

Oil To Biofuels

Case Study Objectives

- Critically evaluate the nature of certain societal challenges (access to clean water, energy demands, climate change, and disease and biomedicine), and explore scientific contributions to solutions to those problems.
- Discover scientific principles and concepts in the context of real world problems facing society.
- Work in diverse teams to collaboratively solve problems and develop leadership qualities.
- Develop appreciation of the interdisciplinary nature of the scientific process and scientific solutions to problems.

Inception.

- Gulf Oil Spill case study.
- Lawrence Livermore National Laboratory (LLNL) diagram of estimated U.S. energy use in 2009, showing energy sources and uses.

Engagement.

- Review the LLNL diagram, discussing energy sources and uses, “rejected energy”, and the consequences of various sources.
- How could this diagram be modified through the use of biofuels?

Research.

- What are biomass and biofuels? How are they used, what are their benefits and negative consequences? Which developing fuels and technologies show the most promise? Characterize the ideal biofuel.
- What are the outstanding scientific challenges related to development, production, and use of your ideal biofuel?
- Estimate the amount of your biofuel required to replace a fossil fuel of your choice (coal, oil, etc.) This is our ideal, but unattainable, target.

Create.

- Prepare a report estimating the fraction of this ideal target that could be met through the expanded use of a chosen biofuel. The following format will help student teams organize thinking and research, as well as create a uniform format among team reports.

Background - Explain the target. What energy sources can your biofuel replace, and how can it be used? What characteristics make it suitable for these uses? What are competing sources?

Analysis – Discuss your biofuel of choice. How much of it could potentially substitute for fossil fuels? Evaluate its suitability and characteristics.

Based on literature measures and availability, estimate how many quads of energy your fuel could supply. What assumptions are included in that estimate?

Projection - Combine your results above into a final number: "X +/- Y % of this target could be met through the expansion of bioenergy. Break it down and show how.

Consequences - What effects (environmental, economic, etc.) should we expect if your projection is reached?

Contingencies - Where is R&D most urgently needed if the projection is to be fulfilled?

Reflect.

Share results. What did students find to be the most promising fuels? What universal pros or cons were found? What do students think is the best way for scientific research to proceed? Discuss.