CNG opportunities:

for your fleet, for your business

OAIMA Annual Meeting

Background:

B.S. from The Ohio State University in Natural Resource, Environmental Sciences

20 years general business including transportation, switched careers to align with degree

4 years with US DOE, Clean Cities program working with all alternative fuels; Biodiesel, CNG, Ethanol, EV, Propane

4 years with Ariel working exclusively on CNG as a transportation fuel

Over a decade of experience in transportation and alternative fuels.

Last 8 years focused on fleet and station adoption of alternative fuels, educating fleet operators and owners on alternative fuel technology and viable adoption processes.

At the end of the day …….

……. If it doesn't make cents,

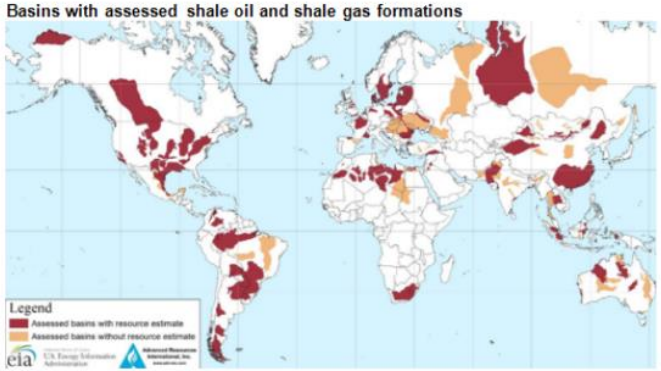
……. it doesn't make sense!

CNG Overview

Why is it here to stay?

Why is it important?

Shale oil and shale gas resources are globally abundant ›

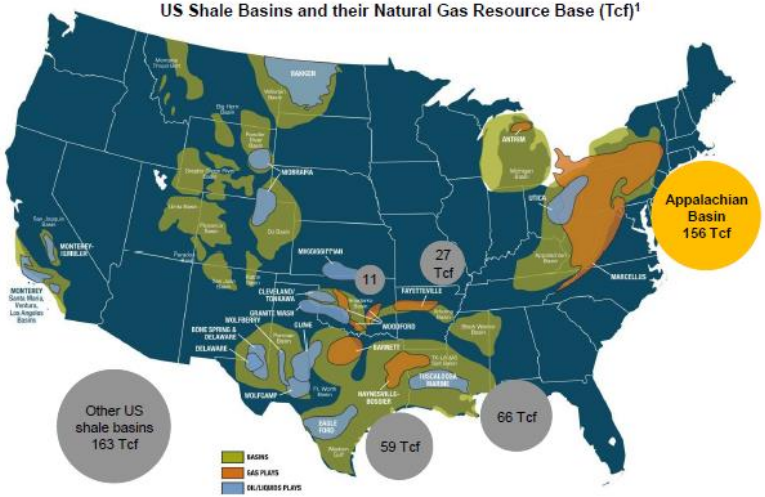


Source: U.S. Energy Information Administration, *Today in Energy*, January 2, 2014.

The Northeast US Appalachian Basin, with its Marcellus and Utica Shales, has the largest natural gas resource base of any US shale basin

NEXUS GAS TRANSMISSION

US Shale Basins and their Natural Gas Resource Base (Tcf)[1]



1. Unproved technically recoverable resources
Source: PacWest Consulting, EIA, DTE Analysis

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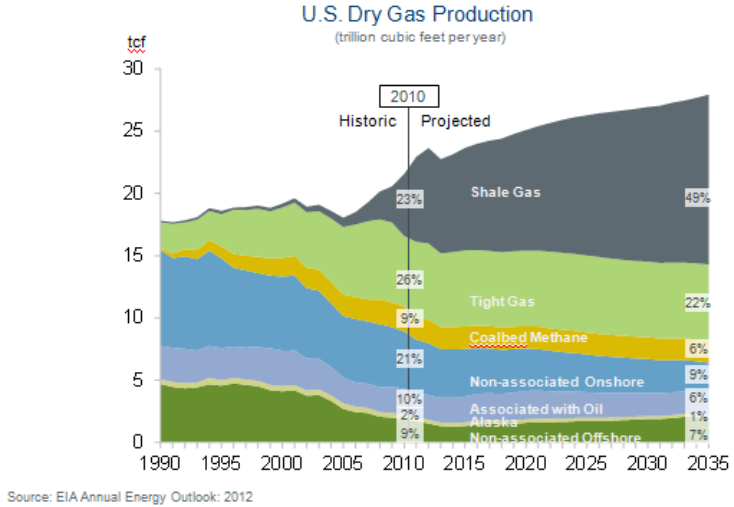
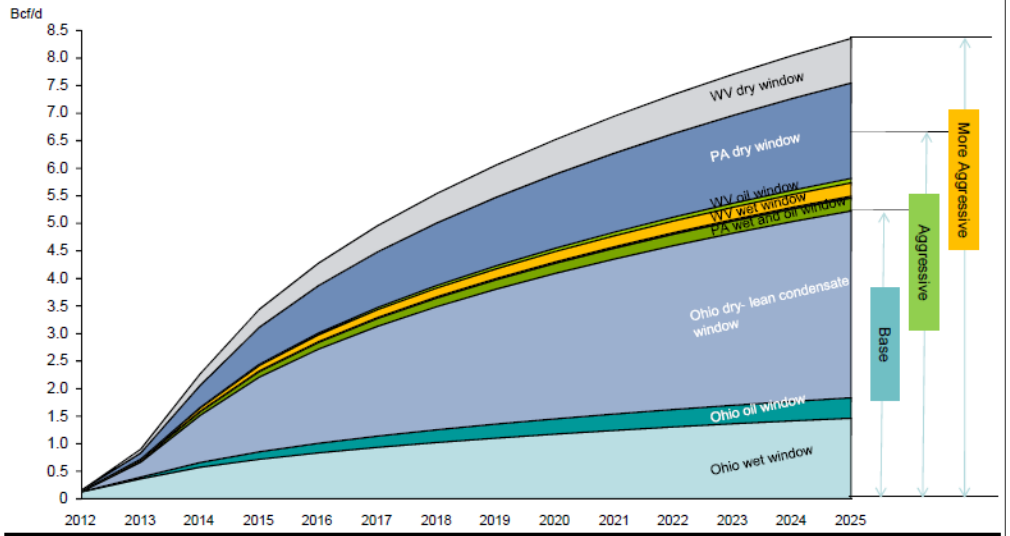
Fundamental Change in the Game



Source: EIA Annual Energy Outlook: 2012

anga
America's Natural Gas Alliance

Utica natural gas production could reach ~2.8 Bcf/d by 2016 and ~ 4.0 Bcf/d by 2020 in our base case



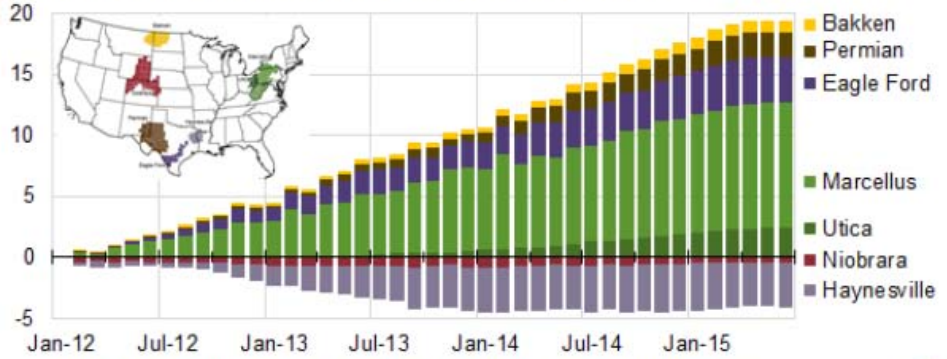
Source: DTE Market Intelligence Modeling

12

JULY 28, 2015

Marcellus, Utica provide 85% of U.S. shale gas production growth since start of 2012

Natural gas production in selected regions (Jan 2012 - June 2015)
cumulative change since January 2012, billion cubic feet per day (Bcf/d)



Since the beginning 2012, the **Marcellus** and **Utica** regions have accounted for **85%** of increases in production from these selected shale gas regions.

eia

Source: U.S. Energy Information Administration, *Drilling Productivity Report*, July 2015

Ohio Utica Shale

Ohio has busy week with 33 new Utica Shale drilling permits

By BOB DOWNING Published: October 14, 2015

Ohio.com
Akron Beacon Journal • Friday, October 16, 2015

What drilling slowdown?

Ohio had what could be a record week for new permits for Utica Shale wells with 33 permits being filed.

That includes 19 permits for Belmont County, three in Guernsey County, five in Harrison County, three in Jefferson County and three in Monroe County.

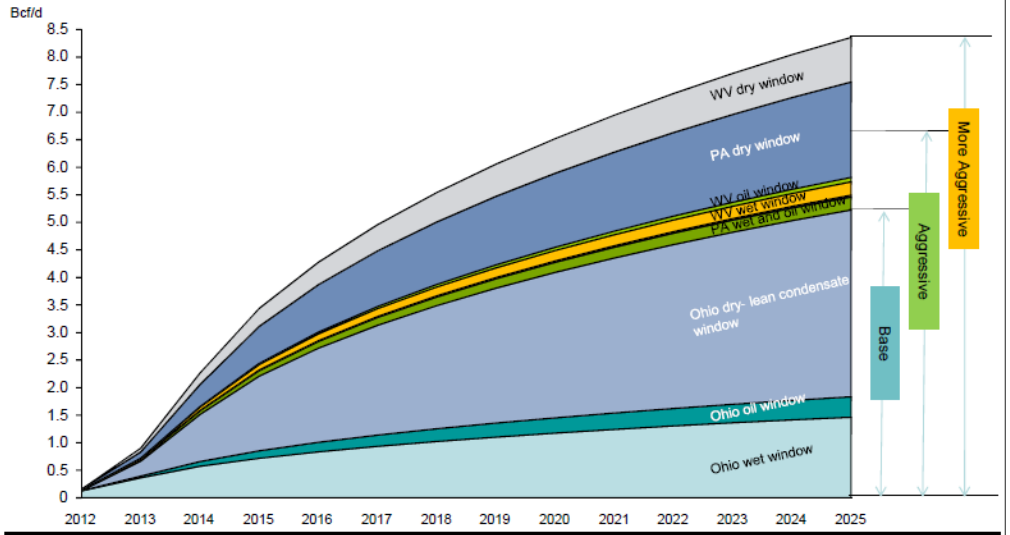
Overall, Ohio has approved 2,041 Utica Shale permits, the Ohio Department of Natural Resources reported.

Of that total, 1,608 Utica wells have been drilled and 1,018 Utica wells are producing, through Oct. 10

Ohio has 24 rigs at work.

Utica natural gas production could reach ~2.8 Bcf/d by 2016 and ~ 4.0 Bcf/d by 2020 in our base case

NEXUS GAS TRANSMISSION



Source: DTE Market Intelligence Modeling

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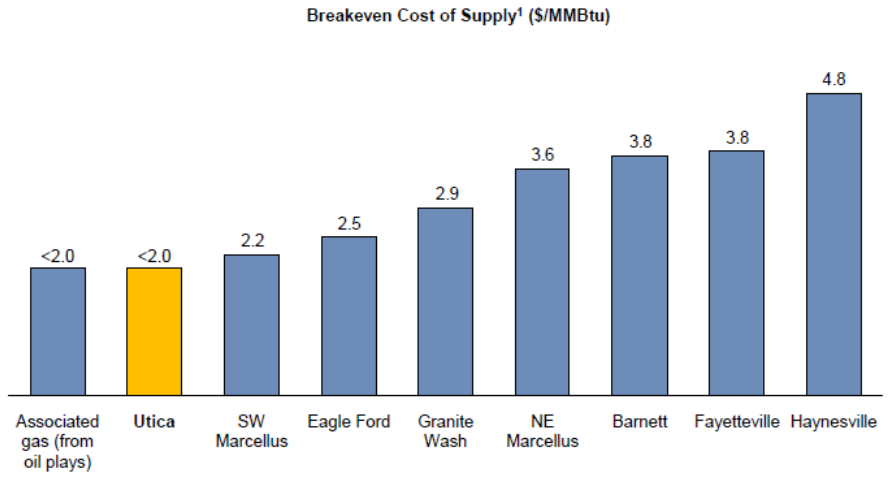
why
it
matters?

Natural gas from the Utica Shale is among the lowest cost supplies available

NEXUS GAS TRANSMISSION



1. 2015 breakeven cost of new supply at after-tax 10% IRR
Source: Wood Mackenzie, DTE Energy analysis

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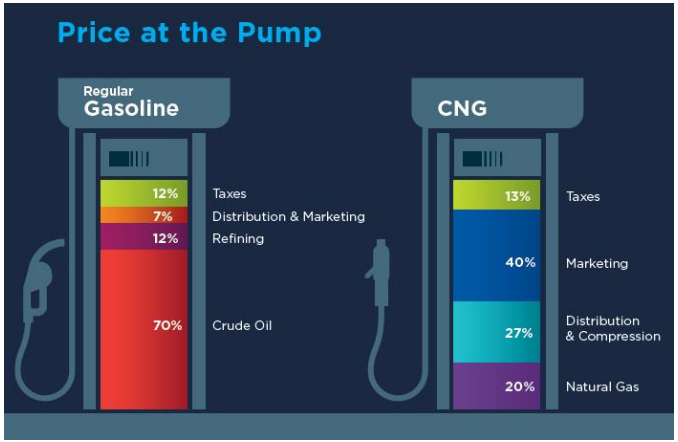
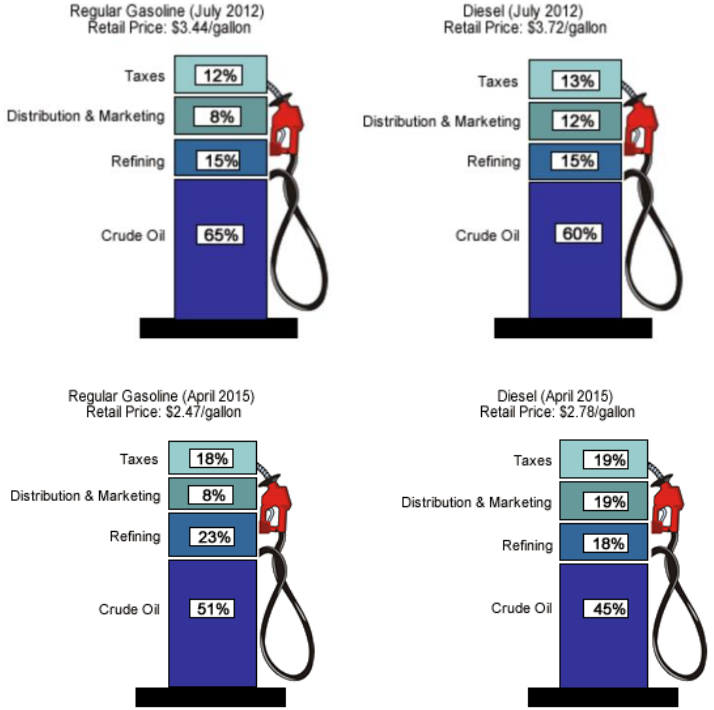
Ohio production of shale gas is very cost competitive.

This increases the stability of the retail price of natural gas as a motor fuel making it more price stable than gasoline or diesel

Why is CNG more price stable than traditional liquid fuels?



Source: American Gas Association *2014 Playbook* graphic



Source: U.S. Energy Information Administration

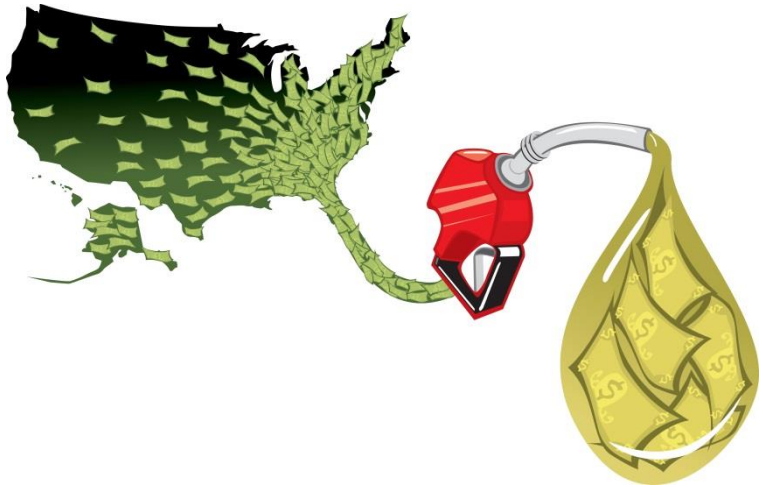
So the fuel, Ohio shale natural gas, is here to stay for a long time.

It is not going away anytime soon!

Shale gas is here to stay. CNG is here to stay.

Why is this important geopolitically?

Energy security, stopping money from flowing out of our country, ripple affect within our producing regions.



Study - economic impact:

Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution

James Feyrer, Erin T. Mansur, Bruce Sacerdote

NBER Working Paper No. 21624
Issued in October 2015
NBER Program(s): EEE EFG LS

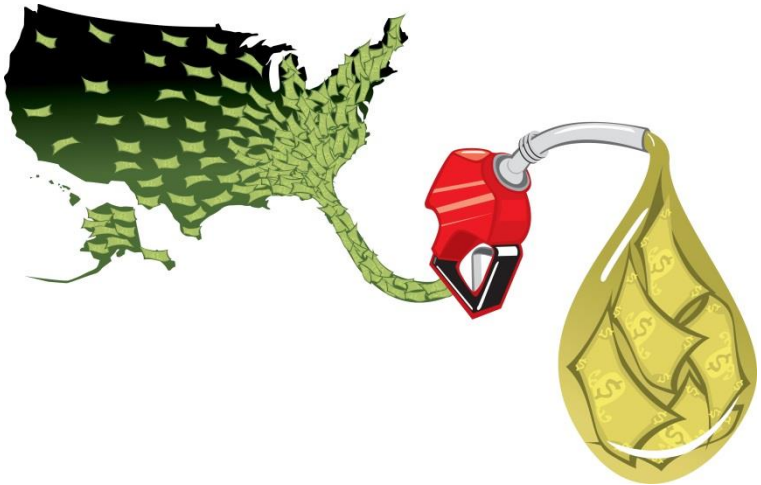
•Every million dollars of oil and gas extracted produces $66,000 in wage income, $61,000 in royalty payments, and 0.78 jobs within the county.

•Outside the immediate county but within the region, the economic impacts are over three times larger. Within 100 miles of the new production, one million dollars generates $243,000 in wages, $117,000 in royalties, and 2.49 jobs.

•Over a third of the fracking revenue stays within the regional economy.

•Our results suggest new oil and gas extraction led to an increase in aggregate US employment of 725,000 and a 0.5 percent decrease in the unemployment rate during the Great Recession.

But what happens when our money doesn't stay home?

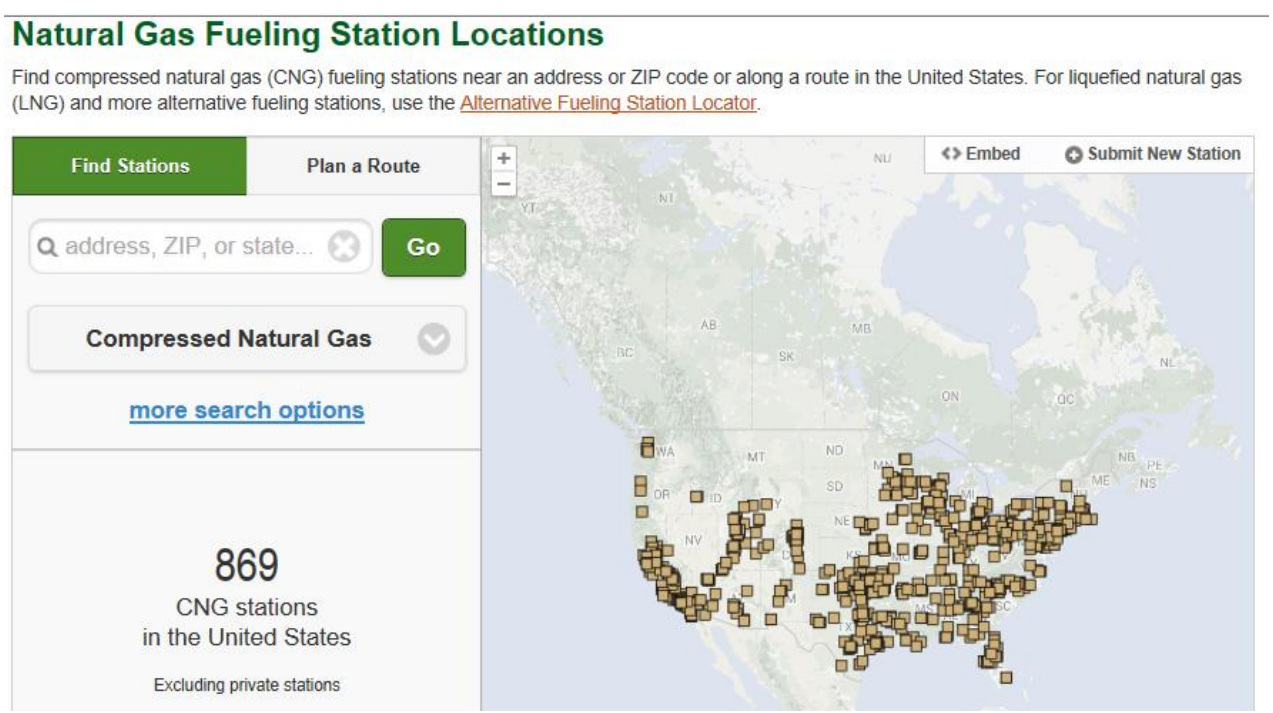


And what happens to the money leaving our country? Indoor ski resort in Dubai … or worse …

How many more snowflakes do you want to buy?

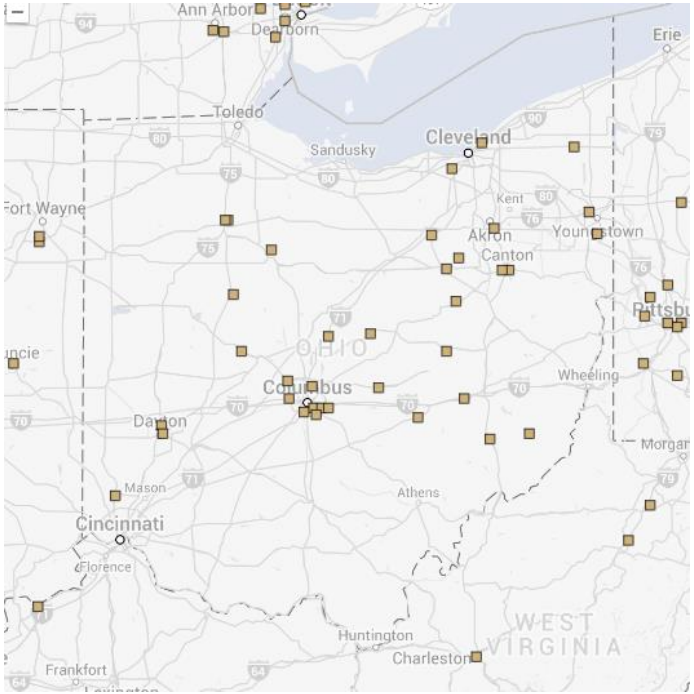
So we understand CNG important and here to stay, …. Now what?

Where to Buy?

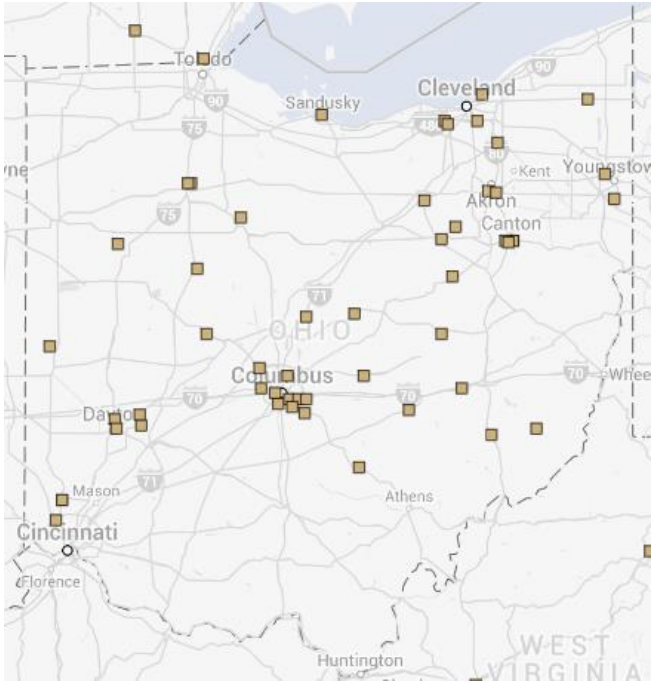


Public CNG stations in USA

www.afdc.energy.gov/fuels/natural_gas_locations.html

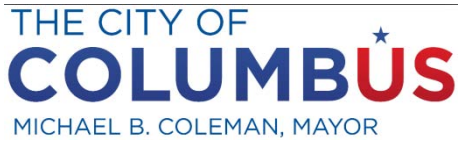


Public CNG stations in Ohio



Public & Private CNG stations in Ohio

Some CNG users/providers in Ohio:



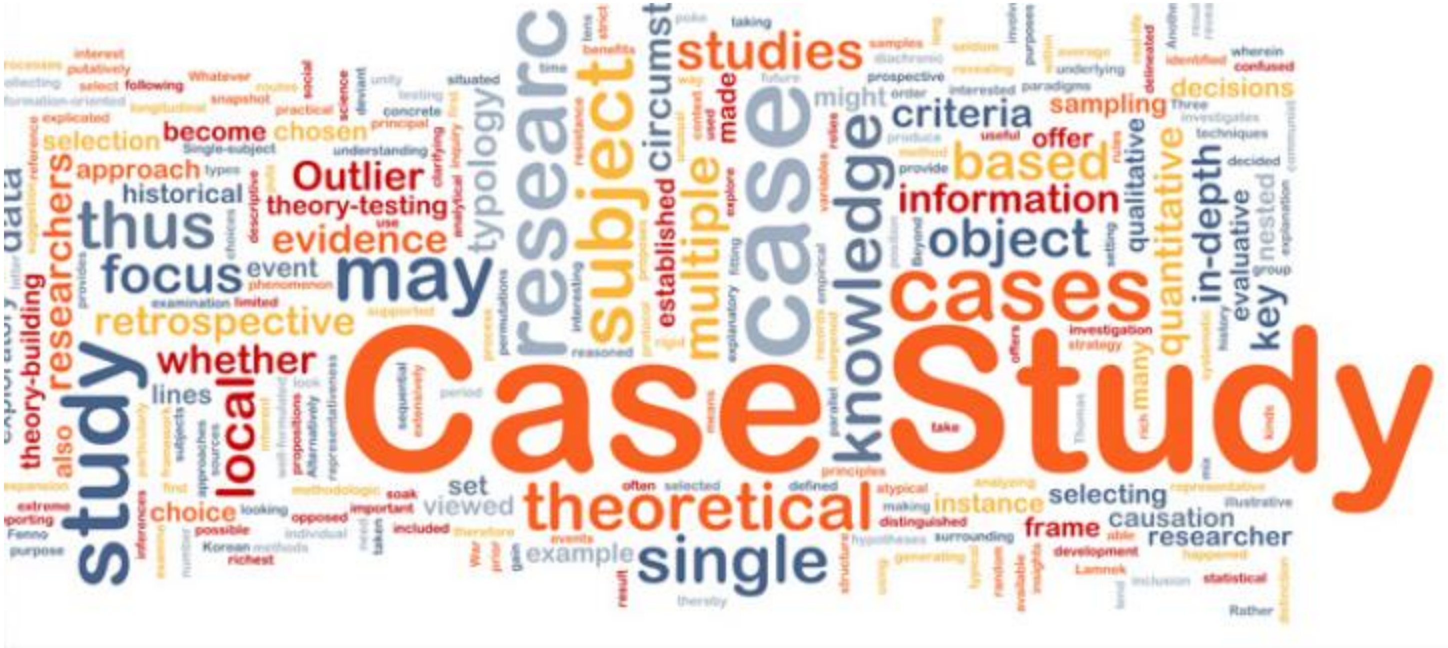
Or you can build your own:


11
12
2056
EXcellence Driven


210706
WM
CNG
CNG

Besides securing fuel supply, one needs to evaluate your fleet need.

First, confirm which is a better fit, CNG or LNG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Love's
Travel Stops

TRAVEL STOPS

Founded in 1964

39 States and Counting

300 Locations and Growing

20+ Stores Per Year Growth

Top 10 Forbes Privately Held Companies

Love's runs side by side 18 month CNG vs LNG comparison

Case Study Excerpt from:

Exclusive Ariel CNG User

TRUCK ECONOMIC PAYOUT

CNG vs. LNG Comparison

	CNG	LNG
Diesel Price	$4.000	$4.000
Natural Gas Retail Price	$2.000	$3.000
Gross Discount to Diesel	**$2.000**	**$1.000**

Truck Inefficiencies

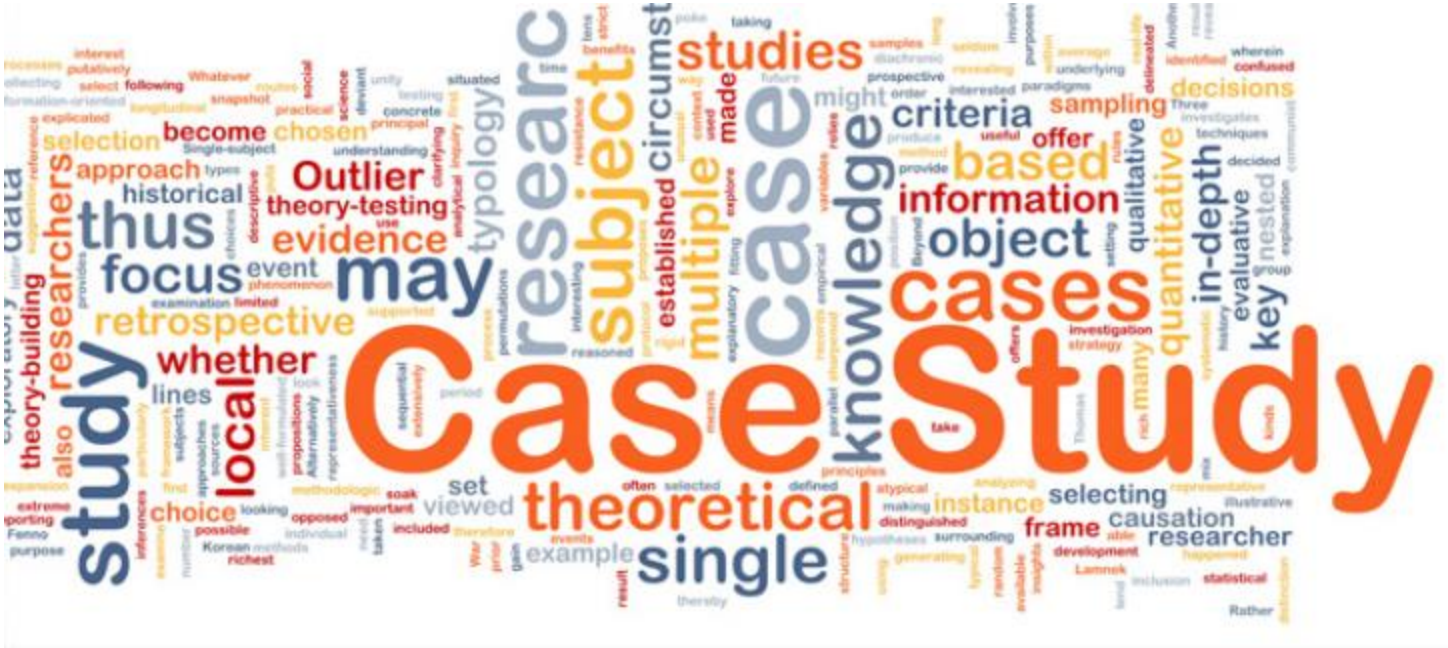
	CNG	LNG
Fuel Economy Loss (12%)	–0.240	–0.360
Out of Route Miles	–0.025	–0.025
Payload Loss	–0.050	–0.020
Additional Maintenance	–0.030	–0.030
Fuel Loss from Venting	N/A	–0.015
Salvage Value Deduction	–0.060	–0.060
Total Inefficiencies	**–0.405**	**–0.510**
Net Discount to Diesel	**$1.595**	**$0.490**

Truck Comparison

	CNG	LNG
Miles Driven (Annual)	125,000	125,000
Fuel Economy	6.20	6.20
Fuel Consumption	20,161	20,161
Truck Premium (CW 11.9L)	60,000	60,000
Net Discount to Diesel	$1.595	$0.490
Fuel Savings (Annual)	$32,157	$9,879
Payback (Years)	**1.87**	**6.07**

Why does

Care?



CaseStudy
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evaluative
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theory-building
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HONDA

Honda of America Mfg., Inc.

Marysville, Ohio
CNG station – Public/Private

Honda uses CNG for own vehicles. It's vendors eventually will be required to use CNG as Honda campus will be diesel free!

Why does Honda care?

“The station is part of Honda’s Initiative toward reducing CO2 emissions. Honda is encouraging the use of CNG powered vehicles by its suppliers and logistics companies”

“There are more than 100 suppliers in the region that could utilize their CNG station”

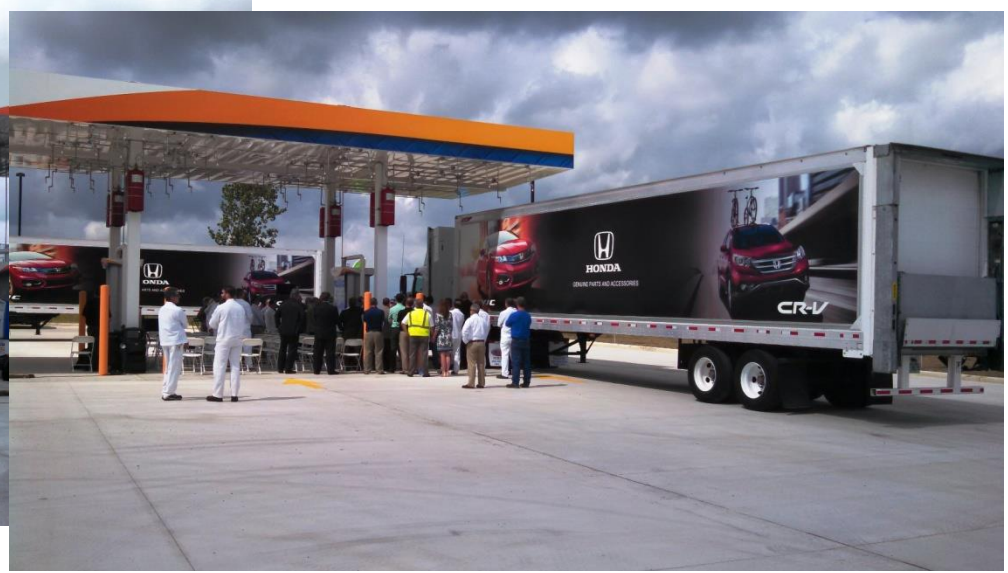
“Honda is estimating the potential for more than 3,500 deliveries per week to be CNG powered”

“That would be approximately 20,000,000 CNG powered miles per year”

“This conversion would avoid nearly 20 million pound of carbon emissions each year”

“That the equivalent of adding 7,400 acres of forest to the U.S. every year”


TRILLIUMCNG
Making CNG Work for You
HONDA


HONDA
CR-V


HONDA
The Power of Dreams
TRILLIUM CNG
HONDA
A 'NATURAL' SOLUTION FOR MORE EFFICIENT SHIPPING
+100
+3,500
20M
Diesel
3.86 lbs
VS.
Compressed Natural Gas
2.90 lbs
This conversion from diesel to CNG...
20 Million
pounds of carbon emissions every year
TRILLIUM CNG
CNG Work for You
WORLD STANDARD COMPRESSORS
HONDA

So, as shown with Love's and HONDA …

CNG has emerged as the fuel of choice for OTR and most off road applications

LNG does seem to be a better fit for:


LIQUEFIED NATURAL GAS
CNW1
SR 11065


CN
CN
CN

80% energy density versus 50% weight compared to diesel

So what is the practical different between CNG and LNG for OTR logistics?

Cryogenic

Cost Difference ~ from LOVES trial

	CNG	LNG
Net Discount to Diesel	$1.595	$0.490
Fuel Savings (Annual)	$32,157	$9,879
Payback (Years)	**1.87**	**6.07**

Todays diesel is on par or cheaper than LNG

Boil-off

Liquid vs Gas

Same engine in both vehicles!

Cryogenic – Ever freeze a flower in liquid nitrogen?

Boil-off ~ kind of like this …. But starting at -258 degrees Fahrenheit

So even if you froze your tanks to Zero degrees…

So for OTR or Off Road, CNG has been chosen nearly 90%+ of the time over LNG
(especially now as diesel is the same cost as or less than LNG).

So, once you've secured your fuel supply and you've identified CNG is a better fit ….

Evaluating your specific fleet need and vehicle availability.

But where do you start?

When evaluating your own fleet, start with vehicles that use the most fuel.

Gallons consumed is your most important data. Miles traveled or hours run are less important.

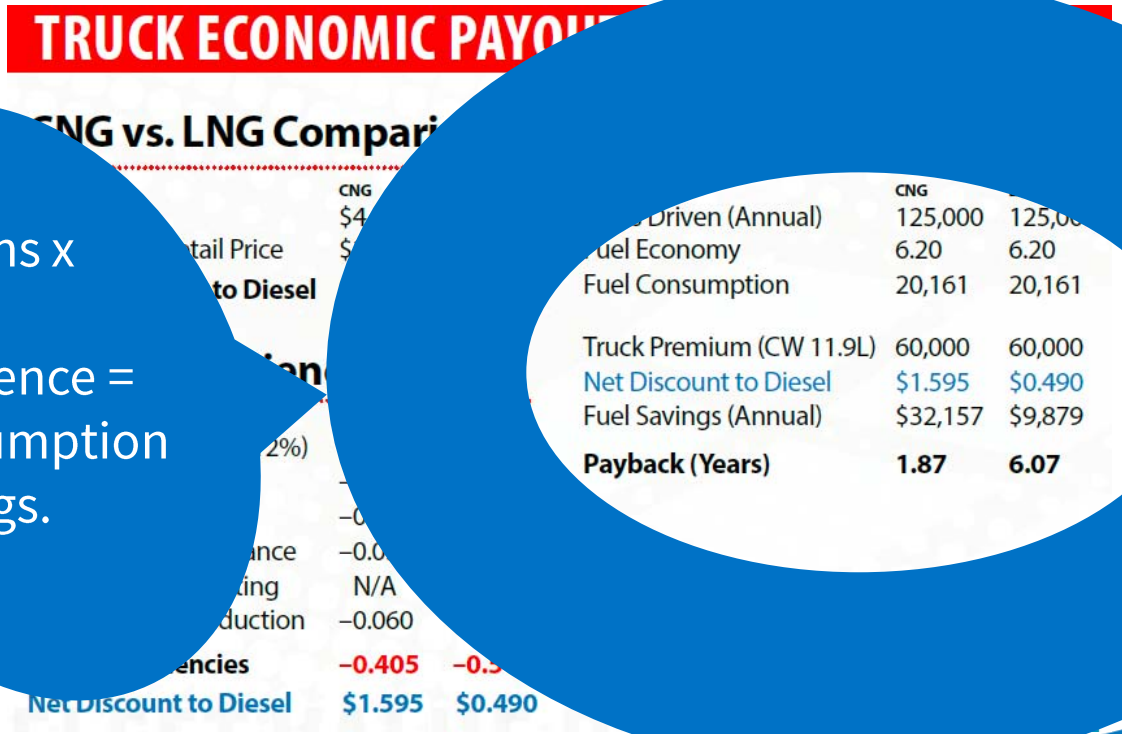
The more gallons consumed the more your fleet will save.

Miles or hours are indicators but actual fuel consumption is your best data point.

This represents your savings.

Total gallons consumed X dollars per gallon saved!

Gallons x price difference = consumption savings.



Monday, November 9th In Ohio

Highest Diesel Fuel Prices in the Last 24 hours

Price	Station		Area	Thanks
3.99 update	**Sunoco** 2091 Grafton Rd & Butternut Ridge Rd	map	Elyria	stacer513 3 minutes ago
3.89 update	**Sunoco** 5326 Turney Rd & Granger Rd	map	Garfield Heights	Buckeyedoc1 9 hours ago
3.89 update	**Marathon** 16717 Royalton Rd & Howe Rd	map	Strongsville	Brwnigrl 1 hour ago
3.79 update	**BP** 959 E Steels Corners Rd & Hudson Dr	map	Stow	jchtinman 8 hours ago
3.77 update	**Speedway** 1295 W Main St & Sunrise Dr	map	Kent	joshpara 4 hours ago
3.69 update	**7-Eleven** 16625 Royalton Rd & Howe Rd	map	Strongsville	Brwnigrl 1 hour ago
3.65 update	**Canton Fuel** 1600 US-62 NE near Gross Ave NE	map	Canton	kacompton 2 hours ago
3.55 update	**Gas Mart** 21820 Lakeshore Blvd & 218th	map	Euclid	rmallen007 7 hours ago

2.26 update	**Marathon** 480 E Main St & Clark St	map	Wilmington	samehoe **2 hours ago**
2.26 update	**Go Mart** 928 E State St near Townsend Pl	map	Athens	Nevilx4 **16 minutes ago**
2.26 update	**BP** TOP TIER 3101 Middlebranch Ave NE & Atlantic Blvd NE	map	Canton	hispeed4 **34 minutes ago**
2.26 update	**Murphy USA** 3220 Atlantic Blvd NE & Harmont Ave NE	map	Canton	matt99nascar **1 hour ago**
2.26 update	**Speedway** 1120 Canton Rd NW near 11th St NW	map	Carrollton	lumpkey **1 hour ago**
2.26 update	**United Dairy Farmers** 395 E Main St & Grant St	map	Wilmington	samehoe **2 hours ago**

Transportation Topics has the national average price of diesel at $2.48

For OTR Vehicles

~ based on 3350 gallons/yr consumption

Fleet Conversion Calculator

Fleet Inputs	
Fleet Size (number of vehicles)	10
Average Miles Per Year (per vehicle)	30,000
Average Fuel Efficiency (miles per gallon)	9
Average Conversion Cost	$9,000
Average Vehicle Lifespan (years)	7

Market Inputs	
Current Diesel Price	$2.75
Current CNG Price	$1.89
Federal/State Vehicle Conversion Tax Credits	$0

Results	
Months to Break Even (per vehicle)	37.67 months
Lifetime Savings per Vehicle (less Conversion Cost)	$11,067
Annual Fleet Savings	$28,667
Lifetime Fleet Savings (less Conversion Cost)	$110,667

For OTR Vehicles

~ based on 17,000 gallons/yr consumption

Fleet Conversion Calculator

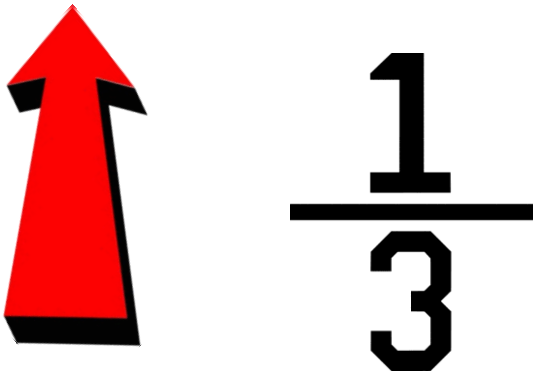
Fleet Inputs	
Fleet Size (number of vehicles)	1
Average Miles Per Year (per vehicle)	85,000
Average Fuel Efficiency (miles per diesel gallon)	5
Average Conversion Cost	$25,000
Average Vehicle Lifespan (years)	5

Market Inputs	
Current Diesel Price	$2.75
Current CNG Price	$1.89
Federal/State Vehicle Conversion Tax Credits	$0

Results	
Months to Break Even (per vehicle)	22.8 months
Net Lifetime Savings per Vehicle	$40,790
Annual Fleet Savings	$13,158
Lifetime Fleet Savings (less Conversion Cost)	$40,790

Fleet managers/owners – here's your low hanging fruit:

Look at your top third consuming pieces of equipment and see if there is a CNG offering!



$\frac{1}{3}$

If there is a CNG offering, then its simply a math equation, gallons used multiplied by savings per gallon.

How much do you save a year versus how much does it cost to purchase?

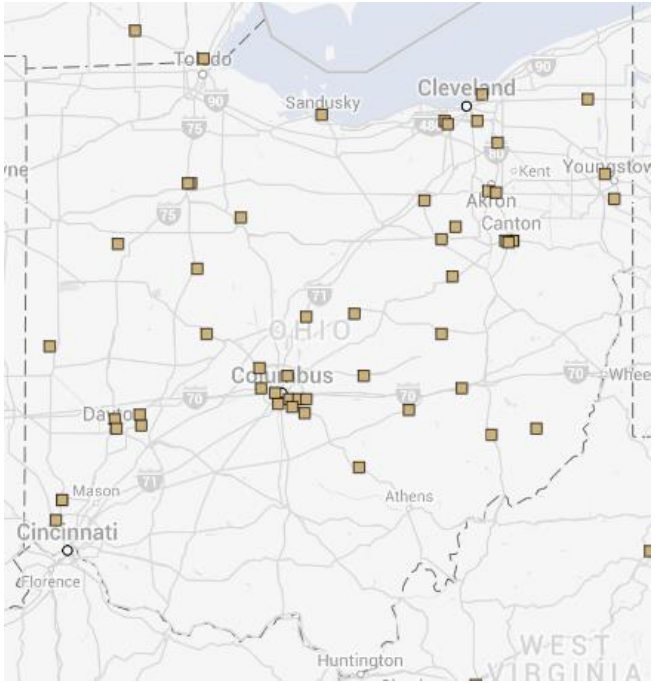
This is why using someone else's CNG station can make so much sense if you are wanting to deploy only a handful of natural gas vehicles (NGV's), eliminated station cost in your ROI calculation.

City of Dublin

Lodi

Marengo

Obetz



Public & Private CNG stations in Ohio

Evaluating if CNG is right for your fleet:

Opportunity cost (how much to buy and use CNG)

Opportunity return (how long until I get my money back and am saving/making money)

ROI = Opportunity Return – Opportunity cost

Start with using others fueling stations, using your highest fuel consuming vehicles

Now lets look at CNG vehicles.




- Light Duty CNG



- Medium to Heavy Duty CNG


- Heavy Duty On Road CNG

NGVs Today

Some off road examples.

Range Anxiety, a thing of the past!

Dedicated - only runs on one fuel. In this context CNG.

Bi Fuel – runs on two fuels at different times. In this context gasoline is the base fuel. The vehicle starts up on either gasoline or CNG depending on the technology. Runs on CNG and when it runs out switches over automatically or manual back to gasoline.

Dual Fuel – run on two fuels at the SAME time. Typically Diesel engine that is fogged with CNG either generically in air intake or directly into cylinder. When CNG runs out, vehicle runs as dedicated diesel engine.

Dedicated

Bi Fuel

Dedicated/Bi Fuel

Bi Fuel

Dedicated

Bi Fuel

Dedicated

Bi Fuel

Dedicated

Dual Fuel

What about off road vehicles?


1341
OZINGA
KENWORTH
OZINGA
Clean Fuel
Clean Air
OZINGA
Natural Gas
Clean Fuel Clean Air

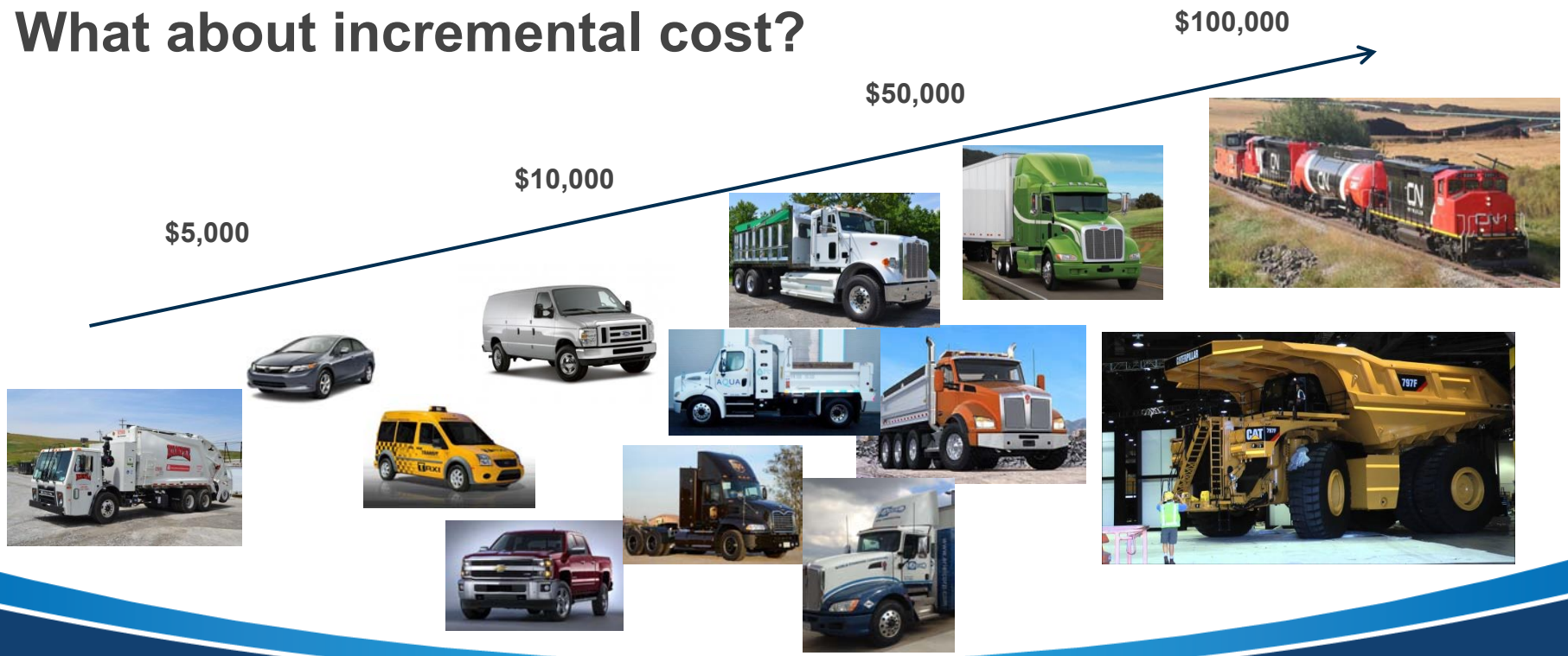

HYBRID


FritoLay
CNG
COMPRESSED NATURAL GAS
CNG


CAT


CATERPILLAR
795F
CAT
795F

What about incremental cost?

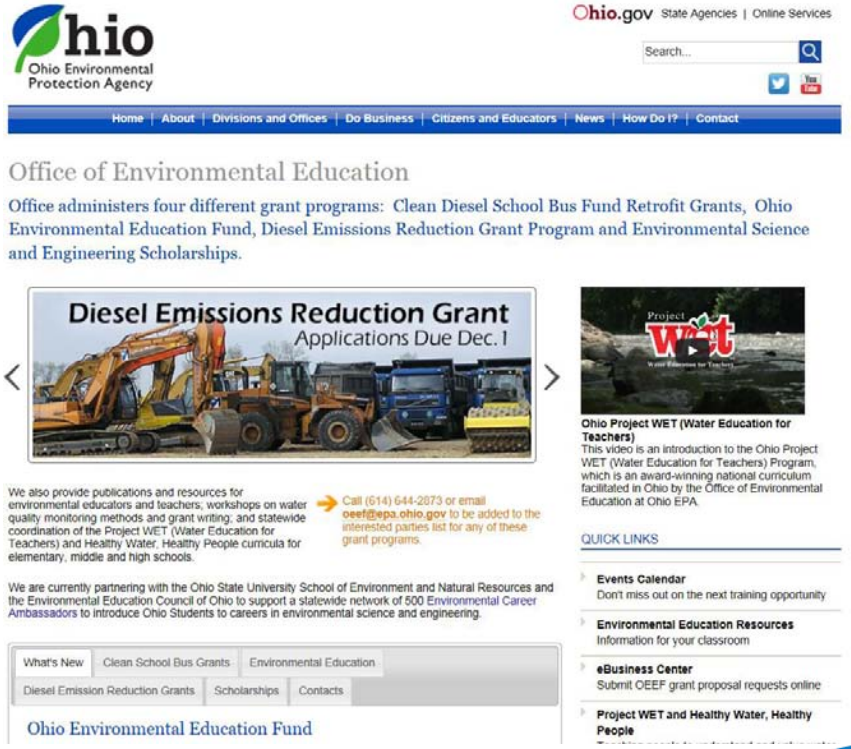


Let’s get sidetracked!

Funding

www.epa.ohio.gov/oeef/EnvironmentalEducation.aspx#131364255-whats-new

Google search “Ohio EPA” and “DERG”




Diesel Emissions Reduction Grant
Applications Due Dec. 1

2015 Diesel Emission Reduction Grants

$15 million to reduce air emissions from diesel fleets in priority counties

DERG@epa.ohio.gov

http://epa.ohio.gov/oee/derg.aspx

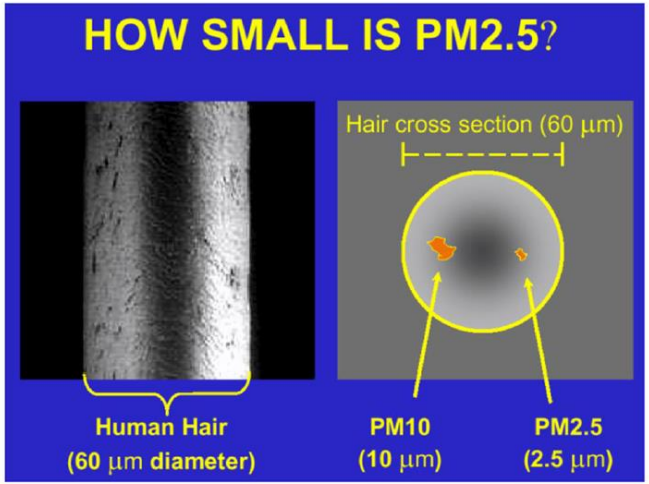
Ohio Environmental Protection Agency

Diesel Exhaust and Health

- Diesel exhaust contains small soot particles known as fine particulate matter
- Fine particles can lodge in the lungs and aggravate conditions such as asthma and bronchitis
- US EPA has determined that diesel exhaust is a likely human carcinogen

Ohio Environmental Protection Agency

Fine Soot Particles



Cite: Health Effects of Fine Particles, Dr. Bart Ostro, October 2003

Ohio Environmental Protection Agency

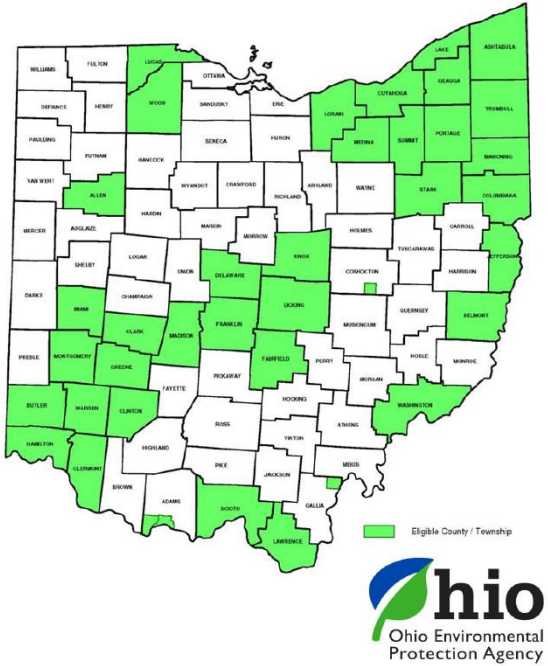
DERG Grant Program

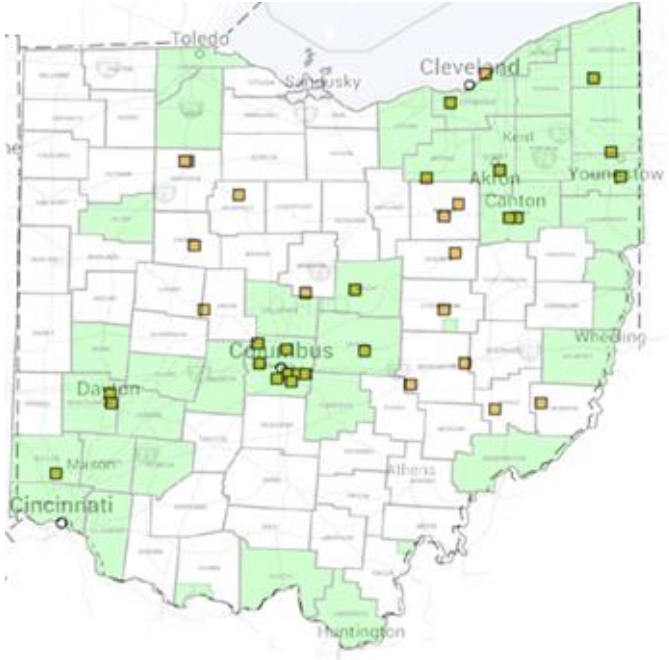
- Administered jointly by Ohio EPA and ODOT
- Federal Highway Administration, Congestion Mitigation and Air Quality (CMAQ) funds
- Grants will REIMBURSE up to 80% of eligible project costs
- Grant sizes (federal share): $50,000 - $1 million
- Competition, transparency and documentation are required of all federal aid projects

Eligible Fleets

Applications may be submitted from fleets operating at least 65% of the time in Ohio nonattainment counties: those not meeting federal air quality standards for fine particulates (PM 2.5) or ozone (green counties on map), or those in maintenance status as determined by US EPA

CMAQ Program
Eligible Counties & Townships





Superimposed CNG station map on Ohio EPA Non-Attainment Map

DERG Grant Application Review

- Application deadline 4:30 p.m. December 1, 2015.
- Answers to Frequently Asked Questions will be posted to DERG Website.
- Any PPPs that were not executed when application was submitted must be executed within 14 days of deadline.
- Ohio EPA expects to announce projects *recommended* for funding around January 15th
- FHWA issues formal eligibility determination
- Recommended projects may not proceed or seek bids for equipment until LPA agreement with ODOT has been executed, and FHWA has issued project authorization
- Another DERG RFP will be released in 2016

Ohio Environmental Protection Agency

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Q&A


Q&A
How
What
Why
When


QUESTIONS
ANSWERS

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