

# Compressed Natural Gas (CNG) Passenger Vehicle Application Value Proposition

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# Compressed Natural Gas (CNG)

## ANGA



- ANGA consists of 30 of North America's largest natural gas companies
- The alliance promotes the benefits of natural gas through education programs, advertising, government affairs activities, and special projects – such as this one.



**A STEP IN THE RIGHT DIRECTION**

**AMERICA'S NATURAL GAS smarter fuel today.**

Nearly a quarter of new transit buses in the U.S. run on clean, abundant American natural gas.

We have more natural gas right here in the U.S. than Saudi Arabia has oil. It's clean-burning and costs about 40 percent less than gasoline at the pump. So, why aren't we using it even more?

Together we can take a big step toward cleaner air and cheaper fuel. Start a conversation on how to bring more natural gas vehicles to your community.

**LEARN MORE AT [ANGA.US/NGV](http://ANGA.US/NGV)**



# CNG Value Proposition

## natural gas value proposition

- **Clean**
  - Generating electricity burns cleaner with less pollutants and no mercury
  - Vehicles emit 25% less CO<sub>2</sub> than gas or diesel
- **Abundant**
  - US has more than 2,000 trillion cubic feet
  - More being discovered every day
  - Enough fuel to power America for generations
- **Domestic**
  - 98% of the natural gas we use comes from North America
- **Jobs**
  - \$385 billion contributed to US economy in 2008
  - 2.8 million US jobs supported

Natural Gas = Fewer Emissions  
(Pounds per Billion BTU of Energy Input)

	Natural Gas	Coal
Carbon Dioxide	117,000	208,000
Carbon Monoxide	40	208
Nitrogen Oxides	92	457
Sulfur Dioxide	1	2,591
Particulates	7	2,744
Mercury	0	0.016

Source: EIA, *Natural Gas Issues and Trends*, 1998

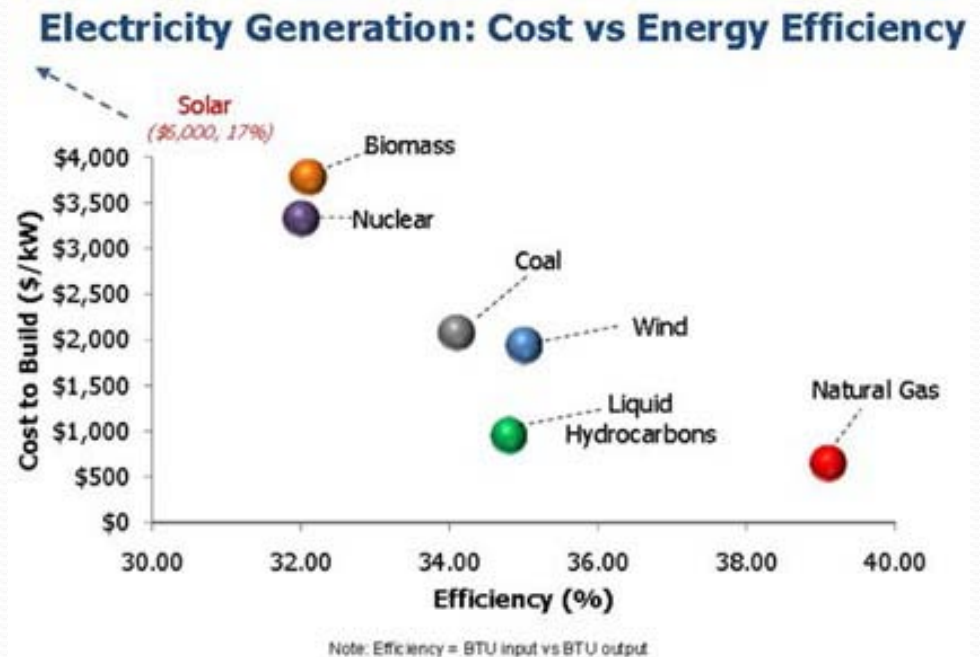




# CNG Value Proposition

## why natural gas?

- Efficient in generating electricity
- Coal comparison
  - 39% more efficient than the oldest 50% of existing coal generation capacity
  - 58% more efficient than the oldest 10% of coal fired plants
  - Need to burn 60% more coal to generate equivalent power
- Beats out all other sources
  - Each new plant increases in efficiencies and continually improve the value



Source: Black & Veatch



# Economic Impact

## employment, income, value

### Natural Gas Impact on the U.S. Economy

	Direct	Indirect	Induced	Total
<b>Employment</b>				
2008	622,411	723,102	1,482,801	2,828,314
2007	586,501	693,957	1,412,401	2,692,499
2006	517,233	620,061	1,282,248	2,419,542
<b>Labor Income (billions of dollars)</b>				
2008	69.9	48.9	62.5	181.2
2007	66.1	47.0	59.5	172.6
2006	60.1	42.6	54.0	156.7
<b>Value Added (billions of dollars)</b>				
2008	172.1	92.5	120.1	384.7
2007	161.9	88.8	113.8	364.4
2006	146.6	81.1	103.3	330.9

Source: IHS Global Insight, 2009

### Economic Impact of Natural Gas Compared to State Annual Average GDP (billions of dollars)

Ranking	State	GDP
1	California	1,846,757
2	Texas	1,223,511
3	New York	1,144,481
4	Florida	744,120
5	Illinois	633,697
6	Pennsylvania	553,301
7	New Jersey	474,936
8	Ohio	471,508
9	North Carolina	400,192
10	Georgia	397,756
11	Virginia	397,025
12	NATURAL GAS	384,734
13	Michigan	382,544
14	Massachusetts	364,988
15	Washington	322,778

Source: IHS Global Insight, 2009



# CNG Value Proposition

## fleet vehicles

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- **Buses and Mass Transit**
  - Transit agencies across the country are increasingly switching to NGVs
- **Taxis, Vans and Shuttles**
  - Airport and hotel shuttles, taxi services, etc. are increasingly switching to NGVs
- **Service Provider Fleet Vehicles**
  - Several major companies have invested heavily in natural gas fleet vehicles
- **Select Companies and Municipalities**
  - UPS, AT&T, Ryder, Verizon, Utah, Kansas City, Seattle, Los Angeles, Washington DC, Long Island, and many more.....



# CNG Value Proposition

## aftermarket conversions

- **Individual consumers purchase an aftermarket CNG conversion kit**
  - Install system on their own personal vehicle
  - Maintain the vehicle for safety and use
  - Many variables which increase risk
- **CNG conversion kit providers**
  - Many companies providing these products at very different levels of volume and quality
  - There is no standard guiding the safety, quality and efficiency of these systems
- **Emerging Certifications**
  - CNG United Systems Installation Certificate
  - CSA Vehicle Fuel Systems Inspector Certificate





# CNG Value Proposition

## EPA & CARB certified

- **Current OEM production vehicles**
  - 1997 Honda Civic GX
  - 2010 Ford MV-1 Sedan
  - 2011 GM Cargo Van
- **Introducing Bi-Fuel production vehicles**
  - 2013 GM Chevrolet and GMC
  - 2013 Ford F-250 and F-350
  - 2013 Dodge Ram 2500 4X4
- **Certified engines for conversions on vehicles up to 14,000 GVWR**
  - (90) General Motors
  - (42) Ford
  - (4) Chrysler
  - (4) Workhorse
  - (3) Isuzu
  - (2) Mitsubishi
- **Certified conversion companies**
  - Altech – Eco
  - American Honda Motor
  - BAF Technologies
  - CNG Store
  - Cummins Westport
  - Doosan Infracore America
  - Emissions Solutions Inc.
  - General Motors
  - GoNatural CNG
  - High Pressure Group
  - IMPCO Technologies
  - Landi Renzo USA
  - NatGasCar
  - NGV Conversions
  - Westport Innovations

*Source: NGVAmerica, EPA & CARB*





# CNG Value Proposition

## CNG US production vehicles

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- **2012 Honda Civic GX**
  - Introduced in 1997
  - From \$26,155 to \$31,427 MSRP
  - 1.8 liter 16 valve SOHC
  - 8 Gallon CNG fuel tank, 248 mile range
- **2012 GM Express / Savana Cargo Van**
  - Introduced in 2011
  - Starts at \$41,890 MSRP, CNG option
  - 6.0 liter V8 engine
  - Multiple CNG fuel tank configurations
    - 200-300 mile range
- **2012 Ford VPG MV-1 Sedan**
  - Introduced in 2011
  - 4.6 liter 2V EFI V8 engine
  - 21 Gallon CNG Fuel tank, 290 mile range



# CNG Value Proposition

## bi-fuel CNG US production vehicles

- **2013 GM Chevrolet Silverado and GMC Sierra**

- \$11,000 bi-fuel CNG option
- 6.0 liter V8 engine
- Single light-weight Type 3 CNG fuel tank
- 650 mile range



- **2013 Ford F-250 and F-350**

- \$9,750 to \$10,950 bi-fuel option
- 6.2 liter V8 engine
- Up to 24 GGE Type 4 composite CNG fuel tank
- 600 mile range



- **2013 Dodge Ram 2500 4X4**

- 5.7 liter hemi V8 engine
- 367 mile range



# CNG Value Proposition

## 10 million global CNG powered vehicles

- Chevrolet – US, Thailand
- Citroen – France, Germany, China
- Fiat – Italy, Germany, Spain, Brazil, Czech
- Ford – US, Germany, India
- Geely – China
- GMC – US
- Honda – US
- Hyundai – India
- Lifan – China, Peru
- Mitsubishi – India
- Opel – Germany, Spain, Czech
- Renault – Germany
- Skoda – Germany, Spain
- Volkswagen – Germany, Czech



# CNG Value Proposition

## future CNG powered vehicles

- **CNG vehicles continually demonstrate their value to the global market**

- Reducing emissions
- Increasing fuel efficiencies
- US production of natural gas



- **Expansion of fleet vehicles**

- Existing fleet operators are expanding
- New major companies are entering this market to capture the efficiencies



- **Development of passenger vehicles**

- Passenger vehicle OEMs are developing vehicles to address this emerging market



# CNG Value Proposition

## governmental incentives

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### Past

- **Income Tax Credits for Alternative Fuel Vehicles expired on 31 Dec 2010**
  - From \$2,500 to \$32,000 depending on size of the vehicle
  - Newly proposed HR 1380 addresses incentives for vehicles
- **Income Tax Credits for Alternative Fuel Infrastructure expired on 31 Dec 2011**
  - Up to \$30,000 for large stations
  - Up to \$1,000 for home refueling

### Proposed

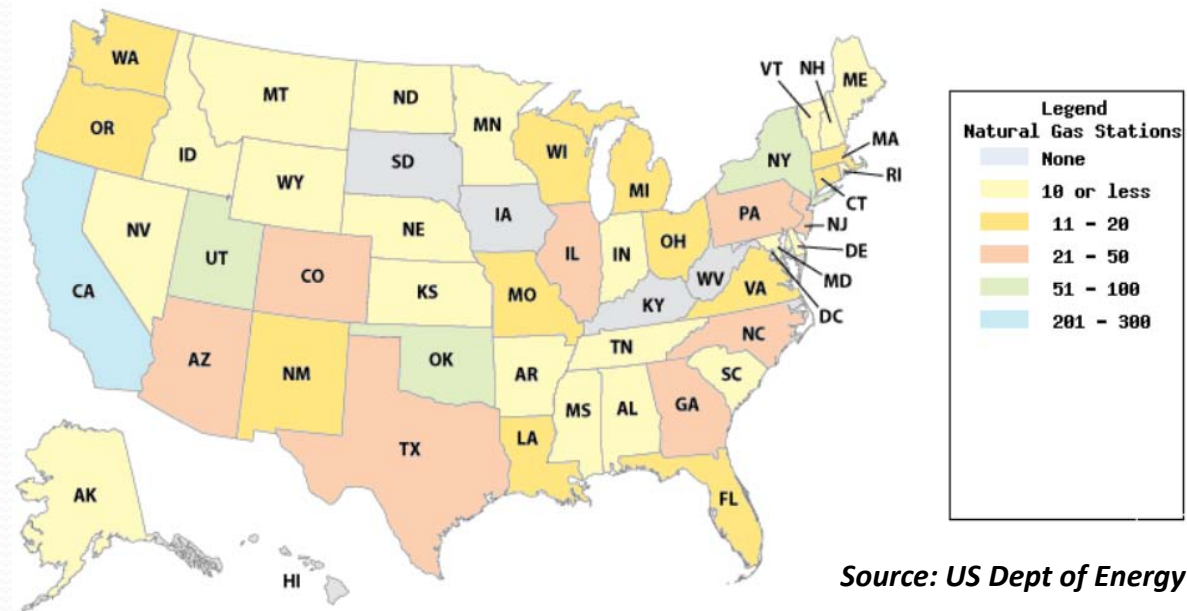
- **HR 1380 New Alternative Transportation to Give Americans Solutions Act of 2011**
  - Known as the NAT GAS Act
  - Introduced 06 Apr 2011
  - Currently referred to several committees
  - Multiple tax credits for CNG / LNG fuel
  - Multiple tax credits for CNG / LNG vehicles
  - Funding to develop CNG / LNG vehicles
  - EPA streamline certification for retrofit kits
  - EPA incentives to produce CNG / LNG vehicles

# CNG Value Proposition

## fueling CNG vehicles



- More than 10 million Natural Gas Vehicles (NGV) on the road worldwide
- 110,000 NGVs in the US on the road today
- More than 1,100 NGV fueling stations in the US
- Natural gas fueling station corridors:
  - Las Vegas to California
  - Idaho to Arizona
  - City of Seattle
  - and growing.....
- Home Fueling
  - \$4,500 cost plus install
  - 8 hour duty cycle



# CNG Value Proposition

## performance comparisons

### Emissions

- The EPA notes that CNG vehicles emit about 25% less carbon dioxide as compared to gas or diesel
- A CNG school bus is 223.5 times less toxic than it's gas or diesel version
- Converting one heavy duty truck from diesel to CNG is equivalent of taking 325 cars off the road



### Fuel Economy

- Cleaner burning fuel means less costs for maintenance of the fleet
- Diesel fuel
  - Typical 25% overall savings
  - 38% price savings
- Gasoline fuel
  - Typical 22% overall savings
  - 39% price savings

Source: Dept of Energy Oct 2011





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Source: IHS Global Insight, 2009





# CNG Value Proposition

## workforce required

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- **Program Managers** \$80-125k
  - Manage CNG program from initial development to production launch
  - Compliance to regulatory standards
  - Scope, time, cost and quality
- **Engineering Managers** \$80-125k
  - Manage engineers and designers as they develop the CNG vehicle
  - Compliance to engineering standards
- **Engineers** \$60-90k
  - Detailed development of engineering specs to assigned CNG components
- **Designers** \$60-90k
  - Detailed design files to engineering specs to assigned CNG components
- **Quality Engineer** \$60-90k
  - Quality assurance and control plans that meet specific CNG requirements
- **CNG Inspectors** \$40-60k
  - Perform inspection protocol on CNG conversion and production vehicles
  - Certify outcomes of the inspection
- **CNG Technicians** \$40-60k
  - Mock up and configure CNG system on demonstration vehicles
- **CNG Mechanics** \$30-50k
  - Perform maintenance protocol on CNG conversion and production vehicles



# CNG Value Proposition

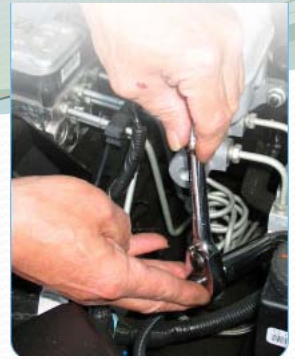
## workforce development

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- **The Center for Professional Studies**
  - Since it's founding in 1993, CPS has trained and certified over 7,000 technical professionals at over 400 corporations served in multiple industries
  - CPS is a Michigan based licensed vocational training institute
  - Our methodology is a fast paced, hands-on approach which covers theory, industry application and then demonstrated on real life company projects
  - In 2009 CPS applied this corporate training model to 255 unemployed technical professional with a 97% job placement rate in meaningful employment
- **Compressed Natural Gas (CNG) System – Practitioner Program**
  - Using CPS's highly successful Practitioner Certification model a unique program has been created to meet the specific needs of CNG systems in vehicles
  - This 3 course program includes all the key elements of understanding the theory, application and then hands-on real projects
  - This certification achieved by each participant demonstrate their competence

# CNG Value Proposition

## practitioner certification courses



- **CNG System – Engineering Vehicle Integration** [Syllabus](#)
  - Overview of the various CNG vehicles that operate in the global market
  - Specifications and configurations are reviewed and outlined as a block diagram
- **CNG System – Installation and Inspection Certification** [Syllabus](#)
  - Overview of the various CNG conversion kits available in the US market
  - Standardized installation process, maintenance protocol and inspection protocol is reviewed and applied on a vehicle
  - CNG United Systems Installation Certification is achieved
  - CSA Vehicle Fuel Systems Inspector Certification is achieved
- **CNG System – Vehicle Program Management** [Syllabus](#)
  - Detailed review of program management tools, techniques and methodologies that are compliant to TS 16949 and ISO 9000 quality standards
  - Detailed review of the FMVSS and CMVSS standards to ensure compliance
  - Program plan is created to develop a new CNG vehicle platform



# THE CENTER FOR PROFESSIONAL STUDIES

*Optimizing performance by accelerating experience*



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