dena.de/en/projects/renewables/power-to-gas-strategy-platform.html

"power to gas" is being developed in Germany and the United Kingdom to convert intermittent renewables to baseload power and to provide a renewable form of methane.

Although this paper focuses on biogas, the potential for gas produced from renewable electricity should also be explored.

Potential for Biogas Development in California

California could generate more than 10 percent of its total gas consumption – 284 billion cubic feet of gas per year - from organic waste. If all technically available organic waste were converted to biogas, it would be equivalent to 2.4 billion gasoline gallon equivalents (gge) of transportation fuels or nearly 7,000 megawatts of renewable power (Table 3 and Appendix B).[26]

Table 3 - Estimated Annual Biomass Residue Amounts and Fuel Potential for California

Feedstock	Amount Technically Available (Bone Dry Tons or Billion Cubic Feet)	Potential Fuels Production (Million gasoline gallon equivalents gge)
Agricultural Residue (lignocellulosic)	5.4 M BDT	272 gge
Animal Manure	3.4 M BDT	170 gge
Fats, Oils and Greases	207,000 tons	56 gge
Forestry and Forest Product Residue	14.2 M BDT	710 gge
Landfill Gas	106 BCF	457 gge
Municipal Solid Waste (food, green waste)	1.7 M BDT	159 gge
Municipal Solid Waste (lignocellulosic fraction)	10.5 M BDT	525 gge
Waste Water Treatment Gas	11.8 BCF	66 gge
Fuel Potential		**2,415 gge**

Compiled by Rob Williams, University of California, Davis, April 2014 (revised 19 May, 2014).[27]

26 CEC 2008, "*An Assessment of Biomass Resources in California, 2007, 2010 and 2020*," at p. iii, finding that the technical potential of biomass is 6,800 megawatts in 2020. The fuels potential is based on the assessment by UC Davis in Table 3 and Appendix B that using 67% of diverted organic waste and other biomass residues can produce 2.187 billion gasoline gallon equivalents of fuel. Using 100% of diverted organic waste plus the other organic waste and residues can produce 2.5 billion gasoline gallon equivalents of fuel.

27 Williams, R. B., B.M. Jenkins and S. Kaffka (California Biomass Collaborative). 2014. An Assesment of Biomass Resources in California, 2012 – DRAFT. Contractor Report to the California Energy Commission. PIER Contract 500-11-020. For an explanation of Notes and Sources, see the full table and notes in Appendix B.

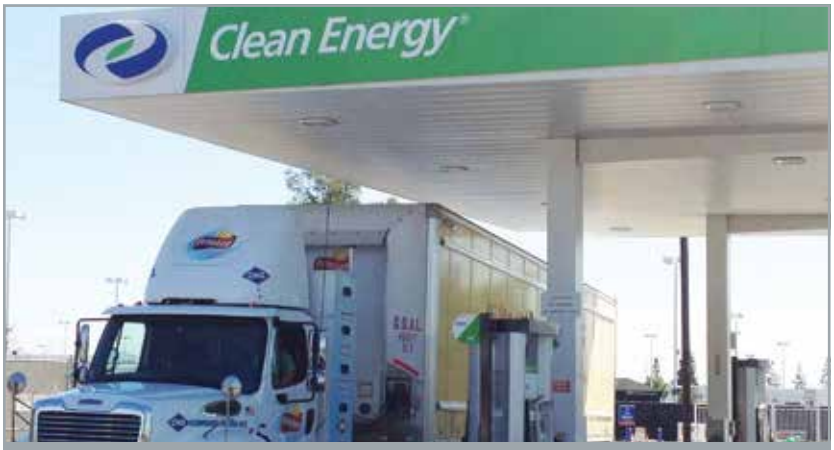
The Benefits of Biogas

Increasing biogas use would provide many economic, environmental, public health and safety benefits to California. Most importantly, increasing biogas in California will:

- Provide immediate and significant greenhouse gas reductions;
- Produce low carbon fuels, renewable electricity and energy storage;
- Increase energy independence and fuel diversity;
- Produce jobs and economic development in every region of the state;
- Leverage private sector investment of three to four times as many dollars;
- Reduce air and water pollution, environmental justice impacts and landfilling;
- Increase recycling; and
- Reduce wildfire risks and impacts.

A Renewable Gas Standard could cut California's GHG emissions by more than 10 million metric tons of CO_2e per year.

Above all, biogas provides immediate and significant greenhouse gas reductions. Replacing just ten percent of California's natural gas with renewable gas would reduce GHG emissions by 12.6 million metric tons from fossil fuel displacement alone.[28] The actual emissions reduction would be much greater due to upstream reductions in black carbon (from reduced wildfire) and methane emissions from dairies and other uncapped sources.



Clean Energy Renewable Fuels is selling 100,000 gallons per day of its renewable biogas, called Redeem, to California customers. Redeem has 90% lower GHG emissions than diesel.

In the fuels sector, biogas provides the lowest carbon fuels - or transportation of any kind – currently available, lower carbon per mile than electric or fuel cell vehicles (Table 4).[29] Renewable gas can also provide a renewable source of hydrogen for use in hydrogen fuel cells, either for electricity production or as

28 Calculated using US EIA's emissions conversion factor of 54.5 kg of CO_2 per 1,000 scf of natural gas. www.eia.gov/environment/emissions/CO2_vol_mass.cfm. California's 2012 gas consumption of 2.313 trillion scf, of natural gas in 2012 emits 125,827,200 metric tons of CO_2 equivalent emissions. 10% of those emissions is 12.6 MMT CO_2e.

29 CARB Look-Up Table, footnote 3.

a transportation fuel. When renewable gas is used to displace diesel, it can significantly reduce toxic air contaminants, particulate matter and other air pollutants.

Table 4 - Carbon Intensity of Transportation Fuels(grams CO_2e per megajoule energy)

Transportation Fuel	Carbon Intensity
Gasoline	99.18
Diesel	98.3
Biodiesel from Midwest soy beans	83.25
Corn ethanol	74.70 to 120.99
Natural Gas	68
Sugarcane ethanol	58.4 to 78.94
Hydrogen Fuel Cell Vehicles	39.42
Electric vehicles	30.80
Renewable Diesel	19 to 39
Landfill gas	**11.26 to 15.56**
Dairy Biogas	**13.45**
Wastewater biogas (large facilities)	**7.89**
Biogas from food and green waste	**- 15**

Source: California Air Resources Board May 2014 Look-Up Table30

In the electricity sector, increasing the use of biogas can help California meet its renewable energy goals, especially as California increases renewable electricity beyond 33 percent. Biogas can provide renewable electricity that is available 24/7 and can easily ramp up and down to complement wind and solar power, which are only available intermittently. Bioenergy helps to fill in supply when solar and wind are not available, enabling California to increase its renewable energy portfolio at much lower cost and with greater grid stability.[31]

California Bioenergy's project at New Hope Dairy generates renewable electricity for the Sacramento Municipal Utility District (SMUD).

30 Id.

31 Energy and Environmental Economics, January 2014, Investigating a Higher Renewables Portfolio Standard in California. http://www.ethree.com/public_projects/renewables_portfolio_standard.php.

In addition to the overall benefits of bioenergy, each bioenergy sector provides specific benefits, summarized in Table 5 below:

Table 5 – Sector Specific Benefits of Bioenergy

Sector	GHG Reduction (Million metric tons MMT)	Benefits
Diverted Municipal Organic Waste	5-10 MMT CO_2e / year (not including fossil fuel displacement)	• Reduced landfill waste • Revenue and/or energy for local governments • Production of organic fertilizers
Landfill Gas	6.77 MMT CO_2e / year (not including fossil fuel displacement)	• Reduced pollution and environmental justice impacts from fossil fuels
Livestock Waste	6 MMT CO_2e / year (not including fossil fuel displacement)	• Reduced odor, air and water pollution • Revenue for dairies • Production of organic fertilizer
Agricultural Waste	Estimate not yet available	• Reduced air pollution from open field burns • Production of organic fertilizer and soil amendments
Wastewater Treatment Biogas	3 MMT CO_2e / year (not including fossil fuel displacement)	• Produce revenue and/or energy for local governments • Production of organic fertilizer and soil amendments
Forest Waste	Can reduce GHG emissions from wildfire by 65 percent or more	• Protect health and safety • Reduce air pollution • Protect infrastructure and forest ecosystem • Save hundreds of millions in annual wildfire damages • Provide energy and/or revenues to rural communities

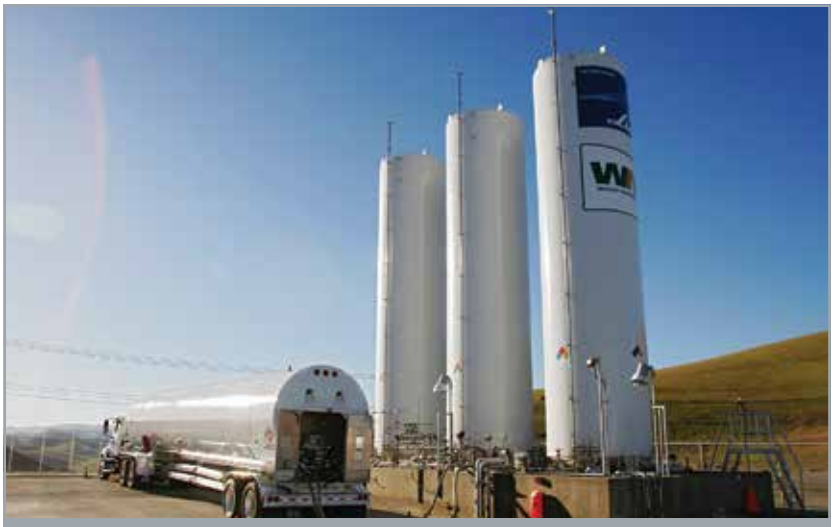
Source: Bioenergy Investment Plan, compiled by BAC in 2014

Organic waste can provide enough renewable gas to power 2 to 3 million homes in California.

IV. Policy Framework For Renewable Gas

California has adopted several policies to promote biogas development, reduce landfilling of organic waste and increase renewable fuels. To date, these policies have achieved mixed results. Recent funding programs are helping to spur new biogas projects, but many of the recent regulatory policies have yet to be implemented, are prohibitively expensive, or do not provide enough certainty to attract the investment necessary to expand the biogas market. Several key policies are summarized below; a more complete description of the policy framework for biogas is included in Appendix A.

- **The 2012 Bioenergy Action Plan**, adopted by nine state agencies and Governor Brown's Office, details 55 separate actions that state agencies should take to increase bioenergy. Agencies are at varying stages of implementing these actions, the most important of which were codified in SB 1122 and AB 1900.
- **SB 1122** (Rubio, 2012) requires utilities to procure 250 megawatts from small-scale bioenergy facilities. The California Public Utilities Commission (CPUC) is more than a year late in adopting the rules to launch this important program.
- **AB 1900** (Chesbro, 2012) requires the CPUC to set new standards for pipeline biogas injection and to allocate the costs of meeting those standards. The CPUC has adopted the most stringent standards in the United States and has not yet completed the cost allocation phase of the proceeding.
- **The Low Carbon Fuel Standard** (LCFS). The Air Resources Board has adopted carbon intensity values for most sources of biogas, which is helping to incentivize new development. ARB needs to reevaluate some of its earliest carbon intensity analyses and adopt one for forest biomass based fuels. The program also needs to provide long-term certainty about the value of LCFS credits in order to increase market investment.



Methane generated at Waste Management's Altamont Landfill is converted to 13,000 gallons a day of renewable fuel used in WM trucks.

- **The Electricity Program Investment Charge (EPIC)** funds clean electricity R&D, technology deployment, and market facilitation. The California Energy Commission has allocated more than $37 million to bioenergy projects in 2014, but it is not clear how much will be allocated to bioenergy in future years.
- **The Alternative and Renewable Fuel and Vehicle Technology Program.** The Energy Commission allocated $18 million to biomethane based transportation fuels, out of a total of $100 million available in 2014, even though organic waste based fuels are the lowest carbon fuels or transportation available.
- **Cap and Trade Revenues.** California's 2014–2015 Budget allocated cap and trade revenues to organic waste diversion and dairy digesters, but did not allocate any cap and trade revenues to biogas based transportation fuels, renewable hydrogen from biogas, forest biomass facilities or biogas from wastewater treatment facilities.

The policies described above are helping to launch a handful of new biogas projects in California, but they are not sufficient to grow a self-sustaining biogas industry. Some, such as SB 1122, are far behind the implementation schedule required by statute. Others, such as the LCFS program, do not provide the long-term certainty required to attract industry-wide investment. The biogas sector needs an effective regulatory framework and greater long-term certainty to reach the level of market penetration that will drive down costs and enable biogas to compete with the historically low cost of natural gas.

CleanWorld's facility in Davis converts organic waste and landfill gas to 5.6 GWh of renewable energy and cuts GHG emissions by 13,500 tons per year.

Achieving the potential production and benefits that biogas can provide in California will require a sector-wide policy to decarbonize and diversify California's gas supply.

V. Why A Renewable Gas Standard Makes Sense

California has a number of policies and funding programs to promote biogas development, but lacks the coordinated framework to significantly increase renewable gas production and distribution. Overcoming market barriers, especially low natural gas prices and utility resistance, will require a sector-wide approach that guarantees a biogas market in California, just as the state's

Renewable Portfolio Standard (RPS) guarantees a market for renewable electricity. Adopting a Renewable Gas Standard (RGS) that is phased in slowly with appropriate cost and other controls will help California meet its greenhouse gas reduction and clean energy goals.

California's RPS Works

California's RPS has been hugely successful in expanding renewable electricity generation. When the RPS was first adopted in 2002, renewable energy constituted only 10 percent of California's electricity supply, leaving the state overly dependent on natural gas and highly vulnerable to market manipulation by out-of-state gas traders. Thanks to the RPS, renewable sources now provide more than 20 percent of California's electricity supply and are on track to provide 33 percent by 2020.

The first RPS legislation, SB 1078, specified the many reasons to adopt a renewable portfolio standard:

- To increase the diversity, reliability, public health and environmental benefits of California's energy mix;
- To promote stable energy prices, protect public health, improve environmental quality, stimulate sustainable economic development, create new employment opportunities, and reduce reliance on imported fuels; and
- To reduce air pollution and improve public health throughout the state by reducing the burning of fossil fuels and associated environmental impacts.[32]

San Jose's facility can convert 90,000 tons of waste to 1.6 MW of renewable electricity. The facility was developed by Zero Waste Energy Development Company and is part of the city's zero waste by 2022 plan.

A Renewable Gas Standard would achieve these same goals for the gas sector: significant reductions in air pollution and greenhouse gas emissions, increased fuel diversity and reliability, increased job and economic opportunities, protection of public health and the environment, and reduced reliance on fossil fuels.

32 SB 1078 (Statues of 2002), adding Public Utilities Code section 399.11.

Designing a Renewable Gas Standard

Just as the RPS has driven the development of renewable electricity in California, a Renewable Gas Standard (RGS) will drive development of renewable gas. Like the RPS, it will be important to design an RGS that sets appropriate timelines, price protections and other measures to ensure that the RGS maximizes benefits while minimizing ratepayer impacts. A California RGS should include the following elements:

Phase-in and Percentage Requirement

Technically, renewable gas could provide more than 10 percent of California's total gas consumption.[33] Phasing in a lower percentage over several years will minimize ratepayer impacts and allow the industry and the market to develop in a more stable manner.

Recommendation:

- 1% RGS by 2020
- 3% RGS by 2023
- 5% RGS by 2025
- 10% RGS by 2030

Who Must Comply with the RGS?

The RGS should apply to all retail sellers of natural gas. Initially, it should apply to all gas sales under the jurisdiction of the California Public Utilities Commission (CPUC), which oversees the distribution of 82 percent of all gas consumed in California. It should apply to both the utilities, which own and sell about a third of the gas that they distribute, and to gas providers that sell more than two-thirds of the gas directly to large gas customers.

The RGS could be applied to publicly owned utilities and other gas providers on the same timeline or phased in at a later date.

Price and Market Protections

Given the very small percentages and gradual phase-in of the RGS, the impact on ratepayers should be negligible. Nonetheless, it will be important to include price and

Phoenix Energy uses wood and agricultural waste to generate renewable power in Merced County.

33 Assuming biogas production from all organic waste sources of 284 billion scf/year and total natural gas consumption of 2.3 trillion scf/year.

market protections with appropriate off-ramps to protect ratepayers and the market. Allowing utilities to bank compliance and/or borrow against future compliance may also help to reduce costs.

Victor Valley Wastewater Authority produces 9 million kilowatt hours and avoids landfilling 1,400 tons of waste per year.

Additionality and Ratepayer Benefits

To maximize the benefits for California ratepayers and the public, eligible biomethane under the RGS should be subject to the requirements of AB 2196, which sets forth eligibility requirements for biomethane under the RPS.[34] AB 2196 limits RPS eligible biomethane to biomethane from new projects that are either: 1) used for onsite generation; 2) delivered via a dedicated pipeline; or 3) if delivered via a common carrier pipeline, provide specified environmental benefits to California.

VI. Conclusion

It is time for California to accelerate the development of renewable gas. The technologies are proven and the benefits are enormous. Adopting a Renewable Gas Standard will help California to achieve its greenhouse gas reduction, clean energy and energy independence goals. It will also protect public health and safety, reduce environmental justice impacts, and create jobs and economic development.

A renewable gas standard will accelerate biogas development by guaranteeing a market and encouraging the most cost-effective projects with the greatest benefits. By ramping up slowly and with ratepayer protections, it can provide maximum benefits to the grid and the transportation sector without risk to ratepayers or the public.

It is time for a Renewable Gas Standard.

34 Public Utilities Code section 399.12.6.

Policy Framework for Bioenergy in California

Executive Order S. 06-06 and Senate Bill 1505

Governor Schwarzenegger issued Executive Order S. 06-06 in 2006 to increase production of biofuels and biopowered electricity. That Order calls for:

- 20 percent of California's RPS target to come from biomass generation by 2020; and
- 40 percent of the biofuels that California uses to be produced in-state by 2020 and 75 percent to be produced in-state by 2050.

SB 1505, enacted in 2006, requires that one-third of the hydrogen used in publicly funded hydrogen fueling stations be generated from renewable sources. SB 1505 declared that it is "the intent of the Legislature that the state board work with other relevant state agencies on the production of hydrogen, with an emphasis on hydrogen produced from renewable resources, as part of a strategy to reduce the state's dependence on petroleum, achieve the state's greenhouse gas emission reduction targets, and improve air quality for the state's residents."

2012 Bioenergy Action Plan

In 2012, the Brown Administration significantly updated and expanded the state's Bioenergy Action Plan to promote bioenergy development, both biogas and biomass. The 2012 Bioenergy Action Plan was adopted by nine state agencies including the Governor's Office to:

- Increase environmentally and economically sustainable energy production from organic waste;
- Encourage development of diverse bioenergy technologies that increase local electricity generation, combined heat and power facilities, renewable natural gas, and renewable liquid fuels for transportation and fuel cell applications;
- Create jobs and stimulate economic development, especially in rural regions of the state; and
- Reduce fire danger, improve air and water quality, and reduce waste.

The 2012 Bioenergy Action Plan was intended to identify the technical, regulatory and financial barriers to bioenergy development and state actions to address those barriers. While some state agencies have worked to streamline permitting or otherwise promote bioenergy development, progress has been slow and far too limited.

Assembly Bills 1900 and 2196

In 2012, California enacted AB 1900 (Gatto) and AB 2196 (Chesbro) to promote the instate production and distribution of biomethane. AB 2196 significantly limits the eligibility of out-of-state biomethane under California's RPS while AB 1900 is intended to promote the in-state production and use of biomethane. As AB 1900 states, the bill is intended:

> "To meet the energy and transportation needs of the state, the com-

> mission shall adopt policies and programs that promote the in-state production and distribution of biomethane. The policies and programs shall facilitate the development of a variety of sources of in-state biomethane."

AB 1900 also requires the California Public Utilities Commission (CPUC) to identify impediments to biomethane procurement, offer solutions to address those impediments, and adopt pipeline access rules that ensure "nondiscriminatory open access to its gas pipeline system."

The CPUC has completed the first phase of the AB 1900 rulemaking, in which it adopted new standards for pipeline biomethane to protect public health, pipeline safety and heating (energy) value of the gas. The standards are without doubt the most stringent pipeline biomethane standards in the United States. They include requirements for testing, monitoring and controlling 17 constituents of concern, as well as a heating content requirement that, taken together, are virtually cost-prohibitive. Meeting the 990 Btu heating requirement alone may double the cost of pipeline biomethane. Without other incentives or biogas purchase requirements, AB 1900 will not achieve its purpose of promoting and facilitating biogas development in California.

Senate Bill 1122

In 2012, California also enacted SB 1122 (Rubio), which requires the utilities to purchase 250 megawatts of renewable electricity generated from organic waste. SB 1122, which has been added to California's existing feed-in tariff program for distributed scale renewables (SB 32), requires the investor owned utilities (PG&E, Southern California Edison and SDG&E) to purchase energy from small-scale (3 MW and smaller) bioenergy facilities. SB 1122 requires that the 250 megawatts be made up of:

- 110 megawatts generated from food and food processing waste, wastewater treatment, diverted municipal organic waste and codigestion;
- 90 megawatts generated from dairy and other agricultural waste; and
- 50 megawatts generated from forestry waste.

The CPUC is more than a year behind in adopting the specific program rules to implement SB 1122. A staff proposal issued in the Fall 2013 suggested some helpful changes to the existing feed-in tariff (ReMAT) program, but left open a number of issues that are critical to the successful implementation of SB 1122. Those issues include the minimum number of bidders required in each feedstock category, the required location of facilities, penalty and inflation adjustment provisions, a method to ensure that all sectors can participate in the program, and other issues.

Transmission and Pipeline Access

Interconnection to both pipelines and electric lines is a significant barrier to biogas development in California. Bioenergy projects must be able to connect to the transmission or pipeline grid to be able to export renewable electricity or biogas for use offsite. As mentioned in section B, the new standards for pipeline biomethane will be cost-prohibitive without additional subsidies, utility purchase requirements or other policies to make the standards feasible. In addition to the

biomethane standards themselves, pipeline interconnection can be a significant cost of biogas project development, sometimes as much as 20 to 30 percent of total project costs. California's investor-owned utilities charge anywhere from two to ten times as much for pipeline interconnection as utilities in other states.

Connecting bioenergy projects to the electricity transmission grid is no easier. Bioenergy project developers can receive wildly different cost estimates for similar interconnection projects, or even for the same interconnection project. Although the CPUC has provided a timeline and process for interconnection, developers cannot rely on utility timelines, cost estimates or technical requirements, all of which increase biogas project costs and risks substantially.

Funding Programs

Numerous state funding programs exist to help support new bioenergy projects. They are moving the industry forward, although not at the rate necessary to meet the state's low carbon fuels, waste diversion and other goals.

Funding for Electricity and Gas Projects

EPIC. The California Public Utilities Commission created the Electricity Program Investment Charge (EPIC) in 2011 to provide funding for clean energy development. EPIC created an electricity ratepayer surcharge that will generate approximately $350 million in clean energy funding for the years 2015-2017. That funding is allocated as follows:

- $152 million for Applied Research and Development;
- $145 million for Technology Demonstration and Deployment, at least 20 percent of which must go to bioenergy projects; and
- $53 million for Market Facilitation.

The EPIC program, like the former Public Goods Charge on electricity, is a very important opportunity to promote biogas projects and bioenergy more generally.

PIER. In addition to the EPIC program to promote clean electricity, the California Energy Commission also administers the Public Interest Natural Gas Research Program, also known as the PIER Natural Gas Program. The program allocates up to $62 million per year for natural gas related research and demonstration.

SGIP. The California Public Utilities Commission (CPUC) also administers a funding program to support projects that generate electricity for onsite use, known as the Self-Generation Incentive Program (SGIP). Created in 2001 as a response to the California Energy Crisis, SGIP funds distributed generation projects, combined heat and power, and energy storage. It provides incentives ranging from $1.13 to $1.83 per watt, including a biogas adder of $1.62/watt.

Funding from Cap & Trade Proceeds

As part of California's Global Warming Solutions Act (AB 32), California adopted a market

mechanism known as Cap & Trade that gives regulated entities more flexibility in meeting their greenhouse gas emission targets. Regulated entities can: 1) reduce their emissions by the required amount; 2) purchase carbon offset credits; and/or 3) purchase emission allowances that are auctioned off by the state. The auctions held so far have generated more than $1 billion dollars. In the 2014-2015 budget, the State allocated funding in several categories that may support biogas development:

- $25 million to CalRecycle for projects to reduce organic waste and promote recycling;
- $15 million to the California Department of Food and Agriculture for dairy digester projects and other greenhouse gas reduction measures;
- $42 million to CalFire for forest conservation, wildfire reduction and urban forestry; and
- $200 to the Air Board for fuel cell and electric vehicle technology. As noted in Section A. above, one-third of the hydrogen used in these fuel cell fueling stations must come from renewable sources, ie biogas.

CalRecycle has already issued a Request for Proposals for its 2014-15 funding. It received more than $115 million in proposals for the $20 million it allocated to organic waste diversion.

Funding for Alternative Fuels

The Alternative and Renewable Fuel and Vehicle Technology Program, also known as AB 118, provides approximately $100 million per year in grants to promote clean fuels and vehicles. Administered by the California Energy Commission, the program divides the funding between natural gas, electric, fuel cell and renewable fuel vehicles, alternative fuels production and infrastructure. While the mix of technologies and fuels that receive AB 118 funding is more diverse than the current allocation of Cap & Trade revenues for clean vehicles, it is still disproportionately focused on fuel cell, electric, natural gas and other fuels that provide substantially lower greenhouse gas reductions than biogas generated from organic waste.

Estimated Annual Biomass Residue Amounts and Fuel Potential for California (with Notes and Sources)

Compiled by Rob Williams, University of California, Davis‡

Feedstock	Amount Technically Available (Bone Dry Tons or Billion Cubic Feet)	Biomethane Potential (billion cubic feet)	Biofuel Potential	
			(Million gasoline gallon equivalent gge)	PJ (LHV basis)§
Agricultural Residue (Lignocellulosic)	5.4 M BDT [a]	-	272 [h]	32.7
Animal Manure	3.4 M BDT [a]	19.7 [a]	170 [i]	12.3
Fats, Oils and Greases	207,000 tons [b]	(assume conversion to biodiesel)	56 [j]	6.7
Forestry and Forest Product Residue	14.2 M BDT [a]	-	710 [h]	85.4
Landfill Gas	106 BCF [a]	53 [f]	457 [i]	55.0
Municipal Solid Waste (67% of food, leaves, grass fraction)	1.2 M BDT [c]	12.3 [g]	106 [i]	12.8
Municipal Solid Waste (67% of lignocellulosic fraction)	7.0 M BDT [d]	-	350 [h]	42.1
Waste Water Treatment Gas	11.8 BCF [e]	7.7 [k]	66 [i]	7.9
Total		**93**	**2,187**	**263**

* Diesel gallon equivalents can be estimated by multiplying gge by 0.89

Notes and Sources:

M BDT = million bone dry (short) tons, PJ = petajoule = 1015 joules

BCF = billion cubic feet

a. Williams, R. B., B. M. Jenkins and S. Kaffka (California Biomass Collaborative). 2014. An Assessment of Biomass Resources in California, 2012 – DRAFT. Contractor Report to the California Energy Commission. PIER Contract 500-11-020.

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b. From: Wiltsee, G. (1999). Urban Waste Grease Resource Assessment: NREL/SR-570-26141. Appel Consultants, Inc. 11.2 lbs./ca-y FOG and California population of 36.96 million. Biodiesel has ~9% less energy per gallon than petroleum diesel.

c. Technical potential assumed to be 67% of amount disposed in landfill (2012).

d. 67% of mixed paper, woody and green waste and other non-food organics disposed in landfill (2012), (waste characterization and disposal amounts are from: http://www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1346 and http://www.calrecycle.ca.gov/lgcentral/GoalMeasure/DisposalRate/Graphs/Disposal.htm)

e. From EPA Region 9; Database for Waste Treatment Plants

f. Assumes 50% methane in gas

g. Assumes VS/TS= 0.83 and biomethane potential of 0.29g CH4/g VS (food waste) & VS/TS = 0.9 w/ BMP= 0.143g CH4/g VS (leaves. Grass)

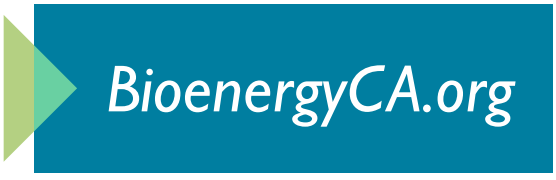
h. Using 50 gge per dry ton (75 gallons EtOH per dry ton) yield. See, for example: Anex, R. P., et al. (2010). Techno-economic comparison of biomass-to-transportation fuels via pyrolysis, gasification, and biochemical pathways. [Article]. Fuel, 89, S29-S35. doi: 10.1016/j.fuel.2010.07.015

i. ~116 ft^3 methane is equivalent to 1 gge (983 Btu/scf methane and 114,000 Btu/gallon gasoline, lower heating value basis)

j. 7.5 lbs FOG/ gallon biodiesel. Biodiesel has ~9% less energy per gallon than petroleum diesel, gives 50 M gallons diesel equivalent. 1 dge = 1.12 gge

k. Assumes 65% methane in gas. §

‡ Compiled by Rob Williams, University of California, Davis. April 2014 (revised 19 May, 2014). Source material: Williams, R. B., B. M. Jenkins and S. Kaffka (California Biomass Collaborative). 2014. An Assessment of Biomass Resources in California, 2012 – DRAFT. Contractor Report to the California Energy Commission. PIER Contract 500-11-020.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