LNG vs. Conservation and Renewable Energy – What Is in the Best Interest of California?

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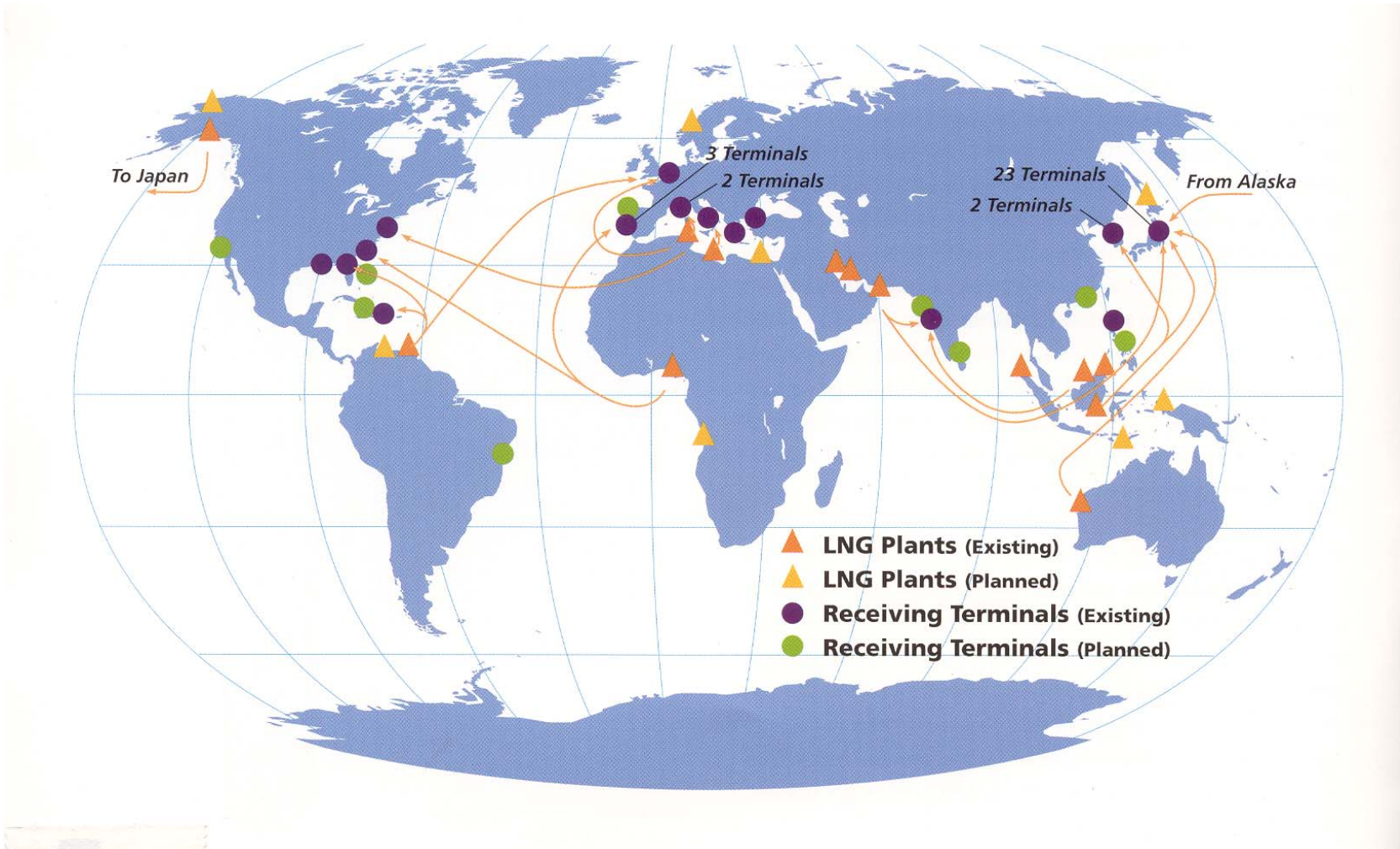
Worldwide View of LNG Supply Chains



Where Is Gas Coming from to Make LNG for the California?

Clockwise from left: Camisea pipeline, Peru; offshore Sakhalin, Russia; Bintuni Bay, West Papua, Indonesia; Barrow Island, Australia

LNG Liquefaction, Tanker and Receiving Operations

Financing Issues - Cost of Greenfield LNG Supply Chain

Element of Chain	Cost ($ billions)
Gas production field	variable
LNG liquefaction plant	~2
LNG ships (8 to 12)	1.5 to 2.5
LNG regasification	0.5 to 1.0
Total (w/o gas field)	4 to 5

Pacific LNG Trade and California

- Financial institutions suffered heavy losses in merchant power projects – risk averse;
- Need long-term LNG contracts w/invest grade entities like California utilities;
- Cost to deliver LNG to CA $4/MMBtu and up;
- CA demand is declining, rebound with business-as-usual approach by 2016;
- Abundant high cost domestic supplies will be developed if prices stay > $4/MMBtu.[a]

a) EnergyPulse online, *Impact of LNG Imports on North American Natural Gas Prices*, June 10, 2004.

What is Legislative History with Onshore LNG Terminals?

- California LNG Terminal Act of 1977 (rescinded 1987):
  - *Maximum population density 10 people per sq. mi to one mile from fenceline, 60 people per sq. mi to four miles from fenceline, same for tanker shipping lanes;*
  - *Fire risk from LNG spills of 25,000 m^3 and 125,000 m^3 were evaluated as basis for safety buffer zone*
  - *Power of eminent domain granted to terminal operator to maintain low population densities*
- *1979 Federal Pipeline Safety Act explicitly states "need to encourage remote siting"*

Is There a Cost Difference Between Onshore and Offshore LNG Terminals?

Project	Capacity[a] (bcfd)	Capital Cost (~$ millions)
Shell/Sempra	1.3	600
Chevron[b] (GBS offshore)	1.0	650
Mitsubishi	1.0	400
BHP Billiton[c] (offshore)	1.5	600

Note (a): bcfd = billion cubic feet per day
Note (b): GBS = gravity-based system (a de facto artificial island)
Note (c): floating terminal

How Are LNG Projects in California Being Designed?

Project	Upstream Gas field and liquefaction facilities	Downstream regasification facilities	Distance to more than 60 people per mile^2
BHP Billiton off Ventura County	NW Australia, floating offshore	Floating offshore, 15 miles from coast	> 15 miles
Mitsubishi Long Beach Harbor	Oman, Tangguh, Sakhalin, other? Sakhalin onshore: Gas from critical Western Gray Whale caving ground, 600 km. pipeline through virgin region.	Onshore in urban/ industrial setting, removal/storage of propane and ethane onsite	< 2 miles

Note: Neither of these projects use seawater to regasify the LNG

How Are LNG Projects in Baja California Being Designed?

Project	Upstream Gas field and liquefaction facilities	Downstream regasification facilities	Distance to more than 60 people per mile^2
Sempra/Shell Near Ensenada, 50 mi. south of border	New Papua, onshore on site of existing village, in SE Asia's largest mangrove forest	onshore, last undeveloped stretch of Baja coast north of Ensenada	2 miles
ChevronTexaco 10 mi. south of border	Onshore at Barrow Island, known as NW Australia's "Ark" – invasive species issue	offshore 600 m. from island – critical marine avian habitat	8 miles

Note: Both of these projects will use > 100 million gal/day of seawater to regasify the LNG

Global Warming – How Much CO_2 in Gas Being Converted to LNG?

Project	CO_2 % of source gas	Fraction of source gas that is combustible excluding CO_2 portion[c] (assume combustible portion is pure methane)	Increase in % CO_2 emissions relative to pure methane combustion w/o sequestration[c]
ChevronTexaco *Gorgon, NW Australia*	11 – 15[a]	.85 - .89	**12 - 18**
Sempra/Shell *Tangguh, New Papua, Indonesia*	~10[b]	.90	**11**
BHP Billiton *Scarborough, NW Australia*	<1	>.99	**<1**

Note (a): The CO_2 would have to be vented to atmosphere or sequestered
Note (b): BP Tangguh EIA webpage
Note (c): If 10% of source gas is CO_2, assume remaining 90% is combustible methane gas.

Global Warming and Air Pollution – How Much Gas Is Used to Make, Transport, and Regasify LNG?

Process Step	Additional Gas Consumption (%)
Wellhead extraction, field gas processing, pipeline transport of natural gas to user	basecase
Liquefaction	9-10
Transport from Far East via tanker	7-9
Regasification	2-3
Total additional natural gas consumed:	18-22

Transport note: Assumes 36-day round trip and 0.20 to 0.25% of LNG cargo consumed per day of voyage by onboard fuel requirements

What Is Cumulative Additional CO_2 Associated with Pacific LNG?

Project	Increase in % CO_2 emissions[b]	Increase in % CO_2 from LNG liquefaction, transport, and regas	Total increase in % CO_2 emissions relative domestic low CO_2 production field
Domestic low CO_2 production field[a]	basecase	0	**basecase**
ChevronTexaco *Gorgon, NW Australia*	12 - 18	20	**~30-40**
Sempra/Shell *Tangguh, New Papua, Indonesia*	11	20	**~30**
BHP Billiton *Scarborough, NW Australia*	basecase	20	**~20**

Note (a): Assumes CO_2 content of field gas is less than 1% by volume
Note (b): Assumes wellhead CO_2 is vented to atmosphere and not sequestered

Seawater LNG Vaporization – What Is the Marine Impact?

- 100,000,000+ gallons/day of seawater used
- Mortality of entrained marine life is 100%
- Once-through seawater usage rate is equivalent to that of a 300 MW combined-cycle power plant
- Seawater temperature is reduced by as much as 20 ^{o}F

May 2003 USCG EIS for proposed Port Pelican LNG terminal and
July 15, 2003 envr coalition comment letter on USCG EIS. See www.borderpowerplants.org

What Are Key Envr., Social or Political Issues with Each LNG Supply Chain?

Project	Key Issue(s)
Sempra/ Shell	1) Political unrest in West Papua could delay or kill Tangguh project despite commitments from China and Korea to invest. BP* working to avoid militarization of the project area, despite clashes. 2) High CO_2 emissions in source gas (~10% CO_2 content), ~30% overall CO_2 penalty. 3) Environmental permit suspended as result of lawsuit in Mexico over risk to existing tourism resort. 4) Regas plant site identified for tourism in state plan. 5) Last untouched spot on Baja coast between Tijuana and Ensenada. 6) Opposition to use of seawater for regasification.
Chevron Texaco	1) Major western Australia environmental organizations opposing Barrow Island "Ark" site. 2) High CO_2 emissions in source gas (11-15% CO_2 content), ~30-40% overall CO_2 penalty. 3) Mexican opposition party and NGO concerns over sovereignty issues related to concession granted for regas plant. 4) Concern over impact of regas plant on threatened avian species on adjacent island. 5) Opposition to use of seawater for regasification.
Mitsubishi	1) Mitsubishi associated with negative impacts with all upstream Pacific Rim LNG liquefaction projects, proposing "spot cargo" format with no fixed LNG supplier. 2) Risk of locating regas terminal in highly populated, critical infrastructure location. 3) Unclear if regas terminal NO_x and PM emissions will be offset by LNG vehicles.
BHP Billiton	1) Upstream impacts may be minimal if floating LNG liquefaction plant used to develop Scarborough gas field. 2) 20% CO_2 penalty associated with LNG processing and transport. 3) Security issues with offshore terminal, +/-?

BP*: British Petroleum, developer of gas fields and liquefaction plant.

What Are Air Quality Impacts of California LNG Terminals?

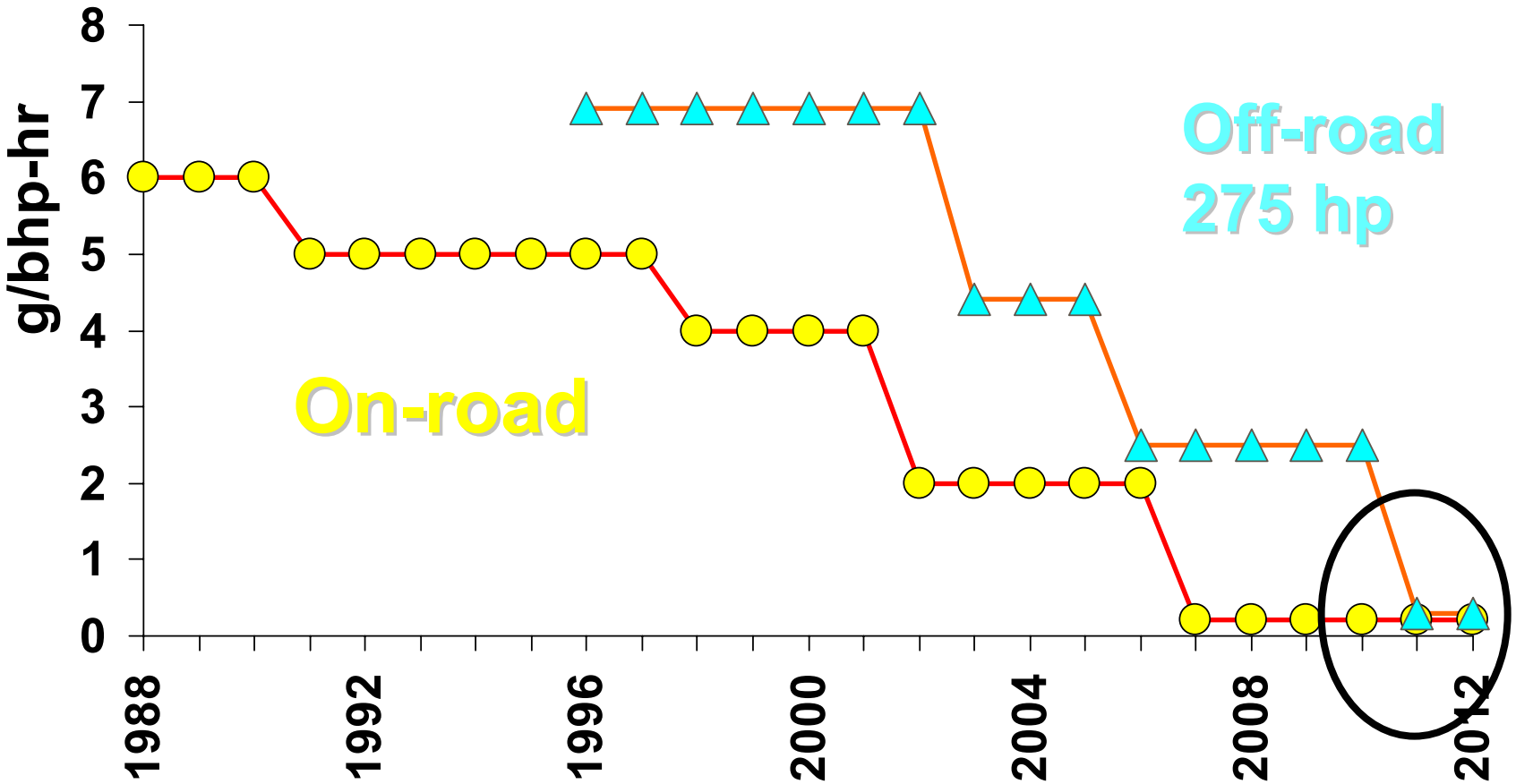
- SES Long Beach LNG terminal:
  - NO_x Emissions[a]: 311 tons per year (tpy)
  - PM_{10} Emissions: 38 tpy *(dual-fuel LNG tankers)*
  - Principal sources: LNG tankers, tugboats, LNG vaporizers
- BHP Billiton Offshore LNG Terminal:
  - NO_x Emissions[b]: 295 tpy
  - PM_{10} Emissions: 19 tpy *(natural gas only tankers)*

Note (a): Sound Energy Solutions, Resource Report 9, Long Beach LNG Import Project, December 11, 2003, Table 9.1-14. Daily maximum emission rates reported in Table 9.1-14 are multiplied by 365 to calculate annual emissions.

Note (b): Environmental Analysis, Cabrillo Port Offshore LNG Import Terminal, Tables 5.7-20 and 5.7-21, Docket 16877, U.S. Coast Guard website, http://dms.dot.gov/.

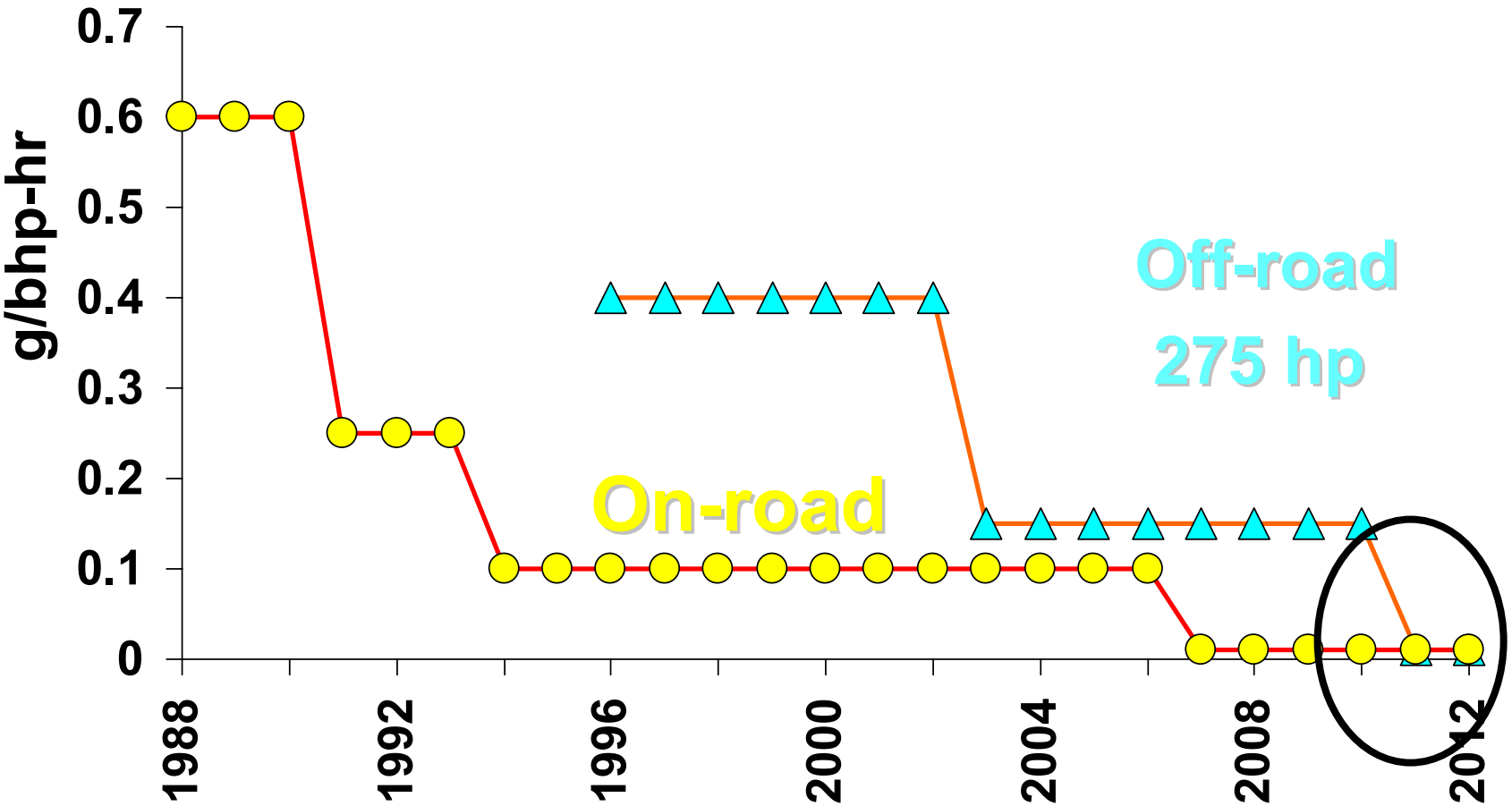
Off-Road Diesel NO_x Standards Catching up to On-Road Standards

Dan Donohoue, Chief, Emissions Assessment Branch, ARB, "Off-Road & Stationary Diesel Engine/Equipment Advancements: CARB's Perspective", Jan. 2004, CAPCOA Diesel Conf.



Off-Road Diesel PM Standards Catching up to On-Road Standards

Dan Donohoue, Chief, Emissions Assessment Branch, ARB, "Off-Road & Stationary Diesel Engine/Equipment Advancements: CARB's Perspective", Jan. 2004, CAPCOA Diesel Conf.



Will LNG Terminal Emissions be Offset by Use of LNG in Vehicles?

- No. No difference in on-road heavy duty LNG and heavy duty diesel (HDD) vehicle NO_x and PM_{10} limits from 2007 onward. Use of on-road certified HDD engine is option for major POLB emitters - terminal tractors
- Nearly 100 on-road diesel engine terminal tractors are currently in use at POLB (at APM Terminal)
- However, phase-in of LNG would not begin until 2009 model year at the earliest. On-road and off-road NO_x and PM_{10} heavy duty vehicle limits are same from 2011 onward.

What is Estimated Cost of On-Road Diesel or LNG Terminal Tractor Relative to Off-Road Basecase?

- ~550 off-road HDD terminal tractors (aka yard hostlers or yard goats) at POLB;
- Complete fleet turnover ~ every 7 years;
- Current cost premium for LNG-fueled yard hostler: $32k on $65k base (off-road diesel engine) terminal tractor price;
- Cost premium for onroad diesel: $6K

Rigorous Evaluation of LNG Need – Has It Been Done?

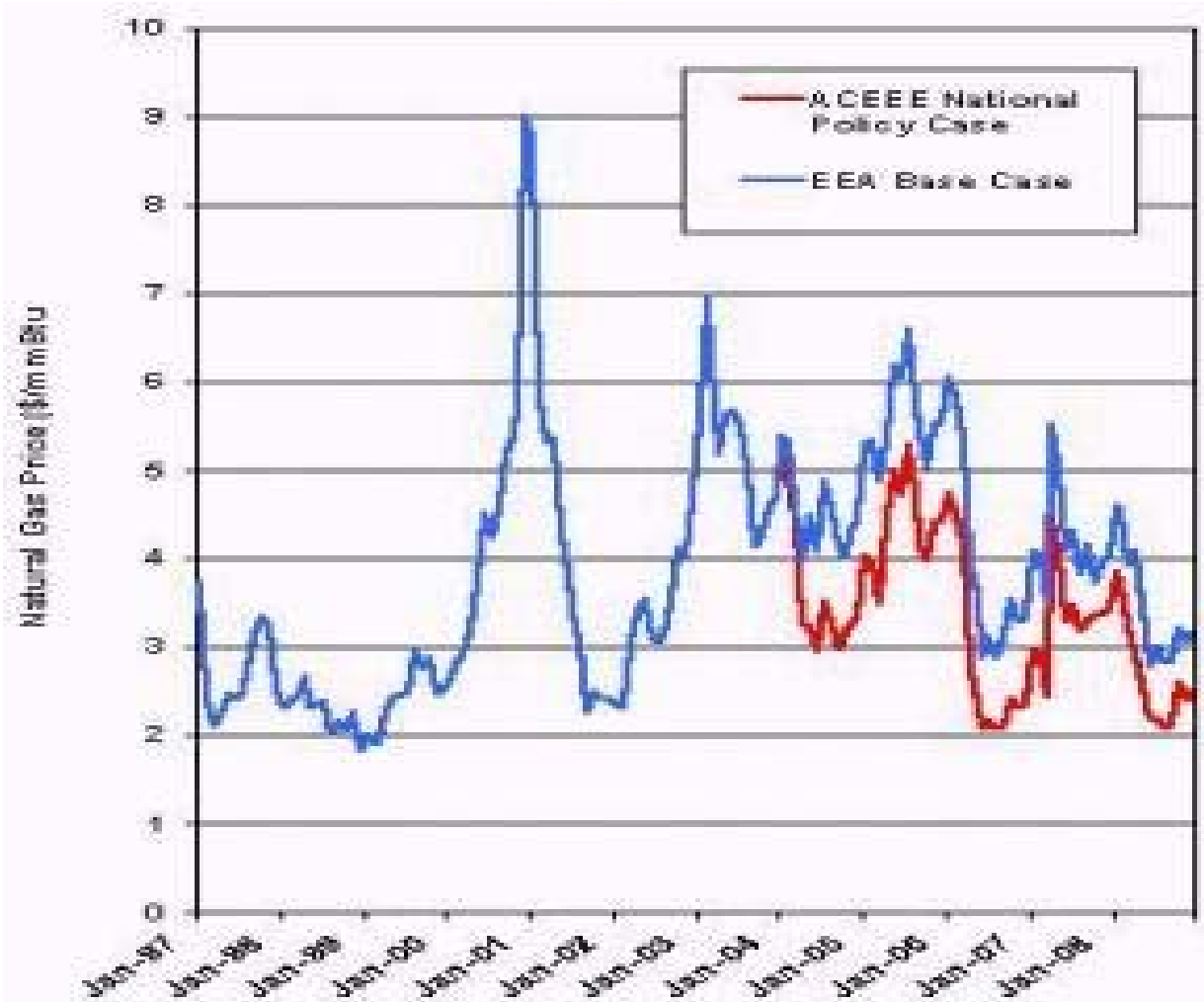
- May '03 Energy Action Plan, Action No. 6:
  - Evaluate the net benefits of increasing the state's natural gas supply options, such as liquefied natural gas;
  - Monitor the gas market to identify any exercise of market power and manipulation, and work to improve FERC-established market rules to correct any observed abuses.

CEC's Dec. '03 Assessment of LNG vs. ACEEE Dec. '03 Alternatives

- CEC: Opportunity to access supply from other continents, may help downward pressure on price;
- Overdependence on foreign supply is concern.
- ACEEE: Saving peak energy fastest way to reduce gas usage and price. 20% price reduction, $0.90/MMBtu, possible in 12 months;
- Small change in consumption has disproportionately large impact on price - CA reduced peak by 11% in late spring of 2001 and helped break market power.
- $30 billion investment nets $100 billion in savings.

ACEEE: American Council for an Energy-Efficient Economy

ACEEE – National Effect of Efficiency and Renewables on Natural Gas Price



Risks of Increased Dependence on NG/LNG

- CEC states ". . *Natural gas generation expected to increase from 36% in '04 to 43% in 2013."*[a]
- *Orrin Hatch, Dec. '03 – "Must determine if price surges are result of market forces or manipulation."*[b]
- LNG floor price on West Coast will be ≥ $4/MMBtu. At this price coal power is much cheaper than gas.
- Confirmation - Sempra Energy is aggressively pursuing 1,450 MW coal project in Nevada to supply Southern California (LADWP).

a) CEC Integrated Energy Policy Report, December 2003

b) *Surge in Natural Gas Prices Brings Fear of Sharply Higher Heating Costs*, Canadian Press, 12/16/03

California and Natural Gas Needs – Increase Supply or Decrease Demand?

Gas Demand, Projected Demand Increase, Gas Options	Gas Quantity, mmcfd (million cubic feet per day)
Average daily natural gas use in California, 2001	6,600
Projected increase in gas demand over 2002 baseline, 2006-2016	0-200[a]
Average projected daily natural gas delivery from one LNG terminal	700-800
Reduction in California gas demand from conservation measures and renewable energy supplies identified as cost-effective priorities by state	1,100 – 1,500[b]

Note (a): Dervied from presentations by PGE, SoCalGas, and SDGE at CEC/CPUC Natural Gas Workshop, Dec. 9-10, 2003. 2006-2016 demand increase in SoCalGas/SDGE territory: 0 mmcfd. In PGE territory: 0-200 mmcfd.
Note (b): Derived from Synapse Energy Economics evaluation submitted in March 23, 2004 RACE coalition comments in CPUC Utility Long-Term Natural Gas Procurement Proceeding, Rulemaking 04-01-25

What is the Cost of Energy Options for California?

Energy Options[a] and 2004 Residential Power Rates	$/kwh[b]
Natural gas combined-cycle power plant (baseload)	0.05
Natural gas simple cycle power plant (peaking)	0.16
Wind	0.05
Solar thermal (parabolic trough)	0.14 – 0.17
Geothermal (flash)	0.05
Energy conservation measures[c]	0.03 – 0.06
San Diego Gas & Electric 2004 residential charge	0.15[d]
CFE, North Baja California 2004 residential charge	0.22[e]

Note (a): California Energy Commission, *Comparative Cost of California Central station Electricity Generation Technologies*, August 2003, pg. 3 and 11.
Note (b): "levelized direct cost" – assumes life-of-project natural gas cost in $5/MMBtu to $6/MMBtu range.
Note (c): California Consumer Power and Conservation Financing Authority, "*Clean Growth: Clean Energy for California's Economic Future – Energy Resource Investment Plan*," February 2002, Table 6-2, pg. 54.
Note (d): Includes only metered kwh usage charge and "electric energy charge," April 2004.
Note (e): Includes only December 2003 published CFE summer usage charge based on 1,000 kwh/month.

Gas Demand Reduction Is Best Policy Approach

- Conservation effort in spring 2001 probably most unifying event among CA citizenry in last 25 years;
- That spirit of common cause can be harnessed again;
- The public interest would be best served by decreasing demand, not increasing supply via LNG.
- Biggest political obstacles to implementing demand reduction policy will be utilities and companies in natural gas and LNG supply business;
- Outstanding opportunity to show leadership, vision, and political independence;
- Political/financial reality – None of the LNG terminals proposed for Californias may reach fruition.

The Clean Energy Option

- Gas demand is static, no growth in 2002-2016,
- Demand and price can be decreased considerably by aggresively implementing energy conservation renewable energy,
- Potential to reduce natural demand by the equivalent of at least 1½ to 2 LNG terminals,
- Best environmental, fuel price, and public policy.