



Advancing Biodiesel:

Toward a More Sustainable, Regional Model to Displace Foreign Fossil Fuels

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Key Aspects

- Redeveloping a remediated Brownfield site in an urban New England port
- Applying principles of Green Chemistry
- Utilizing more sustainable feedstocks with a higher energy balance
- Deploying advanced process intensification technology
- Developing next generation feedstocks for scalability

Urban Redevelopment

- Redeveloped Brownfield site
- Integrated into existing petroleum infrastructure



Principles of Green Chemistry

1. Prevention -It is better to prevent waste than to treat or clean up waste after it has been created.
2. Atom Economy - Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final product.
3. Less Hazardous Chemical Syntheses - Wherever practicable, synthetic methods should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
4. Designing Safer Chemicals - Chemical products should be designed to effect their desired function while minimizing their toxicity.
5. Safer Solvents and Auxiliaries - The use of auxiliary substances (e.g., solvents, separation agents, etc.) should be made unnecessary wherever possible and innocuous when used.
6. Design for Energy Efficiency Energy requirements of chemical processes should be recognized for their environmental and economic impacts and should be minimized. If possible, synthetic methods should be conducted at ambient temperature and pressure.
7. Use of Renewable Feedstocks – A raw material or feedstock should be renewable rather than depleting whenever technically and economically practicable.
8. Reduce Derivatives - Unnecessary derivatization (use of blocking groups, protection/ deprotection, temporary modification of physical/chemical processes) should be minimized or avoided if possible, because such steps require additional reagents and can generate waste.
9. Catalysis - Catalytic reagents (as selective as possible) are superior to stoichiometric reagents.
10. Design for Degradation - Chemical products should be designed so that at the end of their function they break down into innocuous degradation products and do not persist in the environment.
11. Real-time analysis for Pollution Prevention - Analytical methodologies need to be further developed to allow for real-time, in-process monitoring and control prior to the formation of hazardous substances.
12. Inherently Safer Chemistry for Accident Prevention - Substances and the form of a substance used in a chemical process should be chosen to minimize the potential for chemical accidents, including releases, explosions, and fires.

*Anastas, P. T. and Warner, J. C. Green Chemistry: Theory and Practice. Oxford University Press: New York, 1998, p. 30. By permission of Oxford University Press

Alternative Feedstocks

- Waste Vegetable Oil (WVO)
 - Increase value of reclaimed oil
 - Increase collections from restaurants
- Yellow Grease
 - Mostly WVO with percentage of animal fats
 - Valuable BTUs that are mostly being exported today
- Animal Fats
 - Rendered waste product from food supply

Advanced Process Technology

- Ultrasonic cavitation, high shear process intensification with low power consumption
- Use of solid catalysts for pre-treatment eliminates need for liquid acids
- Ion exchange purification columns significantly reduce need for process water



Next Generation Feedstocks

- Jatropha
 - Grows on arid land otherwise unfit for food crops
- Algae
 - Among the fastest growing organisms on earth

