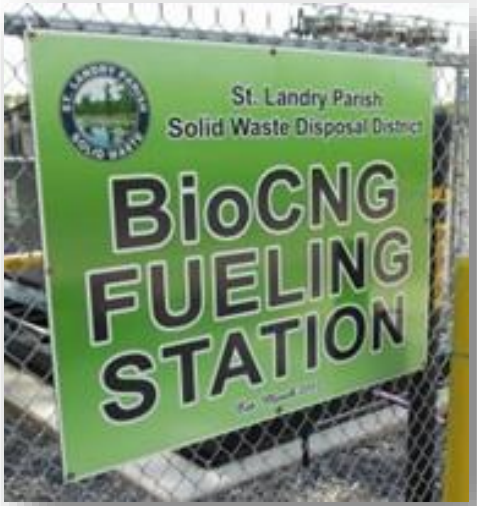
Digester Biogas to CNG Opportunities



Presentation to NACWA Climate & Energy Committee
Chris Voell, Eastern Sales Manager
BioCNG, LLC

BioCNG™

The CNG Revolution has begun!

- CNG (compressed natural gas)
- 15,000,000 NGVs running worldwide
- Fleets (especially refuse) are converting to CNG for cost savings and environmental sustainability.
  - Vehicle emissions contribute to air pollution, climate change, and health concerns.
- Citizens want energy security and independence.
- Vast majority of CNG to date has come from fossil sources.

A new opportunity is before us – biogas to CNG!

Why Biogas-CNG?

- "…renewable natural gas and fossil gas are the only vehicle fuels that can displace significant amounts of oil while safeguarding U.S. national security and strengthening the economy."
- "The U.S. economy is sapped of almost $845 million a day that is sent abroad to buy 45% of the oil to meet our needs. Some $110 million of this goes daily for the oil needed in diesel production."
  - Fluctuating price destabilizes U.S. economy and upsets local community budgets
- "The 10 million trucks and buses on U.S. roadways provide essential services to every American community, and they transport goods worth nearly 70% of the GDP."
  - Buses and trucks make up just 4% of all vehicles, but they use 23% of all highway fuel – almost entirely high-carbon diesel from foreign oil.

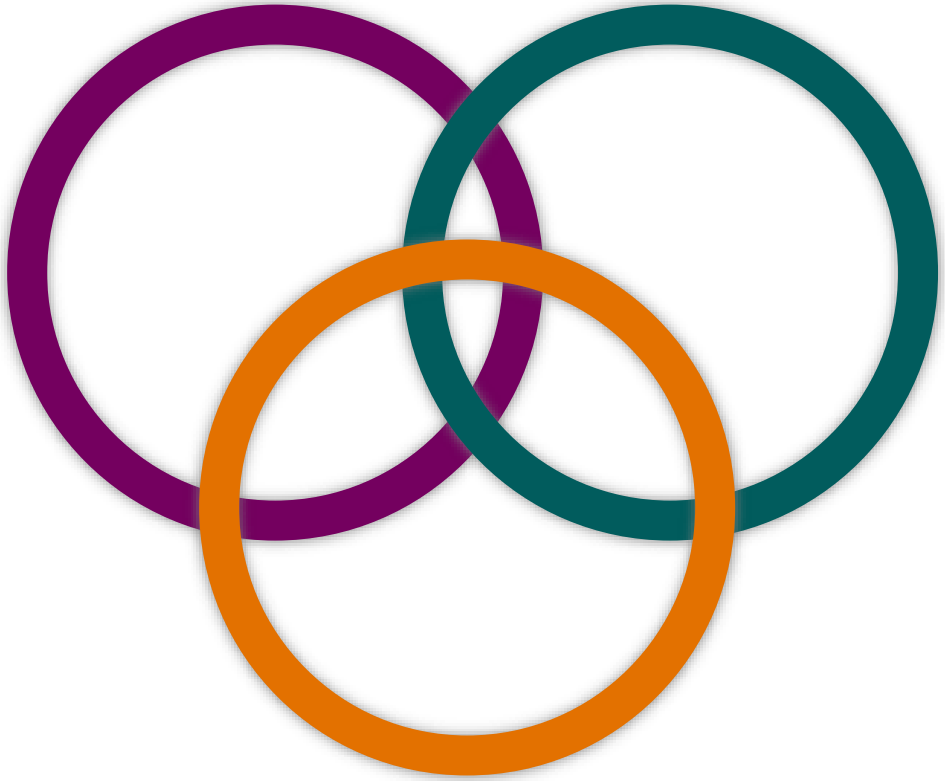
Renewable Natural Gas (RNG) *- The Solution to a Major Transportation Challenge A Clean, Secure, Commercially Viable Replacement for Diesel Fuel Today"*(Energy Vision, 2012)

Biogas-CNG Benefits

- Significant **savings** over gasoline and diesel
  - 50-75% savings over current gas/diesel cost
  - Cost-competitive to fossil-based CNG
- Local, **green**, renewable fuel source
  - Up to 90% GHG reductions v. gas and diesel
  - Renewable fuel and GHG credits
- **Control** your future!
  - Cost locked in for 15-20 years
  - Hedge against rising NG prices

Successful Projects

Biogas Source



Vehicle Fuel Demand

Project Enabler/ Developer

The Biogas Resource

(Energy Vision 2012)

Wastes

All organic wastes contain energy.

Biogas

Anaerobic digestion of wastes at landfills or in digester plants produces energy-rich biogas.

RNG Fuel

Biogas upgrading removes carbon dioxide & impurities to make ***renewable natural gas*** (RNG).

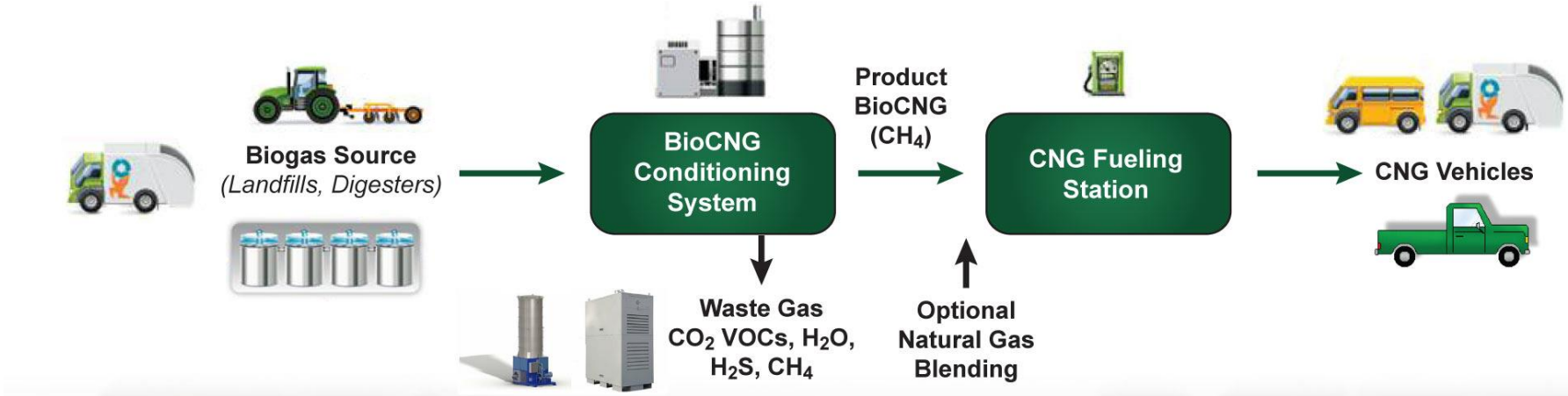
Fuel Stations

RNG goes to on-site fueling stations, or by truck or pipeline to off-site pumps.

Vehicles

RNG works just like regular natural gas to power vehicles.

***Figure 2*. The Pathway from Organic Waste to RNG**


Biogas Source
(Landfills, Digesters)
BioCNG Conditioning System
Product BioCNG (CH_4)
CNG Fueling Station
CNG Vehicles
Waste Gas CO_2 VOCs, H_2O, H_2S, CH_4
Optional Natural Gas Blending

Trucks & Buses Shifting To CNG: Cleaner, Quieter & Cheaper Fuel

Fleets, Communities & Drivers Love Them

Primary Targets for CNG Vehicles

- Trash, recycling, cement and other vocational work trucks
- Transit buses/shuttle buses/school buses
- Major metro fleet management and public works departments
- Heavy-duty freight trucks
- Medium-duty delivery and commercial service trucks
- Taxis and light-duty service vehicles

The more fuel used – the quicker the payback

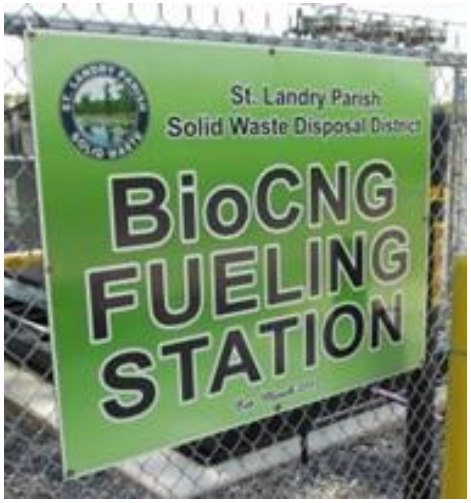
Why BioCNG?

- Use otherwise wasted biogas
- Opens up opportunities where they didn't exist before
  - WWTP, manure and organics digesters, smaller landfills
  - Excess biogas at larger sites
- Incentives for renewable electricity are disappearing in many places
- Growing desire for local and national energy independence and control

It's affordable now!

BioCNG Benefits

- Local, green energy source - < air pollution.
- Cost competitive to NG-CNG at today's prices.
- Renewable fuel credits available (RINs).
- Hedge against potentially rising NG costs.
- Book fuel cost for 15-20 years.
- GHG reductions – up to 90%.



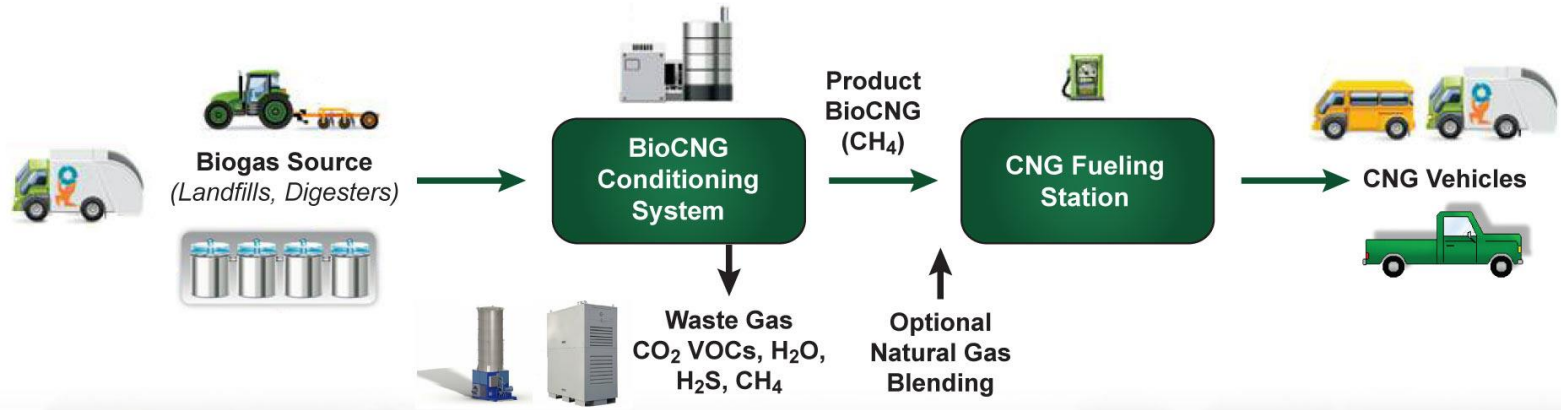
BioCNG Market Potential

- Current Nationwide Biogas Sources
  - 2,000 WWTP digesters (unused biogas)
    - Excess digester capacity as well
  - 195 manure/organics-based digesters
    - At least 8,000 opportunities (new source of biogas)
  - 600 operating LFG energy projects (excess biogas) – electric contracts expiring
  - 500+ landfills flaring gas
- Hundreds of billions of cubic feet of biogas wasted every year.

“Utility of the Future”

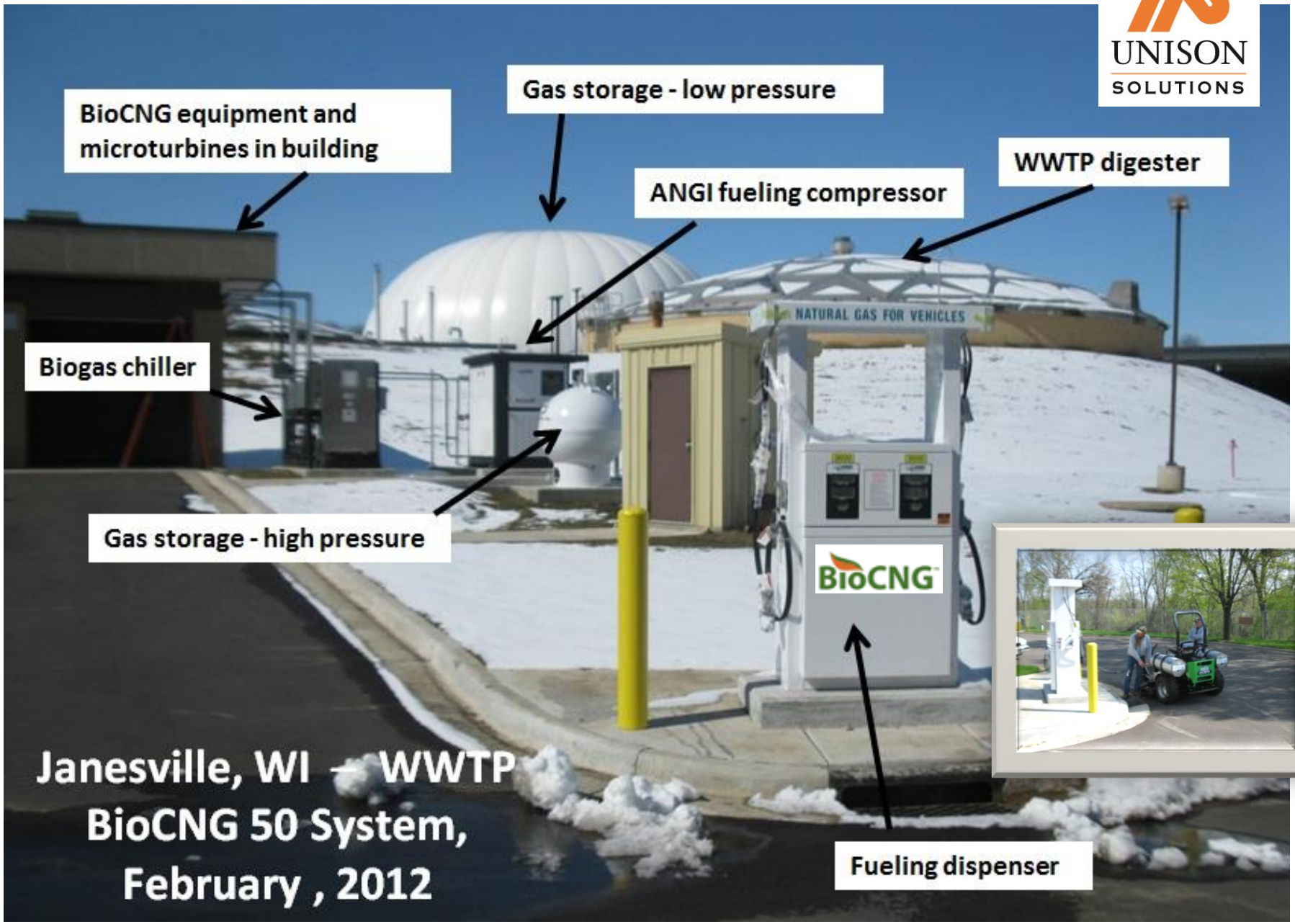
- Triple Bottom Line of BioCNG
  - Social: enhance energy independence by reducing reliance on petroleum
  - Environmental: 90% reduction in GHGs v. diesel
  - Economic: vehicle fuel at 25-50% the cost of gas/diesel
- Upgraded biogas can provide a versatile energy source:
  - Vehicle fuel – replacing gasoline and diesel for POTW and other fleets
  - Electricity production – lower CapX and O&M costs
  - Thermal energy – offsetting NG and propane needs
  - Long-term hedge on energy costs

Upgrade and Fueling System



St. Landry Parish Landfill, Louisiana

(*currently a BioCNG50 – plans to add BioCNG 200)


UNISON
SOLUTIONS
BioCNG equipment and microturbines in building
Gas storage - low pressure
ANGI fueling compressor
WWTP digester
Biogas chiller
Gas storage - high pressure
NATURAL GAS FOR VEHICLES
BioCNG
Fueling dispenser
Janesville, WI – WWTP
BioCNG 50 System,
February , 2012

Janesville, WI

BioCNG Vehicle Fuel Project Fact Sheet

Biogas Source	WWTP digester
Size *(MGD)*	18 MGD
Gas Collected *(entire site)*	200 scfm
Gas Quality	Methane (CH_4) - 62%
Flare	Available
Other Gas Use	Combined heat and power with micro turbines
Available Gas for CNG	50 scfm
Size of BioCNG Unit	BioCNG 50
Components	H_2S removal, chilling, VOC/Siloxane removal, CO_2 removal; (4) 48" inflatable gas storage spheres
Fueling Unit	ANGI fast fueling station
Start-up Date	February 2011
Fuel Production (GGE)	Up to 275 GGE/day
Waste Gases	Routed to turbines for destruction
Back Up For CNG Fueling	NG backup through the use of a manual three-way valve
Fleet Size/Type	Vehicles on order
Outside Users	None at this time
Performance Issues	None

BioCNG System Sizing

- Pre-engineered, skid-mounted
- Multiple modules
- Customization for larger systems

System Size	Biogas Inlet Flow (scfm)	Fuel Production (GGE/day)	Fleet Size Per Unit	
			Light duty	Heavy duty
BioCNG 50	50	200-275	20-27	2-4
BioCNG 100	100	375-550	38-55	5-8
BioCNG 200	200	775-1110	77-110	11-17

Sample - BioCNG 200 cfm

- **$0.66 DGE**
  - Includes RINs of $0.76 DGE
- 200 cfm digester gas (65% methane)
- BioCNG Production
  - ~1,100 diesel gallon equivalents (DGEs)/day (359,000 DGE/yr)
  - Enough fuel for 20-30 HDVs or 100-150 LDVs
- Total system CapX - ~$2,100,000
  - Includes BioCNG upgrade and fueling station engineering, permitting, installation, start up and training
  - 10 years, 3% interest

- Fuel Savings
  - Assuming savings of $2 gallon on gasoline/diesel costs
  - **~$720,000** in annual fuel savings
- Renewable Fuel Credits
  - Assuming $0.76 per DGE
  - **~$270,000** per year

<u>Additional Costs</u>

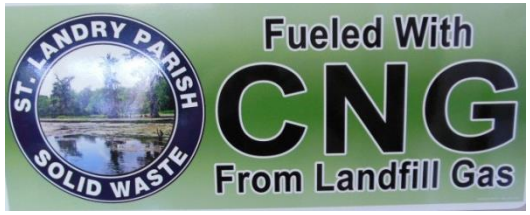
- New Vehicle Premium or Conversion
- Maintenance Facility Upgrade

Project Structures

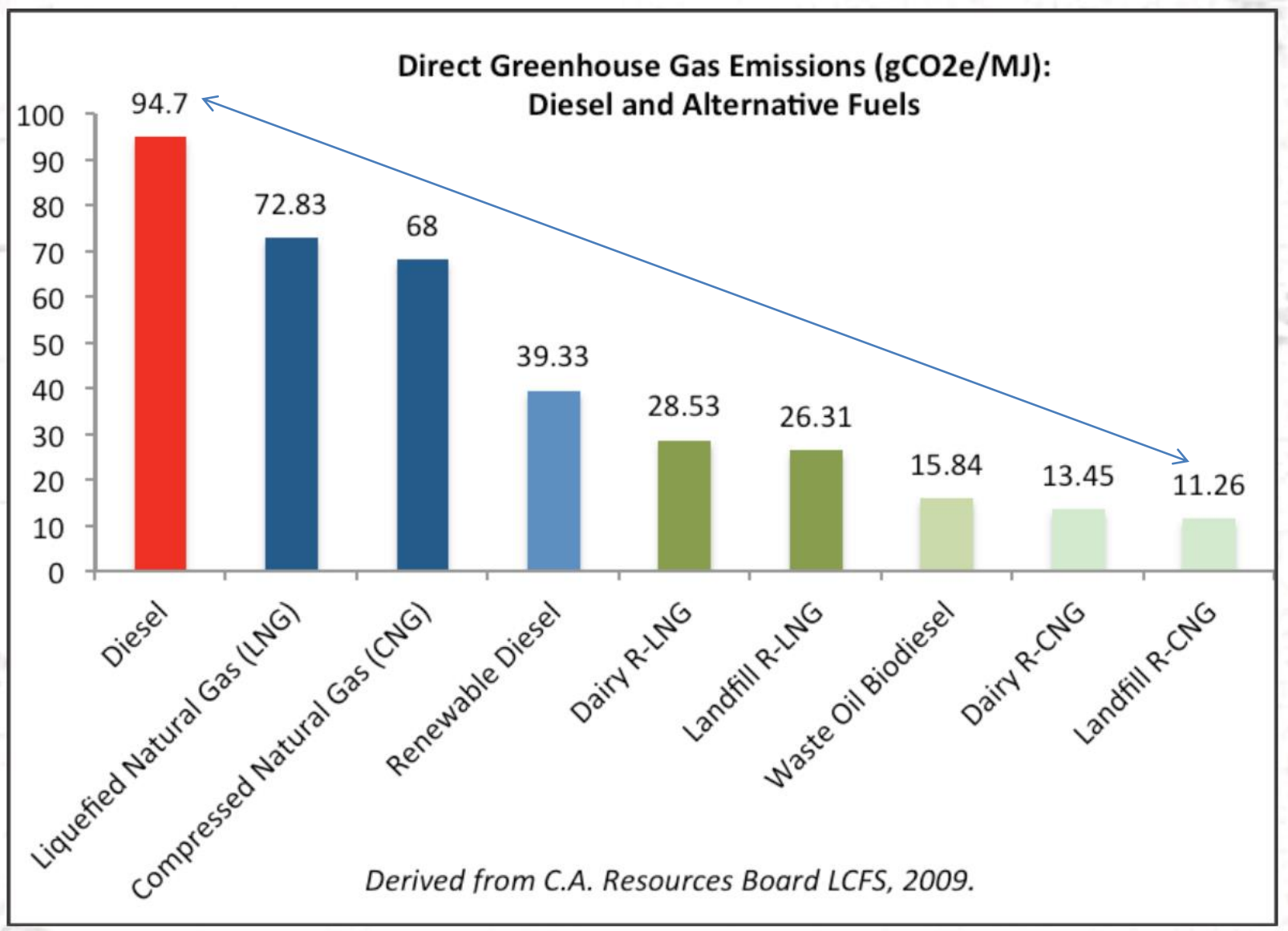
- Produce CNG on site:
  - Facility owner vehicles (heavy duty, medium, passenger)
  - Site users (biosolids haulers, organics haulers)
  - Soon - transfer trailers, over the road tractors, inter-modal
  - Public
- Produce upgraded biogas:
  - Fuel off site station (‘mother-daughter station’)
  - Sell upgraded biogas to end user
  - Fuel for CHP applications
  - Offset NG or propane use
  - Power advanced treatment, nutrient recovery

BioCNG™ Projects

- Dane County Landfill (WI)
  - Replaced BioCNG 25 with BioCNG 50
  - Currently fuel service vehicles and pick ups; plans to fuel packers and transfer trailers
- City of Janesville WWTP (WI) – BioCNG 50
- St. Landry Parish Landfill (LA)
  - Budgeting to add BioCNG 200 to existing BioCNG 50
- Sacramento Organics Digester (CA)
  - Currently installing BioCNG 100 (plans for expansion)
  - Will fuel collection fleet
- City of Riverview Landfill (MI)
  - BioCNG 100 in fabrication

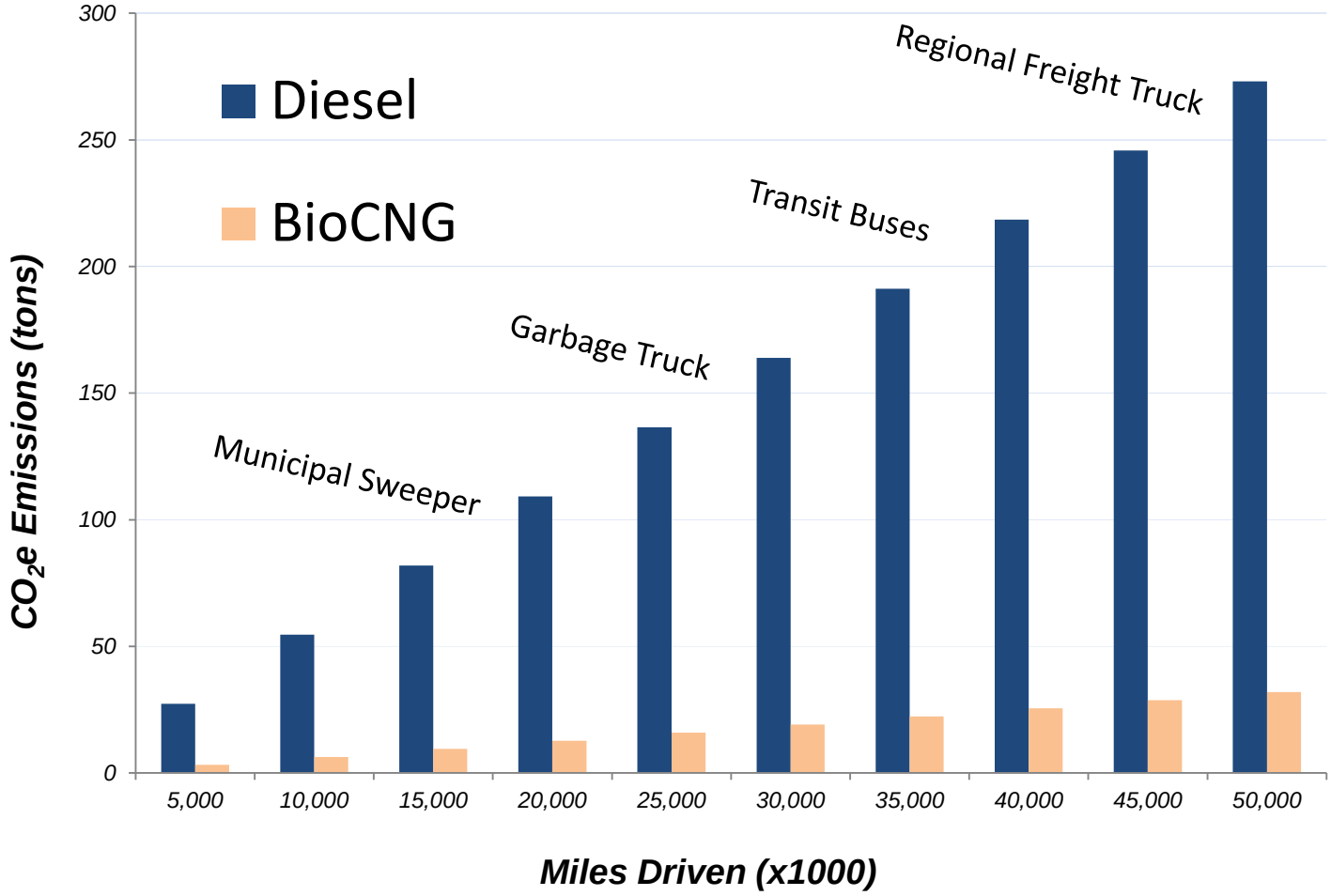


Environmental Benefit



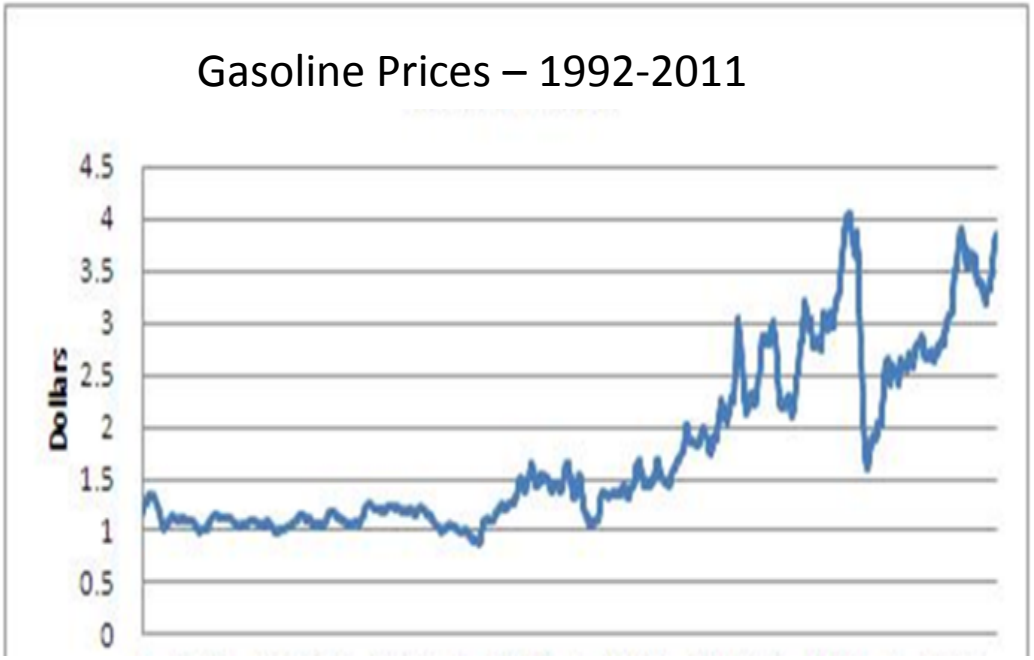
Bio-CNG v. Diesel Emission Reductions

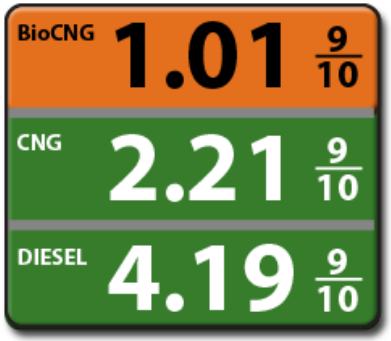
10 garbage trucks converted from diesel to Bio-CNG – reduce 1,000+ tons CO2e annually



Local Control of Fuel Cost

- If you could go back 20 years and lock down your fuel costs, wouldn't you?
  - 1992 - $1.25 gallon gasoline
  - August 2012 - $3.73 gallon gasoline
- Why not control the next 20!





Biogas-CNG Lessons Learned

- Trucks are quieter and cleaner – great customer service
- Smaller, modular systems allow for growth as:
  - Biogas increases; capital becomes available; fuel demand rises
- Fuel complies with CNG engine warranties
- Bio-CNG vehicle performance comparable to gasoline/diesel
- Biogas quality
  - Higher methane – more fuel
  - Biogas contaminants impact on operating costs - not fuel quality

Bio-CNG Summary

- Proven technology
- Lowest cost fuel and fixed long term
- Complies w/engine manufacturers warrantees
- Greenest fuel
- Can be feasible at small scale

www.biocng.us

Chris Voell, BioCNG

Chris.voell@biocng.us

845-695-0240

BioCNG

Vehicle fuel for a green future

Another innovative solution from CORNERSTONE Environmental Group, LLC