

Final Sustainability Report

Fitzgerald Elementary School

12/12/2009
Bentley University
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A Letter to Fitzgerald

I'd like to take this opportunity to thank the wonderful people at Fitzgerald for supporting me throughout this semester. It was truly inspiring to work alongside such dedicated and passionate people. I believe that we made excellent progress over the last few months and without your help none of the accomplishments stated in this report could have come to fruition. I look forward to hearing about the future sustainability achievements that Fitzgerald meets. Please use this report as a guide to implementing whatever initiatives that Fitzgerald deems fit. Thank you and I look forward to working with Fitzgerald in the future.

Accomplishments

1.1) Establishing a Green Team

The first step in creating change in any organization is finding people passionate about the cause. At Fitzgerald we have successfully found a core group of people, made up of teachers and administration, which will drive change. Due to the creation of this team, we have been able to successfully deliver several other key accomplishments. The next step in growth for the green team is empowerment. (See section 3.1)

1.2) Educate Students

We successfully implemented a green week which was composed of awareness presentations, a recycling drive, and in class projects. The awareness presentations were developed and executed by Tom D'Eri. These presentations effectively educated the students, at an age appropriate level, about the most pressing current environmental issues and what they can do to help solve these problems. The recycling drive continued to build on the momentum gained from the presentation by giving the students an outlet to act on their enthusiasm. This recycling drive collected nearly 800 items in a short week¹. To hammer home the points illustrated in the presentations, many teachers did activities focused on environmental awareness. The green week achieved enough interest to build a working recycling program.

1.3) Implement a Recycling Program

Fitzgerald has expanded their past recycling program, which only offered paper recycling, to now provide water bottle recycling, cardboard recycling, drink pouch recycling, and chip bag recycling. In order to recycle water bottles and cardboard, we acquired four 96 gallon recycling "totters" from Capitol Waste. These totter were donated by Capital Waste at no cost to Fitzgerald. To recycle the drink pouches and chip bags Fitzgerald joined the Terracycle Recycling Brigade. Terracycle provides free shipping to collect certain, generally non-recyclable, goods to be used in their products. Not only does Terracycle collect the drink pouches and chip bags for free, but they also donate a small sum of money for each good collected by Fitzgerald (see 1.4). We believe that recycling drink pouches and chip bags is an especially appealing way to engage students on environmental issues. Most students consume these goods on a daily basis, thus, this program can be an eye opening experience to show the students how much they really throw away.

1.4) Created a small revenue stream for the school

Terracycle donates \$0.02 for every item that Fitzgerald collects. We estimate that recycling for Terracycle can bring the school \$1,038.24 annually, assuming all items are recycled. However,

¹ Monday the program was not fully implemented and the students had off on Wednesday.

this is probably not reasonable. Therefore if we assume a recycling rate of 50%, Fitzgerald can expect to generate \$519.12 annually. Due to the fact that this program hasn't been in place all year, we expect to create \$360.50 this year. (See Appendix 1)

Goals

2.1) Engraining Environmental Thinking into the Culture at Fitzgerald

Now that several key accomplishments have been realized at Fitzgerald it is vital that we do not lose ground. In order to maintain our current success and grow as an environmentally responsible establishment we must engrain environmental thinking into the culture at Fitzgerald. If we can realize this goal, Fitzgerald will perpetually improve from an environmental standpoint. Although this may seem like an unattainable goal, it is important not to underestimate the power of a few dedicated and passionate people. In the next section we will highlight the key components to achieving this goal.

Keys to Success

3.1) Empowering the Green Team

The key to driving perpetual change at Fitzgerald is its Green Team. They have already played a major role in all of the school's achievements and must be in a position of power to continue to drive change. The fundamental elements that must be in place to empower the green team are:

- Administrative support

People in decision making positions must be aware, and in full support of the actions of the green team. Without this support the team will have a tough time making any real progress. In order to maintain this backing it is highly encouraged that either Molly McMahon or Alice Shull is continuously briefed on the activities of the green team.

- Meetings

As demonstrated throughout the semester, meetings are a great way to brainstorm ideas and generate excitement about projects. Meetings also give structure and therefore legitimacy to the team's actions. Thus, it is strongly recommended that regular meetings are continued. However, they do not have to be biweekly, there simply needs to be a standard meeting arrangement in place.

- Communication

Communication is critical for any team. For progress to be created at a reasonable rate all members of the team must be aware of what the other members are doing. This can be

achieved through the use of distribution list emails, weekly or monthly updates on each person's activities, and general transparency in everyone's actions.

- Defined objectives

To keep the team organized there should be several overarching objectives that the team wishes to meet. The goals should be audacious and inspiring. These goals could be things such as, sending nothing to the landfill, buying only environmentally preferable products, and carbon neutrality. Obviously these are not short term goals, they may take years to be accomplished, however they are vital to providing direction for the school's initiatives.

- Specific initiatives to meet objectives

To break the objectives down into manageable portions specific initiatives and deliverables must be developed. These could be things like "recycling one more type of good this year", "identify five new environmentally preferable products to buy this quarter", or "measure our carbon footprint this year".

- Organize plans to complete initiatives

In order to actually deliver the specified initiatives, action plans will need to be developed. An action plan breaks down the project into individual tasks and sets deadlines to meet each task. By creating a detailed action plan Fitzgerald can insure that their initiatives can be meet.

3.2) Educating and Involving the Students

- Educating the students

Educating students is the reason why Fitzgerald exists; therefore, it is absolutely essential to have the students buy into the changes being made. Creating buy-in from the students will play a major role in forcing a bottom up change in the culture at Fitzgerald. The first step to accomplishing this is educating them on why environmental issues are important. This mainly must be done through in-class activities. Thus, in order to have widespread adoption of environmental education by the teachers, it must be integrated into the curriculum. This must come down from the administration so that it has legitimacy. Here are some excellent resources to help Fitzgerald incorporate environmental learning into their standard curriculum:

<http://eelink.net/pages/Lesson+Plans>

<http://www.epa.gov/teachers/>

http://www.eric.ed.gov/ERICWebPortal/custom/portlets/recordDetails/detailmini.jsp?_nfpb=true&_ERICExtSearch_SearchValue_0=EJ749191&_ERICExtSearch_SearchType_0=no&accno=EJ749191

<http://www.greenflagschools.org/curriculumlinks.htm>

<http://www.princetonecology.org/id22.html>

http://www.teach-nology.com/teachers/lesson_plans/science/environment/

<http://www.need.org/Guides-Grade.php>

- Involving the students

Once the students understand the problem at hand it is important to give them an outlet to act. As stated earlier, the students can provide significant force in changing the school's culture. If they want something to happen, ultimately, it is the job of the faculty to see that it is done. One powerful way to involve the students is forming a green club or committee. This would be teacher led, preferable someone on the green team, to insure that the ideas and from the students are heard and acted upon. Also the club could organize projects for the children to do. These projects could include recycling drives, science projects, field trips, or anything else the children are compassionate about. The best projects would be those that are thought of by the students. Anything that shows the student's dedication to becoming more green would be a powerful way to show everyone else at the school that changes should be made.

3.3) Involve the Community

- PTO

Since the PTO acts as the main point of contact to the community for the school it is imperative that they are involved in the schools sustainability efforts. This can be done through PTO led projects such as "The Walking School Bus" or through the creation of a PTO subcommittee for green initiatives. A subcommittee would be very effective in driving change because they would be able to create funding for initiatives, share local contacts, and once again demonstrate the commitment that Fitzgerald has to becoming more sustainable. If a subcommittee was created it would have to be in close contact with the green team.

- Drives for the needy/recycling drives

Fitzgerald can serve as a hub for charitable drives of all kinds. Since Fitzgerald is a central and well known point for the local community it is an excellent location to hold drives. Drives are a great way to involve the community and show Fitzgerald's dedication to helping the area. Types of drives that should be considered are: clothing drives, book drives, food drives, E-waste recycling drives, can drives, paper drives, ect. Any type of recycling drive would also be an appealing way to raise funds for green projects. Recycling drives can be coordinated with local redemption centers or organizations that are dedicated to recycling (especially for e-waste) to generate money for the school.

- Local green business forums

Fitzgerald's facility would also be a great place to hold local green business forums. Fitzgerald could rent out its facility for gatherings of local green businesses. This would not only be a good

way to raise funds but would also foster a relationship between Fitzgerald and the local business community.

- Receptiveness to any green programs

In addition to the previously mentioned projects, Fitzgerald should take care to host or be part of any other green events going on in the Waltham area. This would further strengthen the school's relationship with the community and its devotion to sustainability.

3.4) Green Buying Plan

Implementing a green buying plan is an extremely powerful way to legitimize the sustainability efforts taking place at Fitzgerald. Green buying shows that Fitzgerald is "walking towards the talk". It is important that Fitzgerald has an official plan to solidify the goal of balancing cost, performance, and environmental attributes for all of its products². An official plan also makes it less confusing and quicker to make environmentally preferable purchasing decisions because the organization will have specific criteria that each product should meet. Here are several steps Fitzgerald should take to draft an official green buying plan:

- 1) Identify key stakeholders required to develop the plan. This group will facilitate priority setting and ensure administrative support².
- 2) Examine what your supply chain actually consists of. What are your supplies and where do they come from³?
- 3) Develop an approach to incorporating environmental attributes into Fitzgerald's buying criteria. This will consist of attributes that the buying team feels are important. These environmental features may be things like³:
 - a. Are the product's raw materials produced in a sustainable way?
 - b. Does the product contain hazardous or toxic chemicals?
 - c. Is the product or material packaged in reusable or recyclable packing?
 - d. Does the product itself contain recycled material?
 - e. Was the product produced under fair trade standards?
 - f. Was the product produced using renewable energy?
 - g. Have any measures been taken by the company to facilitate recycling of the product at the end of its lifecycle?
 - h. Does the product have resource saving features (ie energy or water efficiency)?
- 4) Analyze the products that Fitzgerald currently buys to determine which ones meet your environmental buying criteria. This can be done by having each of your suppliers fill out a product feature worksheet or questionnaire. Examples of both of these are shown below.

² Novacovici, Anca, and Jennifer Woofter. *Sustainability 101: A Toolkit for Your Business*. Lulu.com, 2008. Print.

³ Sitarz, Daniel. *Greening Your Business: The Hands-On Guide to Creating a Successful and Sustainable Business*. Nova Company, 2008. Print.

Supply Chain and Purchasing Questionnaire³

Our company is undertaking a review of our supply chain and procurement policies. We ask that you please complete this questionnaire to help us determine our suppliers' compliance with minimum supply chain requirements. This information may be necessary for our customers, shareholders, investors, or other partners in our supply chain.	Yes/No
Does your company have an environmental and/or sustainability policy or environmental management system? If so, please share a copy with us.	Yes/No
Does your company have a product stewardship or extended product responsibility policy? If so, please share a copy with us.	Yes/No
Are any of your products certified by a 3rd-party certification program (such as Energy Star®, Green Seal, or others)? If so, please provide us with details.	Yes/No
Does your company follow an industry Code of Conduct or set of standards? If so, please provide us with details.	Yes/No
Is there any external verification of your adherence to the standards? If so, please provide us with details.	Yes/No
Can you track your products or materials back through a chain of custody to their raw material source? If so, please provide us with details.	Yes/No
Do you have packaging guidelines that reinforce the need for recycled materials in all packaging? If so, please provide us with details.	Yes/No
Do you and your suppliers comply with local, state, national, and international labor standards, including ILO (International Labor Organization) standards? If so, please provide us with details.	Yes/No
Can you certify that all products or materials have been produced without child or forced labor? If so, please provide us with details.	Yes/No
Can you certify that your company complies with all existing local, state, and national environmental regulations? If so, please provide us with details.	Yes/No
Do all of your materials or products comply with all hazardous substance regulations, including the Toxic Release Inventory Act? If so, please provide us with details.	Yes/No
Can you verify the recycled content levels of all of your products or materials? If so, please provide us with details.	Yes/No

Does any of your energy use come from renewable sources? If so, please provide us with details.	Yes/No
Would you be willing to work with our company to reduce the environmental impacts of your products or materials?	Yes/No

- 5) Draft your green buying plan. Make sure there is a clear definition of what Fitzgerald considers to be environmentally preferable products².
- 6) Designate individuals to be responsible for upholding the plan. Preferable this will be someone with decision making power².
- 7) Review the policy with the key stakeholders identified in step 1².
- 8) Finalize the policy and make sure that it is widely circulated².

Product categories that Fitzgerald should place special emphasis on

- Paper

Buy paper that is Forest Stewardship Council (FSC) certified or has high post-consumer waste². Post consumer waste is paper that has been used by a consumer and then has been collected by a recycling program. Through buying paper products with high amounts of post consumer waste Fitzgerald will be helping create a market for recycled goods. By purchasing FSC-certified paper products Fitzgerald will be ensured that their paper is produced in an environmentally sustainable and socially responsible way.

Some reasons why buying environmentally friendly paper is important are²:

- a. An average American consumes about 700 pounds of paper every year.
- b. 90% of computer and writing paper comes from virgin materials.
- c. Paper accounts for the largest percentage of waste in landfills at 40%.
- d. It takes 60% less energy to manufacture paper from recycled material than from virgin material.
- e. Conventional paper uses harmful chemicals in the manufacturing process.

Key terms to be familiar with when choosing which eco-friendly paper to buy²:

- 1) Recyclable: paper can be recycled. This has little meaning because it can be placed on any paper product.
- 2) Recycled-can be a mixture of virgin material, pre-consumer waste, and post consumer waste.
- 3) Chlorine free- paper is bleached with oxygen or hydrogen peroxide and not chlorine dioxide which is very hazardous to the environment, especially marine ecosystems.
- 4) De-Inked Material- waste paper that has had the ink, filter, and coating removed as part of the recycling process.
- 5) Post-Mill Material- Paper waste generated in converting and printing paper outside of the paper mill.

- 6) Recovered, Pre-consumer, and Wastepaper- These terms often refer to non-waste stream materials such as mill broke, other mill wastes, and wood chips.

Cost: Little to no difference from using conventional paper².

Resources to find environmentally preferable paper:

- <http://www.fsc.org/buy-fsc-products.html?&L=518>
- http://www.metafore.org/index.php?p=Forest_Certification_Resource_Center&s=147
- <http://www.edf.org/papercalculator/> - Allows you to compare the sustainability of different paper products
- http://www.truegreenonline.com/Treeless_Copy_Paper.html?gclid=CISr6oDZzZ4CFU1M5QodYwz7sQ
- http://www.staples.com/Staples-100-Recycled-Copy-Paper-8-1-2-x-11-Ream/product_620016
- http://www.greenlinepaper.com/office-paper-envelopes/copy/laser/fax-paper/cat_12.html
- <http://www.conservatree.org/paper/PaperMasterList.shtml> - provides a master list of all types of environmentally responsible paper products

- Kitchen Supplies

Kitchen use is an extremely significant generator of waste. Standard disposable kitchen supplies, such as the utensils, trays, paper towels and napkins, and cups used at Fitzgerald, are made from virgin and sometimes hazardous materials. Much of Fitzgerald cafeteria supplies are made from Styrofoam or polystyrene. Both of these products leach styrene which, according to the FDA, is a possible human carcinogen. Also, conventional plastic utensils are hard to recycle and are manufactured using petroleum. Therefore, it is important that Fitzgerald changes its purchasing habits and buys more sustainable products.

How to change Fitzgerald's buying habits:

- Purchase biodegradable products when possible.
- Purchase products with high recycled content, such as recycled utensils and 100% post consumer waste paper towels and napkins.

Cost: The price of biodegradable products have significantly decreased over the last few years. For example the price of a box of 1000 biodegradable utensils now only costs \$10, while in 2000 it costs \$60². Recycled kitchen supplies are a bit harder to find and thus costs are slightly higher price. However, both of these types of products are only slightly higher priced than conventional goods when bought in bulk.

Resources:

<http://www.excellentpackaging.com/pages/1/index.htm>

<http://www.sinlessbuying.com/tep/catalog/catalog/index.php>

<http://www.bpiworld.org/Certified-Bioedgradable-Foodservice-Items-Plates-Cups-Utinsels>

<http://worldcentric.org/biocompostables/utensils/utensils-200F>

http://www.ecowise.com/index.php?cPath=22_187

<http://www.biosphereindustries.com/>

<http://www.treecycle.com/biodegradable.html>

- Stationary and Supplies

For the same reasons stated in the paper section, it is important to buy environmentally responsible stationary supplies. Since virtually every student must buy several notebooks per year, buying products that are high in recycled content or are produced in another sustainable manner can make a significant contribution to sustainability at Fitzgerald. Although Fitzgerald may not purchase stationary supplies directly for the students, the school can still have a significant impact on the buying habits of the students.

In addition to stationary supplies such as notebooks, inks are also an item that should be taken into consideration when looking for green alternatives because conventional inks are petroleum based which contain higher levels of volatile organic compounds (VOC's). Also documents printed with soy-based ink are more easily recycled because soy ink is easier to remove in the de-inking process².

Cost: The price of eco-friendly stationary is generally 20% more than regular stationary². However, printing items such as color soy based inks can actually provide a cost savings. This is due to the fact that the initial cost of soy ink is price comparable to conventional inks; however, less soy ink is required for printing. Also reusable or recycled ink cartridges are cheaper than regular ones.

Resources:

<http://www.officedepot.com/a/browse/your-greener-office/N=5+11332/>

<http://www.officesupply-link.com/6027/DealerStation/catalog/news.asp>

<http://www.staples.com/sbd/content/about/soul/environmentallypreferableproducts.html>

<http://www.thegreenoffice.com/>

<http://www.greenlinepaper.com/>

<http://www.rebinder.com/>

<http://www.kejriwalstationery.com/aboutus.html>

<http://greenearthofficesupply.stores.yahoo.net/>

- Energy Star Electronics

Although Fitzgerald is a very new school and currently has efficient products, it is important that part of the school's buying policy specifically states that all new appliance purchases must be Energy Star rated. Since Energy Star rated products are more efficient than other appliances on the market, they will save Fitzgerald money while concurrently saving resources and reducing emissions.

Cost: Although many Energy Star products have a higher upfront cost than inefficient appliances, Energy Star products are typically cheaper in the long run due to lower operating costs.

Resources:

www.energystar.gov

- Non-toxic cleaning supplies

In order to promote a healthy environment for students and faculty at Fitzgerald it is important that the indoor air quality is held to a high standard. A basis for measuring air quality standards in buildings is the presence of VOCs or volatile organic compounds. Concentrations of VOCs are found to be about ten times higher outdoors than indoors, due in large part to the concentrations found in household cleaners, furniture, paint, etc. People who are exposed to toxic air pollutants at sufficient concentrations, for sufficient durations, may increase their chances of getting cancer or experiencing other serious health effects, such as reproductive problems, birth defects, and aggravated asthma⁴. Therefore, it is essential that Fitzgerald uses non-toxic cleaners which do not contain VOCs.

Cost: The Prices of non-toxic cleaning agents are comparable to those of conventional cleaning products.

Resources:

<http://www.seventhgeneration.com/>

<http://www.greenworkscleaners.com/>

<http://biokleenhome.com/>

<http://www.all-greenjanitorialproducts.com/>

<http://www.ecomall.com/biz/cleaning.htm>

*For more information on how to better the air quality at Fitzgerald read my classmate's report, *Chilton House LEED Certification: Indoor Air Quality* which is attached.

⁴ Cavanaugh, Katie. *Chilton House LEED Certification: Indoor Air Quality*. Rep. Waltham: Bentley University, 2009. Print.

Potential Cost Saving Projects

Here are two projects that we have identified which can save Fitzgerald money. The numbers associated with these projects are estimates and due to lack of concrete information should be taken only as proof that these projects have the potential to save Fitzgerald money, but how much money is still yet to be determined.

4.1) Dual Flush Retrofit

This project proposes that all of the toilets are retrofitted with dual flush handles. The retrofit product that should be used is the Sloan WES-213A Uppercut Dual-Flush Retrofit Handle Kit. The reason that this retrofit kit was chosen is due to the fact that University of Illinois used this product and saw excellent results⁵. We believe that the University of Illinois can serve as an adequate comparison for Fitzgerald. The Sloan WES-213A Uppercut Dual-Flush Retrofit Handle Kit will sell for approximately 64.99 each⁶.

Financial analysis

The cost benefit analysis for the payback period of this project is subpar. According to the estimates done, it will take approximately 11.26 years for this project to begin to realize savings. By that point the handles will most likely need to be replaced anyway, thus this project may not make sense from an economic perspective. However, it is important to note that due to lack of concrete information this estimate may be extremely off. I urge the users of this document to input the correct numbers into my cost-benefit calculator which was attached when this document was sent. There is strong evidence from the University of Illinois case study to suggest that the payback period may be significantly shorter than the previously indicated period. According to the University of Illinois case study, the payback period for their dual flush retrofits ranged from 0.9 to 5.7 years⁵.

Ecological analysis

According to the aforementioned cost benefit analysis; this project will abate the use of 74,863.8 gallons of water annually. Saving water also saves energy because it takes a large amount of energy to purify water. Finally according to the EPA⁷, "Depleting reservoirs and groundwater can put water supplies, human health, and the environment at serious risk. Lower

⁵ Green Team, Campus Recreation. *Campus Recreation*. Tech. University of Illinois, 20 Mar. 2009. Web. 11 Nov. 2009.

<http://sustainability.illinois.edu/ssc/downloads/projects/2009/watercons/SSC_Campus%20Recreation%20Water%20Conservation.pdf>

⁶ "Sloan WES-213A Uppercut Dual-Flush Retrofit Handle Kit." *SustainableSupply.com - Go - Green - Save!* Web. 11 Dec. 2009. <http://www.sustainablesupply.com/Sloan_WES_213A_Uppercut_Dual_Flush_Retro_Kit_p/wes-213.htm>.

⁷ "WaterSense | US EPA." *U.S. Environmental Protection Agency*. Web. 11 Dec. 2009. <http://www.epa.gov/watersense/water_efficiency/benefits_of_water_efficiency.html>.

water levels can contribute to higher concentrations of natural or human pollutants. Using water more efficiently helps maintain supplies at safe levels, protecting human health and the environment.” Therefore by being more water efficient Fitzgerald will contribute to the overall wellbeing of the community.

Intangible benefit analysis

This project will create great awareness for water, and more generally resource, conservation. The Sloan WES-213A Uppercut Dual-Flush Retrofit Handle is bright green which can be associated with being environmentally conscious. In addition, it will take training in order to make sure the population at Fitzgerald understands how to properly use the handle. This training would be an excellent opportunity to education the people at Fitzgerald about the importance of water conservation and ecological thinking in general. The final benefit of the Sloan WES-213A Uppercut Dual-Flush Retrofit Handle is the fact that it has an antimicrobial coating which protects against the transfer of germs. Given the susceptibility to sickness at an elementary school, any way to reduce the probability of illness is worth investigating.

4.2) WVO Conversion

This project proposes that Fitzgerald works with its busing provider to convert a portion of its fleet to run on waste vegetable oil (WVO). By converting buses to run on WVO the bus company will be able to significantly decrease its operating costs because the cost of fuel is virtually eliminated. A portion of the saving accrued by the bus company must then be passed on to Fitzgerald.

Financial Analysis

The conversion process is relatively simple, requiring only a minimal amount of parts and no extra maintenance. The cost of converting a bus and setting up the infrastructure to facilitate WVO use is approximately \$6,454.95. Due to economies of scale, the cost per bus will significantly decrease as more buses are converted. The approximate savings per bus is \$4,285.71 annually. Thus the payback period is 1.51 years. Once again this payback period could be significantly reduced if more buses were converted. (See appendix 2 for calculations) Also, in determining the savings per bus we used the National School Bus Council’s “Average miles traveled per year per bus” and the “Average fuel consumption (mpg) for school buses (ASBC estimate, assuming large capacity buses, diesel engines) “because we couldn’t get sufficient information from the company. Therefore, our estimates aren’t necessarily accurate.

Ecological Analysis

According to the National Biodiesel Board⁸ the use of B100 biofuel, which is what WVO would be considered, results in emissions reductions of:

Emission Type	Emission Reduction
carbon dioxide	78.50%
Sulfates	100.00%
PAH (Polycyclic Aromatic Hydrocarbons)	80.00%
nPAH (nitrated PAH's)	90.00%
Ozone potential of speciated HC	50.00%
Total Unburned Hydrocarbons	67.00%
Carbon Monoxide	48.00%
Particulate Matter	47.00%

Therefore according to our calculations, each bus that is converted will save approximately 15.8 tons of carbon dioxide emissions annually. (See Appendix 3) That is the equivalent of taking 2.8 passenger cars off the road⁹.

All of these pollutants, especially particulate matter, ozone, carbon monoxide, and sulfates, pose significant health risks to the children riding the buses. Here are some key statistics, provided by the Connecticut PTA¹⁰, about the danger of school bus pollution to children:

- Carcinogenicity of Diesel Exhaust: Diesel exhaust is classified as a probable human carcinogen by many governmental authorities, including the International Agency for Research on Cancer (WHO), the U.S. National Toxicology Program, the U.S. Environmental Protection Agency, and as a known carcinogen by the State of California. The California South Coast Air Quality Management District recently estimated that nearly 71% of the cancer risk from air pollutants in the area is associated with diesel emissions. Diesel exhaust includes benzene, 1,3-butadiene, and soot, all classified as known human carcinogens. Nearly 33 studies have explored the association between diesel exhaust exposure and bladder cancer. A recent meta analysis of this literature

⁸ *BIODIESEL EMISSIONS*. Rep. National Biodiesel Board, 9 May 2007. Web. 12 Dec. 2009.

<http://www.biodiesel.org/pdf_files/fuelfactsheets/emissions.pdf>.

BENEFITS OF BIODIESEL. Rep. National Biodiesel Board, 29 Oct. 2009. Web. 12 Dec. 2009.

<http://www.biodiesel.org/pdf_files/fuelfactsheets/Benefits%20of%20Biodiesel.Pdf>.

⁹ "Emission Facts: Average Annual Emissions and Fuel Consumption for Passenger Cars and Light Trucks |

Consumer Information | US EPA." *U.S. Environmental Protection Agency*. Web. 12 Dec. 2009.

<<http://www.epa.gov/oms/consumer/f00013.htm>>.

¹⁰ "School Bus Emissions." *Welcome to the Connecticut PTA!* Web. 12 Dec. 2009.

<http://www.ctpta.org/legislative/sbus_emissions.htm>.

found increased risk between 18-76%. These findings are based primarily upon studies of truck drivers, railroad workers, bus drivers and shipyard workers.

- Diesel Exhaust Contains 40 Hazardous Air Pollutants: In addition, diesel exhaust contains both carbon particulates and 40 chemicals that are classified as “hazardous air pollutants” under the Clean Air Act.
- Particulates and Respiratory Diseases: Exposure to particulates has been associated with: increased mortality among those with cardiopulmonary diseases; exacerbation of symptoms for asthma, bronchitis, and pneumonia; decreased lung function; and retarded lung development. It has also been correlated with increased hospital admissions and emergency room visits for respiratory illnesses.
- Children’s Susceptibility: Children may be especially susceptible to adverse respiratory effects following exposure to fine-diameter particulate matter (PM2.5) emitted from diesel engines. Nearly 94% of diesel particulates have diameters less than 2.5 micrometers (um).⁴ The average diameter of diesel particulates is 0.2 micrometers. Smaller particles are able to penetrate children’s narrower airways reaching deeply within the lung, where they are more likely to be retained. Higher rates of respiration among children may lead to their higher exposure, when measured per unit of their body weight.

To view this report in full go to http://www.ctpta.org/legislative/sbus_emissions.htm

Intangible Benefit Analysis

A project such as this stands to generate significant publicity for Fitzgerald and the entire Waltham Public School District. A project similar to this one was implemented in the Dallas County School District and generated noteworthy press for the district. The key barrier to implementing this program is finding a consistent fuel source since WVO must be obtained as a waste product from cooking. However, this also represents a significant opportunity for the district to strengthen its ties with the community’s restaurants and deli’s because WVO removal is a cost for these companies. Therefore, this project represents a unique opportunity for Fitzgerald to decrease its costs, improve the community’s air quality, help the environment, and support local businesses. In conclusion, this project shows Fitzgerald’s commitment to finding innovative solutions to environmental and budgetary problems.

Appendix

1)

item	average amount consumed per week	contribution per item	week collecting this year	weeks in a school year	revenue per year per student
drink pouches	2.5	\$0.02	25	36	\$1.80
chip bags	1	\$0.02	25	36	\$0.72
	number of students	current year revenue	total revenue per item		
drink pouches	412	\$515.00	\$741.60		
chip bags	412	\$206.00	\$296.64		
total revenue per year	\$1,038.24		total probable revenue per year	\$519.12	
this year's total revenue	\$721.00		this year's total probable revenue	\$360.50	

2)

Parts ¹¹	Price
GFS Commercial Heavy Duty Conversion System	2,761.00
automation	760.00
Installation	2,200.00
275 Gal Used Poly Tote with cage	135.00
FSIX100 Convertible Filter Housings	299.95
OC-20 Centrifuge with control valve and mount	299.00
Cost of Conversion	6,454.95
Average miles driven by a school bus annually ¹²	12,000.00
Miles per gallon ⁹	7.00
gallons used per year	1714.286
Average savings per gallon ¹³	\$2.50
Annual Savings	\$4,285.71
Payback Period (years)	1.51

3)

Emission Type	Emission Reduction	Emissions per Mile (grams)	Yearly Emissions for Standard Bus (Tons)	Yearly Emissions from WVO Bus (Tons)	Tons of Emissions Reduced
carbon dioxide	78.50%	1708	20.17229518	4.337043464	15.83525172
Sulfates	100.00%				
PAH (Polycyclic Aromatic Hydrocarbons)	80.00%				
nPAH (nitrated PAH's)	90.00%				
Ozone potential of speciated HC	50.00%				
Total Unburned Hydrocarbons	67.00%	0.69	0.008149229	0.002689246	0.005459984
Carbon Monoxide	48.00%	1.78	0.02102265	0.010931778	0.010090872
Particulate Matter	47.00%				

¹¹ "Commercial over the Road." *Welcome to the Frontpage*. Web. 11 Oct. 2009.

<http://www.greenmyfleet.com/index.php?option=com_content&view=category&id=43&Itemid=111>.

¹² "National School Bus Fuel Data." *American School Bus Council*. Web. 11 Dec. 2009.

<<http://www.americanschoolbuscouncil.org/index.php?page=fuel-calculator>>.

¹³ Rick. "Information from GreaseCar." Telephone interview. 4 Dec. 2009.