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ANL/ESIA-24/20 Rev.1

Summary of Expansions and Updates in R&D GREET® 2024 Rev.1

Energy Systems and Infrastructure Analysis Division
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INTRODUCTION

The research and development (R&D) version of Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET®) model, or R&D GREET, is developed by Argonne National Laboratory (Argonne) with the support of the U.S. Department of Energy (DOE) and other federal agencies. R&D GREET is a life cycle analysis (LCA) model, structured to systematically examine the energy and environmental effects of a wide variety of transportation fuels and vehicle technologies in major transportation sectors (i.e., road, air, marine, and rail) and other end-use sectors, and energy technology systems. Argonne has expanded and updated the model in several areas in R&D GREET 2024 Rev.1. This report provides a summary of the expansions and updates.

EXPANSIONS AND UPDATES

1. NATURAL GAS EXPANSION

The natural gas (NG) pathways have been updated to account for energy use and emissions of the natural gas supply chain at the NG production basin level in the U.S. (16 basins, Figure 1). Based on their production shares, the basins level production data have also been aggregated into higher-level production regions (6 regions, Figure 2, plus U.S. average) to be utilized throughout the R&D GREET model. This update includes all steps of the NG supply chain including production, gathering and boosting (G&B), processing, transmission, storage, and distribution stages. For the segment connecting production region to delivery region (origin-destination pair), NG sources are categorized into three types: conventional, unconventional (shale, tight, and coal bed methane), and offshore. For the segment connecting basin to region, the three NG sources are aggregated as combined NG. The data used for this update is acquired from Khutal et al. (2024).

Each of the 16 production basins are comprised of shares of conventional, unconventional, and offshore gas. Gas composition data (by share of constituents) for both raw and processed NG was used to calculate the gas properties (e.g., lower heating value, higher heating value, density, carbon content, sulfur content, and CH_4 fraction) for both raw and processed natural gas.

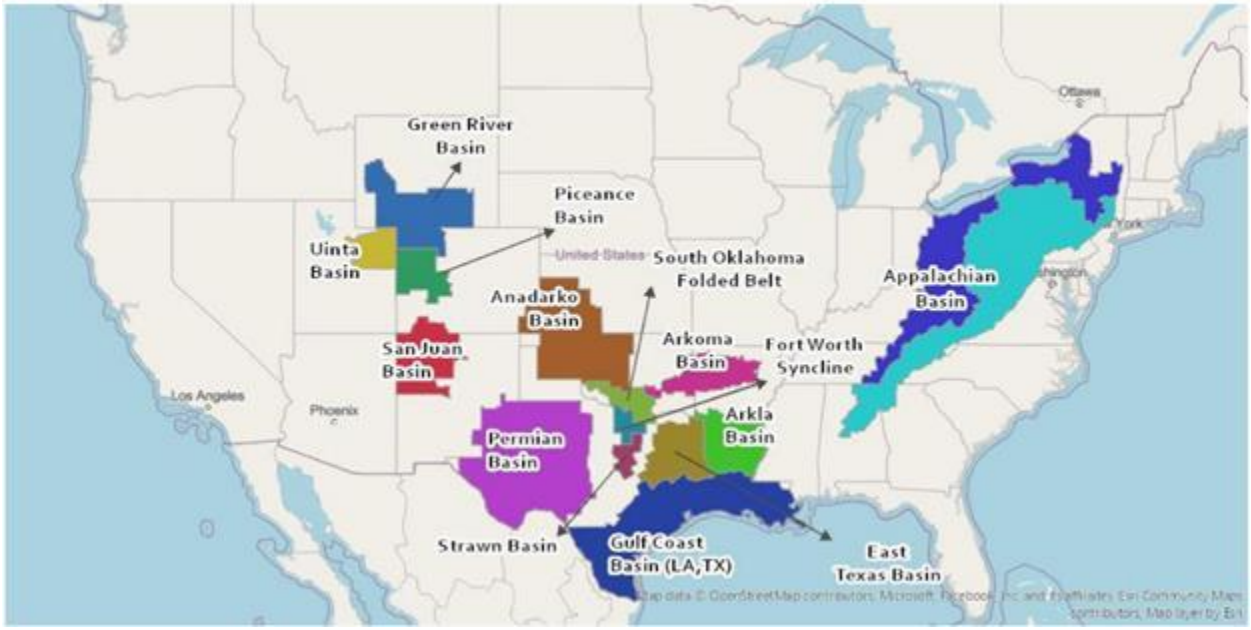

Figure 1. U.S. natural gas production basins

Additionally, the distance of pipeline transmission between origin and destination is developed to reflect each of the specific production and delivery segments. Due to the layout of NG transmission pipelines and compression stations across the United States, each production basin or region supplies NG to any of the other regions. More details on the implementation can be found in the report by Zhou et al. (2025).

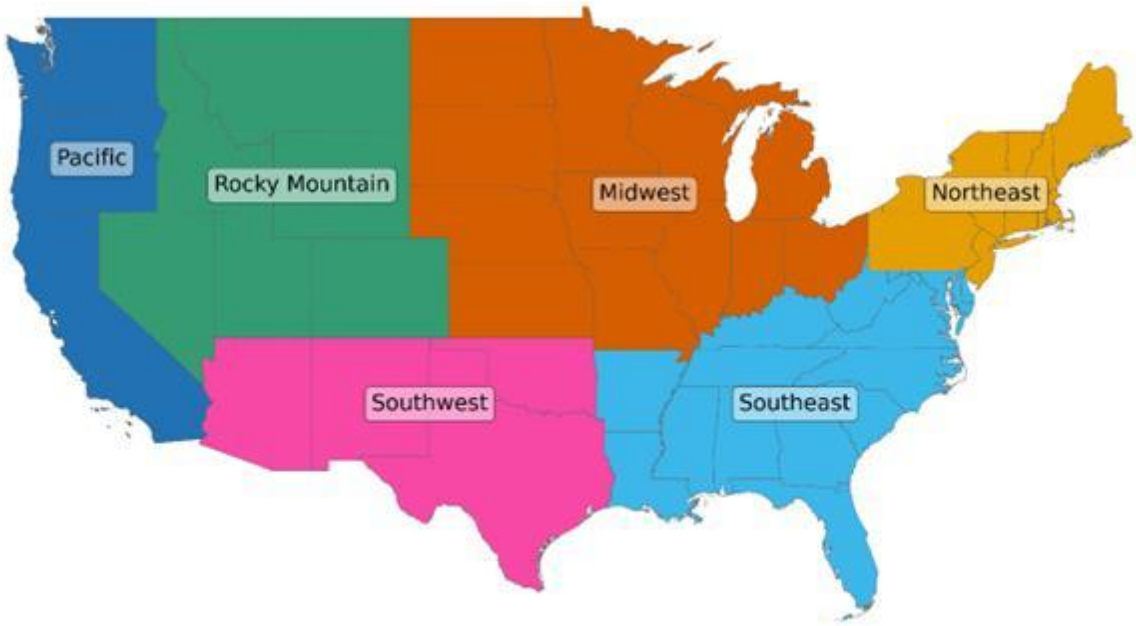

Figure 2. Natural gas production and delivery regions

2. MARINE FUELS

Ethanol is added to the list of marine fuels in the "Marine_WTH tab". The feedstocks for ethanol are corn, corn stover, switchgrass, miscanthus, poplar, willow, forest residue, grain sorghum, and sugarcane. Users can change the combination of the feedstocks in the EtOH tab; the default feedstock is 100% corn.

3. R&D GREET MARINE MODULE

The marine module is updated with the estimates from R&D GREET 2024 Rev1. FOG (Fats, oils, and grease) is replaced with landfill gas as feedstock for methanol and ammonia. Ethanol is added to the list of marine fuels in the module. Users can select one or more feedstocks from the feedstock mix to view the input parameters and emission estimates. It's important to note that users must click on "Update Results" after selecting the feedstocks in BioFeedMix slicer.

4. CLEAN FUEL EXPANSION WITH COAL MINE METHANE

Capture and upgrading of coal mine methane (CMM) from active underground coal mines are added to the "Clean_Fuels" tab. The pipeline CMM produced from this pathway can be used as a process fuel or compressed and used as a transportation fuel. Detailed life cycle analysis of CMM capture and upgrading is documented in Ou and Cai (2024). Pipeline CMM is also added as an option for process fuels in the other pathways in the "Clean_Fuels" tab.

5. UPDATE OF WET MILL ETHANOL

We conducted a detailed Life-cycle analysis (LCA) to update GHG emissions of the US corn wet milling ethanol. Besides ethanol, the LCA considered dextrose and feed products including corn germ, gluten meal, and fibers (Do et al. 2025). Process-level energy and material balances for these products were collected through an industry survey of U.S. corn wet mills. A process-level allocation method based on mass outputs was applied to allocate energy and emission burdens to each product within wet mills. In addition, a plant-level allocation method based on mass outputs was implemented to estimate product-specific emissions.

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