LIFE CYCLE ANALYSIS

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NATURAL GAS

Natural gas is a fossil fuel that is used in residential, industrial, and transportation applications in addition to an expanding role in power production. Domestic sources of natural gas include onshore and offshore conventional wells with a wide range of production rates. Other domestic sources of natural gas include unconventional wells that use technologies that stimulate the reservoir to enhance natural gas recovery.

Life Cycle Greenhouse Gas Analysis of Natural Gas Extraction & Delivery in the United States

On May 12, 2011, NETL provided the following presentation at the Cornell University lecture series on unconventional natural gas development. The presentation summarizes the life cycle analysis (LCA) greenhouse gas (GHG) research on natural gas extraction and delivery in the United States (on a lb CO2e/MMBtu basis) and a comparison of the life cycle GHG profiles of average natural gas and coal-fired power production and delivery to an end-user (lb CO2e/MWh basis). Specifically, the presentation details seven natural gas profiles: onshore conventional gas, associated gas, offshore gas, tight sands (gas), shale gas (based on Barnett Shale), coal bed methane gas, and the year 2009 domestic average mix. Each natural gas source is upgraded in a gas processing plant, compressed, and delivered to a large end-user (e.g., power plant).

Authors: Tim Skone, Joe Marriott, PhD, James Littlefield
Date: July, 2013

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Unconventional Natural Gas: An LCA with a Conventional Answer

LCA of a Natural Gas Combined Cycle plant. Develops an Inventory of emissions results, and calculates Life Cycle costs for the plant with and without CCS.

Authors: Tim Skone, James Littlefield, Joe Marriott, PhD
Date: October, 2012

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LCA: Natural Gas Combined Cycle (NGCC) Power Plant

LCA of a Natural Gas Combined Cycle plant. Develops an Inventory of emissions results, and calculates Life Cycle costs for the plant with and without CCS.

Authors: Tim Skone, Greg Cooney, Kristyn Ivey, Matt Jamieson, James Littlefield, Joe Marriott, PhD
Date: September, 2012

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Role of Alternative Energy Sources: Natural Gas Technology Assessment
Natural gas is seen as a cleaner burning and flexible alternative to other fossil fuels, and is used in residential, industrial, and transportation applications in addition to an expanding role in power production. New technologies have allowed increased domestic production of natural gas. The projected supply contributions afforded by new natural gas plays may keep the price of natural gas relatively low for the foreseeable future. Since natural gas is comprised mostly of methane, the control of fugitive emissions is imperative to reduce the greenhouse gas footprint of natural gas.
Authors: Tim Skone, James Littlefield, Robert Eckard, Greg Cooney, Joe Marriott, PhD
Date: June, 2012

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LCA of Natural Gas Extraction, Delivery and Electricity Production
This is a life cycle inventory of greenhouse gases from natural gas power systems. The average greenhouse gas (GHG) emissions from natural gas power are 527 kg of carbon dioxide equivalents per MWh of delivered electricity. Data uncertainty include emission factors for natural gas extraction, natural gas pipeline parameters, and well production rates. Opportunities for reducing GHG emissions from natural gas extraction and delivery include better practices for unconventional gas well completions, improved compressor efficiency, and reduced pipeline fugitive emissions.
Authors: Tim Skone, Joe Marriott, PhD, James Littlefield
Date: January, 2012

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LCA: Natural Gas Combined Cycle (NGCC) Power Plant (Archived 2010)
This is a life cycle environmental and cost profile of a combined cycle natural gas power plant with scenarios using domestic natural gas or imported liquefied natural gas (LNG). Scenarios with and without carbon capture and sequestration are evaluated. Carbon capture removes 90 percent of the CO2 emissions from the natural gas combined cycle facility, but reduces life cycle greenhouse gas emissions by 61-to-71 percent. The results are sensitive to the source of natural gas due to the methane emissions during natural gas extraction and the added energy requirements of LNG transport. Adding carbon capture and sequestration increase the cost of electricity from $90 to $130 per MWh.
Authors: Robert James, Laura Draucker, Raj Bhander, Barbara Bennet, Tom Davis, Robert Eckard, William Ellis, John Kauffman, James Littlefield, Amanda Malone, Ron Munson, Mara Nippert, Massood Ramezan
Date: September, 2010

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LCA of Greenhouse Gas Emissions for Hydrogen Fuel Production in the USA from LNG and Coal
This is a LCA (LCA) that accounts for the greenhouse gas (GHG) emissions from the production of hydrogen from liquefied natural gas (LNG) via steam methane reforming (SMR) or from coal gasification. Carbon capture and sequestration (CCS) is one option for managing carbon dioxide emissions from hydrogen production. By employing a CCS system with a 92 percent capture rate at an SMR plant, the life cycle GHG emissions from hydrogen production from LNG are reduced by 64 percent. Gasification of coal is another pathway to hydrogen production, but the GHG emissions are highly variable due to coal mine methane (CMM) emissions. Mitigation of CMM is a key opportunity for improving GHG emissions from the the coal-to-hydrogen pathway.
Authors: Eric Grol, Massood Ramezan, John Ruether
Date: November, 2005

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