

RNG WORKS



Lowering Your Carbon Intensity Score

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OVERVIEW

- ▶ What Makes Up Your Carbon Intensity
- ▶ Importance of Electricity
- ▶ Ways to Reduce Your Carbon Intensity

What Makes Up Your Carbon Intensity

Landfills/WWTP

- ▶ Electricity Consumption for Upgrading
- ▶ Natural Gas/Propane for Flare/TOX pilot
- ▶ Methane Fugitives (required 1%)
- ▶ Pipeline Transport
- ▶ Compression/Liquefaction

Animal Manure

- ▶ Electricity Consumption for Digester and Upgrading
- ▶ Natural Gas/Propane for digester heating and Flare/TOX pilot
- ▶ Methane Fugitives (required 2%)
- ▶ Pipeline Transport
- ▶ Compression/Liquefaction

- ▶ Credit for reducing baseline methane

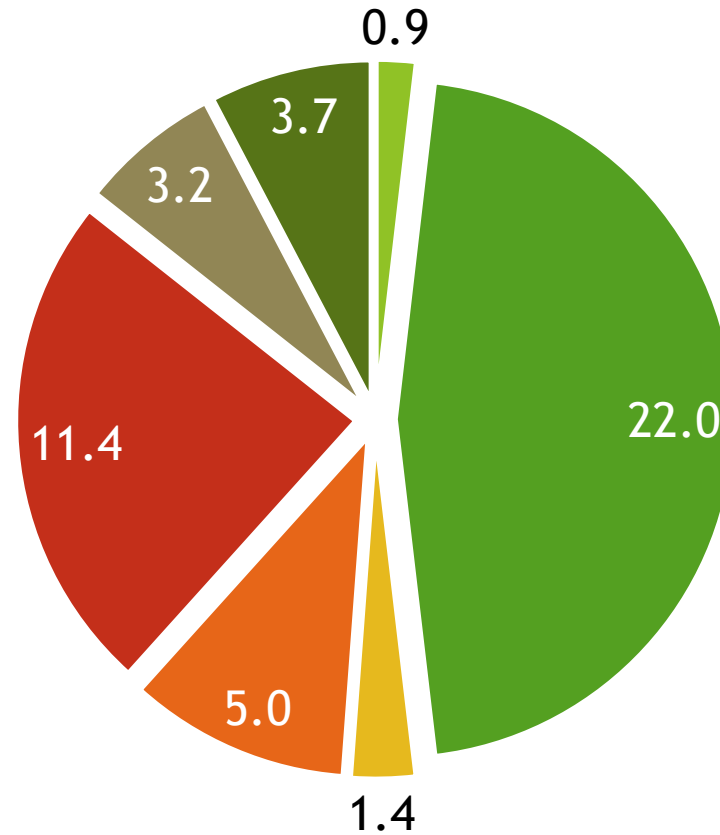
Organic Waste

- ▶ Electricity Consumption for Digester and Upgrading
- ▶ Natural Gas/Propane for digester heating and Flare/TOX pilot
- ▶ Methane Fugitives (required 2%)
- ▶ Pipeline Transport
- ▶ Compression/Liquefaction

- ▶ Potential credit for landfill diversion

Landfills/WWTPs

- ▶ Electricity and pipeline transport make up a significant portion of the landfill/WWTP RNG carbon intensity
- ▶ Landfill/WWTPs facilities located closer to California and located in regions with lower electricity emissions will have lower carbon intensities

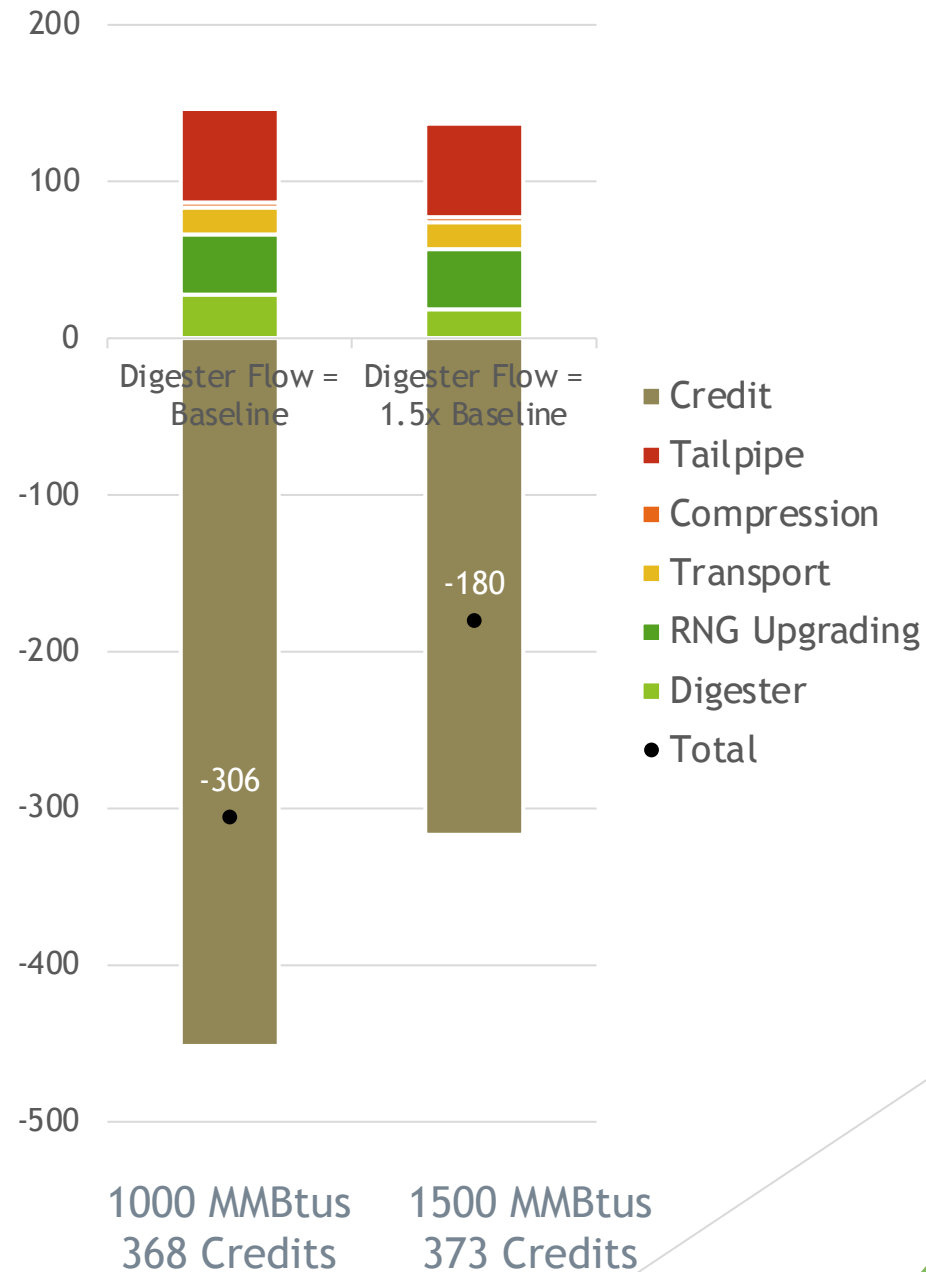


- Biogas Extraction
- Electricity
- Natural Gas
- Fugitives
- Pipeline Transport
- Compression
- Tailpipe

Based on a landfill using 30 kWh/MMBtu product; located in MROW Region; 2,000 mile pipeline distance using the new LFG Tier 1 Calculator; Total CI - 47.63

Animal Manure

- ▶ The main emissions contributor to the carbon intensity is digester operations (mostly NG) and gas upgrading (mostly electricity)
- ▶ Credit is given for methane offsets
- ▶ The total methane offset is based on cow/swine counts and baseline manure management practices
- ▶ The carbon intensity varies with gas production but overall LCFS credit generation remains relatively constant

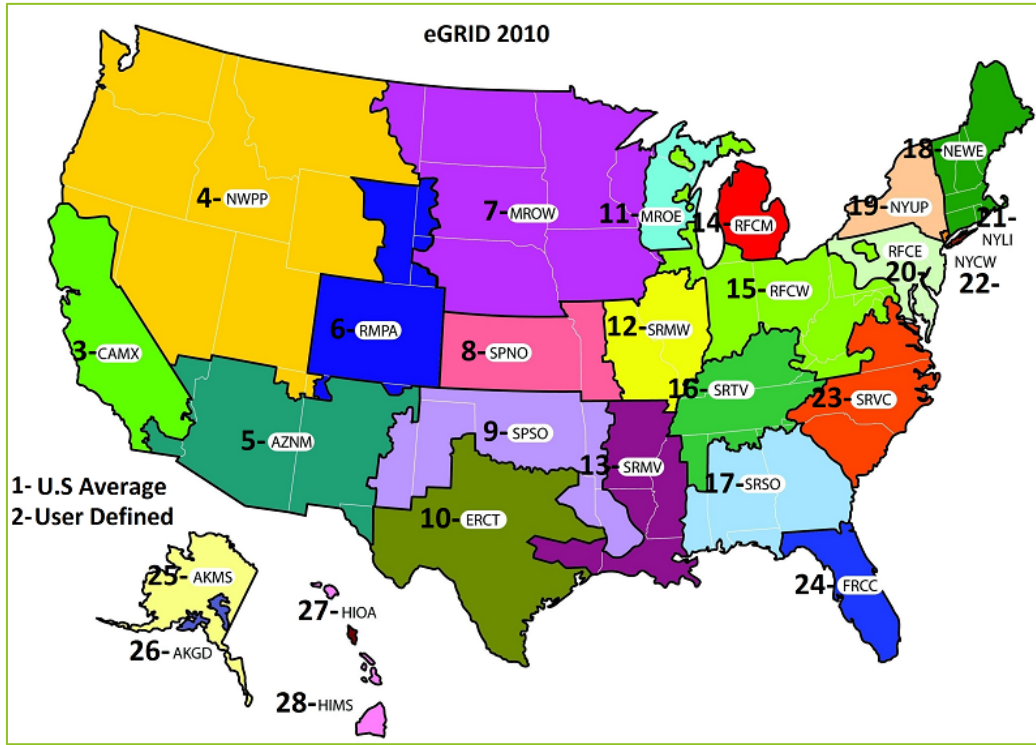


Organic Waste

- ▶ The carbon intensity for organic wastes is highly dependent on whether the feedstock can be classified as “landfill diverted”
 - ▶ ARB Defined “Food Scraps” - the portion of municipal solid waste (MSW) (including intentionally separated from MSW, or separately collected) that consists of wastes derived from plants or animals for the explicit preparation or consumption of food for human and animals
 - ▶ ARB Defined “Urban Landscaping Waste” - portion of MSW (including intentionally separated from MSW, or separately collected) that consists of materials resulting from any public or private landscaping activities such as leaves, grass clippings, plants, prunings, shrubs, branches and stumps
- ▶ The credit given varies by feedstock and resulting credit in g/MJ is dependent on the efficiency of gas production in the digester
- ▶ Without the credit, organic waste pathways will have carbon intensities similar to, or exceeding, landfills

Importance of Electricity

- ▶ The impact on the carbon intensity from electricity generation is dependent on where the RNG facility is located. CARB uses the eGRID regions developed by EPA. The LCFS calculators and GREET3.0 use 2014 data (eGRID2014v2).



eGRID Region	States/ US Region	Emissions from Electricity (gCO ₂ e/ kWh)
NEWE	New England	356
CAMX	California	370
NWPP	Pacific Northwest	477
US Average		610
ERCT	Texas	639
MROW	Northern Plains	684
MROE	Wisconsin	892
SRMW	Missouri/ Illinois	924

Ways to Reduce Your Carbon Intensity - Energy Efficiency

- ▶ Reducing energy consumption relative to gas production
 - ▶ This includes both electricity and natural gas
 - ▶ Focus on energy efficient gas upgrading systems
- ▶ Understanding the relationship between gas production, credits and resulting carbon intensity
 - ▶ If the goal is the lowest possible carbon intensity
 - ▶ For animal manure projects this is when baseline emissions are equal to the methane production by the digester
 - ▶ For organic waste projects there is no minimum, but producing less methane in the digester does impact overall credit generation; the current version of the ARB calculator incentivizes maximizing gas production for overall credit generation
 - ▶ Choosing to minimize your carbon intensity for animal manure and organic waste projects would be at the expense of additional gas production and RIN generation
 - ▶ Using a portion of raw biogas for onsite energy use to reduce the need for fossil natural gas and not reduce overall credit

Renewable Energy Use

- ▶ Use of renewable energy sources such as renewable electricity will reduce the carbon intensity of the fuel
 - ▶ For RNG projects, renewable electricity needs to be produced behind the meter and directly reduce grid purchases of electricity
 - ▶ Green tariff programs, RECs or other purchasing agreements are not allowed for “process energy”
- ▶ Solar is a great opportunity to reduce the carbon intensity for RNG facilities
 - ▶ The carbon reductions from solar are valued at LCFS credit prices since the reductions are directly translated into additional LCFS credits

eGRID Region	States/ US Region	Emissions from Electricity (gCO ₂ e/kWh)	\$/kWh (@\$180/credit)
NEWE	New England	356	\$0.064
CAMX	California	370	\$0.066
NWPP	Pacific Northwest	477	\$0.084
ERCT	Texas	639	\$0.115
MROW	Northern Plains	684	\$0.123
MROE	Wisconsin	892	\$0.161
SRMW	Missouri/ Illinois	924	\$0.166

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