



BUILD WITH PROPANE GUIDE

COMMERCIAL EDITION

YOUR HANDBOOK FOR PROPANE SYSTEMS,
NEW TECHNOLOGY, AND PRODUCTS.



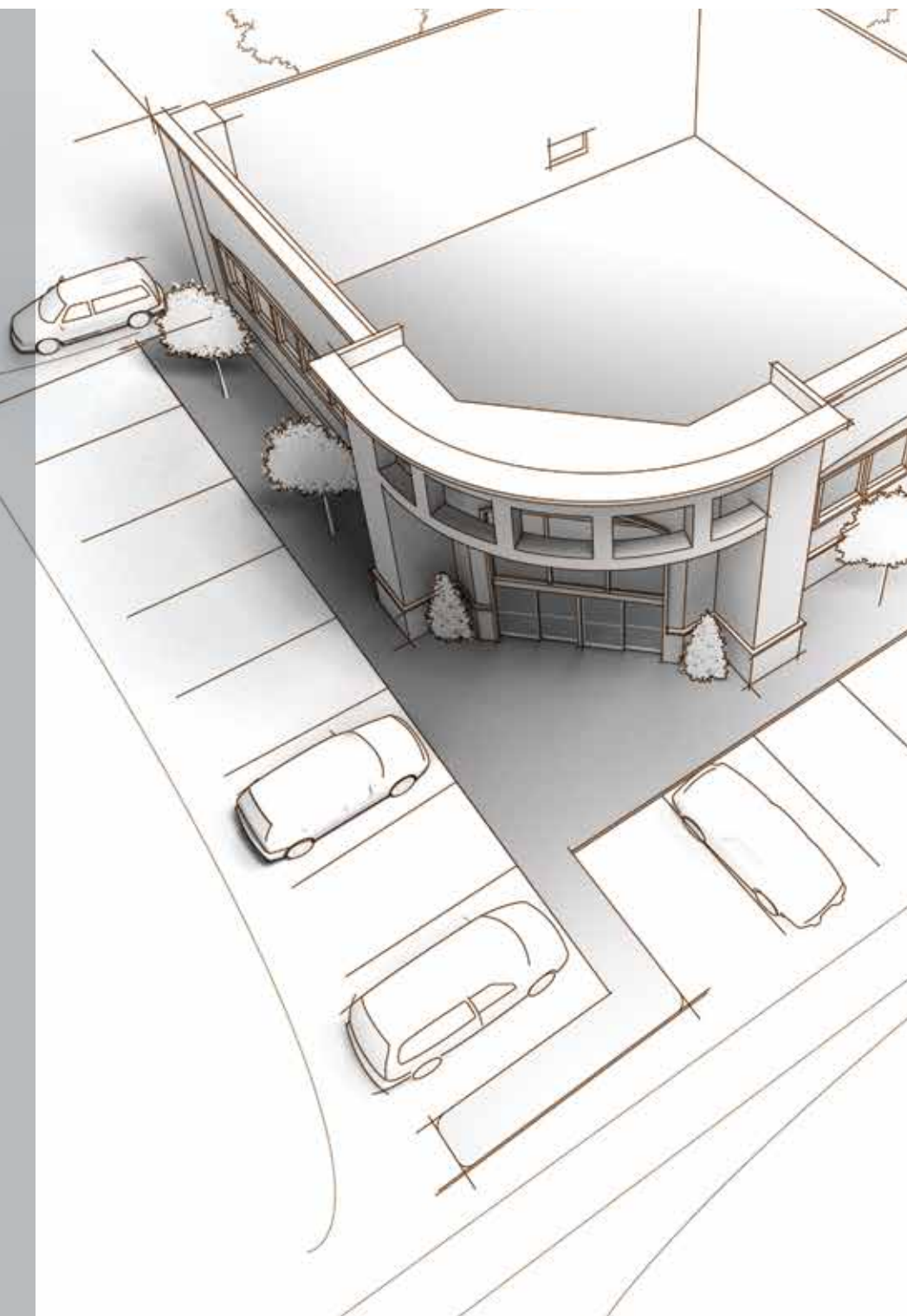
[BUILDWITHPROPANE.COM](https://buildwithpropane.com)

COMMERCIAL EDITION

TABLE OF CONTENTS

Introduction to Propane	2
Propane Storage Systems	4
Efficiency and Green Building	6
Attributes of Propane	7
Propane Applications	8
Propane Incentives	10
Propane and Renewable Energy	11
New Technology	12
Restaurants and Retail	14
Propane in Schools	16
Propane in Hospitality	18
Propane in Warehouses	20
Propane on the Jobsite	22
Propane Autogas	24
Propane Training and Retailers	25

If you're new to propane, consider this guide a warm introduction.



PERFORMANCE

A HIGH-PERFORMANCE ENERGY SOURCE



PROPANE IS VERSATILE

It can fuel projects ranging from a remote park cabin to a sprawling luxury resort.

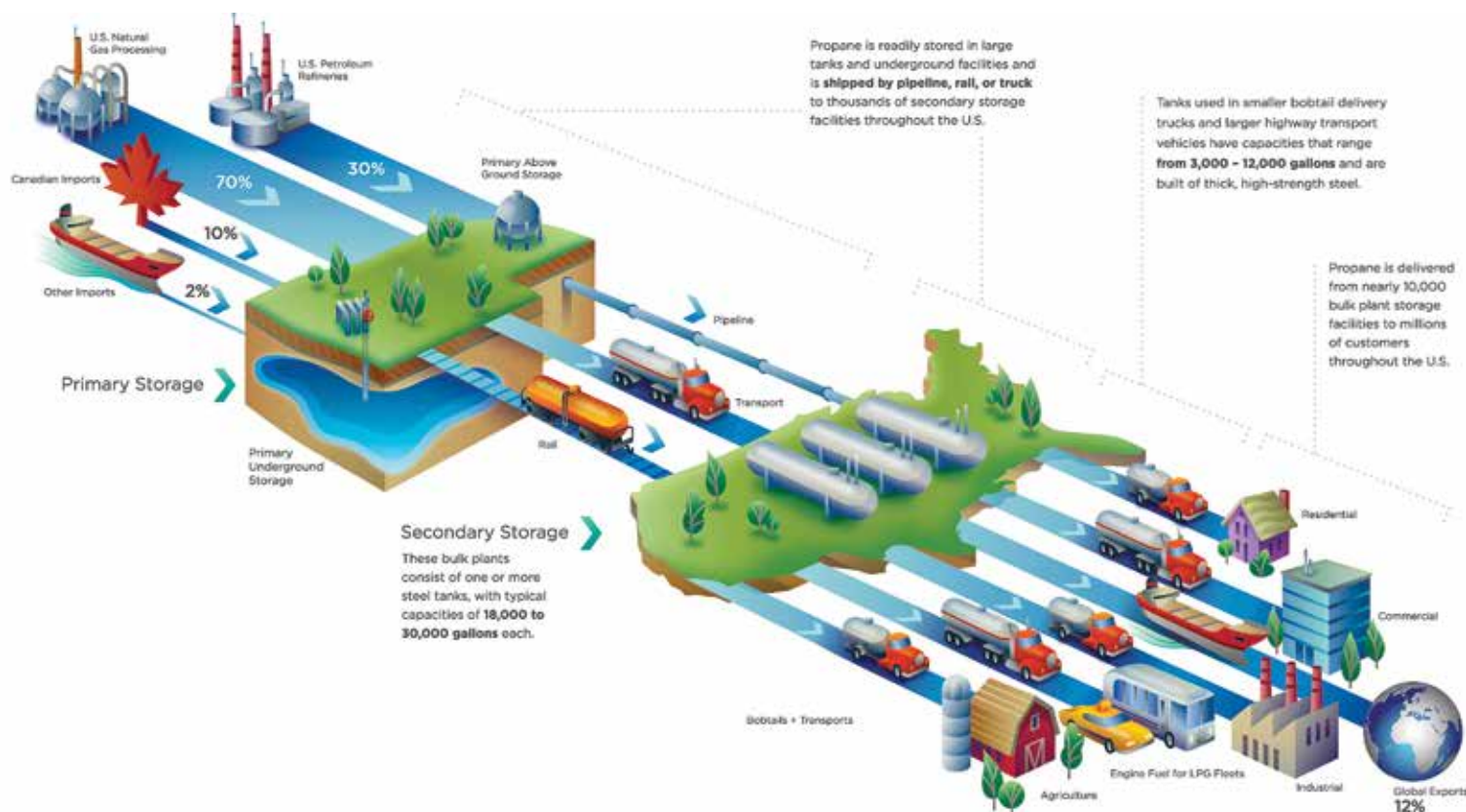
NO MATTER WHAT ROLE YOU HAVE IN THE COMMERCIAL CONSTRUCTION

process, you share a set of common goals for your building: top-notch performance and efficient, low-cost operation. And propane is a smart, flexible, and reliable gas energy choice that will help you meet those goals.

If you're new to propane, consider this guide a warm introduction. You'll learn about the basic properties and attributes of propane, how it's delivered and used in commercial construction projects, and the typical applications that are fueled by propane. If you're already building with propane, this guide will help you learn more about propane's versatility in commercial construction. You'll discover innovative technologies and energy and environmental advantages that will help you construct a building that meets even the highest performance goals.

Over the last several years, the Propane Education & Research Council (PERC) has invested millions of dollars in research, videos, training courses, and guides such as this that focus on propane applications, including new technologies, installation, maintenance, servicing, and safety. We've found that propane is versatile enough to fuel projects ranging from a remote park cabin to a sprawling luxury resort. With the information in this guide, you'll have the awareness and resources you need to incorporate clean, efficient propane into your projects.

DELIVERED TODAY'S PROPANE



Source: National Propane Gas Association

American Energy

Propane is a nontoxic gas produced from natural gas processing and crude oil refining. Propane is made here in America. In fact, the United States is a net exporter of propane, which means we make more than enough to meet demand. In the wake of the shale revolution, domestic propane supply has greatly increased, and this fuel can now do even more to advance America's energy security and protect the environment. Propane fuels our vehicles, forklifts, and commercial mowers; heats our homes and commercial spaces; and fuels American farming and manufacturing.

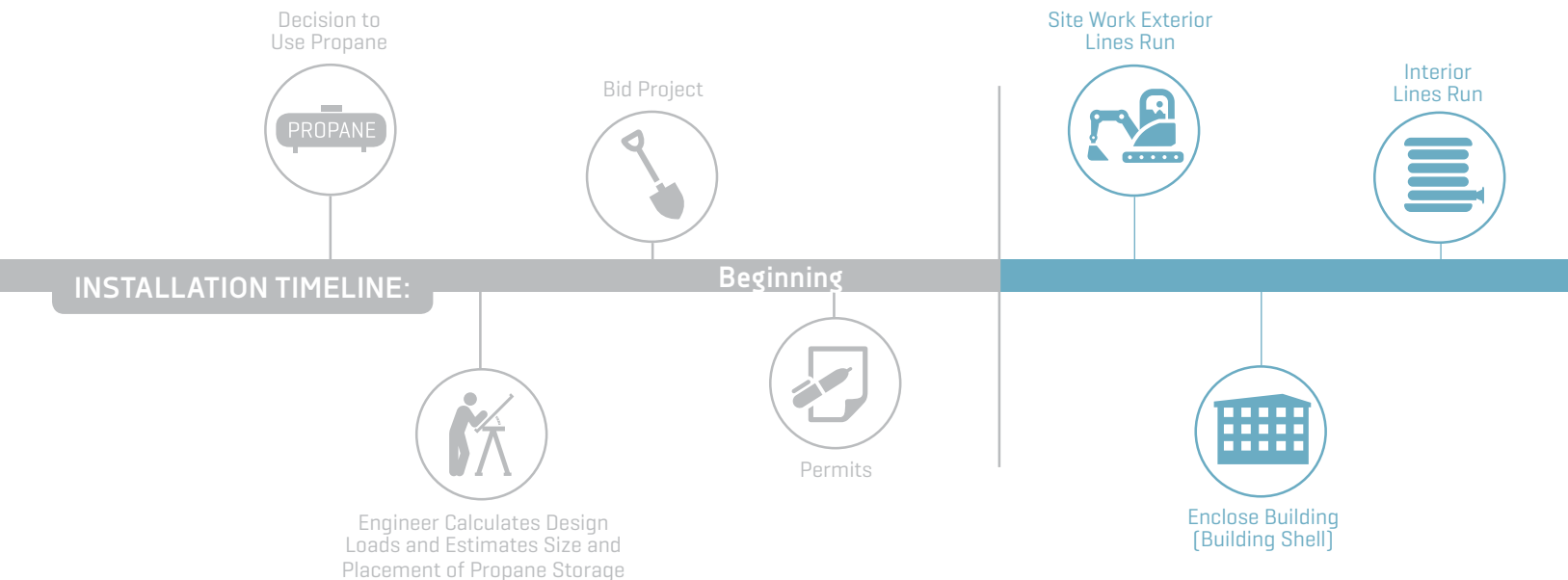
Construction-Friendly

In commercial construction, propane is used much like natural gas. It provides fuel for energy-efficient gas space heating,

water heating, cooking, fireplaces, and clothes drying, though it can also fuel a variety of other building needs. The primary difference is that propane is stored on site in tanks that are regularly filled by bobtail truck or highway transport vehicle. Propane brings all of the advantages of gas to buildings at an affordable energy cost.

Propane is versatile, and it's easy to incorporate in a construction project. With propane, you're not at the mercy of a public utility. And with the option of aboveground or underground storage tanks, propane professionals can install and connect building systems and other applications on your schedule. Propane also provides jobsite flexibility by providing gas energy for portable generators and temporary construction heaters.

PROPANE SYSTEMS



PROPANE IS QUICKLY EXPANDING INTO COMMERCIAL CONSTRUCTION MARKETS

through innovations in commercial tank manufacturing and commercial distribution networks. Propane can now be used for any gas commercial building application that does not have easy access to natural gas, including new construction, interior construction for new tenants, major renovations, and building efficiency upgrades.

There are three components to a commercial building's propane infrastructure:

- Storage [tank].
- Distribution system [piping network].
- Optional components.

Storage [Tank]

Propane tanks can provide on-site propane storage for commercial building projects of any size, from the smallest commercial building to a sprawling resort or retail complex. Sizes range from 125-gallon tanks for spot energy needs to 120,000-gallon storage tanks. One tank can be sized to serve all of a building's gas energy needs based on its total maximum load, measured in British thermal units [Btu], or multiple smaller tanks can be manifolded together.

Propane storage can be underground or aboveground. Tanks can be placed at multiple sites throughout a project, or one central tank can be used with gas piping running throughout the complex of commercial buildings.

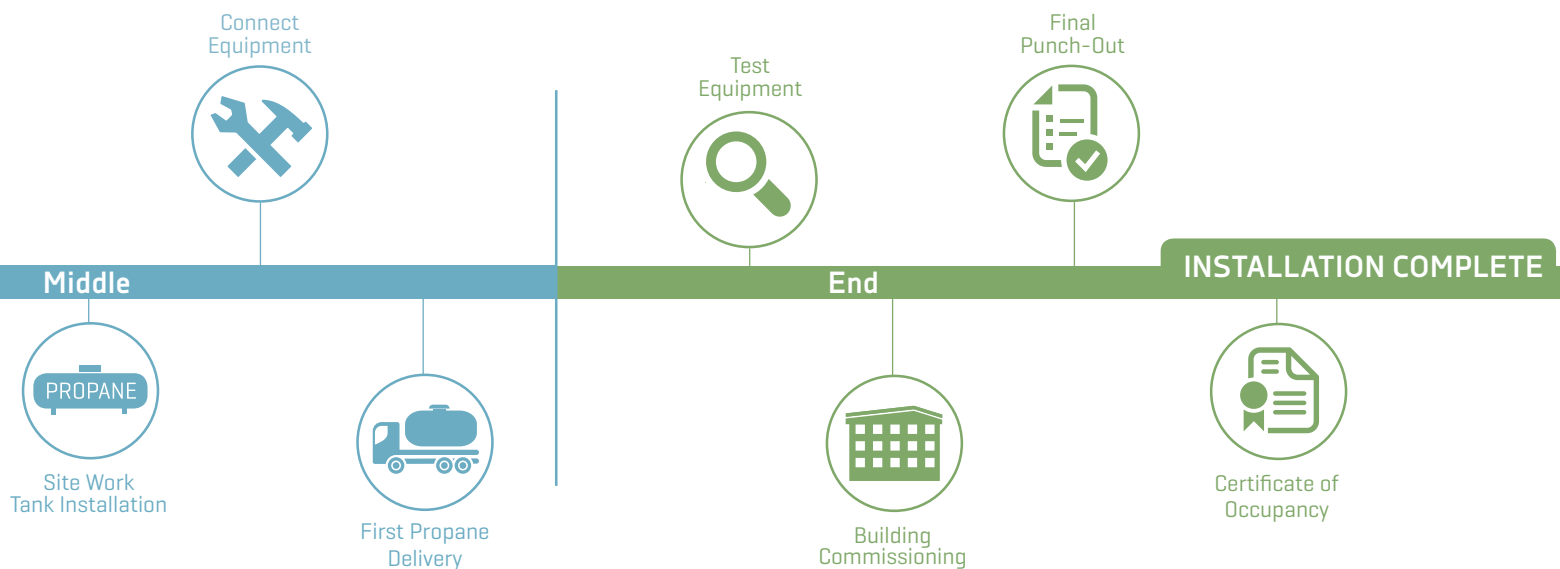
Placement of the propane storage is easily addressed, even in complicated efficiency upgrade scenarios. Your propane supplier will work with you and your client to determine the proper size and number of tanks to meet the building's propane needs and site plan. Tanks can be fenced, buried, or landscaped to enhance security, safety, and aesthetics.

Distribution System [Piping Network]

Propane distribution systems are designed to be similar to natural gas systems. Underground gas mains deliver the propane to individual service points on buildings. Outside gas piping is buried according to locally applied codes and standards.

National Fire Protection Association (NFPA) standards govern the use of propane and gas in buildings. NFPA 58 [Standard for the Storage and Handling of Liquefied Petroleum Gases] is the main resource for tank and underground gas line installation, and NFPA 54 [National Fuel Gas Code] governs inside gas piping installation. Visit nfpa.org for more information.

OTHER SYSTEM COMPONENTS



Commercial construction professionals should be aware of two new types of products available for exterior and interior gas piping: plastic underground pipe and corrugated stainless steel tubing (CSST), respectively. Plastic underground pipe can be used for exterior underground gas piping, such as from the propane storage site to the building or in a network of piping to metered points of a building or complex. CSST is used inside residential and commercial buildings instead of, or in addition to, black iron pipe and other gas piping options. Installers can string this tubing throughout a structure, like electrical wire, making interior gas line installation quicker and easier for the contractor. CSST piping must be installed by trained personnel in accordance with manufacturer's instruction and state and local building codes.

Optional Components: Remote Tank Monitoring

Propane tanks for commercial use are typically remotely monitored by your propane supplier to ensure that the propane supply is reliable and uninterrupted. These smart monitoring devices allow propane companies to track their customers' propane levels and average usage so they can schedule propane deliveries when needed. Some of today's advanced monitoring systems also integrate with building management systems and allow owners or facility managers to also track their propane usage.

Optional Components: Metered Service

Propane metering is a hassle-free way of providing sub-metered propane service to retail tenants, even if they draw from the same propane storage. Just as with electric or natural gas service, your propane company can install individual unit meters so tenants can be billed for the propane they use each month. With meters, you won't have to devise a way to divvy up the costs of unequal use among the tenants, or simply attempt to recoup the cost with higher rent. Meters provide an accepted way to bill the exact cost of propane to the individual tenants who use it.

Optional Components: Vaporizers

Vaporizers can be used to increase the performance capacity of the propane system without the need for larger-volume propane storage tanks. A vaporizer is essentially a boiler that uses heat to aid the natural vaporization process of propane from liquid to gas. The result is a virtual increase in the Btu delivery capacity of the propane storage system without a corresponding increase in the size or number of propane storage tanks — which may not be possible where space is limited.

CLEAN ENERGY

PROPANE AND GREEN BUILDING



*Propane
increases energy
independence
and reliability.*

COMMERCIAL CONSTRUCTION PROJECTS, INTERIOR WORK FOR TENANTS, RENOVATIONS, AND

efficiency upgrades are often measured in their environmental effectiveness by standards such as Leadership in Energy & Environmental Design (LEED), ANSI/ASHRAE/IES Standard 90.1, and the new, enforceable International Green Construction Code (IgCC). Propane can go a long way toward helping a project meet these green building standards. For example, in LEED v4, commercial building projects may be eligible for up to 28 points — mostly related to the Energy and Atmosphere provisions. The 2012 IgCC has a similar approach to voluntary green rating systems, but it makes many of the voluntary points in other rating systems mandatory requirements in order to comply with the code.

Here are some ways propane can help builders earn points toward LEED certification in these and other categories:

- **Efficient heating.** Energy and utility savings derived from propane-fueled furnaces, boilers, and water heating systems can help designers and engineers exceed standard-efficiency systems.
- **Temporary heat.** Portable propane-fueled construction heaters can help meet LEED requirements for clean indoor air quality during the construction and pre-occupancy phases of building.
- **Meters.** Developers can earn one point toward LEED certification for installing propane meters for individual tenants or the whole building.
- **Propane autogas.** A LEED credit is available for buildings that install alternative-fuel refueling stations or provide low-emitting and fuel-efficient vehicles, maintenance vehicles, or buses, such as those fueled by propane autogas.
- **Mowers.** The use of propane-fueled mowers can help earn a LEED point by achieving emissions reduction requirements from site management equipment.

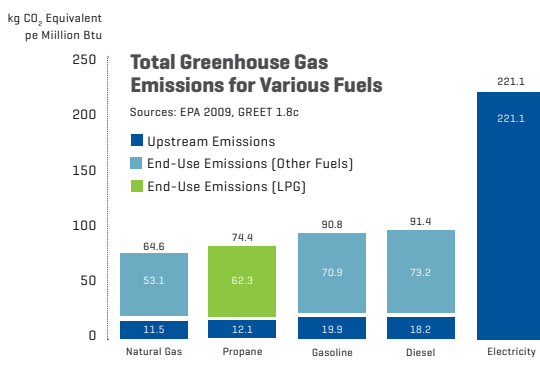
PERFORMANCE

PROPANE FUNDAMENTALS

IF YOU'RE LOOKING FOR THE BEST ENERGY SOURCE FOR HIGH-PERFORMANCE COMMERCIAL BUILDINGS, THE CHOICE IS SIMPLE.

Gas is the smart, efficient, and environmentally friendly choice for a building's major energy applications, and both propane and natural gas provide similar performance characteristics. Like natural gas, propane is an abundant, domestically produced source of energy. There are a few fundamentals that building professionals and their clients should know about propane.

It's clean energy. Propane can reduce CO₂ emissions by as much as 50 percent compared with electricity in applications such as water heating, because much of the nation's electric power is generated by coal- and oil-fired power plants. Propane has similar advantages



over heating oil. For example, recently a Maine YMCA switched from heating oil to propane for its space and water heating, resulting in a CO₂ emissions reduction of 183,000 pounds per year — the equivalent of taking 17 cars off the road every year.¹ By using propane and related applications, construction pros can earn points under green building programs, such as the LEED Rating System.

It reduces energy costs. Propane systems and appliances are typically far more efficient than their electric counterparts. For example, a propane condensing tankless water heater can save building owners or operators up to 50 percent on their water heating costs when compared with the costs of operating a standard electric storage tank heater.

It's versatile. Propane allows you to construct your buildings with first-rate amenities regardless of where they are located. Propane can fuel a building's vital systems, including power generation, space heating, and water heating, even if the building is located off the grid, without access to off-site energy sources such as electricity or natural gas.

It protects your power supply. Standby generators fueled by propane enable a business to stay open during severe storms that bring widespread power outages. With propane available, on-site generators maintain lighting, refrigeration, heating, and air conditioning, while propane-fueled appliances such as water heaters can continue to operate without interruption.

It provides maximum comfort. With options such as energy-efficient propane furnaces, which heat air to a much warmer temperature than electric heat pumps, and propane fireplaces, hearths, and outdoor heaters, which keep guest areas and outdoor patios inviting and toasty, propane amenities and heating systems turn buildings into comforting and appealing destinations.

It's designed for safety. Typically used in gas form, propane is stored and transported as a liquid under pressure. Propane is nontoxic and odorless, so processors add a chemical odorant (ethyl mercaptan) to help users detect leaks by way of an easy-to-identify rotten-egg smell. The propane industry's voluntary Certified Employee Training Program (CETP) helps ensure that propane installation and service personnel are well qualified to handle even the most challenging tasks. In addition, propane is a well-regulated industry that follows the codes and standards set by the NFPA, the Department of Transportation, the Department of Energy, and various state and local regulatory bodies. For more information, go to propanesafety.com.

1. Newport Partners LLC. *Maine YMCA Saves Time and Money with Propane-Fueled Space and Water Heating System.* Case Study. [Washington, D.C.: Propane Education & Research Council, forthcoming on buildwithpropane.com, fall 2013.]

VERSATILE WATER HEATING AND SPACE HEATING

MANY OF A BUILDING'S KEY SYSTEMS AND AMENITIES RUN AT THEIR BEST WHEN THEY'RE FUELED BY PROPANE.

Water Heating. Propane tankless water heaters provide an enormous range of hot water supply options, along with best-in-class efficiency ratings as high as 99 percent. Propane tankless systems are sized up to 199,000 Btu/hour [199 kBtu/hour], with individual units typically offering at least 4 gallons per minute [gpm] with a rise of 70 degrees Fahrenheit. Many models achieve efficiency levels [called Energy Factor for tankless units] of 95 percent or higher by using a condensing design to extract extra heat from combustion.

Propane tankless systems can also be banked together in larger groups or racks to satisfy higher demands for commercial buildings. A rack of six tankless units could deliver up to 30 gpm with a rise of 70 degrees Fahrenheit. Innovations such as factory-assembled racks of units and shared venting expedite field installation time and reduce costs. Sophisticated controls, valves, and pumps cycle the banked units to spread the usage evenly, provide redundancy in case one unit needs to go offline for service, and ensure steady delivery of hot water across a wide range of flow rates.

These innovations drive significant energy cost savings from tankless designs. Hot water energy costs using condensing tankless systems can be as little as half those of electric storage tank units. Tankless systems' cost-effectiveness, as well as their reliability and redundancy, are very attractive in buildings with significant hot water usage. For example, more than 100 Chili's restaurants in the Northeast use banks of tankless water heaters.² An informal survey of the installation at one Chili's location revealed savings of roughly \$1,800 per year in energy costs, although the improved reliability was the main factor driving the decision to go tankless.

Another high-efficiency option for water heating in commercial buildings is a propane high-volume water heater. High-volume commercial propane water heaters have high output capacities well suited for the high-demand applications often found in

restaurants, hospitality, and health care. System sizes can range from units less than 200 kBtu/hour up to 1,000 kBtu/hour or higher, with flow rates from 4 to 20 gpm [at a rise of 70 degrees Fahrenheit] for a single unit.

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Space Heating. Commercial propane furnaces and boilers offer efficient and reliable operation and are readily available in configurations and capacities to suit any commercial building. For example, packaged rooftop unit [RTU] air conditioning and gas furnace systems contain all heating and cooling components in a single cabinet and are available in modular sizes to easily match each unit to a building zone. Compared with packaged rooftop heat pump units, the air conditioning-furnace system avoids the need for less efficient and more emission-intensive electric resistance supplemental heat.

In addition to specifying RTUs, which are typically noncondensing units with thermal efficiencies of 80 to 82 percent, architects and engineers often specify residential-size condensing furnaces for installation within a building's thermal envelope. These furnaces have capacities up to 150 kBtu/hour and efficiencies as high as 97 percent [measured by AFUE]. To compensate for their lower capacity levels, a pair of furnaces may be twinned to combine their heating output into a

VERSATILE DEHUMIDIFICATION

single-duct delivery system, effectively doubling their capacity. Still other propane heating configurations are available, including boiler-fed hydronic systems, which heat about one-third of all U.S. commercial floor space, and radiant zone heaters, which are well suited to large, open spaces.

Dehumidification. Commercial buildings often have significant moisture loads [also known as latent loads] during cooling, especially in more humid locations and for buildings such as hospitals, schools, restaurants, and office buildings. In many cases, the need to simply cool the air [called sensible load] may be lower in new commercial buildings due to tighter code provisions on insulation, windows, and high-efficiency lighting, which gives off less heat. As a result, humidity control is increasingly important. RTUs may not be able to satisfy the latent load as reliably and efficiently as a hybrid air-conditioned-desiccant system.

In the hybrid system, the desiccant system addresses the latent load by absorbing moisture from air moving through the unit. The desiccant is then “regenerated,” or dried out, as moisture is driven out of it when it is heated via gas combustion with propane or natural gas. In applications with heavier latent loads, this hybrid system is often more effective and energy efficient than a traditional RTU air conditioner.

For example, an Atlanta elementary school was suffering from poor indoor air quality and occupant discomfort because the existing RTU could not adequately control indoor relative humidity [RH] levels. The RTU A/C unit was replaced with a hybrid unit, which was able to maintain the desired 50 percent RH at an average thermostat setting 2.4 degrees higher than the 70.4 degrees Fahrenheit average set point the old system used. In other words, the older system was overcooling the space in an attempt to remove more humidity from the air. Based on energy simulations, this higher set point made possible with the hybrid system reduced cooling energy consumption by about 10 percent,³ thus providing both energy savings and better control of the indoor humidity.

HEATING OIL CONVERSION

While many buildings in the Northeast use legacy heating-oil systems, heating oil has consistently lost market share at a rate of about 2 percent per year as propane, natural gas, and electricity have increased in popularity. There are several reasons for this shift:

Efficiency

Heating equipment fueled by propane or natural gas is available at higher efficiency ratings than what's commonly available for oil systems.



Environmental issues

Several states in the Northeast are phasing in low-sulfur heating oil regulations.



Storage

Heating-oil systems come with an oil tank storage system, which can be smelly, dirty, and expensive and time-consuming to maintain. Propane tanks, on the other hand, can be safely installed underground and are periodically inspected for safe operation by a propane retailer.



When it comes time to upgrade or replace heating-oil equipment, converting to propane can eliminate costly heating oil repairs, and reduce maintenance costs, efficiency losses, carbon emissions, and environmental risks. A recent recreation center retrofit in the Northeast included a change from heating oil to propane, resulting in energy savings of \$23,500 per year.¹ The payback was immediate, because costly chimney repairs and expensive heating oil equipment replacement were not needed.

3. “Chapter 9: Heating and Cooling.” In *Energy Star Building Upgrade Manual* [U.S. Environmental Protection Agency, 2008]. http://www.energystar.gov/buildings/sites/default/uploads/tools/EPA BUM_CH9_HVAC.pdf?7b3b-ae65. 21.

INCENTIVES

REBATES AND TAX CREDITS

BUILDING WITH PROPANE ISN'T JUST ENVIRONMENTALLY FRIENDLY, IT'S ALSO ECONOMICALLY SMART.

Many states and localities provide tax credits, rebates, grants, and other incentives for high-efficiency propane projects.

PERC's Propane Heat and Power Incentive Program provides as much as \$10,000 in financial incentives to qualifying construction professionals who use eligible propane-fueled products such as premium generator sets, combined heat and power systems [CHP], or pest control heat treatment.

The Propane Heat and Power Incentive Program also serves as a research initiative. To qualify, construction professionals and

businesses that participate in the program agree to share their experiences with PERC and their peers. The research includes tracking product performance data such as fuel consumption, hours of operation, and cost savings.

Visit buildwithpropane.com/heatandpower for more information and details on how to apply.

PERC's Propane Mower Incentive Program provides a similar opportunity for landscape contractors. The program provides \$1,000 per qualifying new mower purchase or \$500 per qualifying mower conversion. In return, users provide feedback and performance data for one mowing season. Find more information about this incentive or fill out an application at poweredbypropane.org.

Tax credits. Many federal incentives for energy-efficient commercial building and fuel sources are available to offset first costs and enhance return on investment, including:

- The Energy-Efficient Commercial Buildings Tax Deduction provides a deduction of up to \$1.80 per square foot to commercial building owners or tenants who reduce the building's total energy and power cost by at least 50 percent relative to ASHRAE Standard 90.1-2001. If a building makes only one type of retrofit (envelope, lighting, or mechanical equipment), owners can still earn a deduction of \$0.60 per square foot if the upgrade would reasonably contribute to an overall building savings of 50 percent if additional elements were installed.
- A Business Energy Investment Tax Credit is available for up to 10 percent of expenditures for eligible CHP systems, with no maximum limit stated. CHP systems must exceed 60 percent energy efficiency and can be sized up to 50 megawatts.
- A Business Tax Credit of up to \$2,000 is available for residential and multifamily builders, contractors, or developers who reduce a home's total heating and cooling energy consumption by at least 50 percent relative to a standard "built-to-code" new home. Because the credit is calculated by the "dwelling unit," not the building, it is particularly valuable for contractors and developers of low-rise multifamily properties.
- Alternative fuel tax credits are available for vehicles that use propane autogas, such as school buses, construction equipment, forklifts, shuttle vans, and maintenance vehicles. The Alternative Fuel Excise Tax Credit provides a 50-cent price reduction per gasoline gallon equivalent of propane autogas. The Alternative Fuel Infrastructure Tax Credit is a 30 percent tax credit (not exceeding \$30,000) on fueling equipment installed between Jan. 1, 2006, and Dec. 31, 2013.

Several of the federal incentives are scheduled to expire at the end of 2013, but incentives are sometimes extended. Check the Database of State Incentives for Renewables and Efficiency [DSIRE] for current provisions at dsireusa.org.

PERC'S PROPANE MOWER INCENTIVE PROGRAM



provides rebates on propane-fueled mowers.
poweredbypropane.org

INNOVATIONS

PROPANE AND RENEWABLE ENERGY



WITH ELECTRICITY PRICES ON THE RISE ACROSS THE UNITED STATES MANY BUILDING OWNERS

and construction professionals are turning to renewable energy sources to generate heating and electricity. Because propane has low greenhouse gas emissions and can easily be stored on site, it's ideal for enhancing a wide range of renewable energy systems. When properly designed, propane-enhanced renewable energy systems operate with little, if any, intervention by building owners and managers.

- **Electrical generation systems.** In systems where solar photovoltaic panels or wind turbines are used to generate electricity "off the grid," a propane generator can provide auxiliary power when stored battery voltage cannot meet the electrical load of the building.
- **Solar thermal systems.** Propane can fuel commercial solar backup systems, which store solar-heated water, provide efficient backup heating at thermal efficiencies greater than 95 percent, and offer controls that easily integrate with upstream solar systems to control flows and temperatures.
- **Bio-mass heating systems.** Bio-mass fuels include wood, pellets, dry-shell corn, and other indigenous plant materials suitable for producing heat in a combustion chamber. Buildings with bio-mass heating systems often use hydronic heating delivery. An auxiliary system is necessary for times when the fire is out or the bio-mass system is unable to meet a variable heating load, and propane's flexibility makes it an excellent energy source for these applications.

*Propane is
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INNOVATIONS

COMBINED HEAT AND POWER



COMBINED HEAT AND POWER (CHP) SYSTEMS ARE A PROVEN COMMERCIAL TECHNOLOGY THAT CAN SLASH UTILITY BILLS FOR BUSINESSES.



These systems use a propane or natural gas engine, heat exchanger, and generator to create electricity that powers the building. Simultaneously, the heat from the unit is captured by the heat exchanger and used to channel thermal energy to applications like space heating, domestic water heating, dehumidification, or other loads like swimming pool heat. Utilizing both the electrical and thermal output of the propane CHP system achieves system efficiencies as high as 85 percent,⁴ while typical stand-alone electric generation from the grid is only about 30 to 50 percent efficient.

In commercial settings, CHP systems can greatly improve energy efficiency when compared with traditional systems. These systems are most effective in buildings with significant and steady thermal demands, which could include heavy domestic hot water needs [e.g., hotels, hospitals, car washes], swimming pool heating, or space heating through a hydronic system. CHP systems can be ideal for retrofit situations when existing water heating equipment needs replacement, electric rates are increasing, or on-site power generation is an increasing priority. Most CHP systems can be used for standby power during grid-based power outages.

According to the EPA, CHP units could be utilized in 10,000 of the current 48,000 hotels in the United States, with nearly 1,000 of those hotels experiencing a return on investment in five years or less.⁵

In many states it is even possible to sell extra electricity produced by the CHP system back to the energy grid. These net metering programs allow utilities to issue kilowatt-hour credits to customers, who can use them to offset any electricity consumed from

INNOVATIONS

NEW TECHNOLOGY

the grid. In most cases, the transfer is accomplished through a bi-directional meter. The meter turns backward as excess electricity is sold to the utility. Optimized CHP systems can sync with utilities to operate when electric rates are highest, maximizing cost savings. PERC's Propane Heat and Power Incentive Program provides as much as \$10,000 in financial incentives to offset the cost of propane-fueled CHP systems. Read more about the program on page 10, or visit buildwithpropane.com/rebates.

Commercial Standby Power Generation

Most businesses can't afford any downtime from a power outage. While storms, unpredictable weather, and unreliable power grids create an uncertain supply of electricity, propane-fueled standby generators provide insurance against power disruption — and the lost revenue an outage can bring. They can also protect critical systems, including security, refrigeration, safety lighting, automatic doors, and IT systems.

In the past, commercial standby generators were typically powered by expensive diesel systems. Today, manufacturers offer a number of affordable, propane-fueled standby generators that are powerful enough to serve a variety of commercial building sizes, with capacities up to 400 kW.



Tankless Water Heater Arrays

Propane tankless water heaters are hard to beat for top-notch energy efficiency. For larger commercial installations, where the building's hot water demand exceeds the capacity of a single tankless unit, multiple tankless units can be banked to increase capacity.

Available in freestanding or wall-mounted versions and compatible with indoor or outdoor installation, these arrays can be shipped to the site pre-assembled, with much of the gas, water, and vent piping pre-configured.

They are available with a common venting system, which further speeds installation by allowing the entire rack to use the same exhaust and intake venting. By combining efficient operation with a simplified and expedited installation, tankless racks are a smart choice for both new construction and retrofit projects.

Air Turnover Systems

Designed for large spaces with high ceilings, such as warehouses and big-box stores, floor-mounted air turnover heating and cooling units save energy by reusing heat that would otherwise be trapped at the ceiling. These units continuously circulate large volumes of interior air by pulling in ground-level air, heating or cooling it, and returning it to the space above. Propane combustion supplies thermal energy to the heat exchanger, while propane glycol is used for cooling purposes. These systems eliminate the need for multiple rooftop units, roof penetrations, and duct work and can be completely operational in one to two days.

*Tankless
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smart choice
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BUILDING

PROPANE IN RESTAURANTS



The cost of energy is a major component of a restaurant's operating costs, with energy-intensive appliances and high demands on hot water and HVAC systems. Choosing energy-efficient propane kitchen appliances and space heating and water heating systems can lower those costs and provide a quick return on investment.

Water heating. In high-demand scenarios, an array of propane tankless water heaters is a space-saving and cost-efficient way to produce hot water. These tankless racks create redundancy, so the hot water supply will continue even if one unit is out of commission. Tankless water heaters used in commercial applications offer economical, on-demand, endless hot water, and they can be installed inside or outside, depending on climate.

Space heating. An efficient rooftop furnace can quickly and cost-effectively heat a restaurant, and it can serve two different zones for the kitchen and seating area. Newer units have multiple stages and microprocessors to reduce energy costs, along with variable airflow to meet diverse heating loads.

Cooking. Restaurants use about five to seven times more energy per square foot than other commercial buildings. Commercial kitchen appliances are energy intensive, so choosing energy-efficient gas appliances is a smart choice. Propane and gas can be used to cost-effectively fuel a variety of kitchen equipment, including stoves, ovens, fryers, rice cookers, griddles, steamers, broilers, and buffets.

Fireplaces. Propane fireplaces can be used for decorative or space heating purposes. Propane units are "heater-rated," meaning they can provide efficient heating to an individual room or space, such as the seating area of a restaurant. High-efficiency propane fireplaces can achieve fireplace efficiency (FE) ratings of more than 90 percent.

Patio amenities. Radiant heaters, wall sconces, and tiki torches maximize the curb appeal of your patio and entrance area. Propane patio heaters extend the outdoor living season by raising the outdoor air temperature to comfortable levels. Fire pits, hearths, and decorative flame features provide a cozy amenity and gathering place to highlight an outdoor courtyard or patio.

Propane tank. A high-demand setting such as a restaurant may require multiple tanks, buried to preserve parking and views from the patio area. Propane suppliers will work with individual businesses to determine the proper size and number of tanks to meet the building's propane needs.

BUILDING

PROPANE IN RETAIL



For owners of retail facilities like banks and pharmacies, the bottom line is always top of mind. Building and renovating with propane-fueled space heating and water heating can help slash energy costs and deliver the key performance amenities that are vital to their business.

Water heating. In low-demand scenarios, a single tankless unit installed near the point of use greatly reduces delivery times and standby heat losses. A small installation footprint reserves valuable square footage. A propane-fueled tankless water heater offers economical, on-demand, endless hot water while generating half as many carbon dioxide emissions as a conventional electric storage water heater.

Space heating. An efficient rooftop furnace can quickly and cost-effectively heat a small or midsize retail building. In these buildings, packaged RTUs are air conditioners with a propane or natural gas heating section. They greatly outperform similar units from 15 years ago [the typical life expectancy of an RTU]. Businesses replacing older units with newer, high-efficiency units can expect a payback within two years of operation.

Standby generator. Standby generators can provide backup power for heating and cooling systems, keeping your business open and protecting against damage to perishable inventory. While storms, unpredictable weather, and unreliable power grids create an uncertain supply of electricity, propane is a safe and dependable energy source that won't fail in a storm.

Metered service. In retail buildings such as strip malls, propane metering is a hassle-free way of providing propane service to tenants, even if they draw from the same tank. Instead of owners needing to divvy up the costs of unequal use among the tenants, or simply attempting to recoup the cost with higher rent, meters provide a surefire way to bill the exact cost of propane to the tenants who use it.

Vaporizer. A vaporizer is essentially a boiler that uses heat to aid the natural vaporization process of propane from liquid to gas. The result is a virtual increase in the Btu delivery capacity of the system without a corresponding increase in the size or number of the propane storage tanks — which may not be possible where space is limited.

Propane tank. A single 1,000-gallon underground tank is a common size for this type of building. Underground burial helps maintain limited parking and enhances safety.



STANDBY GENERATORS
can provide backup power
for heating and cooling systems.

BUILDING

PROPANE IN SCHOOLS



School administrators have enough to worry about with large student populations and ever-tightening budgets. The last thing they need to worry about is the reliability — or the cost — of their heating. Schools heated with propane can drastically cut down on their utility bills while utilizing trustworthy systems that ensure the heating won't fail at an inopportune time.

Water heating. A large building, such as a school, may combine local propane tankless water heaters near rooms such as bathrooms and science labs with larger commercial storage tank water heaters near the cafeteria. Storage tank water heaters can supply domestic hot water to consistently high demand from the kitchen or showers, while tankless units support the use of low-flow fixtures, offering a turndown ratio of 20:1 for more precise and efficient response to hot water demands.

Propane boiler. For many schools and institutions, high-efficiency propane boilers are the most cost-effective heating option. High-efficiency propane combination space and water heating systems can provide both domestic hot water and hydronic heat, as well as supplemental heating for pools when needed.

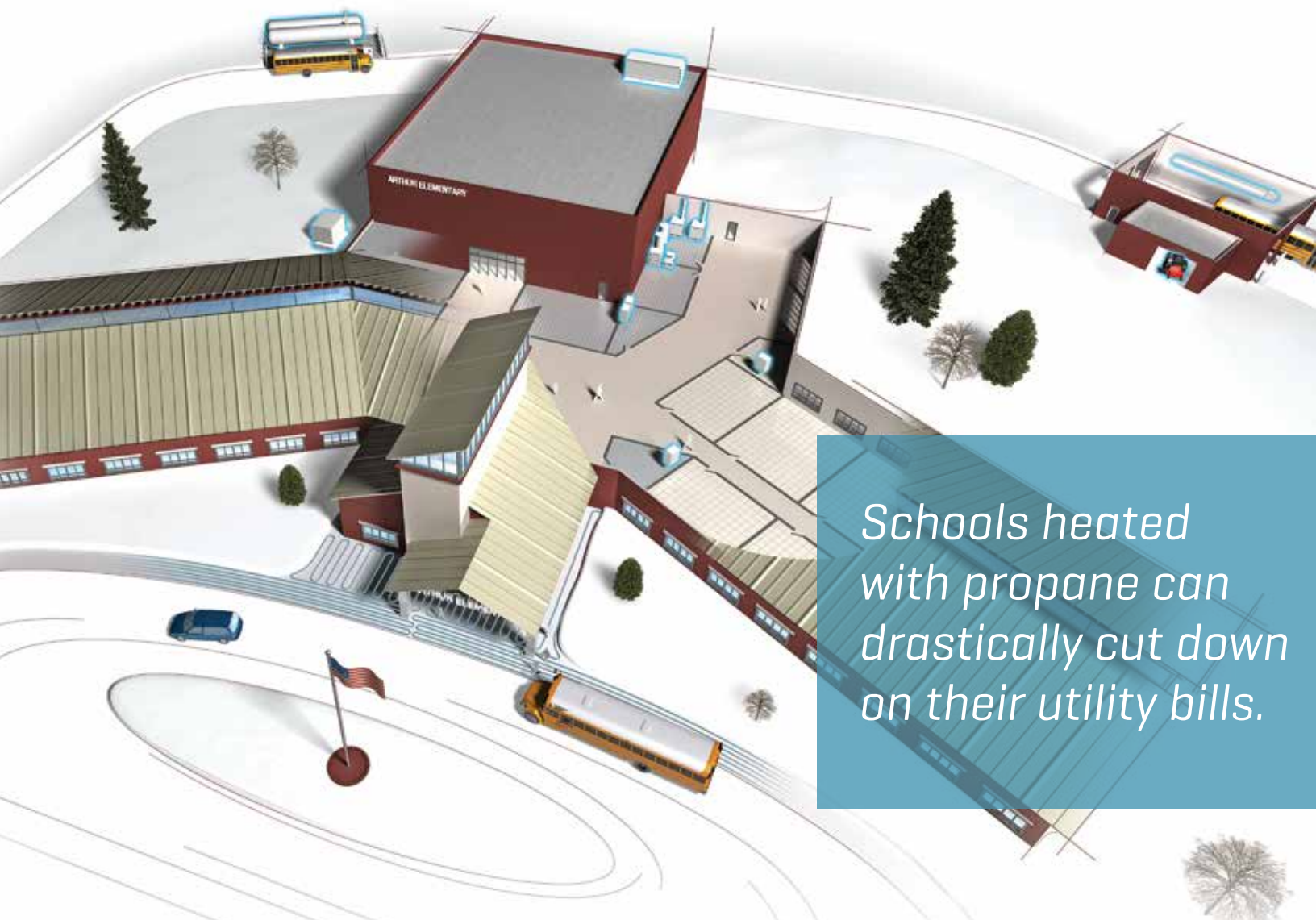
Cooking. Both professional and aspiring chefs prefer propane gas cooking appliances in the cafeteria kitchen or culinary classrooms. Commercial kitchen appliances are energy intensive, so choosing energy-efficient gas appliances is a smart choice. Energy Star-qualified cooking appliances demonstrate not only gas savings, but also electricity and water consumption savings.



**CHEFS PREFER
PROPANE GAS**
cooking appliances
in the cafeteria kitchen.

Snowmelt system. Buried hydronic heating pipes create safe, low-maintenance, snow-free walkways and playgrounds, reducing dangerous slippery surfaces. The use of snowmelt systems reduces maintenance and cleanup of entrances and common outdoor areas by eliminating the need for salt and snow removal. In turn, these systems help prevent slush, mud, and salt from entering the school. Smart controls ensure the system runs only when it needs to, reducing energy costs.

Standby generator. Educational buildings can become shelters during emergencies, supplying electricity, heat, air-conditioning, and hot water. On-site generators fueled by propane allow for institutions to stay open during and after hurricanes and severe storms that bring widespread power outages. Propane generators can maintain lighting, heating, air-conditioning, and refrigeration.



Schools heated with propane can drastically cut down on their utility bills.

Vehicles. Off-road and on-road vehicles running on propane last longer and cost less to fuel and maintain. School buses with propane engines require fewer lubricants, coolants, and brake replacements; put less weight on the steering axle; and have increased acceleration. Propane-fueled commercial mowers produce almost 50 percent fewer greenhouse gas emissions than similar gasoline-powered commercial mowers,⁶ a plus for school districts that specify a sustainability requirement.

Propane tank. In this example, an 18,000-gallon aboveground tank supplies propane to the applications in the main building

as well as fuel for propane vehicles and mowers. Tanks can be fenced, buried, or landscaped to enhance security, safety, and aesthetics.

Dehumidification. High humidity levels inside buildings can create a series of problems, such as mold growth, condensation concerns, and complaints about lack of comfort. Propane-fueled desiccant dehumidifiers remove and control high humidity levels inside buildings, especially in humid climates and for spaces such as gymnasiums, pool areas, and public showers and bathrooms.

6. Energetics Inc., Propane Reduces Greenhouse Gas Emissions: A Comparative Analysis [Washington, D.C.: Propane Education & Research Council, 2009].

BUILDING

PROPANE IN LODGING



Hospitality projects are being transformed by propane inside and out. Guestroom fireplaces or outdoor fire pits and hearths provide unmatched ambience and cozy gathering spaces. Efficient, propane water heaters, furnaces, and kitchen appliances can help slash operating costs while keeping guests comfortable and satisfied.

Water heating. According to the Energy Star Building Manual, nearly a third of a hotel's energy consumption goes toward water heating. Propane water heaters are very efficient at heating water and quickly delivering it to where it's needed at set temperatures. Multiple storage tank water heaters with efficiency levels of 95 percent or greater, shown here, can efficiently meet a hotel's hot water needs during periods of high demand.

Space heating. By delivering more-even heat, and more heat closer to the floor, boiler-fed radiant heating systems can be an energy-efficient heating source throughout a lodging building. High-efficiency propane boilers are a cost-effective heating option, and they can be paired with water heating systems to provide both domestic hot water and hydronic heat.

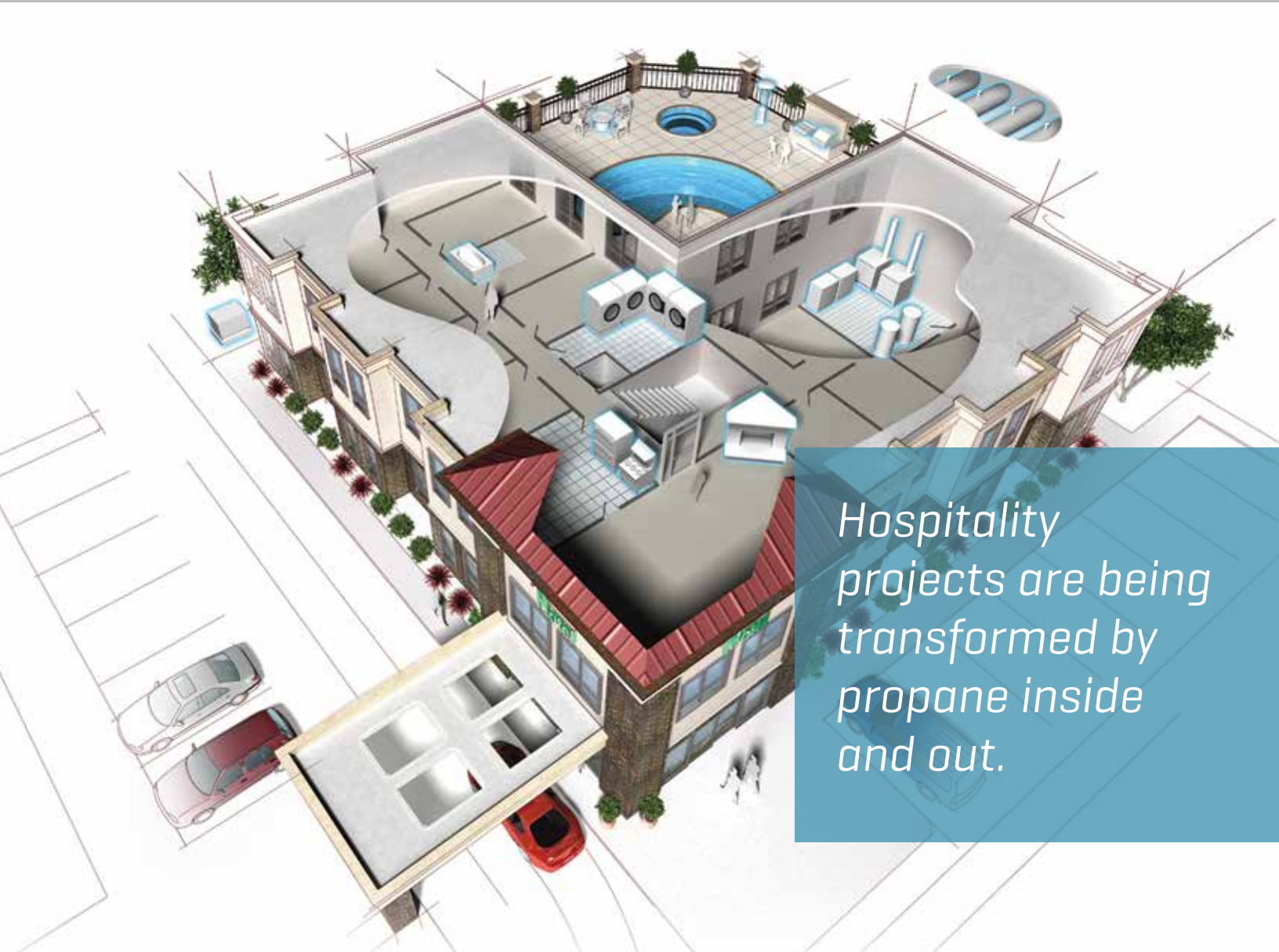
Laundry. Because of their efficiency and heating capacity, propane and natural gas are most commonly used for commercial clothes and linen dryers. Propane clothes and linen dryers produce hot air with more moisture than electric heaters, helping relax wrinkles.

Cooking. Propane and natural gas restaurant-grade kitchen appliances are the cooking tools of choice for hospitality chefs. Gas cooktops offer unsurpassed control and greater capacity,

with precise temperature adjustments and more-uniform heat distribution than electric burners. Gas appliances are also more cost-effective: an energy-efficient propane fryer can save a hotel restaurant 39 percent in energy costs annually (roughly \$900 in a typical commercial kitchen) over a standard-efficiency electric fryer. The high-efficiency propane equipment also saves 50 percent on CO₂ emissions compared with the baseline electric fryer, reducing emissions by more than 11,000 pounds of CO₂ annually.⁷

Fireplaces. Fireplaces add warmth and ambience to guestrooms and welcome areas and can provide comfy, efficient heating to a room or space. Fire pits, hearths, and decorative flame features provide a cozy amenity and gathering place to highlight an outdoor courtyard or patio. Two-sided fireplaces take it to another level by separating two defined areas for cocktails and for dining.

Patio amenities. Patio heating allows hotel dining rooms to expand their seating area to the outdoors and extend the outdoor dining season. Rustic outdoor lighting and propane-fueled flame features can give your destination a unique look that your guests won't forget. Restaurants can even add a seasonal outdoor kitchen with propane grills or cooking appliances.



Hospitality projects are being transformed by propane inside and out.

Combined heat and power (CHP). CHP systems create electricity while providing supplemental heat for a hotel's swimming pool and radiant heating system. Because of their year-round hot water loads for laundry, pool heating, guest rooms, radiant heating, and more, hospitality buildings are an ideal candidate to utilize this rapidly growing technology, which can also provide electricity during power outages.

Standby generator. A hotel's ability to stay open during a power outage is an important competitive advantage. On-site standby generators fueled by propane allow hotels to stay open during

and after hurricanes and severe storms that bring widespread power outages. Propane generators can maintain lighting, heating, air-conditioning, and refrigeration.

Propane tank. Propane tanks can be remotely monitored by the propane supplier to ensure the propane supply is reliable and uninterrupted. These smart monitoring devices allow propane companies to track their customers' tank levels and average usage to ensure they schedule propane deliveries when needed.

BUILDING

PROPANE IN WAREHOUSES



Providing affordable heating for cavernous warehouses or big-box stores might seem daunting, but with systems including propane-fueled heating, high-capacity water heaters, and backup generators, large buildings can keep all systems running comfortably and efficiently 24/7.

Water heating. Propane tankless water heaters achieve energy factors as high as 97 percent and can be strategically combined into high-capacity banks. Power-vented, high-capacity commercial storage propane water heaters also have thermal efficiencies as high as 97 percent. Either system will meet the hot water demands of a commercial building while saving energy.

Space heating. Floor-level air rotation systems are used for heating facilities up to 150,000 square feet and cooling facilities as large as 100,000 square feet. Propane combustion provides thermal energy to the heat exchanger, while propane glycol is used for cooling purposes. These systems eliminate the need for multiple rooftop units, roof penetrations, and duct work, and they can be completely operational in one to two days.

Dehumidification. Propane-fueled desiccant dehumidifiers can manage moisture in high-humidity applications, including in outside air ventilation [especially in humid climates] and in spaces such as public showers and bathrooms. Hybrid air-conditioning-desiccant dehumidification systems have been field-tested to outperform traditional RTU air-conditioning systems in both moisture control and energy efficiency.

Cooking. A warehouse or big-box store may include propane cooking appliances in the employee break room as well as in the appliance demo area. Consumers prefer cooking with gas, and fueling demo appliances with propane allows for live cooking demonstrations and special events.

Demonstration areas. Propane home improvement products such as fireplaces, torches, and outdoor heaters lose their visual punch without a live gas connection. Home improvement stores can use on-site propane to show off these dazzling flame effects and comfort benefits to consumers.

Vehicles. Propane fuels 670,000 forklifts in U.S. factories and warehouses. The fuel is eligible for the Alternative Fuel Tax Credit, which allows for a 50-cent-per-gallon credit on propane used in forklifts. Check for the latest propane autogas incentive programs at www.afdc.energy.gov.

Propane tank. A propane tank for this type of building may serve the fuel needs of the building as well as a propane refueling station. Commercial and industrial applications may use multiple tanks or a single high-capacity tank, depending on the needs of the building.



*Propane-fueled
desiccant dehumidifiers
can manage moisture
in high-humidity
applications.*

JOB SITE

TEMPORARY HEAT



PROPANE-FUELED TEMPORARY CONSTRUCTION HEAT KEEPS PROJECTS ON SCHEDULE THROUGHOUT THE COLDEST MONTHS OF THE YEAR.

Temporary heaters have come a long way from the days of mushroom-style pot heaters, which had the potential to spread carbon monoxide throughout a building. Today's heaters run much more efficiently, using technology such as electronic modulating burner controls and remote space thermostats to automatically adjust gas flow. They can also draw clean, outside air for combustion or be placed outside with temporary ductwork to deliver heat to the building. And they are available for seasonal rental.

Construction heaters range in size from small, portable heaters that produce about 35,000 Btu of heat to large heaters capable of heating hospitals or resorts, with energy outputs up to 5 million Btu. Combined with proper ventilation, temporary heaters allow construction materials such as floor finishes, drywall work, plastering, and painting to dry and cure even during cold weather.

Temporary construction heat can also keep your workers warm and productive. In some regions, codes or safety regulations require that workers have a supplementary heat source when work area temperatures drop below a certain level.

Regardless of the application, propane is the cleanest and easiest choice for the energy source. On many projects, a natural gas connection isn't available until the building is nearly finished. While kerosene and electric heaters are available, each has distinct disadvantages. Kerosene heaters have high greenhouse gas emissions, may leave a film on walls or equipment, and use fuel that can be spilled. Electric models can't generate nearly as much heat as propane heaters, and it can be difficult to supply electric heaters with an adequately sized electricity supply source on jobsites.

Propane, on the other hand, is portable and convenient. Project managers can work with their local temporary heat and propane provider to budget and plan for construction heat. When the cold weather arrives, the propane retailer or rental company can

JOB SITE

CONSTRUCTION EQUIPMENT



Generator manufacturer Generac has introduced two portable propane generators in recent years. The LP3250 produces 3,250 watts and operates for 9 hours on a 20-pound propane tank, while the LP5500 produces 5,500 watts and offers a 4.75-hour run time with a 20-pound tank. Both models incorporate a tank holder into the frame itself, so the propane tank sits securely out of the way.

deliver the heaters and set them up with a propane tank connection. The process is mostly turnkey from start to finish; the builder is responsible for ducting the heat into the building and powering it as needed.

Portable generators. Portable propane generators provide convenient and trustworthy power for construction crews working on sites not yet connected to the power grid. Approved for use outdoors,⁸ these generators provide on-the-go power without the tradeoffs of gasoline.

Portable generators that run on propane are always easier to keep in running condition because propane does not degrade over time like gasoline. And unlike gasoline, propane is biodegradable and there's no chance of spilling when refueling. Portable propane generators also emit fewer carbon dioxide emissions and toxic pollutants than comparable gasoline-powered portables. These generators run on small, portable propane tanks, which are usually available from an exchange location, even when gas stations are closed during a power outage.

Floor care. Floor burnishers, polishers, and strippers are available with propane engines, providing cordless operation and long working time between refills. The equipment uses an emissions monitoring system that shuts down the engine if oxygen levels in the exhaust surpass preset limits.

8. Portable propane generators are not OSHA-certified for indoor use.

VEHICLES

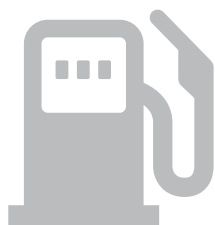
PROPANE AUTOGAS



WHETHER YOU'RE A CONSTRUCTION PROFESSIONAL OR A BUSINESS OWNER, THERE ARE PLENTY OF REASONS TO SWITCH YOUR VEHICLES FROM GASOLINE OR DIESEL TO PROPANE AUTOGAS.

MILE FOR MILE, PROPANE AUTOGAS

costs less than
gasoline or diesel.



Propane autogas is flexible enough to work in both on-road vehicles, such as work trucks, school buses, shuttle vans, and maintenance or delivery vehicles, and off-road vehicles such as forklifts and lawnmowers. After an initial investment, your business can expect to save money in areas where conventional and other alternative fuels would pile on to your operating costs.

Fuel. Mile for mile, propane autogas costs less than gasoline or diesel. And when you add in federal and state government fuel tax credits, the already competitive payback period on propane autogas investments is even shorter.

Maintenance. Thanks to the dependable, clean performance of propane autogas, work vehicles will have lower maintenance costs than they get with conventional fuels. Unlike diesel engines, propane autogas engines require less oil by volume, no additional filters, and no costly emission fluids, which means lower costs during each maintenance cycle.

Infrastructure. Propane autogas is abundant. Many fleet owners prefer having a refueling station located on their property. Installation of propane autogas refueling infrastructure is affordable. It costs much less than installing a compressed natural gas (CNG), gasoline, or diesel refueling station.

With thousands of refueling stations located across all 50 states, propane is an accessible, readily available low-carbon fuel. To obtain state-specific information about propane refueling locations, use the Alternative Fueling Station Locator, maintained by the U.S. Department of Energy.

TRAINING

PROPANE BUILDING RESOURCES



Visit **buildwithpropane.com** for propane news, research, and resources.

ONLINE RESOURCES

buildwithpropane.com

Construction pros should visit **buildwithpropane.com** to check out the latest news and insights on building products and trends, learn how to install and operate propane equipment, and find information on construction-related events, conferences, and conventions.

The site has a wealth of research and resources on propane-fueled equipment and building systems. You'll find training videos, interactive tools, and an online product directory stocked with commercial building products. While you're there, sign up for the *Propane Energy Update* newsletter to receive updates on news and products for commercial construction professionals.

Propane Training Academy — propanetrainingacademy.com

The Propane Training Academy was created to provide architects, engineers, builders, and other construction professionals with free and informative training materials on propane and its many applications, installation specifics, and products. The courses on this site are registered for education credit with the American Institute of Architects, Green Building Certification Institute, National Association of The Remodeling Industry, and National Association of Home Builders, and they're a smart way for certified construction professionals to maintain their standing with those organizations.

Find a Propane Retailer — usepropane.com/fpr.aspx

A propane professional can give you answers to your questions about propane applications. Use this handy online tool to find a propane retailer in your area, and you'll be on your way to a successful propane project.

