Abstract

Natural gas is finding its place at the heart of the energy discussion. The recent emergence of substantial new supplies of natural gas in the U.S., primarily as a result of the remarkable speed and scale of shale gas development, has heightened awareness of natural gas as a key component of indigenous energy supply and has lowered prices well below recent expectations. This study seeks to inform discussion about the future of natural gas, particularly in a carbon-constrained economy.

There are abundant supplies of natural gas in the world, and many of these supplies can be developed and produced at relatively low cost. In North America, shale gas development over the past decade has substantially increased assessments of resources producible at modest cost. Consequently, the role of natural gas is likely to continue to expand, and its relative importance is likely to increase even further when greenhouse gas emissions are constrained. In a carbon-constrained world, a level playing field — a carbon dioxide (CO_2) emissions price for all fuels without subsidies or other preferential policy treatment —maximizes the value to society of the large U.S. natural gas resource.

There are also a number of key uncertainties: the extent and nature of greenhouse gas emission mitigation measures that will be adopted; the mix of energy sources as the relative costs of fuels and technologies shift over time; the evolution of international natural gas markets. We explore how these uncertainties lead to different outcomes and also quantify uncertainty for natural gas supply and for the U.S. electricity fuel mix.

The environmental impacts of shale development are challenging but manageable. Research and regulation, both state and Federal, are needed to minimize the environmental consequences.

The U.S. natural gas supply situation has enhanced the substitution possibilities for natural gas in the electricity, industry, buildings, and transportation sectors.

In the U.S. electricity supply sector, the cost benchmark for reducing carbon dioxide emissions lies with substitution of natural gas for coal, especially older, less efficient units. Substitution through increased utilization of existing combined cycle natural gas power plants provides a relatively low-cost, short-term opportunity to reduce U.S. power sector CO_2 emissions by up to 20%, while also reducing emissions of criteria pollutants and mercury.

Furthermore, additional gas-fired capacity will be needed as backup if variable and intermittent renewables, especially wind, are introduced on a large scale. Policy and regulatory steps are needed to facilitate adequate capacity investment for system reliability and efficiency. These increasingly important roles for natural gas in the electricity sector call for a detailed analysis of the interdependencies of the natural gas and power generation infrastructures.

The primary use of natural gas in the U.S. manufacturing sector is as fuel for boilers and process heating, and replacement with new higher efficiency models would cost-effectively reduce natural gas use. Natural gas could also substitute for coal in boilers and process heaters and provide a cost-effective alternative for compliance with Environmental Protection Agency (EPA) Maximum Achievable Control Technology standards.

In the residential and commercial buildings sector, transformation of the current approach to efficiency standards to one based on full fuel cycle analysis will enable better comparison of different energy supply options (especially

natural gas and electricity). Efficiency metrics should be tailored to regional variations in climate and electricity supply mix.

Within the U.S. market, the price of oil (which is set globally) compared to the price of natural gas (which is set regionally) is very important in determining market share when there is the opportunity for substitution. Over the last decade or so, when oil prices have been high, the ratio of the oil price to the natural gas price has been consistently higher than any of the standard rules of thumb. If this trend is robust, use of natural gas in transportation, either through direct use or following conversion to a liquid fuel, could in time increase appreciably.

The evolution of global gas markets is unclear. A global "liquid" natural gas market is beneficial to U.S. and global economic interests and, at the same time, advances security interests through diversity of supply and resilience to disruption. The U.S. should pursue policies that encourage the development of such a market, integrate energy issues fully into the conduct of U.S. foreign policy, and promote sharing of know-how for strategic global expansion of unconventional gas production.

Past research, development, demonstration, and deployment (RDD&D) programs supported with public funding have led to significant advances for natural gas supply and use. Public-private partnerships supporting a broad natural gas research, development, and demonstration (RD&D) portfolio should be pursued.