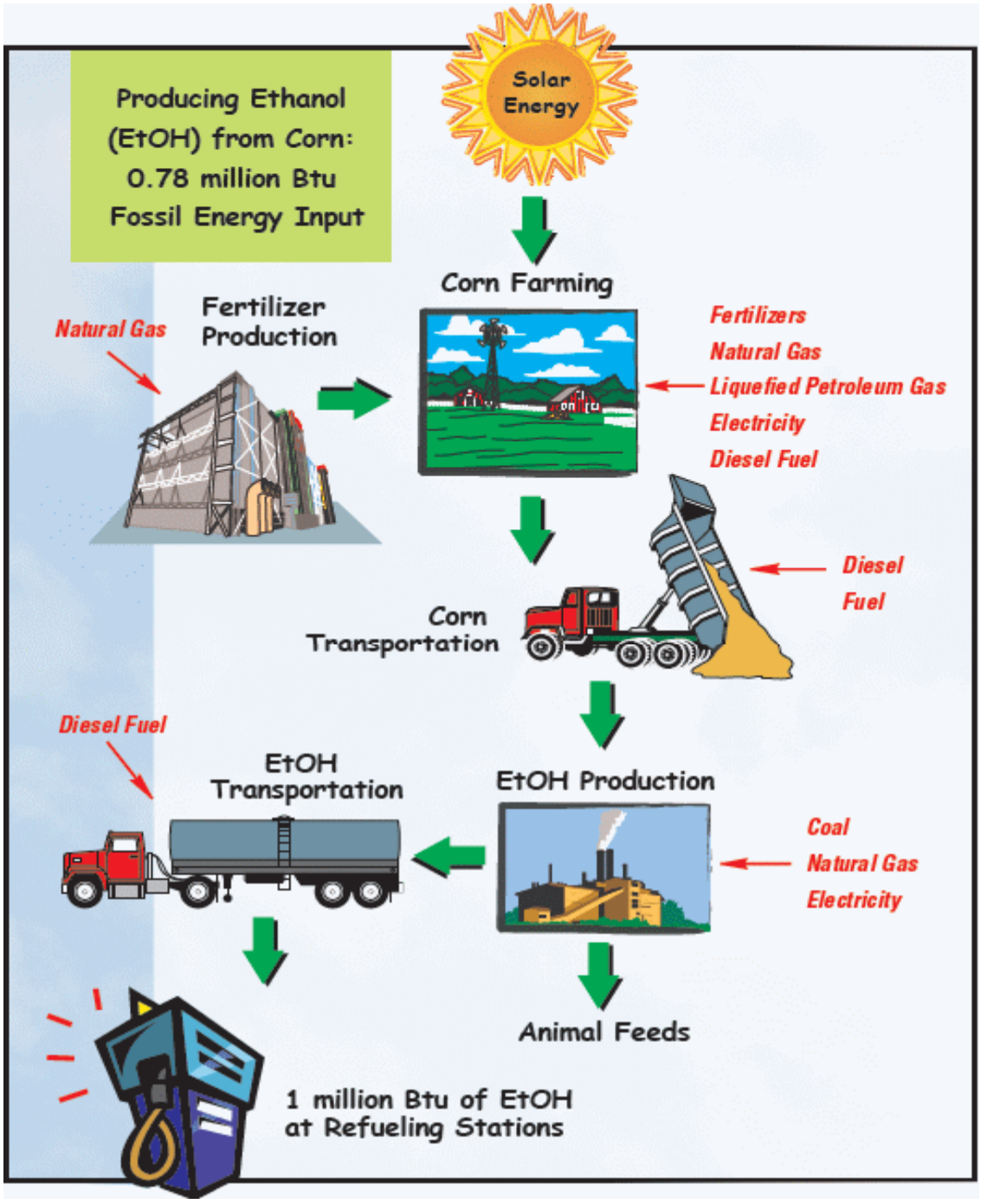
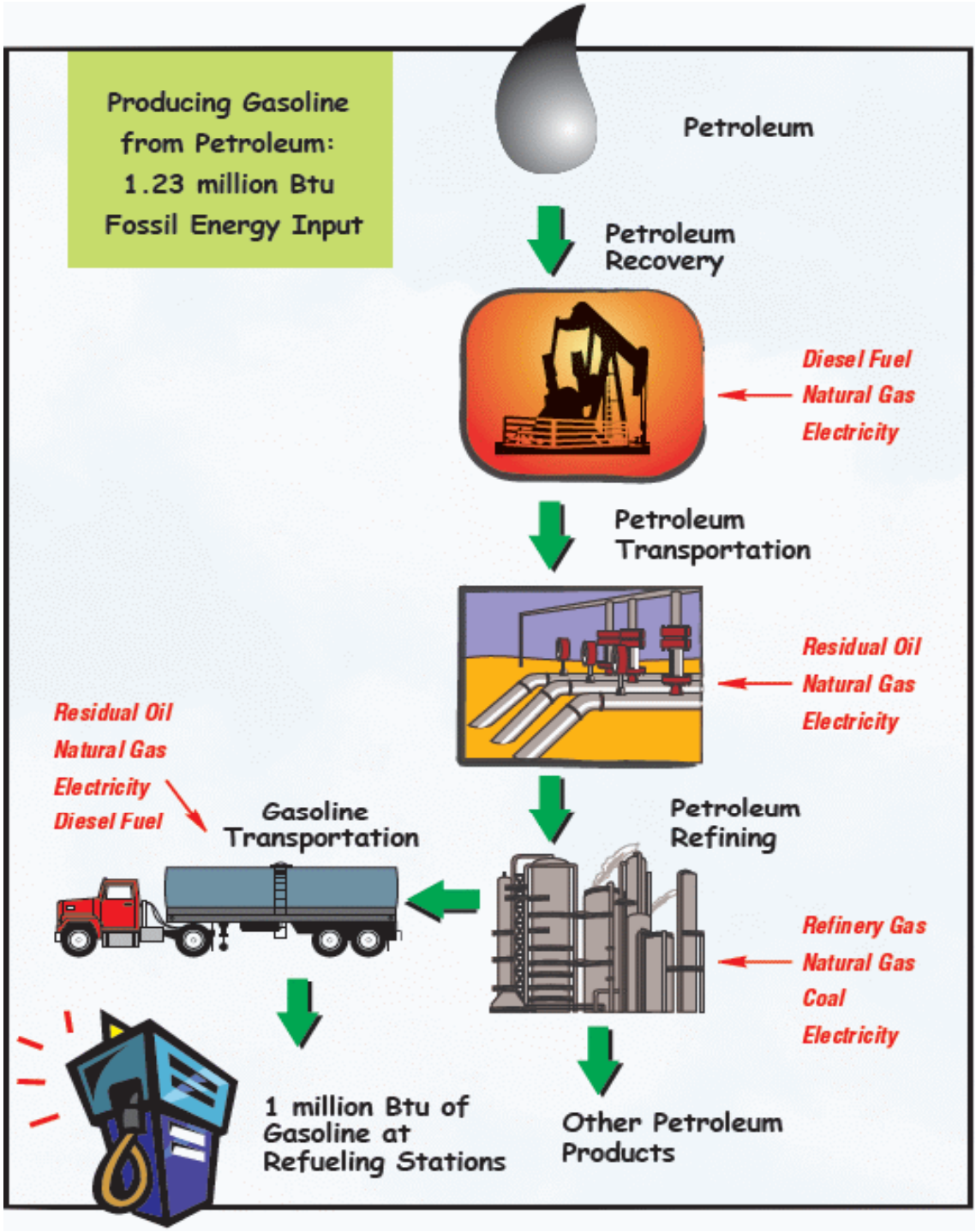
*This figure shows the fossil energy inputs used to produce and deliver a million Btu of ethanol and gasoline to a refueling station. This figure is based on GREET (Greenhouse gases, Regulated Emissions, and Energy Use in Transportation) model. The GREET model is in the public domain and is available at:* http://greet.es.anl.gov/

**Section: BIOFUELS**

**Comparative Results between Ethanol and Gasoline Based on an Evaluation by the GREET Model**




Producing Gasoline from Petroleum: 1.23 million Btu Fossil Energy Input
Petroleum
Petroleum Recovery
Diesel Fuel
Natural Gas
Electricity
Petroleum Transportation
Residual Oil
Natural Gas
Electricity
Residual Oil
Natural Gas
Electricity
Diesel Fuel
Gasoline Transportation
Petroleum Refining
Refinery Gas
Natural Gas
Coal
Electricity
1 million Btu of Gasoline at Refueling Stations
Other Petroleum Products

The GREET model was developed by Argonne National Laboratory under the sponsorship of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy in order to fully evaluate energy and emission impacts of advanced vehicle technologies and new transportation fuels. The first version of this public domain model was released in 1996. Since then, Argonne has continued to update and expand the model with GREET 1.8d.1 version now available. The model allows researchers and analysts to evaluate various vehicle and fuel combinations on a full fuel-cycle basis that includes wells to wheels and the vehicle cycle through material recovery and vehicle disposal.

**For a given vehicle and fuel system, GREET separately calculates the following:**

- Consumption of total energy (energy in non-renewable and renewable sources) and fossil fuels petroleum, natural gas, and coal).
- Emissions of CO2-equivalent greenhouse gases – primarily carbon dioxide, methane, and nitrous oxide.
- Emissions of six criteria pollutants: volatile organic compounds, carbon monoxide, nitrogen oxide, particulate matter with size smaller than 10 micron (PM10), particulate matter with size smaller than 2.5 micron, and sulfur oxides.

**GREET includes more than 100 fuel pathways including petroleum fuels, natural gas fuels, biofuels, hydrogen, and electricity produced from various feedstocks.**

**GREET includes more than 80 vehicle/fuel systems:**

- Conventional spark-ignition engine vehicles
- Spark-Ignition, Direct-Injection Engine Vehicles
- Compresson-Ignition, Direct-Injection Engine Vehicles
- Hybrid electric vehicles
  - o Spark-ignition engines
  - o Compression-ignition engines
- Plug-in hybrid electric vehicles
  - o Spark-ignition engines
  - o Compression-ignition engines
- Battery-powered electric vehicles
- Fuel-cell vehicles

**Source:**

Figures: Ethanol: The Complete Energy Life-Cycle Picture. Second revised edition, March 2007
http://www.transportation.anl.gov/pdfs/TA/345.pdf

Text: Argonne National Laboratory, Transportation Technology R&D Center,
http://greet.es.anl.gov/