

# Critical Infrastructure: Evaluating Lessons Learned for Natural Gas Utilization in Agriculture



*Photo Credit: United Soybean Board*

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**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
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## CRITICAL INFRASTRUCTURE: EVALUATING LESSONS LEARNED FOR NATURAL GAS UTILIZATION IN AGRICULTURE

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## Introduction

Farmers have long explored alternative management techniques and advanced equipment to provide energy savings associated with grain drying. Propane is a clean burning fuel source that can be effectively distributed to rural areas that lack access to natural gas infrastructure, making it an ideal fuel source for numerous agricultural operations including grain drying. According to the National Propane Education and Resource Council, propane is used by nearly 900,000 farms across the country, powering roughly 80 percent of U.S. grain drying operations. While Propane has long been a critical energy source in agriculture, Ohio is in the midst of an energy transition that has led many Ohio farmers to consider investing in natural gas infrastructure to support the energy demands of their farm operations.

For example, growth in the production of oil and gas that form the Marcellus and Utica shale formations is transforming the oil and gas industry in Ohio. According to the U.S. Energy Information Administration gross natural gas production in Ohio has increased from 78,858 million cubic feet in 2011 to 1,466,854 million cubic feet in 2016 (USDOE/EIA, May 2017). In addition to the supply shock, natural gas is undergoing a transition on the demand side as well, displacing coal for electrical generation. In July 2015, the monthly natural gas share of total U.S. electricity generation surpassed the coal share for the second time ever, with natural gas fueling 35.0 percent of total electric generation to coal's 34.9 percent share (USDOE/EIA, October 2015). In Ohio, natural gas accounted for 1.7 percent of net electrical generation in 2003 compared to 24 percent in 2016 (USDOE/EIA, June 2017).

Expanding shale oil and gas development and processing is also the main driver of growth in propane production. According to EIA's Short-Term Energy Outlook, the U.S. production of hydrocarbon gas liquids, which includes propane, butane, ethane, and natural gasoline, is expected to increase from less than 2.5 million barrels per day in 2008 to 4.33 million barrels per day in 2017 (EIA 2017 Short-Term Energy Outlook). As a result, the U.S. inventories of propane and propylene reached 97.7 million barrels in September 2015, which marked the highest level in the 22 years that EIA has collected weekly propane inventory statistics (USDOE/EIA, September 2015). While growth in domestic propane supplies and lower oil prices will likely support more competitive, lower propane prices, energy prices overall are often volatile and difficult to predict because they are global markets that are extremely sensitive to both supply and demand shocks.



## Project Overview

The primary objective of this research project was to gain insights into Ohio farmers' awareness, interest, and knowledge of investing in critical infrastructure to convert from propane to natural gas. The research team was interested in understanding trends, awareness, and attitudes with a specific focus on:

- Consumer level of interest for investing in extending natural gas service to their farm
- Evaluating the real costs of extending natural gas lines, ongoing fees/cost, as well as the costs of converting equipment
- Cataloguing benefits, challenges, and lessons learned from farmers who have invested in natural gas conversion

A primary goal of this project was to determine the overall level of interest of investing in extending natural gas service to Ohio farms and identifying individuals who have experience with this type of project to summarize the benefits and challenges. This provided information and data to identify actionable recommendations that will inform future Extension outreach and education programs.

Table 1 below, outlines the detailed issues of interest that relate to each of the research objectives.

Table 1	
Research Objectives	Issues of Interest
Identify Ohio farmers that have already invested in converting their farm from propane to natural gas.	<ul style="list-style-type: none"><li>• Cost of the natural gas conversion project</li><li>• Project payback period</li><li>• Benefits and challenges from the conversion</li><li>• Level of satisfaction</li></ul>
Assess interest of Ohio farmers in extending natural gas line to service their farm operations.	<ul style="list-style-type: none"><li>• Level of concern regarding availability and cost of propane</li><li>• Required equipment upgrades</li></ul>
Evaluate the awareness of existing natural gas infrastructure.	<ul style="list-style-type: none"><li>• Proximity of nearest natural gas line to the farm</li><li>• Size and type of natural gas line</li><li>• Primary contact in the natural gas value chain</li></ul>

Findings from this study provided research-based data driven tools that will help Ohio farmers navigate propane to natural gas energy infrastructure investment options. The outreach, education and tools will help prepare Ohio farmers to identify and understand the opportunities and threats of propane to natural gas conversion projects by fostering informed decisions, leading to better long-term profitability of Ohio farms.



## Literature Review

Relevant literature focuses on the economics of farm management and effects on rural economies, specifically related to energy costs. Publications, such as “Impacts of Higher Energy Prices on Agriculture and Rural Economies”, are published by the USDA Economic Research Service (ERS). This particular publication is a comprehensive analysis of the impact of energy costs on farming. Conclusions resulting from the study are also shared, in part, with other reviewed literature (Shoemaker, McGranahan, and McBride 2006, Shoemaker, McGranahan, and McBride, 2006). The conclusions are:

1. Energy-related production expenses vary for different crops
2. Energy impacts are lower for livestock producers
3. Technology is recognized as helping to lower energy costs in the future
4. Energy cost effects vary regionally
5. Consumer food prices are impacted indirectly by energy costs, but more as a result of manufacturing and processing than production
6. Farm county economies and populations did not appear to be impacted by higher energy prices affecting the agricultural sector

Farms of all types, whether grain, dairy or poultry, have historically sought ways to reduce energy costs in order to mitigate risk and boost profit. Converting from propane to natural gas has been an ongoing discussion for at least a decade. In the Poultry Engineering, Economics & Management Newsletter (Campbell, Simpson, Donald & Macklin, 2008) explained what is involved in converting from propane to natural gas, including common pitfalls and problems, and the economics and possible payback of a conversion project. Since drying corn is one of the major energy-related expenses for farmers, literature compares the use of propane and natural gas, in addition to the use of other energy saving methods, for this purpose (AgTalk 2011 and Sanford, 2005).

Of all the concerns for farmers, energy price volatility remains one of the most significant, since prices are difficult to forecast. Literature (Parker, 2014) describes volatility of prices and supply of propane and trends related to energy prices and consumption (Hitaj and Suttles 2016, Park, Ahearn, Covey, Erickson, Harris, Ifft, McGath, Morehart, Vogel, Weber and Williams, 2012, Parker, 2014 and Sloan, 2016). Other literature points to new technology that could support “going green”, although it is currently not necessarily economical (Hewson, 2009). With new technologies coming on board, according to the latest trends reports (Sloan, 2016 and EIA, 2014), prices will become even more competitive.





## Study Design

Our research team conducted a survey using an Internet and email tailored design method (Dillman et al, 2009). The OSU Research team used the Qualtrics software to design the survey instrument, which was distributed electronically by the Ohio

Soybean Council Communications Director and the Ohio C.O.R.N. Newsletter Editor. The Communications Director and Newsletter Editor sent an email invitation to sample frame population inviting them to participate in the electronic survey, informing them that the survey is for research purposes only, how long the survey is expected to take, and that they may exit the survey at any time. The survey was launched on December 1, 2016 and was active until May 22, 2017. The response data was housed and managed on Qualtrics systems. All information is secured via industry standard firewalls and stringent information technology security policies and procedures.

As a part of the survey, participants who have invested in natural gas infrastructure projects on their farm were asked if they are interested in participating in an interview with a member of the OSU Research Team. After the farmer interviews were conducted, the research team permanently removed personal identifiers from the dataset and their responses to the survey were de-identified so they could not be reasonably identified. For participants who did not volunteer for an interview, the research team did not have access to personal identifiers associated with each individual respondent. Participants from both the survey and face-to face interviews were informed their feedback would be reported in aggregate.

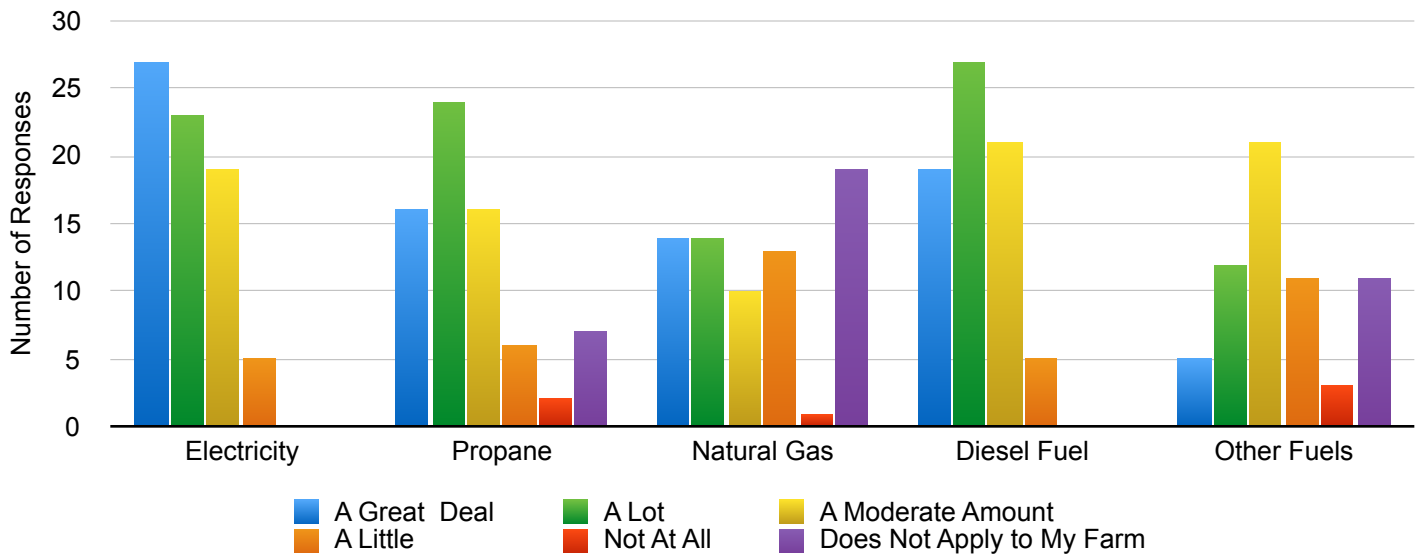


## Electronics Survey Results

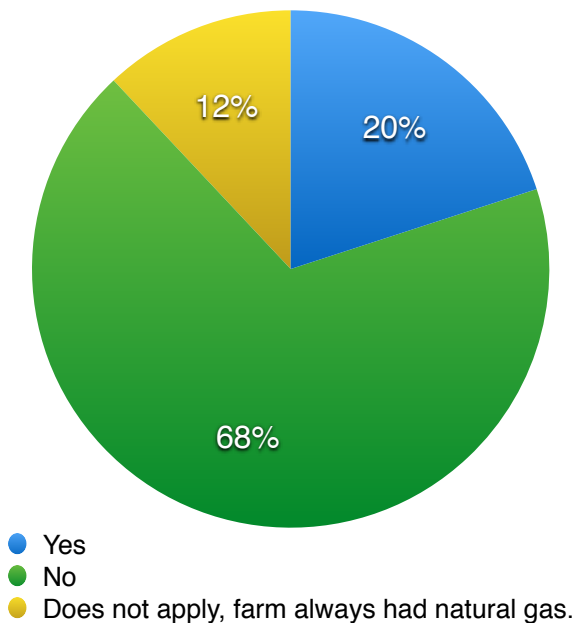
Survey design work began in May 2016. The final research protocol, a 10-item survey and informed consent correspondence was submitted to The Ohio State University Office of Responsible Research Practices in August 2016 for review receiving final approval on September 16, 2016. The survey was launched on December 1, 2016 using an email survey yielding a total of 88 responses.

Descriptive statistics were used to provide simple observations and summaries about farm energy use, cost concerns, and the level of interest for investing in extending natural gas service to their farm. Basic statistical analysis including frequencies, percentages, means, modes, medians, ranges, standard deviations, and variance were utilized to analyze and summarize the data using a combination of Excel and Qualtrics Data Reporting software. A summary of the key findings by survey question, are listed below.

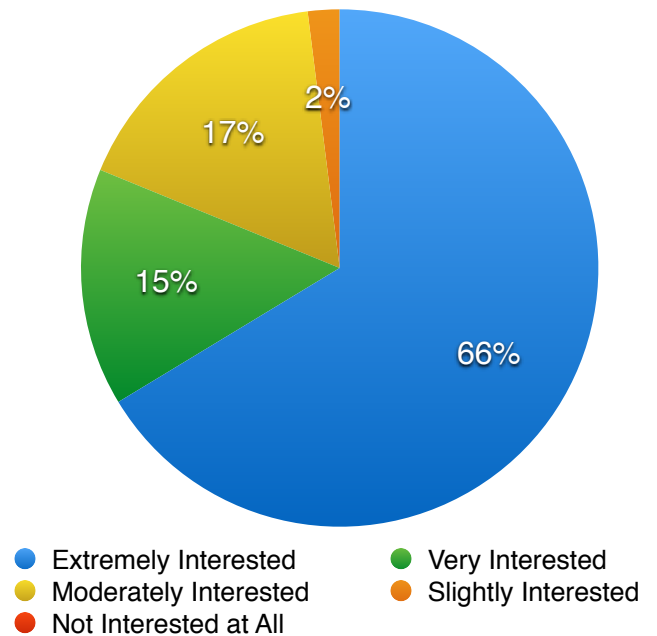
**Question:** Please indicate your level of concern regarding current or future energy prices for the following energy sources on your farm.



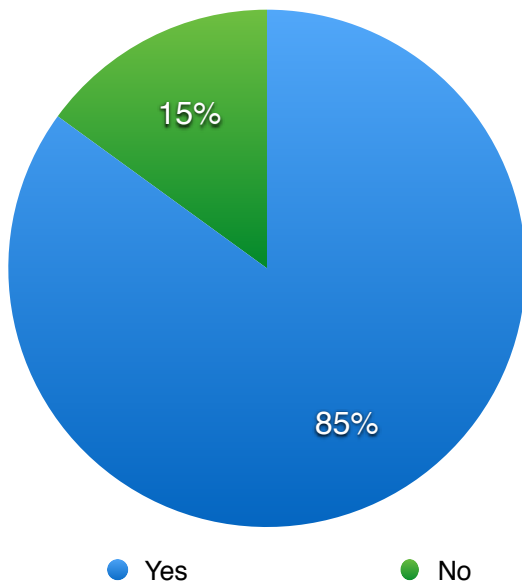
**Question:** Have you extended a natural gas line to your farm and converted your farm operations from propane to natural gas?



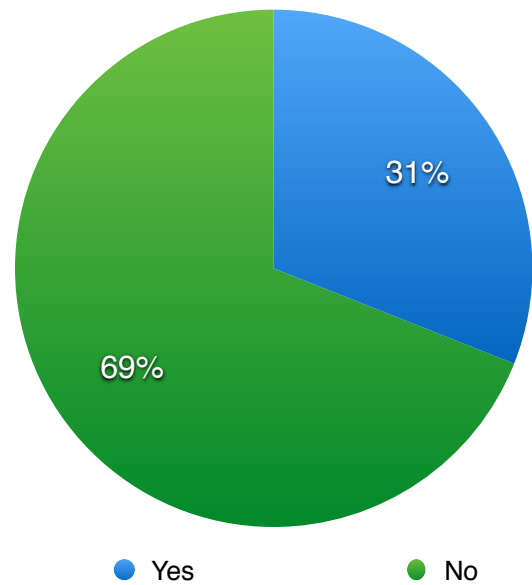
**Question:** What is your level of interest in extending a natural gas line to your farm to convert from propane to natural gas service?



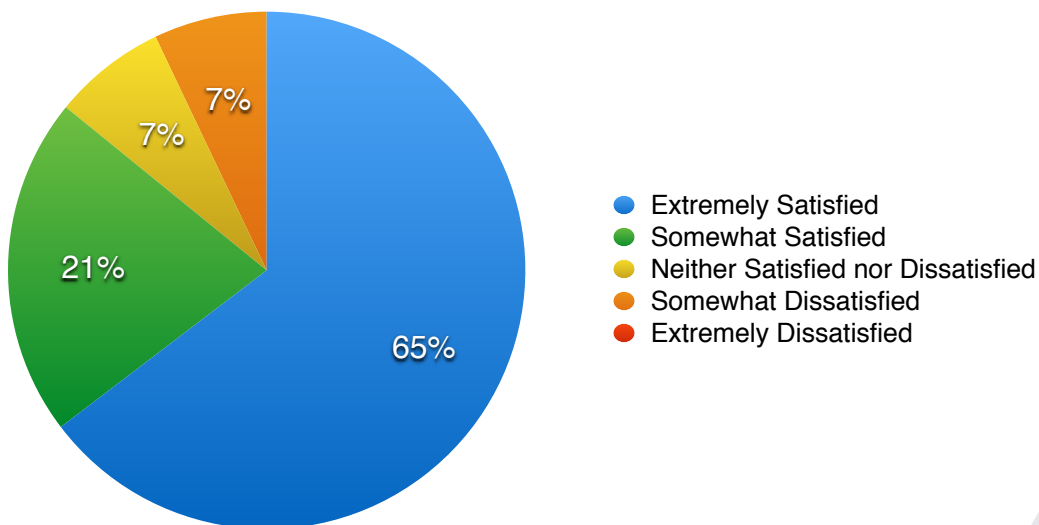
**Question:** Are you aware of the location of the gas line nearest to your farm?



**Question:** If you are interested in converting to natural gas, do you know who to contact to start this process?



**Question:** 14 respondents that converted from propane to natural gas were asked to rank their level of satisfaction with the decision to convert their farm from propane to natural gas.





## Lessons Learned from Farmer Interviews

In most instances, large interstate or intrastate natural gas pipelines are under very high pressure, therefore local farms are often not allowed to tap into these. However, if there is a local natural-gas distribution line, it may be cost-effective to switch from propane to natural gas. However, there are a number of considerations beyond the simple project payback period to investigate. In this section, key lessons learned from the farmer interviews are summarized to highlight critical economic, implementation, and operational considerations to guide the overall project evaluation in determining if it makes sense to switch the farm from propane to natural gas.

- **Proximity of nearest natural gas line to the farm** - The first and perhaps most critical consideration in evaluating this process is to determine if there is a natural gas distribution line in close proximity to your farm. This will make a significant impact on the overall project cost and payback period. Based on the farmer interviews, the shortest distance from the farm to a natural gas line was 2,000 feet, the furthest distance was 10,560 feet, and the average distance for all farmers interviewed was 4,866 feet. In comparison, the 88 farmers who completed the electronic survey indicated the average distance from the farm to the interconnection point was 9,731 feet, which is nearly a mile greater than the distance from the completed projects. All of the completed projects connected to a local natural gas distribution line.
- **Peak Demand** - If you determine there is a natural gas line in your area, it is important to confirm there is enough pressure available to support the peak demands of multiple grain driers running at the same time during the drying season. Perhaps the most surprising and critical finding from the farmer interviews was six of the nine farms indicated they had some level of concern over peak demand spikes lowering the pressure in the natural gas line servicing their farm. For example, in one extreme case, a farm had spent roughly \$100,000 to extend a natural gas line to their grain drying operation in 2011 and used natural gas for three years providing significant cost savings due to high propane prices at that time. After the gas line was extended to the farm, additional users contracted with the natural gas company to tap into the same line. Then, in the fall of 2014 their dryer utilized a large volume of natural gas and this peak load triggered the low-pressure alarm, the farm was shut off, their meter was locked out and natural gas service was never brought back on-line. When asked if they were satisfied with their natural gas conversion project, the farmer noted:

*Yes, we would certainly do it again (based on the energy prices at that time), however we would approach it differently. I would make sure we have a delivery guarantee or service guarantee in the contract. At a minimum, we would want language to get a prorated fee back from the gas company to recover our initial installation investment in the event we could not use the gas line we paid to install. At the time, we didn't know they could stop our service and never thought this would be an issue.*

While this may be an extreme example, five other farmers indicated that the pressure in the gas line would periodically drop when they operated grain dryers, causing them to shut their dryers down. Another farmer noted he always calls his natural gas provider to increase the pressure in the natural gas line during the drying season. In summary, it is important to make sure the infrastructure is properly sized for your facilities' peak demand, and also account for possible future additional loads in the area that could influence your farm.

- **Fuel price** – A common thread from our interviews was related to the timing of the project development. The majority of the natural gas conversion projects were completed between 2011 and 2013. During this time frame, farmers were motivated to explore alternatives to propane as this was the largest gap in spot pricing between propane (Mont Belvieu) and natural gas (Henry Hub) since 2000. While propane prices were high during this time, it is important to remember energy prices are commodities tied to global markets and often fluctuate. For example, propane spot prices (which does not include the cost of transportation, local distribution, and overhead) in Mont Belvieu, TX recently peaked in June 2008 at \$1.86 per gallon, again in September 2011 at \$1.56 per gallon, and a third time in February 2013 at \$1.44 per gallon, however prices have since dropped to \$0.65 per gallon in April of 2017 (USDOE/EIA, June 2017). A farmer interview noted:

*They (gas company) came to us with a contract, we ran the numbers and it appeared to be economical, providing a one-year payback. Remember, propane was very expensive and natural gas was cheap during this time (2011). Based on today's market conditions the payback would not be as attractive.*

It is important to evaluate current energy prices and understand overall market trends at the time you are considering a conversion project. For additional information on energy pricing, production, and consumption trends please review the technical report [Energy Overview: Evaluating Propane and Natural Gas Trends](#).

- **Cost to Extend the gas line** – Several projects received an “all in one” quote from the natural gas cooperative to extend the line, while other farms completed their own trench work to save cost on the installation. Based on the farmer interviews the lowest cost to trench the gas line from the interconnect point to the farm was \$0.63 per foot, the highest cost was \$13.63 per foot, and the average cost was \$7.86 per foot. It should be noted the lowest installation cost per foot (\$0.63) was based on a project where the farmer completed his own trenching. The other projects had the gas line installed by the gas company or their contractors. One interviewed farmer was asked how his installation cost was so low and he noted:

*Yes, I have a backhoe and we took a couple days after wheat harvest and dug gas line trenches from the interconnect point to my dryer, home, and hog barns. We had a guy come in and hook everything up and complete the pressure test. Everyone around here knows someone that does this type of work.*

- **Cost for farm equipment conversion** – In addition to trenching cost, some farms have additional cost to convert their equipment from propane to natural gas. Common equipment costs include replacing burners (or modifying orifices), replacing regulators, and updating the gas line plumbing systems to accommodate the appropriate volume demands of natural gas. The cost to convert a dryer from propane to natural gas will vary based on the type, size, and age of your dryer. Based on interviews with farmers and equipment manufacturers, the reported conversion cost ranged between \$1,800 and \$5,000. In addition, two farmers indicated they decided to purchase a new dryer instead of upgrading their old one. Finally, one farmer utilized the [USDA Rural Energy for America Program \(REAP\)](#) to help fund a portion of his project. The USDA REAP Program provides guaranteed loan financing and grant funding to agricultural producers to purchase or install renewable energy systems or make energy efficiency improvements such as grain dryer replacements.
- **Project Planning/Timing** – Regardless if you are drying grain or heating livestock buildings, access to a secure energy source on your farm is critical. As with any construction project, understanding the timeline is important to minimize risk and operational downtime. While in most instances, the installation process went as planned, one farmer noted the following:

*I was told that I would have gas in the fall and I bought a natural gas dryer. The gas company didn't get me natural gas that season and I had to buy a vaporizer (\$3,500) so that I could run my gas dryer on propane. I didn't get natural gas service for 3 years after we started the process.*

However, other farms suggested the installation process proved to be seamless and quick. One farmer noted, “the installation of the gas line took three months, and the additional plumbing at the dryer only took 8 hours total”. While it is difficult to predict how the project development process will go, it is important to have open communication and prepare for timeline setbacks that may occur during the drying season.



## Next Steps

Based on the electronic survey results, 68 percent of the farmers interviewed indicated they did not know who to contact to convert

their farm from propane to natural gas.

Furthermore, phone interviews with two grain dryer companies indicated that 90 percent of their customers would strongly consider converting to natural gas, yet in general the natural gas companies did not seem interested. However, based on farmer interviews, nine indicated contact was initiated by a natural gas cooperative provider.

After you have reviewed this information, what is the next step? First, use the map to the right to identify a natural gas cooperative provider in your area and determine if there is interest. If there is mutual interest, schedule a site visit to evaluate your farm operations and the exact location of the interconnection point. When meeting with a representative from the natural gas cooperative, key questions to ask include:

[Click Here For Larger View](#)



- What is the proximity of the nearest natural gas line to the farm?
- If it is feasible, what is the size and type of gas line available to your property?
- What is amount of natural gas pressure available at the farm?
- Is there a service contract that needs to be executed?
- Does the natural gas cooperative have a service delivery guarantee?
- What is the current fuel price? What was the price last year? What is the anticipated price next year?
- What are the costs for running a line from the nearest natural gas line to the farm?
- Regarding construction costs, what are the charges for a service meter tap?
- Is there a monthly meter fee?
- Are there any other specific costs required by the natural gas cooperative to convert?
- Upon conclusion of the project, what part of the infrastructure is the farmer liable for? Is this in writing? Does this require additional insurance?

Once you have had the initial meeting, additional considerations include:

- What are the property trenching costs? Is there an option for the farm to complete some of this work if the equipment is available?
- What are the conversion costs for dryer burners, regulators, and any additional mechanical equipment upgrades?
- What is the timing for the project implementation? How can you guarantee the construction process is complete prior to the drying season?
- Are funding opportunities available to support this project? (e.g., USDA Rural Energy for America Program, Other)
- Can the natural gas cooperative provide enough natural gas during the peak drying season? How is this calculated and what measures are in place for future gas demands brought onto the distribution line servicing your farm?



## Closing Comments

Energy price uncertainty and its' relative cost in the production of crops has emerged as one of the greatest concerns for farmers. The Ohio Soybean Council and OSU Extension seeks to provide resources and information that will assist farmers in making informed decisions regarding energy use on the farm. This project offers timely lessons learned, tools and resources that can assist in the decision-making process.

After gathering all the data and information, if you feel converting your farm operations to natural gas makes sense, please click [here](#) and complete the [Natural Gas Conversion Project Payback Estimator worksheet](#). When finished with this worksheet, you will have an idea of how long it will take for this project to be paid back based on your specific farm location and energy needs.



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