

Apache

AUSTRALIA

ARGENTINA

CANADA

EGYPT

NORTH SEA

U.S. CENTRAL

U.S. GULF



***Natural Gas will power your vehicle-
“probably sooner than you think”***

Cal Cooper

Already big in the world....

NASA
C 99-2815



National Aeronautics and Space Administration
Lewis Research Center

- ◆ Global = 12.6 MM vehicles
 - ◆ Pakistan 2.6 MM (61%)
 - ◆ Iran 2.0 MM (12.6%)
 - ◆ Brazil 1.7 MM (3.4%)
 - ◆ Argentina 1.9 MM (15.3%)
- ◆ PROVEN, SAFE, ECONOMICAL

Natural Gas Vehicles



HOUSTON



PERTH



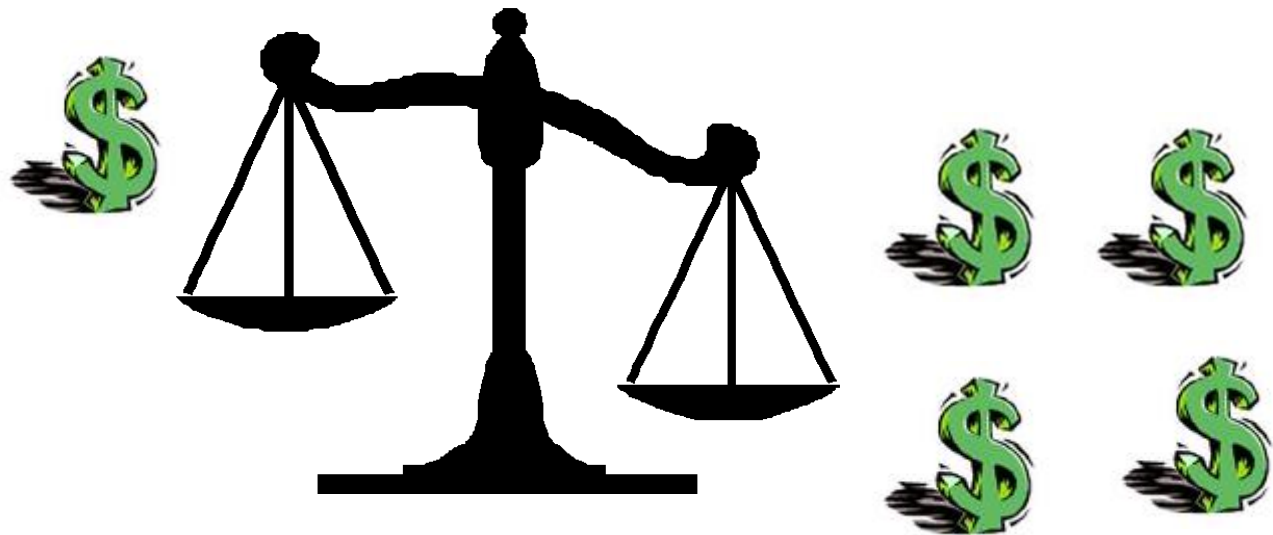
SYDNEY

It's about supply, cost, location



Energy Price : Advantage Gas

- ◆ Traditional linkage oil and gas price:
 - ◆ About 6 times on energy value basis (BOE)
 - ◆ With \$100 oil and \$4.00 gas, now 25 times by energy
 - ◆ Or 4 times “normal”
 - ◆ Price equalization seems unlikely in North America



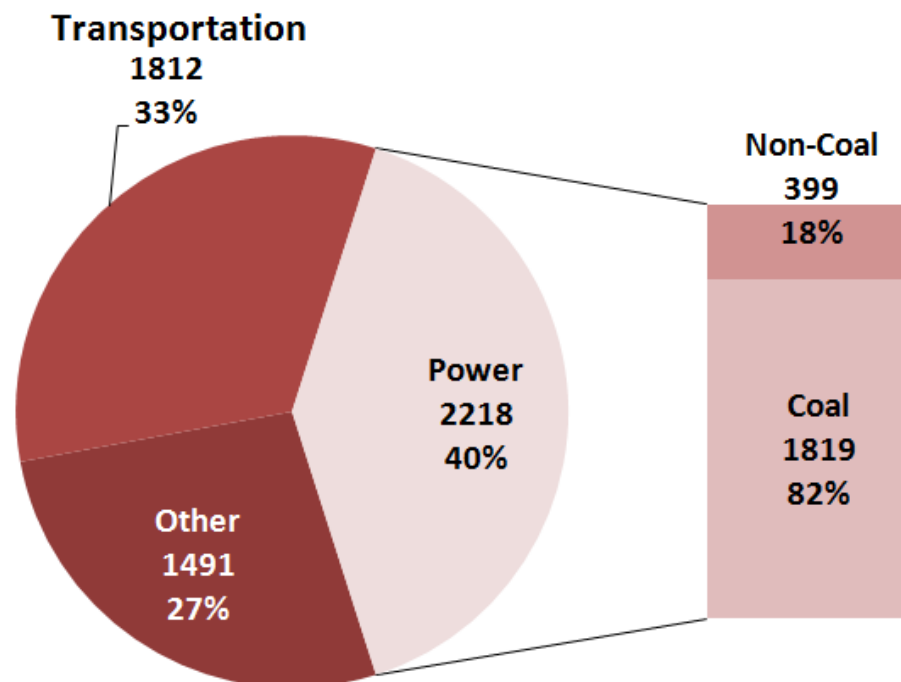
GHG Emissions Snapshot – Million tonnes year



GHG Emissions	734
Transportation	198 = 27%
--vehicles	135 = 18%
Power	119 = 16%



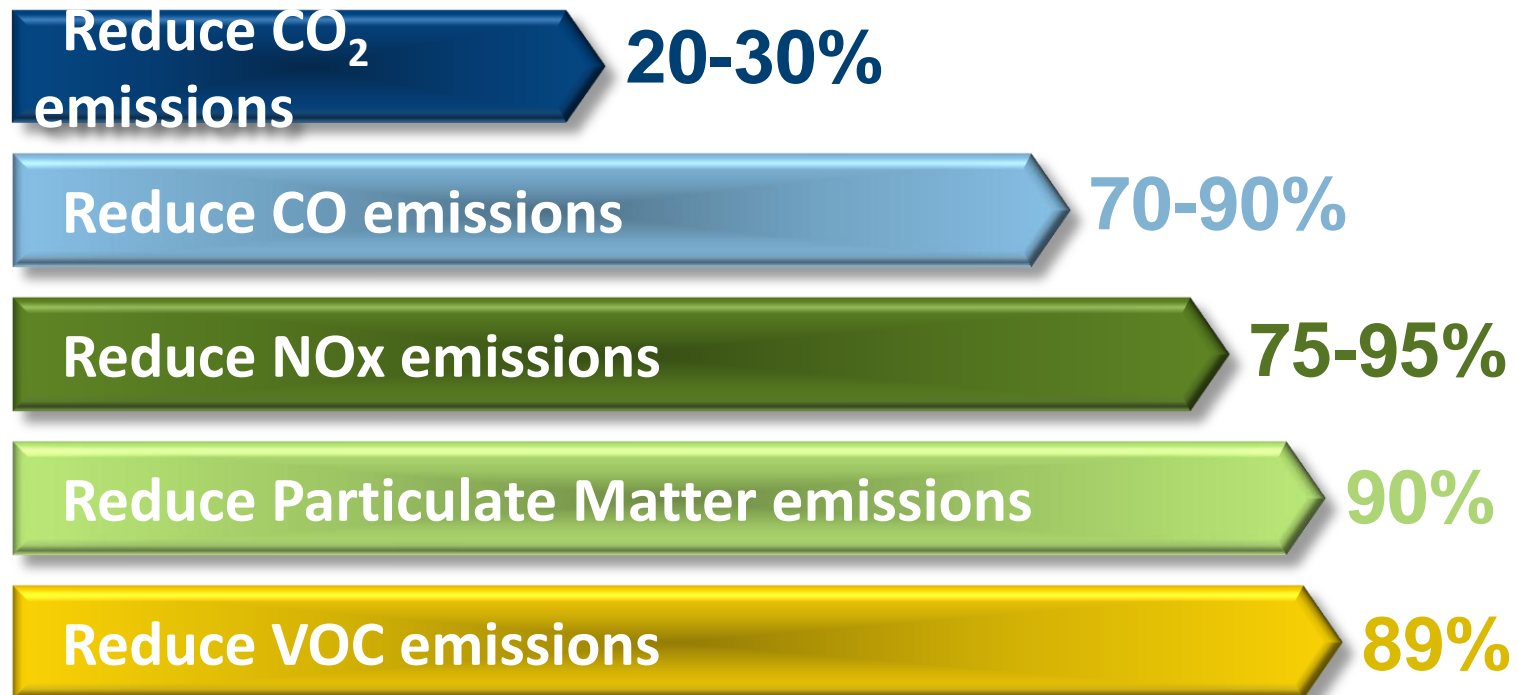
GHG Emissions (5521 MMTY)



CNG Vehicles emit ~25% less CO₂e

Emissions -- Natural Gas Vehicles

- ◆ Gasoline + Diesel “Tough to Beat”but



Infrastructure: “off the shelf”-- Cost Reasonable



- ◆ Above Ground
- ◆ Skid mounted systems
- ◆ Storage, compression, delivery
- ◆ Sound proofing +/-

Fuel Sales Price < \$2 GGE @ \$4.00 MCF

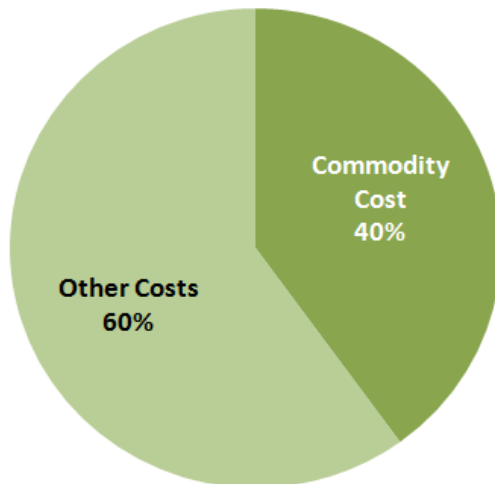
Add ~12.5 cents every \$MMCF

Capital ~ 1- 1.5 \$MM

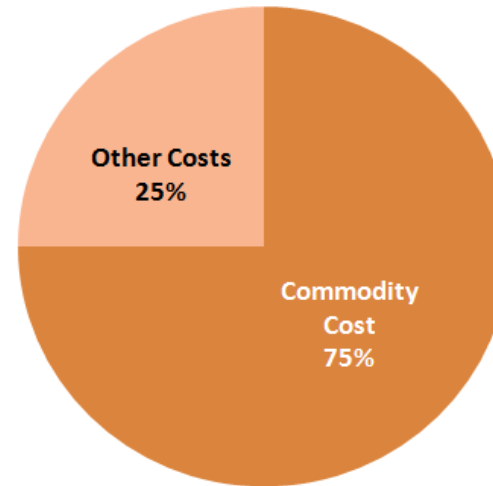
Break even sales ~ 1000 GGE/d (77 vehicles @ 13 GGE)

Price Sensitivity: CNG vs. Petrol

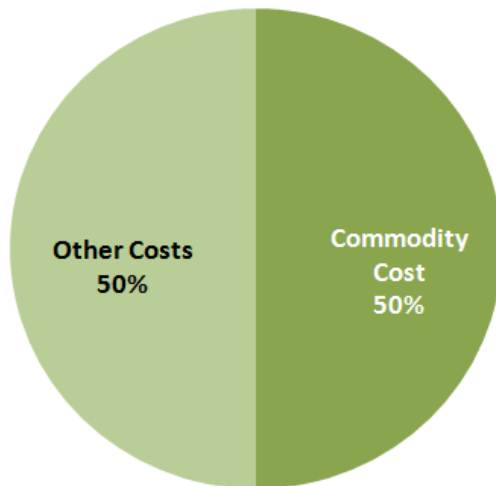
CNG, \$5 MCF



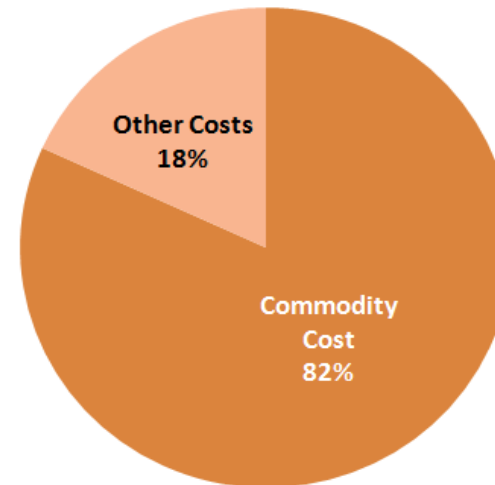
Petrol, \$80 Bbl



CNG, \$5 MCF -> \$7.50 MCF



Petrol, \$80 Bbl -> \$120 Bbl



What fuels the perfect car...?

CNG

Gasoline

Batteries

Biofuels

Some or all of
the above?

Who cares?



Electric Cars are NOT Zero Emissions



Power Sector Issues

- ◆ Subsidies
- ◆ Environmental Costs
- ◆ Backup for Alternatives



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

Obstacles.....In North America

- ◆ The 1990's CNG market failure
- ◆ Lack of infrastructure
- ◆ Dreams of electric vehicles, biofuels
- ◆ Entrenched interests
- ◆ Chicken or egg?....start up challenge
- ◆ Vehicles last decade(s) unlike my phone
- ◆ Cost/ Benefit =?
- ◆ Regulations, certification

- ◆ Respect Economics
- ◆ Value air quality benefits
- ◆ Try It, Encourage others