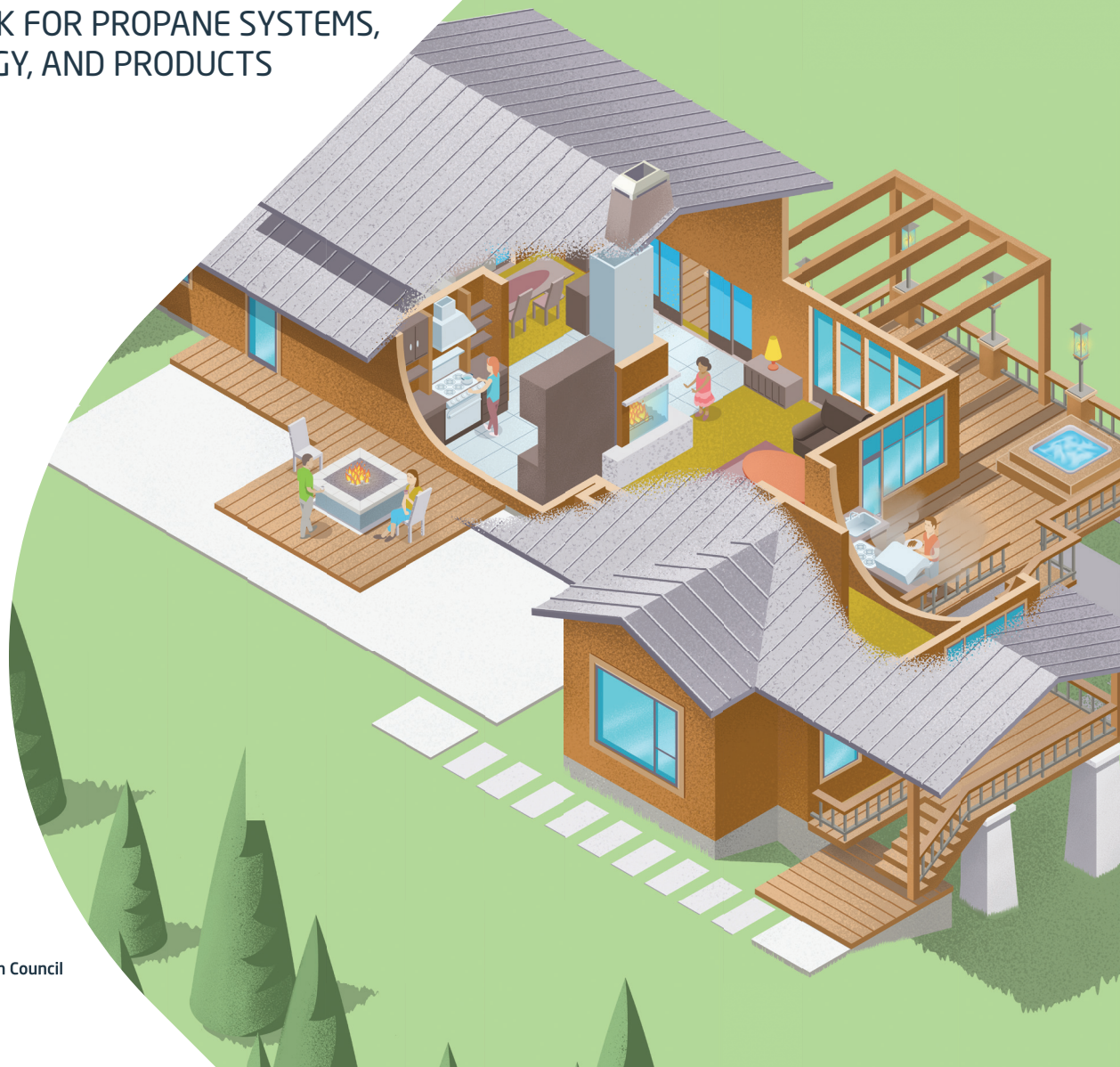


Build With Propane Guide: Residential Edition

YOUR HANDBOOK FOR PROPANE SYSTEMS,
NEW TECHNOLOGY, AND PRODUCTS



Welcome to the Build with Propane Guide

This book is designed to help you learn more about propane's versatility in providing energy for both traditional appliances and innovative new applications. Additionally, this guide provides a wide range of information on the energy efficiency and environmental benefits that propane can deliver to high-performance homes.

DOMESTIC, CLEAN, VERSATILE, AND SAFE

Propane is a nontoxic gas produced from natural gas processing and crude oil refining. Propane is made 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. There has never been a better time to build and remodel homes using propane as the primary energy source.

Propane is already being used in over 48 million U.S. households for residential uses, including grilling, and by millions of other Americans for transportation, commercial, industrial, and agricultural applications.

Propane shares the same operating characteristics as natural gas, so when natural gas is not available for your project, or the cost of bringing natural gas to each home site exceeds your project budget, don't make your clients give up on their desire to have the efficiency, comfort, and high performance of gas in their new or remodeled home. Offer propane as the best gas energy choice.



Choosing Propane Made Easy by the Propane Education & Research Council

The Propane Education & Research Council (PERC) oversees propane's growing footprint as a safe, clean, and domestically produced energy source by funding research on propane applications in residential and commercial construction, as well as in lawn and landscaping, agriculture, and transportation. PERC is fully invested in driving the development and commercialization of innovative propane applications for new-home construction, remodeling, and efficiency upgrades, especially when high performance at an affordable price is an important consideration.

Over the last several years PERC has invested millions of dollars in research, case studies, online training courses, training videos, and guides such as this one.

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Efficient Energy

There are a few fundamentals you and your clients should know about propane:

IT'S CLEAN ENERGY

Propane emits significantly less CO₂ compared to electricity for key residential applications like water heating. That is because about 30 percent of the electricity in the U.S. is produced by coal-fired power plants. For example, a typical electric storage tank water heater can have emissions two-and-a-half times higher than those of a propane tankless system (see graph at left). The reduction in CO₂ emissions from using a propane tankless water heater over its lifespan is equivalent to switching 432 incandescent light bulbs to CFLs. Propane systems can even help to earn points under green building programs like LEED for Homes and the National Green Building Standard.

IT REDUCES ENERGY COSTS

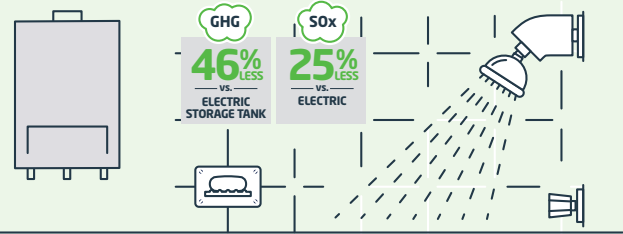
Propane appliances are typically far more efficient than their electric counterparts. For example, propane tankless water heaters can be up to 34 percent more energy-efficient than conventional storage water heaters in homes that have moderate hot-water use. High-efficiency propane furnaces offer best-in-class efficiency, with ratings of 98 annual fuel utilization efficiency (AFUE) now available. That 98 percent efficiency means big savings on heating bills for homeowners, coupled with an affordable installation cost for the heating system.



Propane storage can be buried underground with only an inconspicuous service dome showing.

EMISSIONS

For lower emissions, propane storage tank and tankless water heaters outperform electric models. Propane is also the best choice for energy efficiency that cuts homeowners' energy bills, and keeps up with heavy water heater usage.



Study based on a single detached residence with three occupants and an annual water heating load of 11.6 MMBtu. Water heater energy factors based on Department of Energy and Energy Star minimum ratings for residential water heater technologies.

IT SUPPORTS MODERN LIFESTYLES

Propane provides your customers with the ability to choose first-rate amenities regardless of where they live. Propane space heating is available in both forced-air and radiant systems that can be zoned for individual room comfort. And propane standby generators can provide peace of mind and security for customers in locations that experience rolling blackouts or storm-related power outages.

IT'S BUILDER-FRIENDLY

With propane, you're not at the mercy of a public utility. Propane professionals can install properly sized propane storage and connect home appliances and other applications on your build schedule. Storage tanks can be placed aboveground or buried underground, and large community propane systems can even be designed to fuel an entire development. Propane also provides jobsite flexibility by providing gas energy for portable generators and temporary construction heaters.

Reliable and Safe

Why are more of your new-home construction and remodeling peers telling customers about the benefits of propane? Consider the following:

IT'S DOMESTICALLY PRODUCED

Propane is an efficient, clean byproduct of oil refining and natural gas processing. Propane is made in America, and a transportation network that includes pipelines, rail, and trucks distributes it to retailer distribution points across the country. Propane's reach goes well beyond that of natural gas, whose limited infrastructure is costly to expand. That makes propane a readily available and affordable domestic gas energy source that contributes to U.S. jobs, economic growth, and energy security.

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.

IT'S INSTALLED BY PROS WITH TOP-QUALITY TRAINING.

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 National Fire Protection Association (NFPA), the Department of Transportation, the Department of Energy, and various state and local regulatory bodies. For more information, go to Propane.com/Safety.

TYPICAL PROPANE CONSUMPTION (GALLONS/YEAR)

CLIMATE REGION	HIGH EFFICIENCY SPACE HEATING	HIGH EFFICIENCY WATER HEATING	COOKING	CLOTHES DRYER	HIGH EFFICIENCY DIRECT-VENT FIREPLACE	TOTAL
Warm	22-79	112-119	17	28	16	194-258
Moderate	71-433	124-153	17	28	24-31	268-662
Cold	620-790	490-620	17	28	39-55	991-1,844

Source: Newport Partners 2011 Energy and Environmental Analysis of Propane Energy Pod Homes. Learn more in the online training course An Energy and Environmental Analysis of Propane Energy Pod Homes, available at hanleywooduniversity.com. Findings are based on climate averages across 16 locations developed through building energy simulations. Assumptions include a 2,400-square-foot home built to the 2009 IECC, and the use of high-efficiency propane space and water heating equipment, moderate efficiency propane direct-vent fireplace, and standard efficiency propane cooktop, oven, and clothes dryer. Warm and moderate climates were assumed to use hybrid air source heat pumps with propane furnace backups for space heating.

CO₂ EMISSIONS NATIONAL AVERAGE

(Metric Tons Per Billion Btu Consumed)

PROPANE	HEATING OIL	ELECTRICITY
63	73	133

Source: Developed from U.S. EPA E-Grid 2016 data for electricity and U.S. EIA data for propane and heating oil.





KEY BENEFITS OF ALL-PROPANE HOMES

EFFICIENT SYSTEMS

Propane powers highly efficient appliances for a home's most important energy applications. This means you can meet your most demanding customers' expectations with style and ease.

GREEN PROFILE

When chosen in place of heating oil or electricity, propane lowers a home's overall carbon footprint—often the equivalent of a car's emissions for a year.

ENERGY REBATES

Installing propane enables your customers to reap maximum benefits from any available federal, state, and local energy rebate and tax credit programs. And builders and remodelers can earn up to \$1,500 per home with the Propane Construction Incentive Program. See page 25 for additional rebate information.

ON-SITE ENERGY

When your customers choose propane appliances, they can claim a unique feature: Clean, reliable energy that's on site. That's especially true if a customer chooses to add a propane standby generator, which protects them from unexpected power outages.

The Propane Home

Propane offers a whole-home energy upgrade that delivers superior comfort and efficiency compared with all-electric homes. Using high-efficiency propane gas appliances for major applications provides optimal energy performance unmatched by electric alternatives. For a competitive advantage in home performance, comfort, and efficiency, build your propane homes with these five applications.

SPACE HEATING

Cost-efficient heating with a more comfortable and consistent warmth.



WATER HEATING

Higher hot-water flow rates and lower cost of ownership compared with electric options.



COOKING

The joy and control of cooking with gas, just like the professionals do.



CLOTHES DRYING

Faster drying with all the high-performance features you're looking for.



FIREPLACES

All of the pleasures of a real fire with none of the hassles of wood.



PROPANE CONSTRUCTION INCENTIVE PROGRAM

A competitive advantage isn't the only reward for builders and remodelers. PERC offers up to \$1,500 per house to help us prove the benefits of propane by putting it to use in new construction and remodeling projects.

The program offers incentives starting at \$300 for a single appliance and up to \$1,500 for homes with an appliance that qualifies for a regional bonus. Visit **Propane.com/ConstructionIncentive** to learn more, determine if you qualify, and apply for the Propane Construction Incentive Program.

Keeping Score: All-Propane vs. Standard Homes

Newport Partners LLC, an independent third-party research firm, conducted careful modeling analysis of the Home Energy Rating System (HERS) Index for two homes – one built with standard appliances and systems, and one built with a 95-percent-efficient propane furnace, a 0.95 Energy Factor propane tankless water heater, and Energy Star propane kitchen and laundry appliances. In its analysis, propane homes achieved significant HERS Index improvements over the standard home.

THE ALL-PROPANE VS. STANDARD HOMES

3,600-SQUARE-FOOT HOME (COLD CLIMATE)	PROPANE HOME	STANDARD HOME
Home Energy Rating System (HERS) Index (The lower the score, the more efficient the home).	\$4,873	\$5,409
Annual Emissions (metric tons CO ₂)	47	60

Source: Newport Partners LLC

*The lower the score, the more efficient the home.

BRINGING PROPANE OUTDOORS

The five major propane appliances are core to a home's energy savings and low-emissions profile, but outdoor living features such as generators, outdoor cooking, outdoor lighting, and flame effects can add just as much to a home's overall comfort and resale value as its indoor spaces. At **Propane.com**, you can check out real-world success stories from projects that also include outdoor propane applications: propane-fueled features that give your clients luxurious and energy-efficient outdoor spaces.

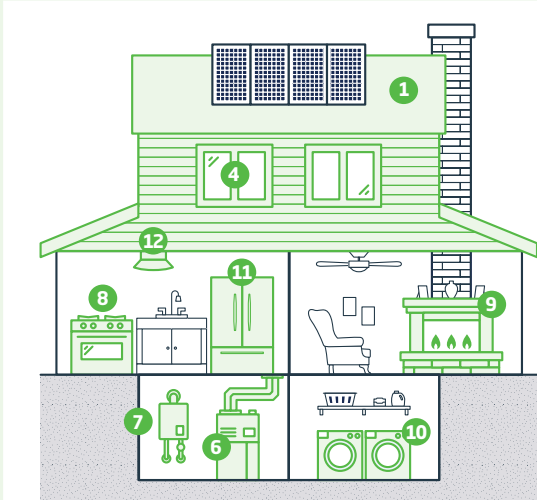
USE THE HOME ENERGY RATING SYSTEM TO GAIN REFERRALS

If you're looking for a new way to showcase the value of your home construction over competitors', consider applying the Home Energy Rating System (HERS) to your projects. Developed by the Residential Energy Services Network (RESNET), the HERS Index can be used to compare a propane home with a built-to-code reference home. The index also allows comparisons of different home designs and specifications. The HERS measure works across climate zones and is used by builders and remodelers to differentiate their high-performance homes from standard new and existing homes.

To try the interactive Virtual Propane Home, which shows HERS Index ratings of propane homes across the U.S., go to **Propane.com /Interactive-Training-Module**.

Reach Zero Net Energy Goals with Propane

THREE WAYS TO LOWER YOUR HERS SCORE



1 FOCUS ON THE BUILDING'S ENVELOPE

1. Insulation quality
2. Insulation quantity
3. Air sealing
4. Window performance
5. House orientation

2 INCLUDE HIGH-EFFICIENCY PROPANE APPLIANCES

6. Propane furnace
7. Propane water heating
8. Propane cooking
9. Propane fireplace
10. Propane clothes dryer

3 TRIM OTHER ENERGY USE

11. Energy Star appliances
12. LED lighting
13. Energy monitoring devices

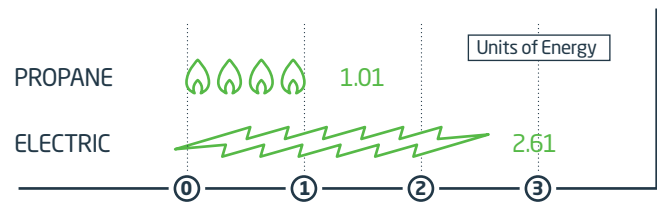
Using propane appliances, you can significantly lower a home's energy consumption, making it easier to achieve Zero Net Energy (ZNE) goals and deliver premium performance to homeowners. It's why propane should be a part of every builder's ZNE strategy.

THE ZNE HOME produces as much energy as it uses, with a HERS Index score of 0 or less. Builders achieve this by increasing a home's energy efficiency, then adding renewable energy sources such as solar.

THE ZNE READY HOME is incredibly energy efficient, with a HERS Index score of 50 or less, and can reach Zero Net Energy status by using propane appliances and adding renewable energy.



SOURCE ENERGY RATIOS*



It takes 2.61 units of electricity to produce and deliver one unit of energy to a home, versus just 1.01 for propane. Propane wins hands down.

*This data is based on national averages, it may be different in your area.

Home and Space Heating

Consider the following propane applications for your next project. Many are manufactured as Energy Star-qualified models:

PROPANE FURNACES

High-efficiency propane furnaces offer best-in-class efficiency, measured by AFUE, giving them a considerable advantage compared with electric or heating oil units. Easily installed nearly anywhere in a home, they can provide space heating for any size floor plan from small residences to large custom homes.

PROPANE BOILERS

High-efficiency boilers offer efficiency, space savings, and the versatility to provide heating, hot water, and even snow melt. They provide heat through a variety of heating delivery systems (including hydronic baseboard systems and in-floor hydronic systems), and they are available in a wide range of heating capacities, with inputs reaching as high as 299,000 Btu/h.

HYBRID HEATING

A hybrid heating dual fuel system can protect homeowners from rising utility costs. These systems are a combination of an air source heat pump (ASHP) or ground source heat pump (GSHP, also known as geothermal heating) with a gas/propane furnace. They improve ASHP and GSHP performance by relying on a propane furnace (typically a high-efficiency unit) during colder winter periods. The overall heating system is more energy efficient, provides greater comfort, and has a smaller carbon footprint.

WORKING WITH GEOTHERMAL

Because geothermal systems require large wells, or “loop fields,” to utilize the ground as a heat source, they may not be an option for projects with constrained space. But if a GSHP system is viable, combining it with a propane furnace can offer the best of both worlds. Using propane backup for heating allows for a much smaller, and much less expensive, loop field for the GSHP. When used with propane backup, the GSHP’s ground loop can be downsized to handle 50-70 percent of the heating load, with the propane furnace satisfying the remainder, trimming initial costs considerably.

DUCTLESS ZONE HEATERS

Propane zone heaters, which can be used in homes, garages, and outbuildings, come freestanding or wall-mounted. You can fit these units with thermostats and blowers, and some provide reliable spot heat even during electrical outages.

FIVE KEY BENEFITS OF PROPANE FIREPLACES

Here are five reasons why propane fireplaces are a smart choice to complement your home heating system.

1 FLEXIBLE DESIGN AND COST-EFFECTIVE INSTALLATION

The ability to direct-vent propane fireplaces (no chimney needed) and their low clearance requirements offer design flexibility and a major remodeling opportunity for wood fireplace conversions. That means propane fireplaces can safely fit in any room of the house, and are an exciting option in new and existing homes.

2 ENERGY EFFICIENT AND BUDGET-FRIENDLY

Vented propane fireplaces can have efficiency levels of more than 90 percent. On the other hand, traditional wood-burning open fireplaces are only about 15 percent efficient.

3 AN EFFECTIVE COMPLEMENT TO HOME HEATING

Propane fireplaces are available in high efficiencies, making them an effective complement to a home’s main heating system. Plus, there’s the added benefit of fireplace ambience.

4 KEEPING THE LIGHTS ON

Propane standby generators offer customers peace of mind by providing continued power to essential home appliances and systems during outages.

5 COMFORTABLE AND CONVENIENT

Homeowners with a propane fireplace are just seconds away from the ambience, comfort, and heating it offers.

Water Heating That Won't Drain the Pocketbook



FIXTURE FLOW RATE

To select the right tankless unit, add up the gallons per minute (GPM) estimated for the customer's household during peak demand. Not all hot water loads will be simultaneous. Check the estimated demand against the unit's GPM specs, accounting for the temperature rise needed in your region (colder regions will need a higher temperature rise).

FIXTURE	GALLONS PER MINUTE
Bathroom sink	1.0
Bathtub	4.0-5.0
Shower	2.5
Multiple showerheads	2.5-12.0
Kitchen sink	1.5
Dishwasher	1.5
Washing machine	2.0

Sources: water.usgs.gov, learn.compactappliance.com. Flow rate for customers' appliances and fixtures will vary due to differences in local water pressure, as well as appliance and fixture performance.

By choosing energy-efficient propane water heating systems over standard electric water heaters, you can help your homeowners significantly reduce their energy costs. The Department of Energy estimates that nearly 20 percent of a home's energy costs are spent heating water. That's why helping your homeowner select an efficient water heater is critical – and propane fuels some of the most efficient tankless water heating technologies available.

TANKLESS WATER HEATERS

Propane tankless water heaters provide comfort, versatility, convenience, and efficiency by supplying high volumes of hot water with compact and highly innovative technology. These systems eliminate standby energy losses that occur in storage tank systems because they only heat water on demand. They're compact in size, and wall-mounted to free up floor space, provide superior energy efficiency, and deliver an endless supply of hot water.

A tankless system can average a flow rate of about 222 gallons/hour, more than three times higher than a standard 50-gallon electric storage tank water heater's delivery of 62 gallons in the first hour. The improved performance can mean the difference between taking a hot shower or a cold shower.

STORAGE TANK WATER HEATERS

Compact in size and equipped with leading features like electronic ignition and highly insulated tanks, Energy Star-qualified propane storage tank water heaters offer superior value to comfort-seeking homeowners.

They are a versatile, efficient, and reliable hot water solution, with a wide range of capacities to meet demands for any home. While they are more compact in size than electric units, they are not small on performance: A 50-gallon propane unit delivers the same amount of hot water as an 80-gallon electric unit.

No More Business as Usual

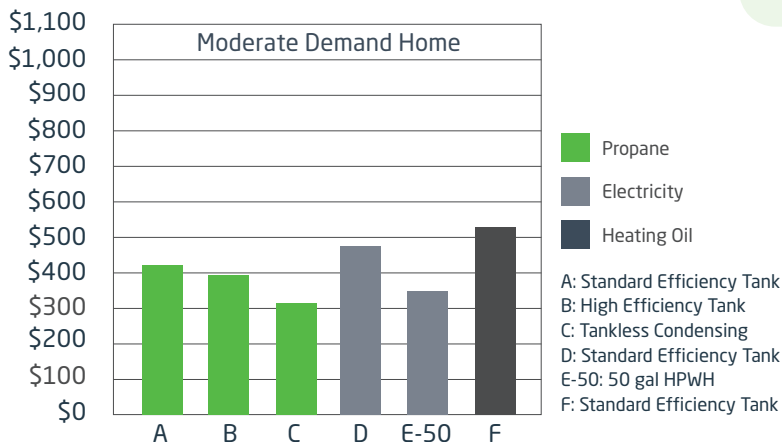
The U.S. water heater market is currently undergoing major product changes, due to increased water heater efficiency standards from the U.S. Department of Energy as part of the National Appliance Energy Conservation Act. Because of the new standards, homeowners can no longer simply go with the cheapest system or a like-for-like replacement. Rather, they must now consider a water heater's long-term value, whether or not it will fit into the available space (new units' higher efficiency means a larger size), noise and temperature impacts (considerations with heat pump water heaters), and performance characteristics. Fortunately, the new requirements also come with a range of technology solutions.

To aid the decision-making process, PERC has analyzed the energy, economic, and environmental impact of 14 residential water heating systems across three climate regions, with a special focus on the performance of propane-powered systems versus electric alternatives.

In new construction projects in any climate region, the system with the lowest annual cost of ownership is a propane condensing tankless water heater. This reflects the propane tankless system's long service life (estimated at 20 years by multiple industry sources) and low annual energy costs, despite the fact that other "on the truck" units might be cheaper initially to install.

Check out the analysis from the study and more water heating resources at **Propane.com**.

ANNUAL ENERGY COSTS: RESIDENTIAL WATER HEATING



Source: Residential Water Heaters under the New 2015 Federal Standards: An Analysis of Energy, Economics, and Emissions. Newport Partners LLC, April 2015.

TANKLESS VS. HEAT PUMP WATER HEATERS

To lower ownership costs, many pros have begun to favor two water-heating technologies: tankless systems and heat pump water heaters (HPWHs).

IS AN HPWH APPROPRIATE?

When you compare tankless and HPWH systems, the first question is whether an HPWH is a viable option. For example, HPWHs have a larger physical footprint, requiring higher vertical clearance and at least 1,000 cubic feet of space around them. Without external venting, an HPWH will cool the air within that surrounding space, potentially increasing the demand on the space-heating system. In general, HPWHs present installation and operational challenges in colder climates and will operate less efficiently in a cooler space, such as a garage, in a heating-dominated climate.

PROPANE TANKLESS SYSTEMS PROVIDE ADDITIONAL BENEFITS

Tankless water heaters offer more than just easier installation. They have flow rates that are three times that of HPWHs and are not limited by storage capacity. And while HPWHs have high efficiency ratings, their electricity consumption still carries an emissions impact. HPWHs have CO₂ emissions which are often at least 30 percent higher than propane condensing tankless units.



THE ULTIMATE GUIDE TO TANKLESS WATER HEATERS

Our most popular and helpful resources on tankless water heaters are collected in these comprehensive ebooks that you can pull up on your tablet or print out for your subs. From venting tactics to whole-house heating strategies, these articles will ensure you have the training and expertise you need to give your customers a flawless tankless water heater installation. Download it free at Propane.com/Water-Heating.

INSTALLATION AND MAINTENANCE TIPS

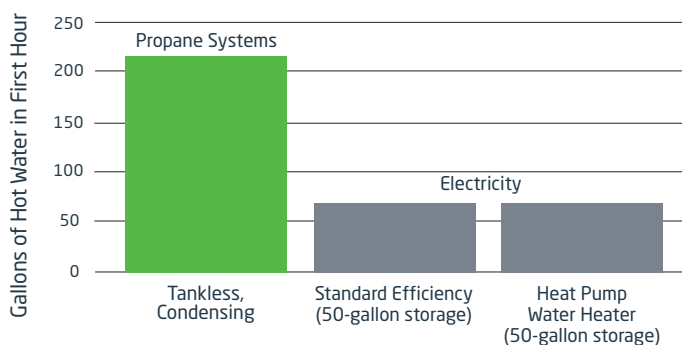
Propane tankless water heaters are less labor-intensive to install than tank-style units, and they use the same plumbing as natural gas water heaters. Most high-efficiency propane models use a fan to power-vent exhaust vertically or horizontally (the fan may require a standard electrical connection). Some tankless models can be installed outside of the home.

For both tankless and storage tank propane water heaters, proper installation depends on a number of factors, such as unit placement, climate, and local building codes. To ensure the unit vents and operates properly, be sure to follow the manufacturer's instruction guide.

Both propane tankless and storage tank water heaters require minimal maintenance beyond annual checkups. Low-cost limescale control systems are available to help reduce buildup in units that run hard water. Since a tankless unit doesn't maintain a stored water supply, it's less subject to corrosion. In fact, tankless water heaters can last twice as long as electric storage tank units. Just as important: Most of the parts are recyclable, so when the tankless water heater reaches the end of its operating life, little of it needs to go to a landfill.

Propane meets or exceeds the performance of other energy choices for residential water heating.

HOT WATER FLOW RATES BASED ON FIRST HOUR RATING (FOR STORAGE UNITS) AND GALLONS PER MINUTE RATING (FOR TANKLESS UNITS)



Source: Residential Water Heaters under the New 2015 Federal Standards: An Analysis of Energy, Economics, and Emissions. Newport Partners LLC, April 2015.

High-Performance Cooking and Clothing Care

RANGES AND OVENS

Propane cooking equipment provides convenience, sharp design, and excellent performance in any kitchen. An attractive, stainless steel gas range that combines a propane cooktop and oven is perfect for space-challenged homeowners. Propane also offers commercial-grade ranges, indoor grill and cooktops, in-wall double ovens, and other gas cooking applications in luxurious custom kitchens.

And with gas cooking being the choice of professional chefs, it's no wonder homeowners love the performance offered in a wide variety of propane cooking equipment. Precise temperature controls allow chefs to quickly switch from searing to simmering, and instant-on and instant-off burners allow cooking and cooling to start right away. This capability also provides a safety feature not found in electric cooktops, which can remain dangerously hot for a few minutes after they've been turned off.

CLOTHES DRYERS

Propane clothes dryers offer homeowners an efficient, convenient, and environmentally friendly laundry solution. Compared with electric dryers, a propane unit will dry clothes faster and relax wrinkles better due to hot air with more moisture. They also offer the latest innovations, such as steam cycles to de-wrinkle and freshen garments, drum lights to better see into the unit, and LCD control screens for greater ease of use.

There are different capacities of propane dryers available, with output levels generally much higher than electric dryers. However, propane dryers can still save about 20 percent annually on energy costs.

When building or remodeling homes, consider piping both the kitchen and laundry areas to accommodate gas appliances. Why? Even if the initial customer chooses electric products, the future option of gas cooking and clothes drying appliances may help the property's resale value.



PROPANE PRODUCTS

With propane, the possibilities are endless. Propane is powering more technology, in more places than ever. From family farms, to homes, to community school districts and beyond, people trust propane as an innovative solution that can cut costs and help them go green. Find out what propane can do at **[Propane.com/Propane-Products](https://propane.com/propane-products)**.

Add Value by Upgrading Outdoor Spaces



FREE ONLINE TRAINING: OUTDOOR LIVING

Ready to learn more about how you can use propane's reliable and efficient energy to fuel the best in outdoor living for your customers? For full course details, go to **PropaneTrainingAcademy.com**. Enroll today to learn more about the economic, environmental, and efficiency benefits of building and remodeling with propane while fulfilling your professional training requirements.

Whether you're an architect, a builder, or a remodeler, it's smart business to consider how propane can help you create competitive advantage. Thanks to an array of new appliances, propane can fuel a wide range of outdoor living amenities that can meet the needs of your most discerning customers.

To see all the ways propane can enable a high-performance home both indoors and outdoors, tour our interactive Virtual Propane Home at Propane.com/Interactive-Training-Module.

GRILLS

It's a fact: More than 60 percent of homeowners who grill outdoors use a gas grill, which heats faster and releases fewer greenhouse gas emissions and particulate emissions than a charcoal grill.

OUTDOOR KITCHENS

For customers who want only the best in an outdoor kitchen, propane delivers. A premium built-in cooking area — complete with large grilling surface, cooktop, oven, and rotisserie — can easily be set up to operate on a propane cylinder or on a home's main supply tank. Cooking outdoors in the summer also helps reduce indoor heat gain and associated energy use for ventilation and cooling.

OUTDOOR FIREPLACES, FIREPITS, AND HEATERS

Chilly weather is no match for a portable propane patio heater or outdoor fireplace. From small tabletop heaters that can help warm up an intimate outdoor dining area to floor-standing models that can deliver a circle of radiant heat up to 20 feet in diameter, propane's clean, versatile energy can raise the outdoor air temperature by between 10 and 30 degrees Fahrenheit. Propane fireplaces and fire pits add warmth and decorative ambiance to an outdoor seating area, and can provide cozy, efficient, localized heating to any space.

IN-FLOOR HEATING

This option is a perfect alternative for customers who don't want a fireplace but want to enjoy a more usable patio space during the colder months.

POOL AND SPA HEATERS

Propane pool heaters can be used to extend a homeowner's swimming season well after their neighbors have closed their pools. They maintain water temperature at the optimum set-point regardless of outdoor conditions. Heaters are easily integrated with the pool's pump and filtration system and can be sized to fit any pool or spa. Propane models are up to 95 percent energy efficient and can provide over twice the heating rate as electric heat pump water heaters, at a lower first cost.

LIGHTING

Today's propane lighting manufacturers create a wide range of styles and options, including a selection of tabletop lamps, many of which can operate on a small, disposable propane cylinder. Tiki torch and pedestal-style propane lamps can create a great visual statement in outdoor entertaining spaces. These lamps eliminate the smell and residue that oil-burning torches can create, and many can burn for 10 hours or more on portable propane, or they can be supplied by the main propane storage tank. Propane lights can also accent landscaping and maintain home security – without the risk of going dark during power outages.

MOSQUITO CONTROL

Nothing can ruin an evening on the patio quite like mosquitoes. Propane-fueled mosquito traps can keep the party going. With a radius of up to an acre, these traps use propane to attract mosquitoes. Flameless technology makes these products a must-have for well-used outdoor living areas.

New plug-in gas outlets for indoor and outdoor use make connecting propane appliances as safe and easy as plugging in an electrical appliance.

FIVE BENEFITS OF PROPANE FOR OUTDOOR LIVING

1 FLEXIBLE

From outdoor kitchens to fireplaces to consistently warm pools, propane helps you meet the full range of customer needs.

2 RELIABLE

Homeowners can use propane to heat their grills faster than with charcoal and their swimming pools faster than with electricity. And, outdoor propane lighting stays on when electric-powered lighting goes dark.

3 SIMPLE

With minimal or no connections to electricity required, propane makes it easy and cost effective for you to enhance a homeowner's outdoor living spaces.

4 SAFE

Propane is nontoxic, colorless, and virtually odorless. As with natural gas, an identifying odor is added to propane so it can be readily detected.

5 CLEAN

Propane grills release less carbon monoxide, particulate matter, and soot than charcoal grills.

On Tap: Quiet and Reliable Power

One of the strongest selling points for residential generators, besides unpredictable weather, is the growing number of non-emergency electrical outages in the U.S. Should your customers need to worry about opening their refrigerator door in a power outage? Show them how propane standby generators can help maintain their quality of life.

A propane standby generator is ideal for customers who live in storm-prone areas or for those who just want the reassurance of never worrying about power loss. When coupled with an automatic transfer switch, home standby generators can deliver

up to 150 kW of power within seconds after an outage takes place. To increase safety and convenience, many whole-home generators also feature remote monitoring systems that can alert customers to any potential operating problems. Emerging technology in generators also includes combined heat and power systems (CHP) for residential and commercial use. (See page 17.)

For customers who want an “off-the-grid” lifestyle – without sacrificing modern conveniences – propane generators are the perfect solution. An increasing number of manufacturers now build propane generators warranted for off-grid use when used as part of a renewable energy system. This may include, for example, residential systems where solar photovoltaic panels or wind generators supply electricity. When stored battery voltage cannot meet demand, the propane generator kicks in to recharge the batteries to ensure uninterrupted power.



INSTALLATION

Propane standby and off-grid generator systems are housed outside, usually adjacent to a garage, shed, or other non-living space. These units typically draw propane from the home's main propane storage tank.

FIVE BENEFITS OF PROPANE GENERATORS

- 1 QUIET**
Many standby generator units produce less than 60 decibels of noise – as quiet as a normal conversation.
- 2 QUICK**
When equipped with an automatic transfer switch, a propane standby generator can produce supplemental electricity, often in as little as 10 seconds after primary power failure.
- 3 SAFE**
The American Red Cross recommends permanent standby generators over portable units as a safer means to provide backup power.
- 4 DEPENDABLE**
A 7kW standby generator drawing fuel from a 250-gallon propane tank can provide enough electricity to power a home for up to five days. Unlike diesel or gasoline, propane won't deteriorate while stored in the tank.
- 5 REASSURING**
With a propane standby generator, your customers can be assured that basic lifestyle needs – such as heating, cooling, cooking, food storage, and hot and cold water supply – will continue under virtually any circumstances.



Powering Innovation

Since its formation in 1998, PERC has awarded more than \$81.3 million for research and development of groundbreaking propane technologies through dozens of partnerships with top companies, universities, and national laboratories. The overriding goal of this support is to help manufacturers develop, test, and bring to market a steady stream of propane-fueled innovations. Some of the most recent residential accomplishments include advancements in micro-CHP.



COMBINED HEAT AND POWER (CHP)

Micro combined heat and power, or micro-CHP, systems show immense promise as a way to push past the efficiency boundaries of traditional heating or water-heating systems. These cogeneration systems produce both heat and power simultaneously, allowing them to surpass the energy savings of even the most efficient boilers.

One benefit common to all micro-CHP systems is that they utilize an on-site fuel source such as propane to generate the heat and power, eliminating the efficiency losses between a power plant and a home and leading to a lower carbon footprint. Another advantage is that many of these systems provide a low-cost, dependable power source that won't go down with the grid.

A vacation house in a remote location on a hillside in Alberta, Canada, for instance, uses a 1.5 kW micro-CHP system that is mainly used to produce electricity to run the A/C system. To produce enough electricity with solar, the photovoltaic panels would need to cover both the roof and the nearby ground. Instead, the micro-CHP system complements the solar panels and contributes to the home's ability to be off the grid and avoid impractical costs to bring in electrical service or natural gas.



CHP OPPORTUNITY CALCULATOR

Calculating the payback period for investments in CHP can be a complicated task, with variables such as fuel costs, incentives, and existing heating systems affecting energy savings and cash flow. To simplify the process, we've assembled a CHP Opportunity Calculator that helps you identify the economic viability of CHP in your homes. Visit **Propane.com** to download the calculator.



Four Steps to a Custom Fit

When it comes to job-site planning for propane, building professionals can follow four simple steps to ensure the right propane storage tank sizing and location and the proper regulator placement.

1 DETERMINE TANK TYPE AND SIZE

There are two main types of propane storage tanks. Tanks with a Department of Transportation certification are generally used aboveground and have a maximum capacity of 125 gallons. Commonly used horizontal tanks certified by the American Society of Mechanical Engineers (ASME) are sized up to 1,000 gallons (water capacity) and, under normal conditions, can be filled with propane up to 80 percent of the rated water capacity. ASME tanks are available for underground or aboveground installation.

OVERVIEW OF TANK TYPE AND SIZE GUIDELINES

PROJECT SIZE	TANK TYPE	CAPACITY	DIMENSIONS
Single appliance	DOT or ASME Horizontal DOT or ASME Vertical	125 gallons 125 gallons	24" diameter, 5'6" length 30" diameter, 4'5" height
Small home or warmer climate with limited gas applications	ASME Horizontal ASME Horizontal	250 gallons 320 gallons	32" diameter, 7'3" length 30" diameter, 9'6" length
Standard four-bedroom home	ASME Horizontal	500 gallons	38" diameter, 9'10" length
Large home with multiple gas applications	ASME Horizontal	1,000 gallons	41" diameter, 15'11" length

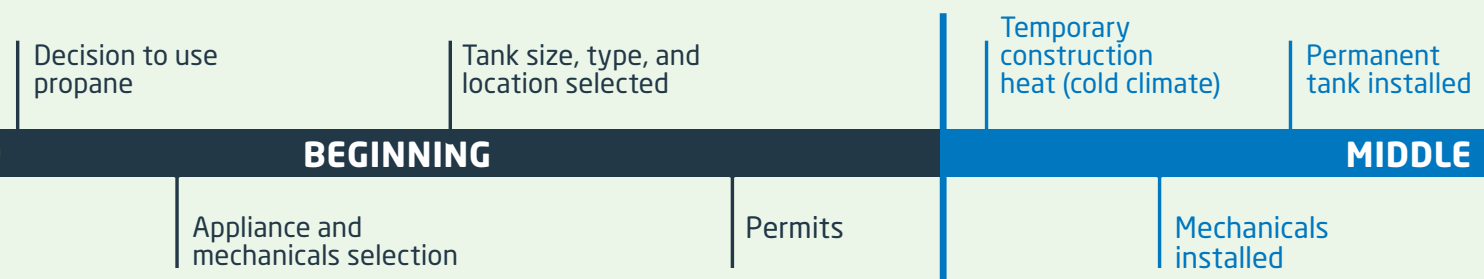
Source: American Society of Mechanical Engineers (ASME) and Department of Transportation (DOT).

In addition to the guidelines noted above, other factors influencing tank size include total square footage of the home, total Btu load of installed propane appliances, and the climate zone. See the "Typical Propane Consumption" chart on page 3 for more details.



Timeline

While the timing on projects is rarely exactly the same, here's where propane would typically fit into your overall build schedule.



2 PLACE THE ABOVEGROUND TANK OR CYLINDER PROPERLY

When selecting an aboveground location for a propane tank, the first priority is to choose an accessible, safety-approved site. Key considerations in that decision-making process include:

BUILDING AND SAFETY CODES

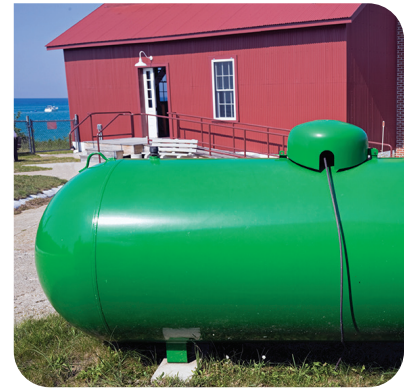
These regulations vary by state and local municipality. In addition to observing local codes, most states require that propane retailers follow the National Fire Protection Association (NFPA) 58: Liquefied Petroleum Gas Code (available at nfpa.org). In most cases, propane tanks must have at least 10 feet of clearance from the home, other structures, and property lines.

EASE OF ACCESS

When siting the tank, it's important to choose a location with easy access for filling and maintenance. For example, in colder climates, consider how delivery trucks will reach the tank during heavy snow conditions. Your propane supplier will give you tank location options.

CUSTOMER INPUT

In addition to safety and accessibility, aesthetics play an important role in project success. Be sure to review all tank location options with your customer, taking into account their feedback for landscaping and overall site design.



First propane
delivery

Appliances
installed

Inspection

END

Standby generator
installed (optional)

Service
test

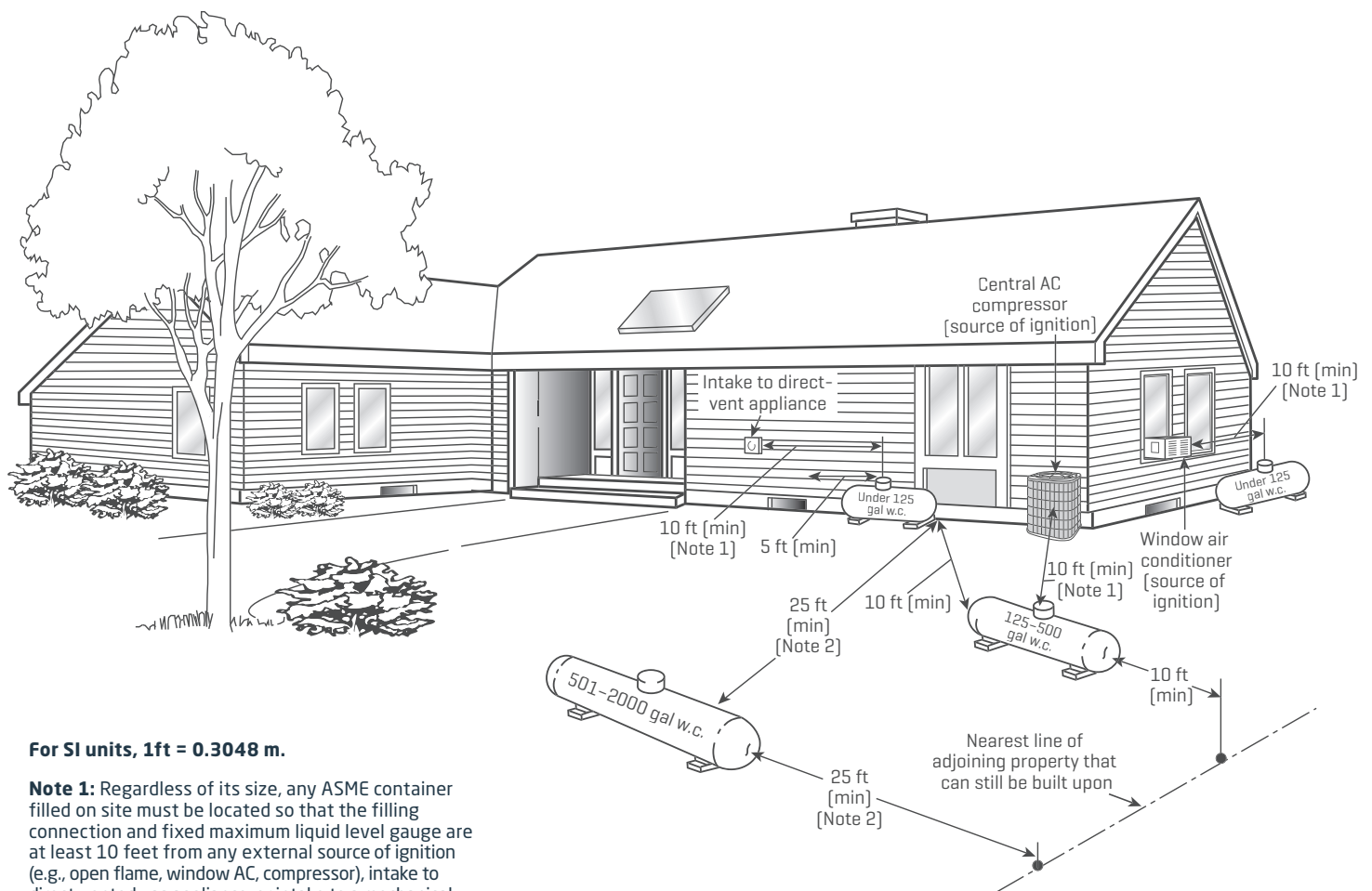
Landscaping

Certificate of
occupancy

3 CHOOSE UNDERGROUND TANK SITE CAREFULLY AND FOLLOW THE PERMITTING PROCESS

With a nearly invisible profile, underground propane storage tanks have become an increasingly popular choice for new-construction customers, as well as homeowners seeking to upgrade their existing energy systems. For builders considering large-scale exurban or other “off-the-main” housing projects, an underground community tank system is an efficient, aesthetically pleasing way to deliver propane’s reliable and efficient energy to customers.

As with aboveground tanks, installation permits and regulations for underground tanks will vary by location. In many cases where septic systems or other excavation projects are part of the overall site plan, it’s possible to coordinate excavation for underground propane storage tanks at the same time. When finalizing a location, choose a site that can easily accommodate propane delivery under all weather conditions.



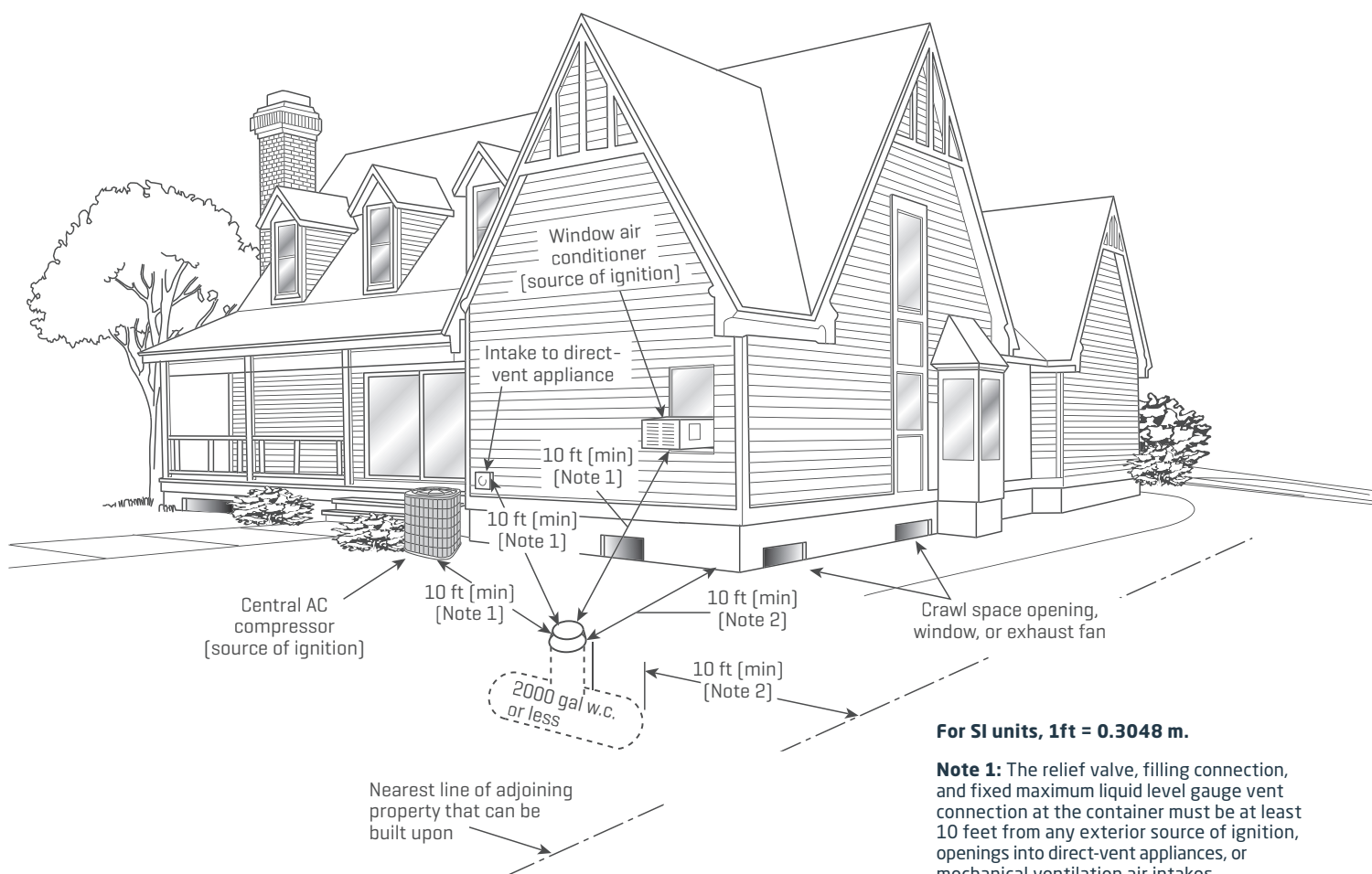
For SI units, 1ft = 0.3048 m.

Note 1: Regardless of its size, any ASME container filled on site must be located so that the filling connection and fixed maximum liquid level gauge are at least 10 feet from any external source of ignition (e.g., open flame, window AC, compressor), intake to direct-vented gas appliance, or intake to a mechanical ventilation system.

Note 2: This distance can be reduced to no less than 10 feet for a single container of 1,200 gal (4.5 m³) water capacity or less, provided such container is at least 25 feet from any other LP-gas container of more than 125 gal (0.5 m³) water capacity.

4 PLACE THE PROPANE REGULATORS PROPERLY

Like storage tanks, propane regulators come with pipe-size and installation distance requirements. For example, regulators cannot be placed closer than three feet horizontally from any building opening (such as a window well) lower than the regulator. Additionally, a regulator installed on the gas piping inlet to the home cannot be placed closer than five feet from any potential ignition source, such as a compressor for central air conditioning. For complete compliance details, contact your nearest propane retailer.



For SI units, 1ft = 0.3048 m.

Note 1: The relief valve, filling connection, and fixed maximum liquid level gauge vent connection at the container must be at least 10 feet from any exterior source of ignition, openings into direct-vent appliances, or mechanical ventilation air intakes.

Note 2: No part of an underground container can be less than 10 feet from an important building or line of adjoining property that can be built upon.

Earn Points Toward Green Certification

Propane can contribute up to 100 points toward the Home Innovations Research Labs National Green Building Standard (NGBS) and other above-code green building programs. These standards incorporate environmental considerations into every phase of the homebuilding process – from lot design and preparation to final construction and homeowner education. In fact, building with propane can get your new construction projects nearly halfway to qualifying for the NGBS Bronze-level green building standard. Since propane performs well by a wide range of “clean and green” measurements, it’s also a smart choice for remodelers who want to help customers maximize efficiency upgrades or environmental retrofit projects.

PROPANE AND THE NATIONAL GREEN BUILDING STANDARD™

Learn more about the national green building standard at homeinnovation.com/green.

CATEGORY	MAXIMUM POINTS FROM PROPANE	NGBS LEVEL OF CERTIFICATION			
		BRONZE	SILVER	GOLD	EMERALD
Lot Design, Preparation, and Development	10	50	64	93	121
Resource Efficiency	16	43	59	89	119
Energy Efficiency	47	30	45	60	70
Water Efficiency	4	25	39	67	92
Indoor Environmental Quality	17	25	42	69	97
Operation, Maintenance, and Building Owner Education	6	8	10	11	12
Additional Points from Any Category	n/a	30	75	100	100
Additional Points from Any Category	100	230	334	489	611

Source: Points and categories based on the National Green Building Standard, ICC 700-2015, approved by the American National Standards Institute on March 22, 2016.



Community Propane Systems

For builders of all sizes, propane's versatility makes it an ideal energy solution. Whether you're building one house or a community with hundreds of homes, there's a propane system to meet your needs.

Community propane systems are centralized gas systems that provide a scalable and flexible energy solution. The systems distribute propane gas through a network of underground pipes that connect to homes with individual gas meters. This makes them virtually identical to natural gas systems, but they can be installed almost anywhere in the U.S.

In addition to homes, community systems can also power other amenities such as standby generators, pools, clubhouses, and gas lamps. Providing gas energy in large developments is much easier with this type of versatility.

BENEFITS TO BUILDERS

What's in it for you? Community propane systems can help you:

- Build a more attractive, more marketable community.
- Meet green building standards with environmentally friendly energy and installation practices that minimize environmental impact.
- Give customers the energy performance they want.
- Create a scalable, convenient solution for an entire development.

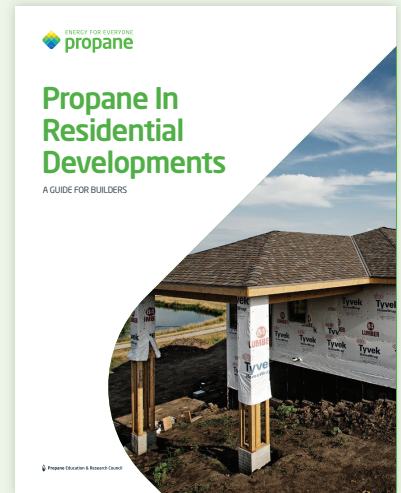
BENEFITS TO HOMEOWNERS

Community propane systems are great for homeowners, too. Homeowners can have:

- The comfort, performance, and efficiency of gas appliances.
- No propane tanks in their yard.
- Automatic delivery (usually out of sight of the home).
- Individual meters, so they'll only pay for energy as it's used.

INSTALLATION AND MAINTENANCE

A propane provider will work with you to design and install the central tank (or tanks) and piping system. These professionals know the federal and state regulations you must meet to ensure your community system is up to code. They will also typically monitor and refuel the central tank, as well as perform ongoing maintenance of the system. For both builders and residents, maintaining a community propane system is hands-off and worry-free.



BUILDER TOOLKIT

Visit Propane.com to download our builder toolkit containing information on communitywide propane in your next development.

Training and Safety: An Ideal Combination

PERC promotes the safe, efficient use of propane as a preferred energy source. Since its creation in 1998, PERC has invested millions of dollars in an ongoing effort to enhance propane safety with building professionals and consumers. A key factor in the success of these programs has been the development of training through Hanley Wood University, which provides builders, remodelers, and other skilled construction professionals with practical, straightforward online courses. These training modules, which cover everything from topic overviews to specific installation tips, are designed to help you expand your use of propane applications in safe and efficient ways. Learn more at HanleyWoodUniversity.com/search/propane.

AVAILABLE CERTIFICATIONS



AMERICAN INSTITUTE OF ARCHITECTS (AIA)

Hanley Wood University currently offers a variety of courses that are approved by the AIA Continuing Education System. All active, registered AIA members must successfully complete 18 learning units (LUs) per year. Of this total, 12 must meet the Health, Safety, and Welfare (HSW) criteria. Learn more at aia.org.



NATIONAL ASSOCIATION OF THE REMODELING INDUSTRY

Hanley Wood University currently offers a variety of courses approved for NARI continuing education units. Each NARI-approved module at the Propane Training Academy qualifies for one NARI CEU Hour. Learn more at nari.org.



NATIONAL ASSOCIATION OF HOME BUILDERS (NAHB)

Hanley Wood University currently offers several courses that can help professionals earn continuing education credits to maintain their NAHB designations. Each of the NAHB's designations has its own unique requirements, including years of experience, required courses, and exams. The same is true for maintaining previously earned designations. Learn more at nabh.com.



GREEN BUILDING CERTIFICATION INSTITUTE

Hanley Wood University currently offers many courses approved for continuing education and training credits with the Green Building Certification Institute, in conjunction with the U.S. Green Building Council. USGBC is the source for Leadership in Energy and Environmental Design (LEED) standards updates and is a leader in the sustainable building field. Learn more at gbci.org and usgbc.org.

Propane Pays in More Ways than One

Energy rebates are one of the most compelling sales pitches to prospective customers, and propane appliances qualify for a number of federal, state, local, and cooperative incentives. As a builder, remodeler, or HVAC professional, you should understand the full range of credits or rebates you can use to help homeowners get the most from their energy dollars. In some cases, both you and the homeowner can qualify for multiple rebates on a single project.

Building your homes with propane can be particularly rewarding. The Propane Construction Incentive Program offers up to \$1,500 per house for each home built or remodeled using propane appliances. Learn more about the program on page 4, or visit Propane.com/ConstructionIncentive to learn more and apply.

TYPE OF REBATE OR CREDIT	LEARN MORE
Federal, state, and local government incentives The federal government, along with some states and localities, provides tax credits, rebates, grants, and other incentives for propane projects.	dsireusa.org
State, regional, and local propane association rebates may also be available for energy-saving propane appliances.	Propane.com and your local propane retailer

FIVE WAYS TO FURTHER BOOST YOUR PROPANE SMARTS

1 WORK WITH A PROPANE SUPPLIER

Visit Suppliers.Propane.com to enter your ZIP code and find a supplier in your area who serves the residential construction and remodeling market. Your local propane supplier will be happy to answer questions about propane tank placement (including above-ground or underground installation), fuel delivery options, and more. You can also find local suppliers by searching Google's business listings.

2 SIGN UP FOR E-NEWSLETTERS

Dedicated specifically to building pros, the Build With Propane newsletter explains how propane can help you deliver the clean, efficient, and high-performing homes and buildings your customers are looking for. Visit Propane.com/Newsroom/Subscribe.

3 GET FREE ONLINE TRAINING

PERC's training courses at Hanley Wood University can help enhance your new construction or remodeling projects with propane applications. Many PERC-sponsored online courses are approved for continuing education credit with leading trade organizations. Learn more at HanleyWoodUniversity.com/search/propane.

4 JOIN US ON FACEBOOK

Participate in a community of like-minded professionals interested in the latest construction technology and business-building thought leadership. Join at Facebook.com/BuildWithPropane.

5 SUBSCRIBE TO OUR YOUTUBE CHANNEL

From builder case studies to instructional how-tos, our training videos examine how propane applications increase home comfort and energy efficiency, as well as reduce carbon emissions. Subscribe at youtube.com/buildwithpropane to ensure you never miss a new episode.

