



Online Ethics Center
FOR ENGINEERING AND SCIENCE

Case: Next-Generation Biofuels

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Description

In this fictional case, a bioengineer completing a postdoctoral fellowship in sustainability considers his options for future employment. He would like to work with advanced microalgae production of biofuels. However, he is offered industry job developing first-generation biofuels, especially increasing yield.

Body

Omar Carver recently completed a post-doctoral fellowship in Sustainability Studies. As a trained bioengineer, Omar had previously completed a doctoral dissertation on how to optimize properties of certain plant-based biofuels to become viable alternatives to traditional fossil fuels. During that research, Omar became increasingly interested in issues of sustainability in addition to his research interests in developing alternatives to non-renewable resources. After he received his Ph.D., he became committed to pursuing research that would not only help to manage and protect the environment, but he also wanted to contribute to improving human welfare and global social equity.

During his post-doctoral research in Sustainability Studies, Omar became aware of the social and ethical issues concerning the development and use of plant-based

biofuels, often referred to as first-generation biofuels. Studies have shown that the mass production of biofuels has destroyed rainforests, does not mitigate the negative effects of greenhouse gas emissions (and sometimes worsens them), and has, in some instances, created farming conditions which limited local food supplies, drove up food prices, and exacerbated conditions of poverty.

Given Omar's growing awareness of issues in environmental and social justice, he has begun to explore the possibility of creating biofuels with microalgae. Some scientists think that this new kind of biofuel might present a sustainable alternative to cheaper fossil fuels and prevent some of the negative social and environmental impacts of first-generation biofuels, mostly derived from food crops. As a sustainability scholar, Omar is aware that this emerging technology also presents scientific, environmental, social, ethical and economic challenges, but he is excited about the possibility to pursue cutting-edge scientific research that has been referred to as the "next generation" of biofuel technologies, and that represents his goals and values.

However, a large energy conglomerate offered a position to continue his research on biofuels derived from plant oils. Many large energy corporations have taken control over the production of these first-generation biofuels and they are set on developing ways in which they can increase their yield and profit. While increasing biofuel plants' yield might lessen the consumption of land and water, and thus improve environmental conditions, Omar is still concerned with other ethical consequences of this research.

Discussion Questions:

- What sorts of potential future consequences of emerging biotechnologies, such as plant-based biofuels and microalgae biofuels, ought to be taken into consideration during the R&D stage?
- Who should be involved in negotiating national and international guidelines and regulations for research and development of these technologies?
- What roles and responsibilities do governments from developed countries have in regulating the development and application of alternative sources of energy?
- What are the social and ethical responsibilities of individual scientists, like Omar, in developing alternative sources of renewable energy, which may have

such far-reaching impacts on the global economy, social and cultural arrangements, environmental health, and even climate change?

Bibliography

Blankenship, Robert E., David M. Tiede, James Barber, Gary W. Brudvig, Graham Fleming, Maria Ghirardi, M. R. Gunner et al. "Comparing photosynthetic and photovoltaic efficiencies and recognizing the potential for improvement." *Science* 332, no. 6031 (2011): 805-809. doi: 10.1126/science.1200165

Buyx, Alena M., and Joyce Tait. "Biofuels: ethics and policy-making." *Biofuels, Bioproducts and Biorefining* 5, no. 6 (2011): 631-639. doi: 10.1002/bbb.325

Ehrenberg, Rachel. "The biofuel future: Scientists seek ways to make green energy pay off." *Science News* 176, no. 3 (2009): 24-29. doi: 10.1002/scin.5591760323

König, Harald, Daniel Frank, Reinhard Heil, and Christopher Coenen. "Synthetic genomics and synthetic biology applications between hopes and concerns." *Current genomics* 14, no. 1 (2013): 11-24. doi: 10.2174/1389202911314010003

Mortimer, Nigel. "Ethics for biofuels ... and everything else." *Significance* 8, no. 3 (2011): 108-111. doi: 10.1111/j.1740-9713.2011.00503.x

Pienkos, Philip T., Lieve Laurens, and Andy Aden. "Making biofuel from microalgae." *American Scientist* 99, no. 6 (2011): 474-481.

Rosenberg, Julian N., George A. Oyler, Loy Wilkinson, and Michael J. Betenbaugh. "A green light for engineered algae: redirecting metabolism to fuel a biotechnology revolution." *Current opinion in Biotechnology* 19, no. 5 (2008): 430-436. doi: 10.1016/j.copbio.2008.07.008

Sawahel, Wagdy. "Biofuels from algae plagued with problems, says review." *SciDevNet*. July 5, 2010. Accessed December 11, 2015.

<http://www.scidev.net/global/biofuels/news/biofuels-from-algae-plagued-with-problems-says-review-1.html>

Tait, Joyce, and Oyelaran-Oyeyinka, Banji. "Are new biofuels the ethical answer?" *SciDevNet*. October 3, 2010. Accessed December 11, 2015.

<http://www.scidev.net/global/biotechnology/opinion/are-new-biofuels-the-ethical->

[answer-.html](#)

Thompson, Paul B. "The agricultural ethics of biofuels: A first look." *Journal of agricultural and environmental ethics* 21, no. 2 (2008): 183-198. doi: 10.1007/s10806-007-9073-6

Thompson, Paul B. "The agricultural ethics of biofuels: climate ethics and mitigation arguments." *Poiesis & Praxis* 8, no. 4 (2012): 169-189. doi: 10.1007/s10202-012-0105-6

Universitat Autònoma de Barcelona. "Microalgae could be a profitable source of biodiesel." *Science Daily*. March 21, 2013. Accessed December 11, 2015. <http://www.sciencedaily.com/releases/2013/03/130321132110.htm>

Links:

NCBI: *The Nexus of Biofuels, Climate Change, and Human Health: Workshop Summary*. Accessed December 11, 2015.

<http://www.ncbi.nlm.nih.gov/books/NBK196458/>

Nuffield Council on Bioethics. *Biofuels: Ethical issues*. London, UK: Nuffield Council on Bioethics; 2011. Accessed December 11, 2015. http://nuffieldbioethics.org/wp-content/uploads/2014/07/Biofuels_ethical_issues_FULL-REPORT_0.pdf

Biofuel.org. *Biofuels: The Fuel of the Future*. Accessed December 13, 2015.

<http://biofuel.org.uk/>

Notes

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