PROGRAM facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Strategic Center for Natural Gas & Oil

7/2006

ENVIRONMENTAL BENEFITS OF DOE'S OIL AND GAS R&D PROGRAMS

Introduction

The Strategic Center for Natural Gas and Oil (SCNGO) implements DOE, Office of Fossil Energy oil and natural gas Research and Development (R&D) Programs. The objective of these programs is to increase domestic production of oil and natural gas while minimizing environmental impacts. Often benefits of the programs are measured in terms of increased recovery factors; however, the programs also provide significant environmental benefits. For example, seismic technologies developed by SCNGO R&D will allow operators to better target reservoirs, and thereby improve their success ratio. This allows for increased domestic production but also has a positive environmental impact by way of drilling fewer wells and disturbing less land. It is of utmost importance to quantify, in a consistent and valid manner, the benefits that accrue to stakeholders from these efforts.

Description of the Process

For each of the categories examined, the quantified benefit was calculated using a per-well factor. This factor was then multiplied over the potentially affected wells as defined by the EIA's AEO 2005Finally, net benefits were calculated by taking the difference between the "Industry Alone" case which represented the yearly environmental impact with the improvements generated by the oil and gas industry's effort alone and the "DOE+Industry" case that showed the impacts with the SCNGO's R&D program combined with industry's efforts.

For example, if an R&D program aimed to reduce the number of dry holes drilled by 20%, the number of dry wells avoided could be determined by multiplying 20% times the number of projected dry wells for each year. Reductions in drilling waste and land usage could then be determined by calculating the benefits provided by not drilling those dry wells. In order to capture the benefits at the sub-program level, this process was performed for three sub-programs in the Natural Gas Program (Deep Trek, Tight Gas Sands and Stripper Wells) and for six sub-programs in the Oil Program (EOR/CO_2 Injection, Advanced Diagnostics and Imaging, Advanced Drilling Completion and Stimulation, Reservoir Efficiency Processes, Arctic Research, and Reservoir Life Extension and Management). The benefits were then aggregated over all nine sub-programs.

Benefits

Environmental benefits were quantified in terms of drilling waste and land usage reduction, produced water disposal, air emissions, oil spillage and CO_2 sequestration. The values presented are the cumulative values for the period of 2005 to 2025 and represent the net benefit of the SCNGO's Upstream R&D programs.

CONTACTS

Brad Tomer
Director
Strategic Center for Natural Gas and Oil
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4692
brad.tomer@netl.doe.gov

Traci Rodosta
Energy Analyst
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-1345
traci.rodosta@netl.doe.gov

ADDRESS

National Energy Technology Laboratory

1450 Queen Avenue SW
Albany, OR 97321-2198
541-967-5892

2175 University Avenue South
Suite 201
Fairbanks, AK 99709
907-452-2559

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4764

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-4687

One West Third Street, Suite 1400
Tulsa, OK 74103-3519
918-699-2000

CUSTOMER SERVICE

1-800-553-7681

WEBSITE

www.netl.doe.gov

The Oil and Gas R&D Programs provide the following Environmental Benefits:

- Less land usage
- Reduced drilling waste
- Less produced water disposed of as waste
- Fewer air emissions
- Reduction in oil spills

Drilling Waste Reduction

The conventional process of drilling oil and gas wells uses a rotary drill bit that is lubricated by drilling fluids or muds. As the drill bit grinds downward through the rock layers, it generates large amounts of ground-up rock known as drill cuttings mixed with the drilling fluids. This material must be disposed of as waste. The net cumulative benefit of reduced drilling waste from the SCNGO R&D Programs is 97,941,000 barrels of waste avoided; representing almost as much municipal solid waste generated by the state of New Jersey in 2003.

Land Usage Reduction

Oil and gas operations require on average 2.5 acres of land per well. The cumulative net benefit calculated in this analysis is 60,000 acres of avoided land usage. When compared with current growth in urbanization, this benefit is significant. For example, from 1990 to 2000, Phoenix, Arizona was one of the fastest growing metropolitan areas in the country and grew over 35,200 acres.

Produced Water Disposed of as Waste

During production of oil and gas, large amounts of water can be brought to the surface with the oil or gas. Typically, the water contains impurities in solution, which precludes free discharge to the environment. Therefore, it either has to be disposed of as waste or, in some cases, injected back into a formation to aid in the recovery of hydrocarbons. In this analysis, the reduction in water disposed of as waste from the SCNGO R&D programs is approximately 15 billion barrels, or 630 billion gallons of water. The Potomac River, by comparison, has an average flow of 943.5 billion gallons of water per year.

Air Emissions

Oil and gas drilling and recovery operations produce significant air emissions. For the purpose of this analysis, air emissions were divided into regulated and non-regulated emissions. The regulated emissions analyzed are Carbon Monoxide (CO), Sulfur Dioxide (SO_2) and Nitrogen Oxides (NO_X). The non-regulated emissions quantified in this report are Carbon Dioxide (CO_2), Methane (CH_4) and non-methane hydrocarbons. The net calculated air emission reduction for regulated pollutants in this analysis is 8,990 tons, approximately half the total regulated emissions for the chemicals industry for 2004. For non-regulated non-CO_2 emissions, the SCNGO R&D programs project a reduction of 4,050 tons. For CO_2 emissions, the projected net cumulative benefit from the program is 2,338,000 tons avoided, enough to offset 250MW worth of coal-fired electricity generating plants' yearly CO_2 emissions.

Oil Spilled

Increased domestic oil production leads to less foreign imports, and therefore reduced tanker traffic from foreign sources. In this way, reduced oil spills are an indirect, yet significant, environmental benefit of improved petroleum recovery. In addition, the Petroleum Program has direct R&D efforts for reducing oil spills at the production site or during transport by pipeline or during storage in tanks. The amount of reduction in oil spills - 580,000 barrels - calculated in this analysis is more than double the impact of a typical offshore oil tanker accident. For example, the Exxon Valdez accident at Prince William Sound, Alaska spilled over 257,000 barrels of oil to the sea.

CO_2 Sequestered While Enhancing Oil Recovery

In order to improve resource recovery from oilfields, CO_2 is often injected into a formation to increase the underground pressure and make the oil easier to pump to the surface. Some of the injected CO_2 remains underground, effectively preventing it from entering the atmosphere and potentially contributing to global climate change. In this analysis, the net cumulative amount of CO_2 sequestered during oil recovery is 173,434,000 metric tons, enough to offset the yearly CO_2 emissions of over 18 GW of coal-fired power plants.