



# 2016 Propane Market Outlook

Key Market Trends, Opportunities, and Threats Facing the Consumer  
Propane Industry Through 2025

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# Propane Market Outlook at a Glance

- ICF projects consumer propane sales to grow by about 800 million gallons (9 percent) between 2014 and 2025. Most of the growth will come from the propane engine fuel market, although lower propane prices associated with the growth in domestic propane supply and lower oil prices will also make propane more competitive in traditional propane markets, including residential and commercial space heating, and forklift markets.
- Despite sharp declines in oil prices, domestic propane production is expected to continue to grow rapidly, keeping downward pressure on average propane resource prices relative to oil prices. This should enable propane to remain competitively priced relative to gasoline and diesel fuel in engine fuel markets, and heating oil in residential and commercial space heating markets.
- Transportation infrastructure constraints resulting from the rapid growth in natural gas liquid (NGL) production, and new high load factor demands for propane outside of the consumer propane market (exports and petrochemical demand growth) may lead to regional propane supply constraints during higher than normal peak demand periods.
- Propane sales for use in internal combustion engines are projected to grow steadily, as clean propane applications (such as commercial lawn mowers, irrigation pumps, and propane vehicles) become more widespread in the marketplace.
- After falling steadily between 2003 and 2012, the number of residential propane space heating customers stabilized and started to increase in 2013 and 2014 due to an increase in propane market share in new residential housing construction, the rebound in the size of the new housing market, and fuel oil conversions to propane.
- The residential new construction market is in the midst of a significant rebound, with propane space heating market share in new construction increasing in 2013 and 2014 relative to both electricity and natural gas, and new housing starts continuing to rebound from their 2009 lows.
- Conversions of fuel oil furnaces to propane will continue to provide growth opportunities for propane marketers in the Northeast, although the recent decline in fuel oil prices is expected to slow conversions away from fuel oil.
- The rebound in new residential construction is expected to continue through 2017, leading to a significant increase in the number of new residential space heating households built each year. The increase in new residential construction, combined with continuing fuel oil conversions is expected to offset residential space heating losses to electricity and natural gas, leading to slow growth in the number of residential space heating customers through 2025.
- However, continuing improvements in energy efficiency will continue to lead to declines in propane sales per residential household.
- The decline in oil prices and the corresponding decline in propane prices in 2014 and 2015 provides a window of opportunity for propane to increase market share in traditional markets that have been hurt by higher propane prices in the last five years.
- Taking advantage of the opportunities and minimizing the challenges that lie ahead will require concerted action by the industry as a whole, including investments in new technologies and participation in the national energy debate.

# 1 Introduction

The consumer propane market is in the midst of a period of very rapid change. The continuing development of propane engine fuel markets is expected to provide significant growth opportunities. Propane sales to traditional propane markets are expected to stabilize due to lower propane prices. However, traditional markets will continue face competition from electric technologies, expansions of the natural gas distribution system, long term energy efficiency trends, and other shifts in the competitive market environment that are changing the nature of the consumer propane business. At the same time, significant changes in propane production, transportation infrastructure, and exports continue to require changes to propane marketer supply planning practices. These transformations are compelling propane marketers to adapt to new market conditions while also providing an opportunity to seize new opportunities expected to emerge over the next decade.

In this report, ICF evaluates the major market factors driving propane demand, and reviews the outlook for propane markets through 2025.

## Changes in Oil and Propane Prices

The most significant change in energy markets worldwide in the past two years has been the rapid decline in oil prices starting in June 2014 (Figure A). While the price decline is the result of a number of factors, the basic drivers included a rapid increase in oil supply, driven primarily by significant growth in North American supply, and an unexpected stagnation in demand growth caused by slower than anticipated economic growth in Asia and Europe. The decline in global oil prices resulted in similar price declines in petroleum products such as gasoline, diesel, and propane; but has not had as dramatic an impact on natural gas or electricity prices in the mainland United States.

ICF is projecting oil prices to remain at low levels through 2016, followed by a slow rebound to about

\$75 per barrel by 2020 for WTI crude oil. This forecast represents a significantly lower long term oil price outlook than the conventional industry wisdom for most of the last five years. The future outlook for oil prices is highly uncertain, and the industry should expect significant volatility in both oil and propane prices.

The recent declines in crude oil prices have resulted in lower domestic propane prices relative to electricity and natural gas, making propane more competitive in these markets. The more competitive pricing outlook provides significant short term opportunities for the propane industry to slow the loss of market share to electricity and natural gas in all markets, and recapture lost market share in regions of the country most favorable to propane.

However, the decline in oil prices is also squeezing the propane cost advantage relative to other petroleum-based fuels. In the long term, continuing growth in domestic propane production, combined with a modest rebound in oil prices, is expected to ensure the

continuation of a fuel cost advantage in markets where propane competes against gasoline, diesel, and fuel oil, particularly for vehicle fleets and large propane users that can be offered high volume pricing.

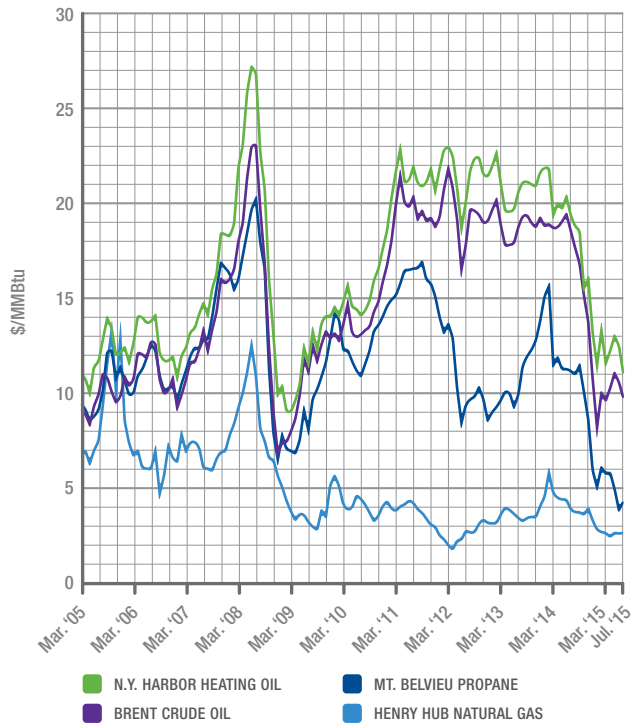
## Outlook for Propane Demand

After declining steadily for more than 10 years, consumer propane (odorized propane) sales increased by about 12 percent between 2012 and 2014. The long term decline in demand was driven primarily by declines in demand in conventional propane markets, including residential, commercial, and forklift markets, due to improvements in propane usage efficiency, competition from other fuels, and the impacts of increasing propane prices. In 2011 and 2012, the decline was accelerated by two of the warmest North American winters on record, which significantly reduced propane demand for space heating. The increase in demand in 2013 and 2014 was primarily due to colder-than-normal weather in the eastern half of the country during the winter heating season, and higher-than-average grain drying demand for propane in the Midwest amid two record corn harvests.

The recent decline in propane prices provides an opportunity for the propane industry to reverse long term losses in certain markets, primarily in the colder regions of the country, while slowing losses in other regions. Going forward, ICF projects steady growth in consumer propane demand, increasing from 9.2 billion gallons in 2014 to 10.1 billion gallons in 2025. Overall, propane demand in conventional markets will continue to decline slowly, while we expect to see significant growth in internal combustion engine markets.

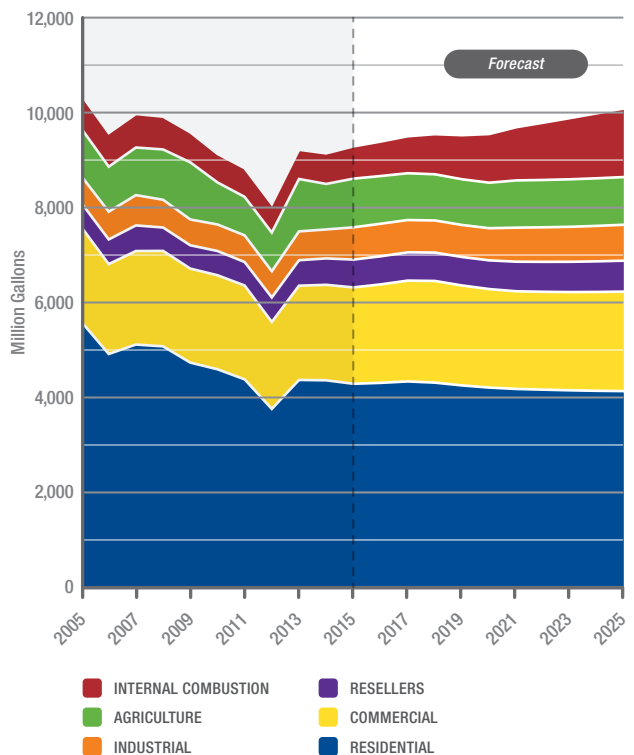
The changes in demand will differ widely by region. Demand in most traditional consumer propane markets in the southern half of the country is projected to continue to fall, as the number of residential households heated with propane continues to decline and propane appliance and building shell efficiency continues to increase. Meanwhile, high propane market share in new construction and continuing fuel oil conversions in the Northeast will lead to growth in propane heating demand in this region.

Fig. A  
Historical Energy Prices



Source: EIA

Fig. B  
Near-Term Odorized Propane Consumption Forecast



## Comparison with Previous Forecasts

This report is the latest in a series of Propane Market Outlooks (PMOs). The previous versions of the PMO are available on the PERC Website at <http://www.propanemarc.com/ProductDetails.asp?ProductCode=9500%2DCS%2D13>. While the key drivers of propane demand have been relatively consistent across all of the versions of the PMO, the outlook for propane demand growth has changed over time, and the outlook for propane demand growth in this version of the PMO is more optimistic than in the previous edition.

ICF is currently projecting a 2020 consumer propane demand of 9.6 billion gallons and a 2025 demand of 10.1 billion gallons, compared to propane sales in 2014 of 9.3 billion gallons, based on a healthier outlook for traditional residential and commercial propane markets as well as additional growth in engine fuel markets.

The improvement in the outlook for traditional markets is primarily due to the lower oil price outlook. The current version of the PMO is based on a WTI oil price outlook rebounding from below \$50 per barrel in 2015 to around \$75 per barrel (real 2013 dollars) by 2020. The lower oil price forecast results in a lower propane price outlook, which makes propane more competitive relative to electricity and natural gas. As a result, ICF is

projecting healthier propane sales in traditional propane markets, including the residential, commercial and forklift markets, as well as in the industrial sector and resale markets.

The lower oil price outlook is also expected to reduce the propane price advantage relative to fuel oil, gasoline, and diesel fuel prices. The lower fuel oil prices are expected to slow the conversion of residential and commercial customers from fuel oil to propane, while the lower gasoline and diesel prices reduce the economic advantage for propane in the engine fuel markets.

Despite the decline in fuel price advantage, ICF continues to project significant growth in internal combustion engine markets, with projected growth over the next decade exceeding what was forecast in the previous PMO. Propane vehicle sales are expected to increase from 12,900 in 2014 to about 34,750 per year by 2020, and then to about 52,500 vehicles per year by 2025. While the introduction of new vehicles and engines has been slower than anticipated, and greater market penetration will be delayed somewhat by the decline in the propane fuel cost advantage caused by lower oil prices, the availability of new emissions-certified engines and the growing acceptance of propane vehicles by commercial vehicle fleet operators, irrigators and commercial landscapers will lead to continuing growth in these markets.



## 2. Critical Energy Market Trends

The U.S. propane industry remains in a period of change. Growth in propane supply, volatile energy prices, evolving energy and environmental policies and regulations, and increased competition with electricity and natural gas continue to shift propane's competitive position in the market. The major market drivers impacting U.S. propane markets are reviewed below.

### 2.1

#### Decline in World Oil Prices

Oil prices increased rapidly from 2001 to 2008, driving up propane prices and reducing propane's competitiveness in many markets. Although the financial crisis in the second half of 2008 reduced oil demand and caused prices to fall to 2005 levels, prices began rising again in 2009 and moved back above \$100 per barrel in 2011. From 2011 through mid-2014, oil prices remained high and relatively stable at near or above \$100. Over the second half of 2014, oil prices declined substantially, falling to about \$50 per barrel by the end of the year. The decline in prices followed several years of rapid production growth, particularly in the U.S.; slowing global demand growth, particularly in Europe and China; strengthening of the U.S. dollar; and the decision by the Organization of Petroleum Exporting Countries (OPEC) not to cut output to support global oil prices.

In the first quarter of 2015, oil prices continued to decline, reaching a low of \$43.39 in mid-March. The second quarter of the year saw the beginning of a slight recovery, with oil prices clearing the \$60 per barrel benchmark briefly in mid-June. The recovery of oil prices continues to be gradual and uncertain, as prices fell again throughout late summer and early autumn, to as low as \$38.22 per barrel in the last week of August.

The recent decline could be accelerated and extended by a continuing stagnation in international economic growth, or the return of Iran as a major crude oil exporter. Conversely, it could be reversed by changes in Saudi oil production policies, increases in political instability in the Middle East and North Africa, or a more rapid than expected rebound in economic activity in Asia and Europe. However, in the absence of major unexpected changes in markets, prices are likely to remain relatively low for the near future, until the lower prices reduce production and stimulate sufficient demand to rebalance the market at a higher price point.

The decline in oil prices, combined with growth in propane production and inventories, will lead to lower propane prices relative to natural gas and electricity in traditional propane markets, including the residential, commercial, and forklift markets, and will provide a window of opportunity for propane to regain market share in these markets.

The time frame for this window of opportunity remains uncertain. However, ICF considers it unlikely that oil prices will rebound significantly in 2016. In the long term, oil prices appear likely to stabilize at prices well below the long term price forecasts prevalent in the last few years. The 2016 Propane Market Outlook is based on WTI oil prices slowly rebounding over the

next five years as market forces adjust, with WTI prices potentially reaching the \$75 per barrel mark in 2020.

Lower oil prices will not benefit all propane markets: they are expected to have a greater impact on prices of gasoline, diesel fuel, and distillate fuel oil than on propane. While propane's price advantage versus gasoline and diesel fuel in the engine fuel markets is expected to remain sufficient to support continuing growth in propane engine fuel markets, at least for propane vehicle fleet buyers and other high-volume customers, the decline in oil prices has eroded some of propane's fuel cost advantage, and, perhaps equally important, has reduced the economic pressure for consumers and fleet managers to convert to new fuels, slowing propane growth in these markets.

## 2.2 Implications of Growth in Propane Supply

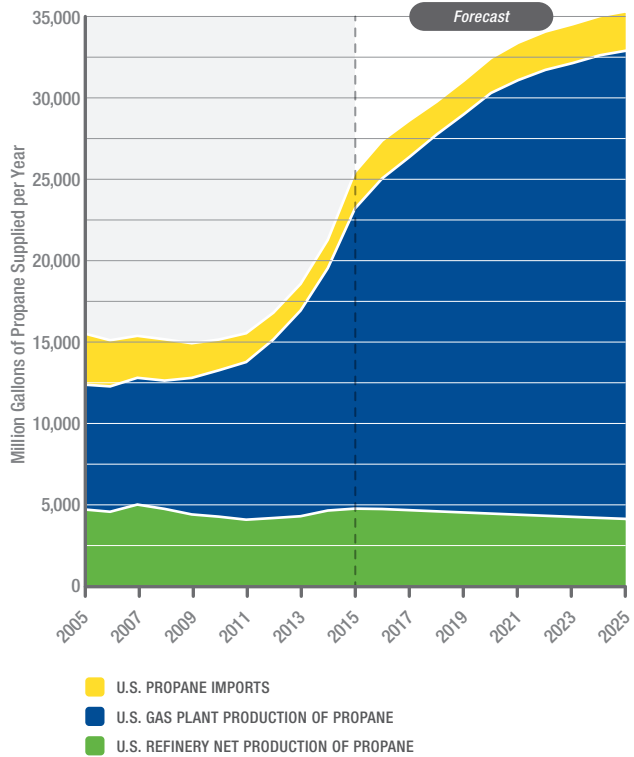
In the future, the North American propane market will be defined by production growth that far exceeds growth in consumer demand.

Between 2005 and 2014, U.S. production of propane from natural gas processing plants and refineries grew from 12.4 billion gallons to 19.6 billion gallons, and is expected to reach 23.2 billion gallons in 2015. The primary driver of this expanding supply has been the growth in propane production from gas processing plants, which increased from 7.7 billion gallons in 2005 (the lowest level since 1991) to 14.8 billion gallons in 2014, and is expected to increase to 18.4 billion gallons in 2015.

In 2005, the U.S. imported more than 20 percent of its total propane supply, including nearly 1.2 billion gallons of propane from outside North America and an additional 2.0 billion gallons from Canada. The U.S. became a net exporter of propane in 2011. By 2014, imports from outside North America had declined to just over 140 million gallons, while imports from Canada had declined to a little under 1.5 billion gallons. By 2014, exports of propane increased to about 6.5 billion gallons, leading to net exports of over 4.7 billion gallons, making the United States the world's largest exporter of propane.

Propane continues to benefit from the changing U.S. supply picture. Long seen as a crude oil derivative with the same supply security issues as other petroleum

Fig. C U.S. Historical and Forecasted Propane Supply



products, propane produced from domestic natural gas liquids (NGL) was sufficient to meet more than 98 percent of total U.S. propane demand in 2014, including both consumer and petrochemical. When refinery production is considered, propane produced in the U.S. from domestic NGL and crude oil resources significantly exceeded total propane demand. Imports from outside the U.S. and Canada made up less than one percent of total supply, and only about 10 percent of propane was produced in U.S. refineries from non-U.S. or Canadian crude oil. In 2014, the U.S. exported about 30 percent of total propane supply.

ICF projects that these production trends will continue. North American production of propane from NGLs is projected to increase from 19.6 billion gallons per year in 2014 to 23.2 billion gallons a year in 2015 and 32.9 billion gallons per year by 2025.

## Propane Markets for New Supply

Most of the new propane production is expected to go to markets other than U.S. consumers. As propane prices have fallen, petrochemical industry demand for

propane has increased and is projected to expand significantly in the future. New propane to propylene petrochemical (PDH) facilities in the U.S. could increase petrochemical propane demand by an additional 2.3 billion gallons per year by 2018. The petrochemical industry is also building new cracking facilities to take advantage of inexpensive ethane supplies. At least some of these facilities will also have the capability to use propane feedstock.

## Propane Exports

The growth in U.S. propane production is expected to significantly exceed growth in domestic propane demand, leading to rapid growth in propane exports. Midstream companies — including Enterprise, Targa, Sunoco, Conoco Phillips, and others — have proposed development of new export capacity to meet demand in international markets with higher propane prices. Figure D below lists the announced propane/butane export terminal projects, which, if all commissioned, would increase LPG export nameplate capacity from about 9 billion gallons per year in 2014 to more than 23 billion gallons per year by 2018. Some of the capacity will be used to export butane, ethane and other NGL products in addition to propane, however, the significant majority of the capacity is expected to be used to export propane.

After 2018, ICF projects investment in new propane export capacity to be sufficient to allow growth in propane production exceeding growth in propane demand to be exported to international markets. Most U.S. propane exports currently go to markets in Central

and South America, and growth in U.S. exports to these regions is expected to expand over time to match growth in regional demand and to displace imports from more expensive sources of supply. However, the growth potential in these markets is relatively limited, and therefore much of the future growth in domestic propane supply is likely to be exported to Asia, primarily to meet petrochemical demand in China, India and Korea. Exports to Asia will be facilitated by the completion of the Panama Canal expansion project, expected in 2016, which will provide Gulf Coast terminals with less expensive access to the Asian market.

## Propane Imports

The growth in domestic propane production has substantially reduced the importance of propane imports to the United States. Since 2005, propane imports have fallen from 20 percent of the total U.S. propane supply to less than 8 percent in 2014. Propane imports from countries other than Canada have fallen to minimal levels, primarily to meet peak winter demand in the Northeast. The U.S. will continue to import marginal quantities of propane from other countries into specific markets, including New England, to meet unexpected spikes in demand and occasional supply shortfalls.

Currently, the only significant quantities of propane imports are from Canada, which remains a major propane supplier to the U.S. West Coast, Upper Midwest, and Northeast markets. ICF is projecting Canadian production of propane to continue to increase in the next ten years, leading to an increase in excess Canadian supply looking for a market. While Canadian producers are exploring

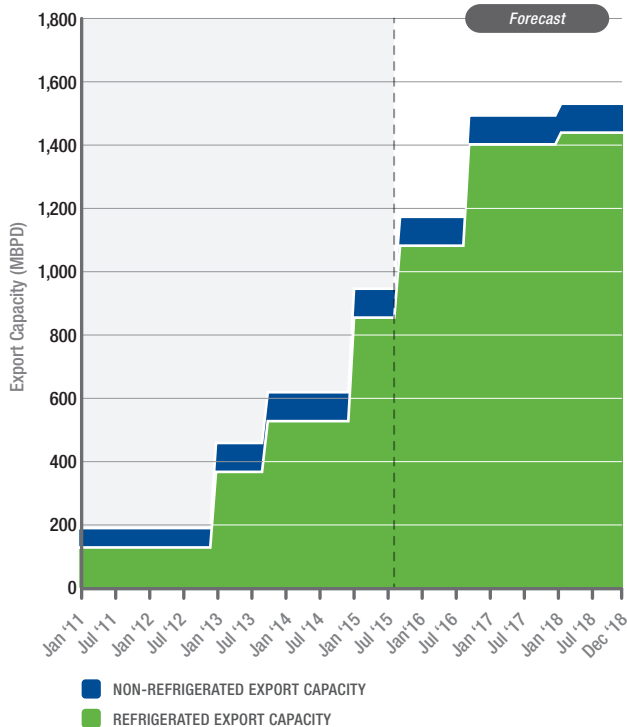
**Fig. D: Existing and Publicly Announced Planned Propane Dehydrogenation Plants**

Company	Output Volume (tons/yr)	Propane Consumption (gal/yr)	Location	Start-up Year
PetroLogistics	640,000	459,900,000	Houston, TX	2010
Dow Chemical	750,000	536,550,000	Freeport, TX	2015
Enterprise	750,000	536,550,000	Chambers Co., TX	2016
Formosa Plastics	65,000	475,230,000	Point Comfort, TX	2016
C3 (Ascend) Petrochemicals	1,000,000	720,510,000	Alvin, TX	2017
REXtac	300,000	214,620,000	Odessa, TX	2017
Williams	500,000	352,590,000	Redwater, AB	2018
<b>Total Proposed/Under Construction</b>	<b>4.2 million +</b>	<b>2.8 billion +</b>		
<b>Total</b>	<b>4.8 million +</b>	<b>3.3 billion +</b>		



Fig.

**E** **Planned Export Terminals and Capacity**



the development of marine propane export terminals on the U.S. West Coast and in British Columbia, most of the available propane supply from Canada is expected to be exported to the U.S., adding to U.S. propane supply.

### Propane Import/Export Balance

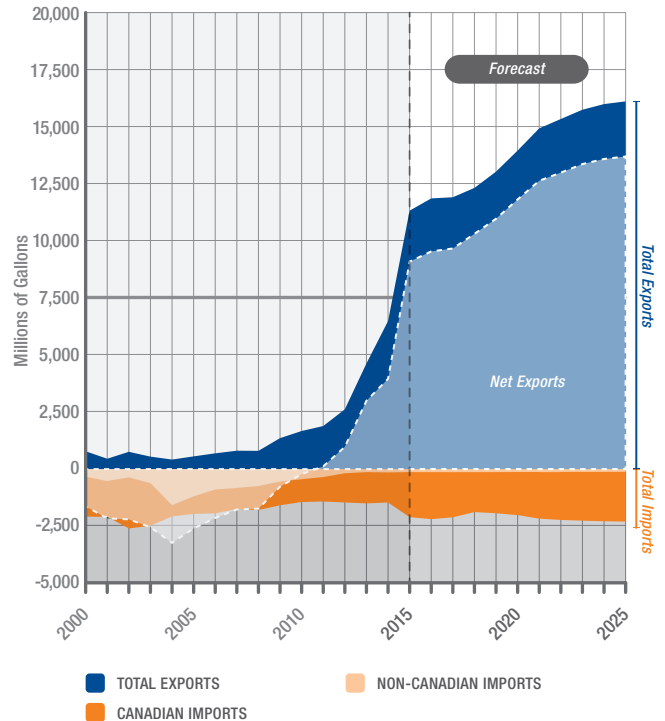
Figure F shows the historical and projected propane import/export balance. Total exports are expected to increase from about 11 billion gallons per year in 2015 to 16 billion gallons by 2025, while net exports increase from 9.9 billion gallons per year in 2015 to 13.7 billion gallons per year by 2025.

### Potential Propane Supply Issues During the 2015/16 and 2016/2017 winters

The 2015/16 winter started with propane inventories at all-time highs, as growth in production exceeded growth in demand and exports during the year. At the end of September, 2015, nation-wide propane weekly storage inventories were at 94.1 million barrels, 28.7 million barrels above the five-year average and 17.3 million barrels above the previous five-year maximum for the same week.

Fig.

**F** **U.S. Propane Import and Export from Canada Forecast**



Total LPG export capacity is poised for significant expansion in the fourth quarter of 2015 and in 2016, with approximately 646,000 barrels per day of LPG-dedicated terminal throughput projected to come on line. While not all capacity will go to propane, ICF projects that the growth in new export capacity will significantly exceed growth in propane and butane production. Purity propane will also see demand growth from Gulf Coast propane dehydrogenation (PDH) facilities, growth in petrochemical cracker demand due to lower prices, and potentially growth in consumer demand due to cold weather and to lower prices.

During the 2015/2016 winter, the high initial inventory levels should be sufficient to offset an increase in exports. However, by the start of the 2016/2017 winter, the growth in potential propane exports may lead to significant drawdowns of propane inventories. The growth in export capacity could lead to tight markets for propane, with higher regional propane prices and potential regional supply constraints, particularly if grain drying demand and winter heating season demand are greater than normal. However, the potential impacts of the new export capacity on domestic supply will depend

on growth in international propane demand and the economics of exports versus the domestic market.

## The Economics of Excess Propane Export Capacity

The availability of additional propane export capacity does not guarantee that the capacity will be used. Instead, it links the domestic propane market to the international propane market as propane exports flow to the markets that value them most and causes domestic and international prices to equilibrate.

U.S. domestic propane prices at Mont Belvieu and other export facilities must generally remain well below international propane prices<sup>1</sup> in order to provide the incentive for international buyers to purchase U.S. supplies. As U.S. exports increase, and must be transported further to reach new markets, the price of propane in the U.S. will need to fall relative to international propane prices to be competitive in these new markets. As a result, increasing propane exports should lead to lower average propane prices at U.S. market centers.

## Increased Price and Supply Volatility

During most of the period from 2016 through 2020, LPG export capacity is likely to exceed available LPG supply. Exports will balance the domestic market, and prices will be set according to the international market price. As a result, domestic prices will be more subject to fluctuations in international demand and prices.

At the same time, the growth in PDH capacity reduces the overall flexibility in the propane market, thereby increasing price volatility. Unlike many of the petrochemical plants in the market today, the PDH plants are fuel-specific and cannot convert to alternative feedstocks when propane prices increase, or significantly increase propane consumption when propane prices fall.

The integration with international markets also makes U.S. propane prices more sensitive to weather conditions in Europe and to economic conditions in Asia, Europe, and other regions.

The volatility in international demand has the potential to make propane supply availability to marketers more uncertain during peak demand periods, unless the

marketers have previously contracted for propane supply. Seasonal stock builds for winter demand will no longer be automatic, and propane in storage will not automatically be available to the domestic market. During peak demand periods, propane marketers without contracted supply may be forced to bid into the market at prices sufficiently high to incentivize exporters to divert supplies away from exports to domestic markets. Given the structure of the export contracts, this will require a significant price premium.

## 2.3

### Changes in Propane Supply Infrastructure

The rapid increase in NGL production, growth in Canadian demand for diluent for the oil sands industry in Alberta, decline in waterborne propane imports into the Northeastern U.S., and other changes in energy markets are resulting in major changes in the propane transportation and distribution infrastructure serving the consumer propane industry. Major recent changes have included the reversal of the Cochin Pipeline and its conversion away from propane service, the reversal and conversion of one line of the TEPPCO from south to north service for products including propane to north to south service for ethane transportation, and the increased utilization of available propane infrastructure to move propane to Mont Belvieu.

ICF anticipates that much of the decline in propane supplied by TEPPCO Pipeline systems will be replaced by new production from the Marcellus and Utica plays in the Appalachian Basin, and the decline in propane supplied by the Cochin Pipeline will be replaced by production from the Bakken and the Marcellus and Utica plays. Production growth in these regions will more than offset the loss of pipeline supplies. However, the loss of the supply flexibility provided by the access to storage on each pipeline will be difficult to replace, particularly given the lack of propane storage capacity in the Northeast.

### Growth in Propane Transportation by Rail

The shifts in supply patterns and infrastructure utilization are increasing propane marketer reliance on rail delivery of propane to serve demand.

<sup>1</sup> After adjusting for transportation cost differences.

ICF estimates that in 2013, rail moved about 2.9 billion gallons of propane in about 92,000 rail car shipments, or potentially as much as 20 percent of all propane gallons used in the U.S. in that year. This represents an increase of about 10 percent since 2011 and 27 percent since 2009.

The increase in rail shipments has occurred as waterborne imports to the Northeast have declined. Rail transport has also increased as the location of propane production has shifted to regions without propane pipeline access, and as the available pipeline infrastructure to move propane has become more constrained. As propane pipelines become repurposed or constrained due to growth in transportation demand for other products, reliance on rail to ship propane is expected to increase.

The increased reliance on rail has significant impacts on propane supply reliability and industry supply planning. Propane rail shipments for the consumer propane industry typically move from origin to destination in what is known as railroad manifest train service. The manifest train network involves local switch crews picking up and delivering cars at multiple locations where they are consolidated at a local railroad serving yard into trains that move to intermediate terminals. From there the cars are handled again and placed on other trains for interchange to another railroad or for forwarding to a destination serving yard. In manifest service, a car is handled multiple times, often parked one or more days at a yard awaiting another connection. Some origin or destination propane locations may be served only two

or three days per week. All of these factors contribute to manifest service being the slowest and least reliable of the services that railroads provide.

The primary concern with an increased reliance on rail for propane deliveries is system reliability. Rail is a highly efficient and reliable mode of transportation for high load factor loads that can be scheduled months in advance. Hence, rail has been very effective in serving the crude oil and diluent markets, as well as high load factor NGL demands such as propane exports. However, rail is not as effective working with seasonal demands that can vary widely from month to month and year to year.

Rail scheduling for seasonal deliveries is generally less reliable than pipeline scheduling, and it is often difficult to predict when full propane railcars will be delivered to the rail terminals and when empty railcars will be picked up and returned to the propane supply terminals even during normal weather conditions. As a result, additional railcar capacity as well as additional storage capacity at the rail delivery terminals is necessary in order to ensure propane availability when supply is required.

Reliance on rail also places the consumer propane industry in competition for the use of the available propane-capable rail cars. Propane-capable rail cars are also used to transport other NGLs, including butane and unfractionated NGL's (Y-mix). The cars also can be used to transport certain chemicals, including ammonia. Growth in NGL production, growth in propane export capacity from the Gulf Coast, and regulatory pressure to minimize flaring of raw natural gas in the Bakken region

## Impact of Winter Weather on Rail Transport

**The “Polar Vortex Winter” of 2013/14 highlighted climate-related challenges to propane rail delivery systems. Severe cold requires rail services to use shorter trains so that air brakes can operate properly, as well as reducing overall train speeds. Cold weather also reduces the efficiency of switching and handling. As a result, the total capacity of the rail system declines during cold weather conditions.**

**The rail industry is therefore required to prioritize shipments during severe cold weather, which complicates propane industry deliveries. Manifest rail deliveries and unscheduled rail deliveries such as those required by the propane industry during cold weather periods generally receive lower priority than more stable rail demands, including unit trains. Hence, the reliability of the rail system for delivering propane declines during the cold weather periods when the propane industry has the most need for reliable propane service.**



and other locations is increasing demand for pressurized rail cars capable of transporting NGLs, including ethane, propane/ethane mixes, propane, and other NGL mixes. The demand for rail cars for these services is high load factor, 365-day utilization, and is expected to lead to additional competition for the pressurized rail cars used in the consumer propane market. These rail cars will be made available to the consumer propane markets during high demand periods when the transportation basis provides additional value in the consumer propane market. However, the overall tightness in the pressurized rail car market is expected to increase the cost of delivering propane by rail, and the need to shift railcars from non-consumer markets to consumer markets will increase the time lags needed for rail service to respond to increases in consumer demand.

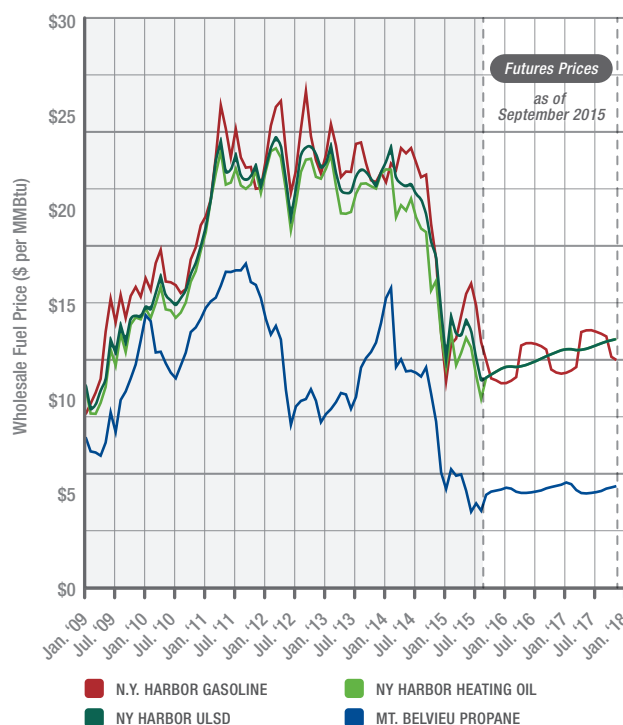
## 2.4 End-Use Energy Prices

Historically, propane prices have been very closely linked to oil prices in both domestic and international markets.

This relationship is changing, but not disappearing, due to the growth in domestic propane supply. In 2012, and again during the 2014/15 winter and throughout 2015, high propane inventories due to warm winter weather combined with growth in propane supply and constraints on propane export capacity pushed propane prices down to historically low levels relative to crude oil.

In the first nine months of 2015, average propane spot prices at Mont Belvieu<sup>2</sup> averaged 58 percent below the Brent<sup>3</sup> crude oil price when measured in dollars per million Btu (MMBtu). This represents a significant decline relative to 2010, when propane prices were only 9 percent below the cost of Brent crude oil on a dollar per MMBtu basis. Based on futures market prices in October 2015, this spread is again expected to be about 58 percent for 2016, as the markets anticipate growth in production exceeding growth in demand. As propane export capacity catches up to supply, domestic propane prices are expected to rebound. However, the change from the U.S. being a net importer to a net exporter of propane has shifted the fundamental

Fig. G Propane, Heating Oil, ULSD, and Gasoline Wholesale Prices



relationship between domestic propane and crude oil prices.

In the longer term, the changing relationship between propane and crude oil prices will be driven by the increasing role played by the U.S. as a supplier of propane to the international market. As U.S. exports continue to increase, world propane prices will decline relative to crude. In addition, growth in worldwide propane supply is expected to exceed growth in non-petrochemical propane demand as major processing facilities come online in Qatar and other propane-producing countries, putting downward pressure on international propane prices.

In the future, ICF anticipates the ceiling on domestic propane prices will be set at the world price of propane minus transportation costs to international markets, rather than at the world price of propane

<sup>2</sup> Mt. Belvieu is the largest propane storage facility in the U.S., and prices at Mt. Belvieu are generally accepted as the market price for propane. Regional propane prices will differ from Mt. Belvieu based on transportation costs and transportation constraints.

<sup>3</sup> The price of Brent crude is currently considered a marker price for world crude oil. Prices of other crude oils, including WTI (West Texas Intermediate) are generally linked to world crude oil prices based on transportation cost differences and differences in crude oil quality. In the past, WTI has been a marker price for crude. However, between 2010 and 2013, transportation infrastructure constraints suppressed WTI prices relative to Brent and other crude oil prices.

plus transportation costs, point at which the floor on domestic propane prices was set during the years in which the U.S. was a major propane importer.

## Petroleum Product Prices

The recent decline in oil prices has resulted in a larger absolute decline in the spot prices for gasoline, diesel, and fuel oil prices than in propane prices. Between 2012 and 2014, the New York Harbor price of gasoline averaged \$11.2 per MMBtu higher than the Mont Belvieu price of propane. New York Harbor diesel prices averaged \$10.3 per MMBtu higher than Mont Belvieu propane, and the New York Harbor No.2 Heating Oil price averaged \$9.4 per MMBtu higher than Mont Belvieu propane prices. By October 2015, futures markets indicated that for 2016, the price differential was expected to decline to about \$6 per MMBtu (or about \$0.67 per propane equivalent gallon) for all three fuels. While this outlook is not as favorable for propane as prices during the 2012-2014 period, the current market outlook for propane prices relative to competing petroleum fuels remains significantly better than the period prior to 2012.

At today's prices, propane is expected to remain attractive relative to gasoline and diesel fuel in most engine fuel applications for fleets and other large volume users that can be offered volume discounts. However, the decline in the spread between these fuels relative to propane reduces the economic incentive to convert, and is likely to slow the growth of the propane engine fuel and fuel oil conversion markets relative to a higher oil price outlook.

ICF projects the difference between the prices of gasoline and diesel fuel and propane prices to rebound slowly over time relative to today's levels, as oil prices rebound, and as markets continue to adjust to the growth in propane supply, leading to a continuation of the attractive economics for propane engine fuel applications for the foreseeable future.

## Electricity Prices

Competition with electricity will continue to be a major challenge to growth in propane sales in most residential and commercial markets. Electricity prices vary widely by region depending on market structure, generation types, and capacity constraints. The capital intensive nature of electricity production lead to retail electricity prices that are generally more stable than other fuel prices. Hence, when energy prices are declining, prices of other fuels can be expected to decline faster than electricity prices.

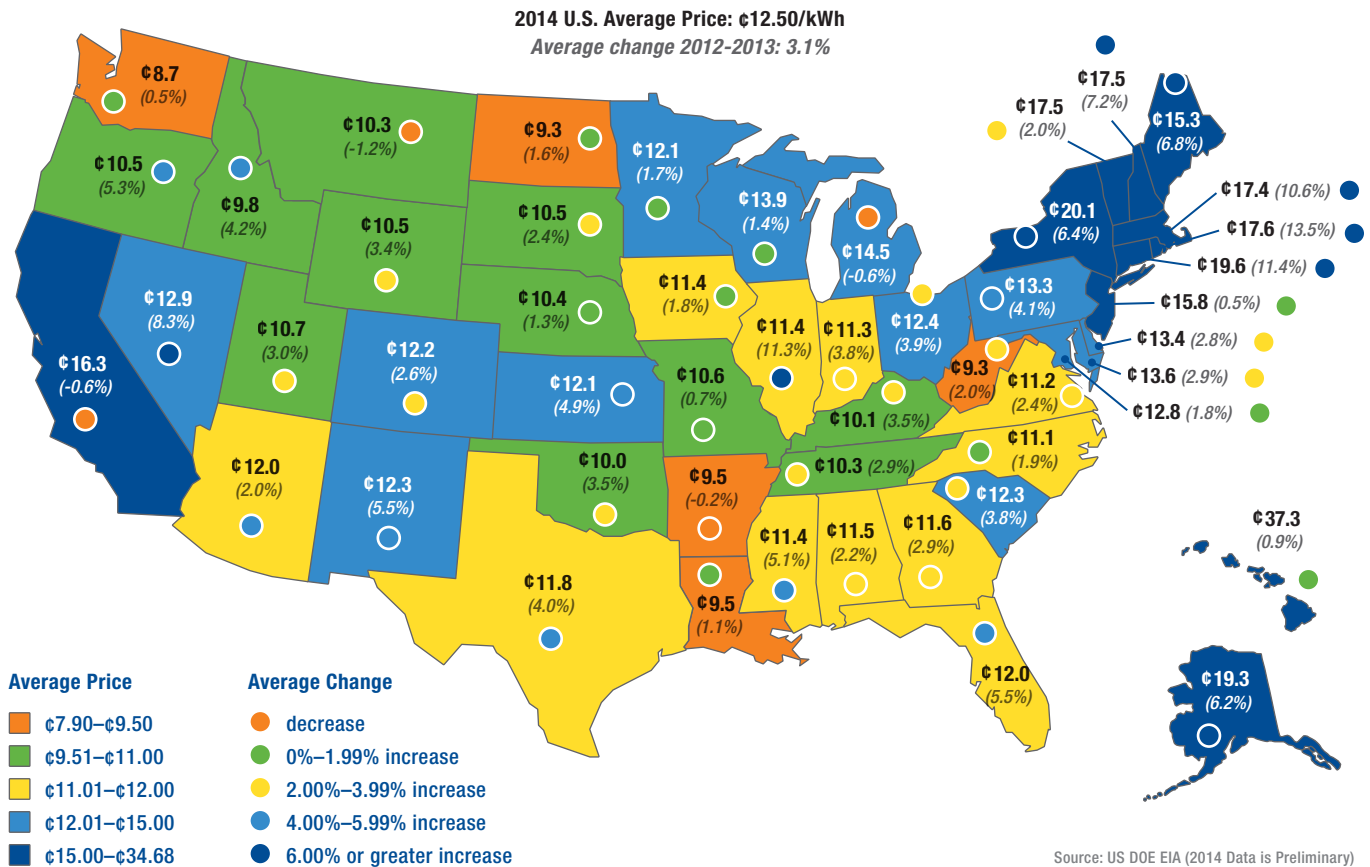
The price of electricity also varies widely by specific location. State average prices reflect the major factors driving prices in the state, but tend to be representative of the prices charged by the utilities serving the major urban areas with the majority of electricity customers. Electricity prices in rural and suburban areas can diverge substantially from these state averages. Within a specific state, some markets are likely to see electricity prices as much as 40 percent higher or lower than the state average, with the higher prices often set by small municipal utilities that serve areas with a high concentration of propane customers. As a result, propane can be competitive with electricity in many communities even in states with relatively low average electricity prices.



LPG Carrier Yuyo, photo courtesy of JX-Shipping of Tokyo, Japan

Fig.

**H** 2014 U.S. Residential Average Price (and change from 2013) per Kilowatthour



ICF expects the decline in propane prices to lead to a significant near-term improvement in the relationship between propane and electricity prices in most major propane markets. While soft natural gas prices continue to translate into lower electricity prices in certain higher cost markets such as New England and the Northeastern United States, the decline in retail propane prices is expected to be greater than any potential decline in electricity prices. In the longer term, increases in power generation investments related to implementation of emissions regulations are expected to lead to a slow increase in future electricity prices partially offsetting any rebound in propane prices. The DOE Annual Energy Outlook is projecting average residential electricity prices to increase by about 12 percent between 2015 and 2025.

## 2.5

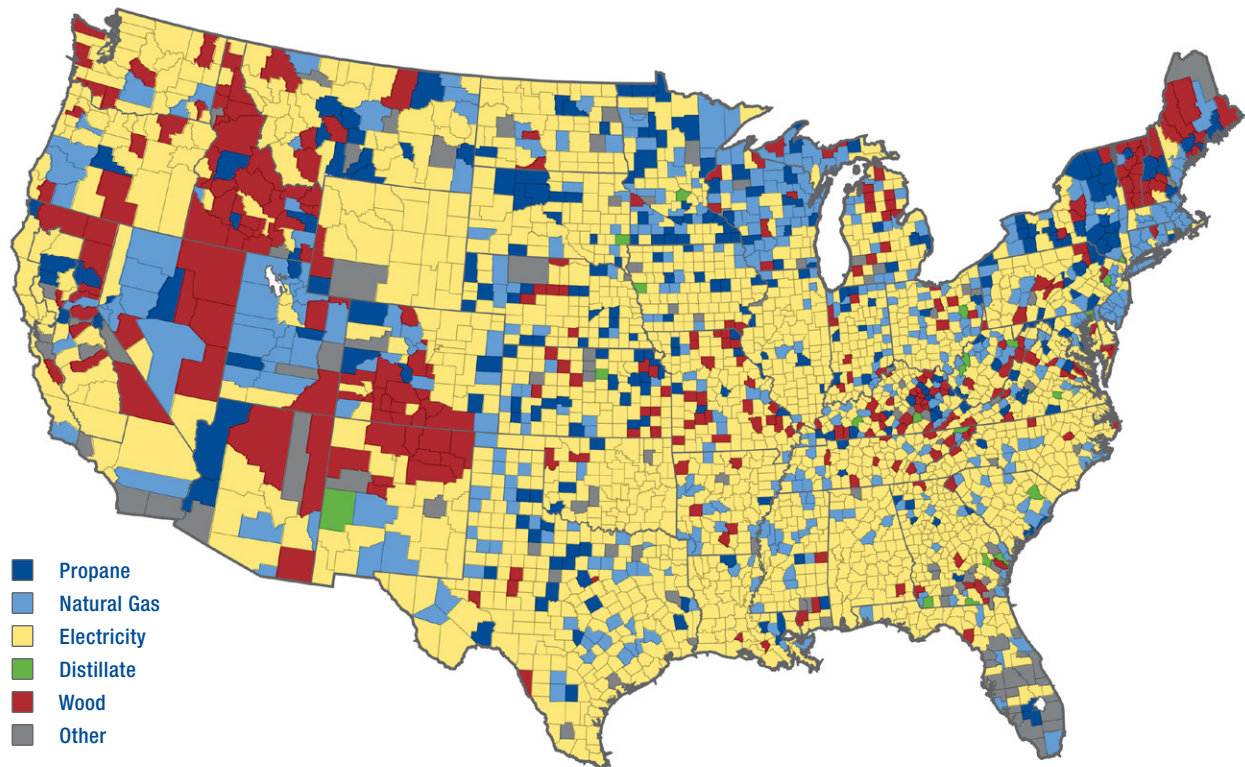
### Competition with Heating Oil, Electricity and Other Fuels

The map below shows the fuel type with the largest increase in the residential space heating market share between 2010 and 2014 for each of the 3,142 counties in the U.S. Overall, electricity's share of the home heating market has been increasing rapidly, particularly in the South, but also in some northern states. The share of homes heated with wood has also been increasing in the last few years, particularly in New England and the upper Midwest. Many of these homes switched from propane and fuel oil to wood due to increased fuel prices. Many of the homes that switched to wood from propane can heat with either energy source and are likely to switch back as propane prices moderate.

Propane gained market share in 1,127 (36 percent) of U.S. counties between 2010 and 2014. Much of the

Fig.

Fuel with Largest Market Share Gains between 2010 and 2014



growth in market share occurred in counties where fuel oil market share declined. However, in a surprising number of counties, propane increased market share at the same time that natural gas market share was declining. In these counties, the propane market was increasing due to new housing growth and conversions from other fuels, while the natural gas system was not expanding, or was losing share to electricity.

Propane's share of the residential space heating market declined in 2,013 U.S. counties between 2010 and 2014. In the majority of these counties, electricity was the fastest-growing source for residential space heat, although natural gas and wood also captured shares of the market in many counties. The decline in propane prices is expected to change the market dynamic in the short term, slowing down propane customer losses to electricity and natural gas.

### Technological Improvements in Electric Heat Pumps

Much of the loss in propane market share in the residential sector in recent years is attributable to competition with conventional electric heat pumps. This competition is expected to intensify over time as ongoing technological improvements reduce or eliminate heat pumps' traditional shortcomings. In addition to improved operating characteristics at low temperatures, the heat output from modern heat pumps has increased, improving the comfort they deliver. Equipment reliability and lifespan also have been improved. As heat pump technology continues to advance, conventional heat pumps will be a growing threat to the propane heating market.

Geothermal heat pumps (GHPs) represent a growing competitive challenge to propane in some key regional heating markets. GHPs are designed to maintain high

Fig.

J

Fuel with Largest Market Share Losses between 2010 and 2014 in Counties where Propane Gained Market Share

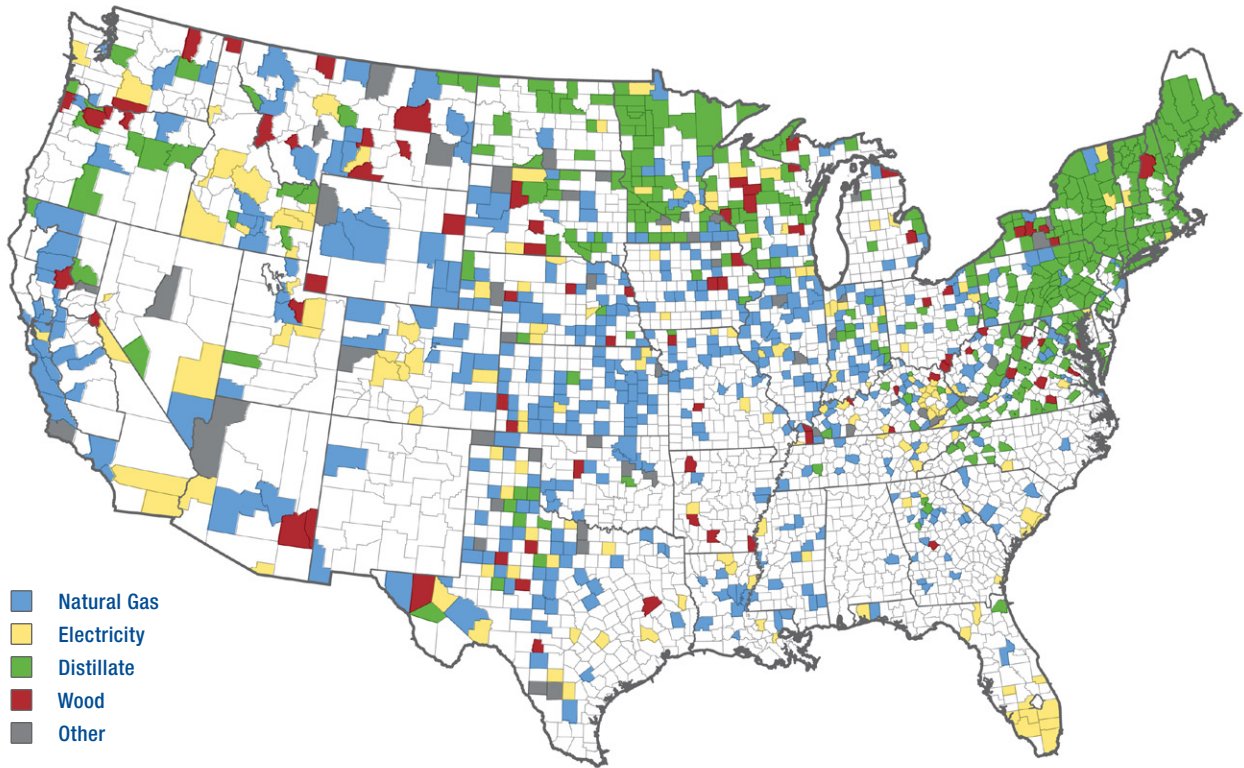
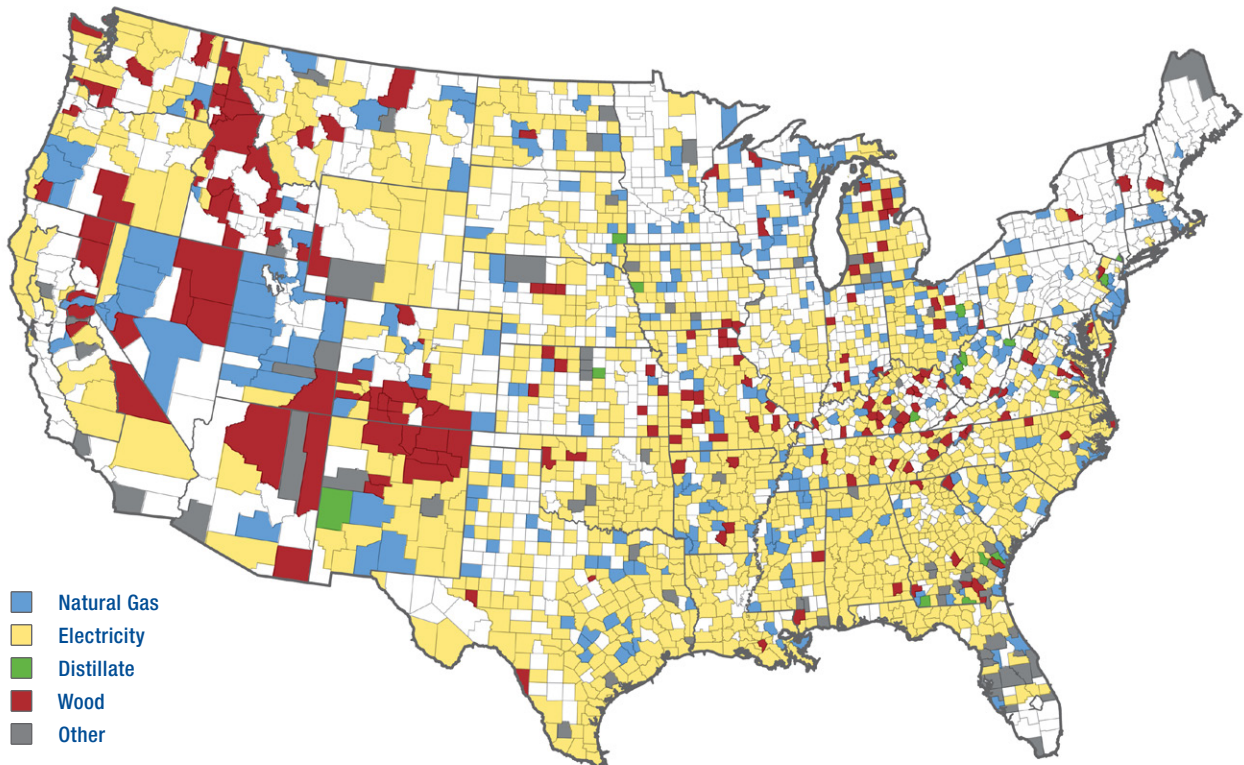


Fig.

K

Fuel with Largest Market Share Growth between 2010 and 2014 in Counties where Propane Lost Market Share





operating efficiency even when outside temperatures drop below 20 degrees Fahrenheit, which allows the technology to be competitive in colder environments where conventional heat pumps are unable to operate economically.

Until recently, market adoption of GHP technology was limited by the very high cost of installation. However, GHPs are now being aggressively marketed as a “green” technology and are currently eligible for a 30 percent income tax credit on the full installation cost. The U.S. Department of Agriculture also provides funding for rural electric cooperatives to install ground loops for GHP systems, with the costs recovered through a utility rate surcharge to the customer. These incentives have provided a significant boost to GHP installations in the past few years, and are expected to stimulate additional growth in GHP installations in the future. As installations increase and as more companies become adept at installing GHPs, the average cost of GHP systems is expected to continue to decline over time.

While heat pump technology continues to improve, heat pumps remain an ineffective source of heat when temperatures fall below their design conditions, and both conventional and ground source heat pumps often use electric resistance heat to supplement the heat pump during these conditions. Propane can provide an economic backup heat source for heat pumps in many markets, maintaining some of the load lost when households install heat pumps rather than propane furnaces.

## 2.6 Energy Policy

National energy policies reflected in alternative fuel and energy efficiency tax credits and water heater efficiency standards can make propane applications more attractive in the marketplace. However, these policies are also likely to increase the energy efficiency of propane applications, accelerating a long term trend that would reduce propane sales per application relative to existing equipment. New energy policies and regulations also have the potential to tilt the playing field in favor of electricity or other fuels in certain applications.

## Building and Equipment Efficiency Standards

Appliance energy efficiency standards and more energy efficient building codes have driven a long term decline in average propane sales per customer in the residential and commercial sectors, directly impacting propane sales to both new and existing customers. They also promote technological improvements in competing technologies, such as heat pumps and heat pump water heaters.

- In 2010, the U.S. Department of Energy (DOE) finalized new rules on residential electric and gas water heaters. The new rules took effect in April 2015. The impacts of the new standards are expected to be significant, particularly for larger water heaters. The efficiency standards for gas-fired water heaters with tanks larger than 55 gallons were increased from an AFUE of 0.67 to 0.80. Standards for electric water heaters larger than 55 gallons more than doubled from 0.97 to 2.21 AFUE. The new large tank electric water heater standard effectively requires the use of heat pump water heater technology to comply with the new regulations, substantially increasing the cost of the larger water heaters. While the new rules reduce electric water heater operating costs, the higher up-front costs provide significant opportunities for propane tankless water heaters to displace large electric water heaters in a significant segment of the water heating market.
- In 2015, the U.S. Department of Energy (DOE) published proposed rules to increase the efficiency of most residential gas furnaces from 80 percent to 92 percent. Unless delayed by legal challenges, these are likely to take effect in 2021. The rule is likely to accelerate the market penetration of higher efficiency furnaces prior to the legal deadline.
- The U.S. Department of Energy (DOE) also published proposed rules to increase the efficiency of commercial gas-fired furnaces from 80 percent to 82 percent in 2015. Unless delayed by legal challenges, the new standards are likely to take effect in 2018.

The existing building code and appliance efficiency standards are expected to result in a continuing decline in average propane use per residential customer of between one percent and 1.5 percent per year. The tightening of energy efficiency standards

will have a significant impact on the economics and energy use of these applications, and should be expected to accelerate the decline in propane use per customer for residential customers. However, the recent changes in efficiency standards for water heaters provides an opportunity, particularly for tankless water heaters, to capture additional market share and to grow propane load.

The national policy focus on energy issues — including energy security, energy efficiency, and emissions — is also likely to result in greater promotion of high-efficiency electric appliances. The propane industry can expect to see significant expansion in the number of utility-sponsored programs that provide incentives for high-efficiency conventional heat pumps and GHPs, and high-efficiency 100 percent electric homes in many regions of the country.

### Alternative Motor Fuel and Infrastructure Tax Credits

The federal alternative fuel excise tax credit provided a significant financial incentive for the use of propane as a motor vehicle fuel. This tax credit of \$0.50 per gallon expired at the end of 2011, but was retroactively extended first to apply to propane used to operate propane-powered vehicles through December 31, 2013, and then again through December 2014. The federal alternative fuel infrastructure tax credit was also reinstated through December 2014 to provide up to 30 percent of the cost of a qualified propane refueling facility. Currently these tax credits are subject to renewal every year, and have not yet been renewed for 2015 or 2016.

The propane industry is promoting the Propane Gas Act to extend these fuel tax credits through 2016, but the future of this proposal remains uncertain. The biofuel, electric, and natural gas industries are also aggressively pursuing these markets, and can be expected to substantially outspend the propane industry on vehicle development, marketing, and lobbying. Without aggressive industry support, future changes in federal and state energy policies may favor these other alternative fuels relative to propane. Long term stability of the tax credits would improve market acceptance of propane vehicles, leading to an increase in the ICF forecast of propane vehicle sales

### Department of Commerce Restriction on PERC Activities

Propane industry marketing efforts to consumers have been constrained since the Department of Commerce restricted PERC activities in 2009. In 2014, Congress revised the language in PERA that authorized the restriction, and the Department of Commerce lifted the restriction in April of 2015. As a result, PERC is now able to use additional tools to educate consumers about propane. The additional flexibility should enable to the propane industry to be more effective in reaching consumers in the future.

<sup>4</sup> As of October 1, 2015.

## 3 Overview of Key Propane Markets

### 3.1

#### Residential Markets

Residential demand represents almost 50 percent of total consumer propane sales. Even though the propane industry added more than one million new residential propane heating customers through new construction and new manufactured housing placements between 2001 and 2012, customer losses exceeded new customer additions, and the total number of space heating customers declined in each year. However, recent data suggests that the number of propane space heating customers stabilized in 2013 and began to increase in 2014 due to an increase in new propane home construction resulting from both the rebound in residential housing construction and a modest increase in propane market share in new construction.

However, even though the number of propane space-heated households has been stable in the last two years, the average residential propane demand per customer has been declining due to improvements in energy efficiency and conservation. These improvements are expected to continue to lead to declining propane sales per residential customer each year for the foreseeable future.

The decline in the number of space heating customers, combined with improvements in efficiency and declining

use per customer, has resulted in a significant long term decline in propane sales in the residential sector.

The residential sector is highly regional and market specific. Growth in the Northeast is offset by losses in the South, while growth in propane market share in new site-built housing construction has been offset by continuing losses in manufactured housing.

#### Residential Demand Outlook

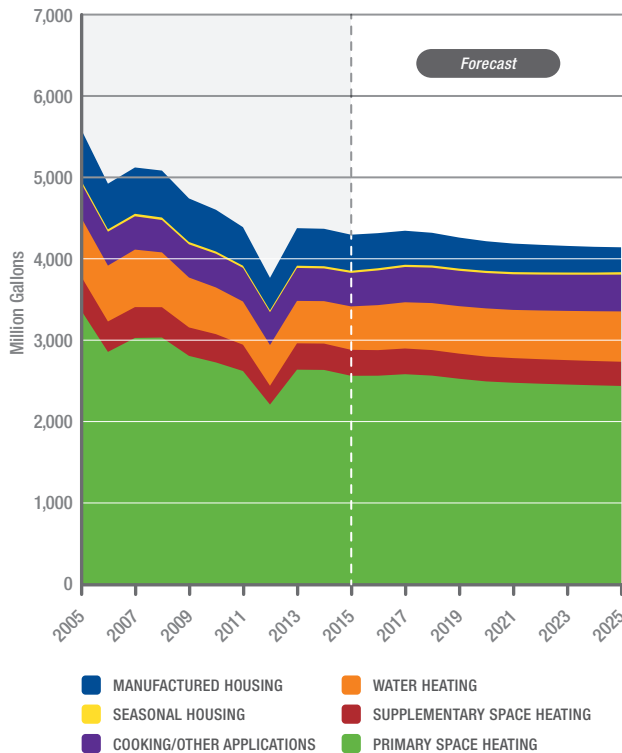
Between 2015 and 2025, residential demand is expected to remain relatively stable as losses in warmer regions of the country are offset by growth in colder regions of the country.

ICF is now projecting relatively stable propane use per customer through 2025, as an increase in price sensitive consumption offsets continuing improvements in appliance efficiency.

Under steady-price conditions, the long term trend toward increased energy efficiency is expected to result in a continued decline in average propane sales per residential customer at a rate of approximately one percent per year. Dramatic rises in heating fuel prices, such as those experienced in 2008 and 2011, have the potential to accelerate this trend, driving efficiency gains at as much as twice the long term trend rate.

Fig.

**L Residential Propane Demand Forecast by End Use**



Declines in prices, such as those experienced in 2012 and again in 2014/2015, lead instead to growth in consumption as customers become less concerned about fuel expenditures. However, low propane prices will not significantly slow the replacement of older, low-efficiency furnaces and water heaters with new higher efficiency units. Hence, in the near term, use per customer is expected to increase modestly due to lower propane prices but lower prices will not reverse the long term trend of declining use per customer.

Low propane prices also should lead some customers that switched to wood during higher priced periods to reverse their consumption patterns by switching back to propane.

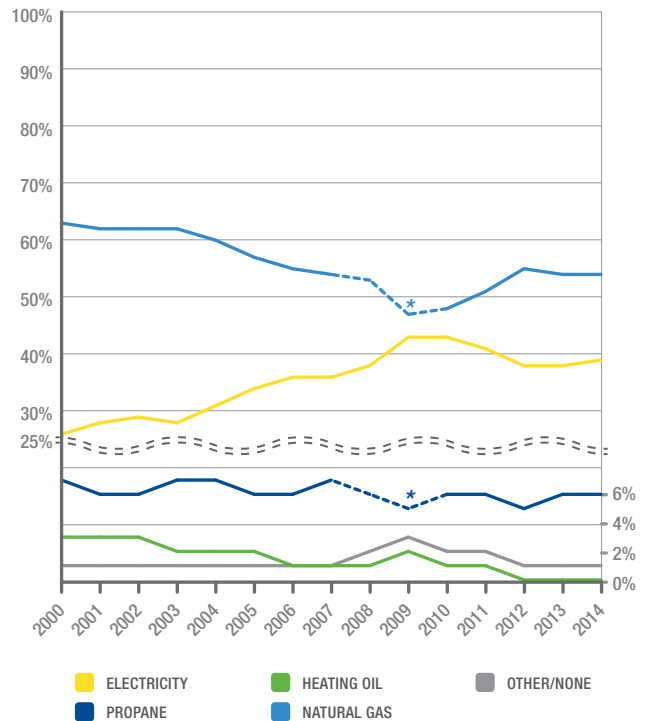
## Opportunities in the Residential Sector

### RESIDENTIAL NEW CONSTRUCTION

Propane remains a premium fuel in the largest and most expensive new homes that are not on the natural gas main. Owners of custom and upscale homes that are built away from the gas main want the convenience

Fig.

**M New Single-Family Residential Construction Market Share**



\* 2008–2009 Data not available  
 Source: U.S. Census Bureau, Survey of Construction 2000 - 2013, American Housing Survey, American Community Survey, ICF Estimates

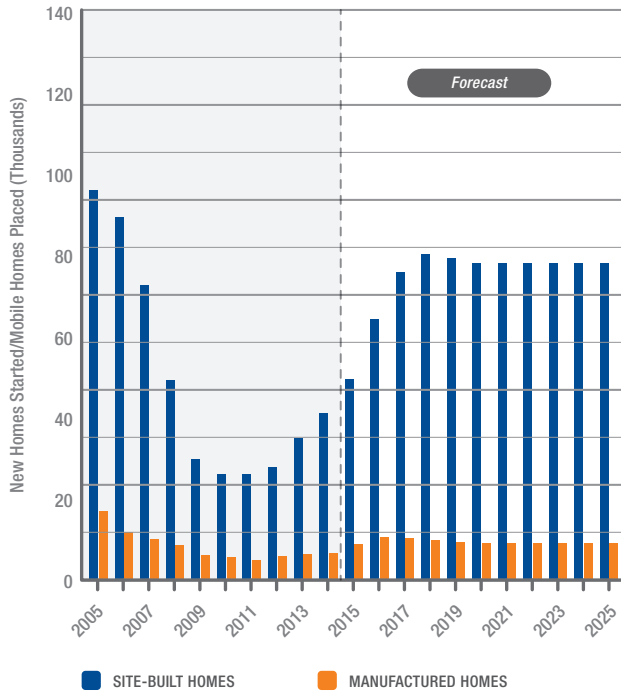
of gas for cooking, heating, and other needs. These customers base their heating and appliance decisions on value rather than cost, and the propane industry has effectively promoted the value of propane throughout the range of residential applications.

Even in the southern sections of the country, where propane heating market share has been declining, propane cooking and water-heating have been increasing, as upscale residences in these regions continue to demand the convenience and comfort of propane for these applications.

Increases in propane prices, combined with an increased sensitivity to up-front cost issues in the homes that have been built, resulted in a noticeable decline in propane space heating market share in new construction in 2010 through 2012. However, lower prices and growth in residential development in regions of the country favorable to propane resulted in an increase in propane market share in 2013. Propane supply constraints and high prices negatively impacted propane market share in

Fig.  
N

**New Propane Heated Households**



Source: U.S. Census Bureau, Survey of Construction 2000 - 2013, American Housing Survey, American Community Survey, ICF Estimates

2014. However, going forward, ICF expects the recent decline in propane prices to lead to an increase in the propane share of the new construction market.

Propane will also benefit from continuing improvements in the residential new construction market. ICF projects an increase in the number of new homes heated with propane to increase from 25,000 in 2011 to about 95,000 by 2017.

Existing customers represent a significant potential market for new propane applications. Many customers use propane for cooking, water heating, or clothes drying, but not for space heating. Other customers are in the reverse situation. More than 2.5 million existing propane customers could convert to propane heat, including more than 1 million customers in the Northeast who are likely heating with fuel oil. Almost 4 million existing propane customers do not heat water with propane, and almost 4 million existing propane customers do not cook with propane. Increasing the number of propane applications among existing propane customers may be the most efficient way to offset declines in use per customer from improvements in energy efficiency.



## FUEL OIL CONVERSIONS

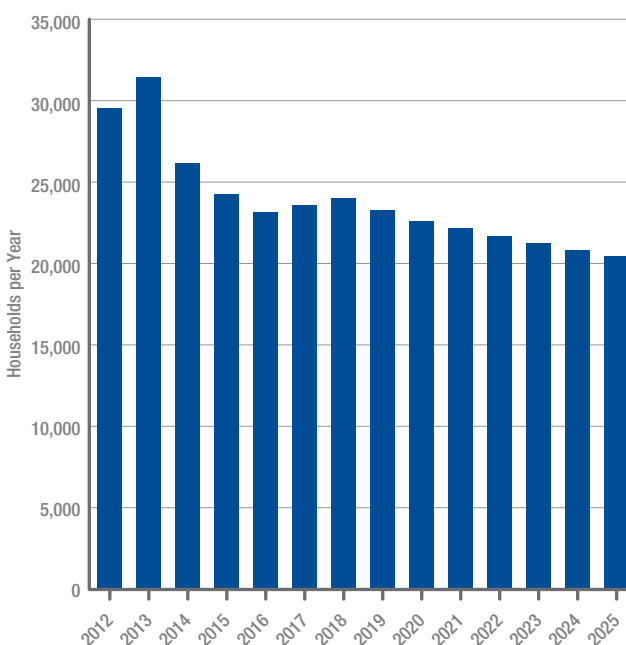
Currently, the residential fuel oil market in the United States is larger than the residential propane market. In 2014, 6.2 million households used fuel oil for primary space heating, while 5.9 million residential households used propane. The vast majority of the existing fuel oil households are located in the Northeast and Mid-Atlantic regions, and a few areas in the Midwest. The fuel oil market has been declining rapidly for the last several years. Between 2008 and 2014, the number of fuel oil households decreased by more than 1.7 million, or 22 percent, from 7.9 million.

Nearly 240,000 homes convert away from fuel oil space heat each year. The majority of these conversions replace fuel oil with natural gas and electricity. However, about 30,000 fuel oil households per year have converted to propane. In the past few years, the propane industry has gained approximately the same number of customers from fuel oil conversions each year as it has from the new residential construction market.

While future fuel oil conversions to propane are expected to decline gradually as the fuel oil market contracts and the number of potential conversions declines, conversions of fuel oil houses should continue to yield a significant number of new propane customers for the foreseeable future (see Figure O).

Fig.

**O** ICF Projection of Residential Fuel Oil Conversions to Propane



Drivers affecting the heating oil market vary by state, but the main factors are the same: relatively high prices of fuel oil compared to other fuels and increasing costs associated with the fuel's environmental impact. With a significant built-in base of consumers, heating oil presents an attractive target for conversions to propane, with a good share of the consumers motivated to switch, and the vast majority of the households located in regions where electricity is relegated to a third tier option for space heating. The 2014 decline in oil prices temporarily reduced the economic pressure to switch away from fuel oil, potentially slowing conversions to propane in the near term. However, in the longer term, ICF expects fuel oil conversions to propane to provide a continuing source of new propane space heating customers.

## WATER HEATER CONVERSIONS

Currently, about 2.75 million households with propane space heating do not use propane for water heating. These households provide attractive opportunities to increase the number of propane applications in each house, leading to growth in propane sales. Current market conditions are highly favorable to converting electric water heating and cooking applications to propane. The implementation of new water heater efficiency standards has increased the cost and complexity of replacing existing water heaters with new units, particularly in the larger sizes, while the decline in propane prices has improved the economics of using propane instead of electricity for these applications.

ICF estimates that adding water heating to existing propane space heating customers could add as much as 342 million gallons to residential propane sales each year. While adding propane water heating to all propane space heating customers is an unrealistic objective, converting only five percent of these customers each year would add 17 million gallons per year to residential sales.

The changes in the marketplace that make propane water heating more attractive to existing propane customers also make propane water heating more attractive to homes that are currently all electric, particularly in areas of the country with high electricity prices. Larger and higher value homes that would otherwise need to install new heat pump water heaters are expected to provide a significant market for propane water heater conversions.

### 3.2

## Commercial Sector Outlook

The commercial sector accounts for about 22 percent of the overall consumer propane market. The near term forecast for propane demand shows stable non-weather driven consumption in the commercial sector through 2014, with the impact of modest economic growth offset by the long term impacts of higher propane prices and improvements in building shell and appliance efficiency. Demand declined in 2011 and 2012 due to warmer than normal temperatures, but rebounded significantly in 2013 and 2014. This projected to be followed by steady demand levels through 2025 linked to gradual growth in commercial activity.

The commercial sector is a diverse market, with a much wider range of customer types and end-uses than other sectors. The market also differs widely by region in a manner similar to the residential sector. PERC research into the commercial sector indicates that there is significant opportunity to expand sales into this market. Understanding the regional differences in fuel use and the variety of commercial propane market segments (e.g., schools, fast food restaurants, and houses of worship) can lead to new opportunities.

One of the key applications — and region-specific opportunities — in the commercial sector will be the conversion of fuel oil heating customers, similar to the opportunity in the residential sector. Fuel oil currently dominates the commercial heating market in the Northeast. The market share for fuel oil in new commercial construction has already declined substantially because of permitting issues with fuel oil storage tanks, leading to additional market opportunities for propane in new commercial construction. While fuel oil use is not as predominant in the Midwest and Western regions, there remain significant pockets of fuel oil use in the commercial sector in these regions that provide opportunities for propane.

Other key opportunities include promotion of tankless water heaters in a variety of commercial segments, including the lodging and resort industry and in institutional and educational settings. In the commercial sector, tankless water heating can have both up front and operating cost advantages relative to electric water heating when electric system cost savings and building space savings are fully accounted for.

Fig. P Buildings Using Propane & Fuel Oil: All Applications

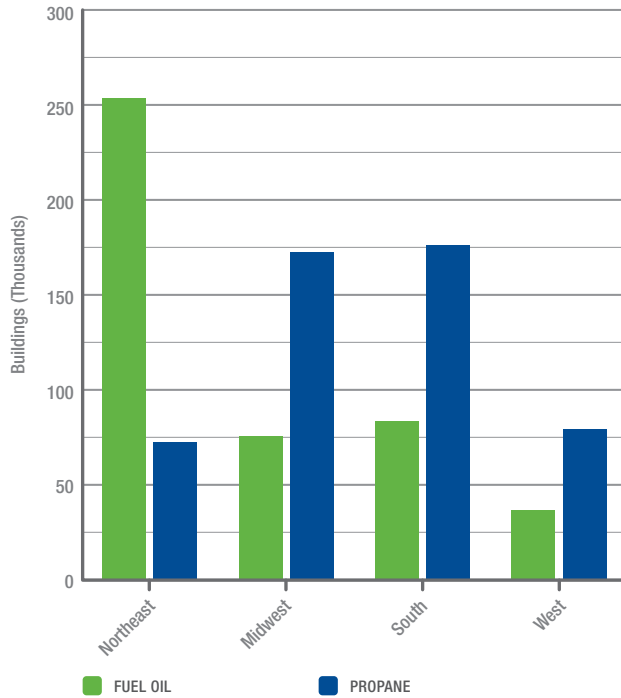
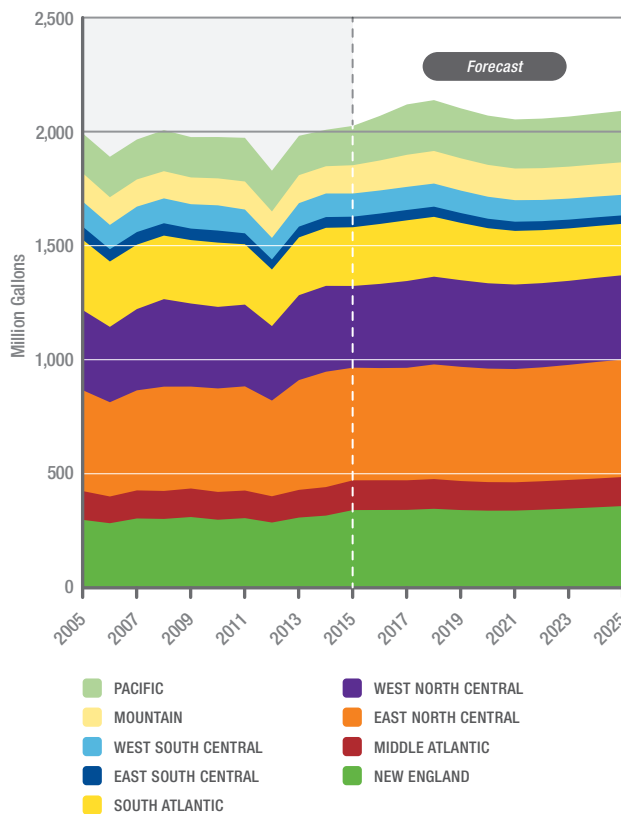


Fig. Q Commercial Propane Demand by Region



### 3.3

## Internal Combustion Engine Outlook

The internal combustion engine market offers long term potential for significant growth in propane sales. ICF is projecting propane sales in this market to increase from about 640 million gallons in 2014 to about 1.7 billion gallons by 2025.

### On-Road Vehicles

Propane provides a viable alternative to gasoline and diesel fuel in the on-road vehicle market, and has significant environmental advantages relative to both conventional fuels. In addition, delivered propane prices to large fleet customers are expected to result in significant fuel cost savings relative to gasoline and diesel-fueled fleets.

For the past few years, propane vehicle sales have been constrained by the limited number of new propane vehicles and certified aftermarket vehicle conversion systems available to the market. However, investments by PERC, ROUSH CleanTech, Blue Bird, CleanFUEL USA, Alliance Autogas, Thomas Built Bus, IC Bus, Freightliner Custom Chassis and others have led to the introduction of a number of new propane-powered vehicles and engines. Industry partnerships with additional original equipment manufacturers (OEMs), including the existing PERC partnership with Freightliner Custom Chassis, have the potential to rapidly expand the number of vehicles and engines available to the market in the longer term.

The introduction of new propane-powered vehicles is expected to generate a near term increase in propane sales in this market. Propane school bus sales are expected to account for about 10 percent of the total school bus sales market in 2015, and propane vehicles are making significant gains in other fleet vehicle markets as well, such as box trucks and shuttle vans.

However, the propane industry will need to overcome significant market hurdles to maximize sales in this sector. In the past, much of the alternative fuel market has been driven by customer preferences to be seen as “green,” as well as the need to comply with alternative fuel requirements and objectives rather than for cost or performance reasons. In addition, much of the alternative fuel market has been sustained by fuel and refueling infrastructure tax incentives.

Fig. R Internal Combustion Engine Propane Consumption

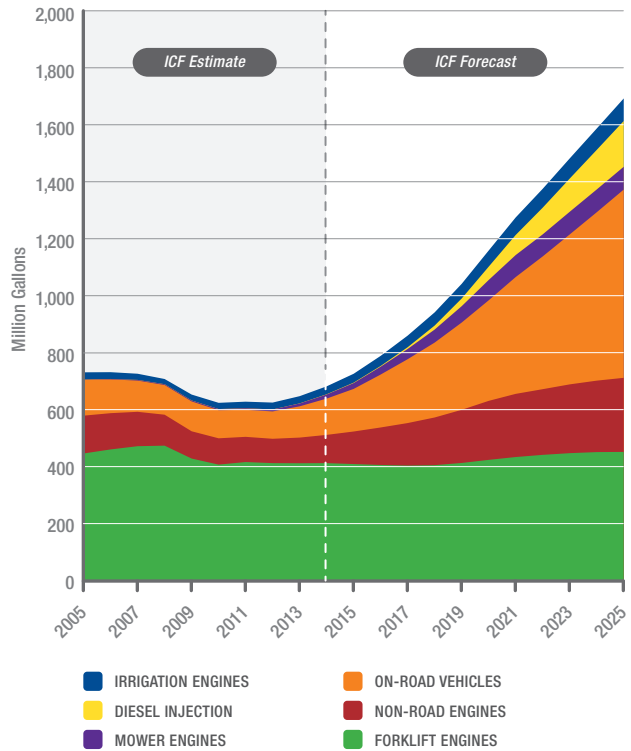
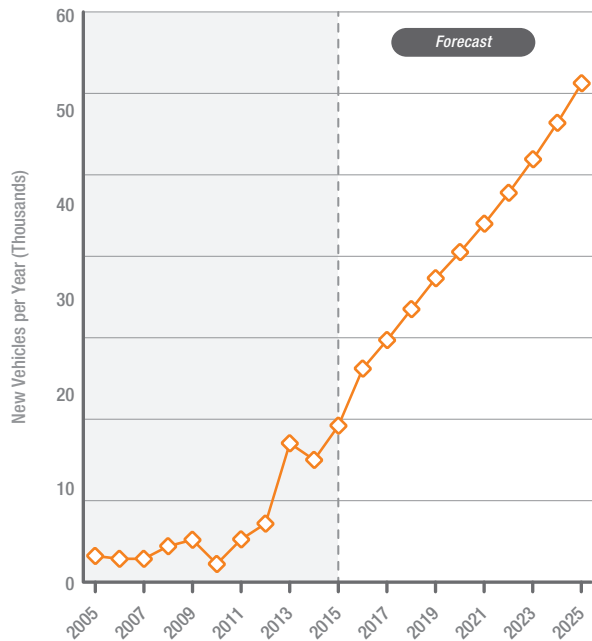


Fig. S ICF Forecast of On-Road Propane Vehicle Sales





More recently, the growth in propane vehicle sales has been driven by the difference between propane and gasoline/diesel fuel prices in vehicle fleet applications. Fuel cost savings enable propane vehicles to make sense on a straight economic basis in most small to mid-size fleet applications, including school buses, shuttles and taxis, delivery vehicle fleets, law enforcement fleets, and other fleet vehicle applications where vehicles are based at a single location. The recent decline in oil prices has reduced the fuel cost savings associated with propane, but has not eliminated the Total Cost of Ownership economic benefits associated with converting to propane vehicles.

### PROJECTED PROPANE ON-ROAD VEHICLE SALES

ICF estimates that about 12,900 new propane vehicles were sold or converted in 2014. ICF is projecting total propane vehicle sales and conversions to increase to 52,000 per year by 2025.

The growth in new propane vehicle sales is expected to be split 40% light duty and 60% medium duty. Most of the medium duty vehicles are expected to be OEM vehicles, while most of light duty vehicles are expected to be conversions.

To accelerate penetration of propane into the on-road vehicle market, the industry needs to encourage the long term extension of tax credits on equipment capital and fuel costs. At the end of 2014, Congress retroactively extended these tax credits through December 31, 2014, and Congress may further extend the tax credits to cover 2015. However, a longer term extension would stimulate propane vehicle sales by providing additional certainty that tax credits would continue. Additional efforts should focus on educating consumers on the economic and environmental benefits of propane vehicles, reducing the regulatory burden for small, low-volume manufacturers and converters, and ensuring recognition of propane's environmental and energy security benefits in the national energy policy debate.



## Forklifts

The forklift market represents about five percent of total odorized propane sales. Propane sales in this market have been declining since the start of the recession in 2007, and are expected to continue to decline through about 2017. ICF is projecting modest growth in propane sales in the forklift market beginning in about 2018 when a new generation of propane forklifts is expected to reach the market.

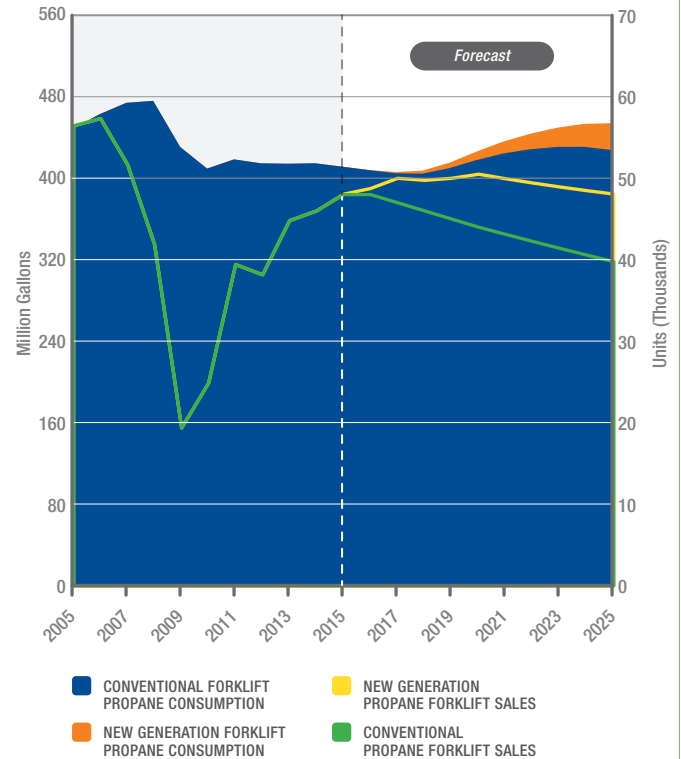
The recent recession caused a substantial decline in the overall size of the forklift market. In addition, the combination of propane fuel price increases, improvements in battery and electric motor technology, and changes in forklift markets have resulted in a loss of propane market share to electricity. Before the recession, propane forklifts represented more than 60 percent of the market for class four and five lift trucks. By 2013, the propane share had fallen to less than 50 percent.

Since bottoming out in 2009 and 2010 during the recession, the demand for new forklift trucks has been experiencing healthy growth. Total shipments from U.S. manufacturers increased by more than 75 percent between 2010 and 2014, while shipments of propane lift trucks and other internal combustion (gasoline and diesel) forklift trucks more than doubled during the same period. While this increase represents a turning point in new propane forklift sales, retirements of existing propane units are still expected to exceed the sale of new propane units through 2017.

Electric lift trucks represent the primary threat to propane in this market. The electric battery, battery charger, and motor technologies used by electric lift trucks have continued to improve over time. In addition, the structure of the forklift market is shifting toward warehousing where electric lift trucks have been preferred to internal combustion lift trucks due to smaller vehicle footprints, as well as noise, emissions, and operator ergonomic concerns. The trend toward additional automation in warehousing operations also favors electric lift trucks.

At the same time, the increased availability of larger propane engines provides an opportunity to increase propane market share in the heavy duty and outdoor forklift market.

Fig. 1  
T Forklift Propane Consumption



The recent declines in oil prices should help slow the loss of propane forklift truck market share to electricity. However, development of a competitively priced new generation of propane forklift equipment with lower operating costs and better emissions and operator ergonomic characteristics than the currently available models will be necessary to avoid a slow decline in propane sales to the forklift market of the future.

## Other Non-Road Engines

The non-road engine market provides substantial growth opportunities for the propane industry, although cost, regulatory, and market structure issues must be resolved to reach this market's full potential. Based on technology available today, three applications are especially promising:

**Commercial Lawn Mowers:** The commercial propane mower market has the potential to generate significant growth in propane demand, possibly rivaling propane forklifts as the largest market for propane engines. Currently, there are about one million commercial lawn mowers in service, with the potential to consume more

than one billion gallons of propane. 17 OEMs have already brought propane mowers into the market.

Propane mowers burn cleaner, result in fewer emissions over competing gasoline-fired equipment, and should have a longer effective equipment life and be less costly to maintain. In most regions, fuel costs are also likely to be lower with propane. However, currently available propane mowers cost considerably more to purchase than comparable gasoline equipment. In addition, there is usually a structural cost to commercial customers of switching from gasoline to propane. Switching requires changes in refueling and servicing practices, as well as employee and service personnel training practices. Maintaining a fleet using two different fuels at the same time also increases costs, while the cost of replacing an entire fleet of mowers at one time is likely to be prohibitive to many potential customers.

As a result, the distribution and servicing structure for propane mowers has developed at a slower pace than the technologies themselves, and the OEMs are not aggressively promoting the available propane models. To address these market issues, the propane industry will need to take a bigger role in marketing, supporting and, potentially, financing the propane mower market if the propane sales growth potential available is to be achieved.

PERC estimates that there are more than 20,000 propane mowers in service in 2014, with about 4,000 new units sold in 2014. ICF is projecting new unit sales to reach 24,000 per year by 2025.

**Irrigation Pumps:** Irrigation pumps provide a high-volume, high-load factor market for propane. While the number of propane pumps in use declined between 2000 and 2008, this trend appears to be reversing. According to the most recent Census of Agriculture, in 2013, 6,204 farms operated more than 13,444 propane irrigation engines, up from 4,960 farms with 12,203 propane irrigation engines reported in 2008.

PERC has made a significant investment in developing new propane irrigation engines. The new propane engines becoming available in this market are substantially cleaner and more efficient than the previous generation of irrigation engines. The major irrigation markets in the Midwest have access to relatively low cost propane, providing the potential for significant cost advantages relative to diesel fuel and gasoline.

Environmental advantages of the new generation of propane engines should also stimulate growth in markets in California and the western states.

**Generators:** The next generation of propane generators has the potential to turn backup, portable, and remote power generation into a major source of propane sales. Kohler, Generac, and other manufacturers are bringing a variety of propane-fueled generators into the market in the next two years. These units should be quieter, cleaner, and have lower maintenance costs relative to competing gasoline and diesel fuel options, and appear likely to be offered at similar price points. These units should be competitive in the backup power generation market, and could be used for electricity peak shaving in some markets with particularly high time-of-use electricity rates. In addition, the propane industry appears well situated to generate significant new propane sales in the towable generator market due to increased costs of diesel generation associated with new emissions regulations on diesel engines.

## Diesel Fuel Displacement

Increases in diesel engine costs necessary to meet more stringent environmental regulations provide the propane industry with a major opportunity to displace diesel fuel use in a wide variety of different applications. The potential size of these markets is astounding. Current diesel fuel consumption in the U.S. is the equivalent of 80 billion gallons of propane.

The propane industry has a number of applications available today capable of competing with diesel engines, including several among propane vehicles, propane irrigation engines, and portable power generation applications. Other applications including diesel co-injection technologies are nearing market availability. Identifying the most attractive markets and applications, and developing the applications needed to serve these markets, will be an important step in growing propane markets in the next few years.

## 4. Regional Propane Markets

The outlook for propane markets differs widely by region based on a variety of factors, including differences in weather, types of available markets such as grain drying, irrigation, and mowing, differences in residential housing growth, natural gas market penetration, propane supply and transportation infrastructure, and other factors. This section provides a brief overview of the regional differences in propane markets based on the regions shown in Figure U.

### 4.1

#### New England and the Mid-Atlantic

The New England and Mid-Atlantic regions include Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, and West Virginia. While consumer propane demand in these regions is dependent on weather, propane demand in these regions has been increasing. Fuel oil conversions and propane market share in new residential construction have led to an increase in the number of residential space heating customers of 18 percent between 2005 and 2014.

#### Demand Outlook

ICF is projecting significant growth in propane demand in the New England and Middle Atlantic regions through 2025 due to significant opportunities in traditional residential and commercial markets, including new construction and fuel switching from fuel oil to propane, as well as growth in engine fuel markets.

The fuel oil market is largely concentrated in the New England and Middle Atlantic regions, where fuel oil holds a significant share of the residential and commercial markets. However, fuel oil customers are rapidly converting to alternative fuels due to the relatively high cost and environmental concerns associated with fuel oil. The fuel oil new construction market has essentially

disappeared. Currently, propane is capturing the majority of new residential construction located off the natural gas mains, as well as fuel oil conversions in buildings without access to natural gas.

The major market threat in this region through 2025 is expected to be the expansion of the natural gas distribution system.

#### Supply and Infrastructure

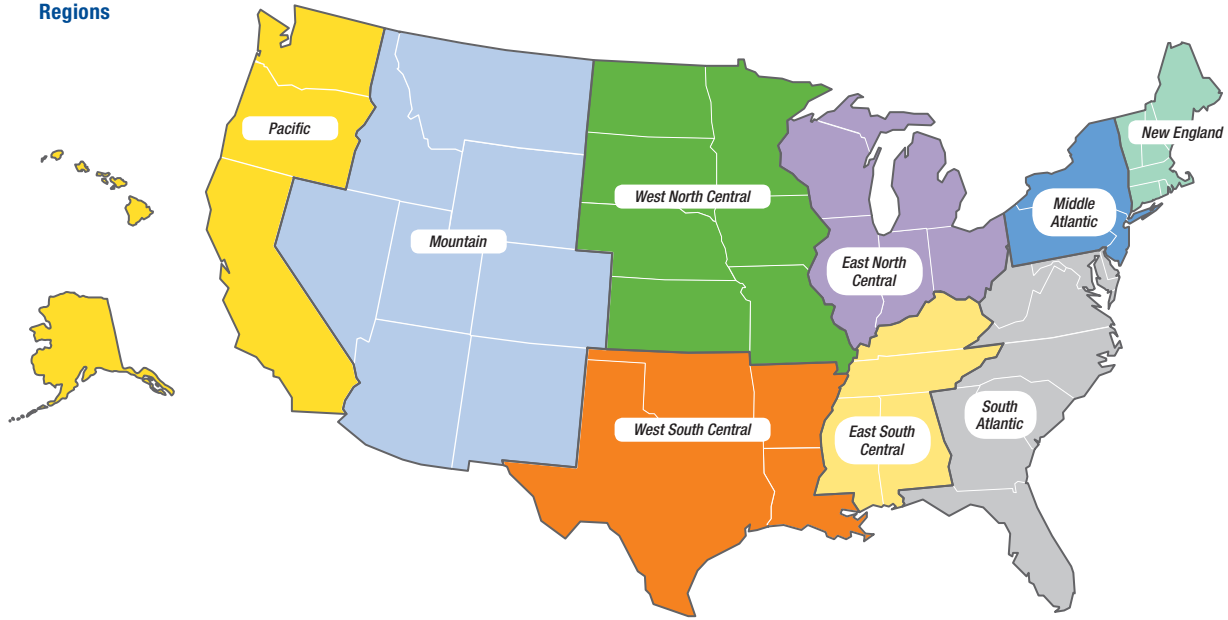
The Northeast faces both significant benefits and challenges associated with recent changes in propane production. Propane production in the nearby Marcellus and Utica basins is rapidly increasing the availability of regional supply, reducing both the need for and the availability of imports into the region.

The growth in regional supply is expected to lead to a fairly significant decrease in propane prices in the region on an annual average basis. However, the growth in production is also expected to reduce the availability of peak period propane deliverability into the region. Pipeline capacity into the region is being reduced due to the need for capacity to export natural gas liquids from the Marcellus and Utica basins back to markets in the Gulf Coast. Waterborne imports are also declining. As a result, the region is growing increasingly reliant on rail for propane deliveries.

Fig.

U

Regions



Given the increased reliance on rail, ICF anticipates the potential for significant future supply challenges during peak periods in colder than normal winters when rail shipments may be delayed, or winters where temperatures in Europe are colder than normal. These conditions would lead to greater exports from the facility at Marcus Hook, and limiting available supplies in the region.

The region also faces potential issues related to the lack of storage facilities. The loss of the Toddhunter facility in Ohio in 2012 reduced regional supply flexibility, and development of new storage fields in the region has faced significant obstacles. For example, the Cresswell Finger Lakes storage facility in upstate New York would provide significant supply reliability and cost benefits to the region if developed, but faces continuing public opposition.

4.2

West South Central Region

The West South Central region includes Texas, Oklahoma, Arkansas and Louisiana. Consumer propane demand in this region has been falling steadily as propane space heated households have converted to electricity. Between 2010 and 2014, the number of residential space heating households in these states declined by about 10 percent.

Fig.

V

New England & Middle Atlantic Demand

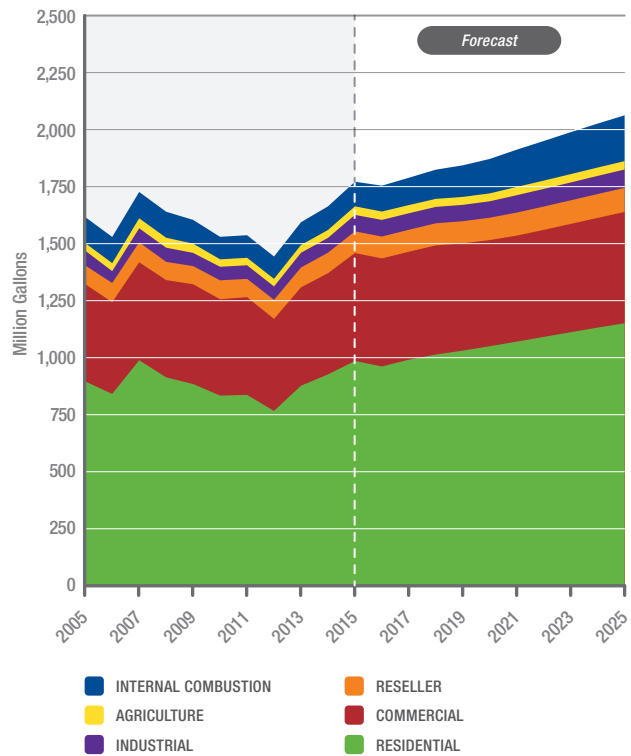
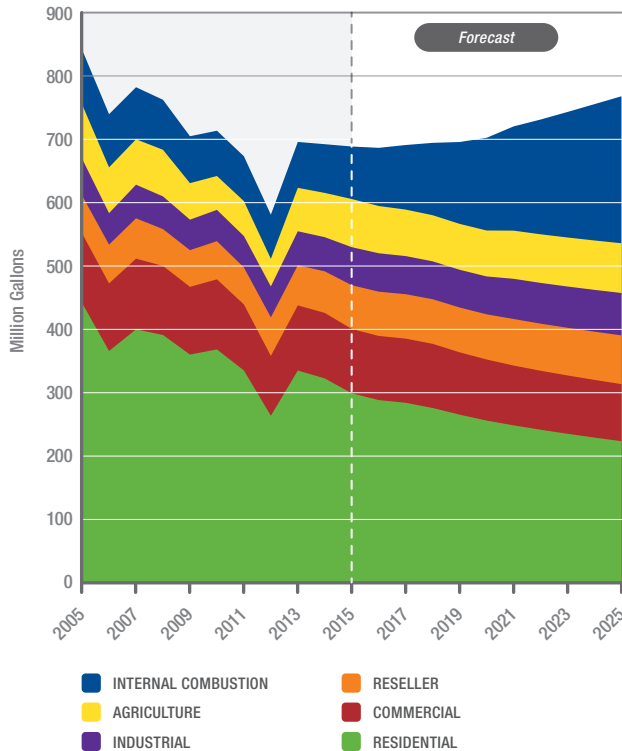


Fig.

**W** West South Central Demand



### Demand Outlook

Consumer propane demand in the West South Central (see Figure W) is expected to grow slowly through 2025, as rapid growth in engine fuel markets more than offsets continuing losses in residential and commercial markets stemming from the continuing shift away from propane space heating to electricity. While lower propane prices are expected to slow space heating customer losses, these losses will continue to erode sales in traditional propane markets in this region.

### Supply and Infrastructure

Most of the propane consumed in the West South Central region is sourced from local production, or from the Mont Belvieu complex in Texas. Mont Belvieu, located near the Gulf Coast of Texas, is the largest propane market center in the world, and includes about 35 percent of the total active primary storage capacity in the U.S.

The liquids transport infrastructure along the Gulf Coast is undergoing a dramatic reorientation to bring additional propane and natural gas liquids from producing regions

in the Northeast (Marcellus and Utica) and the Midwest (Bakken) to the Gulf Coast. Pipelines originally designed to move product from Mont Belvieu out towards the consuming regions are being reversed to direct both purity and raw NGL mix towards Mont Belvieu and the vicinity. The growth in export capacity as well as in the U.S. petrochemical industry are the primary drivers behind this shift.

## 4.3 West North Central Region

The West North Central region includes North Dakota, South Dakota, Nebraska, Kansas, Iowa, Minnesota, and Missouri. Demand in this region tends to be very volatile from year to year due to changes in weather and grain drying demand, however overall demand generally has been declining. Between 2010 and 2014, the number of residential space heating households in these states declined by about 2 percent.

### Demand Outlook

Demand in the West North Central region tends to be quite volatile due to year to year changes in space heating demand and grain drying demand caused by changes in the weather. While this volatility is expected to continue — and overall demand has been on the declining track since even before 2005 — under normal weather conditions, propane demand in the West North Central Region is expected to remain relatively stable through 2025 (see Figure X).

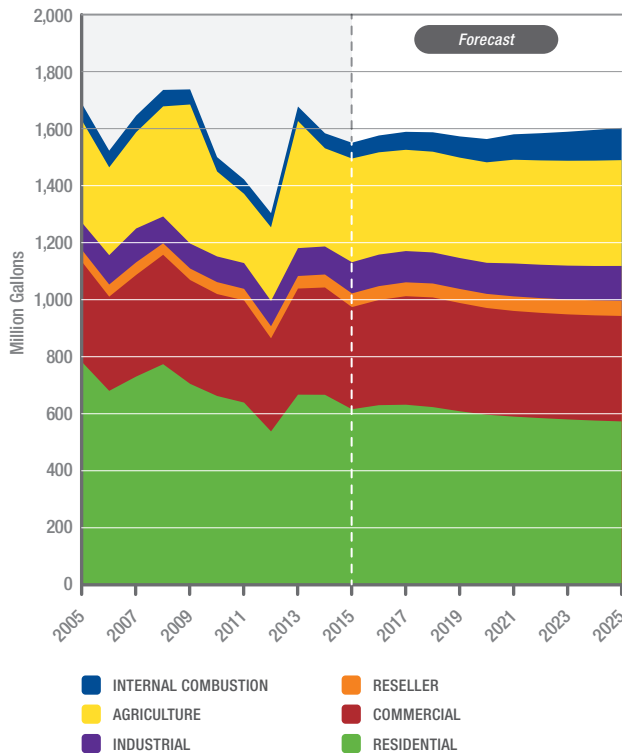
Lower oil and propane prices are expected to improve propane's competitive position in residential and commercial markets in the West North Central. However, continuing customer losses are expected to lead to modest declines in residential and commercial demand between 2014 and 2025. Growth in engine fuel demand is expected to offset the losses in traditional markets.

### Supply and Infrastructure

Propane supply in the West North Central region is sourced primarily from local production, Conway, Kansas via the MAPCO, NuStar and Oneok pipelines, and Canadian imports. Propane supplies in the region are directly affected by two major changes in energy markets. In the past, the Cochin Pipeline has been a major source of propane supply into the region,

Fig.

**X** West North Central Demand



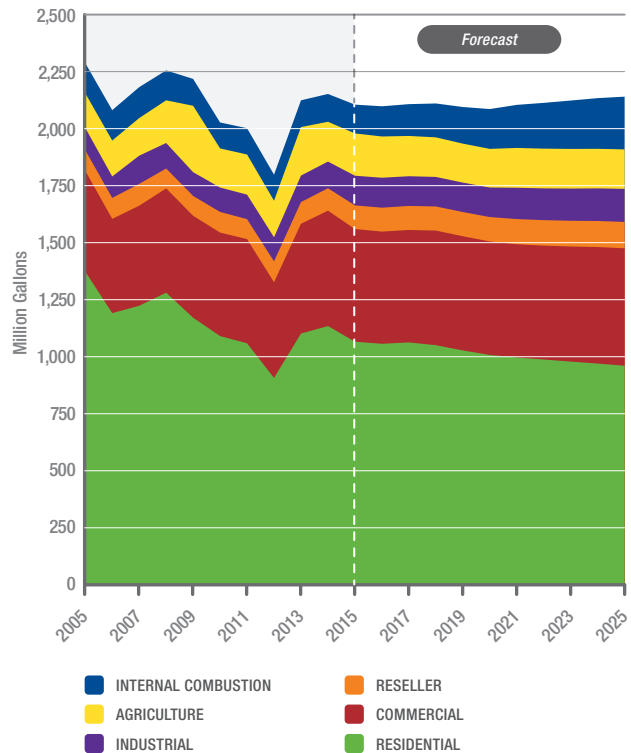
particularly during peak winter periods. The repurposing of the Cochin Pipeline substantially reduces the flexibility of the propane supply infrastructure to meet swings in demand. The loss of the Cochin Pipeline into the region will be offset by growth in propane production from the Bakken, increased rail shipments into the region from Canada, and increased utilization of the MAPCO pipeline system. The growth in supply should be sufficient to meet normal supply requirements. However, these supply options do not provide the flexibility lost with repurposing the Cochin Pipeline, making the region more vulnerable to supply disruptions and price volatility during unanticipated peaks in demand from grain drying load and colder than anticipated winter weather.

#### 4.4 East North Central Region

The East North Central region includes Wisconsin, Illinois, Michigan, Indiana, and Ohio. Demand in this region tends to be very volatile from year to year due to changes in weather and grain drying demand, however overall demand generally has been declining. Between

Fig.

**Y** East North Central Demand



2010 and 2014, the number of residential space heating households in these states declined by about 3 percent.

#### Demand Outlook

Lower oil and propane prices are expected to improve propane's competitive position in residential and commercial markets in these regions, leading to a rebound in propane market share, and a reduction in space heating customer losses to geothermal heat pumps and natural gas.

Overall, ICF is projecting a modest decline in residential and commercial propane demand through 2025. When combined with growth in engine fuel markets, the overall consumer propane market is expected to grow by about one percent per year in this region.

#### Supply and Infrastructure

The East North Central Region relies on several different supply sources. Supply into Wisconsin at the western end of the region has been impacted by the repurposing of the Cochin Pipeline, and the supply flexibility provided

by the Cochin will not be replaced by other supply options, leading to potential increases in supply and price volatility in the state. Supply in Michigan and Illinois includes significant local refinery production and access to storage in Michigan and Ontario. Supply in Ohio and Indiana has been impacted by the changes in the TEPPCO pipeline system. However, Marcellus and Utica production in Eastern Ohio and Pennsylvania is displacing flows on the TEPPCO pipeline system into the eastern states within this region. While there may be a loss of supply flexibility in the eastern half of the region due to the decrease in available propane storage, the overall increase in local propane supply should reduce average propane prices in this region, benefiting consumers.

## 4.5

### South Atlantic and East South Central Regions

The South Atlantic and East South Central regions include Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, and Mississippi. Residential and commercial demand in this region has been declining due to a steady loss in the number of propane space heating customers, primarily to electricity. Between 2010 and 2014, the number of residential propane space heating customers in these states declined by more than 11 percent.

#### Demand Outlook

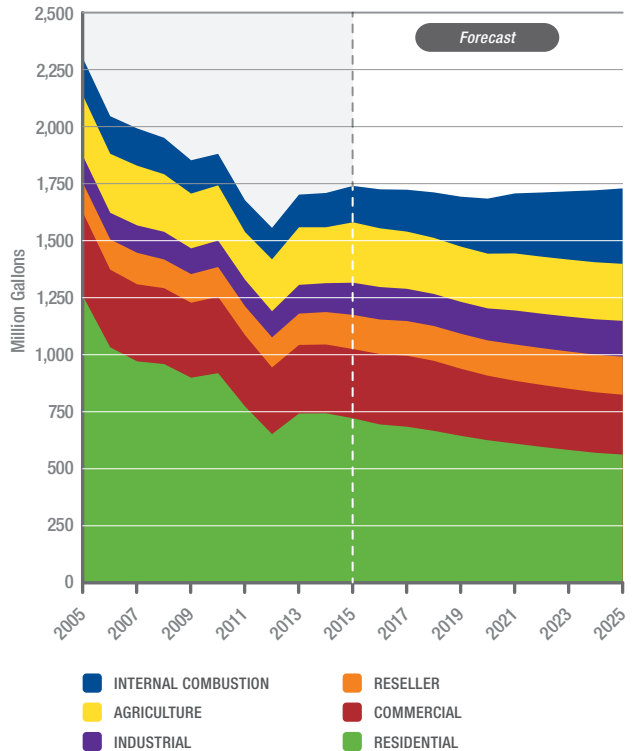
Propane demand in these regions is expected to remain stable through 2025 as continuing losses in residential and commercial demand offset the rapid growth in engine fuel demand. The losses in the residential and commercial sector reflect a continuing decline in the number of space heating customers as electricity and natural gas continue to take propane market share, as well as continuing improvements in energy efficiency.

#### Supply and Infrastructure

Propane supply into these regions is sourced primarily at Mont Belvieu and then delivered to regional markets via the Dixie Pipeline and the TEPPCO Pipeline. There is also growing production from the Marcellus and Utica Basins. While overall propane supply availability in these regions is expected to increase due to the growth in Marcellus and Utica production, general infrastructure constraints may lead to supply issues during peak periods in certain markets.

Fig.

Z South Atlantic & East South Central Demand



## 4.6

### Mountain Region

The Mountain region includes Idaho, Utah, Colorado, Montana, Wyoming, Nevada, New Mexico and Arizona. Demand in this region has been declining due to loss of propane space heating market share to electricity and natural gas. Between 2005 and 2014, the number of residential space heating households in these states declined by about 5 percent.

#### Demand Outlook

Propane demand in the Mountain region is projected to increase by about two percent per year on a normal weather basis through 2025 as engine fuel markets expand rapidly and residential and commercial markets remain stable or experience modest growth.

#### Supply and Infrastructure

Propane supply in the Mountain region is expected to become more robust over time as growth in propane production in the Bakken and in West Texas continues, and as the Magnum storage field in Arizona continues to develop as a propane supply hub for the region.



## 4.7

### Pacific Region

The Pacific region includes California, Oregon, Washington, Hawaii, and Alaska. Recently, demand in this region has been declining primarily due to improvements in propane efficiency. The number of space heating households in this region declined steadily through 2010. However, since 2010, the number of residential space heating households in these states has been relatively stable.

#### Demand Outlook

With the exception of Hawaii, ICF is projecting growth in propane demand in the Pacific region of almost two percent per year through 2025 due primarily to rapid growth in engine fuel markets. The number of residential and commercial customers in the region is expected to increase modestly as lower propane prices stimulate growth in propane market share via new construction through 2025, and slow conversions away from propane to electricity and natural gas. However, the impact on propane demand of the customer growth is expected to be offset by improvements in efficiency.

#### Supply and Infrastructure

Most of the propane supplied in the Pacific region is produced in refineries in California and Washington, or imported into the region by rail. There are currently no major pipelines transporting propane in the region. Growth in propane production in Alberta and from the Bakken is creating significant interest in development of new propane export facilities from the region, with announced projects on both the Washington (Longview) and Oregon (Portland) sides of the Columbia River. The growth in exports should increase the supply infrastructure into the region, although the lack of regional storage centers is expected to lead to an increase in propane rail shipments contracted for delivery into international markets without substantially improving supply availability and flexibility for consumer markets in the region. Overall, regional propane prices should decline somewhat relative to Mont Belvieu.

Hawaii is expected to see continuing competition from renewable resources (solar). In addition, changes in the refinery infrastructure in Hawaii may reduce propane production and stimulate additional imports of LNG, which may displace propane in some markets.

Fig. AA Mountain Demand

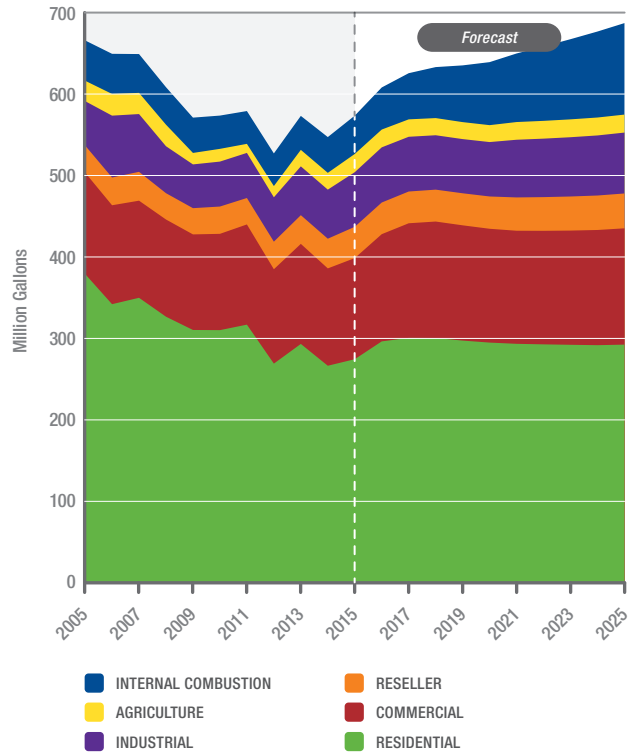
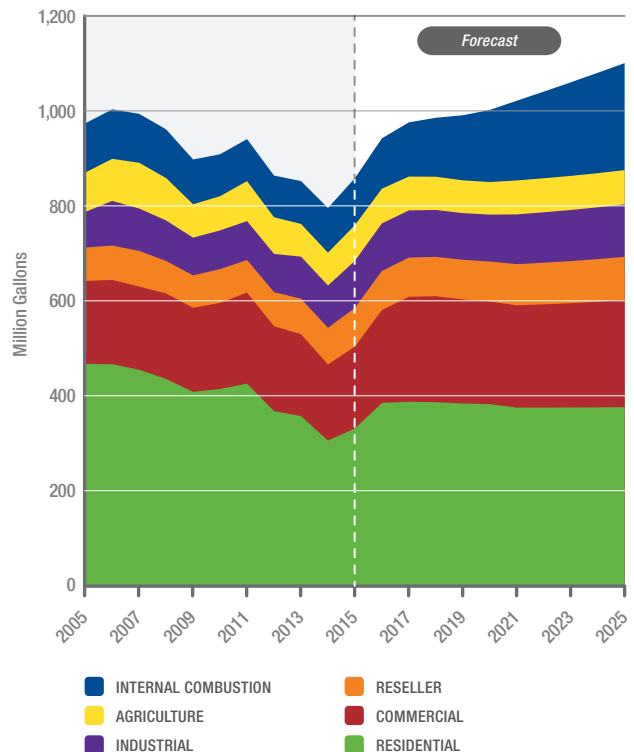


Fig. AB Pacific Demand



## 5. Key Propane Industry Challenges and Opportunities

Achieving future sustained growth of propane sales will depend on the industry's success in responding to the leading market challenges and opportunities likely to be faced in the next few years. Key propane industry challenges and opportunities include:

- Ensuring supply reliability.
- Maintaining current markets.
- Understanding and taking advantage of regional market segmentation.
- Capitalizing on the propane price advantage.
- Participating in the national energy and environmental policy dialogue and regulatory process.

### 5.1

#### Ensuring Supply Reliability in an Infrastructure Constrained Market

The growth in propane production in the U.S. is expected to provide significant benefits to U.S. consumers in the form of lower annual average propane prices across all markets. However, the changes in production and demand patterns for natural gas, NGLs including propane, and other liquids is leading to infrastructure constraints in several regions of the country. The flexibility of the existing storage and

transportation system to meet unexpected and peak winter supply requirements has been substantially reduced. Propane marketers, particularly in the Midwest and Northeast, will be less able to count on the availability of excess pipeline and storage capacity to help meet unexpected changes in propane requirements.

While the market is likely to support development of new storage facilities, such as the Crestwood Finger Lakes facility in Upstate New York and the Magnum storage facility in Arizona, the public opposition to the Finger Lakes proposal illustrates the difficulty in developing this type of new infrastructure. In addition, it is unlikely that new pipeline capacity will be built to support peak period propane demand. New capacity to meet peak period demand would be used on only a few days each year, and would not be needed during warmer than normal winters, making it difficult for propane marketers to support the new contract commitments required to build new pipelines.

As a result, ICF believes that propane markets will need to develop new propane supply practices to ensure supply reliability in an infrastructure-constrained market. These practices will differ by company but could include additions to local storage capacity, increases in the percentage of supply purchased on a firm basis, additions of long haul truck transport capacity, additional commitments for rail transport, increased reliance on

price and supply hedging arrangements, growth in summer load to reduce the seasonality of load, and other practices designed to reduce supply risk and uncertainty.

## 5.2

### Maintaining Current Markets

Maintaining current market share in the residential and commercial sectors will remain one of the biggest challenges facing the propane industry through the end of this decade. The residential and commercial sectors currently account for more than 70 percent of total consumer propane sales. These sectors offer a variety of growth opportunities, both in increasing market share for existing applications — including conversion of heating oil applications to propane and in commercialization of new technologies such as residential tankless water heaters, portable and backup generators — and commercial propane-fired heat pumps and CHP units. However, the threats to these markets remain formidable:

- Propane use per customer has fallen substantially and is expected to continue to decline due to improvements in building and equipment efficiency.
- Electric heat pump technology is becoming more efficient and economical and is likely to continue to erode propane heating market share in many regions.
- Since 2000, the propane industry has lost more than 350,000 manufactured home customers due to the overall collapse of the manufactured home market and to electricity inroads into new units. This trend is expected to continue.
- Growth in natural gas supply is leading to lower natural gas prices and expansions in natural gas distribution systems that lead to conversions of existing propane customers to natural gas.

Given the expected improvements in electric heating technology, and the expected promotion of electricity as a “green” energy source by the electric power industry, maintaining existing propane customers is likely to remain challenging in many markets.

Preserving the current customer base will require an aggressive and coordinated effort by the propane industry. The major propane applications in these sectors have significant non-cost advantages over competing fuels and technologies: warmer heat output

and the convenience of gas add value for customers. The propane industry will need to emphasize this value proposition to capture high-opportunity markets and offset inevitable losses in markets that are driven entirely by cost rather than value.

The recent decline in propane prices provides the industry with a window of opportunity to effectively address these issues and to regain some of the market lost due to higher propane prices in the last five years.

## 5.3

### Understanding and Taking Advantage of Regional Market Segmentation

Market threats and opportunities facing the propane industry differ by region and location. The map below shows the wide distribution of propane residential heating customers. With the exception of the West Coast and the South, where electricity holds most of the market, and New England where fuel oil has the highest share of the residential heating market, propane has more than 10 percent of the residential space heating market in most counties. However, the distribution varies widely depending on climate, energy prices, and availability of natural gas.

Even within specific geographic regions, there can be widely varying differences in weather patterns, customer lifestyles, electricity prices, and competition from other technologies and fuels. While many of the regional differences are concentrated in the residential and commercial sectors, differences in state regulations and electricity prices also affect propane in other demand sectors. Hence, propane industry marketing strategies that can be tailored to specific regional conditions and requirements will be more successful than a one-size-fits-all national approach.

In the residential sector, regions with significant propane market share and significant residential new construction are likely to provide the majority of new opportunities for propane. The map below illustrates where these areas are located. While there is good market opportunity for propane in many counties around the country, the majority of high growth markets where propane is likely to capture a significant share of the new construction are located in the Northeast, Upper Midwest, and Rocky Mountain regions.

Fig.

**AC**

**Propane Space Heating Market Share in 2014**

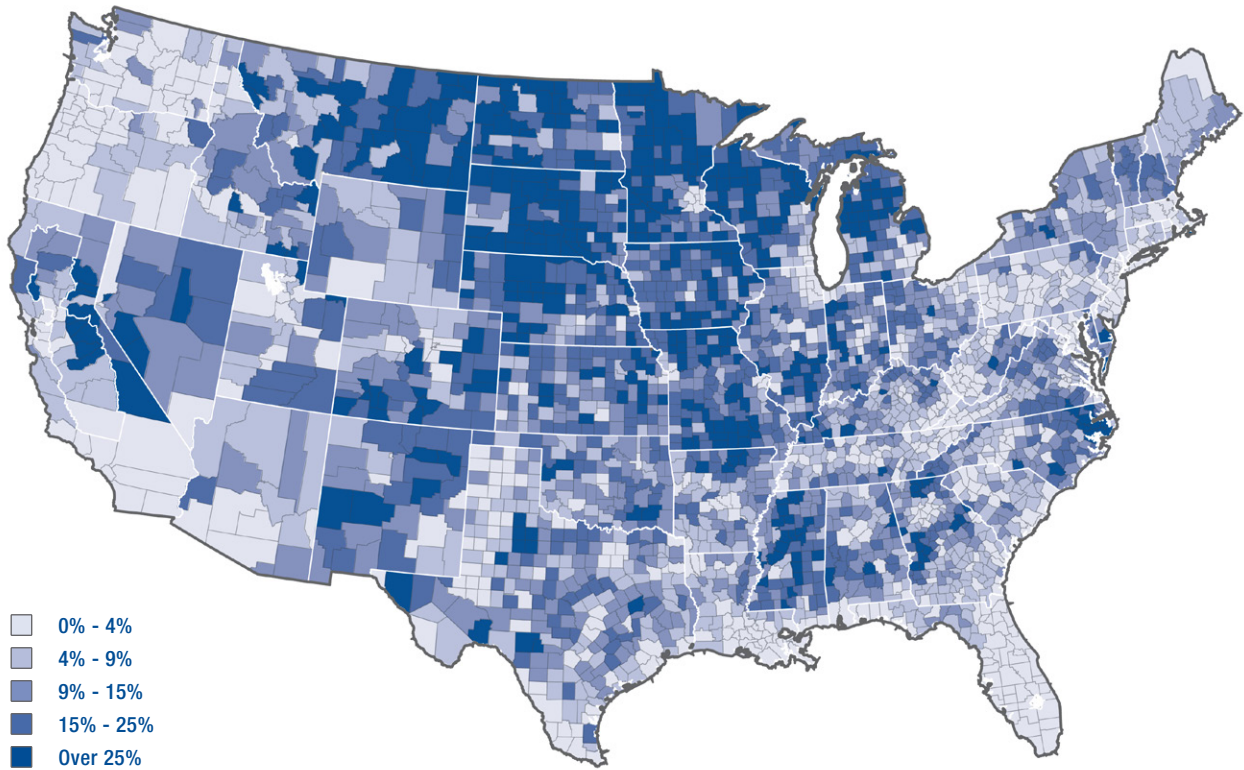
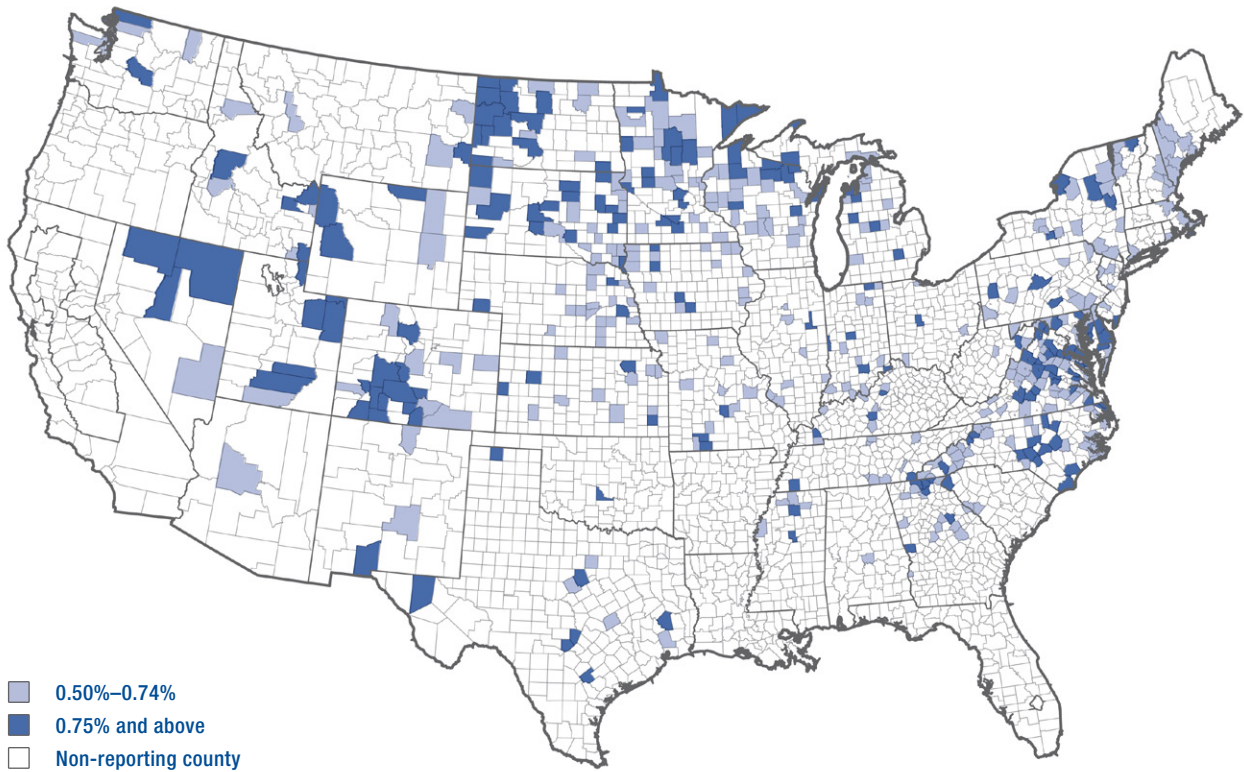


Fig.

**AD**

**Counties with More Than 10% Residential Propane + Heating Oil Market Share and Above Average New Housing Construction Activity**



## 5.4

### Maximizing the Opportunities Created by the Propane Price Advantage

Propane currently has a price advantage over gasoline and diesel fuel in most high fuel volume engine fuel markets, including vehicle fleets, irrigation engines and other applications. However, it is not clear that potential customers will recognize propane's operating cost advantage in heating and engine fuel applications. Encouraging current oil heating customers to invest in new, more efficient propane furnaces will require the propane industry to make a compelling case for long term consumer benefits. Inducing customers to switch fuels may also require facilitating equipment conversions with up-front financing, as well as other steps to simplify the process. Likewise, in the internal combustion engine market, consumers may not be familiar with the new, more efficient generation of propane engines in non-road applications, and may have had only limited exposure to on-road propane vehicles.

Recent declines in propane prices relative to electricity have also made propane more competitive in other traditional markets as well, creating opportunities to slow or reverse losses in traditional markets. However, changing consumer behavior in response to the improved price environment will require significant efforts to educate consumers about changes in the markets. The elimination of the Department of Commerce restrictions on PERC activities allows PERC to increase consumer education efforts in these areas.

## 5.5

### Leveraging the Environmental and Energy Security Benefits of Propane

Propane is a cleaner-burning, lower-carbon fossil fuel than other petroleum-based products such as distillate fuel oil, kerosene, and gasoline. Propane is also a domestically produced fuel and use of propane helps improve U.S. energy security. In contrast to natural gas, where the principal component is methane - a greenhouse gas itself - propane has a near-zero direct global warming potential, making it a preferred fuel over natural gas in some applications.

PERC and its partners are developing technologies and products that build on propane's emissions and supply benefits in applications such as distributed generation,

agriculture, and transportation. However, these benefits and applications are not widely recognized by decision-makers involved in the current national energy and environmental policy debate. Federal and state policy decisions, along with the resulting tax policies and regulations on energy use, are going to play a significant role in either promoting or inhibiting use of propane in a variety of markets. If the benefits of propane are recognized and considered during energy and environmental policy discussions, propane is likely to benefit from the resulting policies and initiatives. But if these benefits are not effectively communicated and recognized, propane is likely to be regulated in the same manner as gasoline and distillate fuel oil, which could considerably limit potential propane market growth.

As a result, the propane industry - through the appropriate national and state trade associations and companies - needs to be actively involved in the federal and state energy and environmental policy dialogue and regulatory process. The industry's companies and appropriate trade associations must engage policymakers in regulatory discussions of specific priority market development targets, such as alternative transportation fuels and distributed generation, to ensure that propane is adequately considered when new energy policies are drafted. This makes it essential for the propane industry to understand the relevant issues and policy options, know the critical stakeholders and their positions, and be seen as an important stakeholder and resource by the organizations and agencies drafting new policies and regulations.

## 6 Final Thoughts

**Profound changes continue to sweep through the North American energy markets in general and propane markets in particular.**

Domestic propane production is expected to continue to grow rapidly over the next ten years due to the expansion of shale gas processing and natural gas liquids production. Much of the growth in production will be exported or used as feedstocks in new petrochemical facilities. Propane prices may increase relative to crude oil in the short term as new propane export capacity and PDH facilities come on line. However, the rapid growth in domestic propane production is expected to lead to a slow decrease in domestic propane prices relative to crude oil. ICF projects the ceiling on domestic propane prices will be set at the world price of propane minus transportation costs to international markets, rather than the world price of propane plus transportation costs that set the floor on domestic propane prices during the periods when the U.S. was a major propane importer. ICF expects propane prices to remain very competitive relative to diesel and gasoline, which should continue to position propane as an attractive alternative to conventional transportation fuels.

Existing propane markets continue to face competition from electricity and natural gas, and sales per customer in many traditional propane markets are projected to continue to decline due to improvements in energy efficiency.

Yet the propane industry also has numerous positive opportunities over the next decade to grow demand. Propane engine fuel markets are expected to continue to grow, and propane will continue to capture market share from fuel oil in residential and commercial markets despite a decline in the competitive price advantage between propane and other petroleum fuels (gasoline, diesel, and fuel oil).

The recent decline in propane prices makes propane more competitive relative to electricity and natural gas, and provides opportunities to regain market share lost in the last few years due to higher prices.

In addition, the increase in domestic propane production from NGLs provides the propane industry with the opportunity to brand itself as a clean, domestic, and secure energy source. The fuel's clean-burning and "100 percent domestic" production profile should provide further impetus to its expanding role in America's fuel mix.

Taking advantage of the market opportunities and minimizing the impact of the market threats will require concerted action by the industry as a whole, including investments in new technologies and new business models.

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