Role of Natural Gas in a Low-Carbon Economy

Background

In the 2011 Prudent Development Report, the National Petroleum Council (NPC) reviewed the *"contribution natural gas can make towards a "lower carbon energy future" by reducing emissions of greenhouse gases (GHGs)."*[1] The focus of the 2011 study was primarily domestic and the major conclusion was that given the abundant natural gas supplies, natural gas can play a *"pivotal role in reducing emissions from various end-use segments"* and makes *"an attractive option in a suite of options"* for potentially meeting a 50% reduction target from a 2005 baseline by 2050. A variety of technologies to reduce emissions as the result of consumption of natural gas in the end-use sectors were reviewed. The NPC estimated that these technologies had the potential to reduce emissions between 120-860 million metric tons of carbon dioxide equivalents (CO2e).

As part of the Conference of the Parties (COP) 21 meeting in Paris, an agreement[2] was adopted which *"aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by holding the increase in the global average temperature to well below 2 °C above preindustrial levels."* A variety of research entities have reviewed the role of the energy sector under such constraints. However, most of the research offers a theoretical view of the future with perhaps optimistic assumptions related to the scale of zero emitting technologies or pessimistic assumptions related to the role of natural gas in a low-carbon environment and discounting the realities surrounding consideration of energy, economic and environmental securities facing communities and countries. On September 5, 2016, the G20 at the Hangzhou Summit communicated that *"Given the natural gas that is a less emission-intensive fossil fuel, we will enhance collaboration on solutions that promote natural gas extraction, transportation, and processing in a manner that minimizes environmental negative impacts."*

Many US oil and gas companies operate internationally in countries which are signatories to the Paris agreement and may be subject to country specific programs as outlined in Intended Nationally Determined Contributions (INDC) pledges. Further, it is presently unclear how oil and gas exported by non-signatories will be treated by countries that have signed the Paris agreement. In addition, many states in the US have developed state or regional regulations related to GHGs. Technologies and work-practices across the natural gas value chain have significantly improved its carbon footprint ranging from incorporation of "green completions" to highly efficient natural gas combined cycle gas turbines. To fully realize the economic, environmental and energy security benefits of natural gas, US oil and gas companies will need to

[1] National Petroleum Council, "Chapter Four: Carbon and Other Emissions in the End-Use Sectors," *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources,* 2011.

[2] [HYPERLINK "http://unfccc.int/documentation/documents/advanced_search/items/6911.php?priref=600008831"]

implement strategies to address evolving regulatory or policy frameworks or take advantage of evolving lower carbon technologies.

Therefore, the focus of this study will be to review the potential for natural gas technologies and policies to reduce GHG emissions particularly in the United States, as well as globally. The report will lay out the potential important role of natural gas in a low-carbon economy, incorporating key principles of energy security, economic security, and environmental (GHG) net benefits. It will highlight a range of natural gas technologies where R&D investment can play an important role for Mission Innovation[3] and related initiatives.

Study Objectives

The NPC will assess the role of natural gas in a low-carbon energy future. The study will review historical technologies and policies that have enabled or constrained greater use of natural gas in the economy and the associated GHG (CO_2 and methane) emission reductions to develop an analytical framework which will be used to analyze various natural gas upstream and end-use technologies that have the potential to reduce emissions from the production and consumption of natural gas in the economy. The study will also review the environmental (GHG) and related energy and economic security benefits of applying the technologies and work-practices identified and the necessary policies or other actions needed to ensure the transition is successful, including roles of various institutions and stakeholders.

Study Scope

1. U.S. and global GHG emissions in a low-carbon economy

Goal: to frame the scope of a low-carbon energy future and to provide a baseline reference for this work

Discuss respected and credible (such as IEA, EIA, others) forecasts (with transparent insights to inputs) of future GHG emissions in view of policies expected to reduce GHG emissions over time. Include discussions of technologies assumed in achieving lower GHG levels, including costs and the expected scale and timing of deployment.

2. Natural Gas – a decade in review and lessons learned

Goal: to outline the change in production and consumption patterns and to assess the drivers and constraints

[3] For more information, please visit [HYPERLINK "http://mission-innovation.net/"]; [HYPERLINK "https://www.whitehouse.gov/blog/2015/11/29/announcing-mission-innovation"];

Discuss trends in natural gas use and emissions over the last decade. Review past NPC and other credible reports that have reviewed natural gas production and end use. Examine technology, policy and infrastructure hurdles that have limited the greater use of natural gas, including integration with renewable sources of energy, utilizing critical path analysis as appropriate in achieving the full potential of GHG reductions and other benefits. In other words, this section of the report will lay out the analytical framework using existing studies for the next section of what worked and what did not over the past decade.

- Overview of current markets and natural gas uses, including consumption patterns and emissions benefits since 2005
  - Residential/commercial, power, industrial, transportation, and exports consumption patterns
  - Lifecycle analysis of natural gas employing updated emissions data and net GHG benefits from 2005 to current, including a listing of GHG reduction technologies (enabled by natural gas) that have been applied
  - Analysis of economic benefits of natural gas from 2005-current
  - Review of current and historical policy instruments (state, federal, and international) to enhance or deter natural gas growth
  - Natural gas infrastructure as an enabler of emissions reductions
  - Address concerns of infrastructure "lock-in" and the associated potential GHG emissions.

3. Role of natural gas technologies in a low-carbon energy economy

Goal: to identify the potential for natural gas in a low-carbon economy for policymakers and industry

Using the analytical framework from Section 2, analyze various natural gas upstream and end-use technologies that have the potential to reduce emissions from the production and consumption of natural gas in the economy.

- Role of natural gas technologies to reduce emissions
  - Upstream and midstream technologies to reduce methane emissions from the natural gas supply chain from production to distribution segments
  - Expanded use of natural gas in residential/commercial, power, industrial and transportation sectors using current technologies
  - Review of current and emerging low emissions, advanced technology applications with natural gas
    - Direct use (feedstock)
    - Carbon capture, utilization, and storage (CCUS)

- Advanced technologies in residential/commercial, power, industrial, and transportation
- Integration with renewables
- Efficiency gains across the natural gas value chain
- Others (as new ideas emerge in study)

- Analysis of GHG reduction potentials per technology. Include costs, potential scale, and performance metrics relative to alternatives.

4. Energy transition with natural gas

Goal: to outline the GHG and related energy and economic security benefits of applying the technologies and work-practices identified in Section 3 and to identify the necessary policies or other actions needed to ensure the transition is successful and roles of various institutions and stakeholders

- Analyze the regulatory/policy framework to enable greater penetration of natural gas, including gas-power integration, Mission Innovation/energy R&D, natural gas infrastructure and trade, CCUS permitting and commercialization, and technology transfer.
  - Provide context for natural gas penetration in view of existing and planned policy frameworks. Highlight policy approaches that achieve cost-effective GHG emissions reductions, and consider natural gas in the broad context of other mitigation technologies.
  - Consider the role of financial markets and innovative carbon financing in non-OECD countries.
  - Consider market or geopolitical factors that may be relevant to realizing GHG and related energy and economic benefits, including the potential for natural gas to help other countries achieve GHG targets and transfer of technologies.
- Identify high priority hurdles and R&D opportunities.
- Examine the role of industry, state and federal governments, including U.S. Department of Energy, Department of Defense, and Department of State, among others.
  - Identify opportunities to catalyze actions that enable the adoption of low-carbon technologies, including natural gas, in a cost-effective and material manner.
- Portray the role of natural gas in achieving a transition to a lower-carbon U.S. and global economy.

Study Organization

The study organization structure, consisting of a study committee, a coordinating subcommittee, and specialized task groups and subgroups, has served the NPC well in past

studies and would likely be replicated in this case. These groups will be staffed by experts from academia, industry, think-tanks, non-governmental organizations and governmental organizations. The key committees and task groups could be the following:

- Coordinating Subcommittee (CSC)
- Task Group – Emissions & Energy Analysis
- Task Group – R&D and Technology
  - Subgroup: Natural Gas Value Chain (production to distribution technologies and infrastructure)
  - Subgroup: End-use (including direct use as feedstock and novel applications with natural gas, integration with renewables)
  - Subgroup: CCUS
- Task Group – Energy Transitions
  - Subgroup: Economics and Energy Security
  - Subgroup: Policy & Regulations
- Task Group – Report Writing

Study Timeline

This study could be completed in 18 months after approval and would include a broad outreach effort.