

*Growth of the NGV Market:
Lessons Learned
Roadmap for Infrastructure Development*

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*“Roadmap For Development of
NGV Fueling Infrastructure
and
Analysis of Vehicular
Natural Gas Consumption by Niche Sector”*

- Underwritten by US DOE, through NETL
- Prepared by Clean Vehicle Education Foundation
 - May 2006 - August 2007

Scope of work

- Roadmap

- Document CNG and LNG infrastructure development to date, assess critical factors, define challenges and opportunities and lessons learned to accelerate future public infrastructure development...
- Focus on HD niche fleets such as transit, refuse, etc (?)

- Data Collection

- Quantify 2005 US vehicular natural gas consumption (CNG and LNG) by top niche sectors, by state and region, retail and “wholesale”

Data Collection Section

- Report defines underlying problem with current data
 - Lack of fuel consumption and NGV inventory data tracking system, inconsistent and incomplete reporting mechanisms
 - Extrapolation of old inaccurate data has led to overestimation of current market and invalid models about future NGV markets and potential for H2Vs; process continues today with academicians using less-than-optimal government data, previously written reports and analyses – most of which were based on inaccurate raw data sources
- Assesses past/present data collection methodologies
 - LDCs (AGA/NGVC), DOE EIA+EPACT, Clean Cities
- Investigates/evaluates potential approaches
 - State PUC filings, MVA records, excise tax records

Data Collection Process

- In CA, PUC filings used for CNG volume, niche sector data extrapolated from fairly reliable data sets
- Other states: utilities and/or stations were contacted
 - AFDC database: Confirm station existence, add stations
 - Use utility bills, tax records and/or interview station operators to assess customer counts, fleet types, fuel usage
- LNG calculated by cross-referencing production at plants against proprietary sales and customer data
- Cross-check information , assess/evaluate, “smell test”
 - Industry and gov’t directories, historical analyses and reports, web sites, press releases, interviews with industry leaders

Summary of Data

- Net total of 892 stations listed fuel use
 - down from 1250 listed as existing in '97 analyses
 - 157 “new” sites added to AFDC db (most removed for lack of response)
 - 51 inactive or defunct locations deleted from AFDC db
- Additional stations exist but have very little or no fuel use
 - Many “mothballed” after years of underutilization
 - Personal CNG fueling appliances not captured but sales data evaluated
- Station count = approximately 82% of ~1100 total stations believed to be in existence (including mfg/whse sites)
 - Widely quoted “1300 stations” is not supported by the data
- Survey data capture estimated at 95+% of fuel throughput

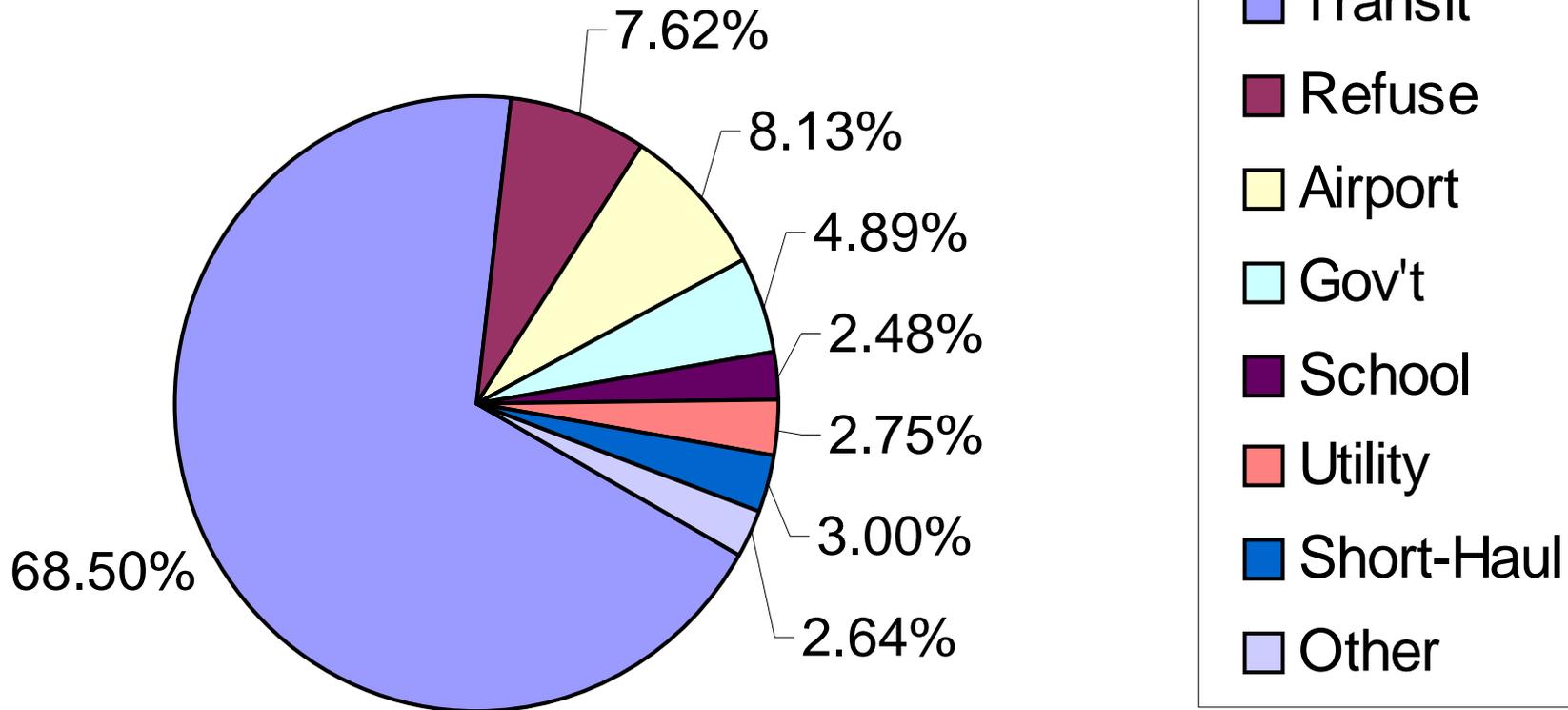
Summary of Data

- Fuel use has grown slowly but steadily
 - 2005 = 200 million GGE
 - LNG:40 million GGE (20%); CNG: 160 million GGE (80%)
 - 2007 likely surpassed 230 million GGE (most of the increase due to increase in transit and refuse vehicles)
 - MDV/HDVs up; attrition of LDVs (many bi-fuel)
- Historically, vehicle counts have been overestimated
- Inventory peaked at 105-110K in 2003, dropped to 92K by 2005 and now estimated at 90K
 - Exit of 3 OEMs, LDV life expectancy, Memo 1A Option 3

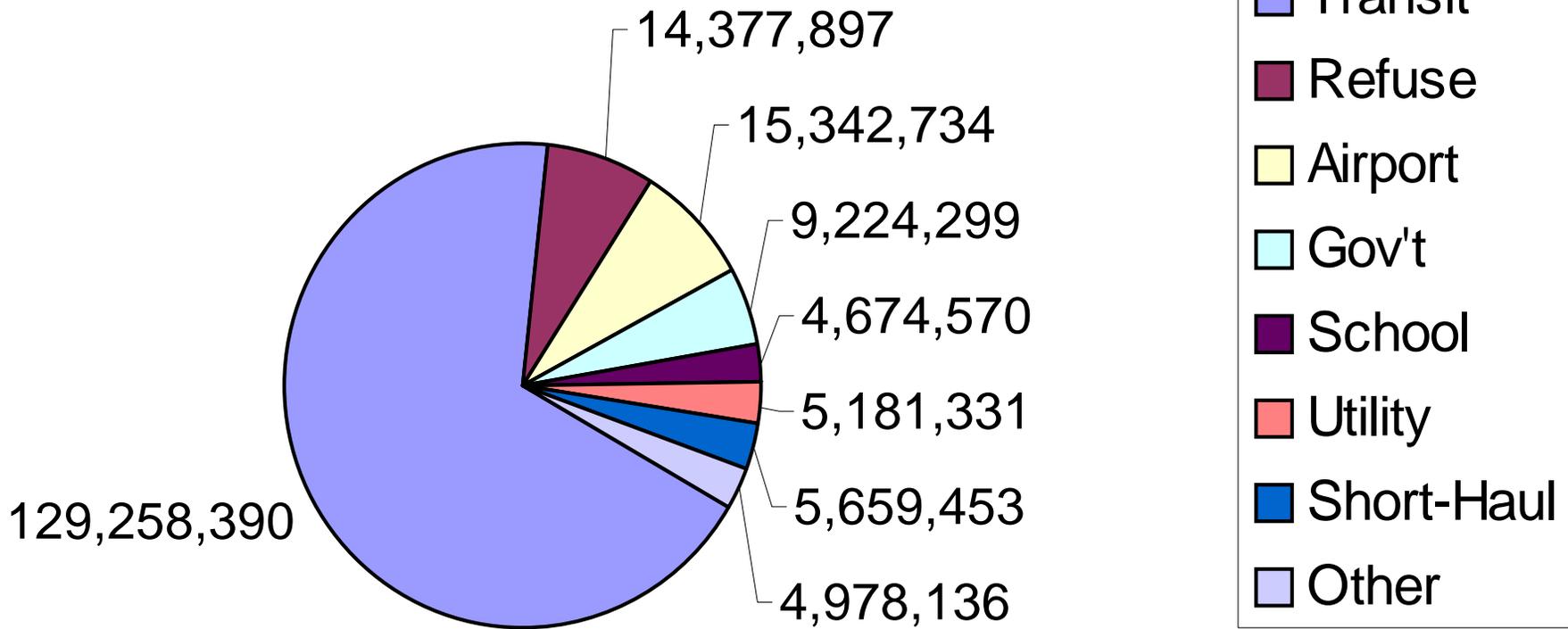
Summary of Data

- 92K NGV market composition in 2005:
 - 12-14K HDVs
(8500-9000 transit, 1500 refuse, 2300 school bus, 1600-2000 in other public and private fleet applications)
 - 10-12K MDVs
(airport shuttles, community transit, package delivery and other step-vans, miscellaneous PW trucks)
 - 66-70K LDVs

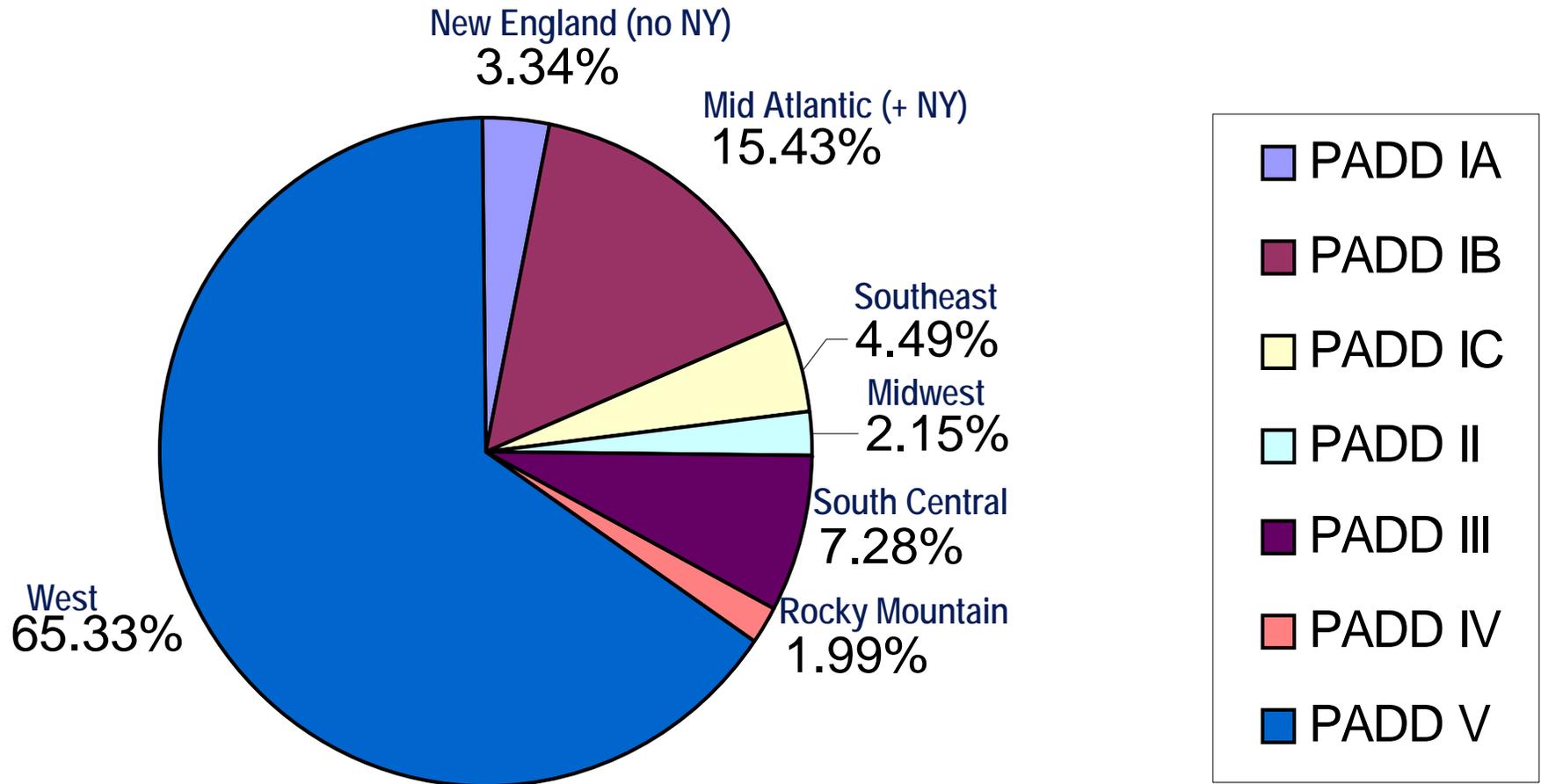
Vehicular Natural Gas by Niche Sector US Total



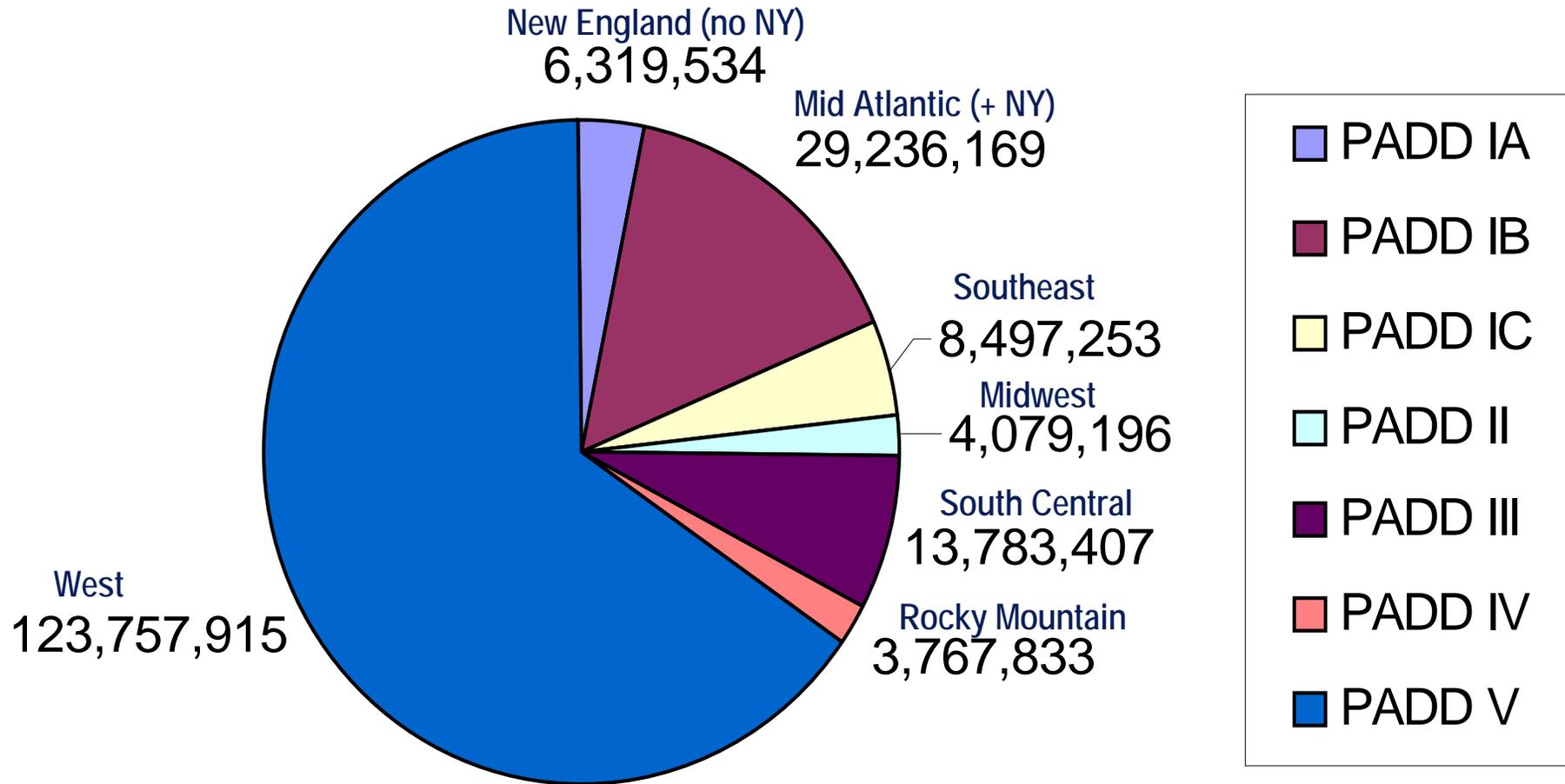
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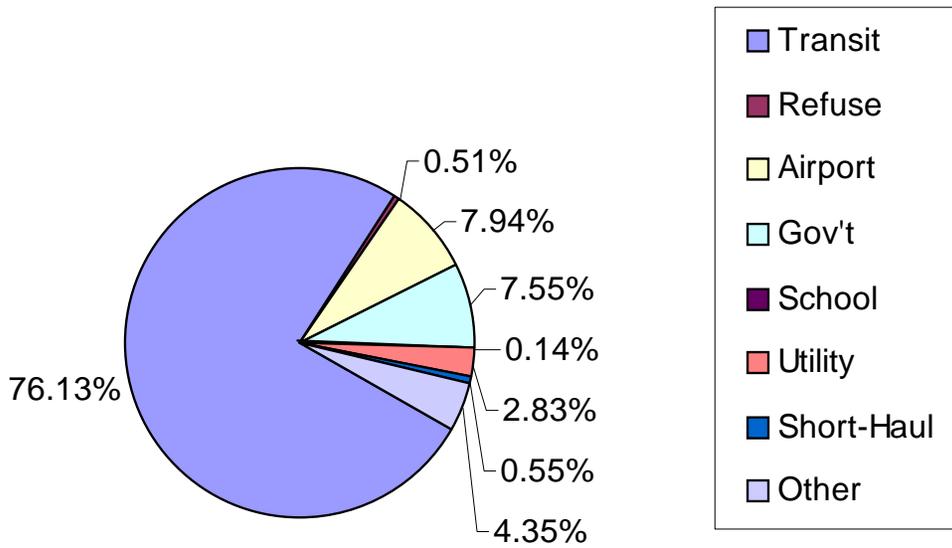
Vehicular Natural Gas Use by PADD



Vehicular Natural Gas Use by PADD



Vehicular Natural Gas Use by Niche Sector PADD IA

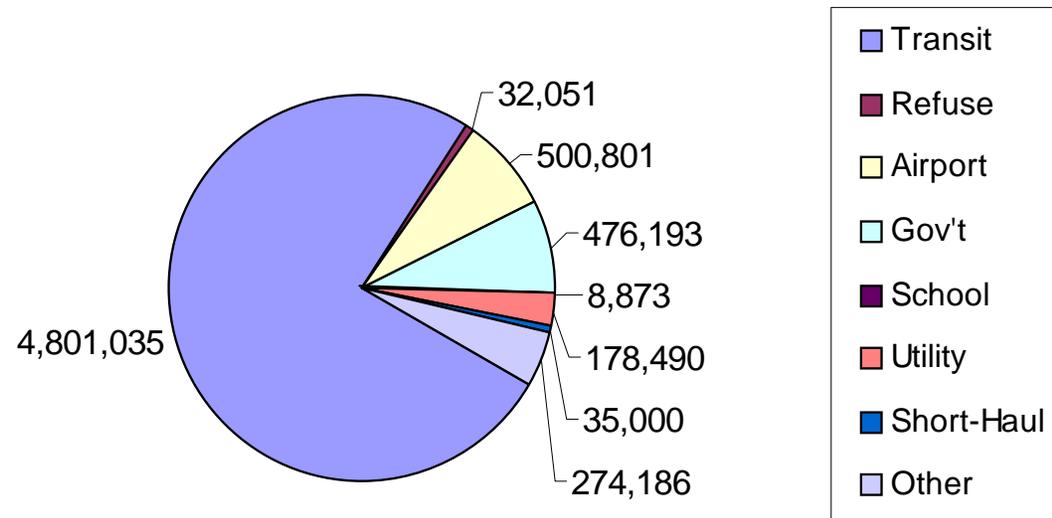


- Maine
- Vermont
- New Hampshire
- Massachusetts
- Rhode Island
- Connecticut

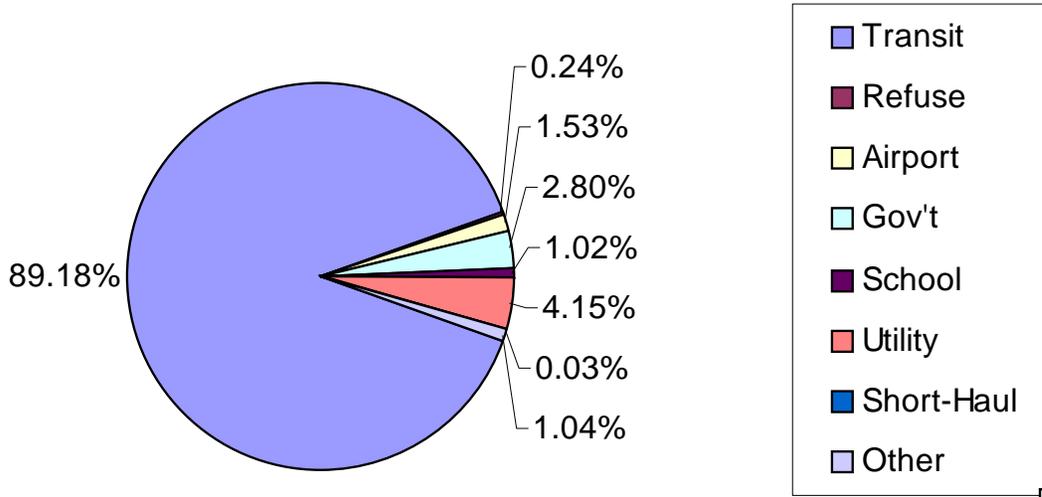
Highlights

- 6.32 million GGEs
- 3.33% of US
- MBTA = 4.5+ million

Vehicular Natural Gas Use by Niche Sector PADD IA



**Vehicular Natural Gas Use by Niche Sector
PADD IB**

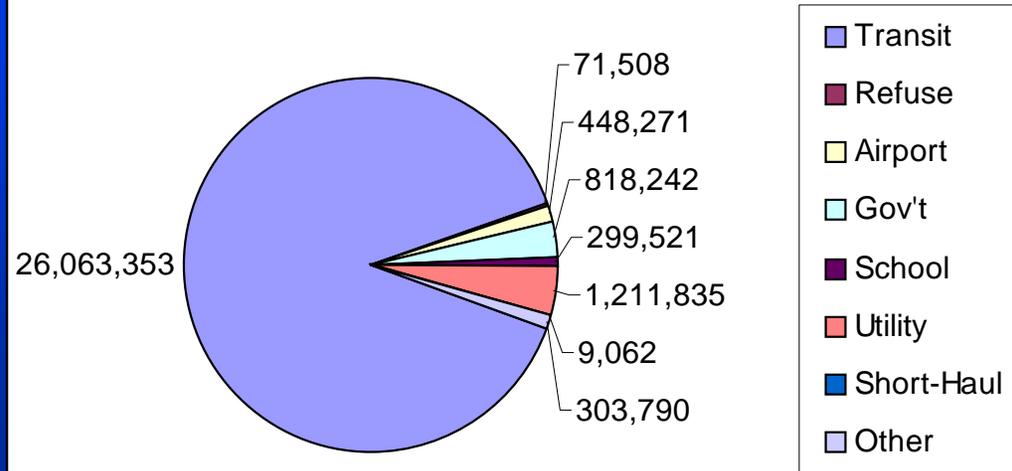


- New York
- New Jersey
- Pennsylvania
- Delaware
- Maryland
- District of Columbia

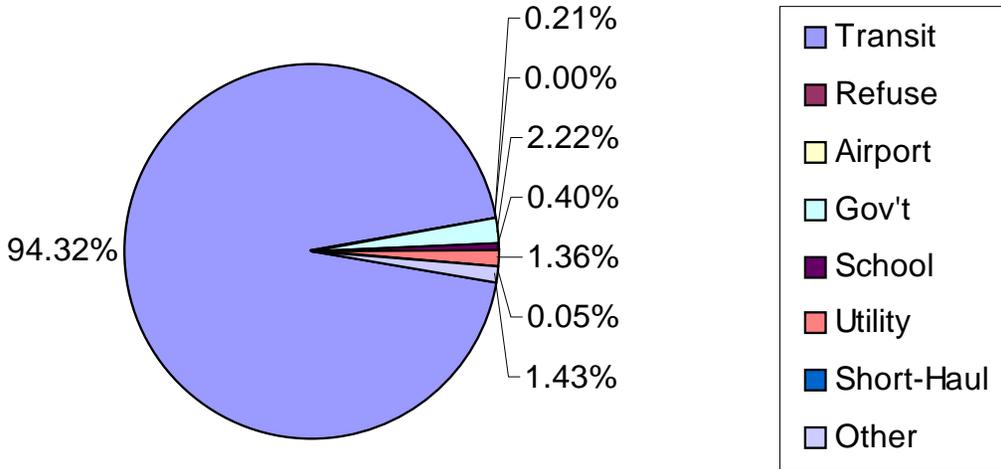
Highlights

- 29.24 million GGEs
- 15.43% of US
- NY ranks 2 – 11.2%

**Vehicular Natural Gas Use by Niche Sector
PADD IB**



Vehicular Natural Gas Use by Niche Sector PADD IC

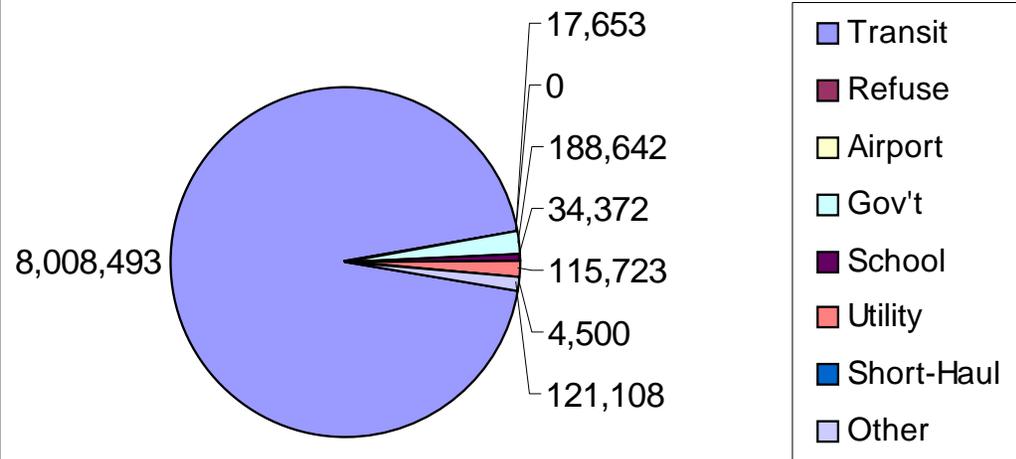


- West Virginia
- Virginia
- North Carolina
- South Carolina
- Georgia
- Florida

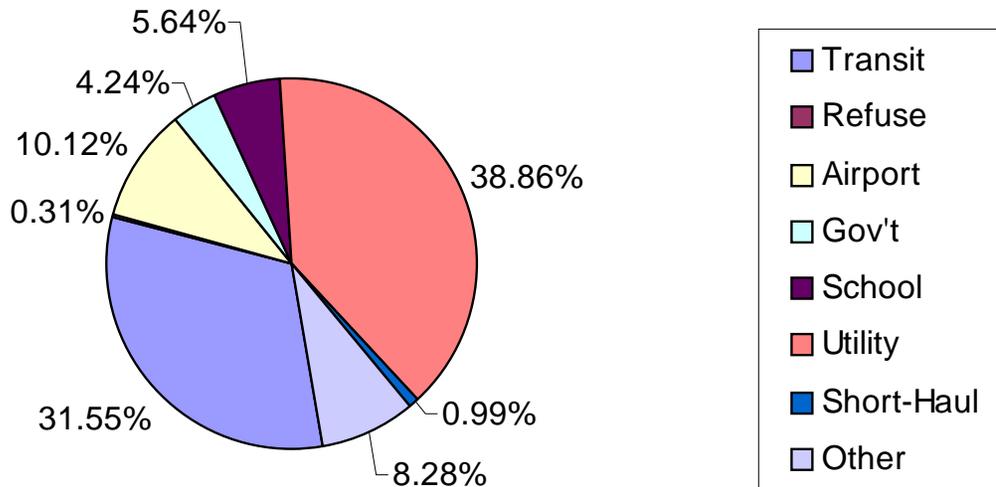
Highlights

- 8.49 million GGEs
- 4.49% of US
- MARTA in GA

Vehicular Natural Gas Use by Niche Sector PADD IC



Vehicular Natural Gas Use by Niche Sector PADD II

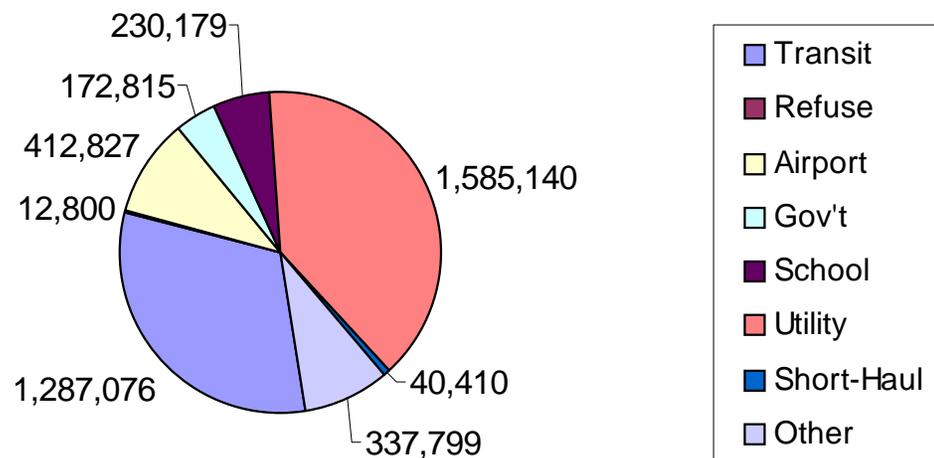


- Ohio
- Illinois
- Indiana
- Iowa
- Kansas
- Tennessee
- Kentucky
- Michigan
- Minnesota
- Wisconsin
- Missouri
- Nebraska
- Oklahoma
- South Dakota
- North Dakota

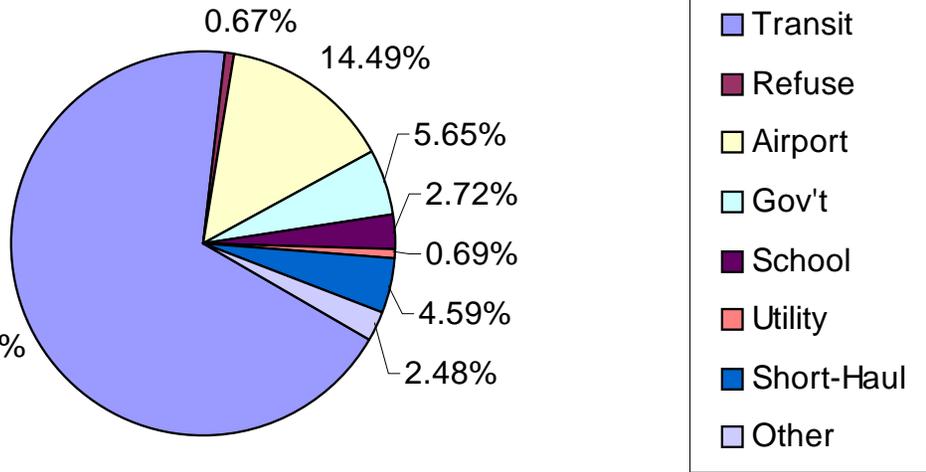
Highlights - Not Many

- 4.1 million GGEs
- 2.15% of US
- OK dominates region (ranks 4th in stations)
- Isolated Pockets: IN, MI, MO

Vehicular Natural Gas Use by Niche Sector PADD II



Vehicular Natural Gas Use by Niche Sector PADD III

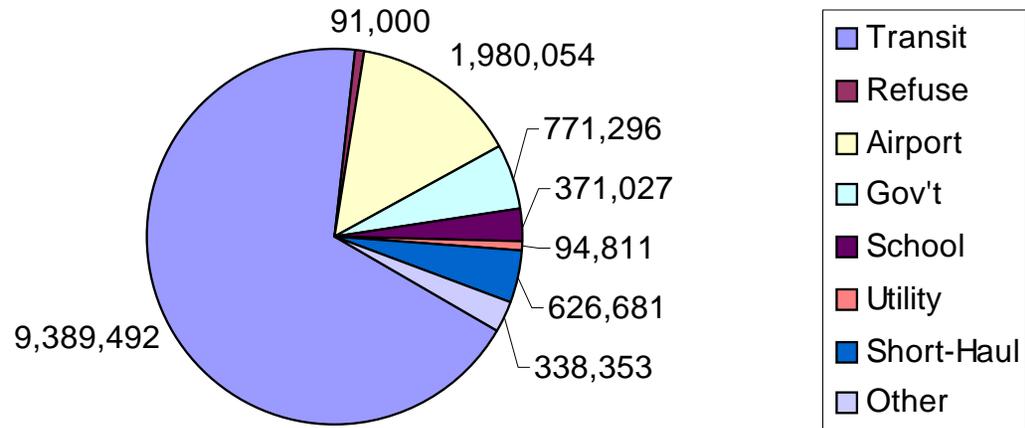


- Alabama
- Arkansas
- Louisiana
- Texas
- New Mexico
- Mississippi

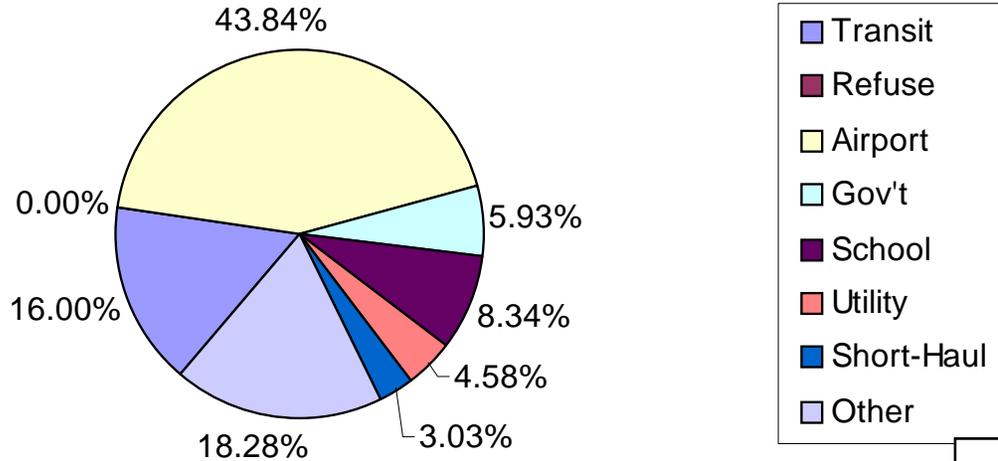
Highlights

- 13.78 million GGEs
- 7.28% of US
- TX dominates (4th in US)
- Pockets: AL, LA, NM

Vehicular Natural Gas Use by Niche Sector PADD III



Vehicular Natural Gas Use by Niche Sector PADD IV



• Colorado

• Idaho

• Montana

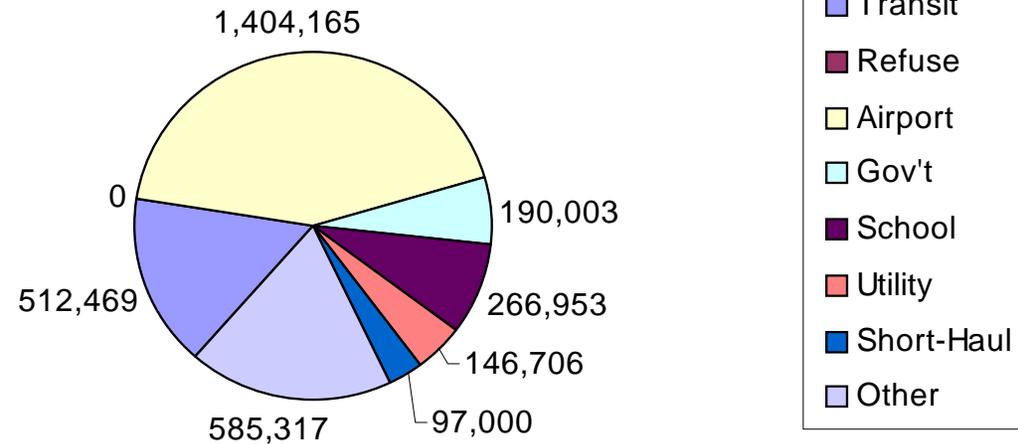
• Wyoming

• Utah

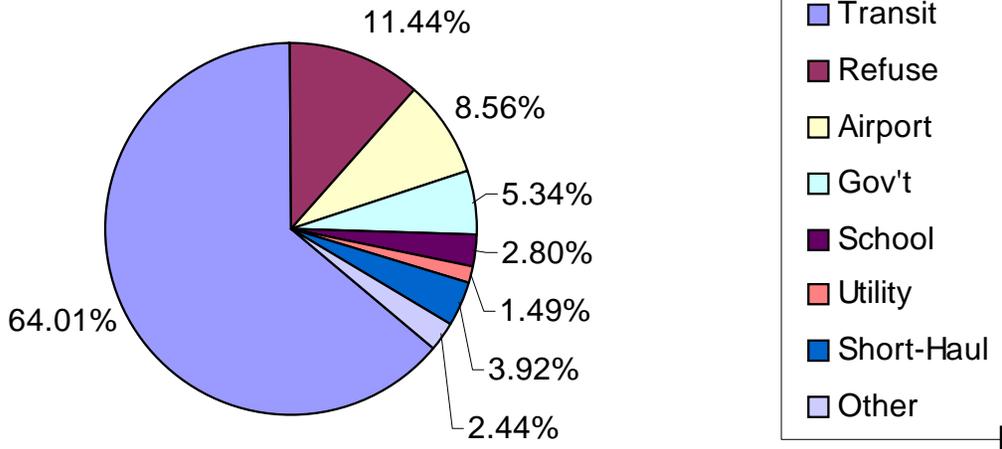
Highlights

- 3.77 million GGEs
- 1.98% of US
- UT and CO airports
- UT station network (2nd in nation)

Vehicular Natural Gas Use by Niche Sector PADD IV



Vehicular Natural Gas Use by Niche Sector PADD V

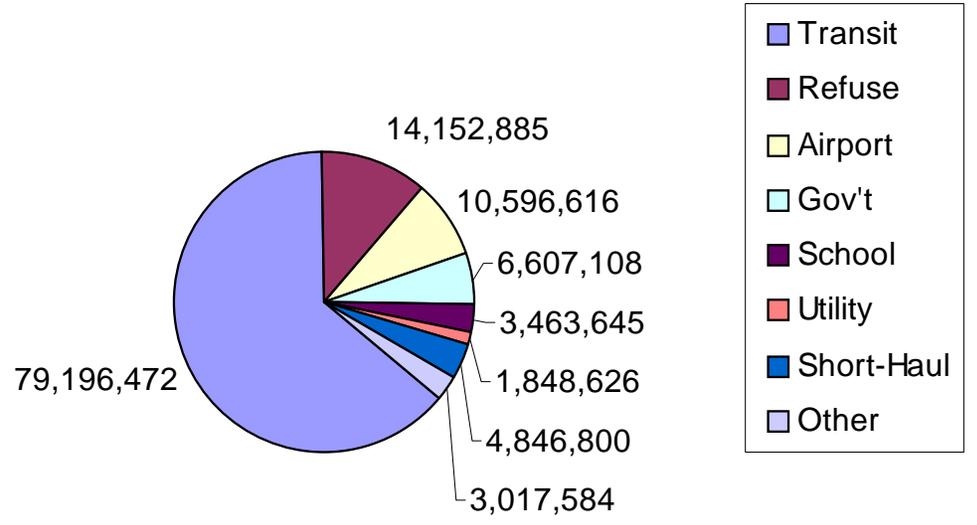


- Alaska
- Washington
- Oregon
- California
- Arizona
- Nevada
- Hawaii

Highlights

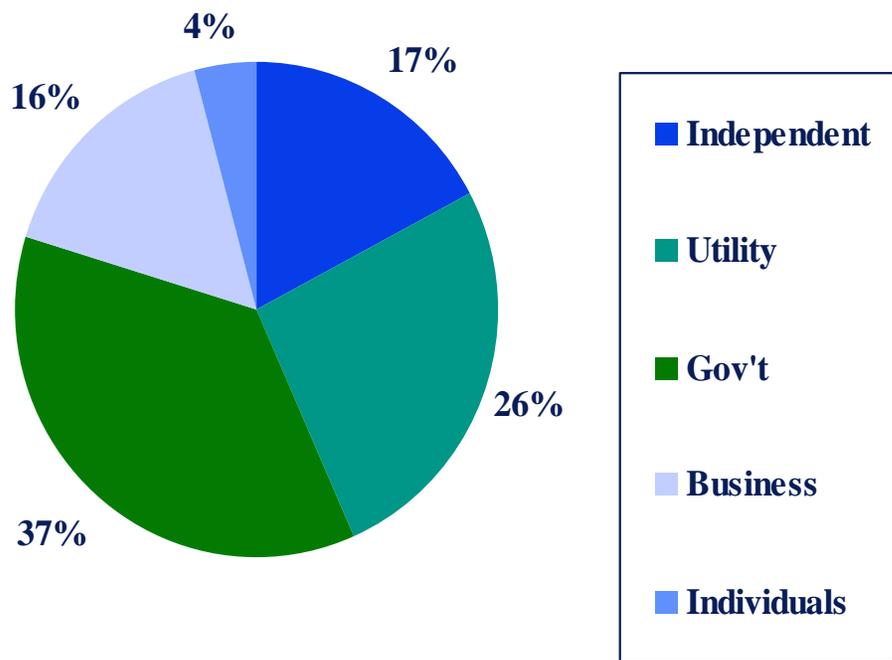
- 123.76 million GGEs (LNG = 27%)
- 65.33% of US
- California dominates
- Transit dominates but other sectors well represente
- 98% of refuse use in CA

Vehicular Natural Gas Use by Niche Sector PADD V



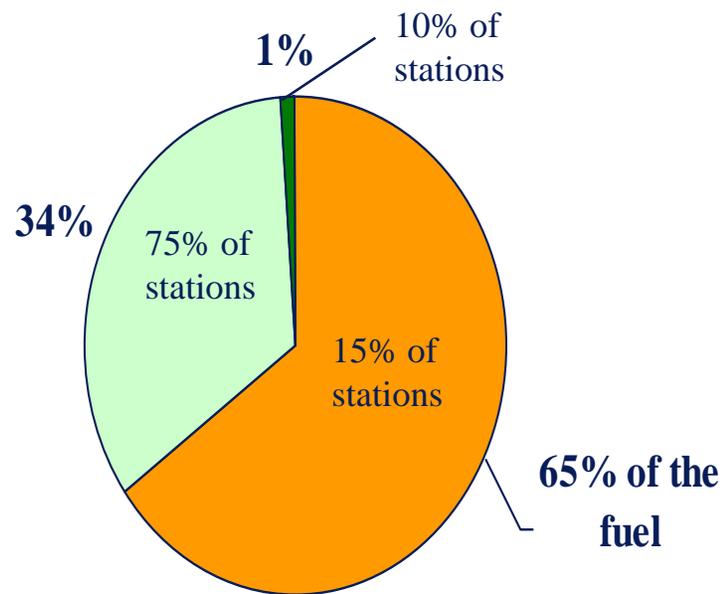
Who Owns and Operates Existing Stations?

(2005)



Which Stations Pump How Much Fuel?

(2005)

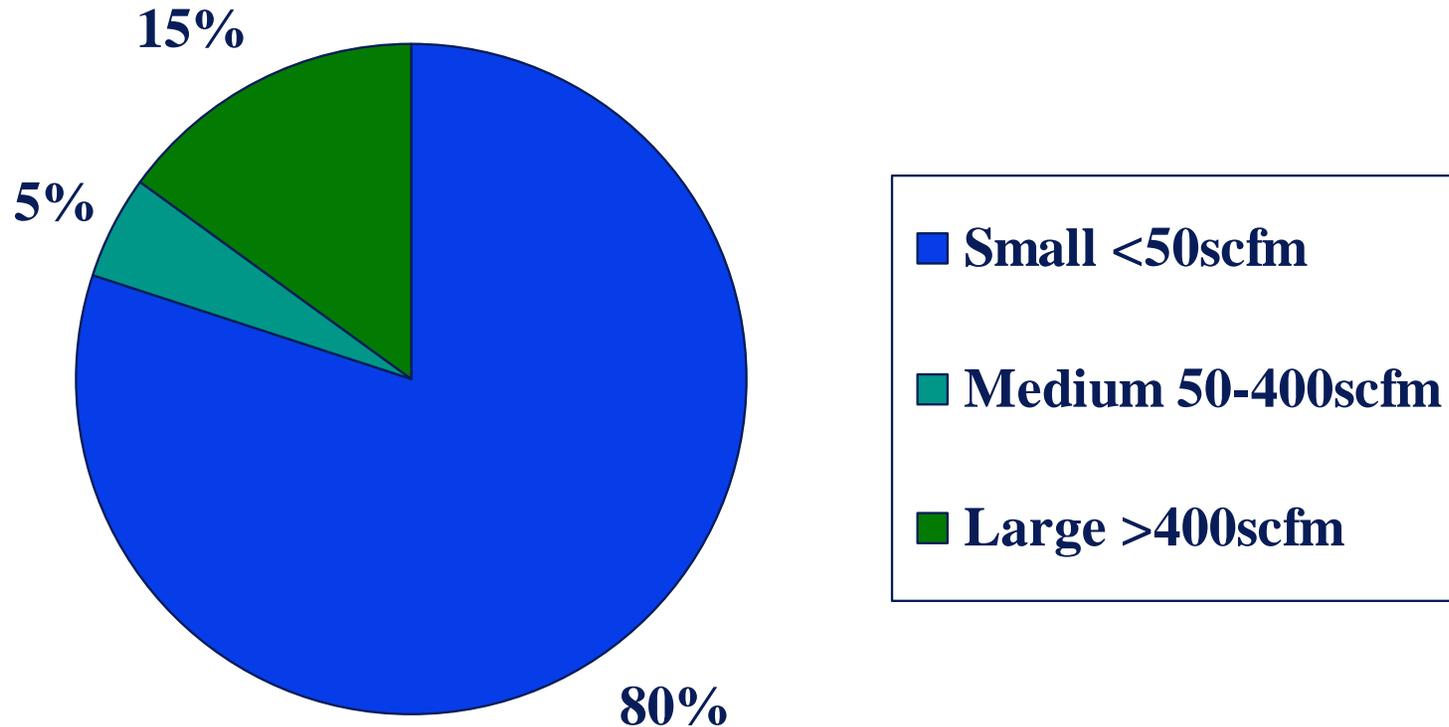


Roadmap

- Status of Current Fueling Infrastructure
 - Who owns and operates,
 - Which stations pump the fuel? What is the station utilization?
 - The prospects for dormant and/or grossly underutilized stations
 - Many have minimal prospects for increased throughput.
 - Many are in need of significant investment to be viable
 - Additional attrition is likely as market continues “correction.”
 - New CNG station development
 - About 100 new “stations” in 2004-2007

Station Development 2004-2007

(100 new stations – does not include “reinvigoration” of existing stations)



25% were new stations for existing clients

60% were new stations for new clients

15% were new retail stations developed by independents

Roadmap

History of NGV market growth divided into four periods

- 1965-1990
Slow, steady growth driven by growing number of utilities – primarily for their own fleets but slowly commercializing technology with customers. Vehicle and station technology leaves a lot to be desired but burgeoning equipment and services industry driven by discovery process and potential. Development of C&S. Toward end, OEM engagement of technology.
- 1990-1997
- 1997-2005
- 2005-2007

Roadmap

- 1965-1990

- 1990-1997

Boom period for vehicle sales and station development driven by growing number of LDCs' (overly optimistic) expectations of market potential due to gov't mandates, new grants for transit sector, OEM introduction of first factory-built LDVs. Petroleum/natural gas price differential is not optimal though and premium paybacks remain longer than acceptable to most private fleets. City/muni, transit and utility markets are main drivers.

- 1997-2005

- 2005-2007

Roadmap

- 1965-1990
- 1990-1997
- 1997-2005

Despite vehicle and station technology improvements, NGV market growth derails as federal mandates don't materialize, utility industry deregulation decimates market development programs, sluggish sales prompt several major OEMs to withdraw, EPA tightens emissions standards and certification requirements eliminating many of the conversion system suppliers. Fueling infrastructure network starts to dwindle as market goes through "correction". Focus shifts from LDVs to HDVs/niche markets.

- 2005-2007

Roadmap

- 1965-1990
- 1990-1997
- 1997-2005
- 2005-2007

Passage of Federal Tax Credits for vehicles and fuel use. Emissions regulations substantially increase diesel ownership costs while NG ownership costs start to decline. Continued improvement in NGV performance/reliability instills market confidence. Public awareness of oil dependence and alternative transportation options grows (although it's fixated on ethanol and hybrids)! Increasing number of OEM HDV options available but OEM's LDV choices remains very limited and conversion/retrofit systems are priced too high. Favorable fuel price differential grows, premium payback periods become more acceptable to private fleets ... Now if we can just get a few more feet on the street to work the market, we'll be in good shape...

Roadmap Discussion

- Factors Affecting NGV Market Development
 - Policy (market pull and market push)
 - Local/Regional AQ, Attainment Status, “Carrots & Sticks”
 - Energy Diversity Initiatives (Federal and State Govt’s, PUCs)
 - GHG initiatives (e.g. CA LCFS)
 - Financial
 - Station Development (land, site dev, fueling equipment)
 - Fuel price differential (traditionally 6/7-1, now 14-1; needs to be 40-50% less)
 - Availability of grants, tax incentives (buy down cost premiums, lower O&M exp.)
 - Vehicle price, payback and life-cycle costs (economies of scale not yet achieved)
 - Market capitalization (significant shortfall between available capital and need)
 - Logistical/Operational
 - Fueling access/convenience, range
 - Service O&M skill sets, training, parts, costs
 - Brand familiarity and loyalty

Roadmap

- Station development, ownership and operation trends
 - Limited amount of new CNG station development
 - Investment in existing CNG station infrastructure, mostly by independents acquiring sites, although some utilities still active
 - HDV fleets, larger stations get greatest effort: more OEM choices, favorable economics
 - Small station equipment sales are down due to lack of OEM LDVs
 - “Pooling” throughput: retail stations, anchor fleets and addition of “outside-the-fence” fueling at existing private access anchor locations
 - Independents target prospects with $> 250,000$ GGE but fleet O&O station economics are favorable at lower throughput thresholds

Technical Issues

- Most NGV industry's technical challenges have been solved
 - Comprehensive Codes & Standards regarding vehicle and tank design addressing manufacture, installation, safety, standardization, etc; (model code body recognition)
 - Engine emissions, power, reliability (add'l R&D would accelerate improvements)
 - Station design/installation practices generally optimized (additional work warranted)
- Onboard and station fuel storage is still very expensive
 - Carbon fiber supplies/costs, steel supplies/costs, number of suppliers
- Integration of available engines into OEM's MDVs and HDVs is expensive and delayed due to allocation of engineering resources to other more pressing "bread & butter" (diesel) concerns
- LDV conversion/retrofit system certification requirements and costs are burdensome and limit product choices

Recommendations

- Public statements from Administration about NGVs' role in support of national goals

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- Revise tax credits to enable tax exempts to benefit
- Extend tax credits to instill market confidence

Recommendations

- Re-engage major automotive OEMs to produce *and market* light- and medium-duty NGVs

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- Provide added incentives for fleets that install outside-the-fence public access capability

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- Create consortia to facilitate truck chassis OEMs' introduction of factory-built HDVs
- Expand sales-marketing programs targeting medium-fuel-use fleets
- Provide added incentives for fleets that install outside-the-fence public access capability
- Expand current NGV stakeholder network

Questions/Comments?

Thank you