CASE STUDIES OF COST-EFFECTIVE NATURAL GAS FUELING STATIONS

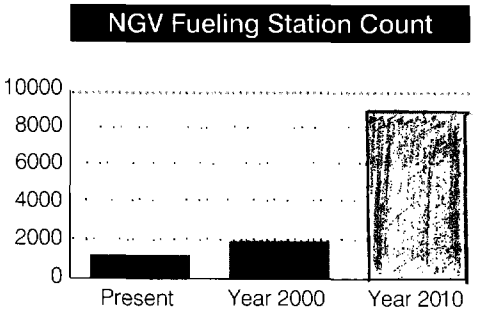
Six companies independently adopting approaches to NGV fueling station infrastructure development that lower upfront investment costs for capital acquisition and installation.

ABOUT GRI

Gas Research Institute (GRI) is the natural gas industry's management organization for research, development, and commercialization (RD&C) of new gas technologies. As a not-for-profit membership organization, GRI receives support from its membership through a funding mechanism approved by the Federal Energy Regulatory Commission (FERC), voluntary member contributions, and, where appropriate, funding approved by state regulatory agencies. In addition, GRI leverages its RD&C program by actively pursuing industry and government cofunding. GRI's membership includes all segments of the gas industry: producers, pipelines, and distributors.

ABOUT A.G.A.

The American Gas Association is working to increase demand for abundant domestic natural gas as a vehicle fuel through marketing activities, advocacy before legislative bodies and regulatory agencies, and communications efforts that include a state-by-state directory of NGV fueling stations, products and services



INTRODUCTION

Development of the natural gas vehicle

(NGV) industry in North America depends heavily on the availability of reliable and cost-effective vehicles as well as establishment of a convenient network of fueling stations. This series of NGV Fueling Station Case Studies was developed by Gas Research Institute (GRI), in collaboration with the American Gas Association (A.G.A.), to benchmark industry practices and demonstrate important strides being made by several companies involved in the expanding North American NGV infrastructure.

BACKGROUND

The domestic gas industry and others are undertaking the development of an NGV fueling infrastructure. The table at left, based on A.G.A. data and GRI estimates, shows the present and future number of NGV fueling stations in the U.S. There are over 1000 NGV fueling stations in operation presently in the U.S. Conservative estimates indicate by the year 2000 that over 2000 stations will be in operation.

This steady growth in station count is also anticipated to be accompanied by an increase in the size (or capacity) of compressed natural gas NGV fueling stations to meet an expanding vehicle population.

As highlighted in the NGV Industry Strategy, copies of which are available from GRI, the growing NGV fueling infrastructure should be comprised of primarily open-access fueling stations with a complement of private onsite fueling facilities (e.g., for transit, school buses, and industrial plant vehicles). Fueling stations will include compressed natural gas (CNG) only, LNG only, and combination LNG and CNG. Public stations will target light- and medium-duty vehicles. Other stations will be primarily for medium and heavy-duty vehicles.

In 1993, an industry goal of $1,000/scfm or lower was established for newer stations. A recent study of gas utilities indicated that several companies were successfully driving costs down to levels approaching or outperforming this target.

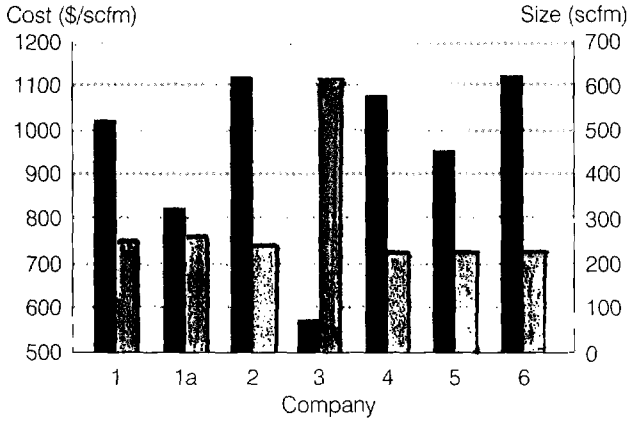
Historically, installed costs for compressed gas fueling stations of 100-300 scfm (standard cubic feet per minute) capacity have been in the range of $1,400-$2,000/scfm. In 1993, an industry goal of $1,000/ scfm or lower was established for newer stations. A recent study of gas utilities indicated that several companies are

successfully driving costs down to levels approaching or outperforming this target.

CASE STUDY RESULTS

Corliss and Associates, working on behalf of GRI, surveyed more than 35 companies involved in NGV market development. As a result, it became evident that several companies were independently adopting approaches to NGV fueling station infrastructure development that lowered upfront investment costs for capital acquisition and installation.

Case Study Station Cost/Size



COMPANIES PARTICIPATING IN CASE STUDIES
▼

Columbia Gas Distribution Companies
Consumers' Gas Company Ltd.
Lone Star Energy Company
Natural Fuels Corporation
Southern Union Econofuel Company
Union Gas Ltd.

The following selected profiles offer an overview of the approaches used by each company in areas critical to infrastructure cost control: design and standardization, equipment packaging, permitting, procurement, and installation. These areas, coupled with placement of stations and development of a customer base, are crucial to the overall profitability of NGV investments.

The bar chart provides a summary of station cost and size for each of the systems profiled in the Case Studies. Installed costs for the majority of these stations are essentially at or below the $1,000/scfm target.
◀

NEXT STEPS

While significant strides have been achieved in the past two years, continued progress is needed to further reduce upfront capital and ongoing O&M cost for NGV fueling stations. Nominal targets of $750/scfm and $0.10/gallon equivalent O&M will further enhance the economics of NGV fueling stations.

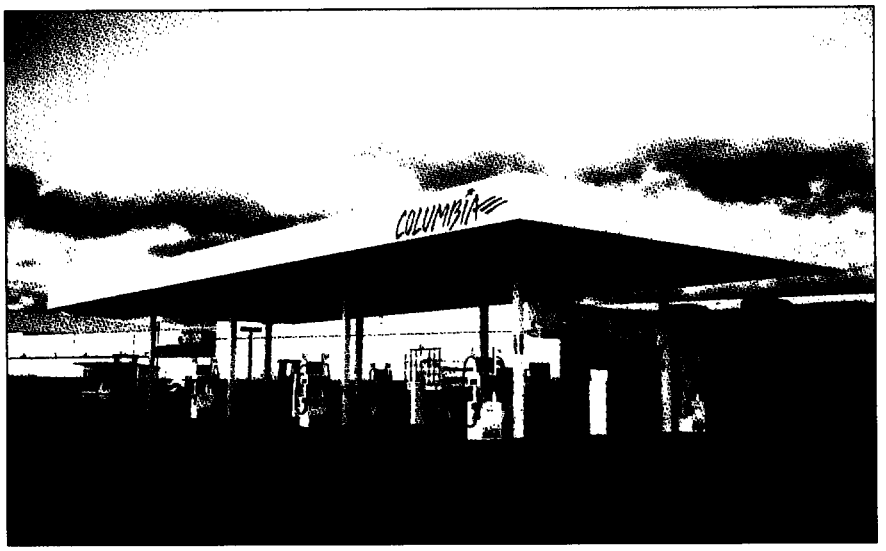
Columbia Gas

GOODALE STATION COST:
$2,374/scfm

CURRENT NEW STATION COST:
$816/scfm

Columbia Gas Distribution Companies have experience with both ends of the cost spectrum in building natural gas (NG) fueling stations. On one hand, the company installed a showcase facility that serves its own NGVs as well as other fleets and individual customers. This facility near Columbus, Ohio, is now the largest open-access station in the United States.

At the other extreme, the company has launched an ambitious construction program—with plans to build about 30 stations each year through 2000—at one of the lowest dollar-per-scfm costs in the business.



BACKGROUND

The Goodale station is only 1/4 mile from a major highway and a mile from downtown Columbus. More importantly, 600 of Columbia's NGVs are just 300 feet away.

The station serves a variety of fleets, including hospital parking-service buses, police cars, auto-parts delivery trucks, and tow-truck/wreckers, as well as about two dozen private citizens.

COST CONTROL

For the Goodale station, Columbia Gas applied traditional cost-control strategies such as judicious selection of equipment and materials and

COST CONTROL STRATEGIES

- Columbia Gas reduced its installation cost substantially by purchasing equipment for 20 stations at once.
- Construction costs were also cut by soliciting bids for supplying all 20 stations.
- Standardization of equipment and selection of modular packages also contributed to lower costs.

"For equipment selection, it's best to standardize and modularize whenever possible, instead of purchasing specialized equipment one or two pieces at a time."

Tim Davis
Columbia Gas

GOODALE STATION DESIGN

Compression	
Compressors, 3 @ 165 cfm each	465 cfm
Gas engine drive	12-liter
Suction pressure	5 psig
Discharge pressure	5000 psi
Storage	
Capacity (approx.)	180 k scf
Pressure rating	5472 psi
Number of vessels	18
Number of storage banks	3
Dispensers	
Number of dispensers	6
Number of fast-fill hoses	12
Number of slow-fill hoses	20
Service pressure	5000 psi
Vehicle Service	
Capacity (approx.)	180 k scf
Pressure rating	5472 psi

NEW STATION DESIGN

Compression	
Compressors	267 cfm
Gas engine drive	95 hp
Suction pressure	45 psig
Discharge pressure	5000 psi
Storage	
Capacity (approx.)	39k scf
Pressure rating	5472 psi
Number of vessels	3
Number of storage banks	3
Dispensers	
Number of dispensers	1
Number of hoses	2
Service pressure	5000 psig
Vehicle Service	
Peak	50 veh/hr
Average	200 veh/day
Fill time (8 gal-equiv)	2 min

solicitation of multiple competitive bids. The company also used its own resources for acquisition.

For new stations, Columbia Gas took a giant step by soliciting bids for 20 stations. "Purchasing multiple pieces of equipment results in substantial cost savings, compared with buying it one or two pieces at a time," says Tim Davis, Director of NGV Market Development.

"Compared with electric motor drive, compression costs are about forty percent less with a gas engine"

The Goodale station's Bauer compressor and Cummins engine were packaged by Bauer. Its dispensers were manufactured by DVCO. New stations will use Ariel compressors and Caterpillar 3304 engines packaged by Kraus, as well as Kraus dispensers.

All of the stations use storage systems manufactured and packaged by CP Industries and card-key systems from E. J. Ward.

ECONOMICS

Columbia Gas selected natural gas engines for compressor drive, for the Goodale station and for the new stations, because of lower operating costs. "Compared with electric motor drive," says Davis, "compression costs about forty percent less with a gas engine. And we are, after all, a gas company, so it makes sense to use our own product."

The Goodale station's capacity utilization factor of 30% is expected to increase to 35% during 1995. Utilization factors of about 30% are projected for the new stations.

COST SUMMARY ($1,000)

GOODALE	
Equipment	
Compressors (3)	200
Storage	180
Dispensers (6)	108
Dryers (3)	45
Card-key system	32
Subtotal	565
Engineering/Construction	
Project management	25
Permitting	10
Construction	565
Subtotal	600
Total	1,165
$ per scfm	2,354
NEW STATION	
Equipment	191
Engineering/Construction	27
Total	218
$ per scfm	816

Instead of servicing the new stations itself, Columbia Gas is contracting out the maintenance. Costs are estimated at about $1,800/month.

OUTLOOK

Clearly, Columbia Gas sees growth ahead for the NGV market. As of early 1995, the company owned and operated 37 stations, of which 26 are open to the public. With plans to build 20-30 more stations during 1995 and an average of 30 stations per year through 2000, the company could be operating more than 200 stations by the end of the decade.

"The NGV market trend has been positive," says Davis. "We think that it's a national trend and that it will continue."

FUEL PRICES

NG, gal-equiv	$0.648
Gasoline,* gal	$1.10
Diesel, gal	$1.20

NG/Gasoline, 58.9%

** Regular unleaded*

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Consumers' Gas

TORONTO STATION COST: $1,121/scfm (U.S.)

Just a few years ago, The Consumers' Gas Company Ltd. was losing money on NGVs. Then the Canadian utility decided to look at the entire NGV business cycle—from vehicle conversion to fuel sales—and create a group of experts to cultivate the market.

Today, Consumers' Gas has turned its NGV business around and is making money on operations related to NGVs, including fueling stations that sell natural gas (NG). According to Perry Stover, Director of NGV Business Development, the key to cost-effectiveness is independence. "We have become a self-sustaining group, in that we design our own stations and manage their construction," says Stover.

Consumers' Gas now owns 49 NG fueling stations (33 of them public) and plans to build three more during 1995. The company has also designed a complete vehicle conversion system—not a "kit," Stover points out—and has set up conversion shops that use only high-quality equipment.

BACKGROUND

The fueling station at the corner of Sheppard Avenue and Victoria Park —a major intersection near a main highway in Toronto—started out as a conventional public gasoline station. In 1985, Consumers' Gas installed an NG dispensing outlet to serve company fleet vehicles as well as the general public. When the NG refueling

COST CONTROL STRATEGIES

- Consumers' Gas standardized its product selection, purchasing equipment in quantity at a lower price per item.
- By acting as prime contractor and packager, Consumers' Gas reduced up-front capital costs and ensured top-quality engineering and construction.
- Profits are maximized by keeping compressors operating nearly 100% of the time, then recovering maintenance costs in the NG retail price.

"Standardization was the most important factor in containing costs, but we also saved money by designing and engineering the station in-house."

Perry Stover
The Consumers' Gas Company Ltd.

Consumers Gas

line bay became too busy, Consumers' built a private station nearby for its fleet vehicles. "Within six months," says Stover, "traffic was backing up again at the public NG outlet, so all the gasoline equipment was removed and more NG service installed."

COST CONTROL

To reduce construction costs, Consumers' Gas standardized its equipment selection. "Standardization was the most important factor in containing costs," says Stover. After evaluating what was available, the company selected a single product and ordered it in quantity at a lower unit price.

Equipment purchased in this way included—

- A prepackaged Sulzer Canada compressor (additional units used at other stations)
- Dispensers, which were rebuilt with new outer shells
- Control panels, which were programmed and constructed in-house from off-the-shelf components.

Also, Consumers' Gas acted as its own prime contractor and packager. "We designed our own systems and hired subcontractors who constructed to our design, using equipment we specified," he says. "This lowered our up-front capital costs and ensured a top-quality job."

STATION DESIGN

Compression	
One compressor	250cfm
Electric motor	100 hp
Suction pressure	155 psig
Discharge pressure	3600 psig
Storage	
Capacity (approx.)	30k scf
Pressure rating	4000 psi
Number of vessels	60
Number of storage banks	3
Dispensers	
Number of dispensers	3
Number of hoses	6
Service Pressure	3000 psi
Vehicle Service	
Peak	40 veh/hr
Average	260 veh/day
Fill time (8 gal-equiv)	3 min

FUEL PRICES

	$U.S.	$Can.
NG, gal-equiv (m^3)	0.94	0.35
Gasoline,* gal (liter)	1.23	0.52
Diesel gal (liter)	1.31	0.49
NG/Gasoline, 76.4%		

** Regular unleaded*

ECONOMICS

The NG station maximizes profits by keeping its compressors up and operating 99.6% of the time. In the rare case of a breakdown, the company's response team is so quick that the compressor is usually running again within an hour or two, maximizing the station's utilization factor.

"You have to spend money to make sure that the equipment is working," says Stover. "Maintenance costs are recouped in the retail NG price." Consumers' estimates its maintenance costs at 7.5¢/gal. equiv. (2.8¢/liter Canadian) and average electricity costs at 5¢/gal. equiv. (or 1.8¢/liter Canadian).

The NG station is owned by Consumers' Gas and rented to the station operator. Capital costs are recovered through rental payments based on monthly gas sales volumes, in lieu of recovering capital costs in gas rates.

You have to look at your entire NGV program, and spend time up front on sales and promotion of the NGV market as a whole . . . It took us eight years to reach profitability."

Stover emphasizes that the profitability of NG fueling stations depends on total sales volume, which takes years to build up. "You have to look at your entire NGV program, and spend time up front on sales and promotion of the NGV market as a whole," he says. "It took us eight years to reach profitability."

COST SUMMARY ($1,000)

	$U.S.	$Can.
Equipment		
Compressor	120	170
Storage	28	40
Dispensers (3)	66	93
Dryer	6	9
Control Panels	18	25
Subtotal	238	337
Engineering/Construction		
Permitting	0.7	1
Construction	41	58
Subtotal	42	59
Total	**280**	**396**
$ per scfm	**1,121**	**1,584**

Today, because the local NGV population has been established, a new station can begin pumping more than 700,000 mcf (20,000 m^3) during the first month. A decade ago, it took several years for a new station to reach that volume of sales.

OUTLOOK

Consumers Gas' expects that the NGV market will continue to grow and generate profits. In fact, Consumers' NGV group can't keep up with the potential amount of business out there. "By operating independently, we're limiting ourselves in a way," Stover says. "The business could grow faster, but we've decided that to control quality, we need to manage design and construction in-house."

The company is willing to share its engineering expertise with other gas companies interested in the NGV market. "We're not in the consulting business," says Stover, "but we're willing to help others get started as long as we can recover our costs."

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Econofuel Company

AUSTIN STATION COST: $972/scfm

Southern Union Econofuel Company, a subsidiary of Southern Union Company, has installed nearly 30 natural gas (NG) fueling facilities over the past 12 years. Econofuel now owns and operates 17 NG stations in Texas, 11 of which are open to the public. In addition, some private facilities in other regions of Southern Union's territory are owned and operated by the utility.

BACKGROUND

Econofuel has taken advantage of its location in the capital of Texas by targeting NG service to fleet vehicles operated by the state. The station located at 3706 Guadalupe, installed Summer 1994, lies within a 2-mile radius of five state agencies as well as the University of Texas.

"Our intent was to serve those agencies," says Luke Allison, Econofuel's Sales and Marketing Representative. However, the station is open to the public and is used by "a handful of individual NGV drivers and some private companies," Allison says.

The site was provided by Diamond Shamrock, a major oil company, which operates the station's gasoline facilities. NG customers fill up the vehicle themselves and use cash or credit cards to purchase the fuel.

COST CONTROL

Since Southern Union is a Gemini Engine Co. distributor, it was natural

COST CONTROL STRATEGIES

- Capital investment was reduced by siting the facility on a gasoline distributor's property, eliminating the cost of land.
- Installation costs were controlled by selecting a skid-mounted compressor package and performing nearly all work in-house.
- Operating costs were reduced by selecting a gas engine-driven compressor, which requires only slightly more maintenance than electric motor drive.

"Engine-driven compressors are not as expensive as most people think, and because electric demand charges are avoided, they cost much less to operate."

Luke Allison
Southern Union Econofuel Company

SOUTHERN UNION
ECONOFUEL COMPANY

"We plan to concentrate on larger fleets and heavy fuel users, both public and private."

for the Econofuel subsidiary to select Gemini's natural gas engine compressor package rather than an electric motor.

"Engine-driven compressors are not as expensive as most people think," says Allison, "and because electric demand charges are avoided, they cost much less to operate."

Because the Gemini compressor package is skid-mounted, installation time and costs were minimized. Econofuel further reduced construction costs by performing nearly all work in-house. Only the electrical and fencing jobs were subcontracted.

Other equipment selections included—

- C. P. Industries storage vessels packaged by Gemini
- DVCO dispensers manufactured by Marcum Fuel Systems, Inc.
- Murphymatic control panel.

"Over the years," Allison points out, "our selection of equipment has been fine-tuned to get the maximum NG fueling capacity at the lowest operating cost."

ECONOMICS

In addition to minimizing operating costs, Econofuel leveraged its capital through the partnership with Diamond Shamrock, which eliminated the cost of land by siting the NG facility on the gasoline distributor's property. In exchange, Diamond Shamrock receives a small margin on NG sales, while Econofuel recovers its capital through a percentage of the fuel sales.

STATION DESIGN

Compression	
One compressor	227 cfm
Gas engine drive	145 hp
Suction pressure	20 psi
Discharge pressure	4500 psi
Storage	
Capacity (approx.)	+25k cf
Pressure rating	5400 psig
Number of vessels	3
Number of storage banks	3
Dispensers	
Number of dispensers	1
Number of hoses	2
Service pressure	3000 psi
Fill time (8 gal-equiv)	4.8 min

COST SUMMARY ($1,000)

Equipment	
Compressor	132.000
Storage	37.400
Enclosure	3.985
Dispenser	18.000
Sequence panel	7.000
Island access panel	0.960
Subtotal	199.345
Engineering/Construction	
Project management	4.800
Permitting	0.350
Construction	4.450
Mechanical	3.500
Civil/structural	3.800
Electrical	4.300
Subtotal	21.200
Total	**220.545**
$ per scfm	**972**

To achieve a 25% before-tax return on investment, Econofuel would have to sell about 250,000 gal.-equiv. of NG annually at this site. "Although fuel sales are still below expectations, they are increasing," Allison says. "Because the station is relatively new, we sometimes have to remind customers that it's there."

A National Guard post nearby will soon receive NGVs purchased by the federal government, which will help improve the station's utilization. "Also, as the overall number of stations is increased, we expect to see gradual increases in load," says Allison. The company plans to install two more stations during 1995.

FUEL PRICES

NG, gal-equiv	$0.659
Gasoline,* gal	$1.07-1.10
Diesel, gal	$1.09-1.12

NG/Gasoline, 60.7%

** Regular unleaded*

OUTLOOK

Econofuel anticipates that the market for NG will grow as mandates for alternative-fuel fleet vehicles kick in. However, "regulations at the state level are being softened somewhat," says Allison. "Legislators are following the federal government's path of reasoning and allowing fleet operators to meet emissions standards without specifying how they do it."

Econofuel's strategy is to continue to build stations where the economics make sense. "We plan to concentrate on larger fleets and heavy fuel users, both public and private," Allison says.

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Lone Star Energy

DALLAS STATION COST: $568/scfm

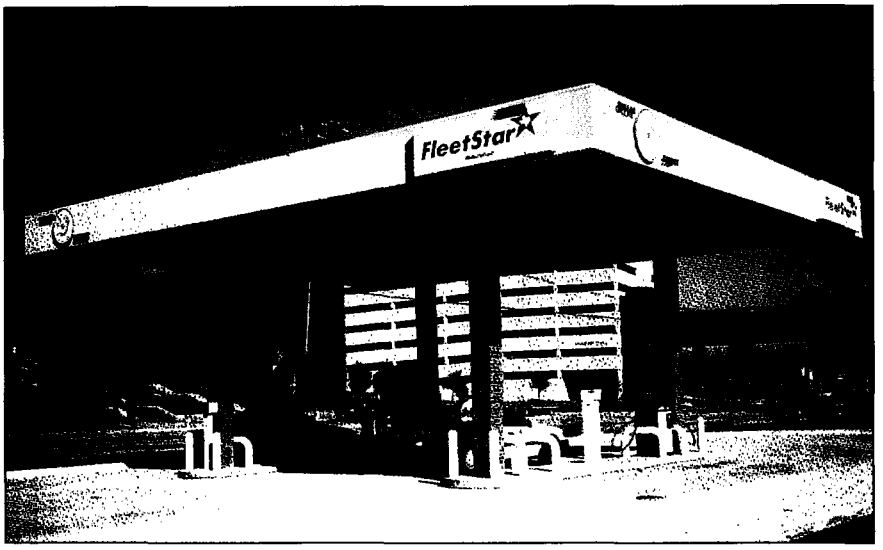
Thanks to strong corporate support and aggressive marketing, Lone Star Energy Company has created a "critical mass" of natural gas (NG) fueling stations that provide maximum convenience to customers in the Dallas-Fort Worth area. "We believe that convenience is the absolute key to success in the fueling business," says Mark Mancino, Lone Star Energy's Director of Operations. "By the end of 1995, no NGV driver should be more than eight to ten miles from a public NG station."

Lone Star Energy is an unregulated affiliate of Lone Star Gas Company, which consolidated all NGV activities into the affiliate's NGV Division in 1991. Since then, Lone Star Energy has formed partnerships with equipment manufacturers, fuel retailers, vehicle conversion companies, and fleet operators while establishing independent expertise in NG station construction.

BACKGROUND

The station, which was built in 1994, lies about a mile from Dallas County's vehicle service center. "We're just a stone's throw from downtown Dallas, where the county has a large criminal justice complex," says Mancino.

The Dallas station serves not only the county's NGVs but also several other fleet operators including the Dallas Area Rapid Transit, the Texas Department of Transportation,



COST CONTROL STRATEGIES

- When building and operating public stations, Lone Star Energy acts as its own project manager, using in-house expertise for everything from design to monthly maintenance.
- Partnership is a key to cutting capital costs, especially when the partner contributes land that includes utilities and paving.
- Positioning yourself as a distributor of natural gas fueling equipment can reduce station component costs.

"Developing the fueling infrastructure is a crawl-walk-run proposition. We started four years ago to create an infrastructure where none existed. Our customers wouldn't be able to make the commitments they're making today if we didn't have the infrastructure there. It's a long-term play."

Mark Mancino
Lone Star Energy Company

LONE STAR ENERGY COMPANY
Clean fuels for transportation

the City of Dallas, McShan Florist, and the Dallas Independent School District. The station's card-key system also allows public access to all customers of FleetStar, a joint venture owned by Lone Star Energy and other partners.

COST CONTROL

For public NG stations such as the one near downtown Dallas, Lone Star typically acts as its own project manager. "We've found it to be more cost-effective to have in-house staff do the design, specifications, permitting, equipment selection, construction management, start-up, and maintenance," Mancino says.

STATION DESIGN

Compression	
One compressor	614 scfm
Gas engine drive	195 hp
Suction pressure	350 psig
Discharge pressure	4000 psig
Storage	
Capacity (approx.)	35k scf
Pressure rating	4000 psi
Number of vessels	3
Number of storage banks	3
Dispensers	
Number of dispensers	2
Number of hoses	4
Service pressure	3000 psi
Vehicle Service	
Peak	300 gal-equiv/hr
Fill time (8 gal-equiv)	3 min

Lone Star Energy minimizes its capital costs through partnerships. Dallas County contributed the land and two-thirds of the capital for the downtown station, with Lone Star's FleetStar affiliate putting up the other third. In return, the county gets a reduced rate on NG fuel, while Lone Star gets the right to sell to third parties and keep those revenues.

Lone Star has found that a partner's property can be a valuable contribution, especially if it comes with utilities and paving. "All we have to do then is cut curbs, add a driveway, and install a compressor, dispenser, and card-key system," says Mancino. Lone Star co-owns stations with a large regional fuel retailer, Fina Oil and Chemical, and is negotiating similar agreements with other partners.

"We've also positioned ourselves as a distributor for several manufacturers," says Mancino, "so we save costs on some key equipment," such as the 614-scfm Gemini Engine Company compressor package at the downtown Dallas station, which incorporates a Caterpillar 3306 natural gas engine. (The compressor package is larger than normal for a NG station because Lone Star tapped into an existing high-pressure gas supply line serving a 1-MW cogeneration facility.) Mancino notes that gas engine compressor drive installation costs can break even with electric motors when savings in electrical service installation are accounted for.

Lone Star Energy also distributes Autogas card-key systems and Clean Fuels Technologies dispensers, which were used at the Dallas station. Other equipment selections included CP Industries storage tanks and Sherex nozzles.

In addition to these cost control strategies, inexperienced NG station builders must learn to understand local codes, says Mancino. "You have to develop a relationship with the code officials and the fire marshall to succeed consistently in obtaining the proper permits and construction approvals."

COST SUMMARY ($1,000)

Equipment	
Compressor	110
Storage	36
Enclosure	35
Dispensers (2)	60
Card-key system	8
Subtotal	249
Engineering/Construction	
Permitting	1
Construction	
Mechanical	40
Civil/structural	43
Electrical	16
Subtotal	100
Total	**349**
$ per scfm	**568**

ECONOMICS

Although the downtown Dallas station's large compressor substantially lowers the dollar-per-scfm cost, other Lone Star Energy stations in the typical 200-scfm range cost less than $1,000/scfm ($190,000) to build.

The Dallas station's utilization factor is projected to increase to 30% in 1995, from its current 25%. Annual NG sales at the site are about 160,000 gal-equiv, or close to 20,000 mcf/yr.

FUEL PRICES

NG, gal-equiv	$0.799
Gasoline,* gal	$1.15
Diesel, gal	$1.10
NG/Gasoline, 69.5%	

** Regular unleaded*

Routine maintenance, which is done by Lone Star Energy during off-peak fueling times, costs about $1,000/month, which includes service based on equipment manufacturers' recommendations. The company monitors the station's operating conditions via modem.

Lone Star's staff on the fueling station side numbers only four full-time people. "They're very capable," says Mancino, "and very busy."

OUTLOOK

By the end of 1995, Lone Star Energy will have 18-20 public NGV stations in the Dallas-Fort Worth area. Mancino expects the number of NGV customers to increase to more than 3000, from 1994's 1500-1600. "By the end of 1996, we're projecting almost 5000 customers," he says.

From the beginning, the company has taken a long-term, yet aggressive approach to the NG business. "Our customers wouldn't be able to make the commitments they're making today if we didn't have the infrastructure there."

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Natural Fuels

DENVER STATION COST: $1,074/scfm

Natural Fuels Corporation is owned by a gas utility and a pipeline. This team of gas industry players has the muscle to compete in Colorado's energy business, where propane is pursuing a share of the market for alternative fuel vehicles.

"Propane is a strong competitor here," says Curt Dallinger, Natural Fuels' Executive Vice President and General Manager. "Four suppliers in the area have been very active in the vehicle fuels market."

To support the NGV industry, Natural Fuels owns or operates 37 natural gas (NG) fueling stations in Colorado. Nineteen of these are public-access stations that serve a variety of NGV fleets, including tow trucks and taxicabs as well as state and federal government vehicles.

BACKGROUND

The Denver NG station, which was installed during January-March 1993, is within ten blocks of the state capitol building. The NG fueling site is owned by Total Petroleum, Natural Fuels' partner in the station, which owns and operates the gasoline facilities.

"This is one of Total's busiest stations, since it's about the only one near downtown," says Dallinger. NG is highly profiled with a sign just below the gasoline prices. Customers use a Natural Fuels card key to access the NG dispenser.

COST CONTROL STRATEGIES

- Natural Fuels reduced its installation costs substantially through a partnership with Total Petroleum, which eliminated the cost of land.
- Equipment costs were minimized by negotiating with suppliers for the lowest price, based on reasonably flexible specifications.
- Natural Fuels did as much design engineering as possible in-house and out-sourced only those tasks where it had no expertise.

"Find a partner that's willing to share their pavement. With equipment, you can beat down the price only so much, but you can save a huge amount of money by using somebody else's land."

Curt Dallinger
Natural Fuels Corporation

NATURAL®

STATION DESIGN	
Compression	
One compressor	228 cfm
Electric motor drive	100 hp
Suction pressure	20 psi
Discharge pressure	4700 psi
Storage	
Capacity (approx.)	40k cf
Pressure rating	4500 psi
Number of vessels	2
Dispensers	
Number of dispensers	1
Number of hoses	2
Service pressure	3000/3600 psi
Vehicle Service	
Peak	30 vehicles/hr
Fill time (8 gal-equiv)	2-3 min

COST CONTROL

Natural Fuels' partnership with Total accounted for the largest installation cost savings. "By sharing their pavement, we saved a huge amount of money that would have been spent on land," says Dallinger. "Compared with equipment, real estate is a much greater investment on a stand-alone basis."

Natural Fuels reduced equipment costs by bargaining with suppliers. "We call this the negotiated purchase approach," Dallinger says, where the station's requirements are adjusted to get the lowest price. "You have to work with the supplier, as opposed to stating iron-clad specifications."

"We're about at the operational breakeven point now . . . Our goal is to be big enough to recover our investment when the NGV market catches up."

The NG facility's Ariel compressor and Reliance electric motor were packaged by Pamco and Natural Fuels. Other equipment selections included—

- Cherco spherical storage tanks
- Natural Fuels dispensers with a Micro Motion meter
- Tech 21 card-key system.

Natural Fuels also exploited its own design capabilities. "We saved quite a bit by doing as much of the engineering as possible in-house," says Dallinger. "We farmed out only those tasks where we had no expertise."

ECONOMICS

Because of relatively low electric rates in the Denver area, Natural Fuels chose an electric motor for compression power. The NG station's electric bills run about $900/month, with demand charges accounting for about $700/month. Monthly preventive maintenance, estimated to cost $200, keeps the system's reliability high, though the equipment can automatically page service technicians round the clock if necessary.

COST SUMMARY ($1,000)	
Equipment	
Compressor	100.0
Storage	19.0
Dispenser	28.0
Card-key system	6.5
Other	17.0
Subtotal	170.5
Engineering/Construction	
Project management	8.0
Construction	
Mechanical	2.1
Civil	30.5
Electrical	22.0
Subtotal	62.6
Other	
Gas/electric hook-ups	3.0
Start-up	2.0
Miscellaneous	7.4
Subtotal	12.4
Total	245.5
$ per scfm	1,074

Natural Fuels plans to recover its capital investment through profit on fuel sales, which average 2000-3000 gal.-equiv./month at the downtown Denver station. Currently, sales profits are high enough to cover the cost of equipment operation.

"We're about at the operational breakeven point now," Dallinger says. "Our goal is to be big enough to recover our investment when the NGV market catches up."

OUTLOOK

Natural Fuels benefits from a state incentive program that stimulates the local NGV market. However, growth is tied to the national NGV market, since Colorado has relatively few vehicles (less than 3 million). "We can't swing the NGV market here, because we're not a California or a Texas," Dallinger explains.

Although propane has captured some state fleet vehicle business, Natural Fuels' outlook for the NG market is positive. "A lot of customers are interested in NGVs, and there's a large federal presence here too," says Dallinger. The company plans to install two more NG fueling stations during 1995.

FUEL PRICES	
NG, gal-equiv	$0.809
Gasoline,* gal	$1.179
Diesel, gal	$1.159
NG/Gasoline, 68.6%	

** Regular unleaded*

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Union Gas

CHATHAM STATION COST: $1,115/scfm

Union Gas Ltd., based in Chatham, Ontario, holds a unique position in the NGV industry—the company's own fleet has the highest percentage of NGVs of any large North American utility. Fully 98% of Union Gas fleet vehicles, which number close to 1000, operate on natural gas. Union Gas also co-owns 24 NG fueling stations. All are public facilities that serve individual commuters as well as fleets.

BACKGROUND

The Chatham station was built in 1991 in just six weeks. "This was the fifteenth station we installed," says Bryan Goulden, Union Gas Manager of NGV Operations, "so we knew what we were doing, and there were no particular surprises."

Union Gas identified the need for an additional facility and selected the site by examining the public station grid and comparing it with a quadrant map of the city. The fuel retailing facility is rented and operated by a private gasoline retailer associated with the PetroCanada oil company.

COST CONTROL

Union Gas acted as its own project manager, performing the engineering in-house and supervising the installation. "We coordinated all aspects of design and construction," says Goulden.

COST CONTROL STRATEGIES

- Acting as its own project manager, Union Gas performed all of the design engineering in-house and supervised construction of the facility.
- Separate bids were tendered for the equipment and for construction.
- The equipment bid addressed multiple stations, resulting in additional cost savings.

"In referring to costs, we prefer to use the word 'optimize' rather than 'minimize', since we want to ensure customer satisfaction regarding filling time and quality."

Bryan Goulden
Union Gas Ltd.

Union Gas
Energy For You

The company tendered its own competitive bids for the equipment and, separately, for construction. The equipment bid addressed multiple stations, resulting in additional cost savings.

"In referring to costs, we prefer to use the word 'optimize' rather than 'minimize'," Goulden says. As an example, he points out that this particular station could have gotten by with a smaller compressor, but the larger size was ordered to ensure customer satisfaction regarding filling time and quality.

STATION DESIGN

Compression	
One compressor	200-250 scfm
Electric motor	100 hp
Suction pressure	40-60 psi
Discharge pressure	3600 psi
Storage	
Capacity	20 k scf
Pressure rating	4000 psi
Number of vessels	10
Number of storage banks	3
Dispensers	
Number of dispensers	1
Number of hoses	2
Service pressure	3000 psi
Vehicle Service	
Peak	15 veh/hr
Average	250 veh/day
Fill time (8 gal-equiv)	5.5 min

ECONOMICS

Gas sales at the Chatham facility are about 25,000 mcf/yr. "The station is generating a positive cash flow for us and for the operator," Goulden says. Monthly maintenance costs are estimated at $460-$570 ($650-$800 Canadian), which translates to about 2.7¢-3.4¢/eq. gallon (or about 1.0¢-1.2¢/liter Canadian).

COST SUMMARY ($1,000)

	$U.S.	$Can.
Equipment Subtotal	205	290
Engineering/Construction Subtotal	43	60
Total	248	350
$ per scfm	1,115	1,575

Union Gas typically recovers its capital investment through a surcharge on the NG price, although this investment has been rate-based.

OUTLOOK

According to Goulden, Union Gas sees the need for open-access NG fueling facilities and the benefits of having a public infrastructure in place. Currently, however, the company is shifting its marketing emphasis toward fleet service. "Our plans are to target more onsite fueled fleets and transit buses," says Goulden.

FUEL PRICES

	$U.S.	$Can.
NG, gal-equiv	0.98	1.39
Gasoline,* gal	1.41	1.99
Diesel gal	1.34	1.89

NG/Gasoline, 70%

** Regular unleaded*

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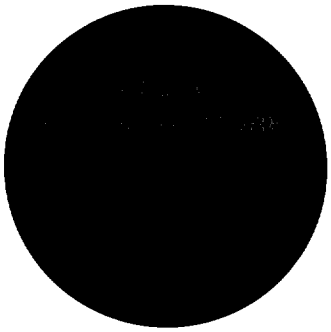

Fueling infrastructure development must

be coupled to vehicle demand. To improve economics, open-access and onsite fueling stations for high fuel-use fleet markets must be carefully timed and sited. Open-access fueling facilities will be exclusively fast-fill systems, and onsite fueling facilities will include either fast- and/or time-fill applications.

Top priority should be placed on building open-access stations capable of servicing all vehicle sizes. Investment in private onsite fueling facilities should only be made for fleets with no other attractive option; example fleets include transit and school buses, and forklifts.

Top priority should be placed on building open-access stations capable of servicing all vehicle sizes.

Fueling equipment cost reductions are likely to come with technology improvements in components such as dispensers, meters and controls. Engineering and design standardization will lower the installed cost of stations, and reductions in maintenance and operating expenses will significantly reduce life-cycle costs.

STRATEGY/ACTION OPPORTUNITY:

Business and technology stakeholders must take the lead in developing a fueling infrastructure that supports the initial market penetration targets outlined in the strategy. The emphasis should first be on providing reliable, durable fueling stations, and then on reducing development and operating costs.

BUSINESS STRATEGIES

- Maximize deployment of open-access stations in the near-term, taking into account customer preferences
- Match market demand to station deployment
- Provide information regarding the availability and competitive price of natural gas fuel to potential customers

NEAR-TERM BUSINESS ACTION OPPORTUNITIES

- Ensure that company-specific fueling station strategies emphasize open-access
- Reduce fueling station costs through standardization, modular designs of various sizes, and by implementing learning curve and volume effects

TECHNOLOGY STRATEGIES

- Develop and deploy fueling station equipment supporting staged-entry strategies
- Develop and deploy standardized fueling station designs for improved cost effectiveness, performance reliability, and user friendliness
- Accelerate development and deployment of LNG fueling station technology for improved cost, performance, reliability, and standardization for station and vehicle compatibility
- Develop fueling systems for transportable use in demonstration projects and fleet development strategies

NEAR-TERM TECHNOLOGY ACTION OPPORTUNITIES

- Develop improved fuel metering and dispensing
- Develop fueling systems that require less land
- Develop improved LNG system designs to eliminate venting, and improve fuel metering, transfer, and hold times
- Establish and communicate the technical and economic trade-offs pertaining to optimizing fueling system sizing against fleet growth and expansion
- Develop technical data to support fuel standards/specifications

To receive copies of the NGV Industry Strategy, FAX your request to:

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