Energy & Environmental Strategies for the 1990's

Proceedings of the
13th World Energy Engineering Congress
1990 World Environmental
Engineering Congress
October 9-12, 1990

Chapter 67

FLEXIBLE FUEL BUILDINGS: A FUELS MANAGEMENT TOOL

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EXECUTIVE SUMMARY

Flexible-fuel buildings (FFB) provide the plant manager options to help control the cost of electrical and thermal-energy production including, but not limited to, the reduction of transportation costs. With the option to use propane as a primary fuel, the decision making process becomes an economic choice without compromise of service or operation. The cleaner fuel of choice, propane, used as a fuels management lever, creates a healthy competition between public utilities and private enterprise. Fuel price shocks and supply disruptions are minimized.

THE PROBLEM

The early 1960's ushered in with it the space age and a very different view of our planet. That view still makes astronauts marvel with wonder. We now see that the planet Earth is indeed fragile and that pollution of the land, sea and air needs to be policed for our survival. Heightened environmental awareness coupled with expanding industrial growth, including demand for more energy, produces a real dilemma. Ozone formation, brown clouds, acid rain, our burgeoning landfills, global warming and the greenhouse effect come to mind when we talk of environmental deterioration.

The nation's most aggressive program to combat air pollution is taking place in the Los Angeles basin. Even with this program in effect the area does not meet federal air quality standards. Post-combustion pollution controls have reached a level of diminishing returns. It is clear that cleaner alternative fuels must be used for our energy security and to meet air quality requirements. A multitude of restrictions shackle the traditional use of our energy resources.

CHOICE OF FUEL

To comply with the Clean Air Act and other pending legislation, Kaiser Hospitals in Southern California selected propane as an alternate fuel of choice. Environmental impacts are mitigated with the use of propane in our boilers, chillers, emergency generators and automotive fleet. Diesel-fueled systems may eventually be phased out throughout the Southern California Region.

SOURCE AND SUPPLY

According to the Department of Energy, natural gas is one of the cleanest-burning fossil fuels with over a 50-year supply in the United States. There are non-traditional sources of natural gas that render over a 200-year supply.

In the United States, about 70 percent of the propane is extracted from natural gas, while 30 percent is produced through the refining process of crude oil. Nationally, the U.S. supplies almost 85 percent of its domestic demand, with an additional 15 percent met with imports. On the West Coast, supply of propane comes from refining operations (about 50%), interregional transfers, offshore gas production on the Continental Shelf, and imports. Projected California propane demand will decrease from current levels, which may result in potential surpluses, according to the California Energy Commission.

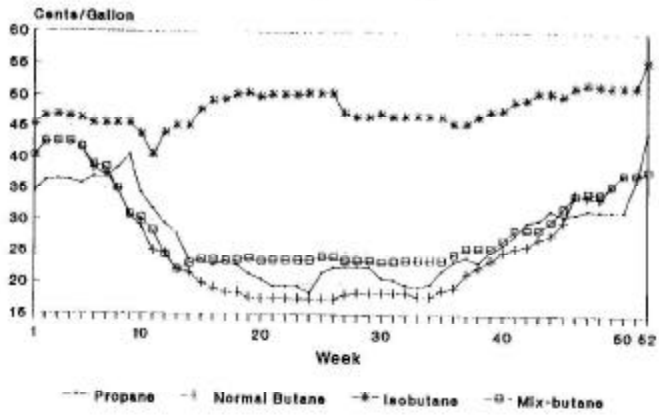
ENERGY COST AND ENVIRONMENTAL IMPACT

The heat value of propane and butane compares favorably with other fuels. Energy content per gallon varies with different fuels; Propane 91,500 Btu, butane 103,000 Btu, gasoline 125,000 Btu and #2 fuel oil with 138,500 Btu. This compares with electricity which has an equivalent of 3,413 Btu per kilowatt hour.

Propane costs dip very low during the summer season, to less than $ 0.20 per gallon. These low prices make it cost effective to use as a primary fuel during the summer. Economics will drive the choice in selecting the most cost effective primary fuel (natural gas or propane) during that window of opportunity. Propane used as a fuels management tool, reduces operational costs. An improved negotiating position with the gas utility is also realized while reducing demand charges. Fuel price shocks and supply disruptions are no longer an issue.

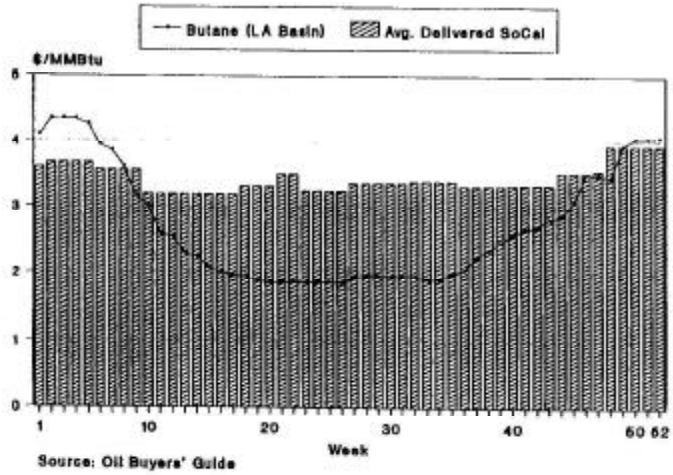
The propane alternative is embraced by the California Energy Commission, Air Resources Board and the South Coast Air Quality Management District as a "clean fuel." It provides a remarkable opportunity in overcoming what seems to be an insurmountable air quality problem. Implementing the use of propane is important for two reasons. First, propane is an abundant and clean burning fuel.

NGL PRICES - 1989
Weekly Average



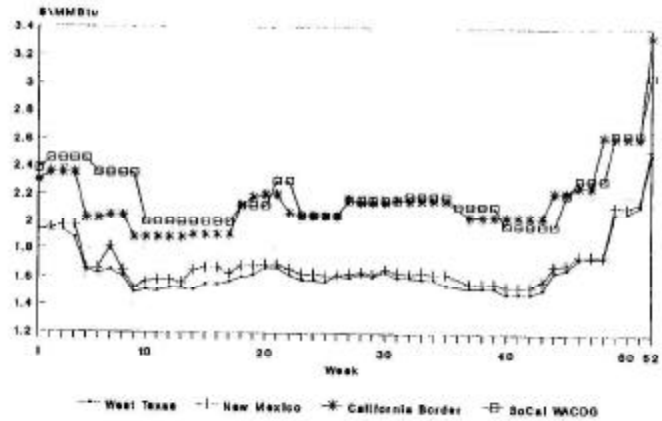
Source: Oil Buyers' Guide

BUTANE vs. NATURAL GAS - 1989



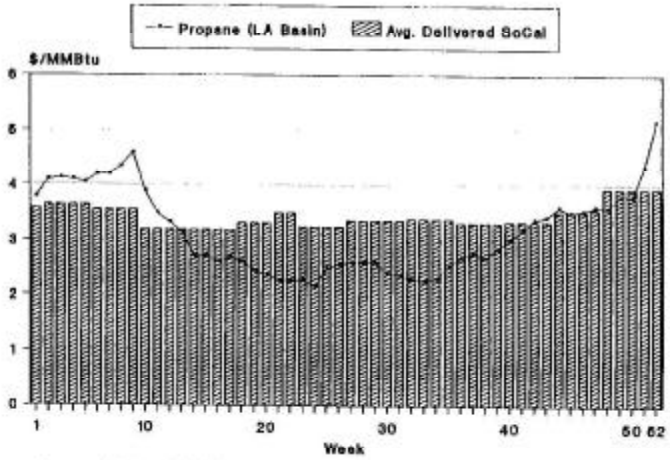
Source: Oil Buyers' Guide

NATURAL GAS SPOT PRICES
Delivered to Pipeline - 1989



Source: Natural Gas Week

PROPANE vs. NATURAL GAS - 1989



Source: Oil Buyers' Guide

Second, the Los Angeles basin is a pollution containment area, where at present no other viable and safe alternative fuel is available.

FLEXIBLE FUEL BUILDINGS

With the option to use propane as a primary fuel, our hospital facility becomes, in the true sense of the word, a Flexible Fuel Building (FFB). A Flexible Fuel Building is a building that is capable of operating on propane, natural gas or a combination of the two. Propane provides an energy diversification that does not compromise service or operation of any of our facilities. It indeed is a fuels management lever that can be activated through the building controls energy management system. Reduced operational costs are possible through a comprehensive and aggressive management decision making process.

With associated vaporizer, blender and instrumentation equipment, a continuous flame process is possible without interruption when switching fuels. Burner-tip energy content remains constant at all times. Switching from natural gas to propane and back to natural gas will not cause interruption in any internal combustion or flame process.

TANK INSTALLATION ISSUES

Propane tanks sized to fit a typical hospital's needs are very large, up to 45,000 gallons. Since space constraints and safety are issues in a hospital setting, propane tanks will be installed vertically, underground in a silo. Title 8 of the California Code of Regulations and the Uniform Fire Code address underground installations. Not only are in-ground installations safe but encouraged in the National Fire Protection Handbook. A silo installation allows easy removal of the concrete cap and tank for visual inspection (every 15 years) as required by Title 8 and the Uniform Fire Code. In California, the requirement for all underground storage systems for hazardous materials must have either double-wall containment, leak detection monitoring devices, or both. Underground propane tanks must have an approved secondary means of containment installed over the entire tank surface (typically, a polyethylene coating). The contamination potential of any inadvertent release of fuel is very remote. If by chance a catastrophic event were to occur, propane would freeze all surrounding material and, at

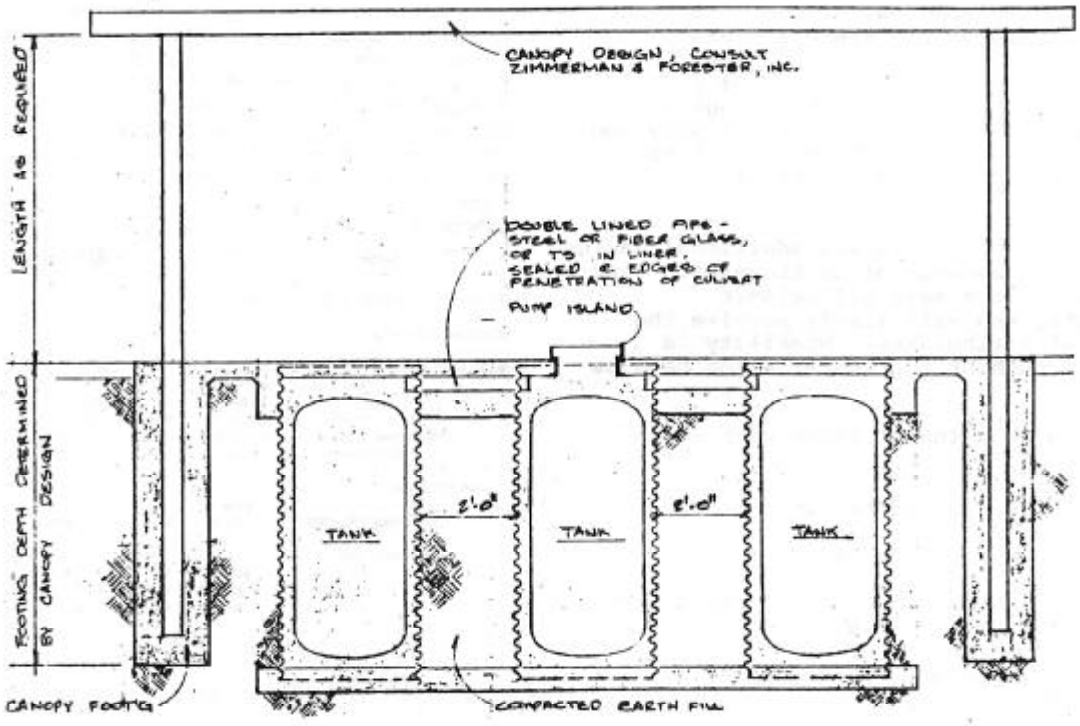


FIGURE 1. TYPICAL TANK SILO INSTALLATION

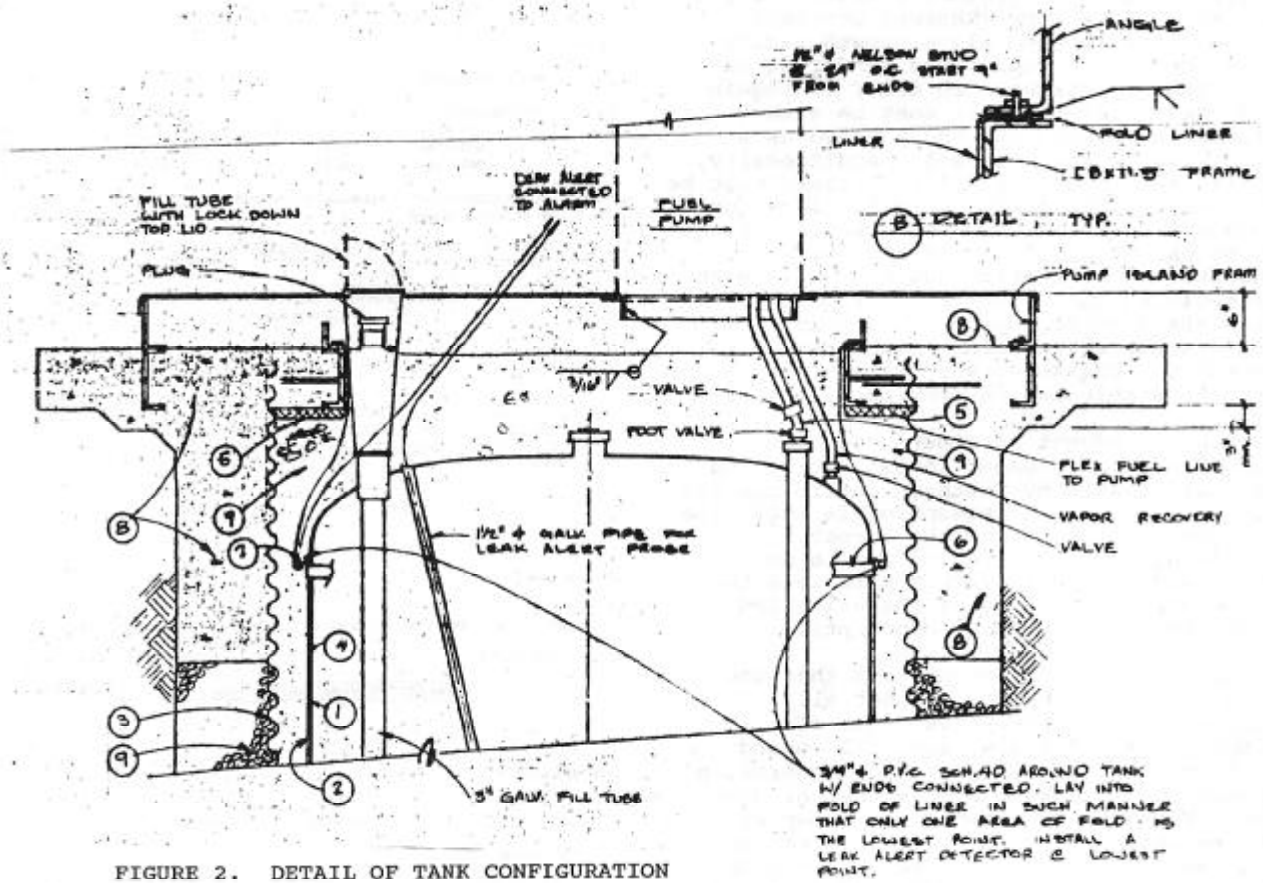


FIGURE 2. DETAIL OF TANK CONFIGURATION

that point, be pumped out of the silo much like water. Eliminated are all risks associated with groundwater contamination including reducing the potential of fire because of the narrow flammable range of propane (2.2-9.5 percent). City, County and State Fire Marshals and OSHPD have given implicit approval for this type of installation.

In California there are additional design considerations because of earthquakes. Tank-silo installations meet all seismic requirements, and will likely survive the strongest of earthquakes. Stability is inherent throughout the installation because of:

a. in-ground installation with earth backfill

b. tank surrounded by metal sleeve (100,000 lbs./square foot) with cathodic protection

c. twin-I-beam construction across the top preventing side movement

d. heavy concrete cap securing the tank in place

This construction design has close tolerances thus allowing for very little movement from a vertical position. Flexibility and reliability are incorporated into the entire system design.

Diesel, as an emergency standby fuel, continues to have many inherent problems. Water condensation and algae growth easily contaminate diesel fuel, thus rendering the fuel unusable. Further, in order to regain use of the diesel fuel, it must be either "polished" or pumped out and treated as a hazardous waste for disposal. Additionally, state law mandates that all fuel tanks must be double walled adding to the cost. If a fuel tank leak occurs, further exacerbation of problems escalate cost associated with groundwater contamination and cleanup. With the associated fuel, tank and air quality particulate discharge problems standby generators may be rendered useless except for emergencies. Unlike diesel, propane is inherently stable and environmentally benign.

With the advent of electronic flow computers currently under investigation and being field tested by Southern California Gas Company, a reasonable assumption is that time-of-use gas is just around the corner. Telemetering devices pave the way to an accuracy and reliability that parallels the electric utilities means of measuring and charging for hourly energy consumption.

Emergency standby generators that use natural gas or propane fuels meet all requirements mandated by the State of California for hospitals (i.e., 10 second start time). Gas-fired emergency generation equipment cost is about double that of diesel-fueled. However, additional costs may be offset by using the generators as electrical peaking units with heat recovery. On peak demand charges may be reduced or eliminated.

Further, special utility interruptible rates (SCE I-6-A) also apply, (load shed in 10 minutes) providing additional savings. The term "cogeneration" is sidestepped for the benefit of concerned electric utilities. SCAQMD permitting is possible since the boilers, chillers and emergency generators are not diesel-fueled. Clearly, the incremental cost difference of equipment would be offset through the savings realized in the daily operation of this facility.

TYPICAL MEDICAL CENTER SUMMER MONTH

TOUB-P, TIME OF USE-LARGE (12 kV PRIMARY SVC)

CUSTOMER CHARGE				=	$272.85
BASE RATE & ENERGY COST ADJ.	CENTS/KWh		KWh		
ON-PEAK	$0.09971	X	276,470	=	$27,566.82
MID-PEAK	$0.07995	X	390,595	=	$31,228.07
OFF-PEAK	$0.05000	X	749,735	=	$37,486.75
LOW INCOME SURCHG	$0.00028	X	1,416,800	=	$396.70
PUC REIM CHG	$0.00012	X	1,416,800	=	$170.02
DEMAND CHARGE					
	$/KW		KW		
NON-TIME RELATED	$2.15	X	2,408	=	$5,177.20
TIME RELATED:					
ON-PEAK	$14.15	X	2,408	=	$34,073.20
MID-PEAK	$2.15	X	2,404	=	$5,168.60
OFF-PEAK	$0.00	X	2,212	=	$0.00
POWER FACTOR ADJUSTMENT	1,840 KVAR DEMAND X $0.20			=	$368.00
STATE TAX $0.02 PER 100 KWh				=	$283.36
TOTAL TOUB-P BILL				=	$142,191.57

I-6-A INTERRUPTIBLE RATE WITH PEAK SHAVING (ON-PEAK, 6HR/DAY)

CUSTOMER CHARGE				=	$272.85
BASE RATE & ENERGY COST ADJ.	CENTS/KWh		KWh		
ON-PEAK	$0.09288	X	0	=	$0.00
MID-PEAK	$0.07465	X	390,595	=	$29,157.92
OFF-PEAK	$0.04542	X	749,735	=	$34,052.96
LOW INCOME SURCHG	$0.00028	X	1,140,330	=	$319.29
PUC REIM CHG	$0.00012	X	1,140,330	=	$136.84
DEMAND CHARGE					
	$/KW		KW		
NON-TIME RELATED	$2.15	X	2,404	=	$5,168.60
TIME RELATED:					
ON-PEAK	$9.75	X	0	=	$0.00
MID-PEAK	$1.45	X	2,404	=	$3,485.80
OFF-PEAK	$0.00	X	2,212	=	$0.00
POWER FACTOR ADJUSTMENT	1,840 KVAR DEMAND X $0.20			=	$368.00
STATE TAX $0.02 PER 100 KWh				=	$228.07
TOTAL I-6-A BILL				=	$73,190.33

PEAK SHAVING GENERATION COSTS
SUMMER MONTH

CRITERIA:

GEN SET SIZING: 4 UNITS X 650KW = 2,600KW TOTAL OUTPUT
FUEL USAGE: 76.6 THERMS/HOUR X 4 UNITS = 306.4 THERMS/HOUR
ON-PEAK HOURS: 6 HOURS/DAY X 5 DAYS/WEEK X 4 WEEKS/MO = 120 HOURS/MONTH
O & M COSTS: 120 HOURS X 2,600KW X $0.015/KW = $4,680.00

NATURAL GAS COST

COST OF GAS = 306.4 TH/HR X 120 HR X $0.375/TH =	$13,788.00
O & M COST =	$4,680.00
TOTAL COST TO OPERATE WITH NATURAL GAS =	$18,468.00

PROPANE COST

GALLONS FUEL = 306.4 TH/HR / .91650 BTU/GAL = 334.32 GAL	
COST OF FUEL = 334.32 GAL X 120 HR X $0.20/GAL =	$8,023.68
O & M COST =	$4,680.00
TOTAL COST TO OPERATE WITH PROPANE =	$12,703.68

FLEXIBLE FUEL BUILDING SAVINGS SUMMARY – SUMMER MONTH	
NATURAL GAS	
PREVIOUS TOUS-P ELECTRIC BILL	$142,191.57
LESS I-6-A PEAK SHAVING ELECTRIC BILL	($73,190.33)
LESS NATURAL GAS COST TO OPERATE	($18,468.00)
TOTAL SAVINGS/MONTH USING NATURAL GAS*	$50,533.24
PROPANE	
PREVIOUS TOUS-P ELECTRIC BILL	$142,191.57
LESS I-6-A PEAK SHAVING ELECTRIC BILL	($73,190.33)
LESS PROPANE COST TO OPERATE	($12,703.68)
TOTAL SAVINGS/MONTH USING PROPANE**	$56,297.56

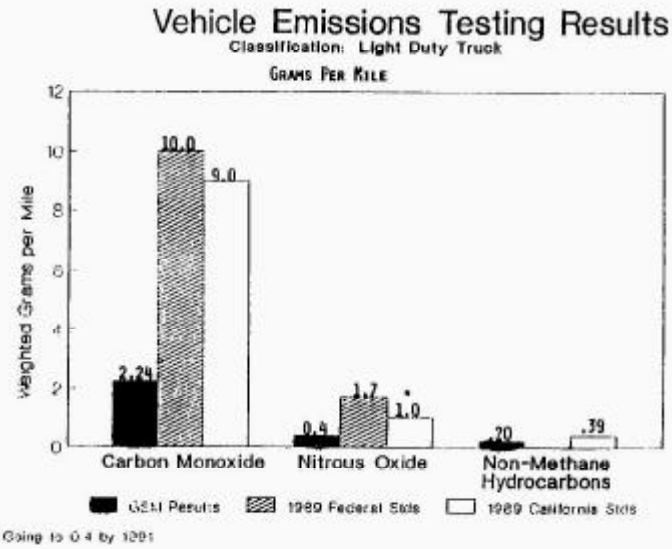
*TOTAL ANNUAL SAVINGS (GAS) = 4 MONTHS X $50,533.24 = $202,132.96

**TOTAL ANNUAL SAVINGS (PROPANE) = 4 MONTHS X $56,297.56 = $225,190.24

NOTES:
SAVINGS FOR USABLE THERMS PRODUCED BY GEN SETS NOT INCLUDED.
ADDITIONAL CAPITAL COSTS FOR MAJOR EQUIPMENT PURCHASE AND INSTALLATION NOT INCLUDED.

TRANSPORTATION FUEL

The California Energy Commission is encouraging the use of cleaner transportation fuels including methanol, natural gas, propane and electricity. Less polluting vehicles have received more attention since SCAQMD adopted a stringent air quality program in March of 1989. This court-tested ruling may eventually ban cars, trucks and buses that use gasoline and particularly diesel fuels. The internal combustion engine fueled by propane is a very clean combustion process compared with its counterpart, the diesel engine. Through the combustion process, the propane engine emits almost no sulfur dioxide, no particulates and close to 80 percent less carbon monoxide. It also produces up to 80 percent less reactive hydrocarbons than gasoline or diesel.



* Going to 0.4 by 1991

Propane fuel delivers up to 90 percent of the mileage of gasoline and has an octane rating of 104. Vehicles powered by propane have been in use since the early 1920's. Most propane powered vehicles operate as dual fuel vehicles. There are several propane fleets and individual applications now in operation in California. There are an estimated 80,000 propane vehicles in the state. Nationally, there are over one million propane-fueled vehicles, and over four million in operation worldwide.

BENEFITS OF FLEXIBILITY

Kaiser's total energy plan calls for design integration of Flexible Fuel Vehicles (FFVs) in the automotive fleet. These vehicles will be fueled from the same central propane tank that supplies the building. FFBs and FFVs, using a single fuel source, increase the flexibility of design and reduce transportation and operational costs. Benefits of selecting propane and natural gas over diesel fuels are that it will best satisfy building and transportation needs. Additionally, it creates healthy competition among utility and fuel suppliers. Utility demand charges for both electric and natural gas may be significantly reduced. Propane offers the simplest, most cost-effective option compared to other fuels because:

- it is a clean burning alternative that can substitute for natural gas, gasoline, diesel fuels and or methanol
- it is the least disruptive alternative for operations and fuel distribution
- average rating of propane is 104 octane, eliminating engine knock, ping and vapor lock
- LPG is a nontoxic gas which produces less carbon monoxide, reactive hydrocarbons and soot and increases engine life to three times that of gasoline
- cost per mile traveled reduces to less than one-half and refueling time is less than that of gasoline
- uninterrupted internal combustion and flame processes

Kaiser Hospitals are dedicated to providing quality health care services for our members, while reducing operational costs in our facilities. At Kaiser we have surrounded our energy opportunities with energy options. We are meeting the challenge of mandated change to protect the environment. Flexible fuel building technology is being adapted for use within our hospital system as a fuels management tool to achieve these goals.