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Sustainability Education as a Catalyst for University and Community Partnerships

Shane Lishawa, Adam Schubel, Alison Varty, and Nancy Tuchman

Abstract

Universities are uniquely positioned to lead society toward sustainability and their collaborations with community organizations are essential to this transition. The Biodiesel Program at Loyola University Chicago Center for Urban Environmental Research and Policy provides a case study of course-based service-learning projects facilitating synergies between the university and the community while concomitantly fostering urban sustainability. This article discusses the program's design and structure, and describes specific examples of community partnerships that have benefited the university, the community, and the environment.

Civilization emerged under extraordinarily stable environmental conditions on Earth over the last 10,000 years (Dansgaard et al. 1993). However, as a direct result of modern society's energy consumption, industrialized agriculture, and land-use practices, the Earth system is reaching critical water, nutrient, and biogeochemical stability thresholds. Once these thresholds are breached, climate and ecological conditions are likely to break down in unpredictable ways, resulting in catastrophic impacts to societies and ecosystems throughout the globe (Rockström et al. 2009). In other words, if civilization's consumption and economic development patterns continue to follow present trajectories, ecosystems and human society will be exposed to increasingly unstable conditions, forcing future generations to adapt at great cost.

The World Council on Environment and Development (WCED) brought the concept of sustainable development to the world's attention in the late 1980s with the publication of "Our Common Future." This document defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). Presently, a suite of human-driven environmental changes threatens to compromise the ability of future generations to meet their needs. Therefore, advancing the cause of sustainability and minimizing further environmental degradation has become crucial for maintaining the stability of the Earth.

Universities, Sustainability, and Experiential Education

Universities are uniquely positioned in modern society to promote and advance sustainability (M'Gonigle and Starke 2006). Universities educate the majority of future leaders, professionals, and K-12 teachers. Institutions of higher education have the ability to both build empowered citizens, who are ready to work toward the goal of creating a sustainable society, and to directly effect change within their communities. We believe that sustainability-focused curricula with experiential education components, such as service-learning, work-study, internships, and cooperative education, can accomplish both of these goals.

To build an engaged citizenry, it is necessary to teach students how to be active and effective members of society and the workplace. Stemming back over 100 years to Herman Schneider's cooperative education program at the University of Cincinnati, many have appreciated the advantages of providing students with hands-on work and internship experiences while they complete their undergraduate education (Stockbridge 1911). Students who are actively engaged in work or internships in their field tend to be more motivated and perform better in the classroom (Markus et al. 1993). Additionally, students who engage in service-learning are more confident citizens and more likely to believe that they can be effective at solving community problems (Eyler et al. 1997).

Furthermore, experiential education can be one of the most effective methods for an institution of higher learning to produce direct, measurable impacts on their communities. For example, the service-learning programs at Loyola University Chicago (LUC) place students within charity, nonprofit, and community-building organizations, thereby providing critical support to needy organizations and simultaneously providing students with the benefits of real-world experiences (Patrick Green, personal communication). In the case of LUC, placing students in such organizations supports the mission of the university, which includes the goal of "working to expand knowledge in the service of humanity."

Thus, we developed the Loyola University Chicago Biodiesel Program (LUCBP) and curricula founded on the belief that university programs which include experiential education have the potential to advance the cause of sustainability by forging relationships between universities and community organizations; providing much needed support to sustainability-focused grass-roots, nonprofit, and under-funded government organizations; and developing empowered student-citizens who are motivated to work in the emerging field of sustainability.

Alternative Energy Education

Global climate change resulting from the anthropogenic combustion of fossil fuels is the greatest environmental challenge facing civilization. Unabated, predicted outcomes of climate change include an increase in extreme weather events, regionally reduced fresh water availability, sea-level rise, increasing ocean temperatures, and ocean acidification (IPCC 2007, 104). Any of these outcomes would compromise the ability of future generations to meet their needs; the current levels of fossil fuel consumption are therefore unsustainable. As such, limiting greenhouse gas emissions by reducing the use of fossil fuels is one of the principal goals of many sustainability programs.

One of the easiest methods to immediately decrease fossil fuel consumption is by using biodiesel. Biodiesel is an attractive alternative fuel because it can be used in unmodified diesel engines with little or no conversion and it can be produced safely and cheaply at very small scales. Additionally, biodiesel combustion emits significantly less particulate matter, polycyclic aromatic hydrocarbons, carbon monoxide, sulfur dioxide, and other forms of air pollution as compared to the petroleum diesel fuel that biodiesel replaces (U.S. EPA 2001). Furthermore, life-cycle analysis indicates that soy-derived biodiesel use emits 41 percent less net carbon dioxide (CO₂) emissions than petroleum diesel (Hill et al. 2006). However, there are serious limits to biodiesel as a solution to the suite of fossil fuel-related environmental problems. First, if all of the oil crops in the United States were used for biodiesel, this would meet only 6 percent of the nation's diesel fuel demand (Hill et al. 2006). Furthermore, exchanging food crops for fuel crops could seriously threaten food security and lead to increased agricultural development in ecologically sensitive native ecosystems and fallow farmlands. Moreover, the process of converting native ecosystems, with high carbon storage and high biodiversity, to agricultural systems, with low carbon storage and low biodiversity, can dramatically increase net CO₂ emissions (Fargione et al. 2008; Searchinger et al. 2008).

The use of waste vegetable oil (WVO) as a feedstock for biodiesel production, however, has all of the environmental benefits of biodiesel use with few of the above-stated drawbacks. WVO biodiesel has greater net CO₂ reductions than virgin oil biodiesel because WVO is a food production waste product (derived from crops not grown specifically for the purposes of fuel production). When farm production inputs are eliminated from life-cycle analyses, WVO-derived biodiesel reduces net greenhouse gas emissions by at least 85 percent as compared to petroleum diesel (data from Hill et al. 2006).

There is particularly great potential for metropolitan areas to utilize WVO for biodiesel. Wiltsee (1998) examined the WVO resources in thirty metropolitan areas in the United States and found an average of over 4 kilograms of WVO generated per person per year. The metropolitan area of Denver, Colorado, for example, has a typical per capita WVO output of 4.17 kg/year. This equates to more than 1.8 million gallons

of WVO per year and a potential biodiesel production capacity of approximately 1.8 million gallons per year.

Loyola University Chicago Biodiesel Program: Courses and University-Community Partnerships

The Loyola University Chicago Center for Urban Environmental Research and Policy (CUERP) houses and supports the Loyola University Chicago Biodiesel Program. CUERP is one of nine “Academic Centers of Excellence” within LUC and seeks to “advance our understanding of the interaction between natural and human systems in large metropolitan areas” (<http://www.luc.edu/cuerp/index.shtml>). LUCBP is a trans-disciplinary education program that facilitates student and community member exploration of fossil fuel-induced environmental problems and seeks solutions to these problems (<http://www.luc.edu/biodiesel/>). Financial support for LUCBP comes from Environmental Protection Agency (EPA) grants, biodiesel sales, private donor funds, and CUERP. LUCBP personnel include one full-time staff member, part-time assistance of five faculty members in CUERP, and support from more than thirty faculty members representing the College of Arts and Sciences, School of Communication, School of Nursing, School of Education, School of Business Administration, and School of Social Work.

The principal solution advanced by LUCBP is the production of biodiesel from WVO. LUCBP acknowledges and teaches the limits of biodiesel production as a solution for fossil fuel-caused environmental problems. Students tend to come into our program thinking of biodiesel as a “silver bullet” solution. We have found that discussing the intricacies of the biofuel debate is a very effective teaching tool. LUCBP has enrolled over 100 students and community members in three undergraduate and graduate courses, an adult continuing education course, a high-school outreach education program, an undergraduate internship program, and an official undergraduate club. All LUCBP courses include experiential education and community service-learning opportunities. Since 2007, students have completed over twenty service projects, resulting in the development of several synergistic community partnerships.

LUCBP Biodiesel Lab

Integral to all of LUCBP curricula is the student- and staff-designed, constructed, and operated biodiesel production facility. The facility, first housed in an abandoned ninth-floor biology laboratory, has been expanded and improved continuously since its establishment in fall 2007. Presently the facility is located in a private, ground-floor laboratory in the LUC Facilities Department garage. Our fuel meets specifications set by the American Society of Testing and Materials Standard for biodiesel. After a prolonged bureaucratic effort, the lab and fuel have been registered with the United States Environmental Protection Agency and the Internal Revenue Service. As of October 2009, the lab has a 10,000-gallon-per-year production capacity.

Solutions to Environmental Problems (STEP): Biodiesel Course

The first course offered by LUCBP, Solutions to Environmental Problems (STEP): Biodiesel, was taught for three semesters (http://www.luc.edu/biodiesel/about_us.shtml). This course was truly interdisciplinary, with participating faculty coming from the College of Arts and Sciences, School of Communication, School of Education, School of Business Administration, School of Nursing, and School of Social Work. Enrolled students came from diverse majors, including sociology, accounting, secondary education, marketing, business, political science, philosophy, chemistry, English, communication, biology, and environmental studies. The course lecture content examined multiple facets of fossil fuel-related environmental and social problems and explored possible solutions to these problems. Lab content focused on building and operating the biodiesel production facility. Additionally, 50 percent of students' grades were associated with experiential class projects ranging from community-focused service-learning projects to scientific research associated with biodiesel production (Table 1). At the conclusion of the first STEP: Biodiesel class, LUC hosted an open-to-the-public sustainability forum featuring the STEP: Biodiesel student projects. Over 200 people attended the first forum. Due to the success of this event, we have continued to host sustainability fora each subsequent semester.

Because of overwhelming demand from students wishing to continue working on the projects that they began in the STEP: Biodiesel course, we also offered a second course, Advanced STEP: Renewable Energy. This course was structured like a graduate student seminar. Each week we read several papers about various aspects of renewable energy and discussed the papers in class. Students fulfilled the rest of the class requirements by working on their wide-ranging projects (Table 1). Students took the class for variable credit, depending upon the scope of their projects.

Table 1. Example student projects, their associated class and semester, and community partners.

Course	Semester	Student Projects	Community Partners
STEP: Biodiesel	Fall 2007	High school education and outreach Emissions collection and analysis Biofuel policy analysis Algae for fuel	Highland Park High School Young Woman's Leadership Charter School Victor Andrew High School Carl Sandberg High School Uncommon Ground Restaurant
Advanced: STEP	Spring 2008	<i>Powering Minds Powering Futures</i> education grant proposal Chicago 49th Ward Community <i>Biodiesel Cooperative</i> development Algae for fuel	Uncommon Ground Organic Rooftop Farm <i>Free Enterprise System</i> Bus Company Chicago 49th Ward Green Corps Chicago Friends of Parks Chicago Park District Heartland Café
STEP: Biodiesel	Spring 2008	Biodiesel community outreach Biodiesel high school curriculum Biodiesel distribution <i>Loyola Fuels the Community:</i>	St. Vincent DePaul Society The Field Museum The Metropolitan Water Reclamation District Koval Distillery

Biodiesel home heating oil assistance University of Illinois Chicago
Glycerin recovery and utilization
Biodiesel emissions research

STEP: Fall Biodiesel emissions research
Biodiesel 2008 Biodiesel byproduct soap production
 and distribution

Biofuels Spring & Biodiesel production
Lab Fall 2008 Ethanol production
 Biogas production

The STEP course was designed to evolve and change course topic through time, spawning permanent and institutionalized sustainability related programs, courses, clubs, and activities, which continue to drive the student portion of the sustainability movement at LUC. The STEP model has since been applied to a second sustainability topic, food. Presently, STEP: Food is being offered for the second consecutive semester.

Many STEP: Biodiesel student projects engaged organizations and individuals in the community with varying levels of success. The following three community partnerships exemplify long-lasting projects that have directly resulted from student service-learning projects.

High School Education and Outreach: Powering Minds, Powering Futures

In the first semester of STEP: Biodiesel, a successful student group project focused on high school education and outreach. The student project created biodiesel and renewable energy curricula and established relationships between LUC and two Chicago-area high schools, the Young Woman’s Leadership Charter School and Highland Park High School. STEP student educators quickly realized that the hands-on, real-world impact of biodiesel production has great appeal to high school students and teachers. Because of the success of the one-semester project and the strong relationships established with partner schools, we saw great potential in applying for funding to continue the project. In Spring 2007 an Advanced STEP student, working with LUC faculty, coauthored a \$75,000 EPA-funded grant to develop and implement a high school education program, “Powering Minds, Powering Futures” (PMPF), which is taught by LUC student interns and overseen by CUERP faculty and staff.

PMPF focuses on increasing awareness among high school students of today’s energy challenges, and on equipping students with the knowledge and problem-solving skills to address those challenges and to succeed in the emerging green-collar economy. By emphasizing hands-on, cross-disciplinary education, PMPF unifies diverse students and departments through work on a common project. In addition to offering teacher professional development workshops, PMPF partners with regional high schools and

provides them with equipment to produce biodiesel from waste vegetable oil from their cafeterias, supporting interdisciplinary curricula, direct material and instructional support, teacher training, and promotional demonstration materials. Since beginning in fall 2008, PMPF has reached over one thousand students and provided instruction and materials to over one hundred teachers.

Additionally, PMPF provides valuable experience in teaching and curriculum development to LUC students interested in environmental and alternative energy education. LUC student interns build mobile biodiesel processors, which they distribute to partner schools, and they provide material and instructional support through monthly visits. Interns assist LUC faculty with the development and testing of interdisciplinary high school curricula related to biodiesel production. Interns also circulate a Mobile Biodiesel Show for events at participating high schools: students cook french fries, then the oil from the fryers is transformed into biodiesel fuel, which fuels the generator that powers the fryer. The Mobile Biodiesel Show provides an educational and promotional demonstration of student biodiesel production activities and it heightens awareness in the general public of the use of WVO for biofuels.

Instrumental to the success of PMPF is a network of participating schools and teachers who provide and exchange lessons, curricula, ideas, and advice through the PMPF program. Materials from teachers are compiled, tested, refined, and redistributed by LUC to participating schools. In turn, original materials developed at LUC are tested and revised by high school teachers participating in the program.

Free Enterprise System Charter Bus Company

The production and sale of renewable, carbon-light, biodiesel fuel reduces the university's carbon footprint, allows for LUCBP to financially sustain itself within the university, provides an excellent opportunity for developing partnerships with the community, and creates an avenue for promoting environmentally sound transportation choices within the city of Chicago.

From the beginning of the LUCBP, it has been the goal of the biodiesel production facility to become a model sustainable business. Not only did we seek to produce a renewable and low-carbon fuel, but we also intended for the facility to achieve economic sustainability (i.e., the sales of the fuel should cover the costs of operating and maintaining the facility). Achieving economic sustainability will allow for the program to become a permanent fixture on campus without the need for continuous fundraising and will legitimize the program as a model for students and community members interested in pursuing green business opportunities.

During the first semester of the STEP: Biodiesel program, a group of students majoring in business, accounting, and environmental studies researched and wrote a business plan for the biodiesel production facility. This plan included detailed economic accounting of the costs of materials and labor necessary to produce biodiesel in our lab; projected the volume of production and the revenue necessary for the

biodiesel program to achieve economic sustainability; and developed a roadmap for achieving our goals. LUCBP has used the student-produced business plan as a framework for the long-term planning of the biodiesel production facility.

The business plan determined that a consistent buyer of LUCBP biodiesel was necessary for the lab to maintain itself economically. LUC has three campuses in the city and students are transported between the campuses in diesel-powered charter buses privately owned and operated by the Free Enterprise System (FES) bus company. Thus, we determined that the shuttle bus company would be the ideal consumer of LUC produced biodiesel fuel.

Over the course of the last two years, we have been negotiating to sell our biodiesel to the FES shuttle bus company. After much discussion and the licensing of our fuel, FES has begun to use LUCBP biodiesel in their buses. Furthermore, due to their vast fuel consumption, FES has agreed to purchase all the biodiesel that the LUCBP lab can provide. Fortuitously, they will purchase our fuel at \$1.00 more than the market price of petroleum diesel fuel because they can claim a \$1.00 per gallon federal tax rebate on biodiesel fuel. Moreover, FES has come to realize the marketing potential of promoting the use of green fuel in their buses.

Thus, the partnership between LUCBP and FES is beneficial to both organizations and to the environment. The LUC biodiesel lab will be able to sell all of the biodiesel it produces; the lab will be nearly economically sustainable, thus fulfilling the goal to become a model sustainable business; FES will promote the use of biodiesel in shuttle buses, which will likely result in good press; and the use of biodiesel in campus shuttle buses will significantly improve air quality on campus and reduce the university's carbon footprint.

Uncommon Ground Restaurant

Uncommon Ground restaurant is an environmentally conscious and community-focused local business that is committed to the principles of sustainability (<http://www.uncommonground.com/>). Their green business practices include purchasing as much of their food from local farmers as possible, hosting a farmers market in their parking lot, growing food and producing honey in their Certified Organic rooftop farm (North America's first), and hosting a biweekly "Green-Room Sessions" that feature Chicago-based environment-focused groups (<http://www.uncommonground.com/pages/green/40.php>).

Since fall 2007, Uncommon Ground has donated their WVO to our lab and LUCBP has been featured several times in the Green-Room Sessions. The WVO has helped us reach our biodiesel production goals and exposure at the Green-Room Sessions has helped us to promote various aspects of LUCBP to the broader environmental community. We have been able to advertise the LUC Sustainability Fora, Earth Day, Climate-Action day, and other environmentally focused public events. As a result, increasing numbers of community members have been attending LUC events.

In turn, we have worked with Uncommon Ground to develop a rooftop gardening and green business internship program for LUC students. Through the LUCBP courses we are able to find interested and motivated students to participate in the internship program. Student interns work up to thirty hours per week for twelve weeks helping to maintain the rooftop farm and working on sustainability-related projects for Uncommon Ground restaurant. Participating students benefit by learning business management and rooftop gardening techniques from a very successful green business. Uncommon Ground benefits by having over 150 hours per week of unpaid labor to help them achieve their sustainability goals. Natalie Pfister, the Director of the Uncommon Ground Organic Rooftop Farm, had this to say about the partnership with LUC:

Forming a partnership with Loyola has been a crucial link for the rooftop farm, as they have provided seven interns over the summer and some that will be staying with us into the school year. Loyola has been wonderful to work with, helping us formulate our intern job descriptions and giving us feedback as we have moved through the entire process. This has helped enrich any further programming that the farm participates in. We consider Loyola to be one of our biggest community assets. The students that helped out on the farm this year have been hard working and highly motivated, bringing their knowledge to the rooftop and the restaurant in the forms of programming, farming, social activism and helping us begin the process of becoming a 501(c)3 non-profit. Each student worked on the farm to complete planting, harvesting and other general maintenance and then also worked on individual projects that were driven by their personal interests. The outcome from this summer's internship program has been unprecedented and is something that has inspired us to not only continue and expand our internship program, but to also expand our community workshop programming and involvement with other schools in Chicago.

Biodiesel Laboratory Internship Program

Each semester, our multidisciplinary biodiesel laboratory internship program offers internship opportunities to students interested in working on different aspects of biodiesel production. Student interns have represented diverse academic majors, including Communications, Biology, Education, Environmental Studies, and Chemistry. We believe that by providing hands-on, applied work experience coupled with reflection and critical thinking, we offer students an invaluable professional/educational service. In turn, student interns have indispensably served the operational needs of the LUCBP biodiesel production lab since its inception. We provide students with a safe, supportive, and reflective work environment where they have the opportunity to expand and explore their knowledge and interests. They, in turn, recognize their value and develop a sense of loyalty to and ownership of the operation. Interns have provided research and assistance in equipment assembly and operation, materials acquisition, production process, waste methanol recovery, development of a program for making soap from glycerin waste, small-business

relations and partnerships, and marketing. We envision that the LUCBP biodiesel production lab will ultimately become a student-run business overseen by a permanent CUERP Biodiesel Lab Manager, functioning as a teaching tool for students and faculty across the university.

The LUCBP lab manager and interns frequently lead tours for interested community groups and individuals and the production facility design and institutional knowledge within LUCBP has become a resource to individuals and organizations interested in producing their own biodiesel. The community organizations that have benefited the most from lab tours and the expertise of our staff and interns include the University of Illinois Chicago's Office of Sustainability, Chicago Park District, Highland Park High School's Green School Initiative, and the Young Woman's Leadership Charter School's biodiesel club.

Continuing Education: Small-scale Biodiesel Production Course

The student-constructed biodiesel lab enabled LUC faculty to develop and teach a continuing education course, Small-Scale Biodiesel Production. This hands-on class served as an introduction to biodiesel fuel and biodiesel production for vehicular and home heating use. Participants were adult learners who were interested in learning how to build and operate their own biodiesel production system. They left with the skills and knowledge necessary to build a small-scale biodiesel reactor, safely produce high-quality biodiesel fuel from used restaurant fryer grease, reuse and recycle the biodiesel reaction coproduct, and test the quality of finished biodiesel. Additionally, we discussed with participants the potential for biodiesel to alleviate greenhouse gas emissions, air pollution, and petroleum use in Chicago and the wider region.

Three City of Chicago and Chicago Park District employees participated in the continuing education course, Small-Scale Biodiesel Production. The knowledge they gained in the course laid the groundwork for the creation of a Chicago Park District biodiesel production facility that is capable of producing 100,000 gallons of biodiesel from WVO per year. The city continues to receive advice from our biodiesel experts and production assistance from trained student interns and LUC benefits by deepening collaboration with the City of Chicago. Kyle Powers, a participant in the course and Developer of Sustainable Programming in the Office of Green Initiatives at the Chicago Park District, had this to say about the course and working with LUC:

The Small-Scale Biodiesel Production Continuum Course provided by Loyola was a great way to learn the basics of biodiesel production, safety protocols and materials handling. It was presented in a manner that made it fun to learn about the process, and it also gave me the tools and contacts I needed to further my research on the subject. The class was the catalyst that helped build many lasting relationships and partnerships (with Loyola and other experts in the field) that were essential in getting the Chicago Park District's Biodiesel Production Program off the ground.

Biofuels Lab Course

As the STEP class progressed from topic to topic, we intended it to leave behind various institutionalized sustainability projects. A one-credit Biofuels Laboratory course has functioned as the academic legacy of STEP: Biodiesel. While emphasizing a practical and applied approach to biofuels, the Biofuels Laboratory course has continued to utilize many of the varied instructional elements of STEP: Biodiesel, including guest lectures, discussions, student projects, and field trips. The Biofuels Laboratory course has functioned as a testing ground for the continued exploration and innovation of bio-energy and waste-to-energy projects on campus. The course has also served as the primary gateway to internships in biodiesel production at LUC, and 50 percent of students enrolled in the course have proceeded to internships in the LUCBP biodiesel lab.

Although the course has only recently begun to involve community partners, we have identified and worked with several organizations with long-term partnership potential. The Chicago Park District has provided tours of their new biodiesel production facility and offers the potential for hosting future LUC student internships; the Metropolitan Water Reclamation District provided a tour to students of their biogas recovery system; and the Koval distillery provided a tour of their ethanol production facility. Each relationship holds potential for ongoing collaboration on biodiesel, biogas, and ethanol projects where students can be involved.

Conclusion

Due to their inherent complexity, environmental problems exist outside of traditional disciplinary boundaries and effective solutions to these problems will likewise arise out of multidisciplinary and multiorganizational contexts (Cortese 2003; Orr 2003). Thus, sustainability-focused educational programs like LUCBP, which emphasize interdisciplinary learning and community collaboration, strive to create graduates capable of transcending dogmatic disciplinary boundaries to develop sustainable solutions to pressing environmental problems while simultaneously producing real-world positive outcomes. The public is hungry for innovative solutions and, as a result, LUCBP has received a wealth of good press within LUC and outside of it (http://www.luc.edu/biodiesel/Video_page.shtml). Furthermore, the LUCBP model is highly reproducible in other universities and colleges.

Positive Outcomes

The LUCBP has resulted in benefits to LUC students, the Center for Urban Environmental Research and Policy, the university, the community, the City of Chicago, and the environment.

- **Loyola students.** As a result of the authentic real-world experiences gained in the LUCBP program, graduates are more prepared than their fellow students to become active and effective community members, organizers, and leaders in the sustainability movement.

- **Loyola University Chicago.** Through the activities of the Center for Urban Environmental Research and Policy, LUC has become an active and valued participant in environmental education, environmental sustainability, and renewable energy in the Chicago region.
- **The local community.** Student service-learning projects have resulted in strong relationships between community organizations, businesses, and LUC. Furthermore, the success of our program has spurred the development of other service-focused university coursework, thereby compounding LUC's positive impact on the community.
- **City of Chicago.** Through our biodiesel outreach education program, hundreds of high school educators have been introduced to renewable energy curricula; thousands of high school students have been exposed to hands-on renewable energy experiences; and the City of Chicago saves substantial taxpayer money and is closer to meeting their CO₂ emissions reduction target because of its Park District biodiesel production facility.
- **Environment.** As a result of reduced combustion of petroleum diesel fuel in Chicago, air quality has been improved and global warming gasses have been reduced.

Program Reproducibility

Many aspects of the LUCBP could be replicated at other metropolitan colleges and universities to the great benefit of the students, community, and environment. Particularly, we found that a biodiesel production facility, once operational, can become a freestanding economically sustainable model business within the university. As such, if other universities were capable of obtaining the funds necessary to start a biodiesel production facility and to scale the operation to the size necessary to generate significant revenue, there should not be barriers to success. We found that the production of a business plan at the outset of the program was not only an excellent applied learning opportunity for students from business and environmental studies programs, but it was also an extremely useful document to frame the development of the biodiesel program. We highly recommend using a business model when building a biodiesel program.

Sustainability-focused course curricula with an emphasis on interdisciplinary learning, experiential education, and community collaboration could and should be replicated elsewhere. Furthermore, students in the STEP courses have commented on the effectiveness of learning in this diverse environment, consistently indicating that they learned a great deal from students in other disciplines. We have found that the community is eager to work with university students and students are eager to gain real-world experience. The passion of college students can be lost in large lecture-based classroom settings, but when given the opportunity to conduct hands-on learning, students apply their enthusiasm toward accomplishing real positive goals.

The success of our program has largely resulted from the multifaceted approach that we have taken in its implementation. Instead of developing only a single undergraduate course, we developed several courses, an internship program, and an adult continuing education course for community members. Each of these courses had community partnership components, which enriched the programs, the students' education, and the outcomes for our community partners. Furthermore, part of the success of LUCBP has resulted from feverish self-promotion. For example, we promoted our program at community events, such as the Uncommon Ground Green Room Sessions; we hosted the Sustainability Fora, which primarily featured LUCBP student projects; and we employed our students to recruit future students for the courses. Most important to our success were the tireless and dedicated participating staff and faculty members.

This project illustrates the potential for sustainability-focused experiential education curricula to initiate synergistic relationships between community partners and the university with the aim of improving environmental quality and heightening awareness of environmental issues.

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