

# Natural Gas: Essential to a lower carbon energy future

key role going forward as a means to a lower carbon generating mix.<sup>i</sup>

The share of natural gas as a fuel for power generation has grown from 18% in 2005 to over 33% in 2015.

Natural gas has proven its role as an integral part of the United States' transition to a lower carbon energy future.

Over the past decade, there has been a significant reduction in the carbon intensity of the national electric supply, due in large part to an increase in gas-fired generation and a decrease in coal-fired generation. Similarly, despite the absence of a comprehensive national carbon policy or defined emission limits, emissions from the U.S. power sector have declined almost 20 percent since 2005, primarily driven by the shift to natural gas.

Market conditions have driven the increase in low emission generating sources, such as natural gas.

This market trend is driven by favorable long-term fundamental economics and is likely to continue into the foreseeable future, regardless of the presence or absence of additional regulation to expressly limit emissions.

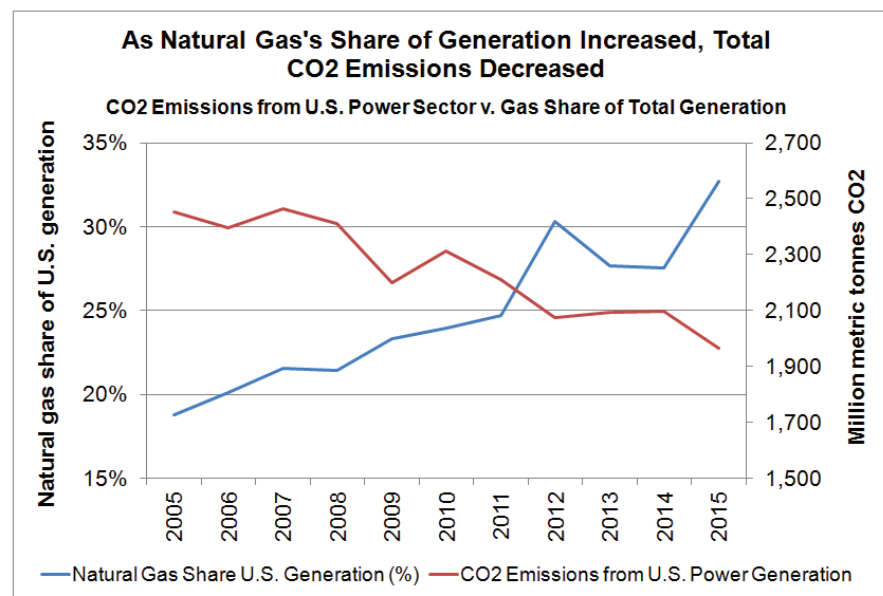
The cost competitiveness and reliability of natural gas generation makes it a critical component of a low carbon energy future.

**Natural gas is an integral part of advancing toward a lower carbon generating mix.**

Natural gas generation offers economic, reliability and development benefits relative to other low carbon generation

options that are available today. As a result, regional power markets have tended to increase the share of total generation supplied by natural gas, a trend which is expected to continue. Studies published by federal agencies, think tanks, and academia have all concluded that natural gas will play a

This growth in market share for natural gas was triggered by competitive natural gas prices as a result of the shale gas revolution. This economic advantage is projected to continue and, with natural gas's operational benefits relative to other power supply options, support further growth in market share.



Source: U.S. Energy Information Administration

Decisions are being made on the regional and local levels now to increasingly rely on natural gas for meeting growing electric generation needs.

These decisions are driven largely by the cost competitiveness of natural gas generation coupled with its reliable nature. The added benefit

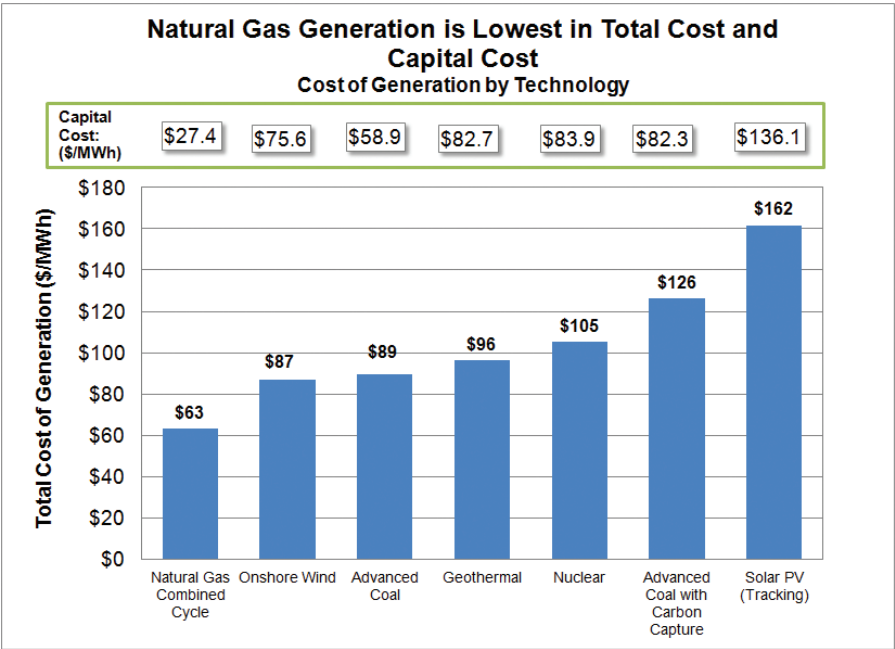
is a reduction of the carbon emission intensity of the U.S. generating mix.

In addition to the value natural gas provides in meeting electricity needs, it is also critical for complementing renewables. Natural gas is critical to meeting baseload electric demand, particularly in areas where other baseload technologies are retiring

and where renewable development is not a competitive supply option.

At this time, natural gas generation is the best available approach to ensure reliability, complement renewables, reduce total emissions, and keep costs lower for consumers.

Natural gas is a cost-effective and established generation technology



Source: Cost data from Leidos Comparison of Fuels Used for Electric Generation in the U.S., 2016 Update

Natural gas is an established generation technology that has been a part of the U.S. generation mix for years. Natural gas combined cycle (NGCC) technology is the lowest cost generation source, both in terms of the capital investment, as well as the total cost of generating electricity (including associated fuel and operating costs). While the costs of renewable generation options such as wind and solar have declined notably over the past few years, their costs still remain well above that of new natural gas and, in much of the country, still must rely on substantial subsidies in order to support their development. According to the U.S. Energy Information Administration’s latest reference

outlook, natural gas spot prices at the Henry Hub are projected to remain around \$5 per million British thermal units (MMBtu) through 2040. Consumers benefit from low-cost generation sources driving electric rates lower.

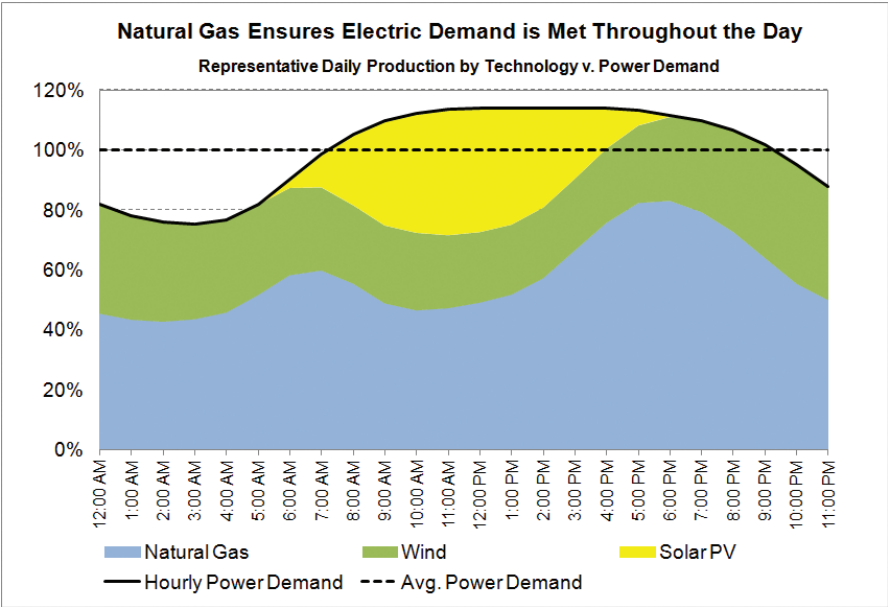
Competitive fuel costs, due to an abundance of supply, make natural gas generation more cost effective to run than in the past. Until recently, natural gas was more expensive and experienced more swings in price when compared to coal. The shale gas revolution has substantially stabilized and reduced natural gas prices due to the availability of abundant low cost gas supplies. According to the U.S. Energy Information Administration,

the development of natural gas from shale fields has increased total U.S. proven gas reserves from 200 trillion cubic feet (Tcf) in 2005 to 325 Tcf in 2015. These new supply basins are being developed and are increasing the total U.S. supply of natural gas. At the same time, rapid improvements in applied technology have helped lower production costs.

In comparison, between 2005 and 2010 the average trading price for natural gas at Henry Hub was \$6.59 per MMBtu. Between 2011 and 2016 the average price was \$3.33 per MMBtu. This fall in price levels has also been matched by a staggering growth in exploration and production.

The abundant domestic supply of natural gas will help to ensure that the cost of operating natural gas plants will remain affordable well into the future and secures its role in a low carbon future.

Natural gas power plants are critical to maintaining reliable electric supply and complement renewable technologies



Source: NREL, NYISO, Pace Global

Like natural gas, renewable technologies such as wind and solar play an important role in the low carbon energy future; however, they only produce energy when the powering resource is available. A cloudy day can result in no or minimal generation from a solar power facility. When the wind is not blowing, a wind turbine is not generating. A reliable electric grid requires supply availability to meet

demand at all hours of the day and in step with the changing seasonal demands for electricity.

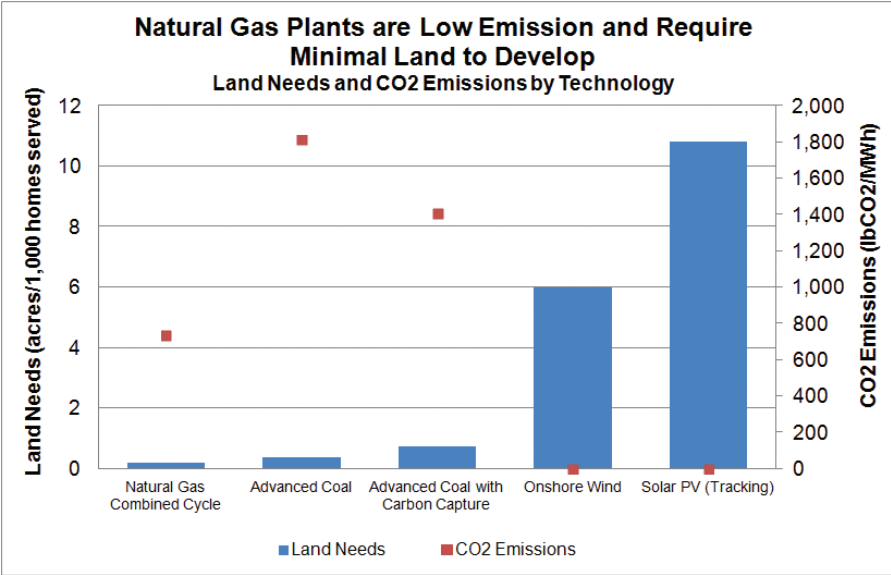
Natural gas generation is a controllable resource, meaning that these power plants can quickly be managed to increase or decrease production based on real time electric demand.

Large-scale battery technology that could store excess energy produced

and release it to meet demand at a later time is emerging as another means to help balance the electric grid, however, it is not cost effective at this time. Even existing generation sources such as coal and nuclear plants do not have the ability to increase or decrease output as quickly and efficiently as natural gas plants. Natural gas generation technologies efficiently balance the electric grid to ensure reliability.

In addition, the saturation point of renewables to maintain reliability of the electric grid and to match generation supply to demand times on a daily basis is not known, but some areas are already experiencing issues due to rapid integration of solar and wind generation and its misalignment with peak energy needs. Changing consumer behaviors, including the installation of residential and commercial solar generation and more energy efficiency, are changing the regular energy demand profile, making it more irregular. This operational flexibility makes natural gas power plants the perfect operational complement to reliably meet wind and solar and the changing electric load profile due to their ability to adjust output in almost real time.

Natural gas generation has low emissions and minimal land requirements



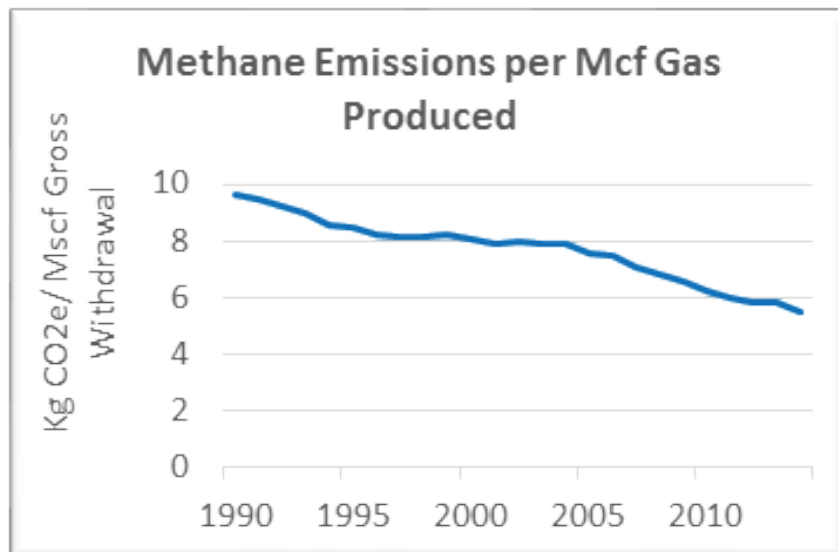
Source: Leidos, 2016

While natural gas produces some carbon emissions, these emissions are much lower than that released from

even the newest and most advanced coal fired plant. Renewable technologies, namely wind and solar,

emit no direct emissions but do have other environmental impacts, namely the significant land needs relative to natural gas. Significant amounts of land are needed if large-scale solar and wind projects were developed and scaled up to produce as much generation as natural gas or coal plants. For an equivalent amount of electric supply, wind requires over 30 times as much land as natural gas and solar requires 60 times more land. Further, these renewable generating facilities often require the development of significant additional transmission infrastructure to bring generation from remote areas to demand centers. When these other important environmental trade-offs are considered, natural gas generation’s position as a reliable and environmentally sound power supply option is substantiated.

## The production of natural gas is also reducing emission intensity



Source: Finding the Facts on Methane Emissions: A Guide to the Literature" by ICF International, April 2016.

The Environmental Protection Agency annually publishes its Inventory of Greenhouse Gases, which reviews and updates methane emissions from the oil and natural gas industries. These inventories document a steady decline in absolute emissions of methane from natural gas operations since 1990. The decline happened despite a sharp increase in U.S. natural gas production over the same time period. Absolute emissions have decreased by 15% between 1990 and 2014 and emissions per unit of gas produced have decreased by over 43% over that period. The decrease is due to equipment turnover, voluntary actions, and regulation. All segments of the gas industry have been active in voluntary reduction of methane emissions.

### Natural gas is essential to a lower carbon energy future.

- Natural gas generation ensures reliability, reduces total emissions, and keeps energy costs lower for consumers.
- Natural gas combined cycle technology is the lowest cost new baseload generation source.
- The abundant domestic supply of natural gas will support competitive natural gas costs well into the future.
- Natural gas-fired generation ensures reliability and complements the intermittent nature of wind and solar.

<sup>i</sup> Studies referenced include: U.S. Energy Information Administration "Annual Energy Outlook 2016 with projections to 2040" assuming Clean Power Plan implementation, U.S. Environmental Protection Agency "Regulatory Impact Analysis for the Final Clean Power Plan Rule", and Duke Nicholas Institute for Environmental Policy Solutions "Ongoing Evolution of the Electricity Industry: Effects of Market Conditions and the Clean Power Plan on States".

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