Cost-Effective Utilization of Biogas

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AAEES Workshop – Energy Management for Water and Resource Recovery Facilities
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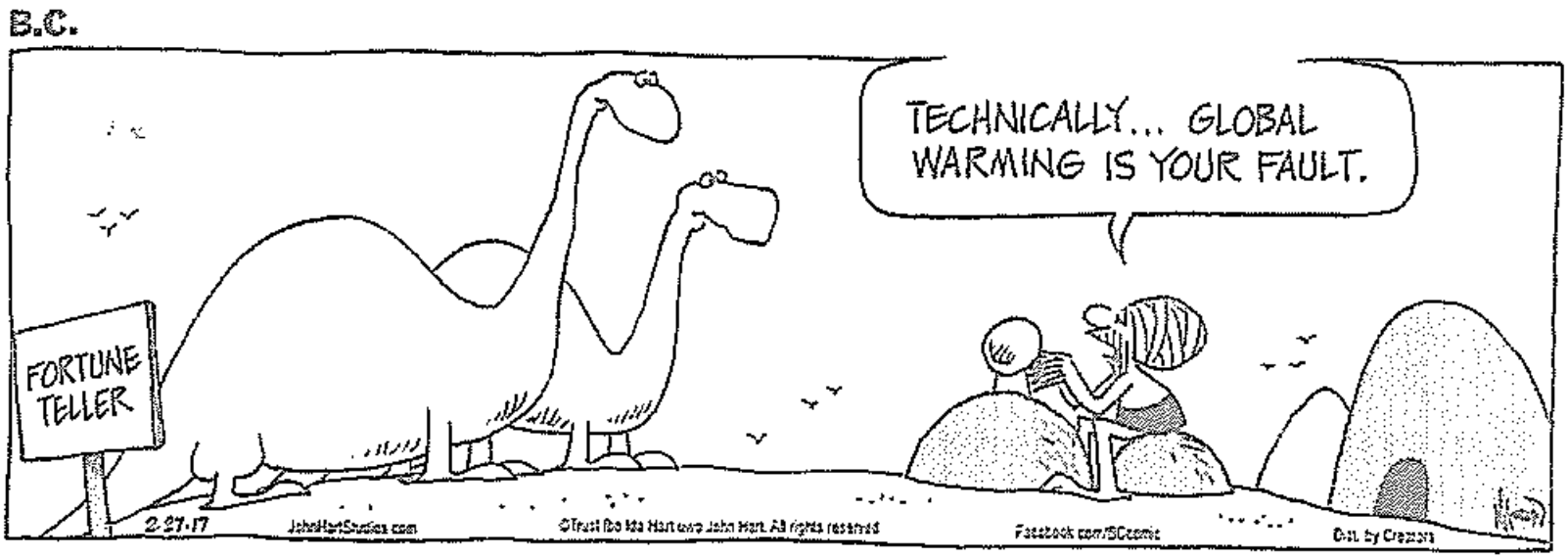
Energy Efficiency First!

- **Energy Audits Lower Your Operating Costs**

- **Most Cost-Effective Energy Services Option**

Why Do an Energy Recovery Project

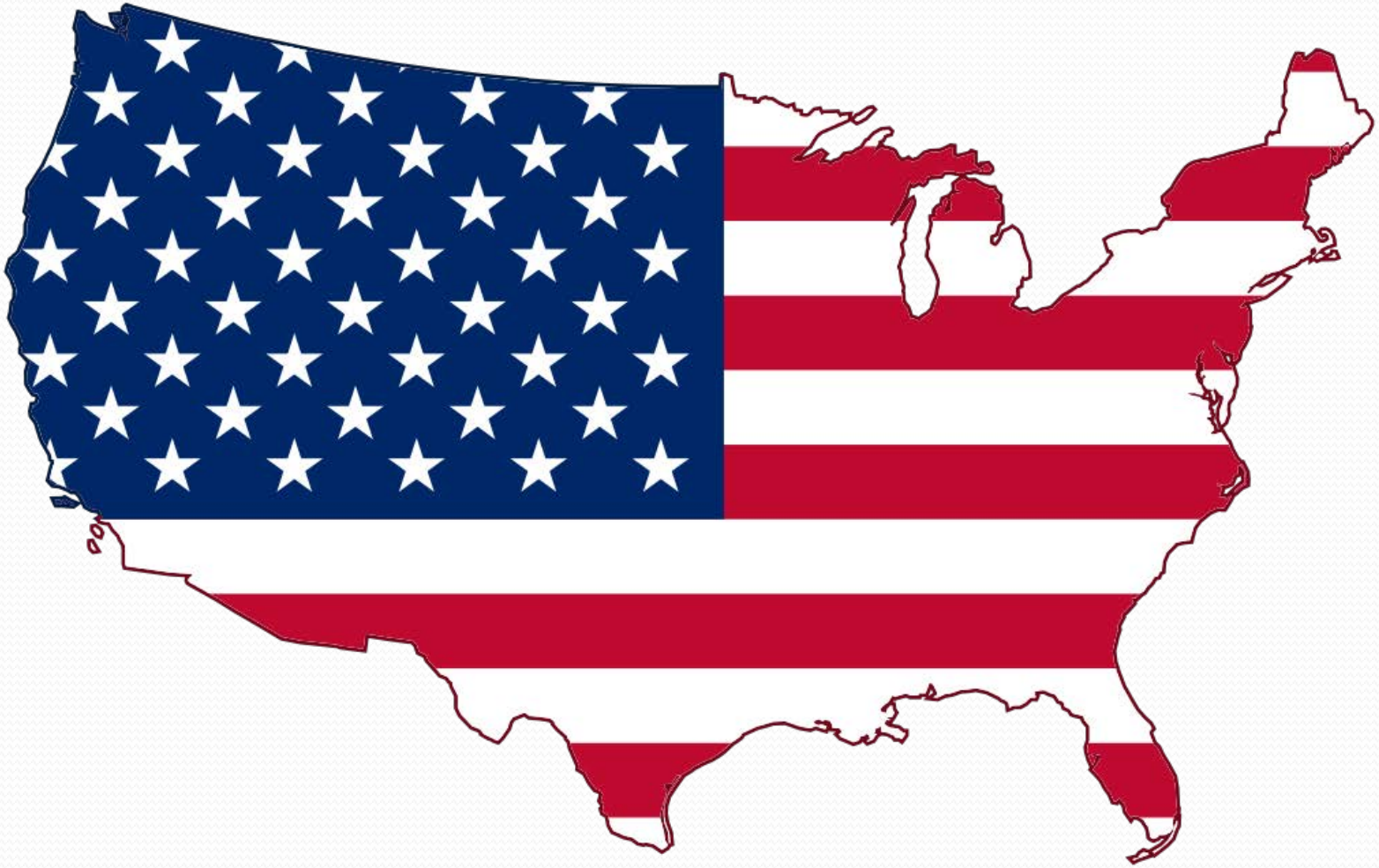
GHG


B.C.
TECHNICALLY... GLOBAL WARMING IS YOUR FAULT.
FORTUNE TELLER
2-27-17

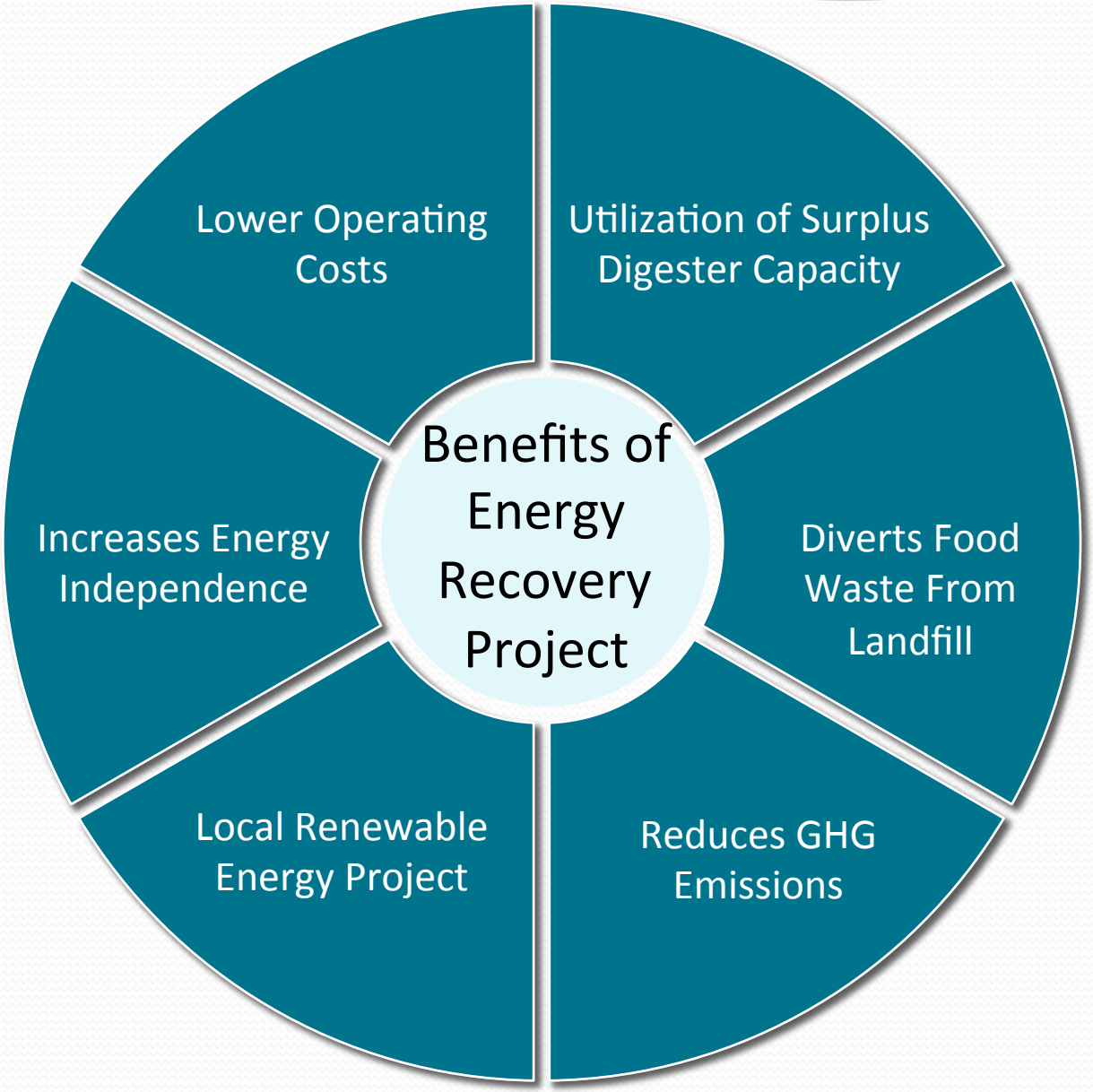
Go Green with Renewables!

Divert Food Waste From Landfills

Energy Independence



Utilize Surplus Digester Gas


Benefits of Energy Recovery Project
Lower Operating Costs
Utilization of Surplus Digester Capacity
Diverts Food Waste From Landfill
Reduces GHG Emissions
Local Renewable Energy Project
Increases Energy Independence

Energy Recovery Alternatives

1. Flaring (do nothing)
2. Heating
3. Electricity
4. CNG (vehicles)
5. RNG (pipeline)

Flaring and Heating

- Excess gas is flared
- Boiler for heating
- No gas treatment

Energy Recovery Projects

K/J Has Investigated 34 Projects

Electricity

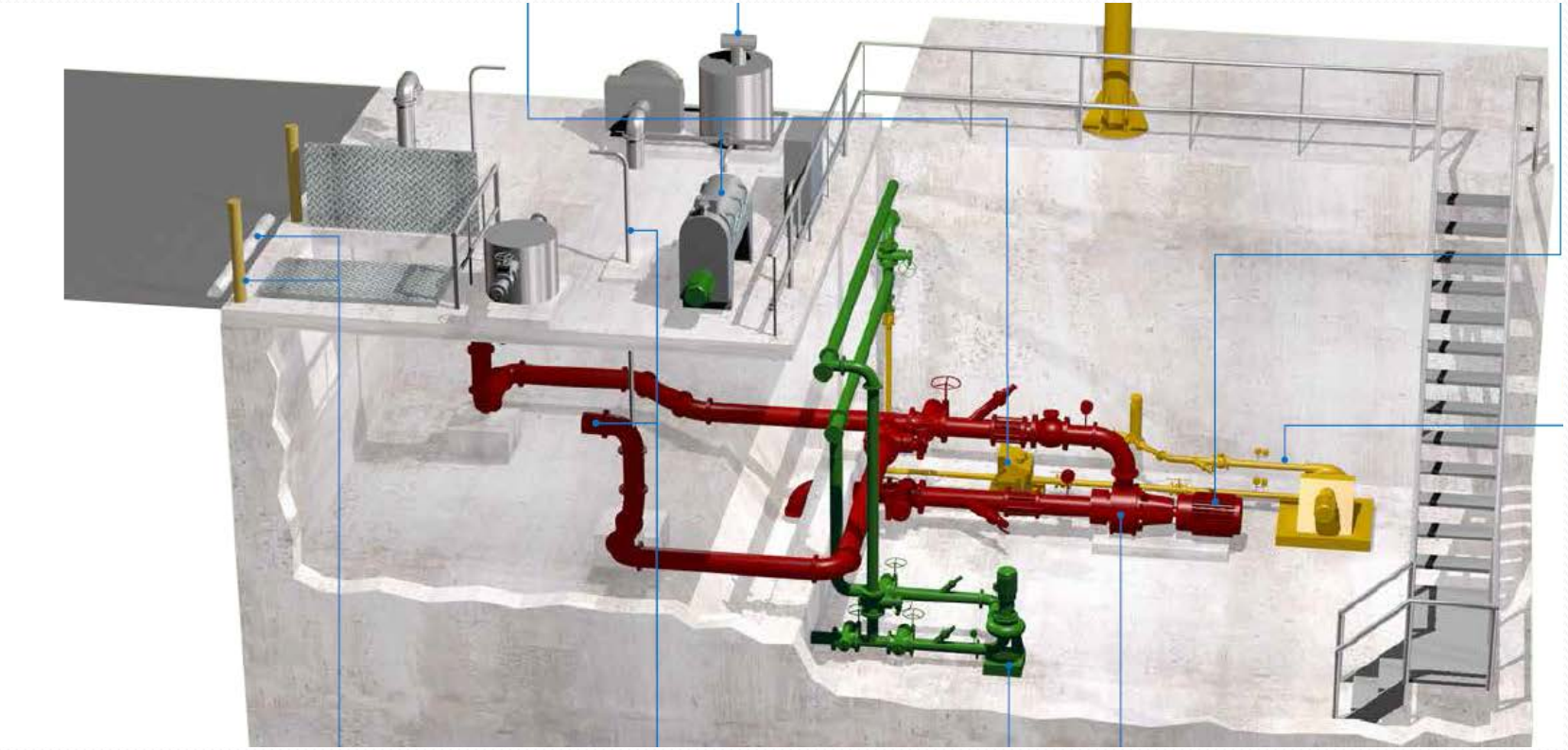
Food Waste Load for Processing

Food Waste Load

Food Waste Load

FOG & Food Waste Facility

Food Waste System Schematic



Digestion - Anaerobic Digesters

Gas Treatment

West Lafayette, IN

Electricity Generation

Microturbines

Electricity Incentives

- NJ Combined Heat & Power (CHP) Program
  - FCFS, $49M budget, $5.5M left
  - $/KW depending on size, capped at 30% of project costs, no project size limit
  - 30/50/20 Incentive Payment Structure
- Net Metering
  - Retail rate
  - Project size limited to on-site use
- RECs

BioCNG™ Vehicle Fueling System Process Flow Diagram

Digester or Landfill → BioCNG™ Gas Conditioning System → CNG Vehicle Fueling Station → CNG Vehicles

BioCNG™ Gas Conditioning System → Microturbines; IC Engines; Boilers

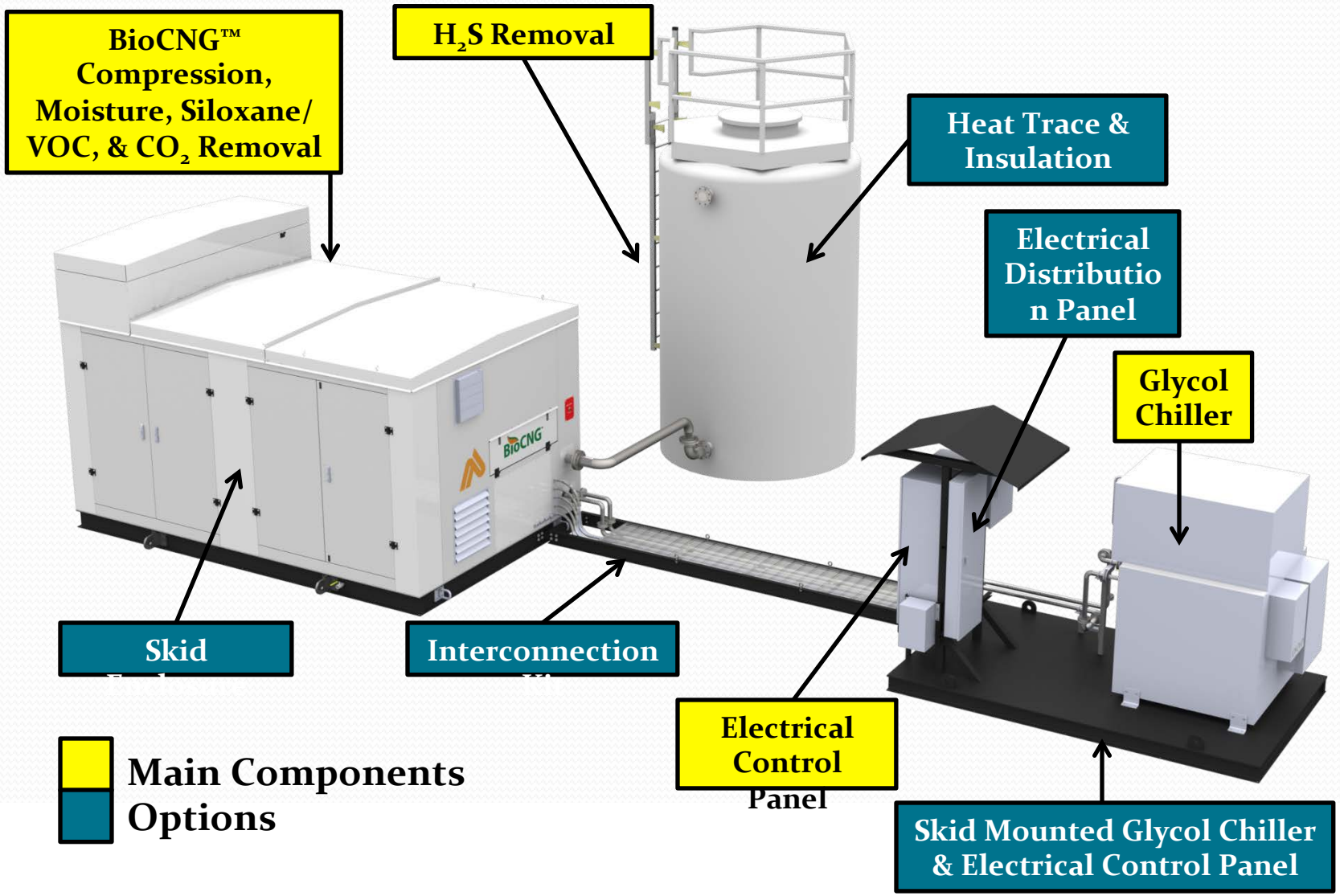
Potential Energy Produced

Vehicle Fuel

Electricity

Heat

BioCNG™ System



San Mateo Gas Treatment Equipment

San Mateo Vehicle Fuel Equipment

San Mateo Vehicle Fueling Station

CNG Vehicles

COURTESY: FORD

CNG Storage

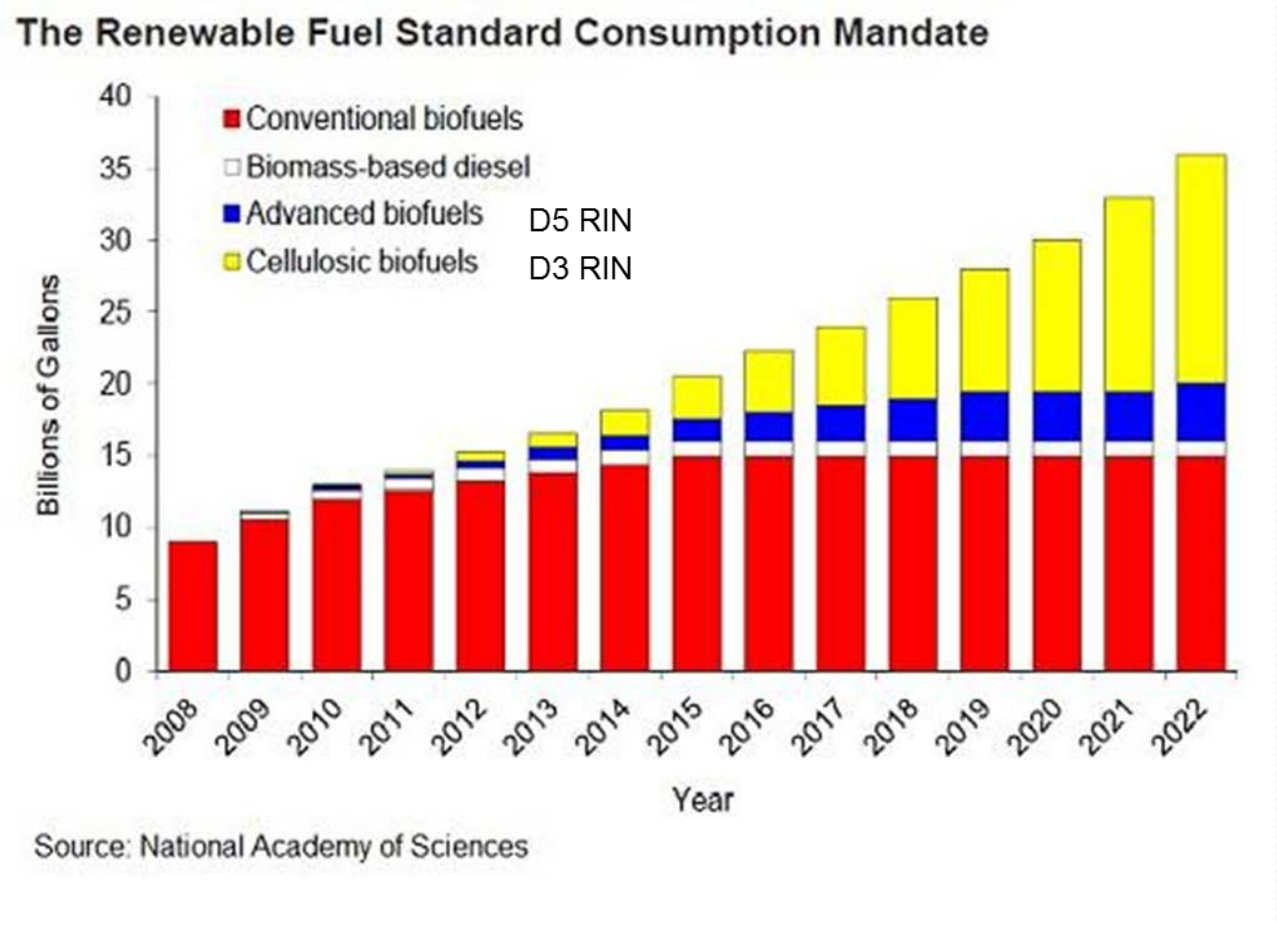
CNG/RNG Incentives

- RECs
- RINs
- Some states Low Carbon Fuel Standard or Clean Fuel Standard Credits

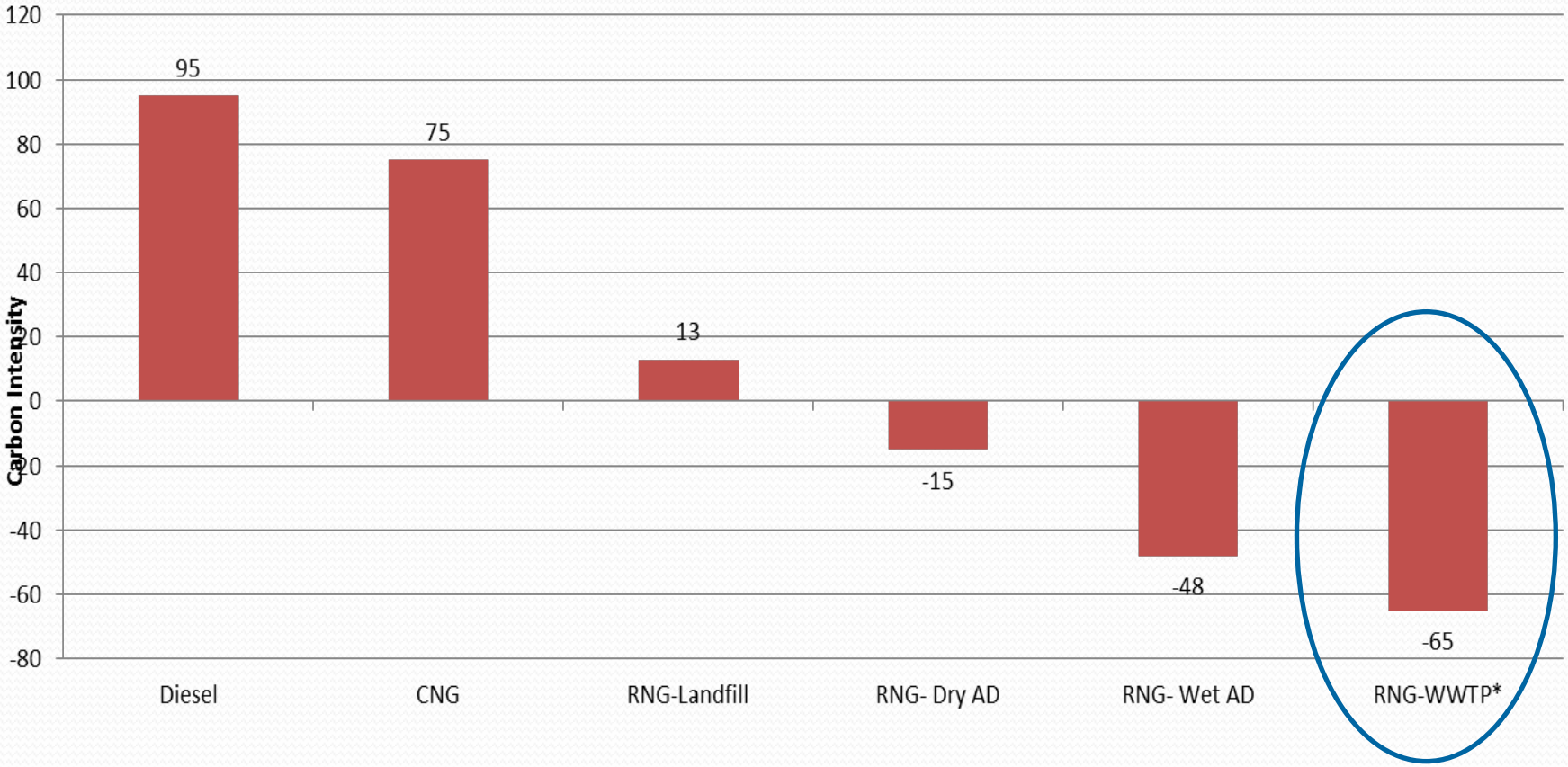
RIN Basic Information

- A Renewable Identification Number (or RIN)
- Assigned serial number for gallon of renewable fuel to track its production, use, and trading
- Federal Renewable Fuel Standard (RFS) until 2022
- Must be used as transportation fuel
- RIN agents or brokers

Federally Mandated RIN Volumes



Carbon Intensity for Fuels and Renewable Substitute (gCO2/MJ)



RIN Basics

- RIN value inversely related to price of gasoline and therefore constantly changing
- Current D3 RIN price: ~$1.80/RIN
- One GGE of RNG is worth 1.48RINs or $2.66
- 1 GGE = 126scf of NG or 250scf of Biogas
- CNG price ~$2.00-$2.50
- Applicable LCFS credits are in addition to RIN

Oregon Clean Fuels Credits

- **Reduces the Carbon Intensity (CI) of transportation fuels by 10% by 2025**
- **Credits for amount below CFS**
- **Clean Fuels Credit ~$50-$60/MTCO$_2$**

Energy Recovery Options

Electricity from IC Engines

- Medium ROR
- High Maintenance and O&M Attention
- Complex Controls, Prefer Constant Gas Supply
- Challenge To Meet Latest Air Emission Standards
- GHG Reductions

Electricity from Microturbines

- Medium ROR
- O&M Easy (contract)
- Easy to Use Electricity
- GHG Reductions

Energy Recovery Options

Vehicle Fuel-Used by Owner CNG

- Owner production and use
- Gas Treatment, Storage, and Fueling Station
- Need CNG vehicles
- High ROR
- Highest value on RIN credits (up to $2/GGE), need Broker
- GHG Reductions
- Clean Fuels Credit (if applicable)

Vehicle Fuel-Used by Others RNG

- Add RNG to pipeline
- Sell RNG to others, need contracts to wheel
- Gas Treatment
- High ROR
- High value of RIN credits (up to $1.50/GGE), need Broker
- GHG Reductions
- Clean Fuels Credit (if applicable)

WTE Model

- Gas Production
- Waste Receiving Equipment Cost
- Generation Equipment Cost
- Generation Equipment Database
- Incentives
- Incentives Database
- Cost-Effectiveness Analysis
- Inputs & Outputs

Energy Recovery Comparison

	Electricity	CNG	RNG
	Cogen	Vehicle Fuel	Pipeline
Complexity	High	Medium	Low
O&M Burden	High	Medium	Medium
End Use	Easy	Medium	Easy
GHG Reductions	Med to High	High	High
ROR	Medium	High	High

Financial Comparison of Options

Alternative	Project Cost	Annual Benefit	Annual O&M Costs	Net Annual Savings
Cogen IC	$7.13	$0.76	$0.70	$0.06
Cogen MT	$10.0	$0.75	$0.66	$0.09
RNG to CNG	$9.8	$1.92	$0.68	$1.24
RNG-Pipe Inj.	$6.9	$1.20	$0.57	$0.63
Heat/Flare	$0.58	$0.24	$0.15	$0.10

Millions of $

Cost-Effective Utilization of Biogas

Thanks for your time!

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