

Think Green.® Think Waste Management.



Collection



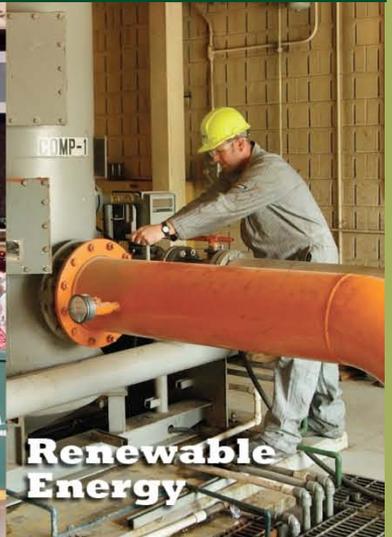
Transfer



Disposal



Recycling



Renewable Energy

LMOP Conference Waste To Wheels & California LCFS January 20, 2011 Baltimore, Maryland

Chuck White

Director of Regulatory Affairs/West

Waste Management



Today's Presentation

- Waste Management's Interest in Fuels
- Waste Management's Shift to Natural Gas
- Regulatory Drivers for Change
 - Focus on Low Carbon Fuel Standard
- Waste Management's Development of Renewable Natural Gas



Corporate Overview

- ❖ **Headquartered in Houston, Texas**
- ❖ **Operations in 48 states, District of Columbia, Canada and Puerto Rico**
- ❖ **Nearly 20 million customers**
- ❖ **Collect about 66 million tons of waste**
 - ❖ **~44 million tons organic waste**
 - ❖ **273 active landfills**
 - ❖ **Approximately 367 collection operations**
 - ❖ **103 recycling facilities**
- ❖ **More than 45,000 employees**



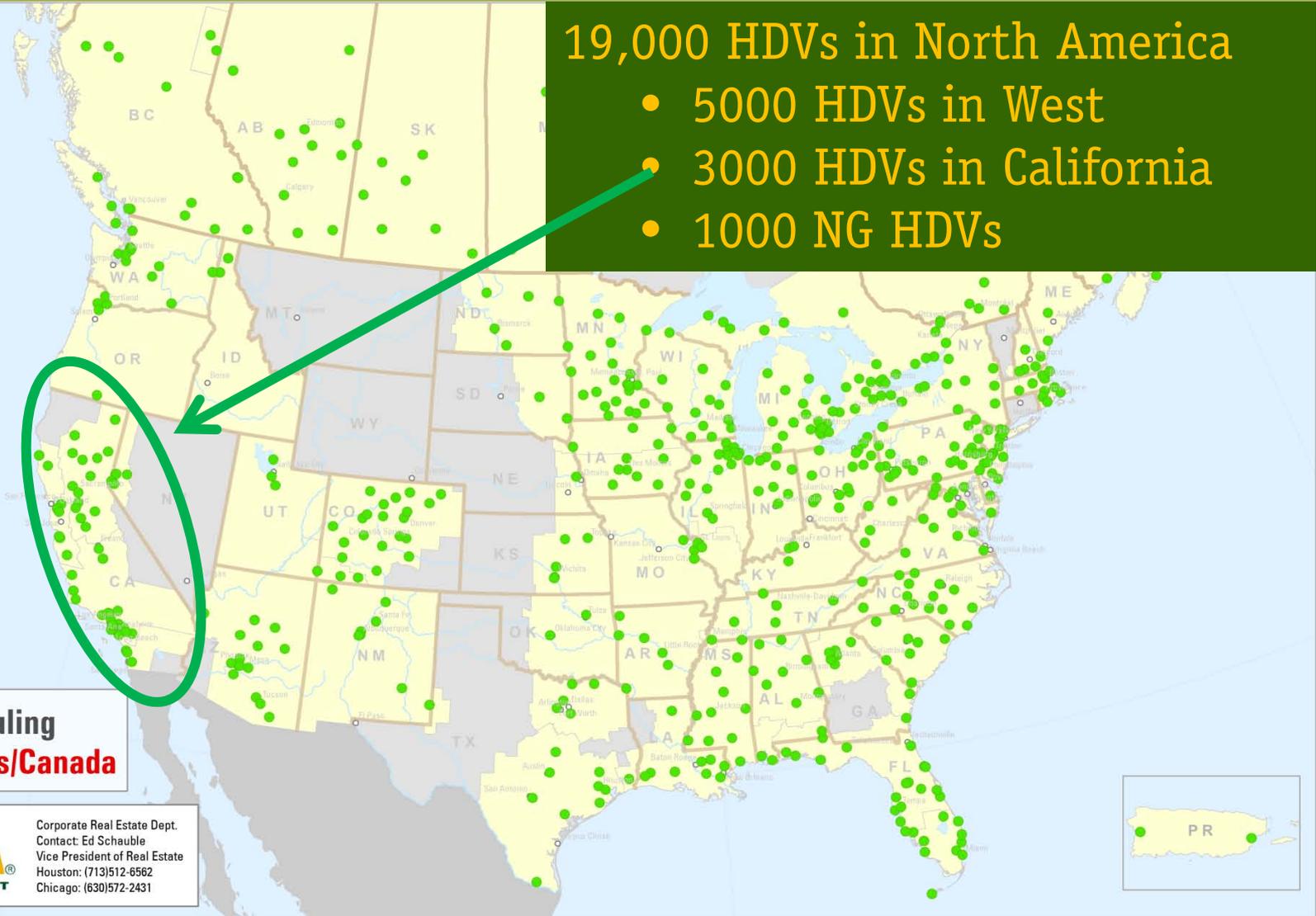
People



367 WM Hauling Districts in North America

19,000 HDVs in North America

- 5000 HDVs in West
- 3000 HDVs in California
- 1000 NG HDVs



Legend

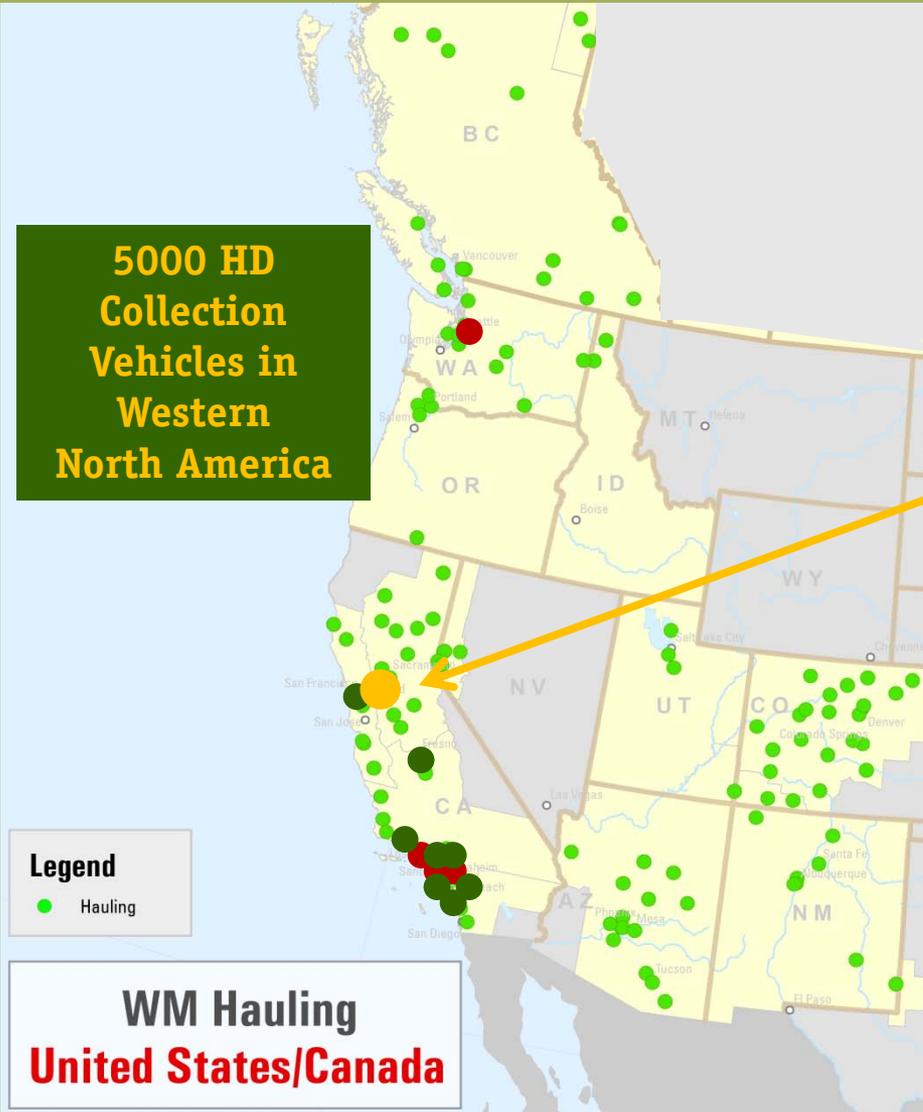
● Hauling

WM Hauling
United States/Canada



Corporate Real Estate Dept.
Contact: Ed Schauble
Vice President of Real Estate
Houston: (713)512-6562
Chicago: (630)572-2431

WM West Group Hauling Districts



- 4 CNG Facilities
– 400 Trucks
- 8 Bio/LNG Facilities
– 400 Trucks
- Altamont Bio-LNG Facility
– 13,000 Gal/day of Bio-LNG
- 5 LCNG Facilities in construction process

WM's CA Natural Gas Fleet (27% and growing!)

WM's California Truck Fleet:

- Diesel – 2200
- LNG/CNG – 800
- Total -- 3000



California Drivers for RNG

- Cap and Trade Regulations Adopted
 - Potential Revenues for BioFuels
- Low Carbon Fuel Standard –
 - Starts January, 2011.
 - 10% reduction in fuel carbon intensity by 2020
- AB 118 – Alternative and Renewable Fuel and Vehicle Technology
 - Deploy innovative transportation fuels & technologies
 - CEC Funding ~ \$100 million per year
- CAEATFA: SB 71 -- Sales and Use Tax Exclusion
 - Equipment to Generate Renewable Fuels

**Today's
Focus !**



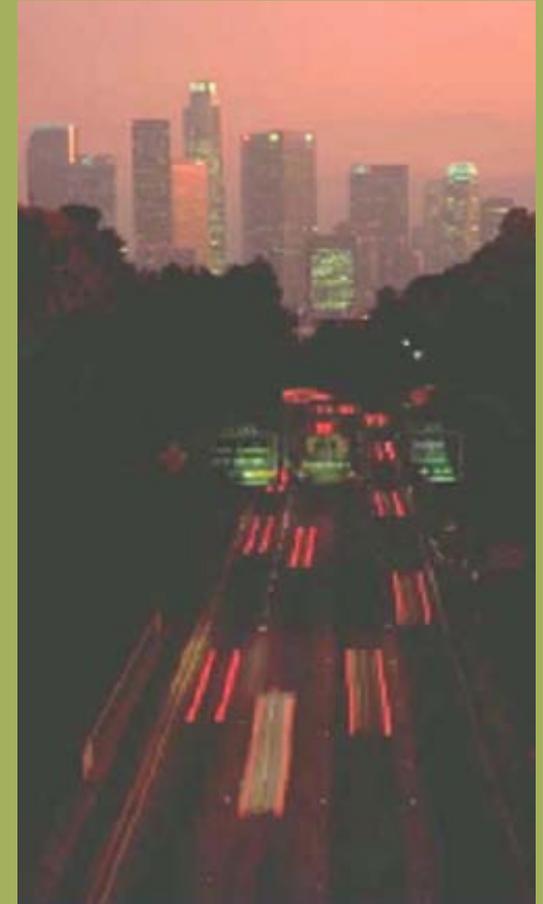
CA Statewide 1990 Emissions Level & 2020 Projection



- 2020 Projection – Business as Usual -- 600 MMTCO2e
- 1990 GHG emissions & 2020 limit is 427 MMTCO2e
- Difference equals reduction goal
 - Approximately 173 MMTCO2e
 - Approximately 30% reduction from 2020 level

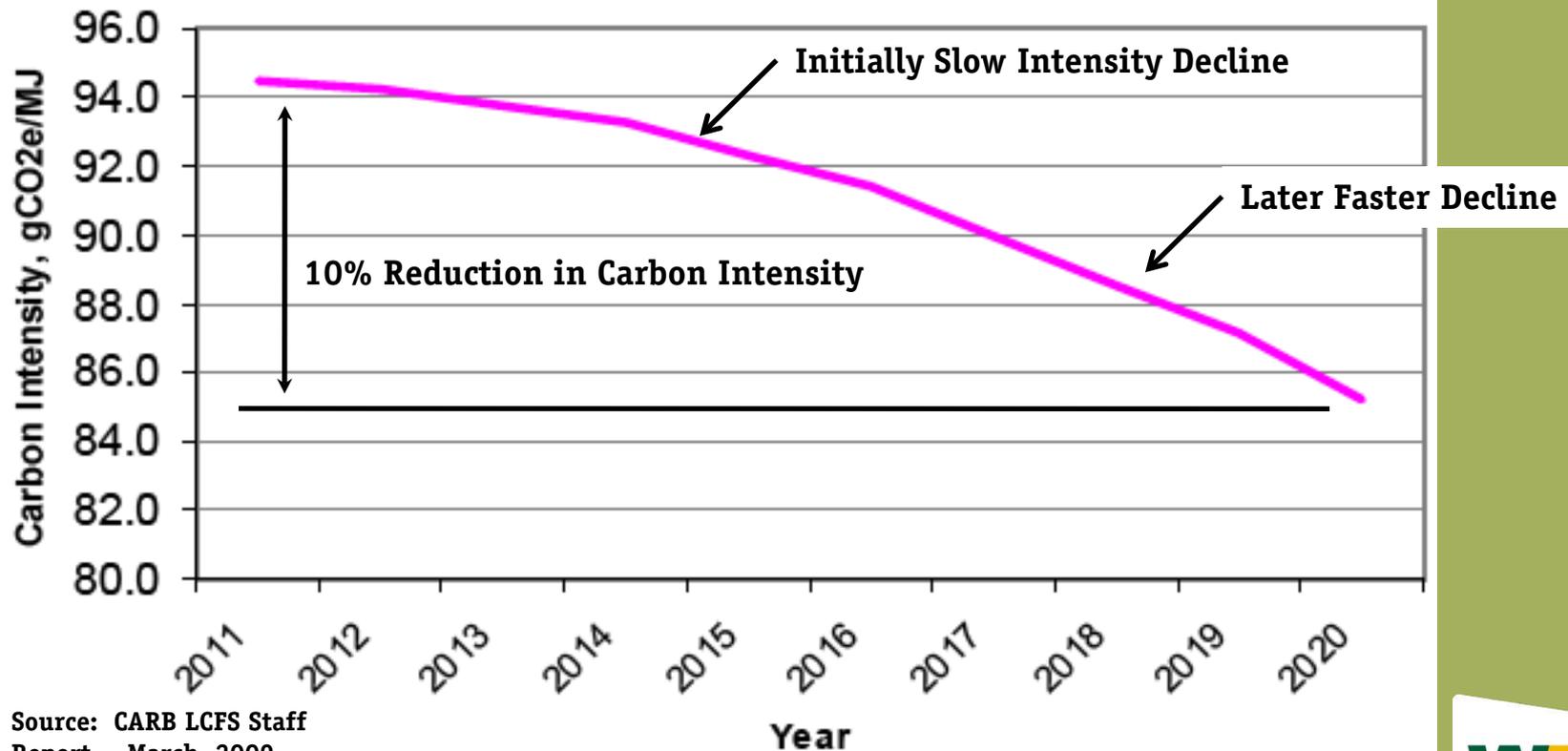
California Low Carbon Fuel Standard

- 10 % Reduction in CA fuel carbon intensity by 2020
 - 2010 is baseline
 - All fuel producers
 - Reduction gradual and weighted to later years
- 16 MMTCO₂e reductions expected by 2020
 - 10 % of AB 32 target
- Increase use of biofuels electricity & biodiesel



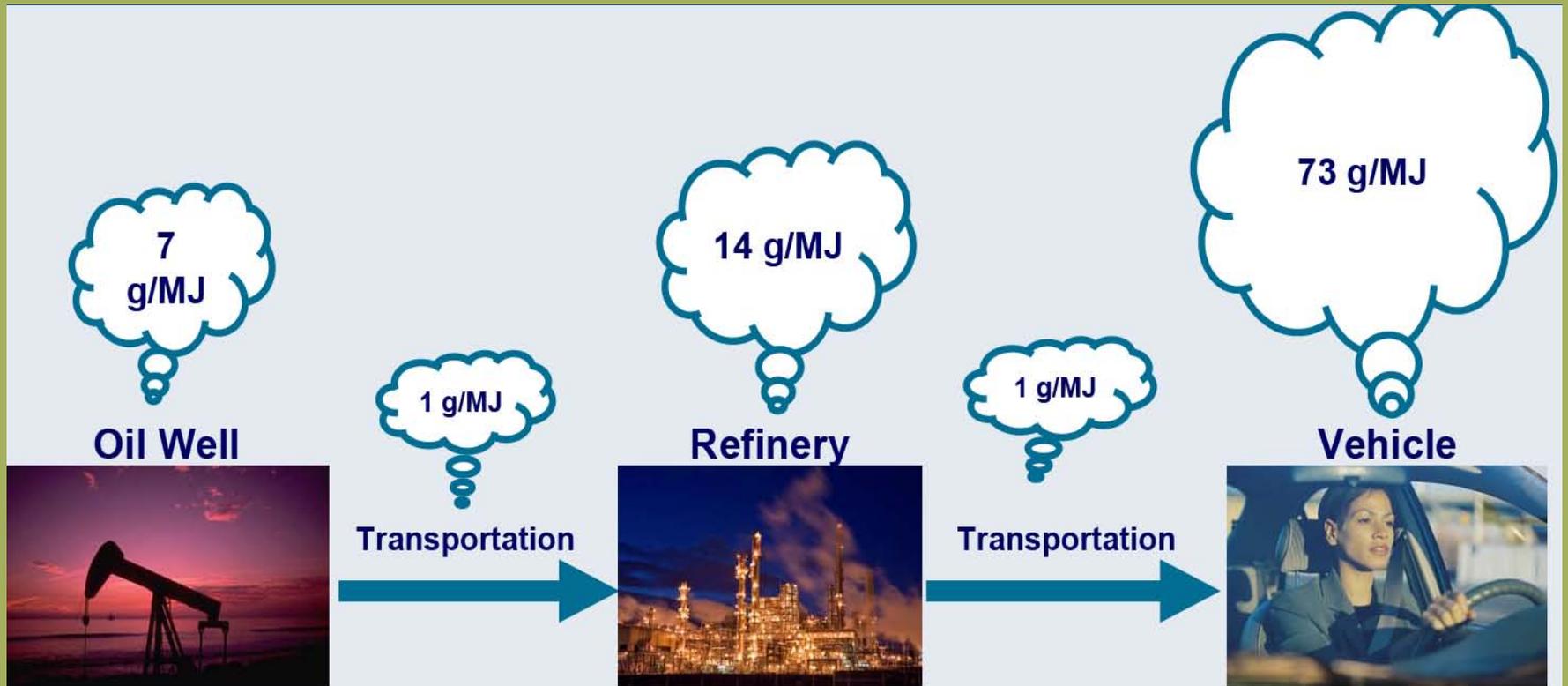
LCFS Carbon Intensity Standard

Compliance Schedule from 2011 to 2020 for Diesel Fuel or Diesel Fuel Substitutes



Source: CARB LCFS Staff
Report -- March, 2009

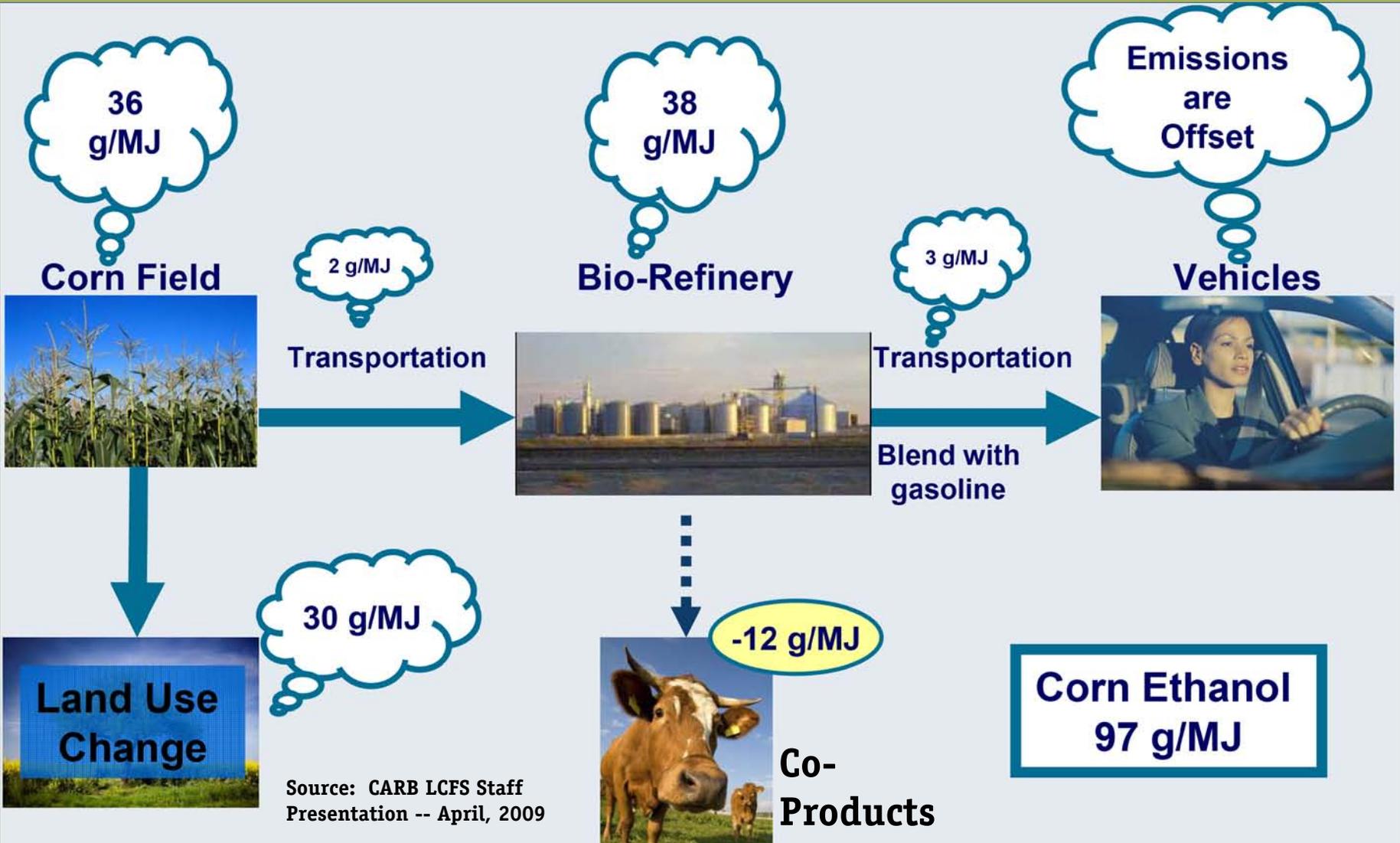
Fuel "Well to Wheels" LifeCycle -- Diesel



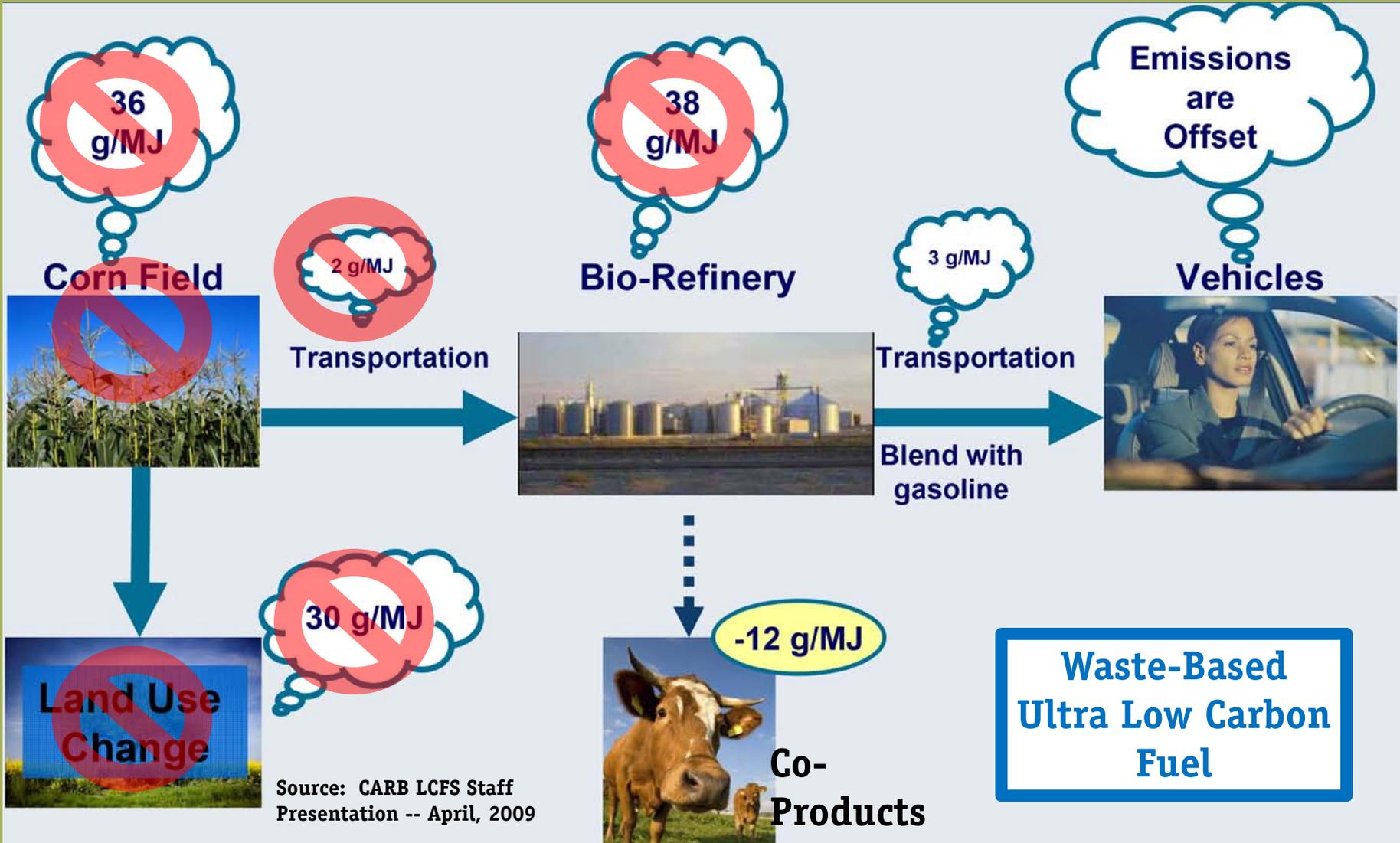
Source: CARB LCFS Staff
Presentation -- April, 2009

Diesel
95 g/MJ

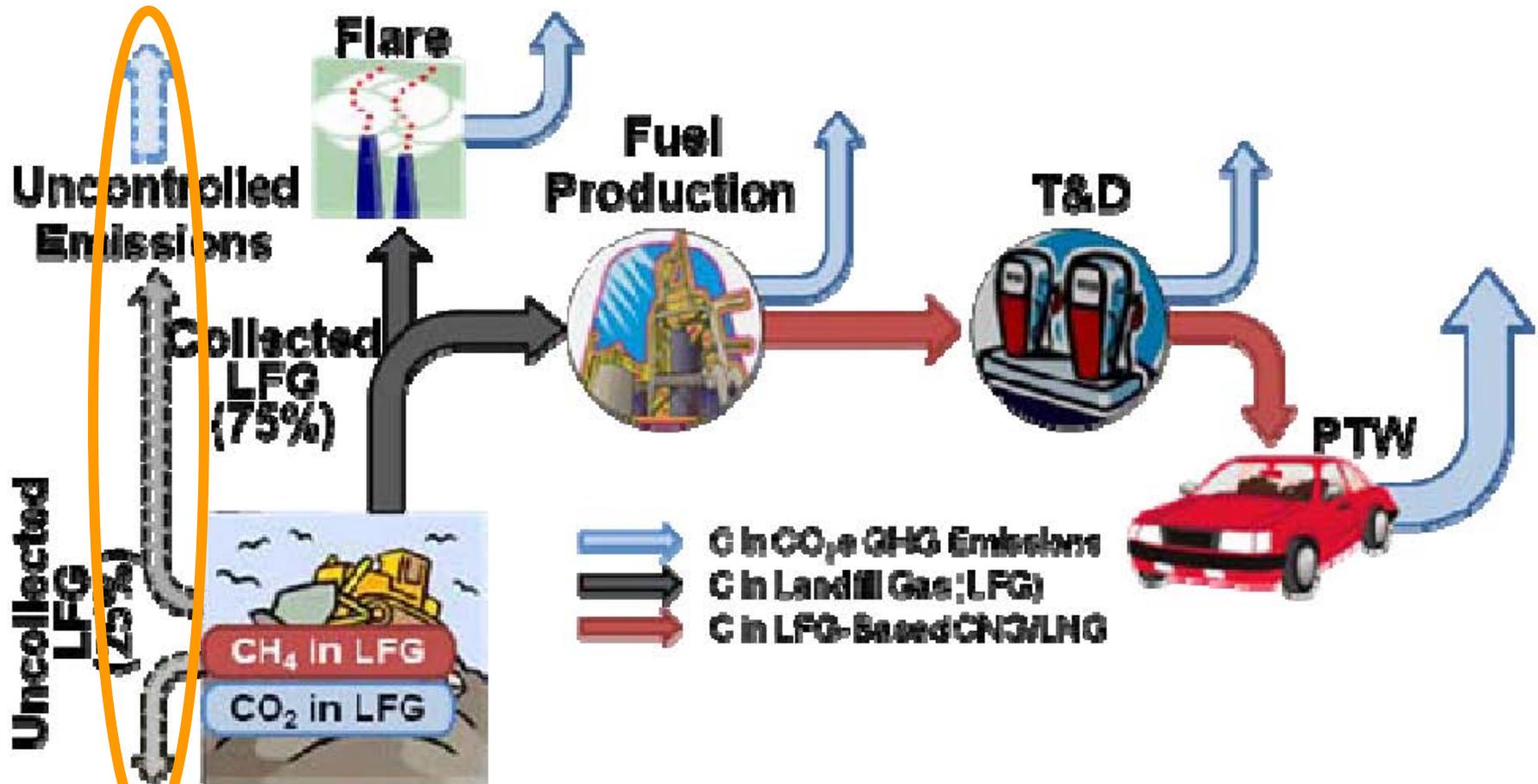
Fuel "Field to Wheels" LifeCycle – Corn Ethanol



Fuel "Waste to Wheels" LifeCycle – Waste Biomass



LCFS Life-Cycle Assessment of LFG to LNG



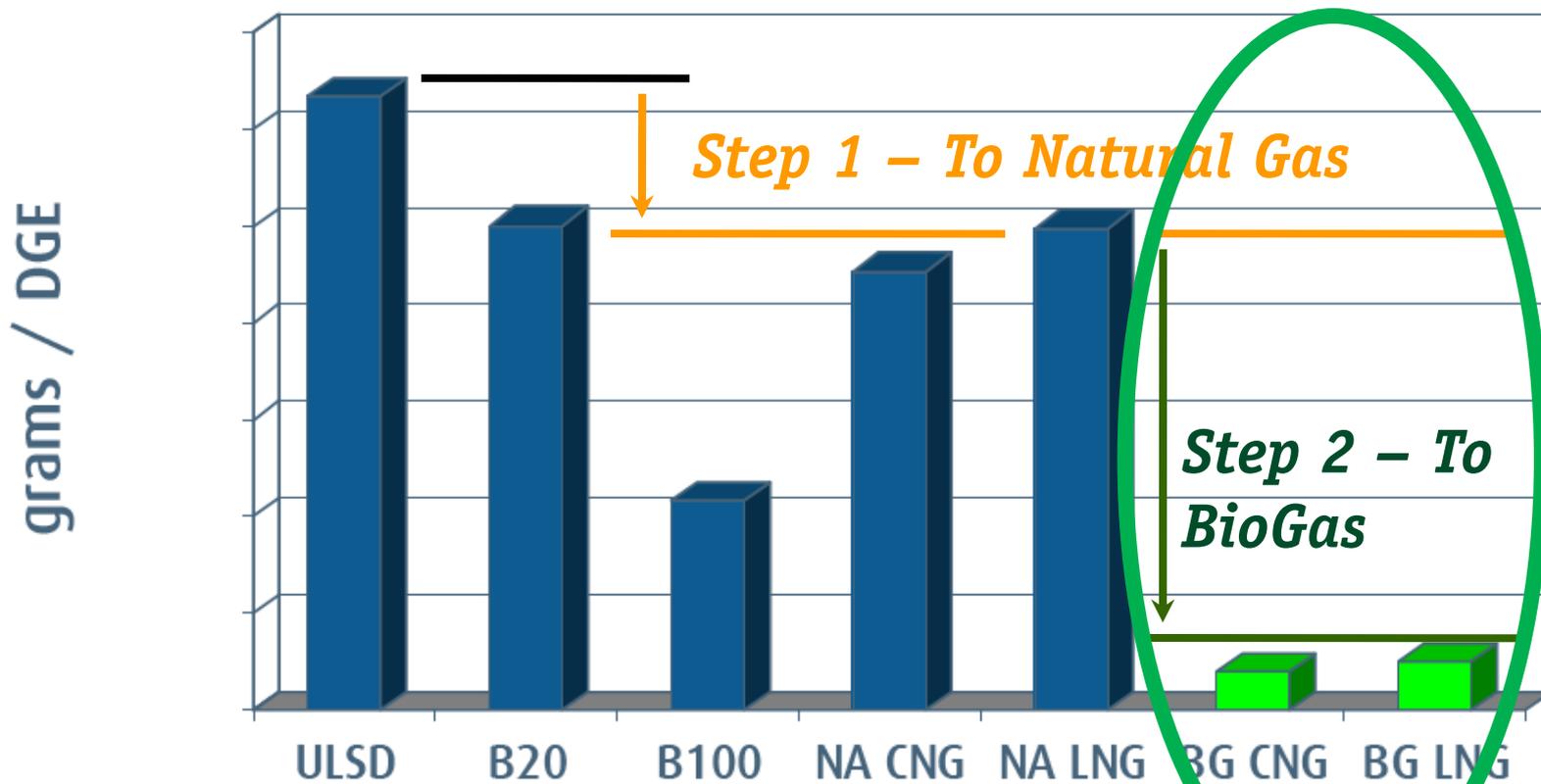
What About Fugitive Emissions?

Source:
Argonne
NATIONAL LABORATORY



Carbon Intensity of Alternative Fuels

WTW GHG Emissions



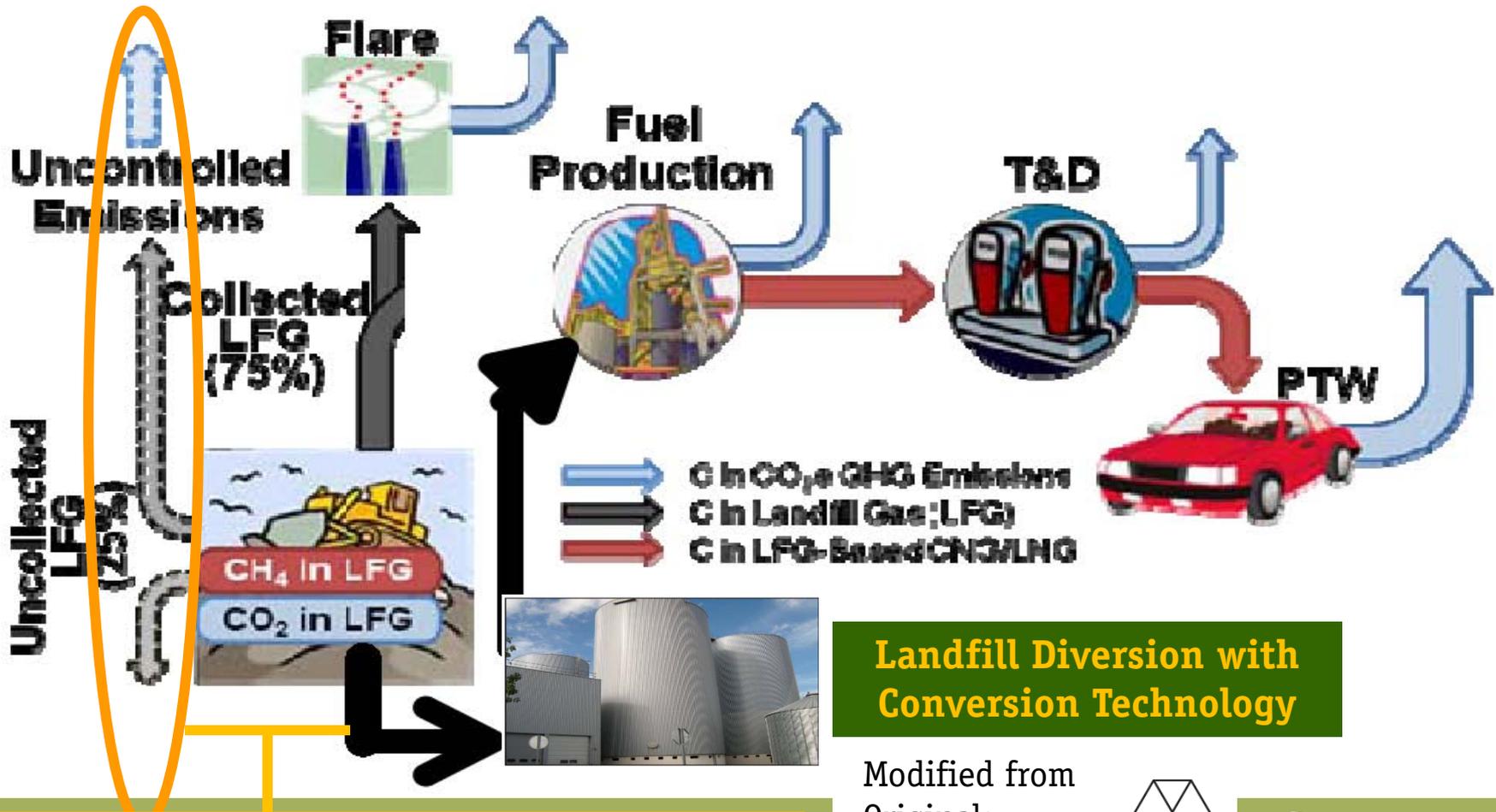
WOW !! Look at Landfill Biogas !!

Comparison of LCFS Fuel Carbon Intensities (gCO₂e/MJ)

Fuel Type	Direct WTW Emissions	Indirect Emissions	Total Emissions	% of Diesel
Gasoline (CARBOB)	95.86	0	95.86	101
Diesel (ULSD)	94.71	0	94.71	100
Ethanol (Midwest WetMill Coal)	90.99	30	120.99	128
Ethanol (Dry Mill Proprietary)	43.20	30	73.20	77
Ethanol (Brazilian Sugarcane)	25.94	46	71.94	76
Biodiesel (Midwest Soybeans)	21.25	62	83.25	88
<u>Biodiesel (Waste Cooking Oils)</u>	<u>15.84</u>	<u>0</u>	<u>15.84</u>	<u>17</u>
<u>Biodiesel (Waste Corn Oil)</u>	<u>5.90</u>	<u>0</u>	<u>5.90</u>	<u>6</u>
<u>Renew-Diesel (Waste Tallow)</u>	<u>19.65</u>	<u>0</u>	<u>19.65</u>	<u>21</u>
CNG (NA Fossil, CA Compressed)	68.00	0	68.00	72
<u>Renewable CNG (Landfill)</u>	<u>11.26*</u>	<u>0</u>	<u>11.26*</u>	<u>13*</u>
<u>Renewable LNG (Landfill)</u>	<u>15.56*</u>	<u>0</u>	<u>15.56*</u>	<u>16*</u>

* Assumes use of Grid Power, Not Site Power. Use of Onsite LFG Power should lower CI by additional ~10%

Are Even Lower Carbon Fuels Possible?



Does Diversion of Waste From LF Result in Avoided Emissions as part of LCFS?

Modified from Original:

Argonne
NATIONAL LABORATORY



WMM
WASTE MANAGEMENT

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Collection



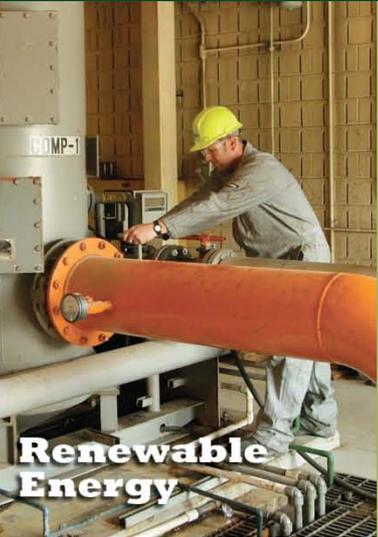
Transfer



Disposal



Recycling



Renewable Energy

So What is WM
Doing About All This

??????????



Gee . . . Where Can We Find BioGas ?

Landfill Gas Collection System

- Landfill Anaerobic Decomposition of Organic Waste = Biogenic
- About half METHANE and half CARBON DIOXIDE as produced in the waste
- Nitrogen and Oxygen introduced by air intrusion
- 450 to 550 BTU per cubic foot of landfill gas
- Flow will increase while landfill is still open, and decrease when landfill closes



LFG to LNG

WM
WASTE MANAGEMENT

Linde

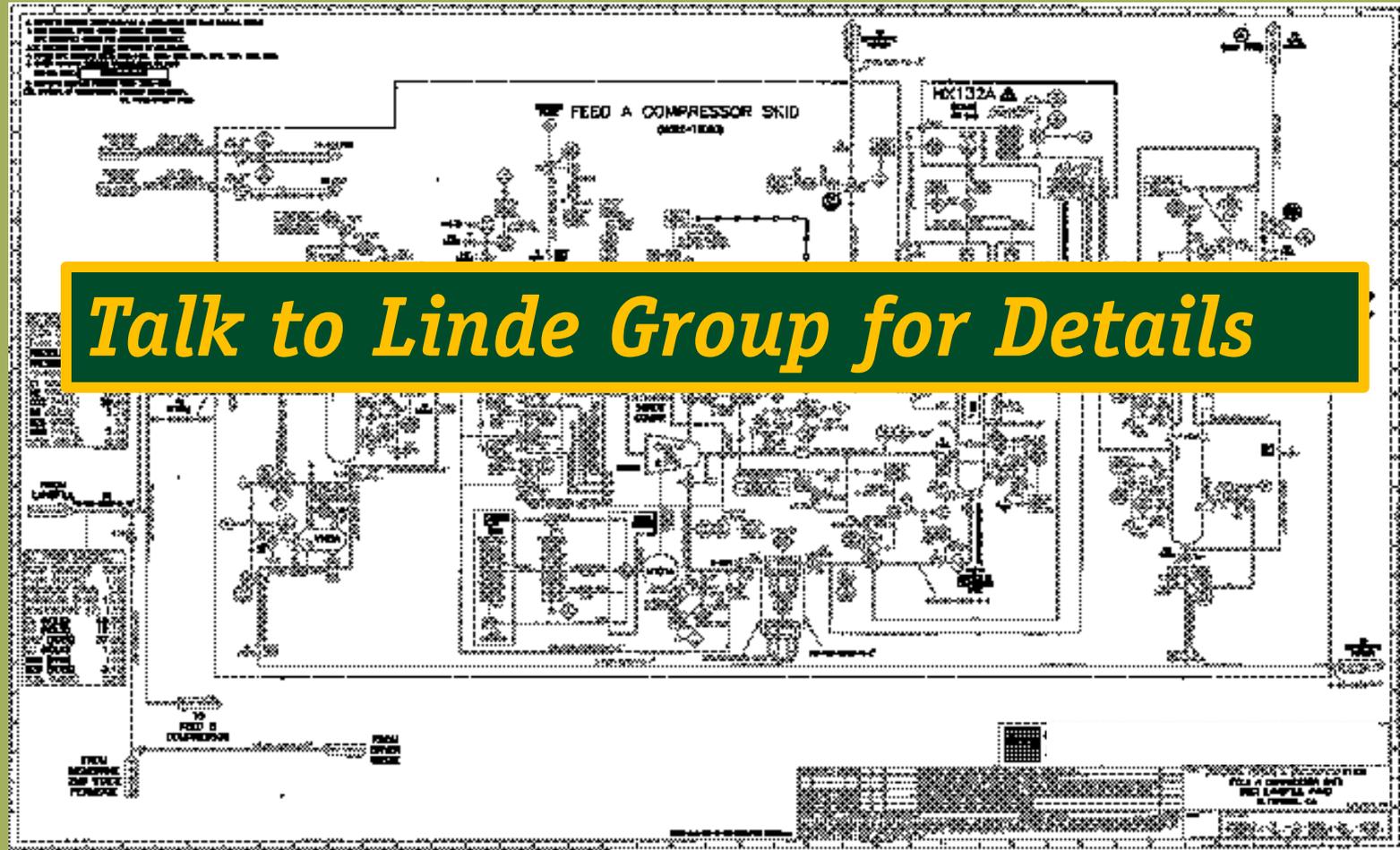
gti



- Recovery and Utilization of Biomethane Landfill Gas for Transportation Fuel
- Altamont Landfill & Recycling Center, Fall 2009
- \$15.5 million capital investment
- 13,000 Bio-LNG Gallons/day
- “Super Ultra Low Carbon Fuel” – lowest in CA
- Largest effort to introduce onsite liquefaction for landfill gas recovery in North America
- Utilize biogas resources and displace fossil fuels
- 2nd Plant planned for SoCal
- LFG to Pipeline CNG?

WM
WASTE MANAGEMENT

Process & Instrument Diagram



Talk to Linde Group for Details

Bottom Line: It's Complicated & Expensive

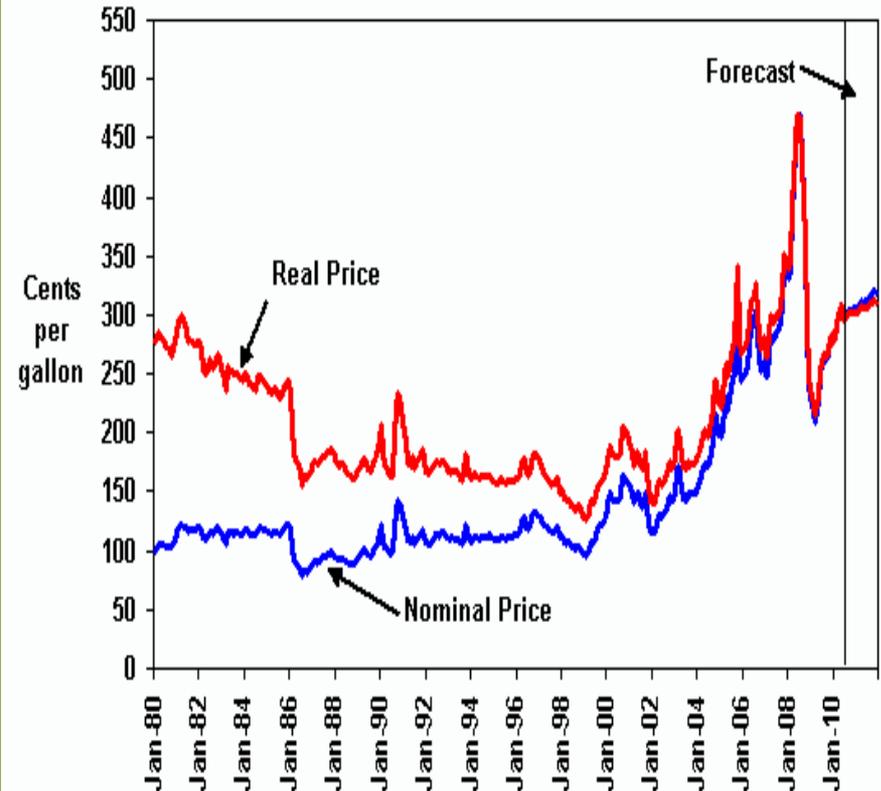
Opportunity/Challenge: Fossil Fuel Price

Natural Gas
Spot 5 Years - \$/mmBTU



13 Sep, 2005 - 13 Sep, 2010

Diesel Fuel Prices: Nominal and Real



Short Term Energy Outlook-July 2010



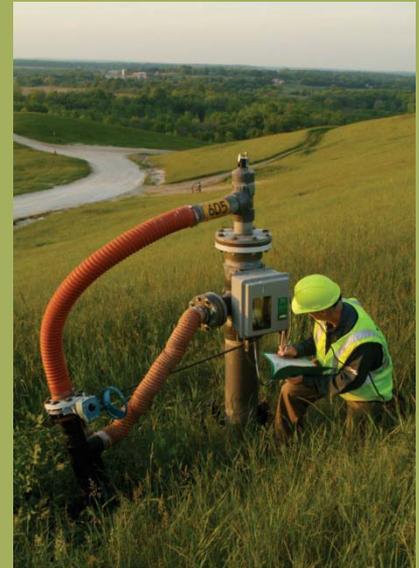
What does LCFS mean to Altamont LFG to RLNG?

- 13,000 Gallons of RLNG/yr = 4.75 million gallons/yr
 - = 400,000 MMBTU/yr @ 84,000 BTU/gal
 - = - 33,300 MTCO_{2e}/yr LCFS GHG Credits
- What is the Value of Carbon?
 - @ \$5/MTCO_{2e} = \$ 166,500/year
 - @ \$10/MTCO_{2e} = \$ 333,000/year
 - @ \$ 20/MTCO_{2e} = \$ 666,000/year
 - @ \$30/MTCO_{2e} = \$ 1 million/year
- What is the Value of the Fuel?
 - \$4.50/MMBTU x 400,000 MMBTU/yr = \$1.8 million/year
 - Therefore, a 9% to 55% potential revenue boost



What About LFG to Pipelines?

- Cheaper, More Efficient & Reliable
- Readily Available Low Carbon Energy
 - >20 existing projects nationwide
- State Laws may Restrict
 - California
 - Hayden Statute
 - CPUC Tariffs currently prohibit
 - GHG C&T and Reporting
- California Utility Concerns
 - Liability, Corrosion & Contaminants
 - moisture, sulfur, O₂, vinyl chloride, siloxanes, etc.
- Pending GTI Study to raise confidence of Treatment & Monitoring Technology?

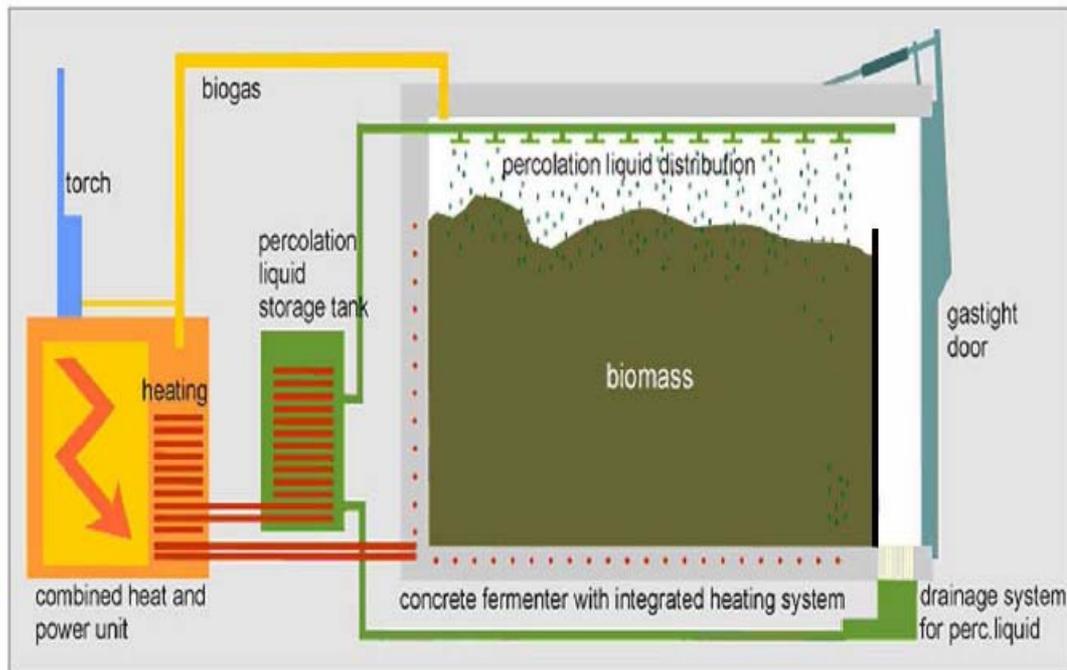


Anaerobic Digestion

*Harvest
Power*

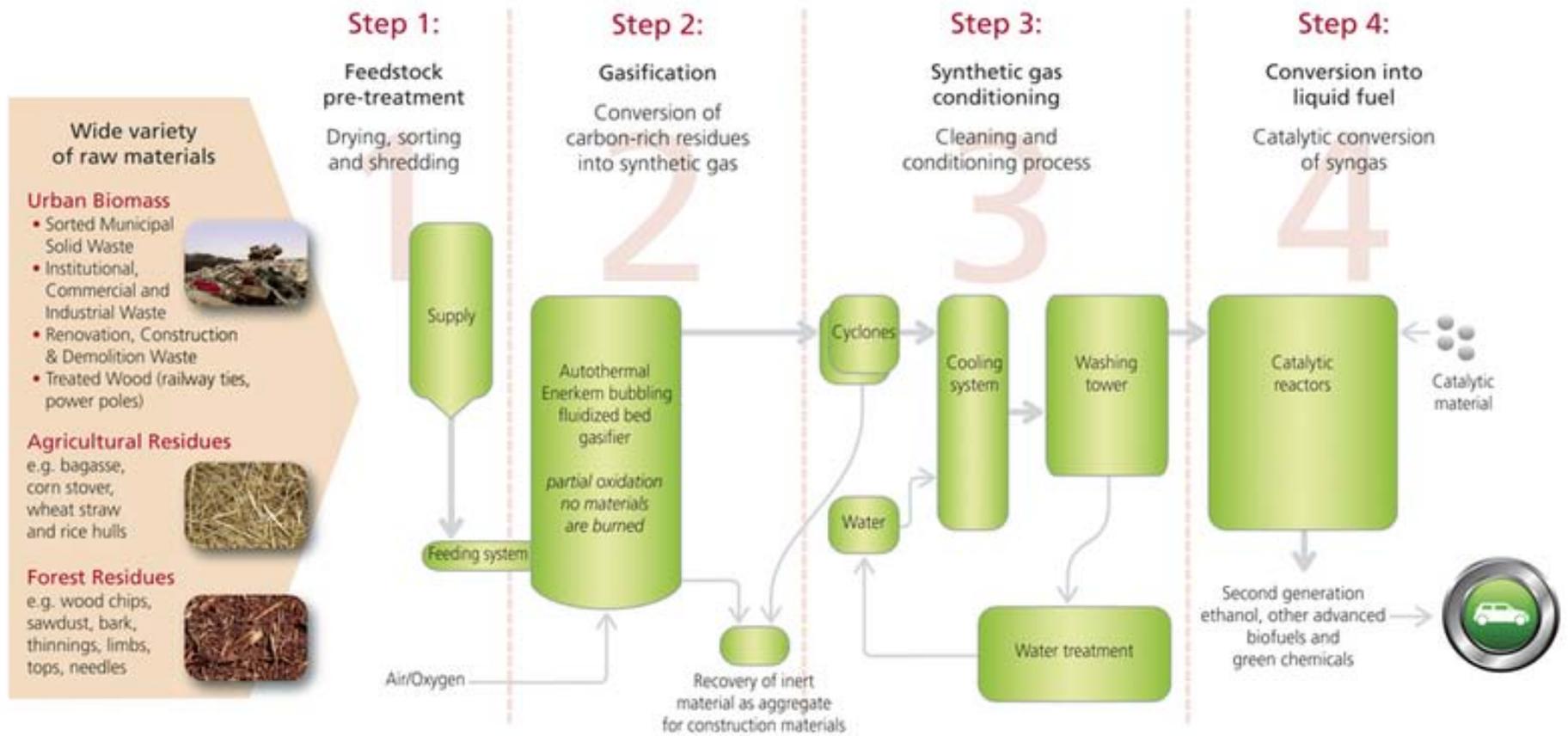
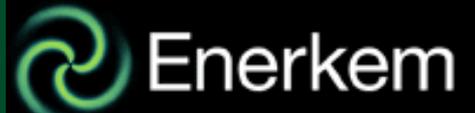
The dry fermentation process anaerobically (without oxygen) digests waste material to produce methane over a 28-day period.

The Process



- 1) Waste material placed in an air-tight building for 28 days (typically 50/50 mix of yard/food waste)
- 2) Percolate and bacteria recirculated during digestion
- 3) Biogas collected and extracted at top of building,
- 4) Methane Gas cleaned and sold or burned for electricity

WM Organics: chemical conversion

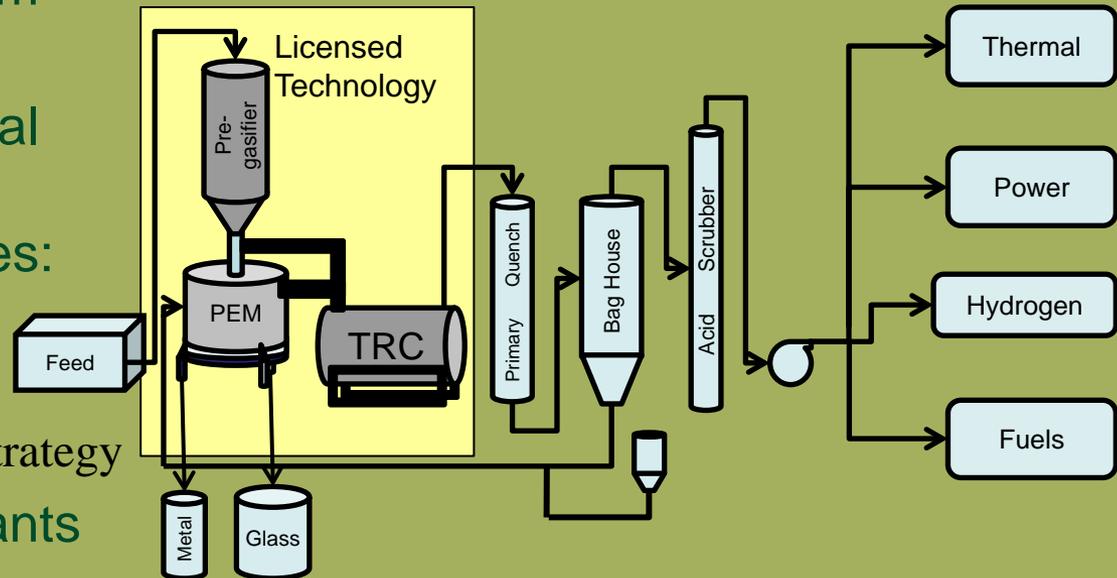


Thermo-chemical gasification to produce syngas which converts into fuels & biochemicals.



S4 Energy Solutions, LLC

- S4 Energy Solutions uses advanced plasma gasification technology to recover energy and useful by-products from waste.
- 25 tons-per-day commercial design at Columbia Ridge Landfill, OR; Project phases:
 - Small scale plant design and construction
 - Scale up and commercial strategy
- Goal of 125 – 250 TPD plants in a distributed model that process MSW and other waste materials.

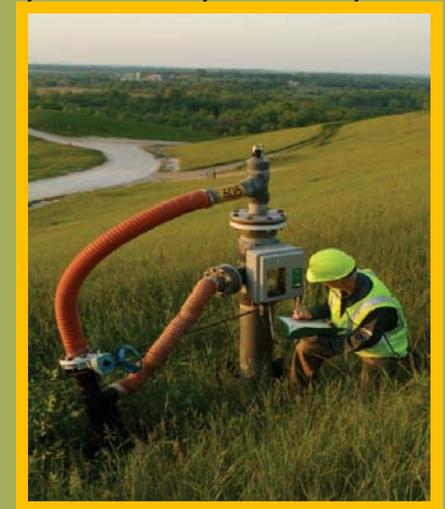


JV:



In Summary . . .

- **What are drivers for energy/fuel from waste?**
 - Fossil Fuel Prices
 - GHG & Renewable Fuel Regulations (LCFS, C&T, RFS)
 - Fiscal Incentives (AB 118, CAEATFA)
- **What is WM currently doing?**
 - Expanding NG Fleet
 - Expanding LFG to Energy/Fuels
 - Investing in State of the Art Technologies
- **What are the technologies of the future?**
 - Landfill Gas is “low hanging fruit” – here today !!
 - Anaerobic Digestion (RACs, Harvest Power)
 - Gasification (Enerkem, S4)



Any Questions?

