



The Green American Road Trip

Austin to Boston on Natural Gas

Castlen Kennedy
October 12, 2010



The Driver: Castlen Kennedy

- ▶ UT graduate student
 - ▶ LBJ School of Public Affairs
 - ▶ Jackson School of Geosciences
 - ▶ Dual Masters thesis will explore nat gas as transportation fuel
- ▶ Part time Apache Corporation employee
- ▶ Trip Sponsors:





The basics of NGVs

- ▶ Natural gas vehicles (NGVs) are designed to run on compressed natural gas (CNG) or liquefied natural gas (LNG).
- ▶ CNG is natural gas compressed to 1% of its volume.
- ▶ CNG is normally dispensed and priced in “gallons of gas equivalent” (GGE).
- ▶ Current application focused on heavy duty and fleet vehicles.

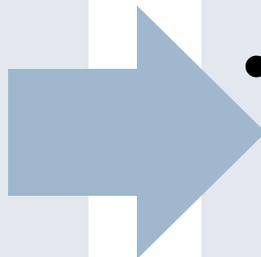




CNG: Why all the interest?

Big Picture Challenges

- Air Quality Concerns
- National Security & Oil Imports
- Economy & Jobs



The CNG Opportunity

- Reduced Emissions
- Diversified Transportation Fuel Mix
- Fuel Cost Savings & Green Jobs





Advantages of CNG

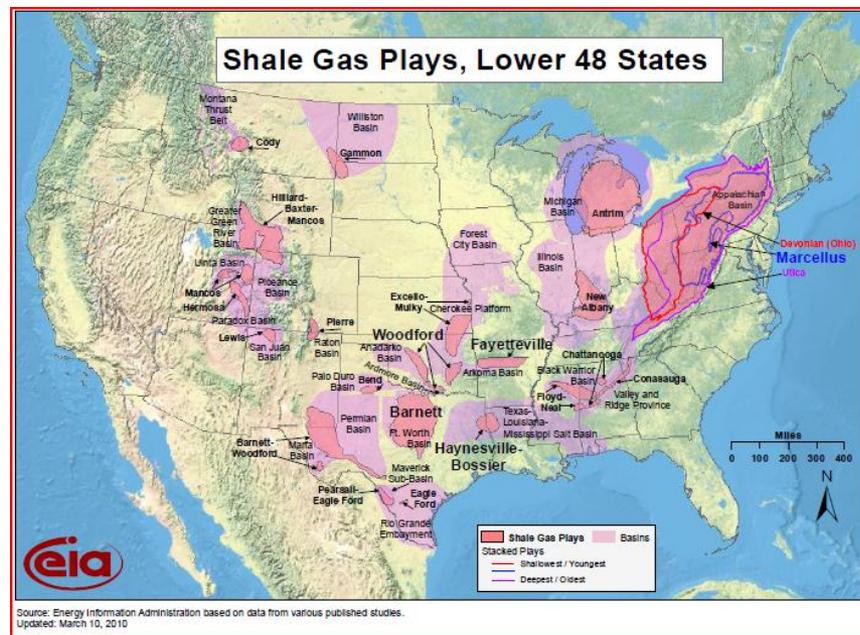
1. Domestic and abundant resource base
2. Cheaper than gasoline
3. Fewer emissions than gasoline





Shale gas expanding U.S. Supply

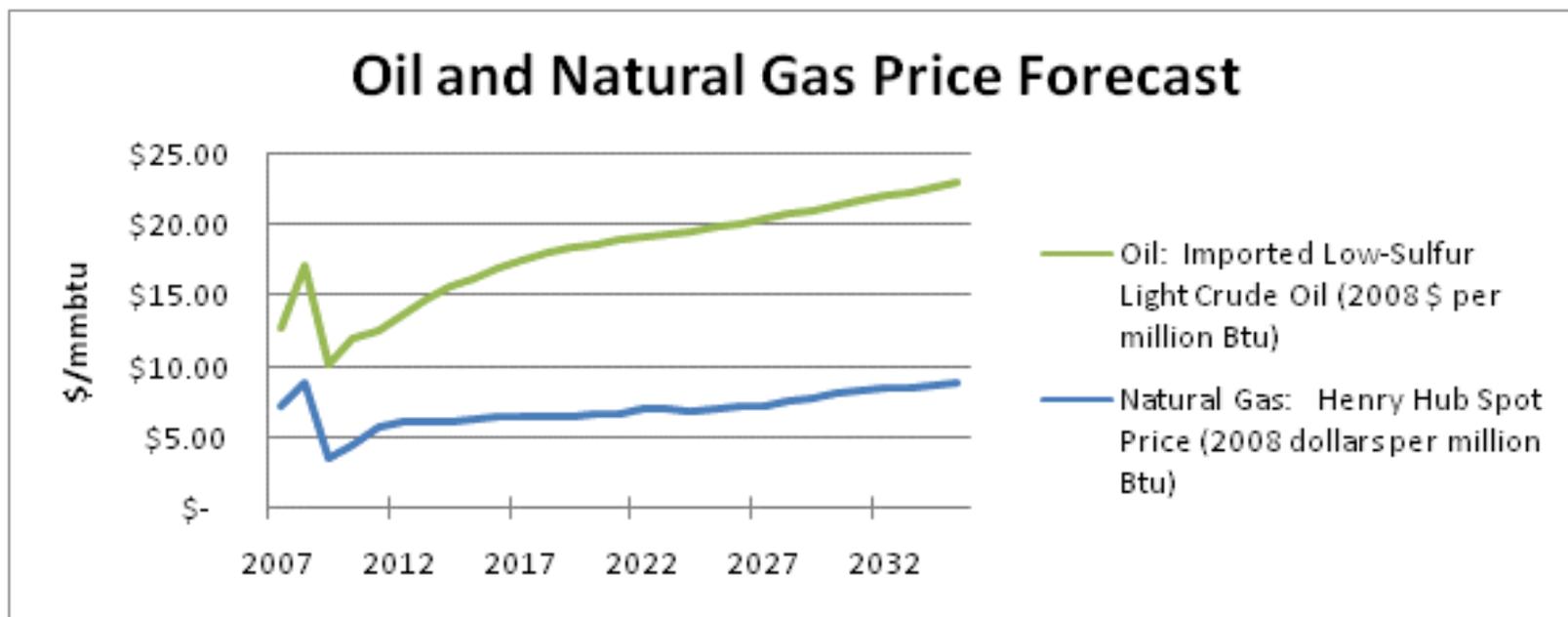
- ▶ PGC 2008 US Resource base estimate = 1,836 TCF, 39% increase over 2006 estimate
- ▶ DOE proved reserves 2008 = 244.7 TCF
- ▶ Total gas supply of 2,087 TCF



*At current consumption rates of 20 TCF/yr,
we have a 100 year supply*



Oil and Natural Gas Multiple Expanding



Source: EIA AEO 2010



Overall Average Fuel Prices

(on energy equivalent basis)



April 2010 Overall Average Fuel Prices on Energy-Equivalent Basis			
	Nationwide Average Price in Gasoline Gallon Equivalents	Nationwide Average Price in Diesel Gallon Equivalents	Nationwide Average Price in Dollars per Million Btu
Gasoline	\$2.71	\$3.03	\$23.52
Diesel	\$2.65	\$2.95	\$22.94
CNG	\$1.91	\$2.13	\$16.57
Ethanol (E85)	\$3.25	\$3.63	\$28.19
Propane	\$4.01	\$4.47	\$34.77
Biodiesel (B20)	\$2.79	\$3.11	\$24.18
Biodiesel (B99-B100)	\$3.69	\$4.12	\$31.98

SOURCE: USDOE



Emission Reductions

- ▶ 90%-97% reduction in carbon monoxide emissions
- ▶ 25% reduction in carbon dioxide emissions
- ▶ 35%-60% reduction in nitrogen oxide emissions

The U.S. Environmental Protection Agency has called the natural gas Honda Civic GX the cleanest internal-combustion vehicle on Earth.

Source: USDOE





Disadvantages of NGVs

- ▶ Infrastructure challenges
- ▶ Cost of conversion
- ▶ Tank space required
- ▶ Safety concerns



US CNG Station Locations



Source: USDOE

785 CNG stations in U.S.
120,000 Gasoline stations in U.S.





Cost of CNG Passenger Vehicles

- ▶ New OEM vehicle – Honda Civic GX
 - ▶ Incremental cost of \$6,800
- ▶ Converted vehicle
 - ▶ Kit and installation cost can run \$10,000 and up
- ▶ Economics realized on high-mileage, low fuel economy vehicles





The Road Trip





The Vehicle

- ▶ 2009 Chevrolet Tahoe
- ▶ Converted to run on CNG or gasoline (dual-fuel)
- ▶ Fuel Economy: 16 city/21hwy (similar for both fuels)
- ▶ Fuel Capacity:
 - ▶ Gasoline Capacity – 26 gallons
 - ▶ CNG – 22 gallons equivalent (5 tanks)
- ▶ ~350 mi CNG range





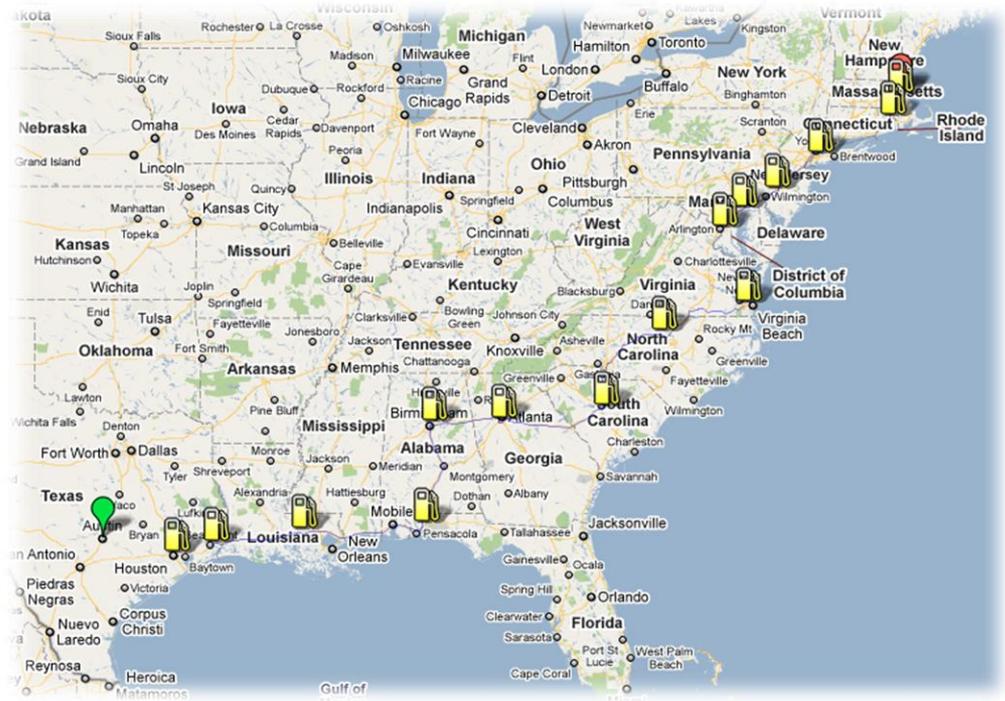
The Trip: by the numbers

10 days

15 CNG stations

28 meetings

2,500 miles





Join the Trip!

The Green American Road Trip AUSTIN TO BOSTON ON NATURAL GAS

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About The Trip

A 10-day, 2,300 mile road trip,
all on natural gas.
May 19 - May 28, 2010

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So while today is mostly a day of driving with two stops for fuel along the way, we also made a cool stop in Athens, GA this morning. In addition to being able to refuel at CNG stations, there are also home fueling devices which allow you to tap into the natural gas already running into your home to fuel the water heater, stove, etc. I think the ability to fill up at home is one of the most interesting aspects of the natural gas vehicle.

Georgia Green Fuel, LLC is the local distributor for the Fuelmaker Phill home fueling device. George and Leon of the company met us at the home of Leon's daughter, Brittany, to show off the device and explain how they work.

Join the Trip





Social Media Results

- ▶ Developed online supporters who followed trip progress
- ▶ Created interactive website for education
- ▶ Developed relationships with NGV enthusiasts & experts

19 blog posts (2/day)

13,000 website page views

7,000 photo views on Facebook

215 tweets (11/day)





Pics from the Road





Pics from the Road





CNG Trip Performance

- ▶ Successfully made it from Austin to Boston on CNG!
- ▶ CNG was 30% cheaper:
 - ▶ Avg price of gasoline = \$2.66/gallon; \$.14/mile
 - ▶ Avg price of CNG = \$2.10/gallon; \$.11/mile
- ▶ CNG was more fuel efficient:
 - ▶ Avg gasoline mpg = 18.74 mpg
 - ▶ Avg CNG mpg = 19.72 mpg
- ▶ CNG was cleaner:
 - ▶ 30% reduction in CO₂ emissions
 - ▶ No detectable CO emissions





CNG Challenges

- ▶ Refueling challenges
 - ▶ Uniformity of equipment
 - ▶ Public access
 - ▶ Station operators
- ▶ Equipment and vehicle availability
 - ▶ Upfront conversion cost & OEM costs
 - ▶ Home fueling device availability
- ▶ Narrow focus: dedicated and fleets/HD
- ▶ Must encourage by doing...





Contact Info

Castlen Kennedy

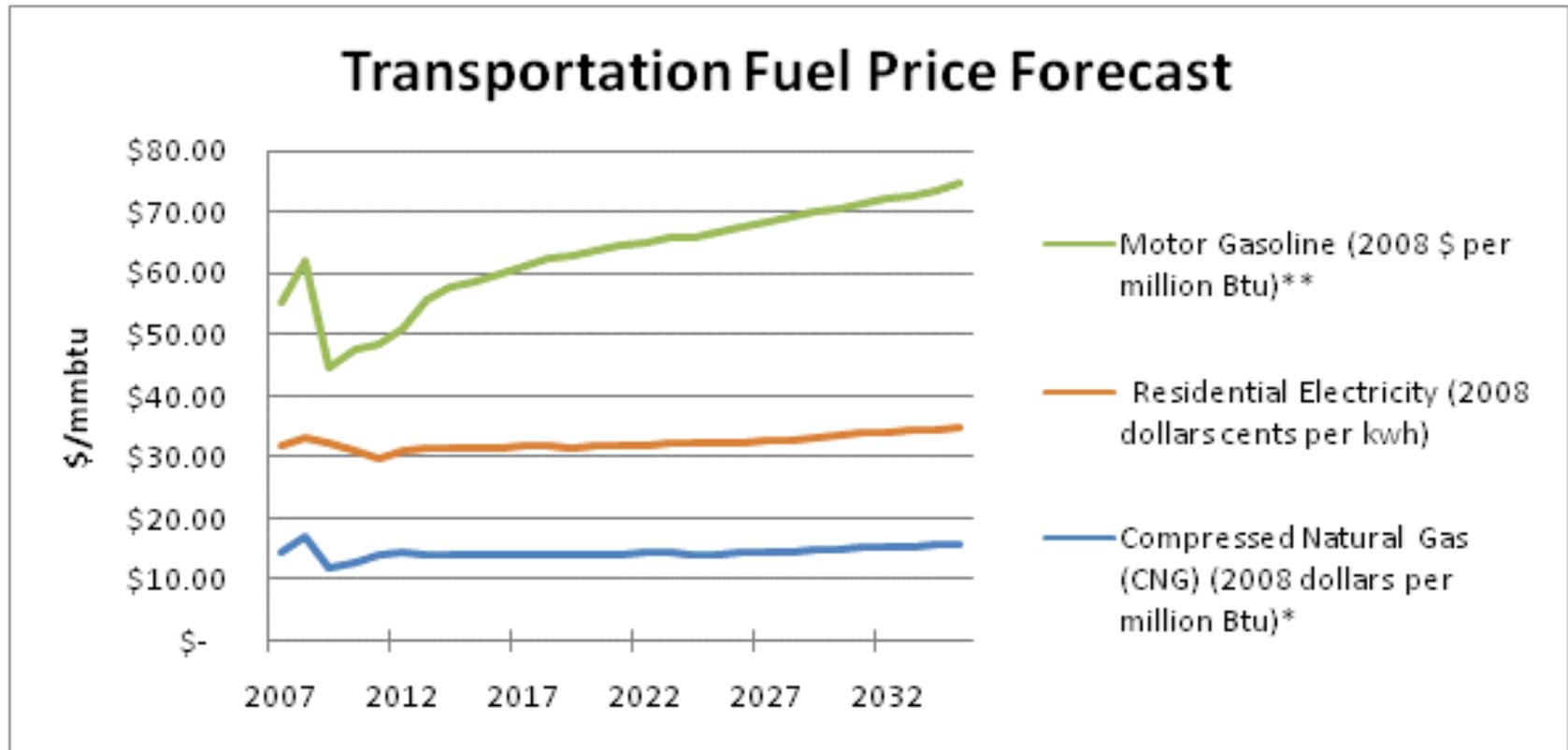
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Price Forecast Anticipates CNG to remain cheaper than alternatives



Source: EIA AEO 2010





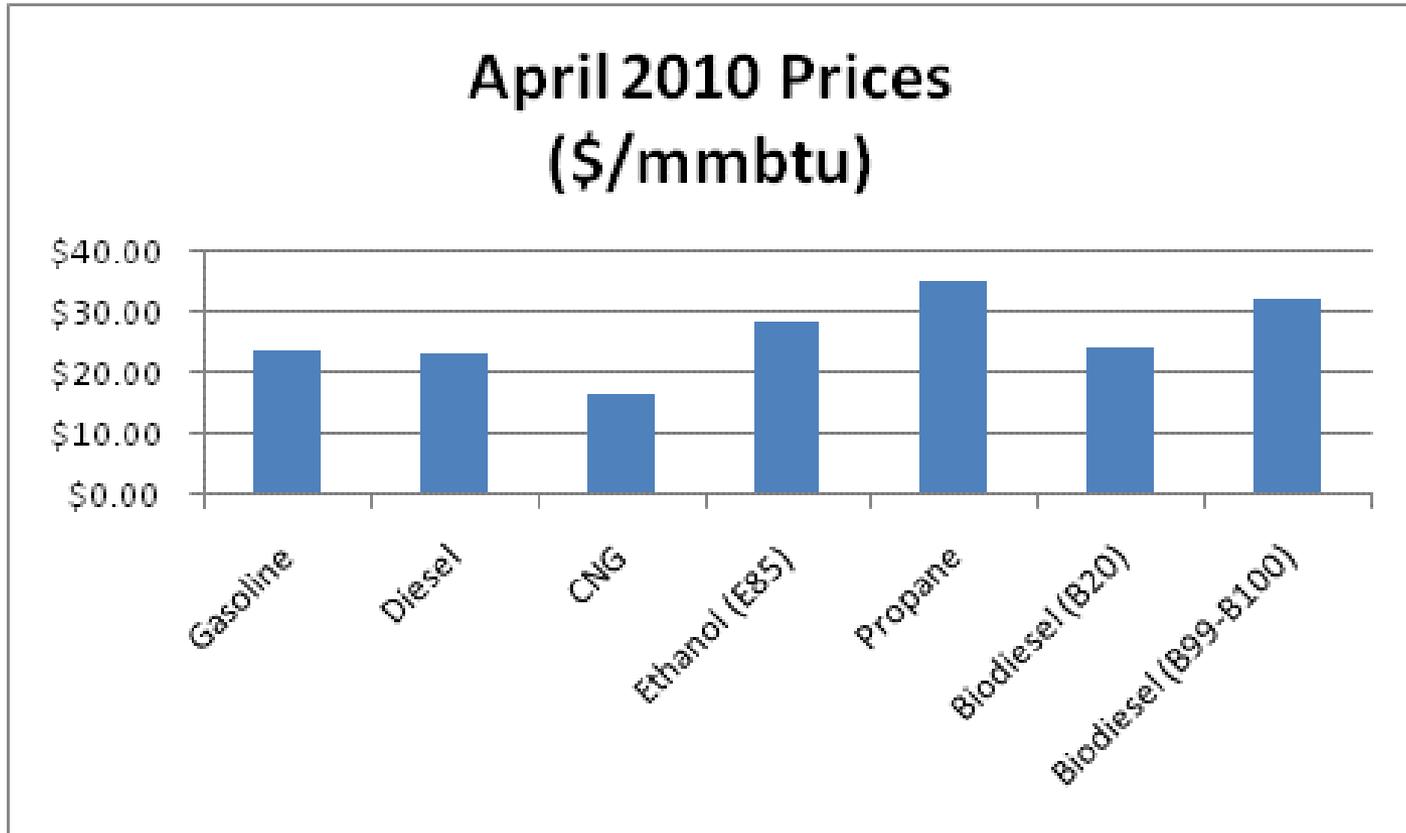
Sample Data from Converted Tahoe

	CNG			Gasoline	
	Standard	High Speed	Low Speed	High Speed	Low Speed
RPM		2200	590	2284	596
HC (ppm)	220	13	9	7	7
CO (%)	1.2	0	0	0.01	0.01
CO2 (%)		11.9	11.8	15	15.2
O2 (%)		0	0.1	0	0
DILUTION	>6.0	11.86	11.8	15.01	15.21



Overall Average Fuel Prices

(on energy equivalent basis)



SOURCE: USDOE

