Propane Conversion Strategies

Energy Alternatives for Minnesota Users of Propane Gas

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Executive Summary

This report presents options the Legislature may wish to consider in order to help Minnesotans reduce their dependence on propane, which can be an expensive and price-volatile fuel, as the 2013-14 heating season demonstrated. Alternatives including converting from propane to other heating sources, adding supplemental heating sources that would reduce but not entirely replace propane usage, and energy conservation. There is no single solution to delivered fuel challenges; determining the best energy alternative is a site-by-site decision, depending on geography, the type of customer, individual preference, and many other factors. Therefore, this report provides a menu of options.

As with any energy question, using less energy, through conservation measures such as building envelope improvements and more efficient appliances, should be the first consideration. In a few areas of the state that are close to interstate natural gas pipelines and that have relatively high densities of demand, it may be possible to build natural gas distribution systems to areas currently dependent on propane and other delivered fuels, especially with changes in the way these systems are paid for. Most of rural Minnesota, however, does not have sufficient densities of population and energy usage to make natural gas system expansions economical. In these areas, alternative delivered and distributed resources can provide long-term cost savings and more predictable and stable prices.

Aside from helping propane users convert to other fuels, the Legislature could get more propane from the limited budget of the Low Income Heating Energy Assistance Program (LIHEAP) by incorporating a summer fill component.

Option 1: Pre-buy a portion of Energy Assistance propane for low-income households during the summer, when it is typically less expensive, with one of the following strategies:

- Use state funds – or a line of credit with willing distributors – to lock in summer prices. Have propane delivered to qualifying households after October 1, then reimburse state spending with federal Energy Assistance funds.
- Use a one-time state appropriation for energy assistance summer fills, then reserve a portion of federal Energy Assistance funds each subsequent year for summer fills thereafter.
- Fund the Propane Prepurchase Program entirely with state funds.

At the same time, the Legislature may consider the following strategies to help Minnesotans access a number of cost-effective alternatives to propane.

Alternative	Key Barriers	Potential Solution Strategies	
Conservation	Up-front costs	**Option 2**	**Create a Rural Heating Conservation Program** to provide conservation rebates for propane users, similar to what is available for natural gas utility customers.
		Option 3	**Provide additional state funding to the Weatherization Assistance Program** for low-income households.
Natural gas system expansions	System costs	**Option 4**	**Allow some or all system expansion costs to be shared across a utility's customer base**, so that existing customers subsidize gas service to new areas.
	Customer costs	**Option 5**	**Create state tax credits toward appliance conversion costs** for customers switching from propane to natural gas.
		Option 6	**Allow building owners to finance their expenses through PACE or a similar mechanism** to convert from propane to natural gas.
Delivered and distributed resources (general)	Up-front costs	**Option 7**	**Provide rebates through a Rural Heating Conservation Program** to help propane users purchase alternative heating equipment.
		Option 8	**Create a Local Energy Infrastructure Loan Program** to support larger-scale projects in facilities like farms, health care centers, and schools.
		Option 9	**Create grants or tax credits for the purchase and installation of alternative heating equipment**.
		Option 10	**Increase access to the existing Renewable Energy Equipment Grant Program**, allowing additional organizations to access these funds.
	Lack of awareness or understanding	**Option 11**	**Provide trainings on installing and maintaining alternative heating systems** to contractors and providers of delivered fuels.
		Option 12	**Establish a state renewable thermal energy goal**.
Solar thermal	Installation costs	**Option 13**	**Reduce soft costs by streamlining permitting** across local jurisdictions.
		Option 14	**Implement "solar ready" building requirements** for new constructions.
Woody biomass	Technical analysis for larger systems	**Option 15**	**Continue to provide state funding for technical assistance and training**, such as through the NextGen Energy Board.
Off-peak electric thermal storage			
District heating and waste heat recovery	Financing gaps	**Option 16**	**Create a state loan fund for district energy and combined heat and power projects**.
		Option 17	**Provide state bonding for district energy systems**.
		Option 18	**Require consideration of combined heat and power in electric utility integrated resource planning**.
		Option 19	**Require utilities to promote combined heat and power through the Conservation Improvement Programs**.
		Option 20	**Include a combined heat and power goal in the Renewable Energy Standard**.

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I. Introduction

This report presents options the Legislature may wish to consider in order to help Minnesotans reduce their dependence on propane, including switching from propane to other heating sources, adding supplemental heating sources that would reduce but not entirely replace propane usage, and energy conservation. There is no single solution to delivered fuel challenges. Therefore, this report provides a menu of options that legislators may consider. These options are not endorsed by the Legislative Energy Commission or its staff.

The report does not address propane supply or storage strategies or review distributor business practices. In addition, this report focuses on those areas in which legislative action may be useful, though many effective solutions are found in other venues.

This report was developed by the staff of the Legislative Energy Commission as requested by Laws of Minnesota 2014, chapter 254, section 25:

LEGISLATIVE ENERGY COMMISSION; PROPANE CONVERSION STRATEGIES.

(a) The Legislative Energy Commission is requested to investigate the feasibility of converting propane gas users to natural gas or other alternative sources of energy. The investigation, among other things, should assess the technical and economic issues for converting nonmetropolitan users of propane gas to pipeline service of natural gas.

(b) The commission is requested to complete its investigations so that any recommendations for legislation are completed by January 15, 2015.

Acknowledgements

In completing this review, the Legislative Energy Commission received input from dozens of leaders in the propane industry, alternative heating industries, state government, research, nonprofits, and other sectors. We thank the many people who contributed. This report would not have been possible without their input.

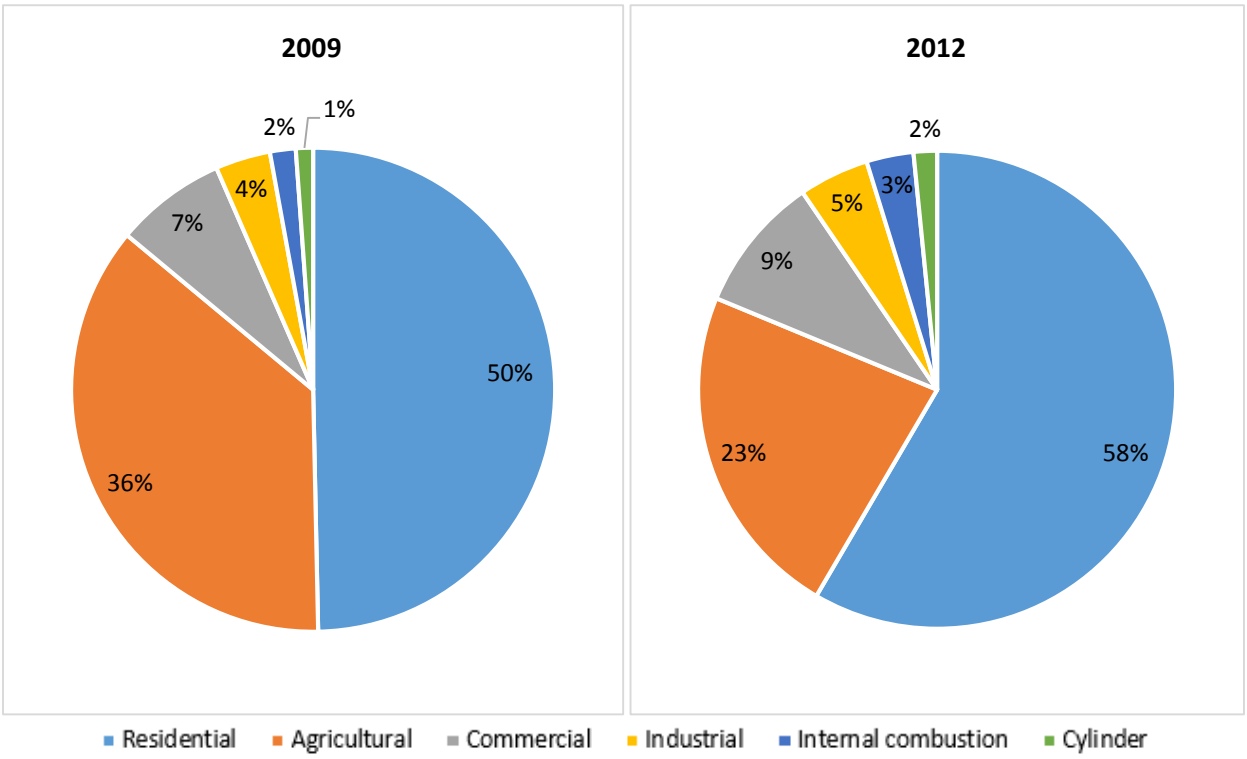
II. Propane in Minnesota

a. Minnesota's Propane Use

Minnesota uses on average about 400 million gallons of propane per year, though this has varied from about 300 to 500 million gallons over the past five years, mainly because of variations in the weather. About three-quarters of the total is used between October and March of each year.[i]

The largest share of propane in Minnesota is used in the residential sector, followed by agriculture.

Figure 1: Minnesota Propane Sales by Sector[ii]

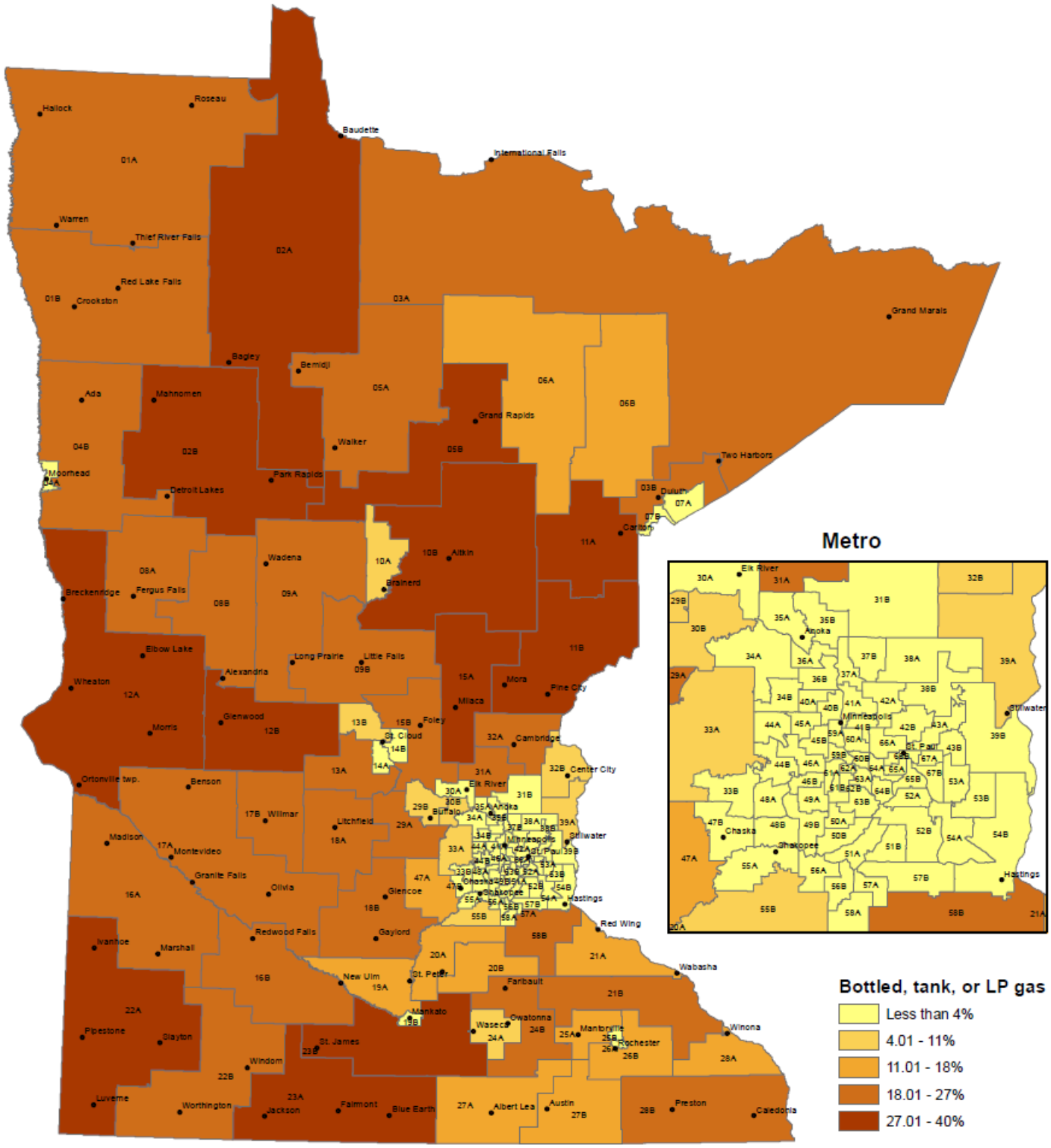


Residential propane use

In residential applications, propane is used for space heating, water heating, cooking, and related needs. Delivered propane is one of the primary heating sources in areas of the state that do not have utility natural gas service, along with electric heat and fuel oil.

Approximately 10 percent of Minnesotans primarily heat their homes with bottled, tank or liquid petroleum (LP) gas. The highest concentrations of household use are found in the northern, western, and southern regions of the state. Propane usage is more a matter of geography than income, and the portion of homes heating with propane is a fairly consistent eight to 12 percent across income levels.[iii]

Figure 2: Households Primarily Heating with Bottled, Tank or LP Gas, by Legislative District[iv]

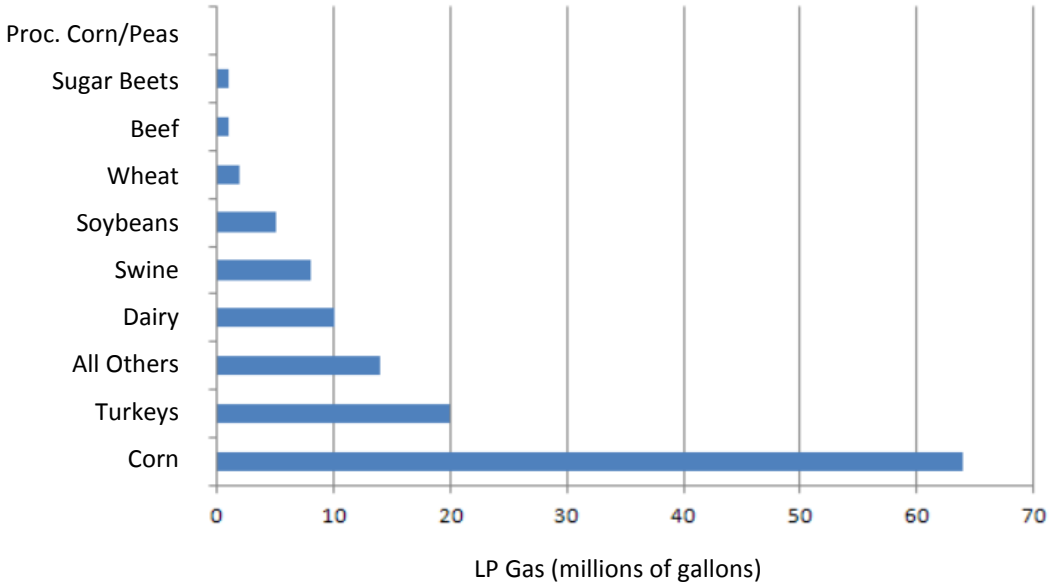


Agricultural propane use

In agricultural applications, propane is used to dry crops, heat barns, and power a variety of farm equipment, such as irrigation pumps.

The largest portion of propane used in the agricultural sector is for corn drying. Proper and safe storage of corn requires it to have moisture levels of 15 percent or lower. In most years, corn must be harvested before it has dried to that level naturally in the field. Extra moisture is removed with dryers, which are generally powered by propane. The amount of propane required depends on fall weather conditions, and twice as much energy may be required per bushel in cool, wet falls compared with warm, dry harvest seasons. Turkey production is the second largest agriculture user, as propane is the dominant fuel used to heat barns.

Figure 3: LP Gas Use in Minnesota Agriculture[v]



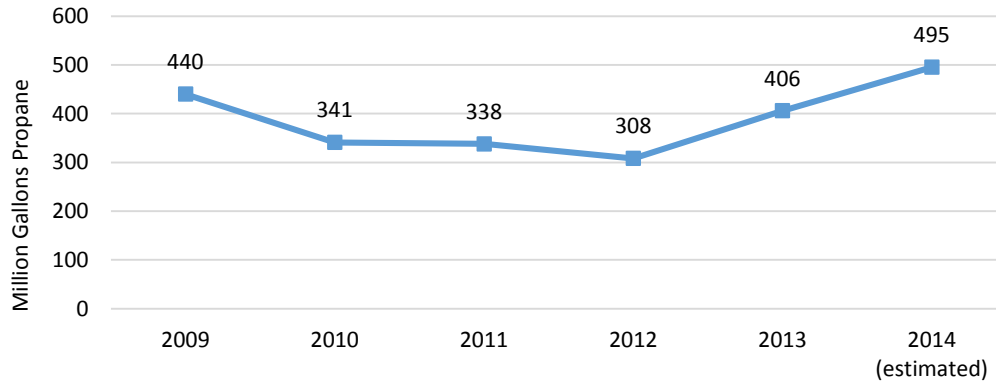
b. Minnesota's Propane Supply and the 2013-14 Propane Shortage

In the heating season of fall 2013 through winter 2014, extreme weather combined with multiple supply challenges to create a propane shortage in Minnesota and across the region. Propane was available in the United States, but it was not in the right place at the right time. As a result, Minnesota and more than thirty other states declared emergencies over the shortage.

Highest demand in a decade

In 2013-14, unexpectedly high demand followed several years of declining use in Minnesota and the Midwest region. In the decade preceding 2013-14, propane sales had declined about 40 percent due to mild winters, the construction slowdown, and efficiency increases. Watching that trend, it made sense for suppliers to send excess propane to other places besides the Midwest market. However, in 2013, sales shot up to their highest level since 2004. The region was not prepared for such high demand.[vi]

Figure 4: Minnesota Propane Demand[vii]



2013 saw an exceptionally large corn harvest, and the harvest was damp and late. Corn drying required more propane than average. Since the harvest came late in the season, it left little time to replenish propane stocks before the winter heating season. Moreover, the corn harvest happened almost simultaneously in states across the upper Midwest. When the harvest comes in gradually, the industry can adjust to deliver propane to the right locations as it is needed; in 2013, farmers across the region needed the propane at the same time.

In early 2014, after a string of mild winters, much of the country faced sustained frigid weather, with coldest conditions occurring in the Midwest, so homes and businesses required more propane for heating.

More propane was also used by large businesses that primarily use natural gas. Natural gas utilities have so-called "interruptible customers" – large commercial or industrial users that receive a discounted price for gas in exchange for an agreement to discontinue gas use periodically at the utility's request. Upon interruption, many customers switch to propane as a back-up fuel, and they can use a lot – sometimes

multiple semi-truckloads each day of the interruption. A semi-truckload is enough to heat 20 homes for a month.

The winter of 2013-14 saw many more natural gas interruptions than has been the norm in recent years, due to the very cold temperatures and an explosion in the TransCanada gas line in Manitoba, which reduced Minnesota's gas supply in January. Xcel Energy, for example, called upon their interruptible customers to stop gas use 20 times, the most since 1996-97, after requiring no interruptions at all during the previous two winters. Other utilities reported similar experiences.[viii]

Delivery constraints

Under plans to reverse its flow, the pipeline supplying the largest share of Minnesota's propane was interrupted during the 2013-14 season, and stopped supply altogether in early spring. Kinder Morgan's Cochin Pipeline, a 12-inch pipeline that runs 1,900 miles from Alberta through the Midwestern U.S. to Ontario, had typically supplied nearly 40 percent of Minnesota's propane, as well as large shares of the supply to neighboring states.[ix] Shipments on the system had declined dramatically over previous years, and the pipeline was only transporting at about 30 percent of its capacity. With oil production booming in Alberta (the northwest end of its line), Kinder Morgan decided to reverse the flow of the pipeline. The Cochin Pipeline stopped receiving propane in late March 2014. Instead of bringing propane into the U.S., the Cochin Pipeline is now moving condensate to Canada, which is used to dilute tar sands oil to be shipped through other pipelines.

In preparation for the reversal, the pipeline was shut down for three weeks in November and December 2013 to make modifications. Originally planned for earlier in the year, Kinder Morgan delayed the shutdown to help accommodate the late crop drying season. However, the shutdown still came during a high-demand time, and propane marketers had to go elsewhere for supply.[x]

In addition, propane deliveries in the first quarter of 2014 were limited by tight supplies and very high prices in Canada.[xi]

Propane supply after the Cochin Pipeline loss

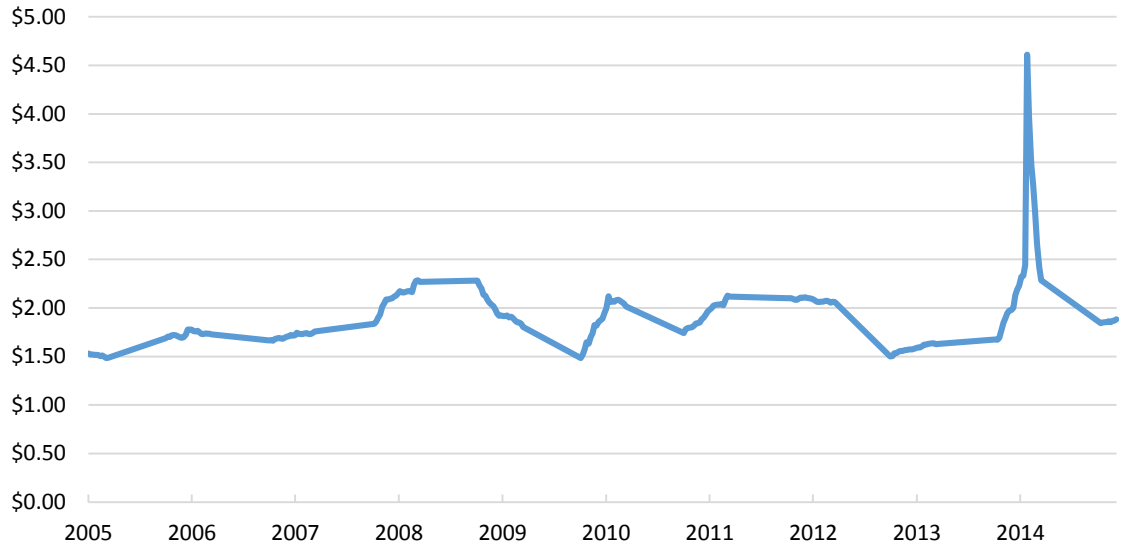
The propane, railroad, and other industries have taken steps to increase rail and storage capacity to offset the loss of the Cochin Pipeline, and State officials have acted to expedite regulation to enable fast action.

The increased proportion of shipments by rail requires a shift in operations and mindset for the industry. Whereas the industry previously relied on "just in time" shipments, quickly ramping up and down in coordination with demand, railroads typically schedule shipments several months in advance. In addition, there is little room on Minnesota railroads, which are currently adding capacity to meet higher demand for shipping commodities such as agricultural products, processed foods, coal, ethanol, iron, and crude oil from the Bakken oil boom in North Dakota. This reduces flexibility and requires more advance preparation for an industry whose demand is largely determined by variations in the weather.

c. Propane Prices

With the exception of the 2013-14 season, the fall and winter price of residential propane in Minnesota has remained roughly in the range of $1.50 to $2.25 per gallon over the past decade. Last season's shortage caused prices to spike dramatically. The U.S. Energy Information Administration reports a statewide high price the week of January 27, 2014 at $4.61 per gallon; some local markets may have seen even higher prices.

Figure 5: Minnesota Residential Propane Price (dollars per gallon, October-March)[xii]



Prices are generally lower during the warmer months of the year, so customers of all sizes are encouraged to fill their tanks during the summer.

d. Energy Assistance for Low Income Households

The State receives funding each year for the Low Income Home Energy Assistance Program (LIHEAP) from the U.S. Department of Health and Human Services. The funds typically come in the fall. Over the winter, money is distributed to help low-income households with heating bills and related expenses, including to households that heat with propane.

The Department of Commerce has statutory authority to pre-buy propane at summer prices and distribute it to qualifying households through the Energy Assistance Program.[xiii] This program has not been funded in recent years. Buying propane in the summer is not guaranteed to save money; in fact, when the Propane Prepurchase Program operated in 2006, it reported a loss because the price of propane actually decreased over the heating season.[xiv] In a typical year, however, propane is more expensive in the winter.

- *Option 1: Pre-buy a portion of Energy Assistance propane for low-income households.*
  Though strategies related to the purchase and storage of propane are outside the scope of this report, it is frequently asked whether Minnesota could make Energy Assistance propane purchases in the off-season to take advantage of often-lower summertime prices.

  Because federal LIHEAP funds are not received until the fall, fuel purchases are made during the heating season, when prices are often higher than they are during the summer. Federal restrictions prevent Minnesota from using state funds to have propane delivered to low-income households during the summer, then reimbursing those state expenditures with federal dollars when they arrive the following fall.

  However, the State may lock in a summer rate for propane – by using its own funds to make summer purchase or by establishing a line of credit with distributors – and have the propane delivered to homes after October 1 (the start of the federal fiscal year). As long as the deliveries occur after October 1, the State may reimburse itself with that fiscal year's LIHEAP funds.[xv]

  Alternatively, some states reserve a portion of federal LIHEAP funds when they are received the fall to be used the following summer. Wisconsin, for example, has set aside $5 million of its FY2015 LIHEAP funding to be used for summer fills the following calendar year.[xvi]

  The tradeoff is that withholding this money will mean the Energy Assistance Program will fall even shorter of the need, at least in the first year that money is reserved. This could be mitigated with a one-time state appropriation. For example, $5 million could be appropriated from the state general fund in 2015 for summer fills, and then $5 million could be reserved from the federal LIHEAP funds in FY2016 and thereafter for summer fills the following years.

A third option is for the Legislature to fund the Propane Prepurchase Program entirely with state funds, and keep LIHEAP funding dedicated to heating assistance needed during the winter.

III. Propane Alternatives

Though the propane industry has increased storage and rail delivery capacity in the past year and expresses confidence that the current supply will be sufficient for a typical fall and winter, another difficult season could see a repeat of propane shortages. The following sections describe alternative options that can provide reliable energy for heating in the long-term. These options are either supplemental, reducing propane demand, or can substitute for propane altogether.

a. Conservation

Conservation and efficiency should be the first consideration for any home or business looking to reduce its reliance on propane. Improving insulation, eliminating drafts, and keeping furnaces and water heaters running well can significantly reduce energy costs.

Energy conservation and efficiency is also an important industry in Minnesota. A 2014 study led by the Department of Employment and Economic Development found that energy efficiency directly employs nearly 10,000 Minnesotans, at wages nearly 50 percent above the state average. Employment in the industry grew 49 percent between 2000 and 2014.[xvii]

Minnesota has a number of heating conservation programs in place currently. Households under 200 percent of the federal poverty level ($47,700 for a family of four) can apply for the Weatherization Assistance Program (WAP) to help with the costs of energy audits and improvements. Households apply for Weatherization Assistance in a joint Energy Assistance/Weatherization application through a local agency.[xviii] Funds for this program come from the U.S. Department of Energy, the federal Low Income Home Energy Assistance Program (LIHEAP), utilities, the State, a $0.001 per gallon fee on propane, and other sources.

Incentives for conservation measures are available through electric and natural gas utilities. The Next Generation Energy Act mandates an annual energy savings goal of 1.5 percent for Minnesota utilities.[xix] Utilities meet this reduction by offering Conservation Improvement Programs to their customers, with conservation incentives such as rebates on high-efficiency appliances, building envelope improvements, and process efficiency upgrades. However, with no natural gas utility, propane customers have little or no access to incentives for heating efficiency. Electric utilities may offer some limited heating-related incentives to propane users, but not to the degree of a natural gas utility.[1, xx]

[1] Electric utilities may provide direct conservation measures for space and water heating to low-income customers using propane and other delivered fuels, and the utilities may claim the energy savings from those measures toward their energy savings goals.

Key challenges and potential solution strategies

Up-front costs

The main barrier to greater heating conservation improvements is the up-front investment needed, even when the measures save money in the long term.

- *Option 2: Create a Rural Heating Conservation Program.*

  The Legislature could create a Rural Heating Conservation Program to provide heating efficiency incentives where there is no natural gas utility. The program could provide rebates for efficient appliances, weatherization improvements, and possibly also for alternative heating equipment, such as the options discussed in later sections of this report.

  The program could be administered statewide by the Department of Commerce. Incentives could be accessible both online and locally, perhaps through the organizations that already provide weatherization assistance, if resources for administration were included. Funds could come from a surcharge on delivered fuels, much as utility conservation programs are funded through a rider on utility bills.

  The program should be targeted to serve Minnesotans who are most sensitive to heating bill increases. This could be done by requiring a certain portion of its funds be allocated to low- and lower-middle income residents.

  A rough estimate suggests that adding a $0.01 per therm charge to propane deliveries could collect $2 million to $4 million per year, while adding $7 to $10 to the average household's yearly propane bill.[xxi] The charge should also be extended to purchases of fuel oil for heating, which would of course increase the program budget and/or allow the per-customer cost to be reduced.

- *Option 3: Provide additional state funding to the Weatherization Assistance Program.*

  The Legislature could allocate additional general fund dollars to the Weatherization Assistance Program to increase the resources available to low-income Minnesotans.

  Despite Minnesota's cold climate and relatively high heating bills, state allocations to the Weatherization Assistance Program (WAP) make up a very small portion of its funding, and a much lower portion than the national average. In 2013, state, utility, and other non-federal funds made up 9 percent of Minnesota's WAP budget, compared with a national average of 39 percent.[2, xxii]

[2] The sources of Minnesota's non-federal funds are: $1,493,394 utility funds, $160,000 LP state fund, $104,176 state funds, and $8,738 miscellaneous.

Increasing WAP funding could have the added benefit of making public funds for energy assistance go farther. As both programs have similar income qualifications,[3] increasing WAP funds should result in more weatherization improvements in households receiving LIHEAP, and thus more efficient use of energy assistance dollars.

[3] LIHEAP is available to households with income at or below 50 percent of the state median income, currently $44,912 for a family of four.

b. Natural Gas System Expansions

Expanding the natural gas system could reduce the number of customers heating with propane. Like propane, natural gas burns cleanly. It is brought to homes and businesses through pipelines, making it much less expensive than delivered propane. Unfortunately, though natural gas is available in abundance in the United States at this time, the high capital cost of building pipeline infrastructure to communities with limited demand means it will not be a feasible alternative for much of rural Minnesota. However, gas service is being extended to a handful of new communities this year, and there are options the Legislature can consider to help expansions be viable in some instances.

Minnesota natural gas systems and regulation

Minnesota has no natural gas resources of its own (or any fossil fuel resources); natural gas is brought into the state through interstate pipelines. Distribution companies connect to interstate pipelines and build networks of smaller pipelines to supply towns and customers.

The areas that are most feasible for natural gas expansions are located close to interstate pipelines with high densities of delivered fuel usage, likely including one or more large customers. Unlike with electric utilities, there is no obligation that all areas of the state have natural gas service. It is not economically feasible to extend service to communities that are located far from an interstate pipeline or that do not have high population densities and/or commercial or industrial customers with large demand that could "anchor" a system. In some areas, pipelines are constrained by geographic and environmental issues, such as rivers, wetlands, forest, or rocky geology that cannot practically be crossed.[xxiii]

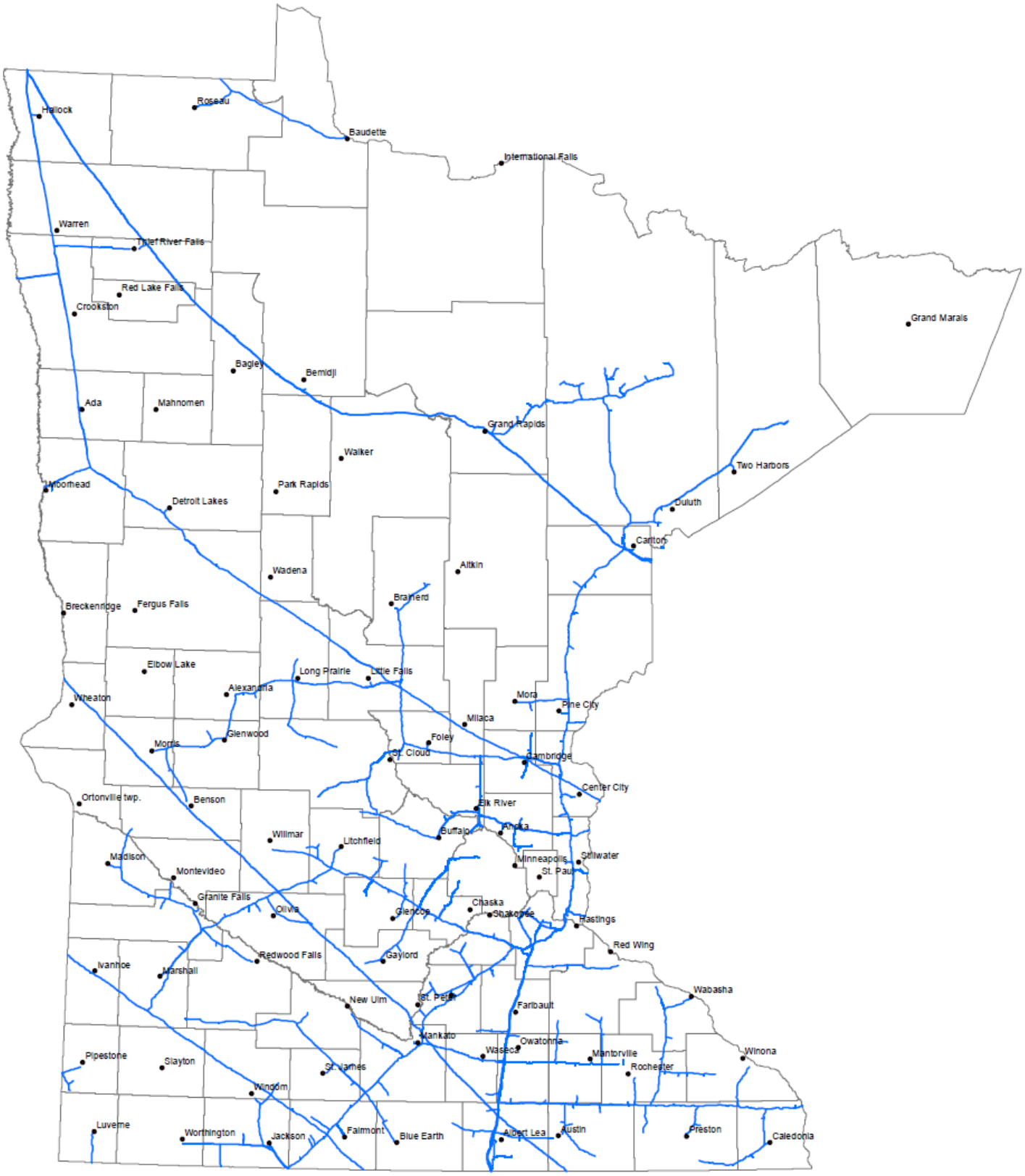
Minnesota's natural gas distribution companies include large investor-owned utilities (IOUs), small private companies, and a number of municipal companies. The IOUs are regulated by the state Public Utilities Commission (PUC). Minnesota has six: CenterPoint Energy, Xcel Energy, Minnesota Energy Resources, Alliant Energy-Interstate Power, Greater Minnesota Gas, and Great Plains Natural Gas Company.[xxiv] Small companies – with fewer than 2,000 customers total and no individual system serving more than 650 customers – are not regulated by the state PUC; neither are the state's 31 municipal utilities.

How natural gas system expansion works today

The following describes the typical process of expanding service to a new area for a utility regulated by the Public Utilities Commission.

The Minnesota Public Utilities Commission has determined that, in order to provide fair and reasonable rates to all customers, the costs of new system expansions should be borne by the new customers, and should not be a burden on existing customers. The incremental cost of the expansion is paid through

Figure 6: Interstate Natural Gas Pipelines[xxv]



what is called a New Area Surcharge, an additional fee added to the new customers' bills each month until the costs of expansion are reimbursed, which can take up to 30 years. The New Area Surcharge must be approved by the Public Utilities Commission. The amount of the Surcharge is determined by the projected cost of the expansion and the number of new customers expected to sign up and consequently contribute to cover the cost. Because both of these factors are projections, the New Area Surcharge is not an exact calculation. If the company collects enough to cover the cost of expansion ahead of schedule, it will stop collecting the Surcharge at that point.

Even with this additional charge, because natural gas is much less expensive than propane, some household customers can save $1,000 per year by switching to natural gas;[xxvi] the savings for commercial, industrial, and agricultural customers can, of course, be much higher. However, utilities report that the maximum New Area Surcharge residential customers will accept is in the range of $25 per month.

A utility may see potential to expand to a new community, or a community may contact a utility and request that it consider expanding to the area. Utilities then employ outreach strategies to get new customers to commit to taking natural gas service. It is generally crucial to have one or more large customers with dependable demand for gas, such as a school, factory, grain elevator, or health care center. Often, these customers will sign a "minimum burn" contract guaranteeing a certain level of demand. To attract households, utilities may hold town hall meetings, set up a website with information about the proposed project and how much a household can expect to save, and even go door to door to sign up customers.

When the investor-owned utility is confident it has signed up enough customers to make the economics feasible, it will go before the state Public Utilities Commission and make the case for the expansion and accompanying New Area Surcharge.

Key challenges and potential solution strategies

<u>System costs</u>

System costs are the largest barrier to expanding natural gas service to new areas. The Legislature could consider giving state-regulated utilities greater flexibility in how these costs are covered.

- *<u>Option 4: Allow some or all system expansion costs to be shared across a utility's customer base.</u>* If the Legislature views natural gas expansion in rural areas as a public good that should be subsidized by other Minnesota citizens and businesses, it could direct the Public Utilities Commission to allow utilities to spread some or all of the costs of expansion among existing customers. To do this, utilities could be allowed to build an expansion fund in advance through a rider on customers' bills, and use the fund to subsidize the costs of expansion projects as they are proposed. Alternatively, the costs of individual expansions could be incorporated utilities' rates in rate cases as new projects arise.

Customer costs

Switching from propane (or another heating fuel) to natural gas requires a building owner to convert or replace furnaces and other appliances, which can be a significant expense.

- *Option 5: Create state tax credits toward appliance conversion costs.*
  The Legislature could consider allowing tax credits for equipment and labor costs for converting or installing new furnaces, water heaters, and other appliances.

- *Option 6: Allow building owners to finance their expenses through PACE or a similar mechanism.*
  The PACE (Property Assessed Clean Energy program) allows building owners to access financing for cost-effective energy improvements, and pay the investment back through their property tax bills as a voluntary special assessment.[xxvii] The Legislature could consider expanding the PACE statute to allow financing for the required appliance upgrades or conversions.

  In evaluating this option, policymakers should consider whether this is in the spirit of the PACE statute, which is focused on efficiency and renewable energy and requires a complete energy audit or renewable energy system feasibility study of the property. Policymakers should also recognize that PACE financing is not currently available to residential customers in Minnesota, due to discouragement from federal entities Fannie Mae and Freddie Mac.

Additional considerations

Natural gas supply

Predictions vary widely regarding the level of future U.S. gas supplies. It is beyond the scope of this report to attempt a judgment on this question. However, policymakers should keep this consideration in mind when making investments that will be paid back over one or more decades.

In addition to national supply, pipeline infrastructure in Minnesota and the region could be a constraint to extending natural gas service. While a number of interstate pipeline companies report some additional capacity at this time, as natural gas usage increases – not only for heating, but increasingly for electricity generation and even transportation – additional interstate pipeline capacity may be needed.

c. Delivered and Distributed Resources

Because natural gas distribution grids are often not economically feasible in much of rural Minnesota, those areas will continue to depend on delivered and distributed resources for their heating needs. There are many viable propane alternatives; the following sections discuss some of the more prevalent options. This is by no means a comprehensive list of possible alternatives, but a discussion of some of the more prevalent options. Transitioning to these resources for heating needs is more cost effective than propane for customers in the right circumstances and will help improve the resilience of Minnesota businesses and communities by making them less vulnerable to supply interruptions.

The delivered and distributed resources discussed below are:

- Solar thermal
- Woody biomass
- Off-peak electric thermal storage
- District heating and waste heat recovery

Transitioning to these alternatives could also provide a boost to the Minnesota economy. Minnesota has no fossil fuel resources; therefore, all of the propane used here must be purchased from outside the state. In 2012, more than $612 million was spent on imported propane in Minnesota.[xxviii] Aside from natural gas, all of the most feasible propane alternatives use Minnesota-based resources, and transitioning to these alternatives would keep more of the money spent on heating in the Minnesota economy.

Using alternative sources of heat also provides collateral benefits in some instances. Burning propane releases moisture, which mixes with litter in poultry barns to form ammonia. Heating sources such as biomass and solar release less or no moisture, reducing the amount of ammonia in the barns. Agricultural producers report that the result is cleaner air, a reduction of bird mortality, and a healthier atmosphere for the people who work in the barns.[xxix]

Most or all of the delivered and distributed alternatives to propane encounter similar obstacles – up-front costs and a lack of understanding – and the general strategies below may be helpful across technologies. Additional fuel- and technology-specific strategies are discussed in the sections that follow.

Key challenges and potential solution strategies

Up-front costs

Even though many options can provide a large cost savings to customers over the life of the system, it generally requires a significant investment to switch to a different heating source. This up-front cost can be a barrier to many Minnesotans, especially low-income homeowners and price-sensitive businesses – the same people who are hit hardest by high and volatile energy prices.

- *Option 7: Provide rebates through a Rural Heating Conservation Program.*
  As described under Option 2 (page 11), such a program would make conservation incentives available Minnesotans outside of natural gas service utility territories. The program could also provide rebates for alternative heating equipment, such as solar thermal installations and wood stoves.

- *Option 8: Create a Local Energy Infrastructure Loan Program.*
  Advocates and industry professionals report that larger-scale projects with reasonable payback periods and partial financing in place are sometimes stopped by an inability to find full financing over a period long enough to allow the project to be cost effective. The State could establish a low-interest revolving loan fund to finance a limited portion of the capital costs of replacing or supplementing propane with an alternative system, such as solar thermal, clean-burning biomass, or biogas. The fund could target commercial and institutional scale projects, such as schools, hospitals and health care centers, farms, and small manufacturers. The fund could be administered by an established lender such as the St. Paul Port Authority or the Department of Employment and Economic Development. Loan repayments would cover expenditures, so that the fund would not need future appropriations.

- *Option 9: Create grants or tax credits for the purchase and installation of alternative heating equipment.*
  Grants or tax credits could be made available to help residential, commercial, agricultural, and/or industrial customers purchase and install alternative heating equipment. A program could be specific to a single technology or include multiple technologies. It should target the highest-value and most environmentally beneficial applications of each technology, and incentivize only the cleanest and most efficient models. This could be accomplished by expanding the scope of existing policies, such as the Community Energy Efficiency and Renewable Energy Loan Program and the Energy Improvements Program for Local Governments, and/or by creating new programs.[xxx]

  Several states have such programs. New York's Residential Pellet Stove Program, for example, offers homeowners $1,000 for the purchase of a new pellet stove with recycling of an existing stove, plus an additional $500 for households under 80 percent of their county's median income. (In addition, a state lending authority provides low-interest loans for energy improvements.)[xxxi] The state of Oregon offers tax credits for purchase and in-home installation of the highest-efficiency wood and pellet stoves, with higher tax credits for more efficient stoves.[xxxii]

- *Option 10: Increase access to the existing Renewable Energy Equipment Grant Program.*
  The Renewable Energy Equipment Grant Program (REEGP) provides $150,000 per year in grants to providers of low-income weatherization services to install renewable energy equipment in households that are eligible for weatherization assistance.[xxxiii] This is a very small amount of

funding relative to the need among eligible households. In the first year that funding has been available, it was not fully used. The Department of Commerce reports that this is due to several factors: the agencies were finishing federal American Recovery and Reinvestment Act contracts, the initial grant program was being retooled to meet current market conditions, and it was found to be labor intensive because not all homes meet the physical requirements for using renewable energy.

Renewable energy advocates report that an additional factor is that weatherization assistance agencies are stretched too thin, and that agency staff simply do not have the capacity to use the fund.

To address this barrier, the Legislature could expand the pool of organizations that can access this funding. Applications could be made available through additional nonprofits that work with low-income homeowners, or directly to contractors and homeowners themselves. To continue at all, this program must be renewed by the Legislature in 2015.

Lack of awareness or understanding

While the variety of potentially cost-effective alternatives can provide welcome flexibility, it also makes it difficult for customers and installers to understand all of the options. Lack of awareness means fewer Minnesotans opt for heating alternatives and may contribute to underutilization of existing programs to incentivize alternatives.

- *Option 11: Provide trainings on installing and maintaining alternative heating systems.*
  The Legislature could allocate funds to the Department of Commerce to train local contractors and propane and fuel oil providers to install and maintain other heating equipment, especially in industries that lack strong workforces, such as solar thermal. This could help companies diversify their businesses and allow them to be a source of information for their customers about alternatives. The program could be targeted by including a sub-focus on agricultural or other applications. Such a program may be able to take advantage of curricula or other resources already developed by organizations such as the nonprofit Clean Energy Resource Teams and the Statewide Wood Energy Team at the Department of Natural Resources.

  Delivered fuel providers can be an especially valuable resource and should be invited to conversations about providing heating alternatives. These are often local businesses and cooperatives that have served the community for years and know it very well. They are also hit hard by volatile supply and prices. Moreover, many providers worked hard to make sure customers' heat stayed on last winter, sometimes making extra trips and exceptions to company policies for customers who couldn't afford the minimum fill.

Options being considered under active state agencies processes

The Climate Strategies and Economic Opportunities (CSEO) project, led by state agencies through the Environmental Quality Board, is considering a number of policies related to heating, including the below. CSEO is focused on reducing greenhouse gas emissions to meet state goals, but because many of the resources best for rural heating in Minnesota are renewable, there is some overlap with this report.

This is a straw man proposal and has not been fully vetted or endorsed by the State.

- *Option 12: Establish a state renewable thermal energy goal.*
  The Legislature could establish a goal that a percentage of the total forecast heating load (measured as fuel delivered for heating use) that is fueled with non-electric sources (including natural gas, fuel oil and propane) in Minnesota come from renewable thermal resources. The CSEO study is considering goals of five percent by 2020 and 20 percent by 2030. The goal could include a small systems carve-out of at least 5 percent of the qualifying renewable thermal resources, to ensure that a variety of end users benefit, such as residential propane customers.[xxxiv]

  Some states have recently introduced renewable thermal standards. New Hampshire, for example, has specified a renewable thermal carve-out in its Renewable Portfolio Standard, beginning at 0.4 percent in 2014 and building to 2 percent in 2025 and thereafter. Electric utilities are held responsible for meeting the renewable thermal requirement, and they will do so by purchasing Renewable Energy Certificates (RECs) from qualifying thermal facilities.[xxxv]

i. Solar Thermal

Solar thermal can be a cost-effective supplement to propane in some instances.

A solar air heating system is typically mounted on the south-facing wall of a building, where exposure to the sun is greatest. The sun hits a collector on the wall, which absorbs the solar energy as heat. When heat is needed inside the building, controls automatically turn on a fan to move air through the heated collector and into the building.[xxxvi] Similarly, solar water heating systems can be integrated into existing systems to reduce fuel needs for hot water. Solar thermal cannot provide 100 percent of a building's heating needs, but it can effectively be paired with propane systems.

Aside from electricity to run a fan for hot air or a pump for hot water, solar thermal systems have no fuel needs (and no emissions). While the initial cost is significant, installing solar thermal allows a building owner to lock in that portion of their heating costs, reducing their monthly heating bills and their exposure to fuel price spikes.

A 2013 Department of Commerce study identified the following high-value market sectors and applications for solar thermal systems:

- Commercial customers using expensive, conventional heating fuels, such as propane.
- Agricultural applications where load characteristics coincide with solar resources, and especially those using expensive heating fuels.
- Low-income housing where fossil fuel price volatility is problematic for owners and residents.

The study (conducted before the 2013 propane shortage) found that solar thermal technologies can be cost-effective alternatives to propane in some settings, especially when available federal tax incentives and state rebates are incorporated. While an increase in the price of propane or a repeat of the price volatility of the 2013-14 season could change the economic calculation, the study found that solar thermal is not cost-competitive with propane in all cases.[xxxvii]

The cost and payback period for a solar thermal system varies depending on the location, the application, and, of course, the unpredictable price of propane or other fuel being offset. A Laundry Room Inc. in Ely installed a system for about $21,000 in 2008. After receiving a $2,640 grant from the nonprofit Northeast Clean Energy Resource Team and a federal tax credit, the laundromat reports the system has already paid back – an especially fast payback, partly because the laundromat has high heating needs year round.[xxxviii] The Rural Renewable Energy Alliance (RREAL, a Minnesota company that manufactures and installs systems) reports that a system installed on a good site for a home heating with propane typically pays off in about 10 years.[xxxix]

The state of Minnesota has offered multiple solar thermal rebate programs. The first operated from 2008 to 2010 and was funded through a Renewable Development Fund (RDF) appropriation of approximately $200,000. A subsequent rebate program operated from 2010 to 2012, funded with

federal funds from the American Recovery and Reinvestment Act (ARRA). Both solar thermal programs were undersubscribed.[xl]

In 2014, the State launched its Made in Minnesota solar thermal rebate program. Available only to Minnesotans served by four investor-owned electric utilities (Alliant/Interstate Power and Light, Minnesota Power, Otter Tail Power, and Xcel Energy), it provides rebates covering 25 percent of the installed costs, up to $2,500 for residential systems, $5,000 for multi-family systems, and $25,000 for commercial systems. As of the start of the 2015 Made in Minnesota program, there are three qualifying Minnesota solar thermal manufacturers: RREAL, Energy Conservation Products and Services, and Solar Skies.[xli] Solar Skies, however, is closing its Minnesota operations, citing a lack of business in the Midwest.[xlii] The Made in Minnesota program can offer up to $250,000 in rebates each year. In contrast to the nearly $15 million annual Made in Minnesota rebate program for solar photovoltaic (electric) systems, the solar thermal program has had difficulty finding enough subscribers to fully utilize its available resources.

All buildings in Minnesota that receive state funds to replace heating and cooling systems are required to consider solar thermal and geothermal heating and cooling systems.[xliii]

Key challenges and potential solution strategies

Lack of awareness and workforce

Lack of awareness and understanding of solar heating, by both building owners and contractors, likely contributes to underutilization of rebate programs and low adoption rates, and lack of a qualified workforce could constrain market growth in the future. These related challenges could both be addressed in part by providing trainings to heating professionals, as described above (Option 11, page 19).

Installation costs

Even if a solar thermal system can save money in the long term, for many customers the large initial cost is a barrier. In addition to the general strategies discussed above, additional options could help particularly to accelerate solar thermal adoption.

- *Option 13: Reduce soft costs by streamlining permitting.*
  The Department of Commerce found that permitting costs can account for up to 20 percent of the installed cost for residential solar thermal systems, especially because there are not uniform permitting requirements across jurisdictions. The Legislature could act to standardize procedures. Alternatively, the State could provide technical assistance to communities or incentives to adopt statewide guidance for permitting solar systems, which has already been developed.[xliv]

- *Option 14: Implement "solar ready" building requirements.*
  Costs can be reduced significantly if new buildings are constructed to be "solar ready." As the Department of Commerce report states, "Roof structure, building orientation, choices about the location of mechanical systems and building design elements can increase the complexity of solar thermal installations, leading to unnecessary expense and higher installed costs." California, Colorado, and New Jersey are among the jurisdictions that have solar ready requirements.[xlv]

Additional considerations

Limited reach of Made in Minnesota rebate program

Because the Made in Minnesota program is only available to customers of four investor-owned electric utilities, it does not serve many of the state's propane users. These utilities' customers are more likely to have utility natural gas service, because their service territories are areas of relatively dense population. Solar thermal is not cost-competitive when compared with the low cost of utility natural gas heating, and this limitation makes it more difficult for the program to use its modest $250,000 annual budget.

Nearby construction affecting solar resource

Customers with solar thermal panels run the risk of a neighboring building being constructed that blocks the sun to their panels. A Laundry Room in Ely reports that this was the case with their installation – the business estimates that a new building next door now blocks about half of their array.[xlvi]

ii. Woody Biomass

Woody biomass can be a cost-effective alternative for propane users in forested areas of the state.

Woody biomass is a general term for any woody material from trees or shrubs. It includes firewood (also called cordwood), the logs typically used in a wood stove or campfire; wood chips; and pellets, which are often made by compressing sawdust or other waste from forest industries. Which type of woody biomass is best for various applications is a facility-by-facility decision, depending on many variables, including the building owner's preferences and the fuel supplies that are available locally. Generally speaking, firewood and pellets are better suited for small systems, and chips for medium-sized and large facilities.

Biomass heating systems can be effective in many sizes, from heating a single household to large industrial use. They can also be well suited to agricultural applications, such as poultry barns and greenhouses.

Woody biomass can be a lower-cost alternative to propane. Generally speaking, wood heat requires a higher up-front equipment investment than propane and has lower fuel costs, though with higher maintenance costs than propane. The University of Minnesota's Department of Forest Resources has built a calculator to assist non-residential energy users considering converting to a chip or pellet system. The web app, available at http://woodenergy.umn.edu/BiomassCalculator/, helps customers estimate the costs and savings they can anticipate in converting from another fuel.

The state of Minnesota does not track woody biomass as closely as other fuels, and there are some gaps and discrepancies in the data. The State does not have data about the availability and price of firewood, for example, nor is there consensus on how many households currently use firewood for heat. The Minnesota Pollution Control Agency (MPCA) estimates that 130,000 households use firewood as their primary source of heat, and another 130,000 use it as their secondary source. The U.S. Census, on the other hand, reports 50,000 households heating with firewood. Whereas MPCA data shows 1.2 million cords of wood used for heating each year, the U.S. Energy Information Administration reports just 600,000 cords.[xlvii]

Because wood is an abundant resource in portions of Minnesota, it can avoid some of the transport challenges that have bogged down propane and other fuels sourced of state. Moreover, about 60 percent of cordwood is harvested by its user, reducing or eliminating altogether the need for a supplier.[xlviii] However, as with any fuel, wood can be subject to supply shortages. Indeed, the 2014-15 heating season began with tighter than normal supplies.

Generally, the cost effectiveness of woody biomass for heating depends on the fuel being used relatively close to where it is harvested. Estimates vary and depend on the type of woody biomass being used, but stakeholders generally report it is not cost effective to move woody biomass beyond 100 miles from the

point of harvest. Additionally, transporting wood greater distances by truck adds to greenhouse gas, particulate, and other emissions.

Increased use of woody biomass for heating could provide economic growth for Minnesota. The state is home to a number of manufacturers of biomass heating equipment. Woody biomass heat could also be an opportunity for Minnesota's forest industry, which has seen a downturn in recent years. Estimates indicate that the industry may be harvesting only half of the wood that can be sustainably harvested in the state. However, biomass for energy may be most economical in conjunction with a thriving timber industry, where wood that is not useable for higher-value purposes can be harvested in tandem with a commercial timber harvest, sorted and used for energy. The growth of biomass energy should not come at the cost of higher-value applications for Minnesota's forest resources.[xlix]

In comparison with propane, woody biomass results in increased emissions of fine particulate matter, carbon monoxide, and other pollutants. Because of higher particulate emissions, some caution that woody biomass is not an ideal alternative for denser areas like the Twin Cities exurbs. The use of woody biomass can, however, reduce greenhouse gas emissions in comparison with propane.

Increasing the use of forest biomass for heating could provide an incentive to thin forests, which is important to reduce the risk of large wildfires. It could also provide a useful purpose for forest thinnings, which are sometimes burned in outdoor brush piles now (with much higher emissions than a wood stove or other biomass heating equipment).

Key challenges and potential solution strategies

Technical analysis needed for larger systems

The Department of Natural Resources (DNR) has received $250,000 in funding from the U.S. Department of Agriculture (USDA), and has formed a partnership with other private, state, and federal organizations to provide complicated analysis for commercial and institutional scale wood energy systems. With USDA funding, the DNR and its partners will identify and evaluate wood energy systems for 15 to 20 buildings, and complete advanced engineering and financial analysis for six to 10 of those facilities.[l]

- *Option 15: Continue to provide state funding for technical assistance and training.*
  Only a fraction of the potential wood energy conversions will be undertaken with USDA funding, and additional funding from the State allows significantly more conversions from propane. One way to accomplish this is to continue to appropriate state funding to the NextGen Energy Board (a state body that researches and recommends state actions on energy) to support bioenergy, including a portion for biomass heating applications.

Additional considerations

Agricultural biomass feedstocks

In addition to forest biomass, grasses, corn stover, and poultry litter, and other feedstocks can be good sources of biomass for heating, especially for use on farms.

iii. Off-Peak Electric Thermal Storage

While electric heating can be expensive, programs that offer discounted electric rates for off-peak heating can be cost effective alternatives for propane users.

Multiple technologies can provide off-peak electric alternatives to propane by storing electric energy when it is available and releasing it when it is needed. Two examples include electric thermal storage heaters and electric storage water heaters. Electric thermal storage heaters typically use electricity to heat specially designed bricks during off-peak hours. Heat is then distributed as needed throughout the day. Various units are available that provide forced air and/or radiant heat, and can replace a building's main furnace or be supplemental. Electric storage water heaters are large and insulated, so water can be heated during off-peak hours and stored for later use, with little or no noticeable impact on water temperatures.

Increasing electric usage during off-peak hours can result in cleaner and cheaper power. When demand is low (generally at night), utilities can run only their most efficient generators, so power production is less expensive and has lower emissions. In addition, the wind tends to blow strongest at night. With low demand, wind power is sometimes "curtailed" – available wind power is not allowed onto the grid.

Reducing the difference between peak and off-peak levels of electricity demand is especially important for rural electric cooperatives that buy power from other generators, and pay partially based on the peak. For financial reasons, many cooperatives offer programs to encourage electric usage at times of low demand through appliance rebates, off-peak rates, and the utility's ability to turn off power to appliances like a water heater for short periods during high demand.

Additional considerations

<u>Emissions impacts</u>
The environmental impacts of switching from propane to electric appliances depend on the generation sources for the electricity used. Because of Minnesota's relatively high proportion of electricity generated from coal, and because propane is a clean-burning fuel, it is possible that transitioning from propane to electricity would increase emissions. As Minnesota's generation mix continues to become cleaner, the emissions impact of electric heating technologies will become more positive.

<u>Electricity prices do not reflect true savings</u>
If customers pay a single electric rate at all times, they do not have an incentive to shift their usage to times when it is more efficient. Allowing the retail price of electricity to vary by time of day – along with the cost of that electricity – would pass price signals to consumers and allow electric heat to be less expensive at off-peak hours.

Many utilities already choose to offer discounted electricity rates for off-peak heating, as noted above. In addition, investor-owned electric utilities are required to offer discounted off-peak rates for charging electric vehicles. The Legislature could consider expanding incentives, reducing obstacles, and/or broadening requirements for utilities to offer and promote off-peak or time-of-use pricing to customers who choose to opt in. Such an initiative would benefit from a thorough consideration of the barriers and potential policy solutions, which could be undertaken by the Legislative Energy Commission or Department of Commerce.

iv. District Heating and Waste Heat Recovery

District heating and systems that make use of otherwise wasted thermal energy can be viable alternatives, especially for large users or areas with a concentration of buildings, such as a central business district, industrial park, or college campus.

Community-scale or industrial thermal energy systems centrally produce thermal energy and distribute it through a network of pipes carrying heated water or steam and sometimes cooled water. In district energy systems, this thermal energy is distributed through a number of buildings in a neighborhood, commercial complex, or university. The thermal energy can be generated in many ways. Heat can be generated on its own, through combustion of biomass, coal or natural gas, and/or with a non-combustion technology like solar thermal. Energy can also be recovered where heat is being wasted, such as in an industrial process. A single thermal energy system can incorporate multiple heat sources.

Combined heat and power (CHP) systems can improve the efficiency of the production of both thermal energy and electricity. In such a system, a fuel is burned to produce power, as in a typical power plant. The waste heat that would normally be lost from the plant's stacks or released into nearby waterbodies is instead captured and distributed to heat buildings or for industrial processes. Combined heat and power can increase the efficiency of power production by 30 percentage points or much more.[li]

Heat can be created with lower emissions at a central plant than with small heaters in dozens or hundreds of separate buildings. Still, if a district energy systems is used to replace propane, emissions may increase, depending upon the fuel source. In a rural area, woody biomass would most likely be a large portion of the plant's fuel, because an area heating with propane probably does not have natural gas service. Burning biomass releases greater amounts of some pollutants, including particulates and carbon monoxide, than does burning propane. On the other hand, sustainably harvested biomass has little or no greenhouse gas impact, unlike propane. In addition, district heat would be likely to supplant higher-emitting fuel oil and electric heat as well as propane.

Key challenges and potential solution strategies

Financing gaps

Industry leaders report that the economics for district energy systems do not always work with the price and timeframe of typical financing. In these cases, grants or low-cost or patient (long-term) capital could make a project economically feasible.

- *Option 16: Create a state loan fund for district energy and combined heat and power projects.* Low-cost and/or long-term state financing could be made available in a revolving loan fund. It could be provided through a dedicated portion of the Local Energy Infrastructure Loan Program (Option 8, page 18) or through a separate fund. It should be noted that these projects can be capital intensive and have the potential to swamp a fund that is intended for multiple purposes.

- *Option 17: Provide state bonding for district energy systems.*
  The Legislature could consider bonding dollars to help municipalities build district energy systems.

CHP options being considered under active state agencies processes

The Department of Commerce, with funding from the U.S. Department of Energy, has organized a combined heat and power stakeholder process to examine the often complicated barriers to CHP, such as regulatory and ownership issues and the unique nature of each CHP project. More information can be found at http://bit.ly/1CS1JMG.

State agencies are also considering the below policies through the Environmental Quality Board's Climate Strategies and Economic Opportunities (CSEO) project. These are straw man proposals that have not yet been fully vetted or endorsed by the State.

- *Option 18: Require consideration of CHP in utility integrated resource planning.*
  Electric utilities are required to submit integrated resource plans (IRPs) to the Public Utilities Commission, showing anticipated electricity demand and the utility's plans to meet that demand. The Legislature could require electric utilities to demonstrate that, before proposing to build new combustion power-only plants, combined heat and power opportunities within their service territories have been thoroughly assessed.

- *Option 19: Require utilities to promote CHP through the Conservation Improvement Program.*
  The goals of the Conservation Improvement Program for electric and natural gas utilities could be expanded to promote the use of CHP systems, including encouragement of utility-owned CHP systems as well as incentives for implementation of non-utility-owned CHP.

- *Option 20: Include a CHP goal in the Renewable Energy Standard.*
  The state's Renewable Energy Standard (RES) could be expanded to include a specific goal for CHP technologies, and could incorporate additional provisions for RES credit to encourage use of biomass for thermal energy production without power production in areas of the state without access to natural gas service.[lii]

Additional considerations

Lack of clarity regarding how to claim energy savings

The state's Conservation Improvement Program (CIP) is fuel-specific. Electricity providers must count electricity saved, and natural gas providers must count gas saved. Combined heat and power crosses those boundaries, producing both electricity and heat and saving a considerable amount of energy in the process. This seems clearly in line with the objective of CIP, but there is no clear guideline under the

program regarding how to credit the savings. The answer is extremely important for utilities, and uncertainty can delay or derail projects.

IV. Conclusion

This report presented legislative options to help Minnesota propane users convert to other sources of energy, as requested by the Legislature in 2014.

Multiple strategies are required to help Minnesotans reduce their dependence on propane. The best choice is a site-by-site decision, depending on geography, the type of customer, individual preference, and many other factors. As with any energy improvement question, conservation and efficiency should be the first consideration. In a few areas that are close to interstate natural gas pipelines and that have relatively high densities of demand, switching to natural gas may be a viable option. Natural gas, however, will not be economical for much of Minnesota. In these areas, alternative delivered and distributed resources can provide long-term cost savings and more predictable and stable prices.

The Legislative Energy Commission looks forward to continuing to be a resource for policymakers in the ongoing efforts to ensure reliable, affordable and predictable energy supplies in the state of Minnesota.

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