

Summary of Expansions and Updates in R&D GREET® 2025 Rev.1

**Energy Systems and Infrastructure Assessment Division
Argonne National Laboratory**

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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, resource utilization, and environmental effects of a wide variety of transportation fuels and vehicle technologies in all transportation sub-sectors (i.e., road, air, marine, and rail) and other end-use sectors, and energy technology systems. Argonne has expanded and updated several areas of R&D GREET 2025 with a new interim version called R&D GREET 2025 Rev.1. This report provides a summary of the expansions and updates of this version.

EXPANSIONS AND UPDATES

1. FEEDSTOCK PRODUCTION FOR BIOFUELS

1.1 Crop Farming Life-Cycle Inventory Data Updates

In R&D GREET 2025 Rev.1, crop farming life-cycle inventory (LCI) data were updated for multiple feedstocks using the latest available data including the 2025 USDA National Agriculture Statistics Services (NASS) survey data. These updates ensure that crop yield and agrochemical input assumptions reflect current agricultural practices and productivity trends across major biofuel feedstock supply chains. Table 1 summarizes the updated LCI categories, data sources, and technical notes by feedstock.

Table 1. Summary of farming LCI data updates in R&D GREET 2025 Rev.1.

Feedstock	LCI Category	Data Source	Note
Corn	Yield	USDA NASS 2025	Yield updated for 2025
	Agrochemical inputs	USDA NASS 2018 & 2021	Inputs averaged from two survey years for 2025
Soybeans	Yield	USDA NASS 2025	Yield updated for 2025
Sorghum	Yield	USDA NASS 2025	Yield updated for 2025
	Agrochemical inputs	USDA NASS 2019 & 2024	Inputs averaged from two survey years for 2025
Spring Canola	Agrochemical inputs	Canadian national survey data and an LCA report by (S&T) ² Consultants Inc (2022)	Fungicide input update
Intermediate winter canola	Yield and Agrochemical inputs	Third-party field trial data (Kwon et al., forthcoming)	Expanded production and area coverage

Dedicated energy crops	Yield and Agrochemical inputs	U.S. DOE Billion-Ton 2023 (BT23)	Additional corrections applied to BT23 data (Kwon et al., 2026)
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Publications:

Kwon, H., Liu, X., Cai, H., and Wang, M. (forthcoming). Life Cycle Greenhouse Gas Emissions of Main Spring and Intermediate Winter Canola in the United States.

Kwon, H., Langholz, M., Liu, X., Clark, R., and Cai, H., and Wang, M. (2026). Life Cycle Analysis of Dedicated Energy Crop Production in the United States. *Biomass and Bioenergy*. 212, 109329. <https://doi.org/10.1016/j.biombioe.2026.109329>.

1.2 Updates of Market-Mediated Effects Emissions

We revised emissions from market-mediated effects—including induced land-use change (ILUC), induced changes in other crop (non-feedstock) production, and induced changes in livestock production—in both R&D GREET 2025 Rev.1 and the associated CCLUB 2025 Rev.1. These revisions are based on the latest GTAP-BIO simulations of dedicated energy crops (i.e., willow, poplar, switchgrass, miscanthus, and forage sorghum) as feedstocks to produce one billion gallons of jet fuel a year via the Fischer–Tropsch Jet (FTJ) and Ethanol-To-Jet (ETJ) pathways (Kwon et al., 2026).

In addition, we updated the default ILUC values in R&D GREET 2025 Rev.1 and CCLUB 2025 Rev.1 for spring canola, using new soil organic carbon results from DayCent simulations for domestic ILUC and the Winrock methodology for international ILUC.

Publication:

Kwon, H., Langholz, M., Liu, X., Clark, R., and Cai, H., and Wang, M. (2026). Life Cycle Analysis of Dedicated Energy Crop Production in the United States. *Biomass and Bioenergy*. 212, 109329. <https://doi.org/10.1016/j.biombioe.2026.109329>.

1.3 Wheat Feedstocks

In R&D GREET 2025 Rev.1, three new wheat feedstocks were added, namely spring wheat, winter wheat, and wheat straw. Although not popular in the United States, wheat is a primary ethanol production feedstock in the European Union.

We collected the following data from USDA NASS:

- State-level production for winter and spring wheat
- State-level planted and harvested acres for winter and spring wheat
- State-level total applications for winter and spring wheat of:
 - o Aggregated fertilizer application rates for N, P₂O₅, and K₂O
 - o Herbicides broken down by active ingredient
 - o Insecticides broken down by active ingredient

The state-level application rates of chemicals for winter and spring wheat farming are calculated by dividing the total applications by the total harvested wheat. This result is then weighted by the production in each state to determine the national averages. To derive energy use in wheat farming, we utilized data from the 2017 Agricultural Resource Management Survey (ARMS) for wheat, as it is the most recent survey conducted by USDA on wheat farming energy use. Details are documented by Kwon et al. (2025).

The leftover aboveground biomass after wheat grain harvest — wheat straw — is a cellulosic biomass feedstock that can also be used for biofuel such as ethanol production. The collection of wheat straw from the field requires additional energy. In addition, supplementary N, P, and K fertilizer application may be required to make up the nutrient loss due to wheat straw removal. The nitrogen content of wheat straw is assumed to be 0.8% by mass (INL, 2026). The P₂O₅ and K₂O contents of wheat straw were also estimated from INL (2026). The ash content of wheat straw from proximate analysis is 10.72%, and P₂O₅ and K₂O contents in ash were 2.15% and 15.45% respectively. Therefore, the P₂O₅ and K₂O contents of wheat straw are calculated to be 0.23% and 1.66%, respectively. The energy use for wheat straw collection was reported by the BT23 study to be 1.642 gallons of diesel per dry ton collected. Given the lack of wheat straw specific ethanol yield, it is assumed that the ethanol yield for wheat straw is 82.5 gallons per dry ton, the same default ethanol yield for cellulosic biomass in R&D GREET.

1.4 Additional Agrochemical Production Emissions

R&D GREET 2025 contains agrochemical production LCIs for fertilizer and herbicide manufacturing as documented in Liu and Cai (2023). In R&D GREET 2025 Rev.1, the agrochemical LCIs were further expanded to include two categories—sulfur-containing fertilizers and fungicides—thereby capturing a broader set of farming inputs that contribute to the life-cycle energy use and environmental effects of feedstock production.

Sulfur is an essential secondary macronutrient for crop growth and is applied across U.S. agriculture. Production emissions were incorporated for three major sulfur fertilizer types—ammonium sulfate, gypsum, and elemental sulfur. The relative shares of these sulfur-containing fertilizer types were informed by USDA Economic Research Service (ERS) fertilizer use and price datasets (USDA ERS, 2019), which provided national reporting of sulfur fertilizer categories through 2015 (the most recent year with disaggregated category data available at present).

The LCIs for ammonium sulfate and gypsum production are already in R&D GREET. On the other hand, more than 90% of elemental sulfur production is from petroleum refining and natural gas processing (USGS, 2026). All the sulfur produced in the United States is the result of environmental measures implemented to reduce emissions of SO₂ into the atmosphere at petroleum refineries and nonferrous metal smelters and to remove poisonous hydrogen sulfide (H₂S) gas from natural gas (USGS, 2026). Therefore, we consider elemental sulfur an industry by-product that has no energy use or emissions burdens associated with the sulfur recovery process, but we consider the transportation of recovered sulfur as a fertilizer from US petroleum refineries to farms. Specific information on the transportation modes and distances for using elemental sulfur as a fertilizer is not available. For other fertilizers, The Fertilizer Institute (TFI) reports the fertilizer transportation and distribution (T&D) details. TFI reported that in 2017, in terms of ton-mile basis, approximately 63%, 15%, 17%, and 5% of fertilizers are transported via rail, truck, barge, and pipeline, respectively, while in terms of tonnage basis, the corresponding mode shares changed to 37%, 51%, 9%, and 3%, respectively (TFI, 2023). Since pipeline is only used for liquid ammonia transportation, we exclude the pipeline share and allocate it to the other three modes proportionally. We assume that the T&D distance by rail is the same as that for ammonia fertilizer, which is 1,164 miles TFI (2019), given that both commodities primarily move from the U.S. Gulf Coast to the farmlands. Then, we estimate that the T&D distances for truck and barge are 201 and 1,291 miles, respectively, using the reported ton-mile and tonnage shares above. Table 2 summarizes the transportation modes, shares, and distances for the elemental sulfur fertilizer.

On the other hand, sulfur fertilizer application rates for major crop production were extracted from USDA National Agricultural Statistics Service (NASS) survey data.

Table 2. Transportation modes, shares, distances for the elemental sulfur fertilizer

Mode	Share	Distance (miles)
Rail	38.1%	1,164
Truck	52.6%	201
Barge	9.3%	1,291

For fungicides, a literature review was conducted to address the energy use and environmental effects of fungicide production. The most applicable source identified was Audsley et al. (2009), which reports estimates of GHG emissions for pesticide production using energy intensity information from Green (1987). However, many fungicide active ingredients represented in these datasets are now restricted or phased out in the United States and are primarily associated with specialty crops rather than major biofuel feedstocks (e.g., corn, soybeans, sorghum). Due to limited relevance of available fungicide-specific data to current practices and the lack of updated, publicly

available LCIs for modern fungicide chemistries, fungicide production emissions were approximated using insecticide manufacturing emission intensities as a proxy. This approach is used as an interim approximation based on broadly similar synthesis complexity and energy requirements across these pesticide classes. The approximation will be revisited when contemporary fungicide-specific inventory data become available through literature or industry reporting.

1.5 Correction of the Nitrogen Content of Camelina Crop Residues

A data error was identified and corrected for the N content parameters used for camelina crop residues in R&D GREET 2025, which influences estimation of N₂O emissions from the residue left to the field.

The camelina residue N contents in R&D GREET 2025 were from a report by (S&T)² Consultants Inc (2016), which in turn cited data from Johnson and Gesch (2013). Upon review, it was determined that the (S&T)² report inadvertently reversed the aboveground and belowground N values relative to the original publication. With this correction, the camelina crop residue N content was revised from 65 gN/kg seed to 47 gN/kg seed (which is consistent with Johnson and Gesch, 2013). This correction reduces the estimated N₂O emissions attributable to camelina residue decomposition.

2. ANAEROBIC DIGESTION PATHWAYS FOR RENEWABLE NATURAL GAS PRODUCTION

2.1 Renewable Natural Gas Production from Animal Manure

R&D GREET 2025 Rev.1 updates biogas produced from manure via anaerobic digestion (AD) pathways. The key improvements include expanding coverage from 7 broad livestock sectors to 25 distinct animal categories (matching those in the EPA Greenhouse Gas Inventory [GHGI]), resulting in 91 unique animal type–waste management system combinations. Included with this is a comprehensive county-level database characterizing business-as-usual manure management emissions across the United States, drawing on data from the EPA GHGI, U.S. Department of Agriculture (USDA) National Resources Conservation Service (NRCS), National Oceanic and Atmospheric Administration (NOAA), and IPCC methodologies. Updated manure properties—including volatile solids-to-total solids ratios, carbon contents, and nitrogen excretion rates—were incorporated alongside refined methane conversion factors for both liquid and dry manure management systems.

Several new methodological features were introduced, including explicit quantification of dinitrogen (N₂) emissions from manure management using IPCC 2019 methodology, management system-specific CO₂ emission estimates during storage, and a complete nitrogen mass balance accounting for losses through direct N₂O, N₂, ammonia volatilization, and runoff/leaching. Users

can now specify custom monthly temperatures and cleanout schedules for liquid manure management systems (e.g., lagoons, deep pits, liquid/slurry). Digestate methane conversion factors were disaggregated to the state level and calculated per animal manure type. These updates collectively improve the fidelity of life cycle carbon intensity scores for manure-derived renewable natural gas (RNG), with notable impacts shown across animal manure types—for example, dairy cow and heifer RNG pathways becoming more carbon-negative and swine pathways showing variation across classes.

For illustrative purposes, we present the default results for dairy cow manure when individual BAU MMS are selected within the model as the counterfactual scenario (Table 1).

Table 1: Life cycle GHG emissions, or carbon intensity (CI), in kg CO₂e/MMBtu LHV (AR6/GWP-100) from combusting dairy manure-derived RNG in spark-ignition transit buses, as a function of the manure management system (MMS) assumed in the counterfactual.

MMS assumed in the counterfactual	CI
Anaerobic Lagoon	-250.9
Daily Spread	154.6
Deep Pit	48.6
Dry Lot	20.4
Liquid/Slurry	-144.2
Pasture	159.0
Solid Storage	42.0
U.S manure-weighted average (default)	-37.7

By comparison to the results in Table 1, the California Low-Carbon Fuel Standard (CA LCFS) average CI for dairy manure-derived RNG is -267.4 ± 92.1 g CO₂e/MJ (mean $\pm$ σ), or equivalently -282.2 ± 97.2 kg CO₂e/MMBtu. The difference in CI between the R&D GREET 2025 Rev. 1 default in Table 1 and the CA LCFS average is primarily attributable to differences in MMS representation in the counterfactual scenario. The majority of dairy manure RNG projects registered under the CA LCFS assume anaerobic lagoon counterfactuals, which yield more negative CI scores. As shown in Table 1, these MMS do produce deeply negative CI scores in R&D GREET 2025 Rev. 1 as well. However, unlike the CA LCFS, R&D GREET considers all non-AD managed manure systems as part of the default counterfactual scenario, which results in a less negative average CI. This weighing across all MMS in the counterfactual scenario has been the default approach in R&D GREET since 2011 to estimate the average CI of AD RNG production from manure.

Publication:

Leonhardt, B.E., Englander, J.G., Cai, H., Wang, M. (2026). *Updates to Anaerobic Digestion Pathways for Animal Manure in R&D GREET 2025 Rev. 1*. Argonne National Laboratory.

2.2 Anaerobic Digestion Technology Option for Wastewater Sludge Treatment

R&D GREET 2025 assumed thermal hydrolysis preceding mesophilic AD (Thermohydrolysis) as the default technology for RNG production from sludge from waste water treatment plants (WWTPs), which produces EPA Class A biosolids. However, an analysis of 30 operational sludge-to-RNG projects in the United States revealed that 23 facilities (representing 70% of combined sludge flow) produce Class B biosolids, indicating that mesophilic digestion without advanced pretreatment is the dominant practice. Data from EPA's Renewable Fuel Standard Program further confirmed that single-stage mesophilic digesters (Meso-1 stage) account for approximately 67% of both facilities and biogas production among WWTP-based RNG projects.

Based on these findings, R&D GREET 2025 Rev. 1 adopts Meso-1 stage as the default AD technology for both the sludge-to-RNG project scenario and AD pathways within the counterfactual (business-as-usual) scenario, replacing the previously assumed thermohydrolysis and meso-1 stage (baseline) defaults, respectively. R&D GREET 2025 Rev.1 also affirms that land application remains the most common disposal route for post-AD biosolids, with approximately 74% of untreated dry sludge ultimately being land applied across all studied facilities—either directly or following intermediate steps such as composting or lagoon storage. This update retains land application as the default digestate disposal assumption for the sludge-to-RNG pathway.

Publications:

Leonhardt, B.E., Englander, J.G., Gan, Y., Ou, L., Cai, H. (2026). *Updating the Default Anaerobic Digester Technology for Wastewater Sludge Anaerobic Digestion Pathways in R&D GREET 2025 Rev.1*. Argonne National Laboratory.

Gan, Y., Leonhardt, B.E., Englander, J.G., Cai, H., Wang, M. (2026). *Lifecycle Greenhouse Gas Emissions Analysis of Business-As-Usual Wastewater Sludge Management Practices*, Forthcoming.

3. SUSTAINABLE AVIATION FUEL PRODUCTION FROM FORAGE SORGHUM VIA FISCHER-TROPSCH AND ETHANOL-TO-JET TECHNOLOGIES

Kwon et al (2026) conducted an LCA of dedicated energy crops as feedstocks for jet fuel production via FTJ and ETJ pathways. While R&D GREET 2025 has both FTJ and ETJ pathways established for willow, poplar, switchgrass, and miscanthus, it does not have the relevant pathways for forage sorghum. For forage sorghum, previous R&D GREET considered it as a feedstock for ethanol production only.

In this update, the forage sorghum FTJ and ETJ pathways are added. For the FTJ pathway, the R&D GREET default process energy efficiency (i.e. biomass to FT fuel yield) for biomass FT gasification process was adopted for forage sorghum, due to the lack of feedstock specific parameter. For the ETJ pathway, the existing forage sorghum to ethanol pathway is connected to downstream ethanol upgrading into jet fuel pathway via ETJ. Details of both pathways are documented in Kwon et al (2026).

Publication:

Kwon, H., Langholz, M., Liu, X., Clark, R., and Cai, H., and Wang, M. (2026). Life Cycle Analysis of Dedicated Energy Crop Production in the United States. *Biomass and Bioenergy*. 212, 109329. <https://doi.org/10.1016/j.biombioe.2026.109329>

4. GEOLOGIC HYDROGEN PRODUCTION FROM NATURAL RESERVOIRS

In R&D GREET 2025 Rev.1, we expanded the geologic hydrogen production pathways in R&D GREET 2025 to better capture the variability of geologic hydrogen production from natural reservoirs in a total of eighteen production scenarios, enabling a more comprehensive assessment of the energy and environmental impacts of variability in raw gas composition, reservoir conditions, and surface processing configurations.

The 18-scenario set is organized into six raw-gas composition classes:

- 92% H₂ + 2% CO₂ + 5.9% N₂ + 0.1% CH₄ + 0% H₂S;
- 80% H₂ + 2% CO₂ + 8% N₂ + 10% CH₄ + 0% H₂S;
- 80% H₂ + 10% CO₂ + 9.8% N₂ + 0.1% CH₄ + 0.1% H₂S;
- 50% H₂ + 20% CO₂ + 29.4% N₂ + 0.1% CH₄ + 0.5% H₂S;
- 50% H₂ + 0% CO₂ + 49.9% N₂ + 0.1% CH₄ + 0% H₂S; and
- 50% H₂ + 0% CO₂ + 30% N₂ + 20% CH₄ + 0% H₂S.

Each gas composition scenario is further evaluated under multiple combinations of:

- Reservoir pressure (high vs. low),
- Estimated ultimate recovery (EUR),
- Produced-water rate, and
- Surface processing configuration (e.g., with or without acid gas removal).

This expansion was informed by stakeholder feedback emphasizing the importance of representing a broader range of plausible field conditions. The expansion offers a more comprehensive characterization of how geologic conditions, operational design, and processing choices influence

life cycle energy and environmental effects of geologic hydrogen production from natural reservoirs.

The natural geologic hydrogen pathway implemented in the Hydrogen module of R&D GREET 2025 Rev. 1 covers well-to-gate life-cycle emissions. Transportation, distribution, and end-use applications of geologic hydrogen have not yet been included. These downstream supply chain elements and end-use scenarios will be evaluated and incorporated into R&D GREET 2026 to enable holistic well-to-end-use modeling of geologic hydrogen pathways, including consideration of production locations and the infrastructure required to transport geologic hydrogen from production sites to end-use locations.

Publication:

Gan, Y., Zhang, Z., Englander, J., Ellis, G., Elgowainy, A., Cai, H., Wang, M. (2026). *Natural Geologic Hydrogen as an Emerging Resource: A Lifecycle Benchmarking Analysis*, Forthcoming.

5. CHLOR-ALKALI HYDROGEN, CHLORINE, AND HYDROCHLORIC ACID

5.1 Sodium Brine for Hydrogen and other Chlor-Alkali products

The R&D GREET chlor-alkali pathways have been updated to include revised sodium brine pathways for membrane-cell production. These brine assumptions are now applied consistently to the byproduct hydrogen, chlorine, and hydrochloric acid pathways. The update replaces the legacy sodium brine representation with new pathways for brine produced from imported purified salt and onsite solution-mined brine. Relative to the previous representation, the revised pathways reduce the energy and greenhouse gas intensity of brine production, with a modest effect on chlor-alkali hydrogen results. Additional details on the methodology, data sources, and assumptions are provided in the accompanying technical memorandum on the sodium brine pathway update (Martinez et al., 2026).

Publication:

Martinez, S., Pandey, I., Shukla, S., Vyawahare, P., Ng, C., Englander, J. G., & Elgowainy, A. (2026). Updated Sodium Brine for Chlor-Alkali Hydrogen, Chlorine, and Hydrochloric Acid in R&D GREET 2025 Rev.1. https://greet.anl.gov/publication-update_brine_2025_Rev1

5.2 Updates to Hydrochloric Acid and Chlorine from Chlor-Alkali Facilities

The pathways for hydrochloric acid (HCl) and chlorine (Cl₂) have been updated using data from Chlor-Alkali facilities from Vyawahare et al. (2025). Although only about 10% of the hydrochloric acid supply is produced in chlor-alkali facilities, the pathway was previously modeled using

stoichiometric hydrogen and chlorine inputs. This effectively assumes production of pure HCl, rather than the aqueous hydrochloric acid solutions typically supplied commercially. In practice, HCl concentrations above 38% are generally avoided because they cause excessive fuming and require additional storage and handling controls. Assuming a higher concentration therefore overstates the emissions associated with HCl use in downstream pathways, where concentrations typically do not exceed 38%.

Approximately 95% of Cl₂ is produced in chlor-alkali facilities. The previous pathway relied on outdated data. This revision updates the pathway to reflect current research, data, and technology.

Publication:

Vyawahare, P., Sun, P., Young, B., Bafana, A., Kim, T., Hawkins, T. R., & Elgowainy, A. (2025). Life Cycle Greenhouse Gas Emissions Analysis of the Chlor-Alkali Process and By-Product Hydrogen in the United States. *Hydrogen*, 6(1), 12. <https://doi.org/10.3390/hydrogen6010012>

6. UPDATES TO THE MARINE MODULE

More feedstock options are made available for the biodiesel pathway in the Marine_Fuel tab of the R&D GREET Excel version. Biodiesel feedstock options already available in R&D GREET—soybean, palm, canola, jatropha, camelina, algae, tallow, corn oil, carinata, palm fatty acid distillate, and used cooking oil—can now be selected from the Biooil tab. Default feedstock is soybean.

The standalone interactive marine module was also updated to reflect the updates in the marine tab of the R&D GREET Excel version (Benvenuti et al., 2025). Vessel choices were increased to 19 from the previous three, each with varying size categories. Boilers and steam turbines are added to the energy converter options alongside main engine and auxiliary engine. For main engine, two different fuels can be selected. The option for pilot fuel is also added for vessels operated by liquefied natural gas, methanol, and ammonia. Details are in the R&D GREET Interactive Marine Module 2026 - Introduction and Instruction document, available with the module.

In addition, we made an update to the transportation and distribution (T&D) modes and distances with regards to residual oil and petroleum diesel as marine fuels. In previous versions of R&D GREET, it assumed that the final T&D leg for residual oil and petroleum diesel was by heavy-duty truck for 100 miles to refueling stations, which is more representative of on-road applications. Through our communication with the American Bureau of Shipping (ABS), it is recognized that the final T&D leg for marine fuels typically involves 100% barge transportation from a port terminal to the ship over a distance of about 20 miles. Therefore, we revised the T&D assumptions to reflect this difference in the marine fuel supply chain.

Publication:

Benvenuti L, CP Kolodziej, S Tripathi, PT Benavides, M Wang, F Masum. (2025). Development of the Well-to-Wake Life Cycle Assessment Model for Marine Fuels in R&D GREET 2025. Argonne National Laboratory. Report No. ANL/ESIA-25/18. <https://doi.org/10.2172/2999533>

7. PROJECTION OF ELECTRICITY GENERATION

The United States Environmental Protection Agency (US EPA) has been publishing results from the Integrated Planning Model (IPM) on electric generation associated emissions including greenhouse gas emissions (GHG) and other criteria air pollutants (CAPs) to estimate the future impacts of environmental policies and regulations on generation mixes and emissions. The IPM can forecast least-cost capacity expansion, electricity dispatch, and emission control strategies while meeting energy demand; and environmental, transmission, dispatch, and reliability constraints. It can be used to evaluate the emissions impacts of proposed policies to limit GHG and other CAP emissions from the electric power sector.

The R&D GREET 2025 Rev.1 now implements the option of IPM results in addition to the existing electricity generation scenarios in the R&D GREET (i.e., Annual Energy Outlook (AEO) and the National Laboratory of the Rockies (NLR) Users can choose this option in the “Inputs” tab in R&D GREET 2025 Rev.1, and examine the impacts of different electricity generation mixes and projections in the model.

For further details of the methods, approach, and assumptions used for this new implementation, please refer to Kim et al. (2026).

Publication:

Kim, T., Lu, Z., Kelly, J.C. (2026). Summary of Post-Processing EPA Integrated Planning Model (IPM) 2023 Reference Case for R&D GREET 2025 Rev.1. Technical Memorandum. Argonne National Laboratory.

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The authors of this report are solely responsible for the contents and conclusions of the report. Argonne does not warrant that the results presented in this report are consistent with the requirements of any particular regulatory or incentive program. Users interested in specific programs are encouraged to review guidance specific to those programs.

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