Greenhouse Gas Impacts of Expanded Renewable and Alternative Fuels Use

Emission Facts

The increased use of renewable and alternative fuels can result in significant reductions in the use of petroleum-based fuels. By displacing petroleum fuels, many, although not all, of these fuels can provide reductions in greenhouse gas emissions. To estimate the impacts of increases in renewable and alternative fuels on greenhouse gas emissions, the entire fuel lifecycle including fossil fuel extraction or feedstock growth, fuel production, distribution, and combustion should be accounted for. There are a variety of lifecycle models and analyses available to perform this type of work, the results presented here are based on one such model, Argonne National Laboratory's GREET model, and one specific set of assumptions.

Lifecycle analyses must contend with the fact that the inputs and assumptions generally represent industry-wide averages even though energy consumed and emissions generated can vary widely from one facility or process to another. Thus, greenhouse gas emissions can vary depending on each of these factors and the assumptions made about those factors. For example, renewable and alternative fuel production plants can utilize different processes and be powered with biomass, natural gas, coal or a mix of these fuels. Similarly, greenhouse gas emissions from alternative fuels like hydrogen depend on the fuel used to make the hydrogen. The combustion, or use of these fuels in vehicles, is another factor that influences lifecycle greenhouse gas emissions. For example, electric vehicles can have a much higher fuel efficiency thereby improving the lifecycle greenhouse profile of electricity as a fuel.

The chart below presents an estimate for the percent change in lifecycle greenhouse gas emissions, relative to the petroleum fuel that is displaced, of a range of alternative and renewable fuels. The fuels are compared on an energy equivalent or BTU basis. Thus, for instance, for every BTU of gasoline which is replaced by corn ethanol, the total lifecycle greenhouse gas emissions that would have been produced from that

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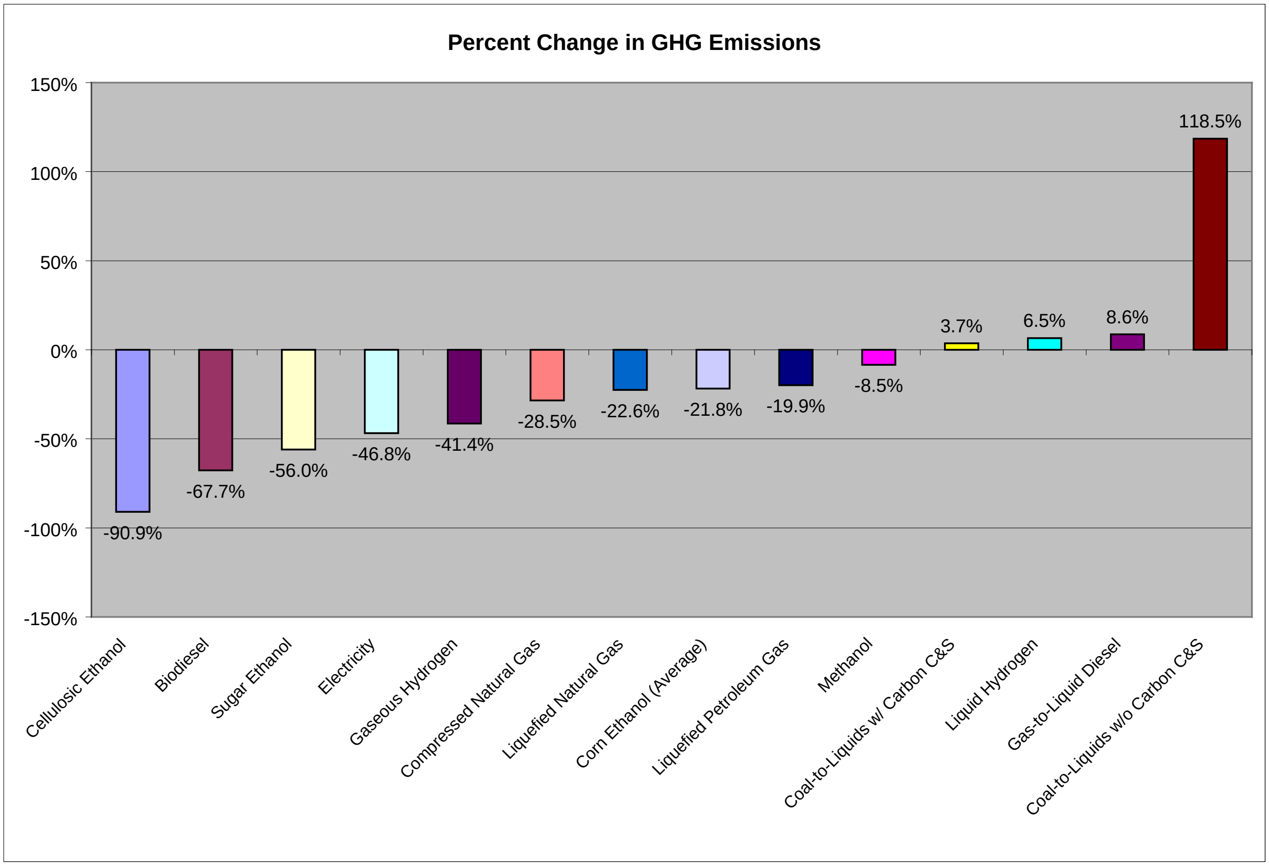
BTU of gasoline would be reduced by 21.8 percent. These emissions account not only for CO2, but also methane and nitrous oxide.



This chart represents best available information about current or projected production practices and the impact of those practices on lifecycle greenhouse gas emissions. The numbers presented for renewable fuels were used in the analysis of the Agency's Renewable Fuel Standard rulemaking. EPA along with other Federal agencies and stakeholders are committed to continuing to improve lifecycle analysis techniques.

Assumptions for ethanol and biodiesel production are based on analysis completed for the Renewable Fuel Standard as follows:

- Corn ethanol: represents current and near future production, primarily through the dry mill process (99%), with natural gas as the primary fuel source (86%). The percent change in GHGs for corn ethanol can range from 54% decrease for a biomass-fired dry mill plant to a 4 % increase for a coal-fired wet mill plant.
- Cellulosic ethanol: represents an average mix of the following feedstock sources and production process; hybrid poplar, switchgrass, and corn stover ethanol produced in the fermentation route, and forest waste ethanol produced in the gasification route.
- Biodiesel: represents an average mix of soybean oil and yellow grease feedstock produced through transesterification.
- Sugar ethanol: represents an average of corn and cellulosic ethanol which we believe is a good estimation of sugarcane ethanol production.

Assumptions on alternative fuels production are based on GREET defaults and the following assumptions:

- Electricity: represents the national average CO2 output rate for electricity in 2004, based on the EPA eGRID database, which assumes a U.S. average mix of fuel types. This number also accounts for the higher per mile efficiency of electric vehicles.
- Hydrogen (gaseous and liquid): represents using natural gas to produce hydrogen and accounts for the higher per mile efficiency of use of hydrogen in a fuel cell vehicle.
- Coal-to-Liquids: represents production of Fischer-Tropsch diesel fuel from coal. The carbon capture and sequestration case includes electricity needed for capture and storage.
- Natural Gas (compressed and liquefied): represents production from fossil sources (e.g., does not account for biogas potential).
- Methanol: represents fuel produced from natural gas feedstock.
- Liquefied Petroleum Gas: represents production from natural gas and crude oil feedstocks.
- Gas-to-Liquids: represents production of Fischer-Tropsch diesel fuel from natural gas.