

FALL 2019

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BATTLING CORROSION

How Technology Has Changed the Fight to Protect

Fighting corrosion has been a key part of pipeline integrity management for almost 50 years. While the threats are fairly well known, technology has changed how the industry assesses and addresses corrosion control.

Pipeline companies have more data about their assets than ever before. How they use that data has a major impact on managing corrosion and extending the life cycle of pipelines and other facilities.

Not only must operators keep up with the staggering amount of data they're collecting through integrity management assessments, but they also must keep ahead of increasing governmental regulations that continually move the goal posts for operational excellence.

Better technology and increased industry standards are all about improving safety, according to Drew Hevle, corrosion control manager at Kinder Morgan.

"Certainly, the concerns about protecting people, the public and environment are ever increasing," Hevle says. "Standards for safety and the environment continue to raise the bar. Regulations are more and more stringent and broader. New technology and capabilities that we didn't have in the past have been applied to continue to improve the safety of pipelines."

One of the key considerations for improving corrosion control processes is the concern over aging infrastructure, according to Dirk van Oostendorp, director of engineering services for Corpro.

"There are some very old pipelines still in service that were built in the mid-1950s," van Oostendorp says. "Typically, when you design and build a pipeline, you design it to last for 25 years. Many of our pipelines are well beyond their design life. If you tried to replace them all, the cost would be astronomical. And there are no guarantees you're going to get the permits to install a pipeline in the same location. Everyone is very focused on what I call geriatric rehabilitation to keep these pipelines operational."

Understanding the Threats

Pipeline corrosion is caused by a number of different factors. The presence of water in a pipeline, soil conditions, proximity of power lines, certain microbes, external damage, impurities in the pipeline - all of these are major causes of corrosion.

The first line of defense is the pipeline coating, applied both externally and internally to protect against the environ-

ment where the pipeline is installed and the material flowing through the pipe. If the coating becomes damaged, there are methods for rehabilitating it as needed.

Cathodic protection (CP) systems guard against exterior pipeline corrosion by applying anodes, rectifiers and DC currents to redirect corrosion to an anode that can be replaced.

AC mitigation protects pipelines that are built parallel to overhead power lines. There are a number of ways to protect pipelines against AC interference, including fault shielding, gradient control mats, grounding systems and gradient control wire.

Microbially influenced corrosion (MIC) can be assessed using nondestructive evaluation (NDE) and compared to existing corrosion data. Proper mitigation is determined on a case-by-case basis, once the characteristics of the microorganisms present in the pipeline are determined.

External damage, from most commonly third-party strikes or installation errors, can also lead to corrosion by causing damage to the coating. Stress corrosion cracking (SCC) is another area of concern, caused by a combination of environmental, stress and material factors.

Further methods of corrosion control are based on pipeline integrity management systems, such as inline inspection (ILI), ultrasonic testing (UT), radiographic testing (RT), hydrotesting and other means.

A Mature Market

Corrosion control is "a fairly mature market," Hevle says, referring to the knowledge of threats and the understanding of longstanding regulations.

"The initial regulations relating to pipeline corrosion came out in 1971, and many of them have not been changed since then," he says. "There's not a lot new in that regard. What is new is the availability of data from integrity assessments we can use to prioritize efforts to identify threats, to understand them better and where we need to apply additional resources for corrosion monitoring and mitigation."

Corrosion threats are also pretty much the same as they have been for 40 years, Hevle says, explaining that a relatively new threat like AC corrosion came to light in the 1980s.

"Those threats are fairly well understood now," he says. "We've had consensus on industry standards on how to address

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NGSA Winter Natural Gas Outlook Forecasts Record Production and Record Demand, Offset by Warmer Winter

Natural gas supply and demand are projected to reach historic highs this winter, the Natural Gas Supply Association (NGSA) said in its 19th annual Winter Outlook forecast of the wholesale winter natural gas market.

The NGSA 2019-2020 Winter Outlook for Natural Gas predicted that record demand will be driven by liquefied natural gas (LNG) exports, pipeline exports to Mexico and domestic demand growth in the electric sector. **NGSA predicted that record production will ably satisfy demand, and said the combination of abundant supplies, warmer weather and healthy storage is expected to result in downward pressure on natural gas prices compared to last winter.** Last winter, natural gas prices at the Henry Hub averaged \$3.33 per MMBtu.

NGSA's Winter Outlook relies on published data and independent analyses. NGSA evaluates the combined impact of weather, economic growth, demand from domestic and export customers, storage inventories, supply activity and "wild card" factors on the direction of natural gas prices of the winter of 2019-2020, compared to last winter.

"All signs point to good news for natural gas consumers this winter," said Orlando A. Alvarez, Chairman of NGSA and head of BP's North American gas marketing and trading business. "The forecast for warmer weather and abundant supply in NGSA's Outlook should enable U.S. natural gas to stay even more affordable and reliable this winter while satisfying growing demand for cleaner-burning electricity manufacturing and heating here and around the world."

According to NGSA, wholesale natural gas prices averaged only \$3.33 per MMBtu last winter.

Key Demand Factors 2019-2020: Export Growth, New Gas-Fired Generation, Warmer Winter

In total, the NGSA Outlook projects customer demand to reach a record 109.3 Bcf/day this winter.

Export customers: Record growth in LNG exports and pipeline exports to Mexico are expected. The NGSA Outlook projects 8.3 Bcf/day in LNG exports and 5.8 Bcf/day in pipeline exports to Mexico this winter, for a record

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Battling Corrosion

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those concerns and regulations put in place to address them.”

However, a major change is coming to the industry. Hevle says the pipeline industry is awaiting sweeping revisions to natural gas safety regulations late this year. Known as the “Gas Mega Rule,” the U.S. Department of Transportation’s Pipeline and Hazardous Materials Safety Administration (PHMSA) is finalizing a set of rules that could double the number of pages of regulations that impact natural gas infrastructure.

According to a report from corrosion protection provider Matcor Inc., PHMSA’s proposed rulemaking will be broken up into three parts. The first section will address the expansion of risk assessment and maximum allowable operating pressure (MAOP) requirements to include areas in non-High Consequence Areas (HCAs) and moderate consequence areas (MCAs). Another part of the rulemaking will focus on the expansion of integrity management program regulations, including corrosion control to gathering lines and other previously non-regulated lines. And finally, the rulemaking is expected to focus on reporting requirements, safety regulations and definitions to include expanding into related gas facilities associated with pipeline systems.

“The trend of increasing regulations just reflects society’s expectations of higher and higher levels of safety,” Hevle says. “In the same way that public expectations are increasing, we also have a better-informed public than ever before because of the information available on the internet and social media.”

For an operator, the governmental regulations should act as a baseline for the minimum required corrosion protections, adds John Strong, technical field specialist for Polyguard.

“If an operator discovers corrosion on a pipeline the government regulations give a timeline for when a remediation is due,” Strong says. “A prudent operator will take this corrosion discovery as an opportunity to learn why it occurred. While the government regulations do drive most of the corrosion work performed on pipelines, it is also in the operators’ best interest to have a proactive stance when it comes to corrosion protection.”

In addition to regulatory considerations, corrosion protection providers are being asked to improve efficiency, says Keith Nevils, product director for pipeline services at Corpro.

“There’s an impetus to do things faster or do it for less money,” he says. “It’s driving in both directions. On the efficiency and quality side, data collection is a big one. Because operators have to report to PHMSA on a regular basis, can you imagine if you had a binder full of papers that you had to look at every time? That’s a terrible way to manage your data, but still a number of companies are doing it that way.”

Lots of Data

New technology has made it possible to collect vast amounts of data about pipeline conditions, but technology has also made it easier to ensure data is accurate, Nevils says. For instance, a voltage meter can be outfitted with Bluetooth to enable a tablet computer to automatically import and view measurements. Technology allows electronic data collection to be pushed into a repository to find at any time.

“We may get some pushback in the industry with a resistance to technology,” Nevils says. “But more and more, we’re finding people who embrace technology.”

Hevle agrees, explaining how Kinder Morgan uses technology to build a robust database on its pipeline systems.

“We use a GIS system now that incorporates data not only from pipeline construction material, but from monitoring corrosion mitigation, as well as gas quality information from other sources,” Hevle says. “We have soils information and satellite photos that we can overlay in our GIS to show transmission power lines that we use to identify where we may have AC corrosion threats.”

Hevle describes how his job has changed since he entered the pipeline industry because of technology, noting that it has become a lot more computer-focused over the years.

“When I first started, it was a question of how to find information to make educated decisions,” he says. “Now we have to find a way to manage all the data we have to make those decisions. We have the opposite problem. We have more data than a person can process. We’re looking at different ways to present the data graphically and automate processes using algorithms to process multiple different components.”

Automated Accuracy

Automating data collection not only improves the accuracy of the information, it also improves efficiency and allows operators to make decisions quicker, according to Alasdair Stoddart, director of pipeline integrity management at Corpro.

“Information collected from an asset is moving from having a technician in the field and data being collected with pen and paper, and then having the information typed into a document, to instead using electronic data capture,” Stoddart says. “That’s becoming a more integral part of asset management. As that trend continues, what we find is that the accuracy of the data becomes hugely improved. We find that the efficiency of gathering information is improved, and the real-time nature of the data is improved to the point where the asset owner has access to the information much faster than in the past.”

By automating data collection and getting the information quicker, Stoddart explains that the pipeline industry is able to move to a risk-based decision-making model, rather than time-based decision making.

Moving from prescriptive corrosion surveys to risk-based inspection (RBI) and quantitative risk assessment (QRA) driven internals is where the industry should be moving, according to Daniel Ersoy, executive director of R&D at GTI. This is also well-aligned with the principles of distribution integrity management plans (DIMP) as required by federal and state regulations.

Changes to Come

While the pipeline corrosion market is mature, there are coming changes that could impact the industry in the next few years in terms of how corrosion control providers work with operators and how new technology will be implemented.

Stoddart sees pipeline operators looking at service providers to be stronger partners in the fight against corrosion.

“We’re looking to become an integrity partner with our customers, being more of a full suite provider from pipeline commissioning to monitoring thereafter,” he says. “Asset owners are looking for integrity companies to provide more guidance. Let the experts do the role they were designed to do more effectively.”

Nevils believes that there is still a tremendous amount of technology that can be introduced to the corrosion control market.

“What we’re doing with data collection, we’re like Google in the early days,” he says. “We’re building the repository for data, and now we need to do something with it, so we can become more predictive. That way we can get in front of the problem, instead of being behind.”

As computing power increases, Nevils says that the pipeline industry will be able to better understand the massive amounts of data it has and will continue to collect about the condition of its assets.

Ersoy agrees, noting how the Internet of Things (IoT) could impact the industry.

“IoT and other communication technology and protocols have the potential to change how we collect, pre-process, communicate and post-process corrosion-related data to make engineering, risk and integrity management decisions,” Ersoy says. “This might make it possible, especially for surface accessible locations, to have sensors for temperature, humidity and moisture, cathodic protection and pipe-to-soil levels, pH, conductivity, resistivity, etc., that are all real-time and communicated to a central database to enable more accurate risk calculations.”

Ersoy also believes that coatings will continue to improve.

“Interest is growing in novel and nano-based coatings for internal corrosion and flow improvement, as well as external self-healing and active passivation and sacrificial protection systems,” he says.

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NGSA Winter Natural Gas Outlook

Continued from page 1.

14.1 Bcf/day in U.S. natural gas exports—an overall increase of 52 percent in U.S. exports compared to last winter.

Alvarez said, “LNG exports are bringing the environmental benefits of our lower emissions to overseas customers, while providing jobs, economic benefits and stability to the U.S. Market.”

Domestic customers: Looking at demand from the various sectors, the Outlook forecasts domestic demand of 87.9 Bcf/day from the electric, industrial and residential/commercial sectors combined this winter.

- ◆ **Electric growth.** The Outlook projects that natural gas-fired power generation will represent the greatest contributor to domestic demand growth this winter. About 7,000 megawatts of new natural gas-fired generation are estimated to have come online during 2019, contributing to electric demand of 27 Bcf/day, about a 5 percent increase in electric sector demand for natural gas compared to last winter.
- ◆ **Industrial growth.** Expected to grow minimally this winter, by about 0.1 Bcf/day. This slight growth is the result of a slowing global economy and business uncertainty about the impact of tariffs. However new builds and capacity expansions in the natural gas-intensive petrochemical and fertilizer industries continue to contribute to the industrial sector’s demand for natural gas. NGSA said 47 major gas-intensive projects are planned over the 2018-23 time period, consuming an estimated 2 Bcf/day more of natural gas annually by 2023.
- ◆ **Residential/commercial growth.** The National Oceanic and Atmospheric Administration’s (NOAA) forecast for a winter that is 4 percent warmer than last winter is expected to cause residential/commercial demand to decrease by 2 Bcf/day.

Key Supply Factors 2019-2020-Record Production and Ample Storage

In total, the NGSA Outlook projects natural gas supply (production, Canadian imports and storage) to average a record 109 Bcf/day this winter.

The Outlook projects a winter of tremendous growth in production of about 4 Bcf/day, which is a substantial 4 percent increase. However, it pales in comparison to the remarkable increase of more than 10 Bcf/day that occurred last winter. While the growth rate is currently slowing, production continues to grow and reach record milestones.

Alvarez said, “We’ve witnessed amazing growth of nearly 40 percent in production in the six years since 2013. The shale revolution has ushered in a remarkable era, with ongoing improvements and efficiencies in production keeping supply flowing. The shale revolution has benefited customers with stable, low prices, and enabled reductions

in carbon emissions to 25-year lows. Natural gas producers are working to do even more to support a clean energy future that is affordable for all.”

In brief, NGSA’s analysis of individual supply and demand factors showed:

Weather-Anticipated 4 percent warmer than last winter and 2 percent warmer than the 30-year average. **Downward pressure.**

Economy-Expected GDP growth of 2.1 percent is similar to last winter’s 2.6 percent. **Neutral pressure.**

Overall Demand-Customer demand projected to average record 109.3 Bcf/day. Major growth of 52 percent expected in the **export sector.** **Electric** and **Industrial** demand are each expected to set new records, with electric demand increasing by 5 percent. Industrial growth projected to be minimal but nevertheless a winter record. **Residential/commercial** demand expected to decrease due to warmer winter. **Neutral pressure.**

Storage-Expectation to enter winter near the 5-year average with about 3.7 Tcf of gas in storage, considerably more than last winter’s 3.2 Bcf levels. **Downward pressure.**

Supply-Production is expected to increase by substantial 4 percent, substantial but not as much as last winter’s soaring increase of 14 percent. **Neutral pressure.**

NGSA used data from Energy Ventures Analysis and the Energy Information Administration for its demand and supply projections and HIS Markit for its economic projections. **The NGSA analysis is based on publicly reported data; the association does not project actual price figures for wholesale or retail markets.**

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“These coatings hold promise to provide improved corrosion resistance and system performance, while simultaneously lowering maintenance and repair costs.”

As the war against pipeline corrosion wages on, technology has changed and will continue to improve safety and integrity throughout the industry.

Natural Gas Facts

Natural gas is an important fuel source, a major feedstock for fertilizers, and a potent greenhouse gas.

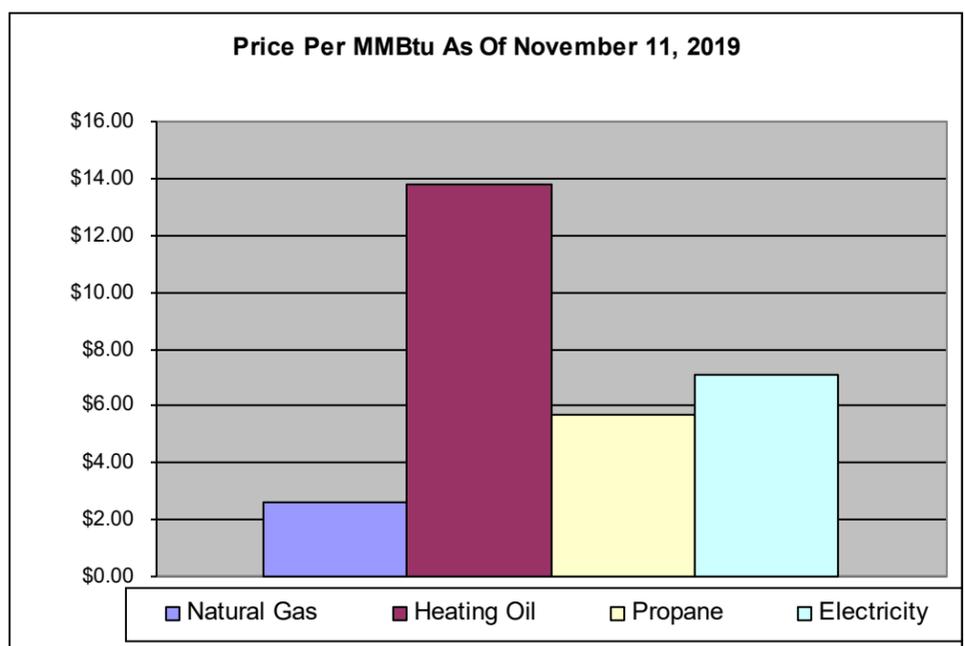
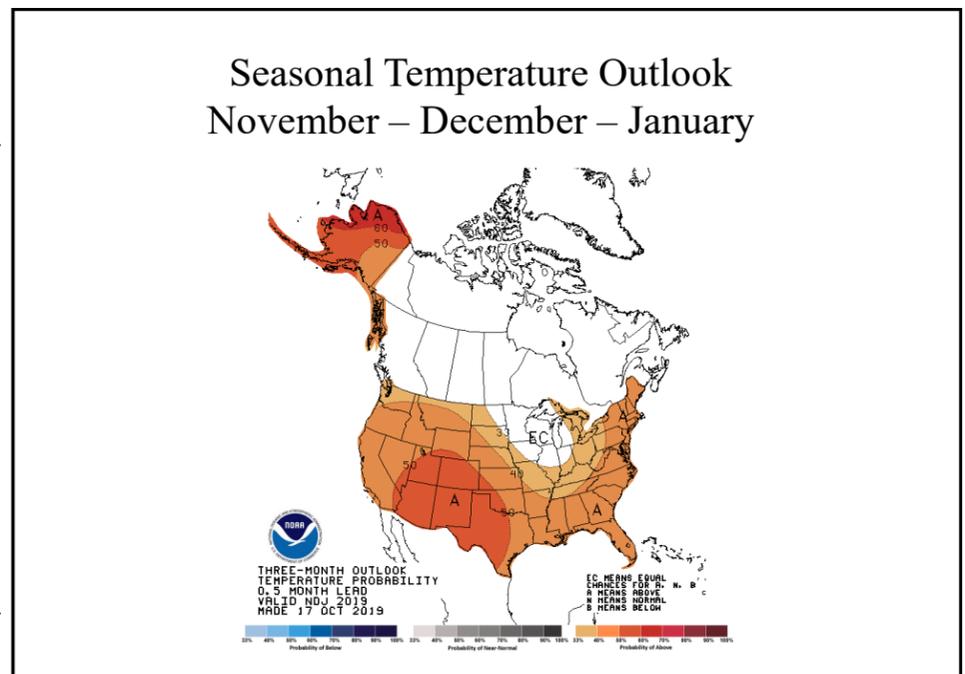
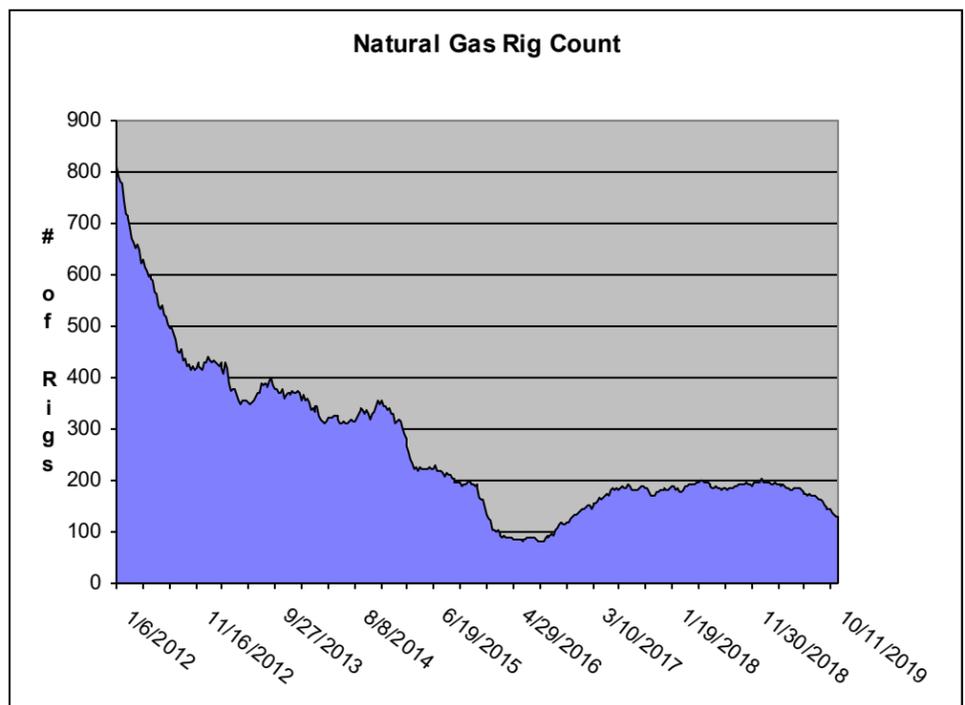
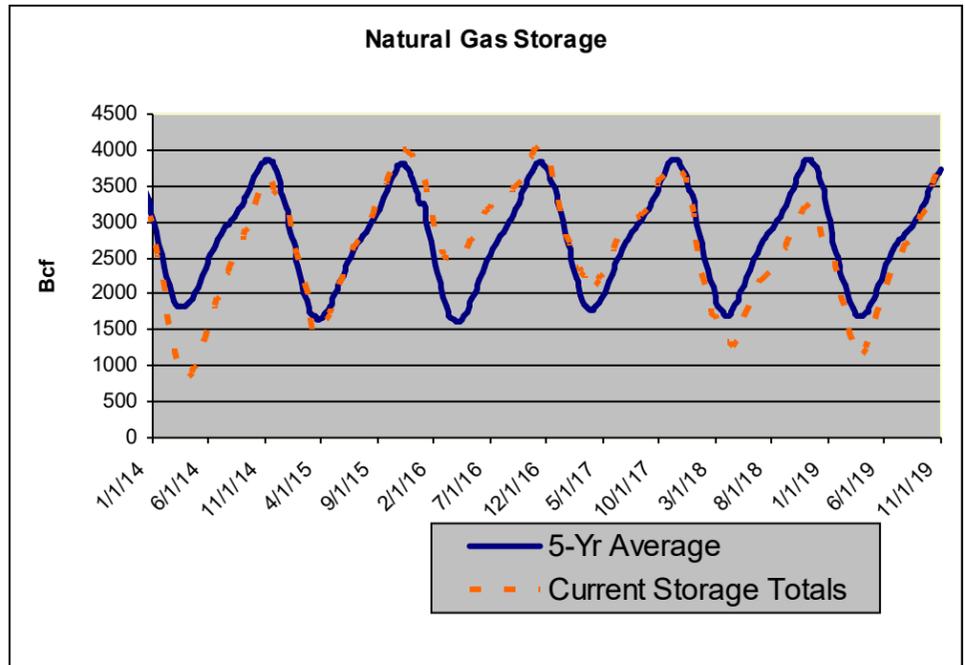
Natural gas storage and transportation is its biggest difficulty because of the low density.

Before gas can be used as a fuel, it must undergo extensive processing to remove almost all materials other than methane.

Natural gas can be found in oil fields, natural gas fields and coal beds.

Natural gas is a non-renewable energy source as all fossil fuels are and is used mostly for generating electricity and heating.

Snapshots



Natural Gas Market 2019-2020 Winter Outlook Overview

U.S. natural gas supply and demand for 2019-2020 winter are both forecasted to experience substantial growth winter-over-winter. Total gas production is expected to grow 3.8 BCFD winter-over-winter, while demand components combined will grow 3.1 BCFD (See Exhibit 1). Winter 2019-2020 storage inventories of natural gas are forecasted to start the winter heating season at 3,712 BCF, near the five-year average level. Assuming a 10-year normal weather for the 2019-2020 winter gas withdrawals are forecasted to total 1,879 BCF, which is slightly lower than the five-year average. The lower-than-average withdrawal is due to record-high production outpacing demand growth (Exhibit 2).

Exhibit 2 presents a sector-by-sector look at changes expected this winter compared to last winter. The decline in the Residential and commercial sector is the result of expected milder winter weather compared to last winter.

The highlights of the 2019-2020 winter outlook include the following:

Lower-48 production is expected to grow further for the 2019-2020 winter.

Dry gas production is forecasted to average 92 BCFD this winter, which will represent 3.8 BCFD (4%) of growth winter-over-winter. This winter, associated gas production from the Permian will contribute to the largest gain since production is likely to ramp up quickly as the 2-BCFD Gulf Coast Express pipeline and cross-border Mexico export pipelines are currently commissioning or recently entered service. Elsewhere production from the Marcellus, Utica, Haynesville shales will grow further to meet regional demand and fill takeaway capacity. The strong growth from these areas will more than offset declines from conventional plays.

Power demand will maintain its growth momentum.

The strong growth in power demand is the result of low-natural gas prices, which encourages the dispatch of gas-

fired generation units, as well as structural growth due to the addition of new and highly efficient combined cycle gas turbines (CCGTs). Structural growth due to these new CCGT additions has increased steadily over time, creating a strong base for power burn growth. On a national level, a 20 cent/MMBTU decline in natural gas prices would increase power burn by 1.2 BCFD while a 20 cent MMBTU increase would reduce power burn by only 0.6 BCFD. Thus, there is more potential upside to power burn for this coming winter because of the market price sensitivity of demand.

Total natural gas exports-Gas exports via pipeline to Mexico and LNG exports-will lead the demand growth this winter.

Total natural gas exports are expected to grow by 4.8 BCFD winter-over-winter. The anticipated increase in gas flow via the Mexico Sur de Texas-Tuxpan pipeline is expected to increase gas demand in South Texas since late September. In terms of LNG, three new trains-Elba Island Phase 2 (0.1 BCFD), Freeport Train 2 (0.6 BCFD), and Cameron Train 2 (0.7 BCFD)-are expected to start up this winter, bringing total LNG export capacity to 8.5 BCFD by March 2020.

Based on the near-term supply and demand dynamics, natural gas storage levels are expected to finish the 2019-2020 winter withdrawal season at 1,833 BCF, slightly above the five-year average.

Production growth is expected to respond quickly to demand gains, resulting in lower-than-average storage withdrawals for the coming winter. Winter weather plays an important role in Residential and Commercial gas demand. A cold winter scenario can result in a below-average end-of-March storage level; however, winter weather is forecasted to be milder this winter compared to last.

there is a growing effort to influence policymakers by groups who think the only way to ensure a healthy and clean environment is to eliminate natural gas. The fact is, they are wrong and more local governments should stand up and speak out against these irresponsible policies that would do little for the environment and lead to irreparable harm for consumers.

There is no debate that solar and wind technologies will help efforts to make the energy we all use cleaner. However, the very nature of these intermittent resources requires that we continue to invest in clean and readily available energy that keeps the lights on when the sun isn't shining, or the wind isn't blowing.

This "all eggs in one basket" approach is short-sighted. The fact is, natural gas use in homes is three times as efficient as electricity, represents the lowest cost option, and its use in residential and commercial applications is among the smallest contributors to greenhouse gas emissions.

More than 175 million Americans use natural gas in their home or business. At a time when families and businesses in states across the nation are finding it harder to make ends meet and home prices are skyrocketing, policymakers should be focused on energy policies that every family can afford.

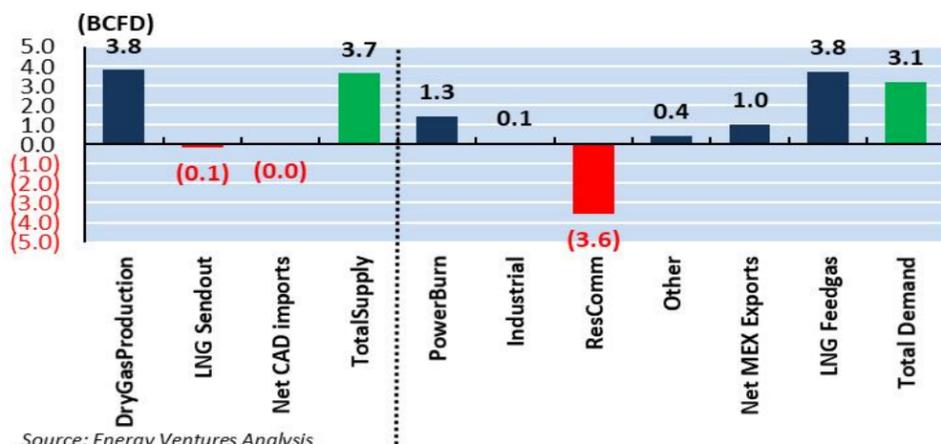
Households that use all-electric appliances pay almost \$900 a year more than those that have the traditional mix of natural gas and electric homes, according to the American Gas Association. How is that a fair solution for families struggling to pay rent and put food on the table, or for senior citizens on fixed incomes?

APGA members know these families. APGA represents more than 700 local, municipally owned natural gas systems in 37 states. The people who count on natural gas for affordable heat, hot water, and cooking live in the communities we serve. Our neighbors shouldn't have to choose between food, medicine, child-care, and their energy costs.

Smart energy policies should include ways to reduce energy consumption by utilizing current energy infrastructure in the most efficient way and planning for our energy future in a way that protects consumer options. This would balance their energy needs and ultimately ensures our energy infrastructure is secure and economically viable for future generations. We all want the best environment possible, and APGA believes there is a better way to achieve that without sacrificing consumer choice."

Exhibit 1: Summary of Winter Natural Gas Supply and Demand			
BCFD	Winter 2019-2020	Winter 2018-2019	Difference
Supply			
Dry Production	92.0	88.2	3.8
Net Canadian Imports	4.7	4.7	(0.0)
LNG Imports	0.2	0.3	(0.1)
Total Supply	96.9	93.3	3.7
Demand			
Power Burn	27.0	25.7	1.3
Industrial	24.8	24.7	0.1
Residential and Commercial	36.1	39.6	(3.6)
Net Mexico Exports	5.8	4.8	1.0
LNG Exports	8.3	4.5	3.8
Other	7.3	6.9	0.4
Total Demand	109.3	106.2	3.1
Implied Withdrawals	12.3	12.9	(0.6)
HDDs	3,469	3,620	(151)

Exhibit 2: Natural Gas Supply and Demand, 2019-2020 Winter vs 2018-2019 Winter



Source: Energy Ventures Analysis

APGA Disappointed in Berkeley Ban of Natural Gas

In response to the action taken by the Berkeley City Council to ban the use of natural gas in new low-rise residential buildings beginning in 2020, APGA's President & CEO, Bert Kalisch, issued the following statement: "I am saddened and disappointed to learn of the action taken by the Berkeley City Council to ban the use of natural gas in new residential buildings beginning in 2020. Unfortunately, across the country,

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