Transforming New York City's W. 28th St Flower Market through sustainable development and collaborations

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Table of Contents

Policy Brief:

Executive Summary:

The current issue dominating this arena is in how organic waste operations are currently handled by floral businesses in and around W. 28th St, commonly referred to as the Flower Market. Figure 1 shows an overhead shot of the case block being evaluated for the report. Currently, the majority of organic waste associated with these businesses is lumped together with in-organic solid waste and shipped, via barge, to out-of-state landfills **[1]**. The result of this practice is overall inefficiency regarding a potential energy source, in addition to, increased costs associated with transporting and storing said organic waste away from the city. The utilization of organic waste as a feedstock for local anaerobic digestion plants would help to eliminate costs associated with its hauling, as well as, add a new energy source for neighboring businesses and institutions. Unfortunately, current legislation regarding organic waste removal focuses strictly on the waste associated with large food services, mandating that all food scraps be handled by haulers with the purpose of composting the material for use in parks and urban farms. The lack of inclusion of plant wastes in government policies marks a significant oversight in current policy and great potential for the creation of a floral consortium between these businesses to standardize waste operation practices and begin generating value from a previously untouched waste stream. The implementation of AD technologies in the floral market would greatly reduce GHG emissions associated with transporting this waste to landfill sites, as well as, provide a new local source for electricity and gas generation.

Context and importance of the problem:

New York City produces 14 million tons of waste and recyclables and is dedicated to reducing the percentage of solid waste en route to landfills by 75% by 2030 **[2]**. An astounding 95% of this waste is exported out of the city limits to out-of-state landfills at enormous costs, both economically and environmentally due to the energy and emission costs associated its transportation **[3]**. Fugitive emissions attributed to landfills and wastewater treatment plants account for a total of 2.8 million tons of carbon dioxide equivalent per year **[4]**. Current business waste protocols are inefficient and unsustainable and there is mounting awareness regarding the need for reformation in the city's operations.

There are no current policies addressing floral businesses and how they dispose of their organic waste. The City requires businesses to hire a licensed hauler to handle company related waste disposal and this disjointed market climate has led to the exportation of large majorities of solid waste to out-of-state landfills due to planning oversights and the general disassociation between respective businesses.

The purpose of this proposal is to advocate the adoption of a strategy for eliminating the costs associated with recollecting and recovering organic waste in and around W. 28th St's floral market. The voluntary technical adoption of anaerobic digesters for the on-site production of biogas is an effective strategy that can alleviate the stream of outgoing waste from these businesses and the carbon emissions associated with its eventual relocation into a landfill. In addition, this strategy would create a new source of bio-energy

from current waste sources which could be utilized for heating, electricity generation, or even for processing into road fuel if the process picks up steam **[5]**.

Anaerobic digestion is a series of biological processes utilizing microorganisms to breakdown biodegradable materials in the absence of oxygen. The processes involved are: hydrolysis, acidification, acetogenesis & methanogenesis **[6]**. AD systems are capable of processing all types of organic materials such as animal waste slurries, energy crops, or food waste and produce biogas and biofertilizers as outputs. Biogas, consisting around 60% methane and 40% carbon dioxide, can be used for space heating, converted to vehicle fuels, or in conjunction with a combined heat and power system (CHP) it can be used to generate electricity. The biofertilizer, commonly referred to as the digestate, can be stored and sold to post production to farms or parks to be used in fertilizing soils **[6]**.

Critique of policy option

There are currently no policies or legislation aimed at addressing the issue of floral organic waste or at the development of biogas operations from urban floral businesses. The geographic nature of Manhattan does not allow for easy implementation of composting or anaerobic digestion systems due to spatial restrictions. Due to these restrictions there is a great need for developed strategic partnerships between businesses and other government or academic bodies.

The lack of policy aimed at addressing these waste issues is a significant oversight that is attributing to New York City's already substantial waste stream and footprint with respect to the various greenhouse gases associated with the city's waste operations. There is a great deal of potential for developing strategic inter-business partnerships and academic alliances for the betterment of the city. It is crucial to evaluate viability across a number of different variables. One way of doing this is through the evaluation of analogous policy implementations as benchmarks, if you will. One such policy that is analogous to this proposal is law number 2013/146 entitled "A Local Law to amend the administrative code of the city of New York, in relation to commercial organic waste."

This legislation, due to begin in July of 2015, requires large food service establishments to recycle their food scrap waste **[7]**. This law could potentially affect arenas, catering establishments, hotels, food manufacturers, and food wholesalers that are large or part of a chain; however, the extent to which the law is enforced is still dependent on regional capacity to process the food waste and whether the cost of processing said waste is competitive with the cost of disposing via landfill or incineration **[8].**

The combination of analogous policy implementations regarding organic waste, as well as, the availability of local institutions with allied ideals is quite promising for the advancement of this initiative.

Policy recommendations:

The waste stream associated with floral organic waste can be diverted and used as feedstock for on-site anaerobic digester systems for the production of biogas. The cost of initial capital investment for individual businesses or partners can be mitigated through the utilization of rebates or incentives similar to NYSERDA programs such as MultiFamily Performance Programs and Existing Facilities Programs **[6]**. To circumvent spatial restrictions in the area it is suggested that, in addition to the development of voluntary technical installations, there be focus on the development of an academic/research partnership between the Fashion Institute of Technology (FIT), a sustainable leader in the area with annual

Sustainability conferences oriented towards the overall campus footprint reduction and various sustainability projects and representation at the 2014 Clinton Global Initiative University conference **[9]**.

The following target steps are recommended for implementing policy action and developing strategies and goals for this project:

1. Form a sustainable floral consortium between W. 28th St businesses with the goal/mission of streamlining and developing standards for plant waste streams to be used for biogas synthesis wherever feasible. Potential locations include the Fashion Institute of Technology, a city university located across the street from W. 28th and the majority of floral businesses.

2. Form an academic partnership between floral consortium and partner universities. FIT and Columbia University are two local institutions that are committed to sustainable development and would be strong partners for consortium, providing space for anaerobic digester system implementation and insight into research and development for streamlining systems and improving waste management protocols.

3. Begin financing evaluations to determine payback periods, current net value of the project, and other economic metrics. Monitor waste and biogas generation, as well as, subsequent electricity production to determine areas of weakness or opportunities for increasing yields. Evaluate the potential for co-digestion systems (using multiple feed-stocks together such as food scrap waste combined with plant materials) in an integrated anaerobic digestion/composting system. The utilization of an integrated system is beneficial because the two technologies provide synergies to one another such as the reduction in retention time of feedstocks from 8-12 weeks to as little as 2-3 weeks **[6]**.

Plant waste generation estimates from the floral consortium can be determined assuming daily waste generation values of a minimum of 60 lbs of organic waste daily per individual business within the consortium. The twelve businesses, each producing ~15 kg of waste a day, would yield:

(30 kg/business) x (12 businesses) x (5 days/week) x (4 weeks/month) x (12 months/yr) = 86,400 kg/yr of plant waste generated from each business per year.

Using Total Solid (TS) and Volatile Solid (TS) percentages for garden waste associated with anaerobic digestion we can loosely determine the potential for biogas and subsequent electricity generation as follows:
TS = 65% ; VS = 90% of TS ; Biogas yield = 0.35 m^3/kg VS (garden waste)

86,400 kg/yr x (0.001 tons/kg) = 95.24 tons/yr
(95.24 tons/yr) x (0.65) = 61.9 tpa solid
(61.9 tpa solid) x (0.90) = 55.72 tpa
(55.72 tpa) x (907 kg/ton) = 50,548 kg/yr VS
(50,548 kg/yr VS) x (0.35) = 17,691.8 m^3 biogas/yr

To determine electricity generation we convert this yearly biogas output to hours and multiple by the a calorific value of 22MJ/m^3 for biogas.

(17,691.8 m^3/yr) / (8,765 hrs/yr) = 2.02 m^3/hr
(2.02 m^3/hr) x (22 MJ/m^3) = 44.44 W or 0.04 kW per hour **[10]**

CHP conversion efficiencies of 30% and 55% for heat can be used to evaluate the total electricity and heat generation potential over the course of the year. It is important to note that these values are simple estimates determined from the perspective of one business owner on W. 28th St and based solely on the observations made on a daily basis. The valuation of production could be better determined by consolidating waste information among the consortium partners and repeating calculations with those data values. Additionally, it should be noted that the responsibility for determining proper metrical evaluation is dependent on each individual business. It is suggested that businesses evaluate their waste generation potential based on:

- waste estimates for bagged plant/garden waste being disposed of via current day standard practice
- evaluation of types of plant-based waste being disposed of due to the varying degree of potential biogas synthesis dependent on flower types (an example of this is illustrated in Table 1 of the appendices).
- time necessary to source-separate trash on-site and whether alternative methods could provide streamlined solutions.

Additional metrics to keep track of for each business include energy usage per month in order to properly evaluate the impact of offsetting current energy needs associated with the business, availability of space to store and separate materials for disposal, embodied energy estimates for travel associated with implementation of off-site biogas generation facility to compare costs and benefits associated with on and off-site systems. Currently, there is an associated cost of collection equaling $38-80/ton of waste within NYC **[11]**. Using this information along with the procured information from floral businesses would allow for simple cost-saving calculations.

The timeframe for such a policy is dependent on a number of factors. Incentivizing compost and AD initiatives within businesses and selling the concept to local institutions with enough space is a time consuming endeavor and a mandate imposed too soon could have significant financial implications on the businesses. Similar policies covering organic waste operations were passed in 2012 with a mandate to begin monitoring businesses by July of 2015 **[3]**. For this reason, I believe an allowance of 3 years to evaluate feasibility AD investment and to allow businesses not suited for such investment to research alternatives, such as joining local composting initiatives or to champion their own composting programs is appropriate with enforcement of the policy beginning by 2018-2019. Choice would occur in regards to whether businesses wanted to have their waste associated with biogas generation through a centralized provider of the technology, locally or if they felt more appropriate composting the waste themselves or through an outside organization.

The project itself is quite relevant to the issues we face and will continue to face in the future regarding waste operation protocols. The policy should be re-evaluated based on the degree to which Anaerobic Digestion technology advances or if innovations in the renewable energy sector yield a new, more efficient or reliable technology for implementation which would serve similar purposes. NYC is required by state law to update its waste disposal plan every 10 years, thus a 10 year period for re-evaluation of the policy seems appropriate. The project would be considered a success if organic waste were being used to produce biogas and electricity generation through combustion, in and around the flower market, prior to 2020. A Gantt chart illustrating a prototype timeline for such a policy implementation can be viewed in Figure 2 of the appendices.

The re-evaluation of current waste protocols is of absolute importance. New York City is a role model across the globe for its persistent innovation and capital investment projects. The GHG emissions associated with transportation of waste to landfills would be offset by the redirecting these wastes to green energy generation initiatives. The implementation of a renewable waste operation policy is not only necessary because of its implicit economic and environmental consequences, but also because it would

further promote the city's significant interest in sustainable long-term planning and resilience, raise awareness within the community, and forge powerful alliances between business consortiums and academic institutions with the potential of developing increasingly beneficial renewable projects in the future.

Appendices:

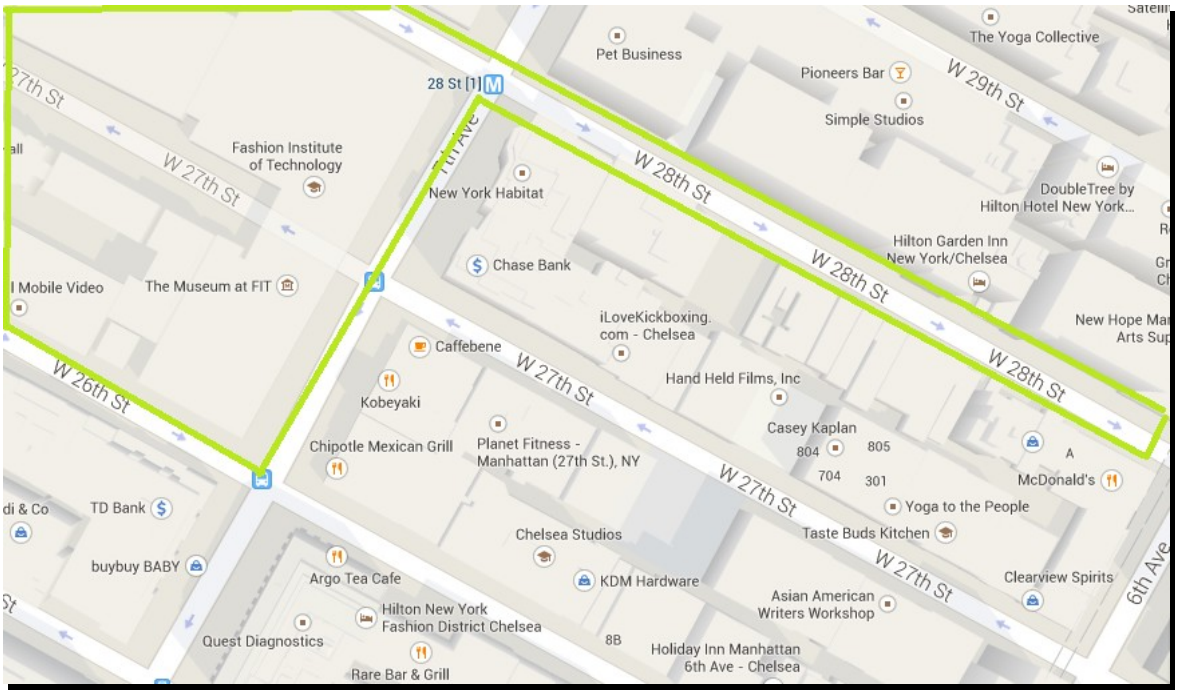

Figure 1 - Area of interest for policy implementation

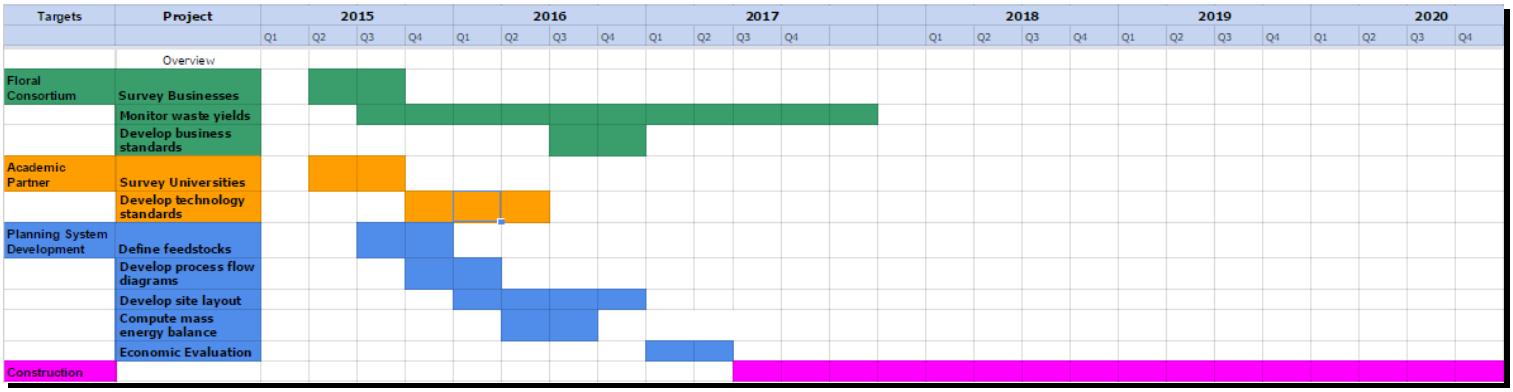

Figure 2 - Gantt timeline for project implementation

Substrate	7% Amt of gas	Amt of gas/kg substrate
African Wattle	0.55791 g	16.47 g
Roselle	0.57259 g	8.26 g

Cabbage	0.57259 g	5.3 g
Brinjal	0.69005 g	12.51 g
Carrot	0.58728 g	7.41 g
Ladies Finger	0.646 g	6.95 g
Nile Tulip Flower	0.60196 g	9.004 g
Silk Tree Mimosa	0.63132 g	31.7 g
Sunset Flower	0.52855 g	4.52 g
Jasmine	0.36705 g	6.78g

Table 1 - Potential biogas production via cut flower feedstock **[12]**

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[11] Coalition for Resource Recovery. *Economics of New York City Commercial MSW Collection & Disposal and Source-Separated Food Waste Collection & Composting.* Retrieved April 17th 2015. Access

[12] International Journal of Research in Engineering and Technology. *Production of Bio-gas from Flowers and Vegetable Wastes using Anaerobic Digestion*. August 2014. Retrieved April 22nd 2015. Access

Background & Rationale:

Defining market conditions:

The specific market being addressed for this report is the New York City flower market district located on W. 28th St between seventh and sixth avenues of Manhattan. The block itself is comprised almost exclusively of florists and florally oriented businesses. The primary goods being exchanged in this market are varying cut flowers and garden plants in large supplies and with varying shelf life/retention times depending on product specification.

There is a relative degree of heterogeneity in regards to operations and practices among the floral businesses located on W. 28th St due to a lack of regulations or standards for floral businesses, in general. Some similarities shared among retailers and event designers are in the methods by which these businesses supply their products. Large quantities of cut flowers are imported into NYC daily and sold to retailers and event planners, alike.

Economic evaluation of product goods are determined primarily from market conditions and competition pricing, which in itself is generally determined from the original cost of the good and overhead costs. In the floral market there is also the question of perishable items, those which perish prior to being sold. In general, a 5% perishing rate is accepted for shipping of products with an additional shop perishing rate included which varies on the shop, **[1]**.

The market itself is complex in regards to which aspects are organized by standards and which by reputation/status. There are major players in the floral event design space who receive the majority of their business because of name recognition within the industry which is evidently a status attribute; however, prices are typically still dictated by the original cost of the good/overhead costs; though markups are common among the more well-known business owners.

Currently, market imperfections exist in the management of business waste within the specified market. There is a lack of coordination between these spatially centralized businesses in regards to how organic waste (flower trimmings, perished goods, etc) are handled and disposed. Additionally, there is a lack of funding and space among individual businesses, within the boundaries of the W. 28th St flower market, to incorporate on-site composting and/or anaerobic digester technology into current operational protocols.

Defining non-market conditions:

Campaign Boundaries	
What is the issue to be addressed?	**Who are the actors?**
There is a current lack of coordination regarding utilization of market waste streams as sources for sustainable	The actors for this policy are the owners and employees of the various businesses (~12) located within the W. 28th St flower

development. Organic waste from floral businesses are currently being disposed with traditional solid waste via barge in out-of-state landfills. Sustainable policy implementations among floral businesses on W. 28th, such as the adoption of anaerobic digestion, would alleviate the negative environmental consequences associated with transportation and landfill of waste and provide a market strategy for offsetting electricity needs via biogas through CHP systems.	market boundary. Additional actors include NYC Department of Sanitation's Bureau of Waste Prevention, Reuse and Recycling; The Mayor's Office of Long-term Planning and Sustainability; The Mayor's Office of Recovery & Resiliency; and the New York State Energy Research and Development Authority; The Fashion Institute of Technology (Academic)
Campaign Contexts	
What are the actors' interests in the issue	**In what arenas do the actors meet?**
Actors' interests vary. Businesses want to keep constant profits and avoid a reduction in sales while promoting the Earth and their products which are natural derivatives of our planet. The Bureau of Waste Prevention, Reuse and Recycling are a city run organization dedicated to reducing waste streams within the NYC system. The Mayor's Offices oriented towards sustainable development are dedicated to limiting environmental impacts associated with city operations. NYSERDA promotes energy efficiency and the advancement of innovative energy solutions in ways that improve New York's economy and environment **[2]**. FIT is a leader in sustainability within the community having hosted its 9th annual Sustainable Business & Design Conference on April 7th of this year. The Sustainability Council at FIT is currently	Forums of action typically move through legislation from government officials or through grassroots organizations and rallying promoting the cause at hand. Policy implementations would be enacted through the individual businesses through the development of some type of Floral Business Association which would further centralize the market and eliminate coordination imperfections. Policy implementations (Mayor's Office), operational strategies (Dept Sanitation), and funding opportunities (NYSERDA) are the forms through which these different actors will interact and collaborate with one another. FIT was selected due to its close proximity with the 28th St flower market. They are sustainable leaders in the academic arena with space on campus for the development of composting/anaerobic digester

seeking grant proposals for the 2016-2017 academic year and the school was most recently represented at the 2014 Clinton Global Initiative University conference in Arizona for a rooftop natural dye garden on campus, as well as, for a muslin fabric composting initiative which is currently operating on their campus **[3]**.	facilities. In fact, the campus is already host to a muslin fabric composting facility.
Campaign Resources	
What information moves the issue and speaks to interests?	**What assets do actors need to prevail in arena?**
Information regarding total tonnage of organic waste streams related to the individual floral businesses on W. 28th St is a necessity in order to estimate potential biogas synthesis yields. Cost estimates for small-scale digester systems, as well as, the evaluation of which particular system parameters (meosphillic or thermophillic, wet or dry, continuous flow or batch, single or multiple digesters, etc) would prove most beneficial for the proposed action and particular feed-stock.	These individual floral businesses already have information regarding their energy demands. Moving forward, it is necessary to educate business owners regarding the negative impacts of their waste streams, the environmental and financial benefits associated with biogas production on-site or within close proximity (within 1 block distance). Additionally, business owners are in need of financing options for the implementation of such scaled projects and education regarding the business models associated with current digester models utilizing similar feed-stocks.

Campaign Targets:

	Determine potential for establishment of a floral market consortium between W. 28th businesses	**Determine potential for academic partnership between consortium and neighboring academic institution**	**Assess feasibility of anaerobic digester system in academic partner site. Develop timetable and determine areas for financial support,**
Information Resources	- Identify businesses invested in block-wide floral business	- Assess potential for academic partnership between FIT and W.28th	- Relative costs and benefits associated with on-site installation in

	consortium to develop standards for re-directing organic waste from landfills to on-site or close proximity (partner FIT affiliate) anaerobic digestion systems. - Inventory of expected "deliverables" (organic waste) from businesses for AD processing in order to accomplish beneficial returns.	Floral consortium to develop anaerobic digestion facility on campus site. - Inventory for biogas production, as well as, digestate yields and utilization of both outputs for community benefits. - Assess potential for academic partnership between Columbia University and flora consortium.	regards to: spatial availability, financial implications, and other impacts such as odor or digestate handling. - Develop timeline for various stages associated with project including surveying, construction, and monitoring. - Determine optimal specifications for anaerobic digestion facility installation: (meosphillic or thermophillic, wet or dry, continuous flow or batch, single or multiple digesters, etc)
Coalitions, Organizations, Advocacy Groups, Lobbies	-The Society of American Florists is the only national trade association representing 7,000 members in the floral industry **[4]**. - Businesses operate independent of one another and power, in the sense of who enacts change, is distributed between the businesses.	-FIT Sustainability Council, established by the University President, currently seeking applications for 2015-2016 grants. - Council was developed to foster sustainable projects throughout the FIT community **[5]** - Columbia University, researching alternative mixing techniques for AD technology that is suitable for agricultural waste treatment **[6]**.	- New York State Energy Research and Development Authority (NYSERDA) promotes energy efficiency and the advancement of innovative energy solutions in ways that improve New York's economy and environment **[2].**
Consistency	- There is great potential for consistent returns from a renewable project of this type. The use of floral waste by-products as feed-stock for anaerobic digestion yields benefits through biogas and digestate	- FIT has demonstrated a commitment to the community and to making progress as a sustainability advocate. - Must be able to thoroughly provide generated value for all partners and member businesses.	- Consistent biogas production is dependent on consistent feed-stock availability. - Utilization of this system provides new energy source for businesses which provides a significant value to member

	production.		groups.
Uncertainty	- Challenges to consistency are generated from uncertainty in the amount of waste generated from businesses over the business year. - Monitoring of waste generation and subsequent biogas synthesis would alleviate some uncertainty in this regard.	- There is uncertainty regarding the willingness of the academic partner to contribute to the consortium's standards. - Utilization of off-site AD system could supplement this risk; however, transportation costs should be evaluated sustainable feasibility.	- Challenges to consistency are generated from uncertainty in the amount of waste generated from businesses over the business year. - Monitoring of waste generation and subsequent biogas synthesis would alleviate some uncertainty in this regard. - There is uncertainty regarding the willingness of the academic partner to contribute to the consortium's standards. - Utilization of off-site AD system could supplement this risk; however, transportation costs should be evaluated sustainable feasibility.
Values and Ethics	- The reallocation and reuse of waste sources would divert waste from landfills and alleviate off-gasing of methane into the atmosphere **[7]** -	- The reallocation and reuse of waste sources would divert waste from landfills and alleviate off-gasing of methane into the atmosphere **[8]** -	- Monitor environmental and safety parameters regarding system operation.

Campaign Analysis:

S.W.O.T Analysis -

The purpose of this SWOT analysis is to determine the strengths, weaknesses, opportunities, and threats associated with the adoption of anaerobic digestion technology standards for the production of biogas from commercial organic waste streams.

Strengths -

- Utilization of a waste stream for energy production provides a "free" feed-stock source.

- Value provided to consortium and academic partner is evident in the sustainable benefits they could associate with their businesses, as well as, rebates and diminished electrical needs.
- The initiative fills a need for sustainable waste management and is also in line with current NYC policies which are attempting to standardize waste operations for large catering and food services businesses (potential synergies in this regards).
- Use of surplus heat and the potential for nutrient byproduct sale allow for financing outside of government incentive programs.

Weaknesses -

- Initiative requires coordination between many different businesses, academic partners, and government groups. Varying interests from these parties need to be evaluated and the mission goal needs to be focused on.
- Lack of awareness regarding total feed-stock output from businesses yields uncertainty regarding biogas generation potential.
- Retention times for biogas production varies; however, it is relatively long (approximately 15-20 days for mesophillic systems).

Opportunities -

- Multiple academic partners with interests in sustainability available for advances for the technological aspects of the initiative through research agreements.
- Value provided to consortium and academic partner is evident in the sustainable benefits they could associate with their businesses, as well as, rebates and diminished electrical needs.
- Opportunity for pilot program implementation either on-site with FIT campus or in off-site locale somewhere in the Bronx or Queens.

Threats -

- Seasonal and cultural implications associated with floral trade business may have periods of significant lull (winter months) in which biogas generation may significantly drop
- Environmental impacts associated with tank leakages not well evaluated and needs to be included in LCA.

The five indicators that would be appropriate for measuring sustainability in this project are:

1. Waste diverted from landfill (in tons)
2. Electricity generated from biogas (in kWh)
3. GHG emissions removed from system (tons CO_{2e})
4. Digestate/fertilizers produced from system (in tons)
5. Waste generation per month and during holidays

The amount of waste diverted from landfills and the greenhouse gas emissions associated with this diversion and would be evaluated to determine the environmental impacts of this initiative. Electricity generation, digestate production, and monthly waste generation rates are evaluated to determine the economic impacts of the implementation of such a project.

Three significant risks to sustainability that are being addressed by this project are GHG emissions associated with landfill waste, GHG emissions associated with the transport of this waste, and general

waste management protocols for urban targets, in general. Values for cost and environmental implications for transportation of waste can be used to determine how much of an offset in these categories an anaerobic digestion system in the floral market would generate. Levelized cost analyses and life cycle assessments can be utilized to better describe these costs and the embodied costs associated with material generation, transportation, construction, maintenance and other aspects of the renewable energy project.

A decommissioning step is considered only for the environmental impacts assessment for this project; however, in order to develop a proper net value and payback period determination for the project as a whole it is recommended that a decommissioning strategy and fund be considered.

	Local Impact	Regional Impact	Global Impact
Year 1	~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration. ~ Construction costs and embodied energies associated with construction	~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration. ~ Construction costs and embodied energies associated with construction	~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration. ~ Construction costs and embodied energies associated with construction
Year 2-5	~Improper control of odor associated with system. ~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration.	~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration.	~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration.
Year 5-10	~Improper control of odor associated with system. ~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration.	~ Air Emissions associated with methane leaks during biogas combustion or digestate aeration.	~ GHG emissions from construction are released and influence long-wave incoming radiation and surface temperatures.
Year 50	~ Operating lifetime met. Decommissioning of plant requires energy and further GHG emissions which impacts local air quality. ~Landfill materials may impact local ecosystems	~ Disposal of materials can have a regional impact due to leached toxins if landfill is located outside of local area. ~ Transportation of waste leads to further GHG emissions. ~ Birds impacted by toxins, non-digestible plastics or metals.	~ Disposal of materials leads to further GHG emissions due to transportation. ~ Fish impacted by dumping of materials into oceans. Kinetic energy of waves breakdown materials into particulates which are ingested by fish and carried up the food chain.
> Year 100	~ Landfill materials may impact local ecosystems.	~ Landfill materials may impact regional ecosystems.	~ Ocean life impacted depending on how waste is removed and displaced. ~ Impact on food chain and human health risks elevated.

Campaign Implementations:

The purpose of this document is to survey the opportunity for non-market policy impacts among floral businesses, which number over 10, in and around the W. 28th St area of Manhattan. Currently, elements involving the import of cut-flowers and their disposal within the NYC floral district are operating in an unsustainable and wasteful manner that is detrimental to natural capital on both a local and global scale. This is due, in part, to the fact that there are no specific operational standards currently associated with running a floral business **[4]**. The following sections will illustrate the

arenas in which this policy has the potential to take place and identify existing market imperfections that are limiting the implementation of said policies.

Policy Arenas Affecting Floral Market -

A current issue facing the market is in the operational procedures undertaken by businesses regarding their organic waste disposal. Currently the city is required by the state to have its waste disposal plan updated every 10 years and for all businesses to contract a private hauler to handle all of their waste removal needs **[9]**. Unfortunately, the majority of the organic waste associated with W. 28th St's market is bagged with regular solid waste trash and, assumingly, shipped via barge out-of-state to be land-filled as is the case for 95% of food scrap waste from restaurant's and the majority of other solid waste **[10]**. It is for this reason that we believe there is a great opportunity to reduce the environmental cost associated with recollecting and recovering the organic waste associated with these florists businesses, as well as, to process said waste in a way that will actually yield positive benefits to the businesses either through local composting initiatives or alternative means.

Rather than allowing these wasted materials to decompose in a landfill, we are proposing the technical adoption of anaerobic digesters in the locality with the purpose of converting all organic waste from these businesses to useable biogas, which can be combusted to generate electricity and heat, or can be processed into renewable natural gas and transportation fuels **[11]**. These digesters are typically associated with the conversion of animal by-products to biogas; however, there has been great interest to expand these inputs. Flowers are a very good feedstock for biogas production with a digestion period of 4-6 days **[12]**. The following chart illustrates the biogas yields per kg of substrate for 7% substrate systems using a variety of different flower species as substrates:

Substrate	7% Amt of gas	Amt of gas/kg substrate
African Wattle	0.55791 g	16.47 g
Roselle	0.57259 g	8.26 g
Cabbage	0.57259 g	5.3 g
Brinjal	0.69005 g	12.51 g
Carrot	0.58728 g	7.41 g
Ladies Finger	0.646 g	6.95 g
Nile Tulip Flower	0.60196 g	9.004 g
Silk Tree Mimosa	0.63132 g	31.7 g
Sunset Flower	0.52855 g	4.52 g
Jasmine	0.36705 g	6.78g

Table 1 - Production of Biogas **[12]**

Uses for the biogas include:

- Heating only - via combustion as cooking fuel yielding about 2.5 kW/cubic meter.

- Road Fuel - The Renewable Transport Fuel Obligation (RTFO) includes biogas for road fuel; however, the real life utilization in this manner is still not common.

- Mains gas or compressed gas - More appropriate for extremely high inflow and output situations and could be implemented depending on total waste estimates.

- Electricity generation through combined heating and power generators **[13]**

The two major costs associated with Anaerobic Digester implementation are the initial capital cost and the feedstock cost **[13]**. Thankfully, the feedstock in this case would be waste products which, in their current non-utilized form, are essentially worthless as they would end up land-filled. We believe that the cost of initial capital investment could be mitigated for businesses through the utilization of rebates and government incentivizing installation projects similar to the residential and commercial incentives currently provided for solar panel installations via the New York State Energy Research and Development Authority (NYSERDA) **[14]**.

Spatial restrictions among floral businesses on W. 28th make it additionally difficult to undergo an undertaking of this magnitude. For this reason, we hope to not only establish technical and monetary mandates, but to also foster and build connections and collaborations between the dense florist community on W. 28th St and The Fashion Institute of Technology (FIT), a State University specializing in clothing and design, across the street. FIT is a leader in sustainability within the community having hosted its 9th annual Sustainable Business & Design Conference on April 7th of this year which I had the pleasure of attending. The Sustainability Council at FIT is currently seeking grant proposals for the 2016-2017 academic year and the school was most recently represented at the 2014 Clinton Global Initiative University conference in Arizona for a rooftop natural dye garden on campus, as well as, for a muslin fabric composting initiative which is currently operating on their campus **[15]**. We see great potential for an academic/research partnership between this institution and the floral businesses across the street, especially due to the campuses large size and available space within a spatially restrictive community.

Existing Market Imperfections -

The primary hindrance to such an undertaking lies in a significant lack of coordination and knowledge among the target businesses. Considering the close proximity in which these businesses operate it would be assumed that agreements between them to improve efficiencies would be available; however, such an undertaking has not been developed in regards to waste removal operations. There is significant social biases that properly handling waste either through composting or anaerobic digestion (AD) projects would prove too significant of a economic hit to businesses. The role of a government mandated management with monetary incentives in place and appropriate protocol requirements would go a long way in streamlining waste operations.

Additionally, the spatial restrictions discussed previously serve as another hindrance for businesses as they have no room to implement composting on their own or to build a function anaerobic digestion system. We believe that academic partnerships would help alleviate this restriction and increase support for the undertaking from the constituents comprising the market.

Primary Function of Policy -

Based on this analysis, the primary function of this policy would be to implement standards by which local florists can improve waste disposal operations and, through their waste, become a source of energy for local businesses, academic utilization, or more. We hope to accomplish this through incentivizing capital projects of this magnitude and by establishing partnerships between local bodies. This would ultimately impact behavior among actors in the floral industry which is a business that should cherish our natural resources in the first place considering the goods they sell are obvious products of nature. The overall remodeling of waste operations in this market would go a long way in improving efficiencies and decrease total tonnage of waste being exported, via barge, to out-of-state landfills.

Addressing Actors involved in Policy -

The main actors impacted by such a policy include:

- Floral businesses within case study region (W. 28th st)
- Fashion Institute of Technology (academic partnership)
- Columbia University (academic partnership)
- NYC Department of Sanitation
- NYC Mayor's Office of Long-term Planning and Sustainability (OLTPS)
- NYC Mayor's Office of Recovery and Resiliency (ORR)

Through the implementation of such a policy the floral businesses are offered an environmentally friendly alternative to their waste removal operations which is significant because many florists are becoming environmentally conscious regarding the environmental costs (energy and water) associated with importing their goods. FIT, which has currently undertaken projects only for the benefit of their campus operations, could extend their reach to the community and truly cement themselves as a leader in sustainability research and implementation for the private sector. The institution would also be collaborating with City offices who's goals are to develop cohesive long-term plans for NYC that can enhance the economy and increase efficiency while also protecting the environment through the development of energy supply, building efficiency, and resiliency **[16]**.

The next step towards implementing such a policy would involve evaluating total tonnage of organic (green) waste from businesses operating around the W. 28th st Flower Market and to calculate how much biogas could be generated from said numbers on a daily basis. Questions of storage, either pressurized or not, for said gas must be answered, as well as, a cost-benefit

analysis evaluating capital costs vs. energy yields over various time increments. Finally, an environmental assessment and safety assessment must be administered in order to evaluate the impacts of such a project, both on the local environment, as well as, on public health weighing various risk factors.

Analogous Policy Implementations -

When discussing projects of such a large magnitude and impacting so many different individuals it is crucial to evaluate viability across a number of different variables. One way of doing this is through the evaluation of analogous policy implementations as benchmarks, if you will. One such policy that is analogous to this proposal is law number 2013/146 entitled "A Local Law to amend the administrative code of the city of New York, in relation to commercial organic waste."

This legislation, due to begin in July of 2015, requires large food service establishments to recycle their food scrap waste **[17]**. This law could potentially affect arenas, catering establishments, hotels, food manufacturers, and food wholesalers that are large or part of a chain; however, the extent to which the law is enforced is still dependent on regional capacity to process the food waste and whether the cost of processing said waste is competitive with the cost of disposing via landfill or incineration **[18].**

The combination of analogous policy implementations regarding organic waste, as well as, the availability of an institution with allied ideals is quite promising. The need for the adoption of a new policy entirely is still unclear as an amendment to sanitation legislation could potentially serve the same purposes. The main advantages associated with a policy of this kind are discussed in the previous section which addressed the main actors involved.

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