Rule 1118.1:
Control of Emissions from Non-Refinery Flares

Review of Technical Assessment

April 19, 2023

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REVISED

Agenda

- Regulatory Background
- Technical Assessment – Beneficial Use of Flared Gas
- Technical Assessment – Food Waste Diversion

Regulatory Background

Regulatory Background

- Rule 1118.1 was adopted on January 4, 2019
  - Regulates emissions from non-refinery flares located at landfills, wastewater treatment plants, oil and gas production facilities, organic liquid loading stations, and tank farms
- 295 flares are subject to the Rule 1118.1:
  - 155 landfill flares
  - 65 digestive gas flares at wastewater treatment plants
  - 49 produced gas flares at oil and gas sites
  - 26 flares at other regulated facilities

Image Courtesy: PROGECO

Regulatory Background – *cont.*

- Rule 1118.1 regulates Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOC) by establishing an industry specific capacity thresholds for existing flares
  - Thresholds are applied to open flares and flares that combust digester gas, landfill gas, and gas produced from oil and gas production facilities

Table 2 – Annual Capacity Thresholds

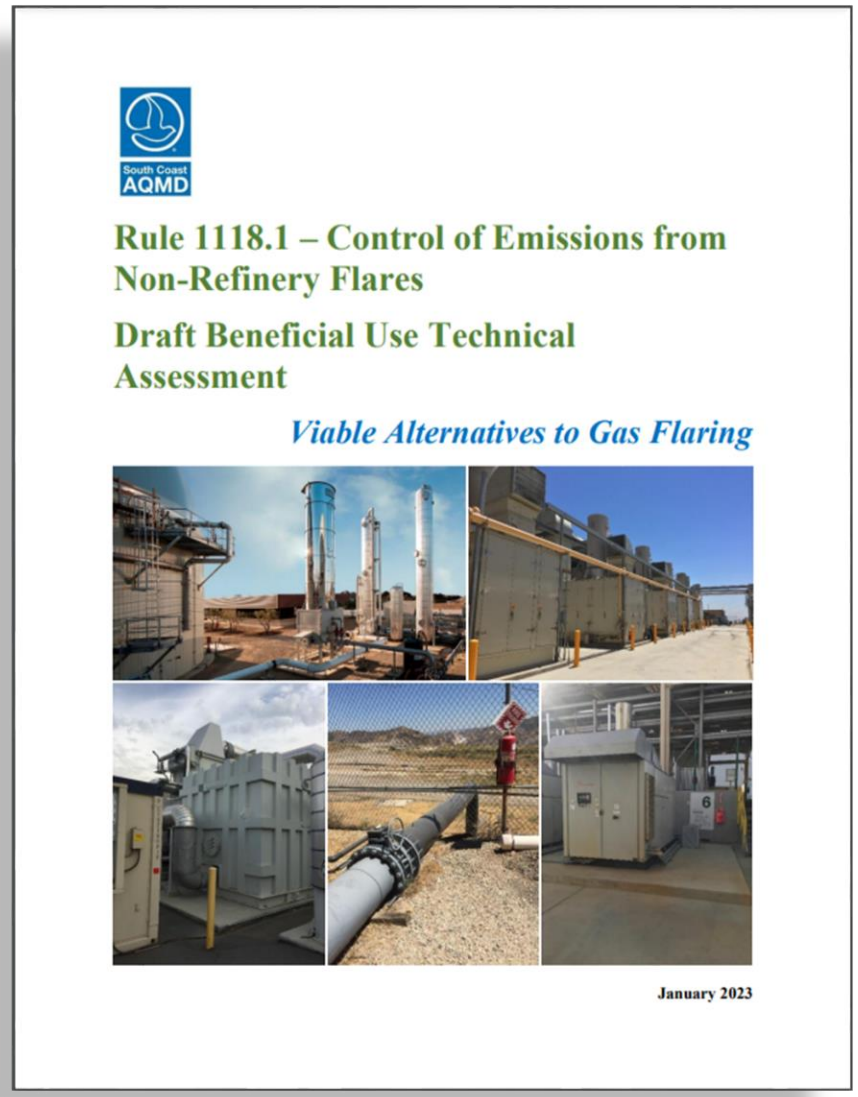
Flare Gas	Threshold
Any gas combusted in an open flare	5%
Digester gas	70%
Landfill gas	20%
Produced gas	5%

Regulatory Background – cont.

- Any flare that operates at greater than the capacity threshold is required to, either:
  - Reduce flaring to below the capacity threshold (e.g., through beneficial use strategies)
  - Replace the flare with a unit complying with the lower NOx emissions limits
- Upon adoption of the rule, the Governing Board directed staff to conduct the following technical assessments:
  - Beneficial Use Technology Assessment to explore technologies, techniques, and approaches to beneficially use gas to reduce flaring and its corresponding emissions
  - Impacts of Senate Bill 1383 – Short-lived Climate Pollutants (SB 1383) requirement to divert organic food waste from landfills to digesters including:
    - Potential NOx impacts for Rule 1118.1 flares
    - Potential NOx impacts to Best Available Control Technology (BACT) limits *(further discussion later in presentation)*
      - ✓ Presented to Stationary Source Committee on January 24, 2020 (Items #1 and #2)

Beneficial Use of Flared Gas

Technical Assessment



Beneficial Use Technical Assessment

- Staff conducted a technical assessment of various technologies, techniques, and approaches to beneficially use gas that would otherwise be flared to reduce flaring and corresponding emissions
- Staff released the draft of this technical assessment on January 27, 2023
- Staff received comments on the draft and will reflect them in the final version of Technical Assessment report

Purpose of Technical Assessment

- Provides an informative guide for the facilities subject to the requirements of Rule 1118.1 seeking alternative strategies to flaring the gas
- Includes information on the benefits and potential impediments to various beneficial use alternatives for each industry sector
- Presents an overview of future technologies and alternatives to flaring that will continue to be developed over time

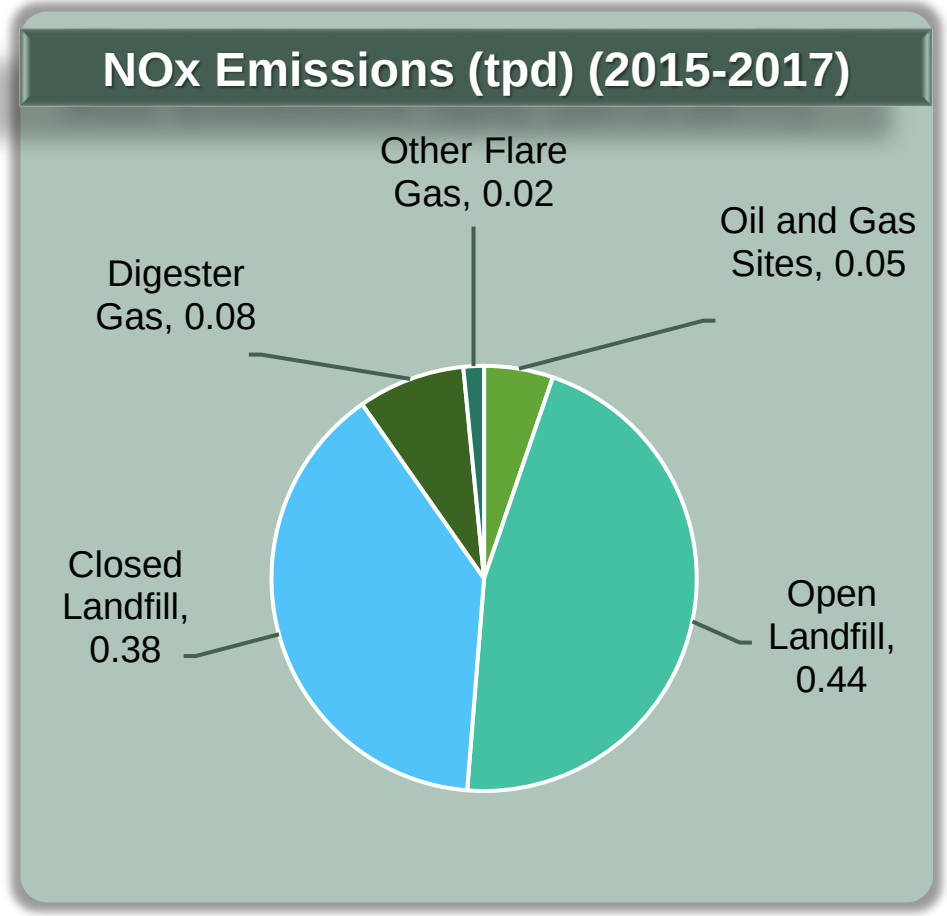
Regulated Industries

Regulated Industries by Rule 1118.1

Three main sources of emissions from non-refinery flares include:

- Landfills
- Wastewater treatment plants
- Oil and gas production sites

The industry with the largest emissions from flaring and the largest flare throughput is landfills (open and closed)



Landfills


Image Courtesy: eThekwini Municipality

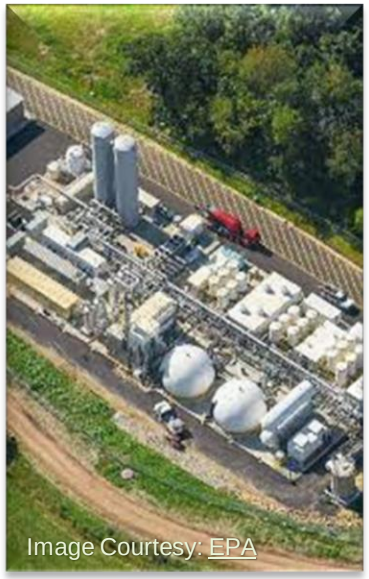
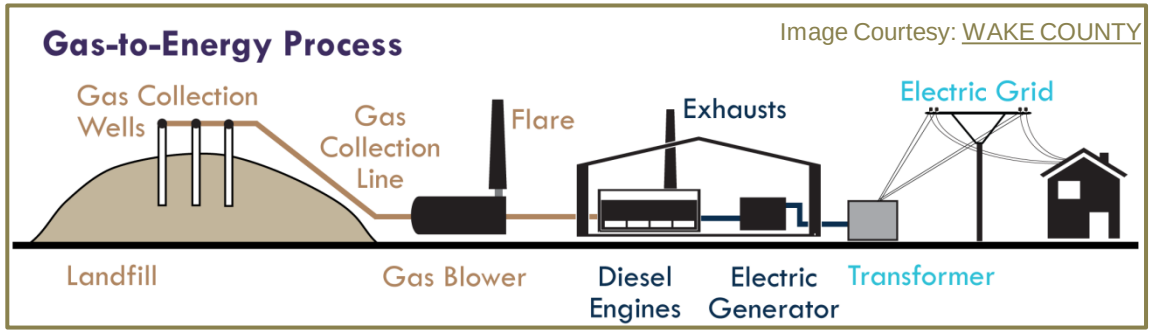


Image Courtesy: EPA

- Landfills account for:
  - Largest throughput of flared gas
  - Largest share of NOx emission
- Raw biogas is called landfill gas (LFG) when produced naturally by anaerobic bacteria in municipal solid waste landfills
- Federal, state, and local regulations require the capture of LFG
- LFG can be combusted through a flare or be used beneficially through:
  - Transportation fuel
  - Power generation
  - Pipeline injection



Landfills – Opportunities and Challenges


Image Courtesy: eneraque

- Many landfills can beneficially use LFG to generate energy that powers onsite equipment or provides power to surrounding users
  - Landfills are not energy intensive operations
  - Large quantity of landfill gas consistently being produced at active landfills
- Over time, landfills experience a decrease in quantity of gas and quality of heat content
  - Eventually neither flaring nor beneficial use is feasible
- Other challenges associated with LFG include:
  - Low heat content
  - High expense to remove siloxane contamination, which can damage equipment or poison the catalyst used to control NOx emissions

Wastewater Treatment Plants

- Wastewater treatment plants (WWTPs) account for category with the second largest volume of flared gas
- Digester gas is produced at WWTPs through anaerobic decomposition in digester units
  - Digester gas is flammable and composed of methane, hydrogen sulfide, CO_2, and siloxane
- SB 1383 was approved in 2016 and seeks to reduce organic waste methane emissions from landfills
  - Such reductions require food wastes, currently being disposed off at landfills, to be diverted to anaerobic digesters or composting facilities
- As organic waste is diverted away from landfills, additional biogas is anticipated to be produced at WWTPs and at other digesters that receive the organic waste


Image Courtesy: Hydroflux Group

Wastewater Treatment Plants – Opportunities and Challenges

- WWTPs have a high energy demand
- Many facilities can utilize the digester gas for:
  - Power generation
  - Boilers to make steam for heating digesters
  - Transportation fuel
  - Pipeline injection
- Challenges:
  - Digester gas has relatively low heat content
  - Removal of siloxane contaminate for digester gas is a challenging and costly process

Image Courtesy: Treatment Plant Operator

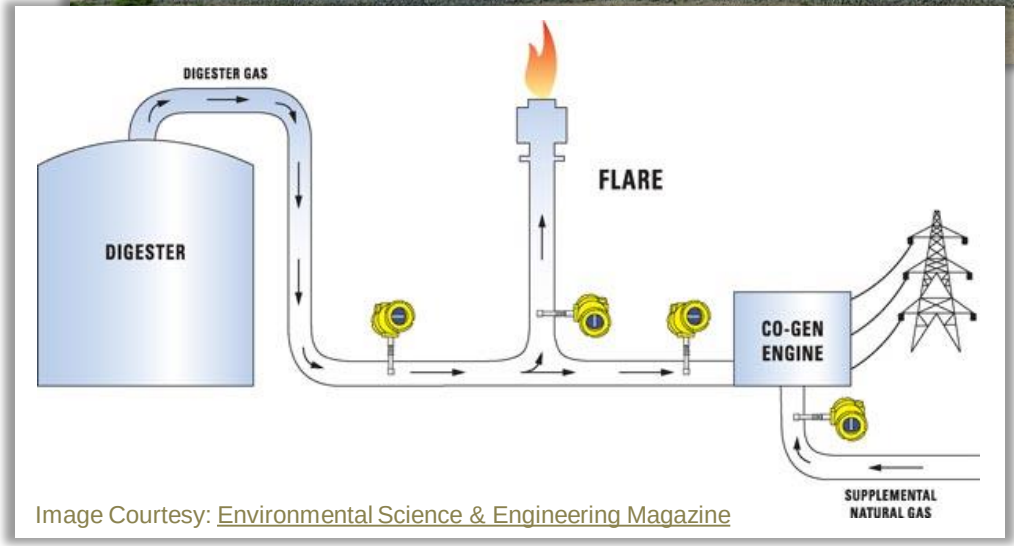


Image Courtesy: Environmental Science & Engineering Magazine

Oil and Gas Production Sites

- Oil and gas production sites are the third category with the largest volume of flare gas
- Produced gas has relatively high heat content (around 900 Btu/scf)
- Many oil and gas sites that produce significant quantities of gas have incorporated beneficial use alternatives to reduce the amount of gas flared:
  - Energy production
  - Pipeline injection
  - Transportation fuel


Image Courtesy: U.S. Department of Energy

Oil and Gas Production Sites – Opportunities and Challenges

- Energy production is more cost effective at energy intensive sites
  - Produced energy offsets existing demand and costs
- Produced gas can be used to generate energy through fuel cells and micro-turbines or to produce transportation fuel
- Pipeline injection is cost effective for companies that have connections nearby or can inter-connect to another company's pipeline or through a municipal connection
- Challenges:
  - Requires gas treatment to remove sulfides, water, CO_2, and other contaminants
  - Produced gas in not considered renewable natural gas, so incentives are not available to assist with its conversion or capture


Image Courtesy: Furtune

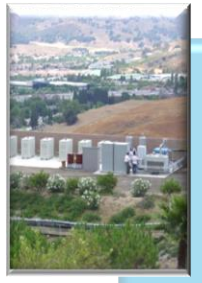

Image Courtesy: Energid Energy Inc.

Potential Alternatives to Flaring Gas

Alternatives – General Considerations

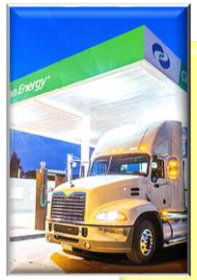
- Backup flares may be required regardless of any beneficial use being implemented
  - May be needed to control flare gas during maintenance, repair, upset conditions, and when excess gas is generated compared to what the beneficial use project can handle
- Not all beneficial use technologies/projects are applicable to all affected industries or target facilities

Potential Alternative Technologies to Flaring Gas



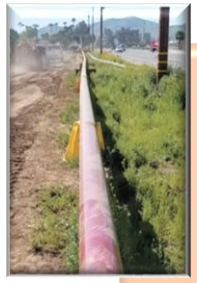
Energy Generation

- Microturbines and Turbines
- Fuel Cells
- Combined Heat and Power



Transportation Fuel

- Gas-to-liquids Process



Pipeline Injection

Energy Generation

Alternatives

Energy Generation – Technologies

Energy generation is commonly used by facilities with energy intensive operations due to its potential cost savings

- Microturbines and Turbines
  - Most systems require gas clean-up
  - Compatible with all source categories subject to Rule 1118.1
  - Useful at landfills with low methane content
  - Sources of NOx emissions, but coupled with NOx control technologies, they can achieve between 4 – 5 ppm NOx
  - Achieve 15 – 30% electrical efficiency
  - Portable equipment available

Energy Generation – Technologies (con't)

- Fuel Cells
  - High electrical efficiency (30 – 70%)
  - No NOx emissions
  - Utilize biogas (digester gas or LFG) or produced gas as the fuel
  - Requires gas clean-up, especially sensitive to siloxanes found in biogas
  - Technology and the associated gas clean-up is costly
  - Limitation for use at certain facilities, such as closed landfills with low methane concentrations
- Combined Heat and Power
  - Generates electricity through capturing the heat that would otherwise be wasted to provide useful thermal energy, such as steam or hot water
    - Nearly two-thirds of the energy used by conventional electricity generation is wasted in the form of heat discharged to the environment
    - Extra electricity compared to the electricity generated by a gas turbine

Barriers to Energy Generation Alternatives

- High upfront cost of equipment
- Unfavorable utility rates for renewable energy technologies
- Environmental permitting requirements
- Lack of transmission infrastructure:
  - No access to ready or cost-effective access to transmission
  - No clear and coordinated planning and permitting processes
  - No clearly established utility regulations that encourage investments in transmission to be reimbursable

TRANSPORTATION FUEL

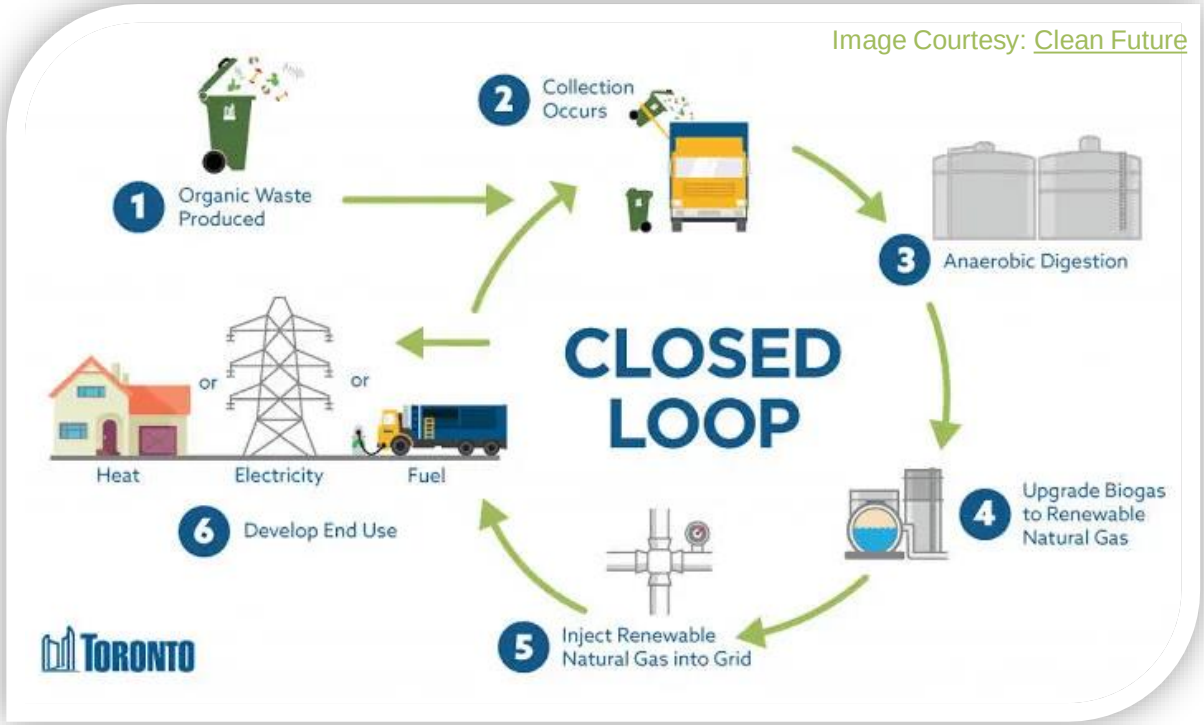
Alternatives

Transportation Fuel

Biogas can be upgraded to biomethane and be used for vehicle fuel applications as renewable compressed natural gas (R-CNG) or renewable liquid natural gas (R-LNG)

- Biogas includes LFG and digester gas
- Biomethane or renewable natural gas (RNG) can be used to generate electricity and recharge battery electric vehicles
- Reduce estimated emissions by 60-85% for NOx, 10-70% for CO, and 60-80% for particulates
- Non-methane VOC emissions and the ozone forming potential decrease by an estimated 50%

Image Courtesy: Clean Future



Transportation Fuel

- RNG is an attractive alternative to distribution of generated power
  - Simplifying local air permitting process due to air emissions being transferred to vehicles
  - Economical due to the established markets that provide greater incentives
- RNG production challenges include cleaning the raw biogas and upgrading it to biomethane
  - Moisture, siloxanes, and hydrogen sulfide must be cleaned from the biogas
- Another alternative process is gas-to-liquids that converts natural gas to liquid fuels such as gasoline, jet fuel, and diesel
  - Process involves gas clean-up to remove sulfur, water, and carbon dioxide to prevent catalyst contamination

Barriers to Use of Transportation Fuel

- Producer- and user-specific challenges can negatively influence the use of biomethane, biogas, and renewable gas as a transportation fuel:
  - Limited access to pipeline and transmission lines for distribution
  - RNG accessibility to vehicle fleets and heavy-duty trucks as end-users
  - Challenges of RNG to compete in the electricity market
  - Project costs and economies of scale

PIPELINE INJECTION

Alternatives

Pipeline Injection

- Another alternative use for biogas is to upgrade and inject into natural gas pipelines
  - Ideal in situations wherein the energy and fuel demand at the location of biogas production are either insignificant or are already met by a fraction of the available biogas
  - Takes advantage of the pre-existing network infrastructure
  - Ideally allows 100% of the biogas to be utilized
  - Allows for more efficient use of the biogas, compared to less efficient power generation at small-scale, on-site, and distributed facilities
- Raw biogas must be treated to be converted into renewable natural gas (RNG)
- RNG is a pipeline-quality gas that can be safely employed in any end use typically fueled by natural gas, including electricity production, heating and cooling, industrial applications, and transportation
  - Must have a methane content around 96-98% to be injected into a natural gas pipeline
  - Carbon dioxide, hydrogen sulfide, moisture, nitrogen, oxygen, and siloxanes must be removed

Barriers to Pipeline Injection

- High investment and operating costs
- Complicated regulatory hurdles (e.g., gas quality standards, gas testing and monitoring requirements, permits) required by government agencies and utility companies
- Limited capacity and/or access to local pipeline capacity, especially in more rural locations
  - Not all sites can feasibly participate in injection projects since some may not be close enough to gas transmission lines
  - Even if there is a pipeline close enough, it may not be able to handle the necessary throughput capacity for biogas injection

Incentives for Alternative Use of Flared Gas

- Market-based incentives are available to encourage the beneficial use of flared gas
  - Including digester gas from wastewater treatment plants and landfill gas, but not produced gas

Federal and State Market-Based Programs
California Air Resources Board (CARB) Low Carbon Fuel Standard (LCFS)
U.S. EPA Renewable Fuel Standard/Renewable Identification Numbers (RINs)
SoCalGas Biogas Conditioning/Upgrading Services (BCUS) Tariff Program
Advanced Transportation Tax Exclusion
California's Global Warming Solutions Act of 2006 (AB 32)
Senate Bill 100 – Zero Carbon Electricity by 2045
Executive Order B-55-18 Carbon Neutrality by 2045
World Bank Zero Routine Flaring by 2030 Initiative
Self-Generation Incentive Program (SGIP)
Senate Bill 1122 – Bioenergy Market Adjusting Tariff (BioMAT)

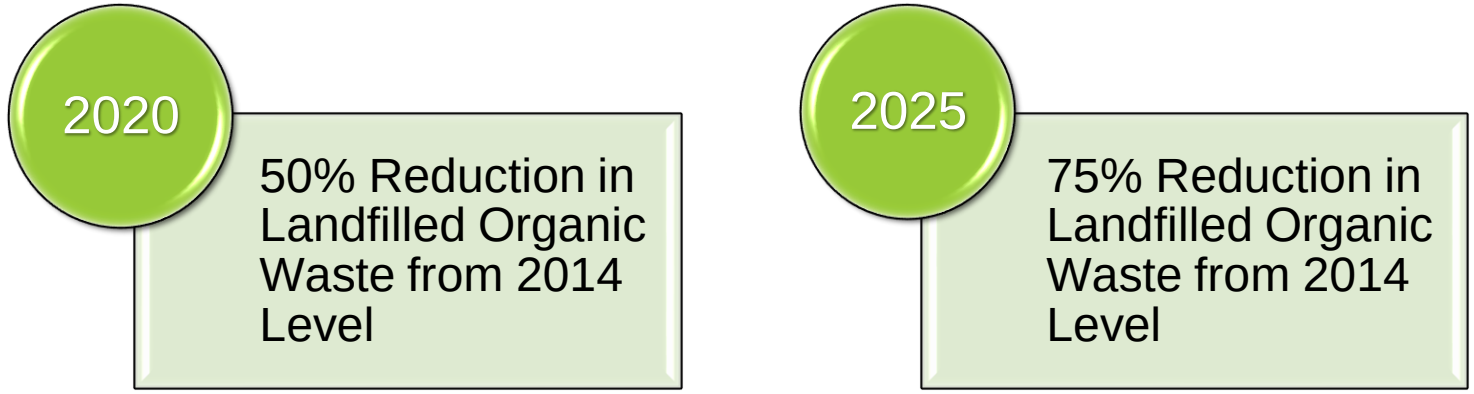
Image Courtesy: Skyline Energy

Food Waste Diversion

Technical Assessment

Background on SB 1383

- SB 1383 establishes targets for reducing organic waste in landfills to achieve methane emission reductions and increase sustainable production and use of renewable gas



- During rule development, data was presented indicating there may be an increase in ammonia and NOx emissions from food waste digestion
- Available data showed no adverse NOx or ammonia impacts by South Coast AQMD facilities conducting food waste digestion
  - Not many studies are conducted on NOx impacts from food waste

BACT Technical Assessment for Flares Receiving Biogas Derived from Organic Waste Digestion

Governing Board resolution directed staff to conduct a technical assessment of BACT for flares receiving biogas derived from advanced digestion and/or organic waste digestion or co-digestion

- Staff reported to Stationary Source Committee 12 months after rule adoption

Staff will continue to monitor new and existing food waste digestion and co-digestion projects

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Question & Discussion