Energy Systems

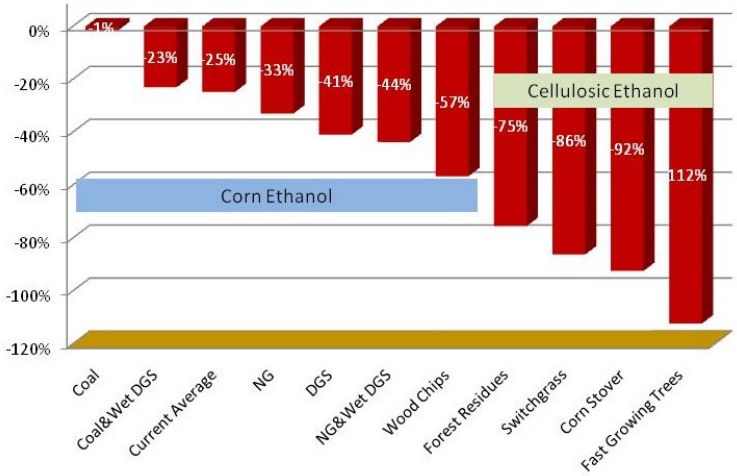
Argonne-EERE Mission in Biofuels

The EERE Vision: A viable, sustainable domestic biomass industry that produces renewable biofuels, bioproducts and biopower, enhances U.S. energy security, reduces our dependence on oil, provides environmental benefits including reduced greenhouse gas emissions, and creates economic opportunities across the nation.

Analysis

GREET: Argonne's Life Cycle Analysis application, is DOE's standard tool for evaluating energy utilization and greenhouse gas emissions of biofuel pathways and comparing them to petroleum fuel pathways.

- Argonne has evaluated corn ethanol, sugar ethanol, a variety of cellulosic ethanol pathways, soy biodiesel, as well as advanced biofuels such as butanol. Argonne continues to expand the GREET model to incorporate significant feedstocks, production technologies, and novel biofuels. (Image GREET pathways)
- DOE and EPA are using GREET to help determine which biomass feedstocks, production pathways, and biofuels qualify meet the RFS2 EISA 2007 mandates
- Argonne has integrated water consumption requirements into biofuel production and compared the impact to petroleum gasoline.
- Argonne will undertake detailed LCA analysis of algal biofuels and infrastructure-compatible advanced biofuels



Using Argonne's GREET applications, GHG emissions of corn ethanol vary considerably among process fuels in plants; cellulosic ethanol consistently achieve large reductions.

Monitoring the impact of water uptake in a stand of poplar trees to enhance biomass feedstock growth

Sustainable Systems

Argonne is conducting field experiments to evaluate and develop technologies to address biomass feedstock water utilization and carbon sequestration

- Argonne has several field demonstrations that use water and nutrient run-off to grow poplar trees and other energy crops
- Argonne has a been evaluating the long term impact of prairie grass and switch grass on carbon sequestration

Bioprocessing

Argonne developed a platform technology named the Separative Bioreactor that enables integrated fermentation and product recovery. The technology improves the energy efficiency for product recovery.

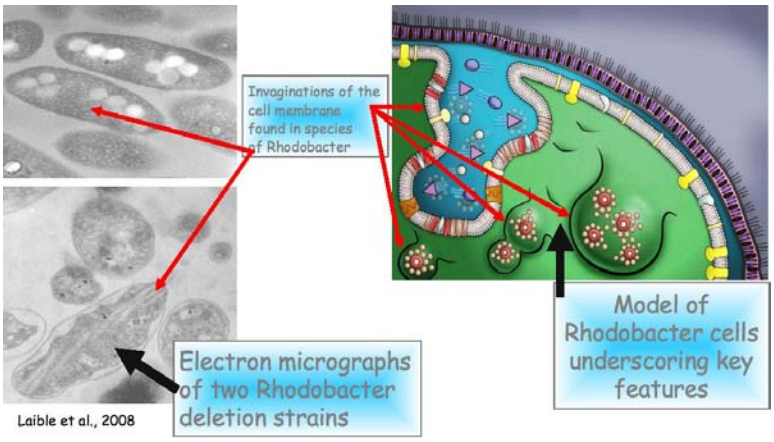
- Working with industrial partners, the Separative Bioreactor has been use in pilot scale demonstrations at the partner site to produce value-added organic acids as co-products in integrated biorefineries.
- Argonne is using the Separative Bioreactor technology to improve the pretreatment conditioning to enable efficient cellulosic ethanol fermentation and production.

An Argonne chemist evaluates biorefinery co-product samples produced by the Separative Bioreactor.

Commercialization

Argonne has a strong track record of commercializing technology and help the creation of new companies.

- Vertec Biosolvents Inc., a company that sells biobased solvents was co-founded by an Argonne scientist and successfully spun-off in the late 1990's.
- Coskata Inc., a company that is conducting a pioneer plant demonstration to produce cellulosic ethanol by syngas fermentation was co-founded by an Argonnescientist. After initial work at Argonne, the company built its own facility in 2006.
- Argonne is in negotiation with an industrial equipment provider and a bioprocessor to license and commercialize the Separative Bioreactor platform.



Cells of the photosynthetic bacterium Rhodobacter Capsulatus have the ability to segregate oil-like biofuel molecules to facilitate energy-efficient separation.

Advanced Biofuels

As highlighted in a recent GAO report,* there is strong national interest in producing advanced biofuels that are infrastructure compatible. Argonne is employing both chemical and biological approaches to production of infrastructure-compatible advanced biofuels that could direct replace gasoline or diesel. Argonne is leveraging expertise developed in Office of Science funded work to meet the EERE mission

- Argonne is designing, fabricating, characterizing, and testing catalysts for direct reduction of biomass to gasoline or diesel replacements.
- Argonne is genetic engineering photosynthetic bacteria to produce and export gasoline and diesel replacements.
- Argonne is developing post-growth technologies to enzymatically convert oils and lipids to gasoline and diesel replacements
- in negotiation with an industrial equipment provider and a bioprocessor to license and commercialize the Separative Bioreactor platform.

** Recommendation from the 2009 GAO report "Potential Effects and Challenges of Required Increases in Production and Use" Recommendation: To minimize future blend wall issues and associated ethanol distribution infrastructure costs, the Secretaries of Agriculture and Energy should give priority to research and development (R&D) on process technologies that produce biofuels that can be used by the existing petroleum-based distribution storage infrastructure and the current fleet of U.S. vehicles.*