

THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF HORTICULTURE AND SCHOOL OF ENGINEERING DESIGN,
TECHNOLOGY, AND PROFESSIONAL PROGRAMS

GREENTOWERS, LLC – LESSONS LEARNED IN THE CREATION OF AN URBAN
AGRICULTURE STUDENT STARTUP COMPANY

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SPRING 2014

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Biology with
interdisciplinary honors in Horticulture
and Engineering Entrepreneurship

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ABSTRACT

Urban agriculture is the integration of agricultural production systems into nontraditional spatial environments, specifically urban and suburban residential and commercial areas, as opposed to more traditional rural agricultural settings. As the world's population grows and becomes increasingly urbanized, humans bear witness to a shrinking minority of persons finding their employment in agricultural production practices. The industrialized agricultural system has bestowed consumers with many benefits, but it is accompanied by a broadening sense of disconnect between the average person and the food that he or she consumes. Urban agriculture offers the unique possibility for average citizen food consumers to become reacquainted with the intimacy that most have lost with their food—primarily how and where it is grown, handled, processed, packaged, and shipped through, all before it reaches their tables. Aquaponics is the integration of hydroponics—soilless plant production—and aquaculture—fish farming. Aquaponics presents a model for a designed ecological semi-symbiotic system, in which each of the major outputs is harvestable for human consumption, while also adding beneficial value to the other biological system components. Aquaponic integration is far more sustainable than either hydroponics or aquaculture alone, and is therefore unsurprisingly a rapidly emerging horticultural technique. Because aquaponic systems are enclosed and utilize circulating water instead of soil, they provide the capability to be integrated into urban agriculture, including areas where soil may be contaminated in brownfields or even completely nonexistent in endless asphalt acreage. Because aquaponic systems pump nutrient-rich water over roots instead of growing plants in soils, the technique also readily scales vertically, without the need to replace spent soils, further lending the practice to spatially constrained urban areas. GreenTowers, LLC is a State College, Pennsylvania startup company innovating in urban agricultural and aquaponic product design.

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ACKNOWLEDGEMENTS

I would like to acknowledge the numerable persons without whose collective guidance and support this thesis work and startup company would never have been possible. First and foremost, I want to acknowledge my tremendous team co-founding Members of GreenTowers, LLC: Yaleh Asadi, Dan Collins, Jon Gumble, Jared Yarnall-Schane, and Michael Zaengle. I would also like to thank two participants who helped out back when GreenTowers was in its earlier project phase, Mike Ghen and Ken Palamara.

I would like to give a special thanks to Dr. Mark Gagnon and the Harbaugh Endowment for Entrepreneurship in the College of Agriculture for his and the endowment's formative role in not only funding my earliest pursuits here at Penn State as a student entrepreneur, but also the guidance and inspiration that programs like the Ag60 and Ag Springboard competition have provided to me. I want to thank Dr. Tim Simpson of the Penn State Learning Factory and Mechanical Nuclear Engineering Innovation Challenge for his role in serving as a mentor and faculty advisor over the past few years for many of GreenTowers' prototyping pursuits. I also want to thank my thesis supervisor, advisor and faculty reader, Dr. Kathy Kelley, Dr. Liz Kisenwether and Dr. Elsa Sanchez, as well as the many other unnamed Penn State faculty that have advised and inspired me over the last four years. I want to also especially thank the faculty instructors in the Engineering Entrepreneurship minor, namely Bob Beaury and Phil Boyer.

I next want to thank all of the individuals who helped out with me during my junior year in getting the on-campus aquaponics research and education facility built and operating, especially greenhouse manager Dr. Scott DiLoretto as well as Dr. Rob Berghage. Having a full-scale functioning aquaponics system on campus has not only taught me a ton personally, but it is an incredibly important tool in teaching other students in the future about the exciting and emerging horticultural science of aquaponic food production. I also want to thank the folks at the

Penn State Horticultural Research farm, namely Bob Oberheim who was instrumental in the approval, for allowing GreenTowers to use their space and workshop tools at Rock Springs Gate H while building the shipping container greenhouse prototype. I also want to thank the newly minted Penn State Sustainability Institute for their continued work and for the creation of the Reinvention Fund grant award, which is providing yet another exciting product prototyping opportunity for GreenTowers this coming summer.

GreenTowers has been blessed too with a fantastic amount of community support, and I am so grateful to my friends at the New Leaf Initiative, especially Eric Sauder, for the amazing networking capabilities at New Leaf that first brought our project team together. I also want to thank my friends and “co.residents” at the co.space home and especially the greatest landlords in history there, Spud Marshall and Christian Baum, for just being awesome people and entrepreneurs and for always helping and enabling me in whatever questions, problems or projects that I have bring to them. I need to give a special shout-out of gratitude as well to the folks at the Penn State Small Business Development Center, especially Linda Feltman for her guidance in the early stages of incorporating our LLC as well as Mallory Meehan for her irreplaceable non-legal editing role in going through draft by draft with me for the many iterations that the GreenTowers, LLC Operating Agreement went through before we took it to an attorney for final approval. I also want to thank our business attorney for his counsel, Jeffery Bower of Bower Law Associates, for his help in finalizing our company’s Operating Agreement.

I want to provide a somewhat more ridiculous thank you as well to Dr. Dickson Despommier of Columbia University for his writing of the book “The Vertical Farm,” my reading of which in my first year at Penn State without question changed the trajectory of, if not my entire life, inarguably at least of my undergraduate career. I started out majoring in biology as a freshman because I thought I was bound for medical school, but Dr. Despommier’s book, in conjunction with a confluence of other influences, pushed me towards plant biology as a focus

within my major, of which I have absolutely zero regrets whatsoever because I legitimately believe today that I have found my life's professional calling in building a career towards improving urban agricultural design and implementation. Thanks to another of my mentors at Penn State Dr. Peter Aeschbacher, I was encouraged to contact Dr. Despommier personally, and not only did Dr. Despommier take my call, but he turned out to be an exceedingly polite, encouraging, and helpful individual and someone I hope to speak with again in the future.

I want to thank the student consultants I have had the opportunity to work with, including the team of senior capstone Mechanical Engineering students that GreenTowers sponsored through the Penn State Learning Factory. I also want to provide a special thanks the Imperial College London MSc Management student consulting team, who were absolutely pivotal in helping GreenTowers to better understand the market segmentation in the urban agricultural space and instrumental in our product pivot towards the consumer market.

I need to also thank the corporate sponsors of competitions that have provided GreenTowers with either funding and/or amazing networking connections. These include Dow Chemical for sponsoring the Sustainability Innovation Student Challenge Award at Penn State, Syngenta and especially Christine Gould for creating the Thought For Food competition and network, Dell for the Social Innovation Challenge, and Toms Shoes for the Start Something That Matters grant and mentoring fellowship.

Lastly I wish to thank Penn State University. State College is my home and my entrepreneurial ecosystem, and just like a repotted plant, I fear that when (or if) I finally ever uproot myself from this place, I will experience some drastic transplant shock. Thank you to this town and this university for providing me with the tremendous wealth of opportunities that can only come from living within an amazing research institution and in an inspiring downtown startup community. Praise be.

Chapter 1

Literature Review: Differentiations of Aquaponics within the Agricultural Space

Aquaponics derives its name from an amalgamation of aquaculture (fish farming) combined with hydroponics (soilless plant production). Aquaculture production is at the heart of the aquaponics system, and unlike traditional hydroponics operations that use inorganic nutrient salts to feed plants, aquaponics instead utilizes fish waste byproducts as the primary input to provide nutrients for the plants grown in the system. As such, fish feed is the true primary material input for aquaponic production and is among its highest costs as an ongoing expense. The reclamation of aquaculture nutrient waste via hydroponic plant culture is accomplished through a few simple biofiltration steps within the process of aquaponic water recirculation.

Fish excrete ammonia [NH_3] through their gills as a nitrogenous waste product (Rakocy, 1992). In traditional aquaculture, periodic partial water changes are required in order to rid aquaculture systems of this waste product, because if ammonia levels are allowed to build up too high, this becomes toxic to the fish. In aquaponics, these partial water changes are theoretically completely unnecessary. Instead, ammonia is converted to plant-available macronutrient nitrates [NO_3] in a two-step biofiltration process, accomplished by two separate genera of naturally occurring aerobic chemoautotrophic bacteria. First, ammonia is oxidized by *Nitrosomonas* spp. into nitrite [NO_2]; then this secondary waste product is further oxidized by *Nitrobacter* spp. into nitrates (Rakocy, 2006). Nitrate is the preferred form of macronutrient nitrogen for the vast majority of horticultural crops, and this soluble nutrient is readily taken up by the roots of plants within the aquaponics system and used as building blocks in the metabolic creation of plant amino acids (Diver, 2000).

The result is the aquaponics system functioning as a recirculating biofilter that somewhat resembles a symbiotic process, as the fish waste ultimately feeds the plants, and through the help of the beneficial nitrifying bacteria the plants in turn clean the water for the fish in a cyclic process. These bacteria establish biofilms on the surfaces of inert materials in the biofilter, typically materials containing high surface area from porosity, like lava rock or heat-expanded lightweight clay pellets or shale. Water must be run over the biofilters continuously, but not completely submerge the surface area materials where bacterial colonization takes place, as the aerobic nitrifying bacteria require an environment with high levels of dissolved oxygen (Rakocy, 2006).

There are a few basic types of hydroponic techniques worth highlighting for their frequent use in aquaponics systems. The first and most common is deep water culture (commonly abbreviated DWC), in which plant roots are completely submerged in water anywhere from six to twelve inches deep, while the leafy biomasses of plants are placed within individual holes in a floating foam raft or plastic cover atop the water. Deep water culture is often accompanied by an air pump and bubble stone in order to ensure that plants' root zones continue to receive the necessary oxygen required for their respiration. Next is nutrient film technique (commonly abbreviated NFT), in which plant roots are instead exposed to a continuous trickling stream of moving water, rather than submerged in a reservoir as in DWC. The last notable technique is media-based hydroponics, which visually resembles soil gardening, but where plants are instead grown directly in an inert media substrate that is periodically flooded and drained with nutrient rich water.

It is crucial to emphasize that one of the defining factors that makes an aquaponics system as a whole unique from its two subsystem components is that aquaponics does not typically require partial water changes in order to rid the aquatic system of undesirable byproducts. Like ammoniacal nitrogenous waste buildup in aquaculture, traditional hydroponics

also requires water changes in order to rid the system of spent soluble nutrient salts that are leftover in the depleted solution after plant root uptake and ion exchange has taken place. When water is changed, the old water containing soluble byproducts needs to be disposed of somehow and is most typically sent down the drain to sewage treatment facilities, where more energy must then be invested into the treatment of that grey water, or is discharged straight into the environment, where nutrient wastes contribute as eutrophication pollutants (Rakocy, 2014). It is therefore because of the recirculating nature of the system that aquaponics is broadly considered to be an extremely water efficient agricultural production technique, commonly claimed to conserve up to 90% of the water that would be required for growth of the same crops in a conventional soil garden or field production. Inevitably some water is still lost to evapotranspiration and must be replaced by rain, grey water or storm water collection or else by de-chlorination of city tap water, but this amount of water is minimal in comparison to the amount required for the complete water changes necessary in hydroponics or aquaculture alone.

In addition to the nitrates made available through the bacterial conversion of ammoniacal fish excrement, most other plant micro and macronutrients are likewise naturally available within aquaponics systems. The sources of these nutrients include other fish waste excrements (i.e. manures) as well as the chemical breakdown of those manures and of algae or any remaining unconsumed fish feed (Diver, 2000). While the hydroponics production within an aquaponics system, especially of high-value culinary herbs, is typically an operation's most commercially valuable output (Rakocy, 2006), plants really only provide the endpoint biofiltration of the nutrient byproducts through their root uptake and biological accumulation; as such, it is truly the staggering of aquaculture stocking and the continuous maintenance of the beneficial microbial populations that are most critical processes for the uninterrupted success of an aquaponics operation. It is of the utmost importance to carefully monitor the pH of an aquaponics system. While bacterial nitrification in the biofilter is most efficient in the pH range of 7.0-9.0, most

hydroponic plant nutrient uptake is maximized in the pH range of 5.8-6.2, and so a compromise between nitrification and nutrient uptake is best achieved when pH is maintained as close as possible to a neutral 7.0 (Rakocy, 2006).

This optimal pH of 7.0 is maintained by monitoring, at least daily if possible, and by the addition of supplemental nutrients. Iron additives are usually necessary and must be added in a chelated form in order to remain soluble and be available to plant roots, the best of which is the Fe-DTPA form, because this chelate specifically remains highly soluble around a pH of 7.0 (Rakocy, 2006). Other commonly required corrective additives include potassium, which is typically added in the form of potassium-hydroxide [KOH], as well as calcium added in the form of calcium-hydroxide [Ca(OH)₂]. These hydroxide additives are typically the best forms of these supplements because aquaponic systems tend to decrease in pH over time once established, and the alkalinity of hydroxide helps to offset this naturally occurring gradual lowering of pH (Rakocy, 2006). Besides these three additives needed for nutrient deficiencies and pH correction, established aquaponics systems typically do not require other macronutrient (nitrogen, magnesium, phosphorous, sulfur) or micronutrient (chlorine, manganese, boron, zinc, copper, molybdenum) supplements, as unconsumed fish feed and other fish waste byproducts provide an adequate supply. A final ongoing expense worth mentioning with the additives is the electrical utility costs required in order to maintain the pumps in the aquaponics system that must run continuously (Bernstein, 2011). This includes not only water pumps, but also sometimes aeration pumps for increasing dissolved oxygen content in the root zones of plants grown in hydroponic deep water culture applications, and also the costs of water heaters which are sometimes required in order to maintain an optimal temperature for a particular fish species, depending on the climate or indoor ambient temperature.

In addition to the crucial biofiltration process, there are other filtration steps that must be integrated into the system design, especially for commercial scale aquaponics production. The

first of these is a solids filter. Fish manure does contribute to hydroponic nutrients, but it typically must be removed to prevent excessive buildup. This is accomplished through the addition of a clarifier, or more commonly a swirl filter, which immediately follows the aquaculture tank in the order of operations for water transfer. A swirl filter works by slowly circulating the water flow and allowing for solids to settle out to the bottom, allowing clarified water to drain from the top via a water-level regulating standpipe (Rakocy, 2006). A good swirl filter design usually includes a valve at the bottom that can be opened in order to remove the settled solids, which can be valuable nutrient-rich manure that can be used for fertilization of gardens or field-grown crops. This solids removal step is typically then followed by the aerobic biofilter already discussed. The water then moves on either directly to the hydroponics system, or to the sump tank. A sump tank is simply the lowest point of water collection in the system, and is the point at which water is transferred via pumps. A sump tank can be placed either at the end of the hydroponics system so that only one pump is required to move the water from the sump back up to the aquaculture tank, or the system can be regulated by two pumps coming from the sump, such that the flow rate of the aquaculture system can be independently regulated from that of the hydroponics system. The figure below, taken from the November 2006 *Southern Regional Aquaculture Center* publication “Recirculating Aquaculture Tank Production Systems: Aquaponics—Integrating Fish and Plant Culture” by James Rakocy et al., illustrates the above described order of operations that is typical of a commercial scale aquaponics system (see Figure 1-1). An advantage of having two pumps from the sump to independently regulate the flow rates of the aquaculture and hydroponics subsystems is that, while a good rule of thumb is for the volumetric capacity of the aquaculture system to be moved every hour by the pump, the hydroponics system usually does not require such a high flow rate. However, the disadvantage is that running two pumps instead of one might significantly increase the electrical utility costs associated with continuously operating the system.

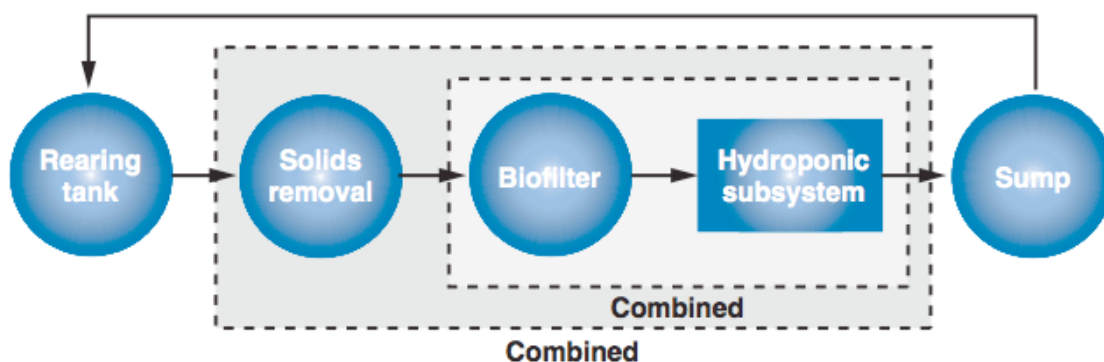


Figure 1-1. Commercial aquaponics system filtration order of operations. From *SRAC* November 2006, “Recirculating Aquaculture Tank Production Systems: Aquaponics—Integrating Fish and Plant Culture” by James Rakocy et al.

An alternative to a clarifier or swirl filter solids removal filter that is more commonly practiced in smaller scale aquaponic production is the integration of a soilless media bed for production of hydroponic crops. Instead of removing solids, soilless medias can contain red worms *Eisania fetida*, which are detritivores that feed on these organic manures and naturally convert them to more soluble fertilizers, just as in any vermiculture composting application (Bernstein, 2011). Soilless medias can be composed of any pH-neutral inert substrate, such as pea gravel, porous lava rock, or a heat-expanded clay or shale product.

In theory, an aquaponics system can be integrated into the aquaculture production of any freshwater species, although by far the most common species is the red Nile tilapia, *Oreochromis niloticus*, which is native to Africa. The red tilapia is the second most commonly cultured fish species around the world and the most commonly chosen for aquaponic systems because it is fast growing, easy to breed, omnivorous, tolerant of poor water conditions, and tasty enough to be commercially marketable as a food product almost anywhere in the world (Rakocy, 2006). Other examples of fish species currently being raised in commercial aquaponics applications include the yellow perch, *Perca flavescens*, a cooler water species native to North America, as well as many other aquaculture species including trout, bass, barramundi, catfish, cod, and ornamental koi, carp

and goldfish. Stocking densities of fish within an aquaponics system can vary hugely, from 500 grams of fish mass (~one pound) per 10-20 gallons in an at-home system, to up to 500 grams of fish per every 2 gallons of water in a high stocking density commercial scale (Bernstein, 2011). The hydroponic plant species suitable for production in an aquaponics system are even more numerable. Particularly well suited to production in aquaponics systems are vegetative crops such as lettuces and culinary herbs, chiefly because they are fast growing and a greater proportion of their biomass is marketable and edible, as opposed to fruiting crops like tomatoes, cucumbers or okra, which, while possible to produce, take a much longer amount of time to grow to maturity and result in significantly less marketable crop since only the fruit is edible (Rakocy, 2006). While basil seems to be the single most common plant grown in aquaponics systems, other herbs can include amaranth, cilantro, chives, dill, parsley, rosemary, sage, tarragon and thyme; and, in addition to practically all varieties of lettuces and microgreens, other herbaceous crops that typically do well include spinach, endive, escarole, kale, rhubarb, Swiss chard, bok choy, collards, mustard greens and watercress. Culinary herbs are typically favored though, mainly because they command relatively high market prices and, like leaf lettuces, they can often be harvested continuously in sprigs without completely removing the plant from the system.

Just as in all forms of agriculture, food safety in aquaponics is of critical importance to the consumer and therefore should also be of the utmost importance to the producer. No matter how small the amount, if an individual is selling food products, that individual is considered a grower and is subject to the levels of professional responsibility that are expected of commercial producers (Hollyer, 2009). Just as in all agricultural practices, health risks to the consumer and liabilities to the producer should always be minimized by carefully following best agricultural practices and standard operating procedures. Because aquaponics involves horticultural production from fish waste byproducts that are converted into plant nutrients by bacterial species, it is understandable that some consumers would be initially hesitant about trusting this production

technique from a personal health and safety standpoint. However, it is vital to recognize that there is a huge difference between the helpful microbes necessary to maintaining the nitrifying action of the biofilter versus the harmful zoonotic pathogens that are transferable from animals to humans, such as *E. coli* and salmonella (Hollyer, 2009). Just as in all forms of agriculture, sanitation is key to minimizing risks, and hands should always be washed prior to harvesting or handling aquaponic crops in any way. In order to prevent the above-ground (or in the case of aquaponics, above-water) shoots from coming into contact with the fish waste water, it is important to never touch roots, grow media, or floating rafts with bare hands during the harvesting or handling plants (Hollyer, 2009). Instead, the harvestable portion of the crops should be handled with gloved hands, removed using scissors or knives that have been sanitized, and immediately placed in a clean and sanitary container (Hollyer, 2009). This way, the edible portions of the plants never even come into direct contact with the fish waste water, and any harmful bacteria that might be coexisting for whatever reason with the beneficial bacteria is never given a chance to contaminate the crop. It is also a good practice to use gloved hands and cover all wounds when handling fish or system water, just to be safe in the event that a microbial contaminate is present (Hollyer, 2009). Also crucial to maintaining a sanitary aquaponics production is making sure to keep up with the removal of any trash or debris that might attract warm blooded pests or vermin to growing, harvesting, or packing areas, as it is these mammals that are known to carry zoonotic pathogens. While not required by any federal or state regulation at the time of this writing, another good idea to assure peace of mind is to have water samples from the aquaponics system tested periodically for the presence of *E. coli* and other human pathogens, which can be done at many research universities or by private laboratories for a very reasonable fee (Hollyer, 2009). These tests are typically standardized and also tend to include tests for coliforms, but it is important to remember that coliforms are not an indicator of food safety risk when it comes to aquaponics, as it is expected that some fish manures will remain in

the system water (Hollyer, 2009). Lastly, when handling any system water or biological components of the aquaponics system, hands should always be washed thoroughly using antimicrobial soap when finished (Hollyer, 2009). Following best agricultural practices and standard operating procedures ensures that aquaponic production is carried out responsibly at all levels and that risks and liabilities are minimized for both the grower and the ultimate consumer.

Overall, aquaponics offers a unique integration of two previously separate agricultural production practices, hydroponics and aquaculture. Aquaponics is notably more sustainable than either of these subsystem components, from the standpoint of water use as well as of nutrient resource consumption, because aquaponics makes use of a waste stream and converts it into an input for another subsystem. Because of its inherent biofiltration and byproduct nutrient recycling, aquaponics is an organic source of hydroponic produce (Diver, 2000), as it requires little to no fertilizers aside from the occasional additive supplements to iron, calcium, or potassium deficiencies. This emerging integrated farming technique offers a clear path forward in the development of urban agricultural production, as aquaponics requires no arable soils, can be practiced indoors or outdoors, and can be designed creatively to take advantage of underutilized spaces.

Chapter 2

Entrepreneurial Team Dynamics in Complex Problem Solving

When one contemplates the essence of what entrepreneurship means, it is crucial to keep in mind that practically all business entities exist and work in order to solve some sort of problem. Markets that have space for new innovations exist because outside individuals or entities have problems that need to be addressed with solutions that have not yet been realized. Problems can take many forms, but they are most typically defined as the needs or wants of some end-consumer. Problems can range from the standard complete lack of any existing solution, to simply an inefficiency that can be improved upon, or even the creation of a product-solution revolutionary enough that once the consumer sees the solution, they suddenly identify their current lack of having that product as their problem. In this sense, startup entrepreneurship is defined by practical innovations that must take place in order to solve problems; doing day-to-day business as a company comes later on, in learning how to leverage and sell a company's solutions to those targeted individuals who have the identified problem, namely marketing and selling to the target customer. The problems of today are often complicated and nuanced, and so they require complex problem solving business strategies. While singular individuals can inarguably solve problems, it is inevitably coherent teams of individuals working together that are usually best equipped to most readily solve contemporary complex problems, regardless of the specifics of the issue.

GreenTowers, LLC would be unable to function as an agricultural product company that works to provide technology-based solutions without the collaborations of various individuals, as well as with exterior entities. The limited liability company was co-founded by six members who were all full-time students and who all came from differing personal and academic backgrounds,

with majors that included biology, mechanical engineering, horticulture and landscape contracting, finance, industrial engineering, and architecture. It has been the experience of GreenTowers that including individuals with different backgrounds adds enormous value to the company as a whole. Complimentary skill sets allow necessary tasks within the company to be assigned in a manner which is already obvious, given individuals' particular skill sets, minimizing dispute and loss of time (see Appendix A, GreenTowers, LLC – Operating Agreement, pg 14, section: Members d) Board of Directors' Role(s) and Responsibilities). Complimentary skill sets also bring to bear variability in business and creative perspective that cannot be overemphasized in the value that they provide.

While providing inclusion in the creative process is important to making the most of company members' individualized perspectives and skill sets, it has also been the experience of GreenTowers that task delegation is absolutely critical to getting work accomplished, especially in a timely manner. This point seems obvious from an employment perspective, but it can often seem at first to be incredibly tricky when working in an entrepreneurial startup situation in which members tend to view one another as friends as well as business partners, which can lead to confusion as to who wields overruling authority within the group. It is a critical lesson gleaned from having taken the leadership role as President of a startup LLC that straightforward task assignments are unquestionably crucial to maintaining all members' work ethics at their optimum levels. Members having a clear understanding as to which tasks are theirs to execute gives them individual autonomy and creativity in devising solutions to those issues, and that autonomy fosters members with a sense of ownership over their work, producing results that represent their best work.

There are plenty of criticisms out there for hierarchical top-down organizational management, but one way or another in any business organization, authority of task assignment needs to come from somewhere in order for tasks to be accomplished (be that some diffused,

democratic or collective authority, or a traditional singular authority). The President can have the guiding vision for the company, but without being able to communicate his or her intentions as well as leverage the talents of his or her partners, vision alone does not translate into execution that produces actionable results. This lesson is straightforward and perhaps even a seemingly obvious one, but it is a lesson that can be learned the hard way in startup organizations that collectively decide to operate their task delegation too far outside the boundaries of structured roles. For GreenTowers, LLC it has been strong organizational management that has so far bred the highest quality and the most creative results from the company's collective goals.

Chapter 3

Business Model Competitions: Structuring Startup Capital and Motivation

GreenTowers, LLC has benefitted enormously over the past two years from the wealth of resources that come from participating in business model and startup sales pitching competitions. As a student entrepreneur, the importance that these competitions can hold for young (and wannabe) businesses cannot be overstated. Being a Penn State student startup, as well as likely a startup with members closely affiliated with plenty of other major research universities for that matter, opens up an abundance of opportunities that otherwise simply would not exist in the cutthroat competitive environment of formulating a startup company, almost regardless of the specific field of innovation.

More so than anything else, business model competitions provide one hugely important asset: motivation. Motivation can take many forms, and obviously startup companies need their members to be self-motivated and intrinsically driven towards getting their business idea off the ground, but the exterior boosts in motivation that competitions supply can be powerful tools to leverage. For one, startup companies (especially student startups) typically have a very small amount of working capital to begin. When there is little or no current revenue coming into a startup business, it can be difficult to tangibly grasp an early startup concept as an actual business, even after the business is officially incorporated and has its first checking account set up. For startups, the incentivize of obtaining a financial reward through participating in startup competitions can be invaluable. Indeed, it was precisely one competition that first networked the GreenTowers, LLC startup team together and provided that initial push, the 2012 Ag Springboard, and agribusiness model competition sponsored by the Penn State College of Agriculture. Because of the potential for a financial prize available, GreenTowers also decided

early on to participate in the Mechanical Nuclear Engineering Innovation Challenge, a Penn State competition whose description might not have fit our value proposition perfectly, but which ended up providing the team with funding critical towards developing our first prototypes. This is not to say that financial incentives alone can or should be the sole motivation for establishing a new business or even participating in startup competitions, but having the financial sustenance required in order to carryout early critical development activities is an absolute necessity for any startup. It has been said that “necessity is the mother innovation,” but having a tangible goal to work towards is also a motivator of innovation.

In addition to the prospect of financial rewards, startup competitions also confer a number of other distinct advantages to participating individuals and teams. GreenTowers has found that chief among these additional benefits here at Penn State are the priceless faculty and mentoring connections and outside networking opportunities that practically always accompany competition participation. To provide a few concrete examples, discussed are some of the networking opportunities that GreenTowers was able to effectively leverage through competition participation.

First was the Dell Social Innovation Challenge in February 2013, a huge international competition in which the team ended as a semi-finalist and received no financial reward; however, through participating with Dell, GreenTowers was specifically invited to partake in the TOMS Shoes Start Something That Matters fellowship in June 2013, in which the team gained insights through working with a specifically paired mentor and also had the opportunity to speak with TOMS CEO Blake Mycoskie. This experience broadened the team’s perception early on about not just the intrinsic rewards but also the common pitfalls and troubles that are associated with building social business models, like B-corporations or financial ties to nonprofits that equitably allocate portions of company profits towards altruistic causes. These early lessons were critical to GreenTowers, as the team was initially very attracted to the prospect of incorporating

our company as a true social business by establishing a financial support relationship in realm of infrastructural or educational development for urban food deserts areas or by enhancing localized food security—these are initiatives that the company still remains interested in pursuing, but that the team now recognizes as distinctly secondary to establishing a profitable revenue stream for the company itself, and which GreenTowers might have the opportunity to reexamine and explore more realistically in the future. A second competition that provided a fantastic networking opportunity was Penn State’s Dow Sustainability Innovation Student Challenge Award, in which GreenTowers placed second in December 2013 and received valuable free publicity as well as gained introduction to representatives from Dow Chemical Company that may be essential contacts in the future. A final competition that led to an amazing networking opportunity was Thought For Food, sponsored by Syngenta in May 2013. GreenTowers was not a finalist in this competition and again received no direct financial reward for our participation, but the following semester the team was invited to join a discussion panel at the Universities Fighting World Hunger Summit and received an all expenses paid trip to Auburn University in order to participate. The subsequent network that we were able to build through meeting other Thought For Food fellows and other attendees at the UFWH Summit has been an amazing opportunity whose financial value is nearly impossible to even quantify.

The last, and perhaps even the greatest, nonfinancial reward associated with all business model competitions is the lessons gained through experiential learning. Whether it is the professional constructive criticisms aimed at the material teams present in the competitions, or simply the reevaluation of business models and assumptions that comes with the critical thinking steps necessary when preparing entries for contests, it has been GreenTowers’ experience that it is impossible to walk away from participating in business model competitions without taking away a few valuable lessons that refine or even completely redefine the focus of the startup. There are of course other avenues, like writing grants or finding an investor that can provide

some form of financial reward as well, but these avenues are a means to a monetary end, and they simply do not confer the same holistic experience that business model and sales pitching competitions do. Even as GreenTowers gets nearer to establishing a true sustainable revenue stream, the company has never stopped participating in competitions and recently submitted an entry into the Agricultural Innovation Prize competition by iStart, which boasts a very sizable one hundred thousand dollar reward to the grand prizewinner. But it is crucial to emphasize that the truest rewards in these competitions is not merely the monetary prizes, but instead the motivations the competitions provide, as well as the value in being forced to question product viability, market sizes and business models, and the immeasurable value gained in meeting new mentors in the forms of academic faculty and business connections.

Chapter 4

Trials and Tribulations So Far: Transitioning from Idea to Business

The rubber really meets the road when the student group or startup project team comes to the realization that they understand their company value proposition and market niche and that the only next logical step is the need to transition from an idea into an actual business. This phase is one in which GreenTowers, LLC is still transitioning through. However, the cofounders also all believe that the company now understands the relevant sectors of the urban agricultural market and is ready to move forward: GreenTowers is an urban agricultural design company that simplifies the experience of participating in small-scale urban farming. Our customers are individuals, families and companies that embrace the local foods movement and desire to grow a portion of their own food themselves, hassle-free, regardless of the location in which they reside or work. GreenTowers provides value with easy-to-use and aesthetically attractive gardening and micro-farming products. The upcoming Living Furniture™ product line allows customers to experience uniquely creative design through using our applied ecological and aquaponics technology products in their homes and offices.

Even though the steps for setting up a legally recognized business are reasonably straightforward, making this transition can seem very daunting, especially to a first-time entrepreneur. This chapter is meant to be especially helpful in the guidelines that it provides for first-time aspiring entrepreneurs in the State College area and Centre region. The steps provided are specific to setting up a Limited Liability Company (LLC) in the Commonwealth of Pennsylvania, but setting up another type of business entity such as a Partnership or S-Corporation are similar in many respects, and the information provided will likely provide some form of guidance to those parties as well. GreenTowers chose to go with the LLC for the

company structure because the LLC provides benefits in terms of both taxation simplicity and asset protection that are a helpful fusion of those offered by both Partnerships and S-Corporations. While a Limited Liability Company provides asset protection just as a corporation can, it is governed by its Members, rather than the shareholders within a corporation. However, the LLC is not subjected to double taxation on both income and assets like corporations are, and the federal government allows it to be classified as a Partnership for the purpose of taxation, allowing for pass-through taxation only on the profits and losses of the individual Members' personal tax returns.

There are five basic steps towards establishing a Limited Liability Company in the Commonwealth of Pennsylvania, four of which are absolutely mandatory and the remaining one^s is highly advisable. They are as follows: checking the availability of and filing for a Fictitious Name in whichever state in which the place of business will be officially located; obtaining an Employer Identification Number (EIN) from the United States Internal Revenue Service; constructing an Operating or Partnership Agreement^s of bylaws by which the company will be governed; filing the initial Docketing Statement with the Department of State; and submitting a Limited Liability Company Certificate of Organization to the Department of State. The above ordered listing is the recommended sequence in which these steps should be executed. Below, each of the above steps is discussed in greater detail in Table 4-1, including online and external resources to establish a Limited Liability Company within the Commonwealth of Pennsylvania.

Item	Filing Agency	Online or External Resource(s)
Fictitious Name	Dept. of State	SEARCH (availability of name in Pennsylvania): https://www.corporations.state.pa.us/corp/soskb/csearch.asp?corpsNav= Download and complete form: 54 Pa.C.S. § 311 (<i>\$70 filing fee</i>)
EIN number	IRS	File and get it online using the IRS EIN Assistant
§Partnership or Operating Agreement	N/A – This is a legally binding but internal-only company document	*Not required by law in PA, but is highly advisable! Reach out to the local Small Business Development Center for pro bono (non-legal) advising: http://sbdc.psu.edu (Penn State SBDC) See Appendix A: GreenTowers, Limited Liability Company – Operating Agreement
Docketing Statement	Dept. of State	Download and complete form: DSCB:15-134A
Certificate of Organization	Dept. of State	Download and complete form: 15 Pa.C.S. § 8913 (<i>\$125 filing fee</i>)

Table 4-1. Pennsylvania Limited Liability Company incorporation resources

A fictitious name is the term used for naming any type business entity and will be the official business name selected by the founders. The first step is to complete an online search to check for the availability of the preferred name. Afterward, the filing of the fictitious name, via completing and mailing in form 54 Pa.C.S. § 311, has an associated \$70 filing fee that must be made payable to the Pennsylvania Department of State, so it is very important to check online first and make sure that the desired entity name is available, otherwise the name will be rejected and the filing fee is wasted and will not be reimbursed. The fictitious name is additionally central to establishing the brand of the business, so care also needs to be taken to ensure that the fictitious name selected communicates an appropriate message for growing the brand that the company will endeavor to embody in the future. Limited Liability Companies in Pennsylvania must have an actual street address associated with the business, even if it is just a residential address—a Post Office Box alone is not sufficient.

Even if a business does not currently have any employees, all business entities must have an Employer Identification Number (EIN) issued by the United States Internal Revenue Service. The EIN is a type of Taxpayer Identification Number (TIN), as is a Social Security Number

(SSN) for personal purposes; so even though the EIN will occasionally be referred to as a TIN, the two acronyms are more or less synonymous for business entities. The IRS has created a very handy online tool called the EIN Assistant that allows an individual to quickly obtain an EIN for their business through the IRS.gov website, rather than going through the back-and-forth paper filing process (see Table 4-1). This saves a significant amount of time and effort, as the user interface of the online EIN Assistant is much simpler to operate than filling out and filing by mail to obtain an EIN from the IRS using the alternative paper form.

While not required by law in the Commonwealth of Pennsylvania, the Partnership or Operating Agreement is an extremely important step to setting up a legitimate Limited Liability Company or Partnership. The Agreement explicitly states the bylaws by which the company will be governed, and aids in resolving any disputes that might arise later on when dealing with issues of Member equity ownership, roles and responsibilities, voting rights, setting salaries, hiring and firing, company dissolution, or Member withdrawal or death. Even though it can feel unnecessary to author legal document for the governance of an entity without any current revenue, setting up this document can save countless hours of painstaking debate or even, god forbid, lawsuits, down the road in the future. For GreenTowers, consulting the local Penn State Small Business Development Center proved to be a hugely beneficial experience, financially and educationally. Ultimately, a business attorney should work with the company to finalize the Operating Agreement, but attorneys are inarguably very expensive consultants to have. While not officially legal counsel, the local Penn State SBDC was able to provide GreenTowers with hours of pro bono assistance in the drafting and editing of preliminary versions of the company Operating Agreement. Only after the SBDC had approved the final draft did GreenTowers approach an attorney to look over and finalize the Agreement. Leveraging the SBDC saved the company a lot of money that otherwise would have gone to legal advise, had GreenTowers not chosen to consult the SBDC initially. Using the local Small Business Development Center is

highly advisable for this reason. Services like this are why the SBDC exists, so making use of those services is a smart resource.

The Docketing Statement is a supplemental form entitled “DSCB:15-134A” that must be submitted to the Pennsylvania Department of State as a cover sheet to the Certificate of Organization. Neither of these forms is required to be notarized, and they must again include an actual street address associated with the company, not a PO Box. The Docketing Statement can only be completed after having received an EIN number, but any changes to the LLC can be revised by refilling another Docketing Statement.

The Certificate of Organization, accompanied by the Docketing Statement, must also be filed to the Pennsylvania Department of State via submitting form 15 Pa.C.S. § 8913 and the accompanying \$125 filing fee. All “organizers,” or the founding members of the LLC, must sign the Certificate of Organization and provide their actual street mailing addresses. Once the Pennsylvania Department of State Bureau of Corporations and Charitable Organizations receives and approves the Docketing Statement and Certificate of Organization, the bureau will mail back a copy of the approved Certificate of Organization accompanied by a form containing an official six-digit Entity Number, and the Limited Liability Company is officially legally setup.

Although the process of setting up a Limited Liability Company in Pennsylvania can seem daunting at first, by following the sequence above and submitting the forms discussed, the process is actually reasonably simple, and it only costs a total of \$195 in associated filing fees for the fictitious name and Certificate of Organization.

As a young company, GreenTowers, LLC has experienced both the positive and negative sides of working with two separate consulting teams: a Penn State senior capstone design team and MSc Management students from Imperial College London, United Kingdom. Both provided learning experiences, but one was definitely more valuable than the other. Both teams were helpful in their intentions, but it must be stressed that readiness to work with consultants is

essential from the company side in order to provide them with enough directionality for their work to be beneficial and meaningful.

In spring 2013, GreenTowers was encouraged to sponsor a team of Penn State Mechanical Engineering senior students for their engineering capstone graduation project, but unfortunately the main takeaway lesson that came out of the experience was essentially that the company's current level of prototyping was not yet ready to take on working with an exterior engineering consulting group. GreenTowers assigned the students to examine the structural integrity of the company's early plans for constructing the very first GreenTowers product concept: a 20-foot shipping container rotated vertically into the air and converted into a vertical aquaponic greenhouse. The mechanical engineers did complete quantified structural analyses, but their findings were undermined by the creative freedom that GreenTowers gave the team in coming up with their design. The engineers' structural plan ultimately required heavy-duty guide wires attached to concrete anchors in order to stabilize the vertically rotated shipping container, which negated the point of turning the shipping container vertically in the first place, which was in order to minimize the container's footprint for spatially constrained spaces. Guide wires and heavy concrete anchors do not work in spatially constrained areas, and the product concept was so unrefined going into the consultation that almost before the engineering team had even finished their capstone design, GreenTowers had already pivoted the product concept, resigned to the technical infeasibility (not to mention questionably safety) of rotating a shipping container vertically into the air. For those and other logistical reasons, GreenTowers moved forward with developing the prototype shipping container greenhouse in the "normal" horizontal orientation, negating the consulting work of the capstone engineering team almost entirely. This was a hard lesson to learn, but it was also a valuable one: do not be coerced or influenced into collaborating with outside expertise or consultants before the company is sufficiently prepared to do so, for whatever the particulars are for project at hand.

GreenTowers also had a very positive experience in working with a consulting group of MSc Management students from Imperial College London (see Appendix C). In contrast to working with the Penn State capstone engineers, GreenTowers was sufficiently prepared to work with the Imperial College London team and thus had a very beneficial experience in working with them. The MSc Management consultants helped GreenTowers to effectively understand the company's identified customer segments, realize new ones, as well as actively decide which segments made sense to target as a startup company. Ultimately, the MSc Management consulting team helped GreenTowers to make an important product pivot, which is discussed in detail in Chapter 5.

Chapter 5

Importance of Embracing the Pruduct Pivot

When GreenTowers first came together as a student project group in fall 2012 in order to form a team to compete in the 2012 Ag Springboard competition at Penn State, the product focus and its target customers were entirely different than they are today. Significantly changing a product's value proposition and target customers is termed a "pivot" and is absolutely crucial for any lean startup company to be willing to do as needed. Key assumptions are often made in the beginning stages of business model development that can turn out to be false when adequate due diligence and market research is applied. A correct product pivot can keep a startup venture on track to success.

GreenTowers began its startup journey by designing a greenhouse built from a recycled shipping container, which was first intended to be a vertical greenhouse but quickly reevaluated and decided to keep in its standard horizontal orientation. It was initially encouraging for GreenTowers to discover that competitors in the recycled shipping container-to-greenhouse space in fact already existed, namely Freight Farms out of Boston, Massachusetts, PodPonics in Atlanta, Georgia, and PharmPods from Denver, Colorado, because these competitors appeared to validate the presumably existing market demand for mobile greenhouse units. GreenTowers saw its own shipping container greenhouse design as strongly differentiated from that of these competitors in two ways. First was in the form of natural lighting, as each of these companies relied solely on artificial lighting and had not removed the corrugated metal siding of the standard shipping container and replaced it with a greenhouse polycarbonate, as GreenTowers had planned to do from the start for design aesthetics. Secondly, each of these competitors utilized solely standard hydroponics as their only method of horticultural production, and our greenhouse

product added significant value in the form of an integrated design for aquaponic production. GreenTowers felt then (as the company still does now) that aquaponic production offers many advantages that distinguish GreenTowers from the competition, including a vast reduction artificial inputs like inorganic hydroponic nutrient salts and water conservation from not needing to dispose of spent nutrient solutions. With our design minimizing mineral waste from artificial nutrient salts as well as reducing electrical waste from artificial lighting, GreenTowers was confident that our shipping container greenhouse would distinguish itself from these market competitors from the angle of sustainability. And perhaps some of these assumptions were and are true, but GreenTowers also overestimated the market size, not to mention the significant logistical challenges, of bringing a product of this scale to market.

The crowd of competitors in this emerging market space proved to be an illusion for a product demand that GreenTowers ultimately realized was not nearly as high as the company initially assumed. When the company was presented with the opportunity in summer 2013 to work with a consulting team of MSc Management students at Imperial College London, GreenTowers had a number of potential customer segments in mind for the shipping container greenhouse product and assigned the MSc consulting team to evaluate each of these customer segments. These initial customer segments included urban restaurants that wanted to grow fresh food onsite, community groups or individuals without access to arable land who desired to setup pop-up gardens to produce food in their neighborhoods, corporate and school campuses that wanted to promote local food or educational initiatives, as well as government or humanitarian groups in that could provide mobile deployment of food production as part of disaster relief efforts. GreenTowers presented these initial theoretical customer segments to the MSc Management consulting team and asked them to help the company with deciding which of these vastly different market segments should become our primary target customers.

Through conducting primary market research in the form of person-to-person interviews and surveys as well as extensive secondary market research, the MSc Management consultants gathered a significant amount of important data about each of these theoretical customer segments and also suggested strategies that GreenTowers should implement for moving forward with the startup company. Results were compiled in their final report presented to GreenTowers in August 2013 entitled “GreenTowers – Customer Segmentation Analysis in a Breakout Market” (see Appendix C). Although construction of the horizontal version prototype shipping container mobile greenhouse was already well underway by the time GreenTowers received the MSc Management consulting team’s report, their results significantly altered the course of the company’s planned trajectory for moving forward with an aquaponics product to bring to market. The MSc Management consulting team specifically targeted and partitioned their survey findings between the demographics of young professionals and baby boomers. Young professionals were defined as working degree-holders ages 18-34, 60% of which already live in privately owned condominiums or apartments and 90% of which in the US lived in or commuted into cities for work. Interestingly, young professionals surveyed indicated that they would on average be willing to increase their monthly rent or service charge by \$30 if there were edible green walls were maintained for them. When asked in team’s survey, “Is knowledge of the origin of your food important to you,” a combined 37% of young professions indicated that food origin was either “Important” or “Very important,” while only 18% said it was either “Unimportant” or “Very unimportant,” and 45% said it was “Neither important nor unimportant.” A slightly greater percentage of those young professionals surveyed (55%) indicated that they would prefer that a living wall was positioned in a communal space and maintained *for them* as oppose to the slightly lesser percentage (45%) who indicated that they would personally prefer to individually maintain their own living wall product.

Baby boomers surveyed by the MSc Management consulting team offered a slightly different story. When baby boomers surveyed were asked about the importance of knowledge of the origins of their food, a full 67% answered that this knowledge was “Very important” to them, while only 33% indicated that it was “Relatively unimportant” or “Very unimportant.” In another question, an even 50% of those surveyed believed that an aquaponic greenhouse or living wall product would increase the value of their property. Additionally, two-thirds of baby boomers surveyed indicated that they currently do not participate in any gardening activities at home, primarily citing having too little time available or the gardening activities being too much work for them to do so.

In addition to the surveys conducted by individuals, the MSc Management consulting team also conducted extensive interviews of representatives from restaurant, catering groups, nonprofits and professional firms throughout the United States and the United Kingdom. What the MSc consulting team ultimately found was that larger organizations, especially restaurants, operate on very small profit margins compared to their sales revenues. In short, the MSc consulting team found that the product size of the mobile greenhouse unit, with a footprint of twenty by eight feet, was simply too large for many of these customer segments.

Obviously there were many crucial takeaways from the findings of this report. Before working with the MSc Management consulting team, GreenTowers had assumed restaurants to be among our most attractive target customers, but the research found that most restaurants operate on such slim profit margins that investment in onsite food production would be a very risky endeavor for most restaurants; even in a 20-foot greenhouse the production capacity to significantly offset most restaurants’ costs of raw vegetable goods simply cannot be met using the single greenhouse. Humanitarian relief providers turned out to be not much of a realistic customer segment either. After all, if a disaster relief organization can pay to ship an entire shipping container full of rice or another high-calorie grain to some location, it would not be

sensible to send instead a greenhouse of the same size that has a primary output of relatively low-calorie leafy greens and herbs. Corporate and school campuses are the two more realistic customer segments for the mobile aquaponic greenhouse, but these customer segments are vastly different from one another, as well as both challenging to attract to an expensive product or market to directly. If an individual or community group (or school or corporation for that matter) were to approach GreenTowers directly and ask to buy a mobile shipping container greenhouse, the company would be glad to work with that customer. But through the process of actually building the shipping container greenhouse prototype, as well as paying the costs and organizing the logistics associated with moving a 20-foot shipping container, GreenTowers was already deterred about the prospect of this particular product becoming the company's first to try to mass manufacture. The MSc Management consulting team findings only served to validate that realization.

Using these results and continued customer and product research throughout the fall 2013 semester and early spring 2014 semester, GreenTowers made its first major product pivot, turning instead towards the consumer market by deciding to design a product of a scale and cost that would be attractive to an upper-middle class urban or suburban resident. The culminating product of this pivotal company decision is the upcoming Living Furniture™ line, which GreenTowers plans to crowdfund the first release of through a Kickstarter campaign this May 2014. Living Furniture™ is the aesthetic integration of aquaponic gardening into utilitarian furniture design. The first in our product line, the Living Furniture Table, features a freshwater aquarium below a glass tabletop as well as a soilless garden at the center of the table, as shown in Figure 5-1. Therefore, besides being an attractive and unique furnishing piece, Living Furniture™ allows the customer to grow leafy greens or herbs effortlessly within their own home or office. Because Living Furniture™ is aquaponic, the plants' filtration diminishes the biggest hassles typically associated with owning a normal household aquarium: cleaning the fish tank and

changing the water. All the customer has to do is feed the fish, or if that task is too much to remember, instead simply purchase an add-on automated fish feeder that does this job for them.



Figure 5-1. Rendering of the Living Furniture™ Table consumer aquaponics product

Because Living Furniture™ has a smaller scale and wider customer base as a consumer product, it now has the capability to be a crowdfunded product—a low risk source of startup capital that definitely would not have been possible if bringing the mobile shipping container greenhouse to market. Crowdfunding is a relatively new form of raising startup capital through websites like Kickstarter.com that allows companies to take preorders to raise revenues upfront in order to finance bringing new products to market.

The original mobile shipping container greenhouse prototype has not outlived its usefulness though either. It is now moving to a local restaurant that has agreed to pay the electrical and water utility expenses necessary to operate the greenhouse, while the GreenTowers team manages the aquaponic production and experiments with yields across a variety of crops. The local restaurant gets the ability to market some of their dishes as prepared with food grown onsite, and GreenTowers gets to put the company insignia and web address on the side of the container to use it as a marketing tool and promote the Living Furniture™ product.

The pivot into the consumer market of providing products that enable indoor aquaponic gardening in residential and office environments broadens GreenTowers' customer base to include magnitudes more potential customers than the relatively large scale greenhouse product would have and also better the chances that this first released GreenTowers product will be ordered in mass and sold by established retailers. GreenTowers' envisions Living Furniture™ retailing in the future primarily at furniture stores, but the product has the potential to also be sold in pet stores, garden centers, as well as online directly through our website or that of another online retail company.

Just like within the mobile shipping container greenhouse market, the indoor aquaponic consumer product market also has its existing competitors. Below is a listing of the other companies and their products that GreenTowers views as the most direct competitors to the Living Furniture™ Table product (see Table 5-1).

Competitor Product	Company / Retail Website	Product Description	Strengths	Weaknesses	Retail Price	Kickstarter Campaign
Aqua Farm	backtotheroots.com/shop/aquafarm	3 gallon tabletop aquaponics	Price (\$60), retailer locations (namely Petco)	Trivially small (nonfunctional size)	\$60	Raised \$248k
Aqualibrium	shop.aqualibrium.com	~10 gallon aquaponics	Aesthetic Design (as far as plastic goes), includes LED lighting	Overpriced given small size & plastic construction	\$629	Raised \$153k
Windowfarms	store.windowfarms.com	Hydroponic vertical planter column	Vertical growth system; cultivates an open-source DIY online community	Very small (four plants)	\$199	Raised \$257k
Aquabundance	theaquaponicsstore.com	Patio aquaponics system	Functionally sized (175 L=46 gallons of grow bed media @ 12" depth), can be placed outdoors	Overpriced, especially given lack of visual attractiveness	\$1,295	N/A - Did not use Kickstarter
Kijani "Smart Aquaponics Garden"	kijanigrows.com	Large system on castor wheels, wooden frame	Functionally sized (55 gallon fish tank + 4'x2' media-based grow bed)	Overpriced given lack of visual design aesthetics	\$949	N/A - Did not use Kickstarter

Table 5-1. Competitive analysis of other small-scale consumer aquaponics product companies

However, none of these competitor companies has integrated their aquaponic system into the design of a furnishing piece, and GreenTowers feels that this differentiates the Living Furniture™ product significantly within the market. Because of this, and because there are no existing patents on this product concept, GreenTowers decided to go through the learning curve of protecting our intellectual property by filing a provisional patent application through the

United States Patent and Trademark Office (see Appendix B). A provisional patent application is not an issued utility or design patent from the USPTO, but rather an undisclosed document filed with the USPTO that legally allows for the use of the “patent pending” status and serves as an official guaranteed twelve month placeholder for defending the intellectual property against infringement by competitors. After the twelve months, if the provisional patent is not carried forward by submitting for a full design or utility patent with the USPTO, the provisional patent simply disappears and the intellectual property is no longer protected. If neither the patent applicant nor the inventor has reported an annual income exceeding three times that of the median United States household income and if neither the applicant nor any inventor or co-inventor listed on the patent application has filed for more than four previous provisional patents, the USPTO allows for provisional patent application filing at a reduced cost via the certification of “micro entity” status on a gross income basis. This reduces the cost of filing the provisional patent application down to only \$65 for the micro entity. GreenTowers had the good fortune of having a patent attorney look over the “Aquaponic Integrated Furnishing” provisional patent application pro bono, and the application was filed on 27 February 2014, giving the company one year to decide whether or not to pay the attorney costs associated with the precise process of filing for a full utility patent from the Patent and Trademark Office. GreenTowers will wait until after the Kickstarter campaign product launch to decide whether it will be worth the financial investment necessary to pursue a full United States utility patent on “Aquaponic Integrated Furnishing,” thereby providing a twenty year protection of the intellectual property and exclusive manufacturing rights the Living Furniture™ product concept.

While only a successful product launch and sustained sales can provide the definitive proof, GreenTowers feels strongly that Living Furniture™ has the potential to make significant market penetration into the emerging indoor personal gardening space. Data from a July 2013 Mintel analyst report titled “Retailers find creative ways to respond to growth in urban

gardening,” shows that a correlation exists between the local foods movement and urban gardening for small spaces. The report concludes that “As more consumers gravitate toward urban living areas, rooftop and other small space gardening is becoming a norm. Products that embrace consumers’ interest in urban gardening are likely to be successful in the lawn and garden market.” The report surveyed two thousand U.S. Internet users aged 18 and older, and asked, “Which of the following best describes your tendencies to buy local goods when it comes to the following food items? (I try to buy local whenever I can [Any food (net); Fresh produce; Baked goods; Meat; Honey, jam or preserves; Cheese or other dairy products].” The report found that “Fresh produce” was the clear frontrunner at 48%, while “Baked goods” followed at 40%, when 62% of the survey respondents said they purchase “Any food (net)” of local foods whenever they can. The report also highlighted Millennials, specifically, as having an interest in maintaining small-space gardens, stating, “Some 30% of Millennials (aged 19-36 in 2013) say they have small outdoor spaces at their home compared to 24% of all adults surveyed.”

A second Mintel research report from April 2013 by John Owen, Senior Household Analyst, titled “American Lifestyles 2013: Five Years Later – Home and Garden,” explores the role of furniture and gardening products in the American psyche through the economic recovery following the global recession of 2008-2009. The report states that consumers are focused on their homes in the aftermath of the recession, saying, “The continued strength of the small kitchen appliances and cookware category is an indication that interest in home meal prep and home entertaining remains strong. It also suggests that the idea of the kitchen as a gathering place for family and friends is as strong as ever. Manufacturers have responded by emphasizing both functionality and design at all price points. Increasingly these products represent opportunities for consumers to express their own personal styles, interests, and skills. Categories such as home décor, lawn and garden products, and patio furniture have also rebounded strongly as consumers have continued to look for ways to personalize their homes. As explored in the Mintel Inspire

trend Objectify, all of these categories may also benefit from growing desire in an increasingly digital world for items that offer a tangible sense of individuality.” In regards to the multifunctionality of the Living Furniture™ as both a utilitarian table piece as well as an indoor garden, the report states, that “there is an overall move to smaller houses and more urban living, necessitating smaller, more versatile furniture and appliances,” and concludes, “While overall spending in the home and garden market dipped in the depths of the recession, many home-related categories now appear to be benefiting from the refocus on home and family that the downturn triggered. As the recovery continues to make halting progress, the emotional role that home plays continues to evolve. Such activities as home meal preparation and home entertainment remain important to consumers for the savings they represent. However, they also represent opportunities to spend on a wide variety of items that enhance the experience.”

Another extensive Mintel research report from May 2012 by Gretchen Grabowski, Travel & Leisure Analyst, titled “Lawn and Garden Products,” further highlights the connectivity between small space urban gardening, healthy eating, and Millennials and young families. The report states that gardening provides more opportunities for healthy living, elaborating that “Americans are looking for more ways to balance their budgets and become health conscious, and as such are increasing the amount of time they spend preparing and eating meals at home. The lawn and garden products market—namely gardening—may become increasingly significant to home cooks as a way to incorporate healthy, fresh produce into their meals.” While not an outdoor product, the report also makes an interesting conclusion relevant to Living Furniture™ as both a timesaving and *non*-DIY product, stating, “Lawn and garden product manufacturers and retailers face a challenge of convincing outdoor space owners that DIY projects are the better choice. They should consider minimizing the appeal of hired lawn and garden help by introducing more user-friendly, time-saving fertilizers, tools, and gardening kits into the market.” The report finds connections between the younger generation and vegetable gardens, stating, “While

Millennial survey respondents are the most likely of the generation groups to not have any type of outdoor space, more in this generation group than any other have household gardens (44%).

Garden ownership is especially prevalent among young Millennials—those aged 18-24—with 45% of this group saying they have a garden. More Millennials grow fruits and vegetables in their outdoor spaces, and—according to Mintel’s Natural and Organic Food and Beverage: The Consumer—U.S., November 2011— they also have a tendency to live in households where someone consumes natural or organic foods and fresh produce. Considering these data along with those showing Millennials are generally more experimental in their cooking and grilling habits, retailers should explore new ways to target young adults” and that “as outdoor space diminishes, the propensity to grow grass is replaced with flowers, plant containers, and edible plants. Fewer respondents with small outdoor spaces than average are growing grass and shrubs in their outdoor spaces. However, they surpass other respondents in their rates of growing flowers and bulbs (65%), plant containers, vegetables, herbs, and fruit.” Relevant to GreenTowers mission of designing products for urban agriculture as well as the company’s location in State College metropolitan area, the report states, “Mintel’s survey data show that, overall, more respondents have household yards, lawns, or gardens than any other type of outdoor space (79%). However, the propensity to maintain other types of outdoor area—like small-space balconies, window boxes, and sunrooms or solariums—increases among Northeastern and urban dwellers. Households in the Northeast are the least likely of any region to have a yard, lawn, or garden (75%), and urban households are more likely to have small spaces (26%).” The graph below (see Figure 5-2) taken from the same Mintel report surveyed 1,802 internet users aged 18 and older who have an outdoor space or window box at home, and asked, “Which of the following, if any, do you grow in or around these [small] spaces?” The report defines “small spaces” as “balconies, window boxes, and sunrooms/solariums.” Even though Living Furniture™ Table is an indoor product (so technically applicable only in sunrooms/solariums without artificial supplemental

lighting), the Figure 5-2 data is interesting, as GreenTowers customers would be able to cultivate some leafy vegetables and/or floral plants as well as herbs.

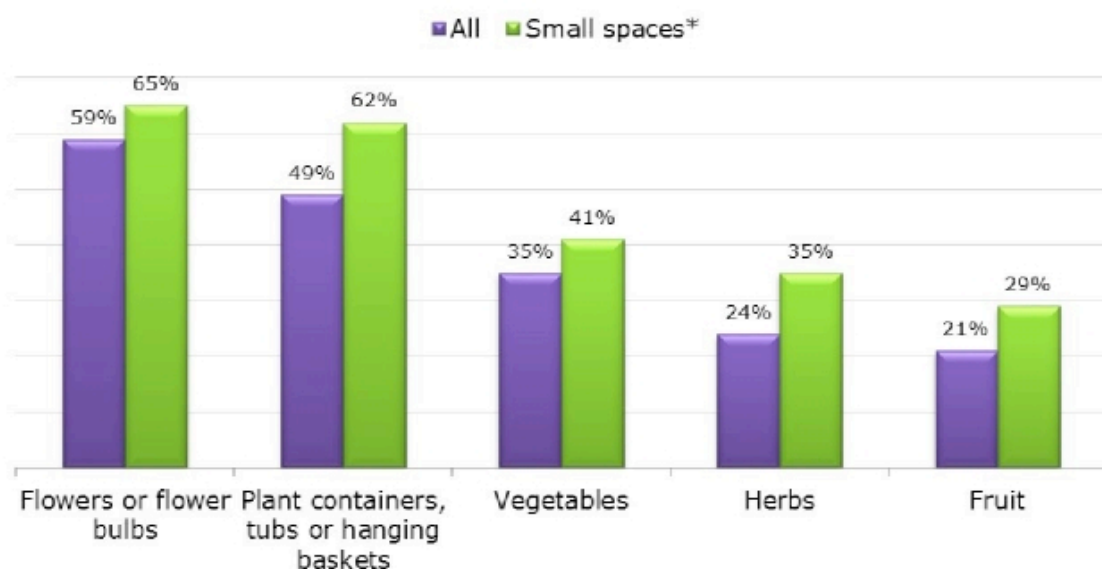


Figure 5-2. From Mintel Lawn and Garden Products - US - May 2012, “Items grown in household outdoor spaces, by household outdoor small spaces, January 2012”

In the same May 2012 “Lawn and Garden Products” Mintel report, correlation is drawn between urban small-space gardening and greater consumer spending as well as greater online sales. These correlations are important to GreenTowers, as Living Furniture™ will not only be small-space, but also higher price-point than many other gardening purchases, and also have online sales taking place through the company website and potentially other online retailers. The report states, “Most purchases [are] in store, but urbanites and small-space owners are shopping online,” and, of the 1,708 Internet users aged 18 and older who have an outdoor space or window box at home and who grow plants, “respondents who live in urban areas and those who have small outdoor spaces are more inclined to make online lawn and garden product orders than average (56% and 57%, respectively).” This data is illustrated below (see Figure 5-3) in a graph taken from the report, where survey takers were asked, “Thinking about where you purchased

your lawn or garden supplies (soils, plants, tools, etc.) in the past 12 months, please indicate where you bought these items in store/online?”

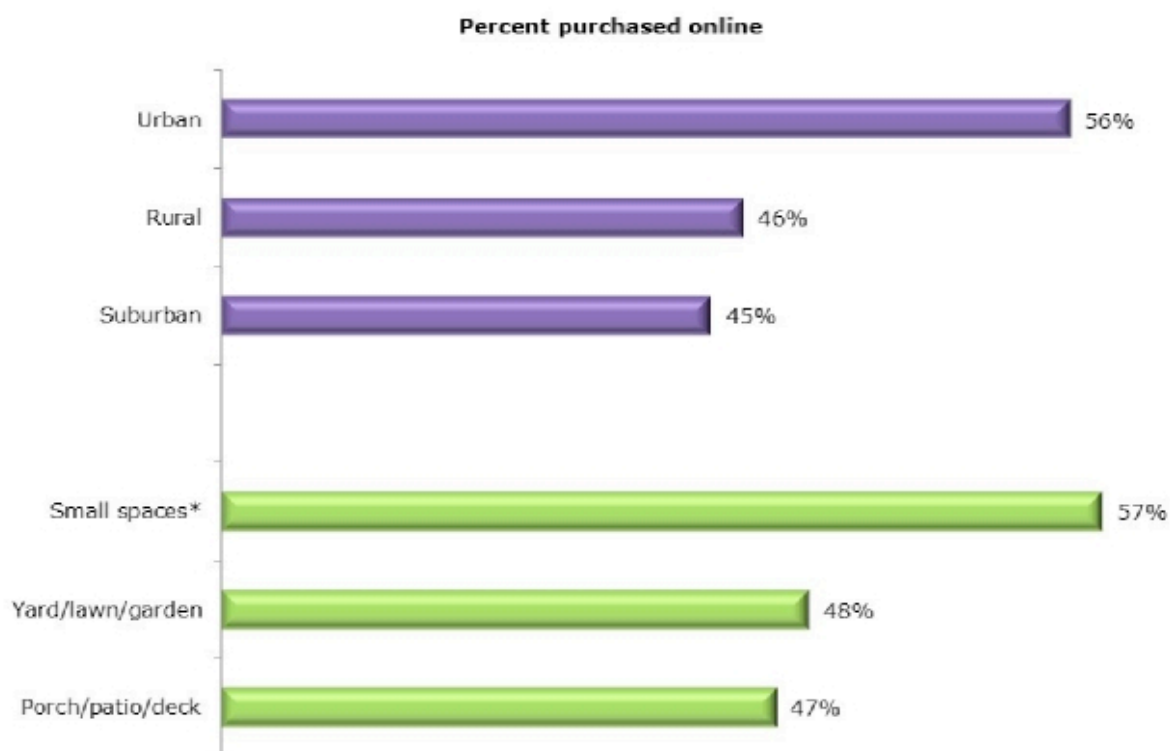


Figure 5-3. From Mintel Lawn and Garden Products - US - May 2012, “Online lawn and garden purchases, by area and type of outdoor space, January 2012”

This May 2012 “Lawn and Garden Products” Mintel report highlights in its key points, “respondents are growing a more diverse array of items in small spaces than they are in any other type of outdoor space. More small-space gardeners are growing flowers and bulbs (65%), container plants (62%), vegetables (41%), herbs (35%), and fruit (29%) than the average respondent with outdoor space. Keeping this in mind, retailers can advertise more diverse small-space gardens as a way of motivating urban dwellers to make lawn and garden purchases,” and, as “Millennials and parents are more likely than older generations and non-parents to grow fruits, vegetables, and herbs, these results indicate that outdoor lawn and garden maintenance can be well-positioned as activities for young consumers and young families.” The report’s executive summary concludes, “While the market for lawn and garden products is poised for growth,

manufacturers must continue to develop new products that cater to Americans' changing living environments and personal health priorities. Opportunities may exist in marketing a wider variety of healthy produce, environmental products, and small-scale gardening kits that make gardening both indoors and outdoors easier and more recreational.” This conclusion obviously points to clear market potential for the Living Furniture™ line, as the product organically produces healthy foods, would resonate and be marketable as an environmental product, and would provide a unique space for small-scale indoor gardening.

GreenTowers has embraced the product pivot, and believes that the ability to do so is absolutely necessary for lean startup companies in order to catch wind of market trends and establish companies early on by bringing to market products that actually meet market demands. GreenTowers believes that the Living Furniture™ Table product will allow the company to take advantage of emerging market trends, in a way that the initial mobile aquaponic greenhouse product simply did not.

Chapter 6

Refleitions on Possibilities for Future Innovations in Designed Ecology for Agricultural Systems

Aquaponics is a compelling technology because it represents a deliberately designed ecology functioning as an agricultural system. One could make the argument that many agricultural production techniques rely on some form of ecological connectivity, and this is recognizably true since practically all outdoor agriculture takes place within an open system, not existing in isolation from the surrounding environment. Field mice, white-tailed deer, and birds all are common pests in United States outdoor agricultural production systems, but these animals are typically considered not to be a part of the system itself, but simply organisms intruding into it as pests, out of place from their designated proper habitats in the surrounding environment. This is of course a complete oversimplification, as all sorts of organisms exist within the framework of agricultural systems—just as in nature, their manures fertilize the environment, their perceived nuisance as pests can also lead to seed dispersal, their grazing and treading upon plants and soils can visibly alters landscapes, and their countless other interactions within human systems all have consequences. But aquaponics is fairly unique in that it represents a functional agricultural ecology with in a *closed* system. This might be partially because aquaponics is often (but not always by any means) practiced as an indoor production system, but unlike the consciously sterilized and antiseptic environment of traditional hydroponics or fertilized greenhouse production, aquaponics derives its strength from the compounding biological interactions of organisms within the system.

It is a principle of ecology that diversity begets stability, and within aquaponics this principle is clearly demonstrated agriculturally. An aquaculture system or a hydroponics system

alone does not mimic an ecological system because both require not only resource inputs, but also the continual removal and outside disposal of wastes in order for these systems to perpetually function. But when aquaculture and hydroponics subsystems are combined, together with the integration of a bacterial nitrifying biofilter, the aquaponics system becomes a polyculture that much more closely resembles an ecological system.

To be sure, aquaponics does not demonstrate a completely closed system, as inputs are still required in the form of energy and fish feed and some corrective nutrient additives, and outputs are harvested and removed for human consumption outside of the system. But aquaponics undeniably more closely resembles an ecological system than either of its subsystem components alone, and further stability and resilience can be derived by the addition of other organisms to the system (Bernstein, 2011). Red worms *Eisania fetida* can be introduced into media-based hydroponic grow beds or biofilters and once there will perform their inherent heterotrophic saprophagous function of consuming decaying organic matter and fish manures, removing those waste and returning richer more soluble and biologically available fertilizers to the system, thereby strengthening it. Crayfish, from the Cambaridae family in eastern North America, are also generalist feeders, freshwater crustaceans that can be introduced below the hydroponic rafts of deep water culture aquaponics systems, where they will feed on broken-off vegetable roots, unconsumed fish feed, and other organic byproducts, thereby adding resiliency and another potentially edible output to the system. Duckweeds of the Lemnoideae subfamily are free-floating freshwater aquatic plants that are high in protein and can be introduced into aquaculture tanks, providing not only protective shade for fish, but also absorbing excess nitrates, providing a naturally-regenerating herbaceous protein supplement to fish diets, and cutting down on photoautotrophic algal growth, thereby strengthening the system. Black soldier fly *Hermetia illucens* are detritivores that can be easily cultured in the solids waste removed from an aquaponics swirl filter, and when harvested as larvae (referred to by the acronym BSFL in

industry) can provide yet another high-protein and calcium-containing feed supplement to aquaculture fish species. In this way, for every additional species that can be integrated into an aquaponics system, the added diversity begets greater stability. With greater diversity and stability also comes greater sustainability: inputs can be reduced as waste outputs are converted into reusable resources for other biological components of the system. Aquaponics provides a baseline model of a semi-closed-loop agricultural system that then becomes a branching point for the integration of other organisms that can work together to functionally generate greater sustainability for the designed ecological system. Many of these ideas and principles are notably recognizable themes in the horticultural sub-discipline of permaculture, in which existing landscape adaption for the permanent sustainable polyculture of dynamic crop production is among the goals.

Putting aquaponic integration aside for just a moment, the aquaculture industry alone lends itself well to the prospect of implementing improvements in food production sustainability. Compared to other commonly consumed sources of protein in Western diets, including poultry but especially pork and beef, aquaculture is extremely sustainable in terms of fish species' protein conversion ratios, of being able to efficiently turn their feed mass into body mass. Another huge facet to consider is the rapid growth of the aquaculture industry. From 1970 to 2008, the production of edible fish derived from aquaculture increased at an average annual rate of 8.3%, compared to an average population growth of only 1.6% annually, and during the same time period the global per capita consumption of fish grown from aquaculture increased tenfold, from 0.7kg in 1970 up to 7.8kg annually in 2008 (Chmela, 2012). This represents an increased output in aquaculture production that is approximately three times the rate of increase of total world meat production (Chmela, 2012). In China as of 2008, the world's leader in aquaculture production, an entire 80.2% of edible fish already comes from aquaculture, whereas that proportion drops to 26.7% of fish consumed globally, up from only 4.8% in 1970 (Chmela,

2012). The aquaculture industry is clearly growing rapidly and shows no signs of slowing. One reason for this trend may be attributed to dire necessity—wild oceanic and estuary fisheries are simply being depleted by unsustainable rates of overfishing, and even where regulations are in place, they can be difficult or impossible for the designated authorities to enforce. Even plenty inland species of freshwater fish, usually harvested more recreationally than commercially and often closely managed by government agencies, are still decreasing in population size, as these species are subjected to downstream environmental pollutants and eutrophic contamination as well as biological contaminations in their habitats from nonnative species. Another driver in the growth of the aquaculture industry though is consumer demand, as, particularly in affluent economies, food consumers' growing knowledgeable of environmental abuses are increasingly translating into market demand for edible fish products that are of guaranteed quality and from sustainably managed sources (Chmela, 2012). Through the invention and industry adoption of recirculating aquaculture systems (RAS), in which water is constantly cycled through mechanical filters and returned to the fish (prequel to the technology from which aquaponics is derived), aquaculture as a whole has become significantly more sustainable over the past few decades, recycling up to 99.75% of RAS water use (Chmela, 2012). Just as conventional RAS technologies allow for the conservation and reuse of water, rather than discharging it directly into the environment or down the drain, aquaponics and the integration of utilitarian subsystems can perform ecological roles to further negate the discharge of additional waste byproducts. Using these instead as resources and inputs for other biological (and especially agricultural) subsystems and (literal) feedback loops within the production system is sustainably biological, and can result in added economic benefits for the grower.

Chapter 7

Urban Potentials for Vertical Implementaiton and Cityscape Integration

The greening of urban areas through the design and construction of green roofs and green walling applications is not a brand new idea, and is already being done widely in cities and suburban areas all around the world. While this industry is not in its early infancy, it is still young enough for startup competitors to innovate new products and solutions to establish themselves within the space. For example, many of the currently existing green walling projects and products available are designed solely for ornamental display, not for the production of edible or otherwise usable crops, and most of the technology employed currently utilizes only traditional soil planters or hydroponic applications, not designed ecological technologies. However, urban agriculture has already entered into the public discourse and lexicon, and the growth of this industry will undoubtedly be accompanied by countless improvements in product design and system sustainability.

Urban agricultural technologies that make the most efficient use of maximizing productivity within the framework of existing limited square footage and from available resources are likelier to be more widely implemented in spatially constrained cities. Today, the notion of the futuristic vertical farm growing massive quantities of food within the city is a widely recognized concept (Despommier, 2010). Constructing such theorized vertical farming buildings for urban production of food would confer many advantages, including finely adjustable climate monitoring for the control of year-round plant production, vast reduction or complete elimination of the need for pesticides and herbicides within isolated indoor environments, simplified onsite farm processing and packaging distribution, and structural integration of smart water capture and reuse technologies (Despommier, 2010). However, the startup cost of constructing a brand new vertical farming building dedicated more or less exclusively to food production would

undoubtedly have a large associated real estate and construction startup cost and would likely take many years before its profitability broke even from the initial expense. For this reason, implementation of urban agriculture that instead makes use of existing city infrastructure, termed reintegration, has fewer barriers to successful execution for the immediate future (Gorgolewski, 2011). Projects that can help demonstrate a progressive approach to agricultural reintegration by forging cooperation with city zoning and construction code offices will expedite further adoption of similar technologies in the future.

Unutilized vertical space exists everywhere in cities, and green-walling technologies will continue advancing to make economic use of these spaces. Vertical space is widely prevalent on the façades of existing buildings, from three-story apartment complexes in State College to towering skyscrapers in Philadelphia. On a smaller scale, and that also happens to already be climate-controlled, the interiors of windows provide yet another opportunity for vertically designed growth systems, as demonstrated by the Windowfarms project in the American Museum of Natural History in New York City.

Unutilized rooftop spaces are also prevalent in the established built environment, and technologies that effectively make use of these spaces, either directly as green roof production or indirectly in sustainable storm water management, will likewise be critical to advancing urban agricultural reintegration. Green roofs that are agriculturally productive would be an excellent addition to any unused rooftop, as they can sustainably manage storm water as well as reduce heating and cooling costs, but structural load bearing requirements make these relatively large scale projects currently quite costly upfront and just not possible for many existing buildings (Gorgolewski, 2011).

Even simple technological innovations that can make logical reuse of other water resources will also be extremely beneficial though, such as separating black water from more easily reusable grey water that does not contain significant coliforms and other zoonotic

pathogens (Despommier, 2010). Showers and bathroom sinks are examples of wastewater sources that have broad potential for reuse in horticultural applications, compared to black water from toilets that contain human fecal coliforms or kitchen sinks where raw meats are handled and bacteria is washed down the drain. Even in municipalities in which grey and black water separation is not yet recognized in any legal framework or where even grey water would not be acceptable for use in any type of food production system, grey wastewater resources can still be sustainably reused in the design of constructed wetlands or other ornamental and recreational city landscape elements. Constructed wetlands are becoming increasingly common in urban design, from simple runoff rain gardens around the edges of parking lots to so-called ravine cities, in which a centralized natural water feature or constructed wetland within the city occupies a lower elevation and natural collection point and water is retained and reused in ecological applications (Gorgolewski, 2011). The infrastructural establishment and the legal recognition for separated drainage of grey versus black wastewater management has enormous implications for determining the rate of adoption and specific types of horticultural technologies, agricultural or ornamental, that can be readily and sustainably reintegrated into the design and development of urban environments.

Advances in reuse of city waste can be even more radical than grey from black water separation though. Unlike nitrogenous fertilizers that are largely produced through the fixation of atmospheric nitrogen, most phosphorous used in agricultural fertilizers today are limited resources still mined from localized and increasingly rare mineral deposits. However, in addition to nitrogen, human urine is also an available source of phosphorous, and the recent Green Urine project by the Water Board Amstel, Gooi and Vetch, has demonstrated within the city of Amsterdam, the Netherlands how phosphorous can be safely extracted from human urine for its reuse in horticultural crop systems. Within aquaponics itself is a subsection of individual practitioners who utilize their own urine as a source of elevated nitrogen for the startup

establishment or ongoing function of nitrifying bacteria in their personal aquaponics systems, aptly titled “pee-ponics.” Human urine contains waste nitrogen in the unusable form of urea, but naturally occurring urease enzymes will readily break urea into ammonium carbonate after a short time, the ammonia from which is exactly the same as that excreted by fish gills and therefore usable in aquaponic applications. With toilets already on the market that conserve water by flushing with air or by having two modes for a large versus small flush, it is easy to imagine a separate black water processing unit, perhaps as simple as the addition of added anaerobic septic tanks, that would effectively break human nitrogenous urea into ammonia and then process this raw material for its reuse in horticultural systems. Even with separated septic sump detention, it is obvious that there would be some cultural resistance to the reuse of human excrement almost anywhere, and it is true that even after conventional tertiary wastewater treatment that includes biological filtration, there are known to be small molecules like pharmaceuticals, hormones and endocrine disruptors that make it all the way through this processing and are released into the environment. For this reason, at least during the immediate years ahead while research is still actively being conducted into this area of biological filtration in order to determine the risks, it is likely that any horticultural or designed ecological system that derives inputs from human excrement would necessarily be limited to only the production of an ornamental aesthetic landscape, rather than for an agriculturally productive one intended for human consumption.

A holistic approach is necessary in order for urban agricultural reintegration to be successfully and widely implemented. A “cradle to cradle” methodology is needed, from the economics of inputs and outputs to in the biomimicry inherently required for designed ecology in agricultural systems (Despommier, 2010). As the nineteenth century prevailing attitude towards suppressing the original elements of a landscape within a city’s design has disappeared, it is being replaced by the sensible desire to integrate beautifying natural features where possible within urban design and to build intentional ecologies into the built environment (Gorgolewski, 2011).

A newly constructed office park may soon include a separated flushing and processing system for recycling human urine into fertilizers for reuse in an attractive and biologically productive outdoor rose garden. A centralized aquaculture tank in a renovated apartment building basement may soon provide a convenient heat sink for a new HVAC system and also supply nutrient water for personal low-maintenance hydroponic gardens on the outdoor patio or deck of every apartment tenant. A skyscraper may soon have a two-foot-wide vertical greenhouse affixed to its exterior south-facing façade, providing added building insulation and also letting office employees purchase freshly harvested vegetables daily right after work from their ground floor lobby. Social and cultural reintegration are just as important as physical and technological reintegration for the development of urban agriculture. Members of neighborhood groups or of company healthy-eating programs may divide and conquer the workload to make hyper-local community supported agriculture available right in their own neighborhood or office park. Transforming low-income areas from food deserts into food-independent oases may be more of a matter of education than of cost, and the demonstration of urban agricultural technologies will have a snow-balling effect that leads to their increasing social adoption and prevalence.

The case for urban agriculture and the development of sustainably designed ecological technologies like aquaponics is more than substantial. Whether the main driver is for the mitigation of traditional agricultural pollutants that contribute to climate change, for a more equitable distribution of fresh food availability, or for the strengthening of local community resiliency through greater food independence, the reasons all make sense from both economic and environmental perspectives (Gorgolewski, 2011). At a time when the current industrial food system hides agricultural production and processing from the public view, there is a palpable movement towards supporting smaller scale and local farmers. The clear and obvious extrapolated path forward is to progressively produce more food hyper-locally, in the exact places in which people increasingly reside: cities. Urban agriculture has the potential to shift the food

paradigm from the current passively disconnect consumer towards the engaged co-producer of the future, and technological innovations will lead the way towards accelerating this logical social adaptation and reintegration.

Appendix A

GreenTowers, Limited Liability Company – Operating Agreement

This is a Limited Liability Company Operating Agreement (the "Agreement") made on January 20, 2014.

The Members to this Agreement agree to the following:

Name:

This Limited Liability Company will be known as GreenTowers, LLC (hereinafter the "COMPANY")

The COMPANY:

- a) The Members have formed a Limited Liability Company.
- b) The terms and conditions of their COMPANY will be outlined in this Agreement.
- c) If the Agreement is executed, the COMPANY Operating Agreement will be in effect on February 1, 2014.
- d) The COMPANY will only be terminated as outlined in this Agreement.
- e) The COMPANY's primary place of business will be 244 E Nittany Ave, State College, Pennsylvania, 16801. The COMPANY will remain at this primary place of business through February, 2014, at which point this primary place of business will be reevaluated and may be officially relocated when an office space is obtained.
- f) The COMPANY will be governed under the laws of the Commonwealth of Pennsylvania.
- g) The COMPANY's purpose is to provide design consulting, fabrication and installation services for urban agricultural and aquaponic horticultural systems, as well as eventually design and sale of consumer products that simplify personal food production.

The Members in this Agreement and each Member's relative Ownership Interest in GreenTowers, COMPANY are as follows:

Dustin David Betz : 41%
Michael Francis Zaengle : 10%
Jared Franklin Yarnall : 7%
Jonathan James Gumble : 10%

Daniel Patrick Collins : 7%

Yaleh Asadi : 2%

Remaining 23% will be presently allocated to the COMPANY for reinvestment into the business, but also preserved in order to offer future incentive to bring in new Members or investors at a later date.

Contributions:

The Members will make/have made initial Capital Contributions to the COMPANY totaling approximately:

Dustin David Betz : \$2,000.00 in Capital

Michael Francis Zaengle : \$500.00 in Capital

Jared Franklin Yarnall : \$350.00 in Capital

Jonathan James Gumble : \$500.00 in Capital

Daniel Patrick Collins : \$350.00 in Capital

Initial contributions noted above have already been submitted and invested in the COMPANY via Members' competition(s) participation or personal Capital Contribution.

Costs:

The COMPANY's primary checking account shall reimburse the Managers or Members for all direct out-of-pocket expenses incurred by them in managing the COMPANY. Receipts shall be required for reimbursements that are taken from any and all shared accounts and also must be turned in within 30 days of the purchase in order to receive reimbursement.

Profits & Losses:

- a) The Members will share the net profits and losses of the COMPANY according to the following percentages:
 Dustin David Betz : 41%
 Michael Francis Zaengle : 10%
 Jared Franklin Yarnall : 7%
 Jonathan James Gumble : 10%
 Daniel Patrick Collins : 7%
 Yaleh Asadi : 2%
- b) The Members' profit allocation will be accounted by the Chief of Finance according to the above percentages after the costs of the COMPANY have been paid or calculated according to the above cost percentages.
- c) Profit allocations will be distributed one time per year. Profit allocations will be distributed at some point during the month prior to the end of the fiscal year, i.e. between September 1 and September 30.

- d) Each member will receive 20% of their profit allocation each year from the COMPANY, although percentages greater (or lesser) than the above listed may be distributed according to a majority Member vote. This means that, until a future majority vote among all Members determines otherwise, 80% of all profits will be reinvested into the COMPANY in order to encourage the acquisition of more of the assets that will be crucial to the COMPANY's longterm success.
- e) The Members will only withdraw their profit allocation during the once yearly financial contribution and distribution accounts auditing by the Chief of Finance, not at any time of their choosing.

Members:

- a) The liability of the Members is limited according to the Limited Liability statutes for the Commonwealth of Pennsylvania.
- b) No Member shall be an agent or employee for any other related firm who will compete directly with the Company while remaining a Member in accordance of this Agreement.
- c) The Members' voting authority will be defined by the following unless otherwise stated in the Agreement: All decisions for contract or otherwise will be made based on a majority vote of percent of ownership. Each Member will have the authority based on their percent ownership outlined above in the Agreement.
- d) Board of Directors' Role(s) and Responsibilities:

Dustin David Betz : President and Operations Director:

President and Operations Director leads and executes the operations and handling of the COMPANY's business, as well as evaluating each Member's perspectives in order to synthesize and determine the clearest actions towards successfully growing the COMPANY.

Michael Francis Zaengle : Chief of Artistic Design and Director of Supply Chain:

Chief of Artistic Design leads visual representation of Company's current and concept work for the viewing of the public, media and investors, as well as leads aesthetics in product design.

Director of Supply Chain assigns and executes steps towards managing raw materials throughout the supply chain.

Jared Franklin Yarnall : Networking Agent and Chief Project Development Manager:

Networking Agent handles communication between current and potential suppliers and partners, as well as works to build and maintain overall COMPANY's network presence.

Chief Project Development Manager oversees organization of new connections and the assembly of new resources in order to drive new project creation and refine existing projects.

Jonathan James Gumble : Chief of Building and Construction Logistics:

Chief of Building and Construction Logistics oversees direction of all installations and manufacturing processes as well as manages product built design and materials sourcing and organization.

Daniel Patrick Collins : Chief of Sales and Marketing:

Chief of Sales and Marketing leads client recruitment and communication as well as manages the COMPANY's market presence in all forms of media, including social media and print media.

Yaleh Asadi : Chief of Finance and Business Operations:

Chief of Finance officially manages the COMPANY's accounting, including the once yearly auditing, as well as analyzes data to build financial projections for COMPANY's growth.

Chief of Business Operations leads advising on legal and business matters and records the official meeting notes as required in this Agreement.

Proxies:

At all Member meetings, a Member may vote in person or by proxy executed in writing by the Member or by his duly authorized attorney-in-fact. Such proxy shall be filed with the other Members of the COMPANY before or at the time of the meeting.

Filing of Notices:

The Members of the Company shall be responsible for preparation, maintenance, filing and dissemination of all necessary returns, notices, statements, reports, minutes or other information to the Internal Revenue Service, the Commonwealth of Pennsylvania, the Members of the Company, and any other appropriate state or federal authorities or agencies.

Liability of Members:

All debts, obligations and liabilities of the COMPANY; whether arising in contract, tort or otherwise, shall be solely the debts, obligations and liabilities of the COMPANY, and

no Member shall be obligated personally for any such debt, obligation or liability of the COMPANY solely by reason of being a Member. However, each Member remains personally liable for payment of his, her or its Capital Contribution as set forth in the Act or as otherwise provided in this Agreement. This section does not prevent an COMPANY Member, should they so choose, from separately agreeing to guaranty or otherwise become liable for a debt which is also of the COMPANY.

Indemnification:

The Company will indemnify the Members, Managers, and agents for all costs, losses, liabilities and damages paid or accrued by the Members, Manager or agent in connection with the Company's business and acting in good faith, to the fullest extent provided or allowed by the laws of Pennsylvania.

Accounting:

- a) All accounts related to the COMPANY, including contribution and distribution accounts will be audited once per year.
- b) All Members will maintain a joint contribution account. All Members will maintain a joint distribution account and will keep accurate and complete books for all accounts related to the COMPANY. Any Member, whether majority or minority, will be allowed to review all books of account at any time they request.
- c) Accounting records will be kept via joint COMPANY checking account.
- d) All financial records including tax returns and financial statements will be held at the COMPANY's primary business address and will be accessible to all Members.
- e) The fiscal year will begin on the first business day of October of each year. A year-end Member meeting shall be held within 2 weeks of the completion of the fiscal year's final accounting.
- f) The following Members will be able to sign checks from any joint Member account:

Dustin David Betz
 Michael Francis Zaengle
 Jared Franklin Yarnall
 Jonathan James Gumble
 Daniel Patrick Collins
 Yaleh Asadi

- g) All checks paid from any joint Member account that total an amount exceeding \$1,000 shall require two Member signatures.

Hiring Employees:

Hiring of all employees must be approved by a majority Member vote, in which all Members receives one equal vote. A relevant profile of the candidate for employment will be presented to the Members in order to inform their voting decision.

Setting Members' Salaries:

Members will be permitted to receive salaries. Each Member's salary will be set only by a Member vote, based on Members' equity shares. Members' salaries will be deliberately evaluated once per year at the fiscal year-end Member meeting, but Members additionally reserve the right to adjust salaries on an as-needed basis at any point of the year, pending the same approval upon a Member equity share vote.

New Members:

The COMPANY will amend this Agreement to include new Members upon the written majority vote totaling greater than or equal to 51% ownership interest of the COMPANY, as outlined in this Agreement.

Suspension of Member's Voting Rights:

Should an irrsolvable disagreement arise between the Members of the COMPANY, a Member may have his or her voting rights suspended indefinitely, should all other Members unanimously vote to do so. No Member will have their equity forcibly seized, but should voting rights be suspended, remaining Members will have the right to offer to buy out the suspended Member's equity share, at the price determined by an independent valuation as outlined in this Agreement.

Withdrawal or Death:

The Members hereby reserve the right to withdraw from the COMPANY at any time. Should a Member withdraw from the COMPANY because of choice or death, the remaining Members will have the option to buy out the remaining shares of the COMPANY. Should the Members agree to buy out the shares, the shares will be bought in equal amounts by all Members. The market value of the shares shall be assessed at that time. The Members will have 30 days to decide if they want to buy the remaining shares together and disperse them equally. If all Members do not agree to buy the shares equally, individual Members will then have the right to bid over a period of 60 days to

purchase the shares individually, where the highest bidder(s) purchase the shares. If more than one Member make the same highest price bid to purchase the remaining shares, the shares will be split equally among those bidding Members. If no Members bids to purchase the shares, the COMPANY will allow over a period of 30 days for a non-Member to purchase the shares at market value, thereby replacing the previous Member.

If no individual Member(s) finalize a purchase agreement within this 150 day maximum time period, the COMPANY will be dissolved.

The name of the COMPANY may be amended upon the written and unanimous vote of all Members if a new Member buys into the COMPANY.

Dissolution:

Should the COMPANY be dissolved by majority vote or otherwise, the COMPANY will be liquidated, and the debts will be paid. All remaining funds after debts have been paid will be distributed based on the percentage of ownership interest outlined in this Agreement. An assignment or sale of a Members interest in the Company does not result in the dissolution of the Company. For the avoidance of doubt, the granting of a lien on any amount of Member interest is not deemed to be an assignment.

Liquidation:

Upon dissolution of the Company, the Members shall liquidate the Company's assets and shall do so as promptly as is consistent with obtaining fair value for them, and shall apply and distribute the assets of the Company as follows:

- a) First, to the payment and discharge of all of the Company's debts and liabilities to creditors of the Company other than the Members;
- b) Second, to the payment and discharge of all of the Company's debt and liabilities to creditors of the Company that are Members;
- c) Third, to the Members in accordance with their capital accounts, after giving effect to all contributions, distributions and allocation for all periods.

Amendments:

- a) Amendments may be made to this Agreement after all Members are informed in writing and upon the unanimous and written consent of all Members.
- b) Amendments must be expressed in writing and have the original signatures of all Members.

Settling Disputes:

All Members agree to enter into mediation before filing suit against any other Member or the COMPANY for any dispute arising from this Agreement or in connection with the COMPANY. Members agree to attend one session of mediation before filing suit. If any Member does not attend mediation, or the dispute is not settled after one session of mediation, the Members are free to file suit. Any law suits will be under the jurisdiction of the Commonwealth of Pennsylvania.

Action Without Meeting:

Any action required to be taken by the Members may be taken without a meeting if a consent in writing, setting forth the action so taken, shall be signed by all of the Members.

Choice of Law and Severability:

This Agreement shall be construed in accordance with the internal law of the Commonwealth of Pennsylvania. If any provision of this Agreement shall be contrary to the internal laws of the Commonwealth of Pennsylvania or any other applicable law, at the present time or in the future, such provision shall be deemed null and void, but this shall not affect the legality of the remaining provisions of this Agreement. This Agreement shall be deemed to be modified and amended so as to be in compliance with applicable law and this Agreement shall then be construed in such as way as will best serve the intention of the parties at the time of the execution of this Agreement.

Entire Agreement:

This Agreement constitutes the entire agreement among the Members regarding the terms and operations of the COMPANY, except for any amendments to this Agreement adopted in accordance with the terms herein. This Agreement supersedes all prior and contemporaneous agreements, statements, understandings, and representations of the parties regarding the terms and operation of the COMPANY, except as provided in the preceding sentence.

All Members signed hereto agree to the above stated Agreement. Any and all witness(es) shall not be a party to this agreement.

Signed this 20 day of January, 2014

Signature: Dustin Betz
Dustin David Betz

Witness: Brian Ginnell
Brian Ginnell

Signature: Michael Zaengle
Michael Francis Zaengle

Witness: Brian Ginnell

Signature: Jared Yarnall
Jared Franklin Yarnall

Witness: Brian Ginnell

Signature: Jonathan James Gumble
Jonathan James Gumble

Witness: Brian Ginnell

Signature: Daniel Collins
Daniel Patrick Collins

Witness: Brian Ginnell

Signature: Yaleh Asadi
Yaleh Asadi

Witness: Steven Prasad

Appendix B

Selections from Provisional Patent Application: Aquaponic Integrated Furnishing

PTO/SR/16 (09-13)
Approved for use through 01/31/2014. OMH 051-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2
This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Express Mail Label No. _____

INVENTOR(S)		
Given Name (first and middle (if any))	Family Name or Surname	Residence (City and either State or Foreign Country)
Dustin	Betz	State College, Pennsylvania
Additional inventors are being named on the _____ separately numbered sheets attached hereto.		
TITLE OF THE INVENTION (500 characters max):		
Aquaponic Integrated Furnishing		
Direct all correspondence to: _____		
<input type="checkbox"/> The address corresponding to Customer Number: _____		
OR		
<input checked="" type="checkbox"/> Firm or Individual Name GreenTowers, LLC		
Address 244 E. Nittany Ave		
City State College	State Pennsylvania	Zip 16801
Country United States	Telephone (717) 602-3531	Email dustinbetz@me.com
ENCLOSED APPLICATION PARTS (check all that apply)		
<input type="checkbox"/> Application Data Sheet. See 37 CFR 1.76.		
<input checked="" type="checkbox"/> Drawing(s) Number of Sheets 4		
<input checked="" type="checkbox"/> Specification (e.g., description of the invention) Number of Pages 9		
<input type="checkbox"/> CD(s), Number of CDs _____		
<input type="checkbox"/> Other (specify) _____		
Fees Due: Filing fee of \$260 (\$130 for small entity) (\$65 for micro entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is \$400 (\$200 for small entity) (\$100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).		
METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT		
<input type="checkbox"/> Applicant asserts small entity status. See 37 CFR 1.27.		
<input checked="" type="checkbox"/> Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SR/158 or B or equivalent.		
<input type="checkbox"/> A check or money order made payable to the Director of the United States Patent and Trademark Office is enclosed to cover the filing fee and application size fee (if applicable).		
<input type="checkbox"/> Payment by credit card. Form PTO-2038 is attached.		
<input type="checkbox"/> The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: _____		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">\$65</div> TOTAL FEE AMOUNT (\$)		

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.55. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 10 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.


If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 2 of 2

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.	
<input checked="" type="checkbox"/> No.	
<input type="checkbox"/> Yes, the invention was made by an agency of the U.S. Government. The U.S. Government agency name is:	_____
<input type="checkbox"/> Yes, the invention was made under a contract with an agency of the U.S. Government. The name of the U.S. Government agency and Government contract number are:	_____


WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

SIGNATURE  DATE 27 February 2014

TYPED OR PRINTED NAME Dustin David Betz REGISTRATION NO. _____
(If appropriate)

TELEPHONE 1 (717) 602-3531 DOCKET NUMBER _____

CERTIFICATION OF MICRO ENTITY STATUS (GROSS INCOME BASIS)			
Application Number or Control Number (if applicable):		Patent Number (if applicable):	
First Named Inventor: Dustin Betz		Title of Invention: Aquaponic Integrated Furnishing	
<p>The applicant hereby certifies the following—</p> <p>(1) SMALL ENTITY REQUIREMENT - The applicant qualifies as a small entity as defined in 37 CFR 1.27.</p> <p>(2) APPLICATION FILING LIMIT - Neither the applicant nor the inventor nor a joint inventor has been named as the inventor or a joint inventor on more than four previously filed U.S. patent applications, excluding provisional applications and international applications under the Patent Cooperation Treaty (PCT) for which the basic national fee under 37 CFR 1.492(a) was not paid, and also excluding patent applications for which the applicant has assigned all ownership rights or is obligated to assign all ownership rights as a result of the applicant's previous employment.</p> <p>(3) GROSS INCOME LIMIT ON APPLICANTS AND INVENTORS - Neither the applicant nor the inventor nor a joint inventor, in the calendar year preceding the calendar year in which the applicable fee is being paid, had a gross income, as defined in section 61(a) of the Internal Revenue Code of 1986 (26 U.S.C. 61(a)), exceeding the "Maximum Qualifying Gross Income" reported on the USPTO website at http://www.uspto.gov/patents/law/micro_entity.jsp which is equal to three times the median household income for that preceding calendar year, as most recently reported by the Bureau of the Census.</p> <p>(4) GROSS INCOME LIMIT ON PARTIES WITH AN "OWNERSHIP INTEREST" - Neither the applicant nor the inventor nor a joint inventor has assigned, granted, or conveyed, nor is under an obligation by contract or law to assign, grant, or convey, a license or other ownership interest in the application concerned to an entity that, in the calendar year preceding the calendar year in which the applicable fee is being paid, had a gross income, as defined in section 61(a) of the Internal Revenue Code of 1986, exceeding the "Maximum Qualifying Gross Income" reported on the USPTO website at http://www.uspto.gov/patents/law/micro_entity.jsp which is equal to three times the median household income for that preceding calendar year, as most recently reported by the Bureau of the Census.</p>			
SIGNATURE by a party set forth in 37 CFR 1.33(b)			
Signature			
Name	Dustin David Betz		
Date	27 Feb. 2014	Telephone	1 (717) 602-3531
		Registration No.	
<input type="checkbox"/> There is more than one inventor and I am one of the inventors who are jointly identified as the applicant. Additional certification form(s) signed by the other joint inventor(s) are included with this form.			

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

TITLE:**AQUAPONIC INTEGRATED FURNISHING****DESCRIPTION****FIELD:**

[0001] Embodiments of the invention belong to designed symbiotic ecological systems incorporated into manufactured furniture, and more specifically, to aquaponic systems built into utilitarian interior and exterior furnishings that include a freshwater fish aquarium and hydroponics production module.

BACKGROUND:

[0002] An aquaponic system generally comprises of an aquaculture module, a biofilter module containing a porous substance of high surface area, a hydroponic horticultural production module, and a reservoir module. The aquaponic system performs a semi-symbiotic nutrient recycling mechanism by means of bacterial organisms within the biofilter module converting ammoniacal fish excrement from the aquaculture module into soluble nitrates that are taken up by plants in the hydroponic production module. The aquaculture module is generally comprised of a tank of any size or shape that is used for the rearing and production of any edible or ornamental freshwater fish species. The hydroponic production module is generally configured to be installed on a supporting structure located nearby the aquaculture module and is generally configured to support the horticultural production of terrestrial or semi-aquatic edible or ornamental plants. The biofilter module is generally configured to be below the water level of the aquaculture module such that water flows by gravity through a porous substance of high surface area in which the aerobic bacteria are cultured. These aerobic bacteria are generally comprised of two separate and naturally occurring chemoautotrophic genera, *Nitrosomonas spp.* that oxidizes ammonia into nitrite and *Nitrobacter spp.* that oxidizes

nitrite into nitrate. The reservoir module is generally located below the biofilter module such that it collects the water that drains through the biofilter that empties into it. The reservoir module is generally never to be completely emptied of water because it typically provides the input point for a pump that then transfers water to the hydroponics production module.

[0003] While aquaponics systems are known, prior art systems are commonly constructed for the commercial scale production of economically useful edible plant and fish species. Other prior art aquaponics systems are small scale and designed for stand-alone or tabletop residential usage. However, such small scale residential systems are generally too small to supplement even the diet of one individual to any significant extent and so generally act as more of a novelty item than they serve any practical purpose. Accordingly, there is a need for a residential scale aquaponic system that serves a utilitarian purpose more so than that of a simple novelty.

SUMMARY OF THE INVENTION:

This Appendix B includes only a deliberately incomplete version of this provisional patent application. This is done purposefully, because the United States Patent and Trademark Office never publicly discloses a provisional patent application—a provisional application is only an official placeholder for a patent pending invention, giving the inventor twelve months to decide whether or not to file for a full utility or design patent. Furthermore, keeping a provisional patent undisclosed is crucial to retaining its leveraging value as intellectual property. For example, if I were to approach another company or competitor and disclose that I have filed this particular provisional patent within the consumer aquaponics product space, it is to my advantage to be vaguely broad enough in my descriptions of the claims of my invention that the other company cannot simply “invent around” my own provisional claims, thereby circumnavigating my intellectual property. Because I expect this thesis to become publicly available within twelve months, I am therefore choosing to show this provisional application only in part, rather than in its entirety as filed with the USPTO.

BRIEF DESCRIPTION OF THE DRAWINGS:

[0009] The above and other aspects, features and advantages of the embodiments of the invention will become more readily apparent by way of example in the following detailed description, reference being made to the figures of the accompanying drawings in which:

FIG. 1 is a frontal schematic perspective view of the invention in its embodiments.

FIG. 2 is a rear detail view of embodiments of the invention, wherein the process and directionality of the pump and plumbing systems, mechanisms, and so on is clarified.

FIG. 3 is a cross sectional detail view of embodiments of the invention, wherein the plant root zone organization and water movement within the hydroponic horticultural production module is clarified.

FIG. 4 is a detail view of embodiments of the invention, wherein coupling channel attachment modules for attachment of accessory module is clarified.

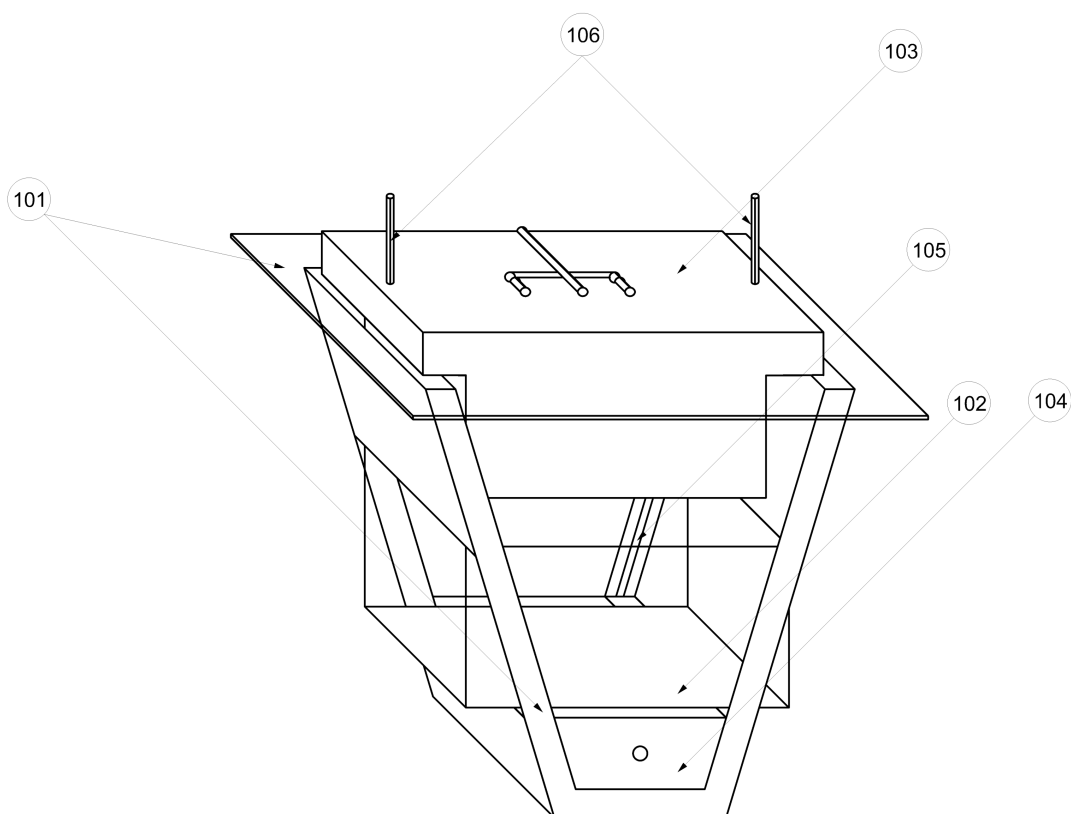


FIGURE B-1. Frontal schematic perspective view of the invention in its embodiments

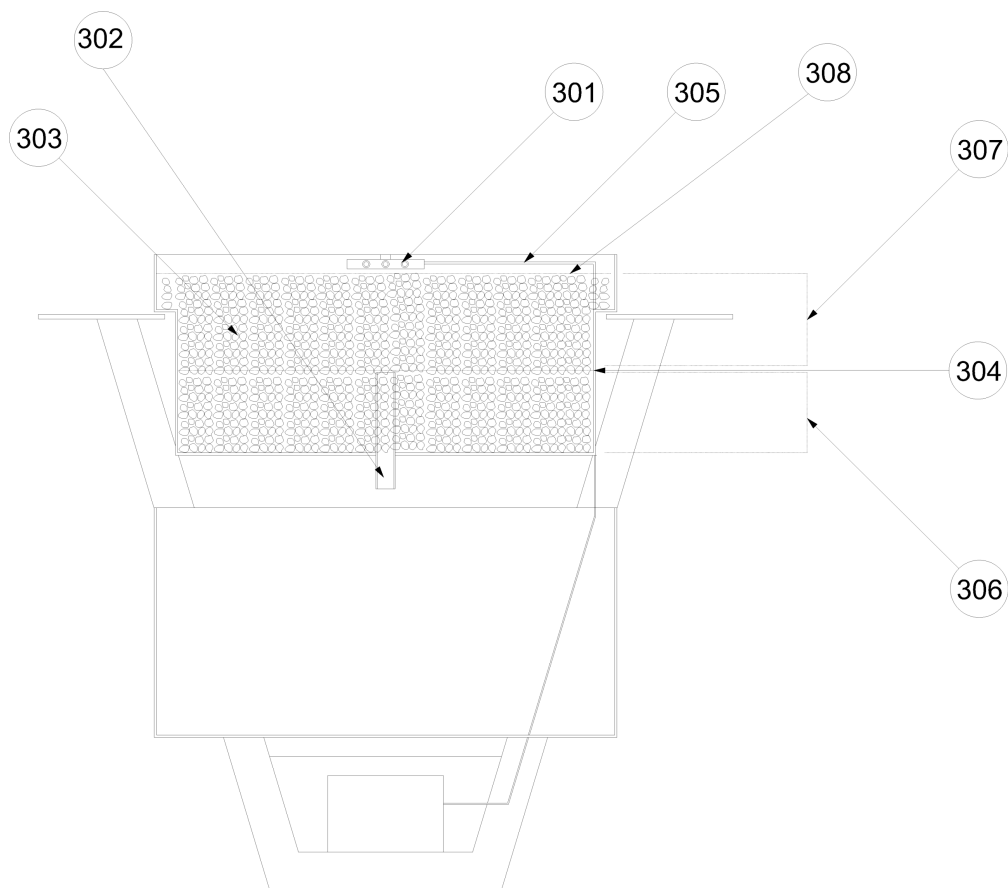
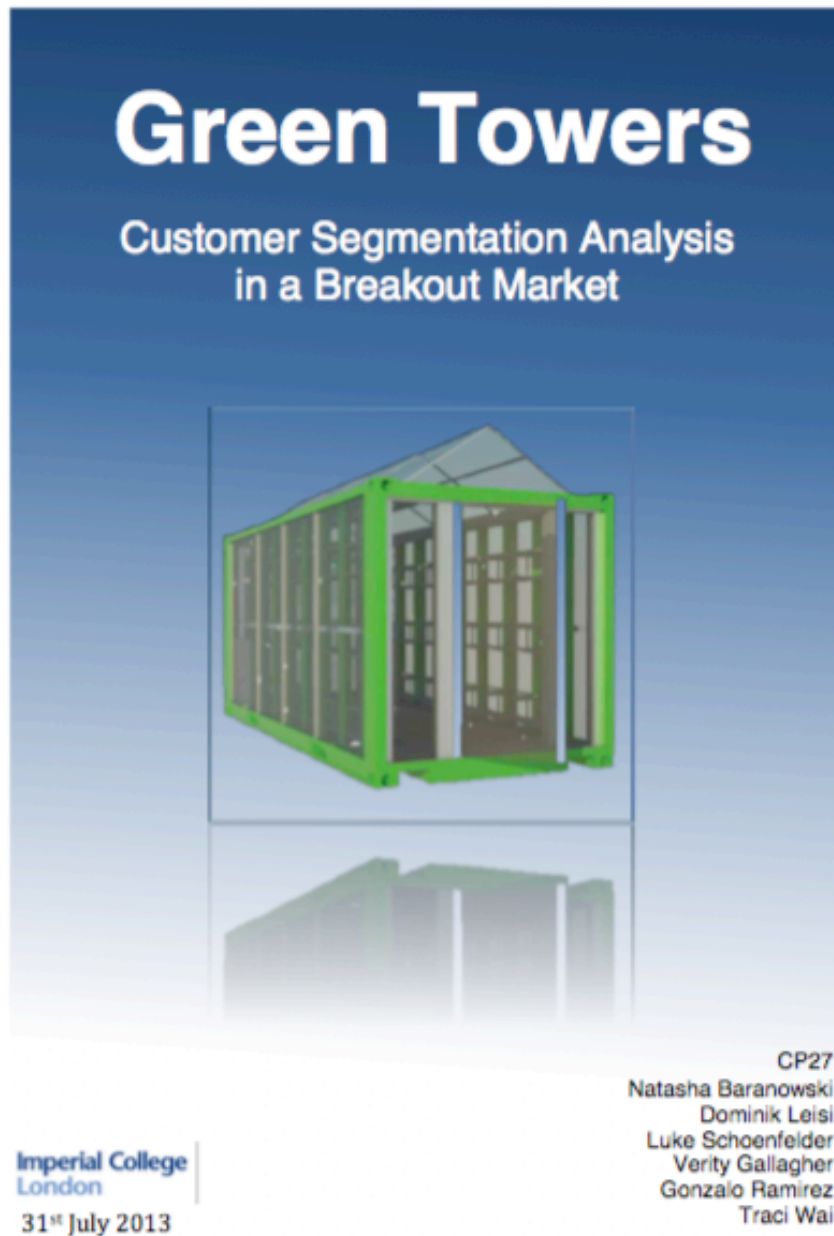


FIGURE B-2. Cross sectional detail view of embodiments of the invention (Note: labeled as “FIG.3” in the above provisional patent application section, titled “BRIEF DESCRIPTION OF THE DRAWINGS”)

Appendix C

Imperial College London Consulting Report: Customer Segmentation Analysis in a Breakout Market (excluding associated document Appendices)



Executive Summary

After careful review of Green Towers' product offering, our top recommendations are simple and quick to implement. We propose the company adopt a timeframe that would ensure it strategically targets each market segment only when it is likely to be most responsive. This allows the team to gain exposure within the industry and build on its experience. Furthermore, it ensures that the company does not spread its resources too thinly across different segments, competing with businesses with more established products and relationships. A slower but more niche approach would help Green Towers to build a reputation as well as specialise in installations that would differentiate themselves from competitors. Both primary and secondary market research identified individuals, specifically baby boomers and young professionals, as an initial target due to a growing inclination to invest in new hobbies, disposable income and desire to lead healthy lifestyles. It is encouraging that both groups of individuals make up a large and growing market and are easy to approach.

Furthermore, interviews and surveys with potential client groups indicated a strong preference for products that come with design consultation and customisation services. This is especially vital if Green Towers are to consider establishing relationships with condominiums and developers. These services add to the customer experience of the products and are especially meaningful for a company seeking to make a social impact. By building personal relationships with customers, the company raises its visibility within communities and is likely to see the company promoted through word-of-mouth. This is particularly significant in reaching baby boomers, who are highly responsive to exceptional customer experience as well as personal recommendations from peers. We therefore recommend that Green Towers invest in extending its product offerings by including consultation and hardware design customisations services to its portfolio. In doing so, the company would position itself as a design oriented firm that could provide aquaponic systems as not simply a lifestyle product, but equally as a solution for cutting costs in restaurants, for example.

Parallel to marketing to individuals, Green Towers could target food trucks on university campuses that are currently used to reach students in peripheral areas. Offering food trucks as a means for growing some of their produce may help them cut costs, particularly if they were to grow the herbs they use. The installation could also serve as a unique feature that attracts customers.

Restaurants, though they make up an important market and may appear to be an attractive segment to target from the start, we recommend that Green Towers approach restaurants only once it has enlarged its portfolio to include hardware design and consultation services. This is important as restaurants do not often have the space for a greenhouse and are likely to prefer a living wall that is adapted to their needs. Design here is crucial, but it is also vital that Green Towers shows restaurants the cost gains of having an aquaponic system to grow certain produce as most restaurants maintain very low profit margins.

As a social business, we understand that for Green Towers making a difference within communities is fundamental. We therefore propose that the company adopt a revenue-dependent social contribution so that all revenue making activities contribute to its social impact. Moreover, it gives the business the flexibility of providing services that add the

most value. To reach this segment, we recommend a two-phase approach that sees the company reach individuals in need both within the United States and abroad. Starting locally within Pennsylvania, we suggest Green Towers approach the national SNAP programme managed (for Pennsylvania State) by Penn State University, which would allow it to assist the initiative in raising awareness about nutrition and gardening. At the same time, contributing greenhouses to schools within low-income communities would help instructors teach students about healthier choices but also provide students with the experience of gardening. The produce from the greenhouses could then be sold as a means of raising funds for activities that are not subsidised. In the long run, Green Towers could approach Native American Reservations where poor nutrition is common and there is a lack of viable space to grow food. Internationally, the company would add value to communities in urban slums as well as refugee camps by offering design and consultation on products that would account for space and water issues within these environments. Interviews with experts also suggest the use of container greenhouses as seedling labs for farmers whose crops have been affected by disaster as an effective component in reconstruction efforts.

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31.07.2013

1. Background

Four key segments were demarcated as fitting target markets at the initial consultation; individuals, corporate offices and campuses, restaurants and humanitarian response. The scope and viability of each segment for both the converted shipping container greenhouses and living wall systems were reviewed and rated based on both secondary research and consultation with industry experts and preferred witnesses. The following report explores the market potential of both products for each of the named segments before offering recommendations on strategic positioning and promotion.

31.07.2013

2. Product Portfolio

Our preliminary investigation identified "Individuals" as too large a segment to reach for both products. A cross sectional analysis of potential customers based on purchasing power, interest and activities revealed two underlying groups of individuals that would act as favourable targets: baby boomers and young professionals. Narrowing the pool of individuals would ensure that products are customised to suit the needs of each market, and marketing material is adapted to maximise sales potential and differentiate the products from the competition.¹

Findings suggest that Green Towers would favourably gain from extending its product offering to include knowledge-based services including a consulting service and hardware design customisation services. This would enlarge the company's portfolio and allow the company to better serve each segment. Though the company does already indirectly offer consultation with regards to installations, listing the service as an offering not only attaches a fee to it, but also allows Green Towers to potentially specialise in certain types of installation (i.e. heritage buildings or small spaces). This further helps the company differentiate itself from competitors by building unique skills, while equally enriching the customer experience of installing either product.

In order to make this happen, Green Towers would need to broaden its skill set, ideally by adding a designer, landscape architect and potentially a structural engineer to their team. This would allow the company to ensure technical feasibility when working with bigger clients and help the company exploit existing expertise and knowledge on aquaponic systems and technology so that its revenue is not only dependent on product sales. This, furthermore, would help the team stay creative, expose them to a variety of projects and present the company as one that is solutions based.

It is important to note that competitor research revealed that living walls as value increasing home installations are currently in the introductory phase of the product's lifecycle, providing the potential to benefit from premium prices and lower financial risk.² As such, we recommend Green Towers to focus on:

- Rapid time to market
- Keeping the product basic and engage in R&D over time
- Obtaining an optimised production process
- Integrating horizontally and absorbing competitors

As a lifestyle product, it is crucial that Green Towers markets the experience of owning each product. Not only does this promote aquaponic systems and their benefits, it equally allows the customer to see how easy it is to maintain and how a system would add value to real estate as a unique feature to a home that decorates and promotes better living. To see this through, we would recommend that the company take advantage of showroom installations to help potential customers visualise the product and experience having it in their homes.

Besides featuring the Green Towers products in showrooms, we would recommend that the company adopt a more business like website where the prime focus is on the unique features and design of each product. The blog could then be attached to the website,

¹ For a full list of competitors, substitutes, and new entrant threats see Appendix IV.

² Global Marketing: a decision-oriented approach p. 465

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providing an opportunity for customers to see the decisions being made behind the scenes as well as the teamwork and collaboration involved in the production of every unit.

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3. Current Product Portfolio

Both young professionals and baby boomers represent segments that provide good market launch opportunities.

3.1 Young Professionals

Both the greenhouse and living wall could be sold to this segment depending on spatial limitations. However, preferred witness interviews with two architects³ state that, in urban condominium housing, living walls provide greater flexibility.⁴ It is recommended that herbs are grown due to their high cost in shops, their speed of growth and the limited quantity required for a single serving.⁵

Target Market: Why Young Professionals?

Young professionals⁶ are a fast growing segment, currently making up 30% of the US "professional"⁷ workforce.⁸ Moreover, these 16.3 million young professionals earn an average weekly income of US\$973, which increases with age to US\$1,241 for 35 year olds.⁹ As such they offer a profitable base of premium buyers. They are also clustered in cities on the east and west coasts, suiting the urban nature of Green Towers' products.¹⁰ We recommend Green Towers start by focusing on those based in the East Coast due to proximity. Finally, Generation Y are potential customers as they seek wellness in their lifestyles. As the personal financial situations of this demographic group improve, increased attention is paid to healthfulness, convenience and value.¹¹

However, 60% work 40+ hours per week,¹² and survey data¹³ demonstrates that while this segment is keen to gain from the benefits of a living wall the majority do not want to maintain the system themselves (see Placement).

Placement: Why Condominiums and How?

Condominiums would allow for young professionals to gain from the benefits of living walls while the systems would be maintained by the condominium management. The largest segment of homebuyers is 25 to 34 year olds¹⁴ and 60% of those we surveyed live in

³ See complete interviews in Appendix II-L and II-M

⁴ Living walls use empty space; do not impact the structural solution of a building (greenhouses may require the ability to support the weight of the container, for example on a roof garden); and provide more visual benefits, for example the possibility to mask ugly structures.

⁵ Focus on parsley, thyme, oregano, chives and basil. Preferred Witness Interview Appendix II-L.

⁶ Between the ages of 22 and 35.

⁷ Careers in management, business and financial operations, computer and mathematical science, architecture and engineering, legal, medical and other similar occupations.

⁸ "The Young Professional Workforce" DPEAFLCIO." Department for Professional Employees, AFL-CIO.

<http://dpeaflcio.org/programs-publications/issue-fact-sheets/the-young-professional-workforce/>

⁹ Ibid

¹⁰ Ibid

¹¹ Nation's Restaurant News (New York), "Millennial Seek Wellness, Value," March 9, 2012.

¹² "The Young Professional Workforce" DPEAFLCIO." Department for Professional Employees, AFL-CIO.

<http://dpeaflcio.org/programs-publications/issue-fact-sheets/the-young-professional-workforce/>

¹³ See the whole young professionals in Appendix I-B

¹⁴ Dobrian, J. "In Boston, Small Apartments Are Big News." Wall Street Journal (New York), June 21, 2013.

31.07.2013

privately owned condominiums.¹⁵ As such, condominiums are a growing and relevant place for living walls, especially as there is a boom in sales in both the east and west coast cities.¹⁶

Furthermore, there is a rising consumer trend towards living walls (although normally hydroponic), including the growth of food, in modern flats.¹⁷ Likewise, organic artisanal food stores are increasingly being incorporated into condominium complexes.¹⁸ We believe that Green Towers' products marry these two needs and would benefit from high demand.

Finally, it is promising that key stakeholders, such as developers and architects, have a demonstrated enthusiasm in green innovations.¹⁹

To access condominiums we recommend the following strategy:

- Partner with companies like Ambius²⁰ to bring the living wall to student housing complexes, starting at Penn State University²¹
- Use success stories to approach large development companies with a track record of success in green buildings, including Toll Brother City Living²² and The Albanese Organisation
- Look for long-term partners who possess market sway and focus on exclusive and selective distribution²³

Price

Industry experts have advised to keep sales in this segment on the macroscale, supporting the case for placing living walls in condominiums.²⁴ Research shows young professionals are happy to increase their monthly service charge by US\$30 if the wall is fully maintained by the complex management and each flat receives a pot of herbs every week.²⁵

We recommend you use a market value pricing strategy²⁶ to price this premium living wall. Currently developers buy macroscale living walls for between US\$400-800/m².²⁷ Value may be added to account for:

¹⁵ See the whole young professionals in Appendix I-B

¹⁶ Investor's Business Daily (New York), "High-End Building Boom," May 7, 2013; Karmin, C. and J Barranel.

"Pricey New York Condos Find Eager Takers." Wall Street Journal (New York), March 20, 2013; Real Estate Finance and Investment (New York), "Data-Driven Sales Firm Eyes SanFran Condo Boom," June 24, 2013.

¹⁷ Dizik, A. "Apartment Gardens: Where Food Grows on Walls and Windowsills." Wall Street Journal (New York), May 28, 2013.

¹⁸ Weinberg, B. "Food Markets: The Latest Must-Have Amenity Fueling Condo Sales." Forbes (New York), April 30, 2013.

¹⁹ "The Visionaire: New York City's First LEED Platinum-Certified Condominiums." gbNYC.

²⁰ "Office Plants - Corporate Landscaping - Grounds Maintenance - Corporate Art - Scent Marketing - Ambius UK." Office Plants - Corporate Landscaping - Grounds Maintenance - Corporate Art - Scent Marketing - Ambius UK.

²¹ For the complete interview see Appendix II-J.

²² Gallagher, L. "Toll In The City." Fortune International (New York), March 18, 2013.

²³ Hollensen, S. Global marketing: a decision-oriented approach. 4. ed. Harlow Financial Times Prentice Hall, 2007, p. 467.

²⁴ The complete interviews can be found in Appendix II-L, II-M and II-N

²⁵ The complete interviews can be found in Appendix II-L

²⁶ Blanchard, O. *Macroeconomics*, 2012, p. 360.

²⁷ The complete interview can be found in Appendix II-L

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- The product grown, e.g. it will be more for herbs than lettuce
- Valuation of urban property increasing by between 3 and 34% with green space²⁸
- And the unique selling points for developers as below

Promotion to Developers and Architects

As food-producing living walls in condominiums are in the introductory stage of their product lifecycle, promotion should be focused on developing product awareness and explaining the benefits.²⁹ Green Towers' unique selling point is around efficient technology and the rotating structure of the living wall. Ensure to have all unique technology patented to sustain competitive advantage and profits over time. This will also contribute towards company long-term valuation.³⁰

Other Selling Points:³¹

- Meets environmental standards
- Increases likelihood of planning permission
- Provides brand equity and diversifies portfolio
- Increases valuation of property
- Provides green marketing strategies, such as around air quality, pollutant reduction, fresh healthy food, consumers education and community social value

Strategy:

- Use sales and successful case studies to promote your business on your website, as well as featuring in partners' case studies
- Focus on Google Analytics³² and spending any promotional budget on featuring high on the search engine

²⁸ "Does Money Grow on Trees." National Archives.

²⁹ Hollensen, S. *Global marketing: a decision-oriented approach*. 4. ed. Harlow Financial Times Prentice Hall, 2007, p. 467.

³⁰ Scotchmer, S. "A Primer on intellectual Property" in *Innovation and Incentives*, p. 65 – 95.

³¹ The complete interview can be found in Appendix II-L

³² The complete interview can be found in Appendix II-L

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3.2 Baby Boomers

Both the rotating wall and greenhouse are interesting to this target market. However, we recommend a focus on the greenhouse as only 6% of baby boomers anticipate downsizing their properties within the next five years, providing the space required to accommodate a large structure.³³

Target Market: Why Baby Boomers?

Baby boomers, aged between 46 and 64, are a large and growing segment, making up 28% of the US population.³⁴ Prior to the recession, baby boomers were recorded as the richest generation in history with a net worth of US\$2 trillion. However, they have been disproportionately affected by the recession, high job losses, increasing medical costs and lengthening retirement making the segment increasingly price sensitive.³⁵ As such, we recommend Green Towers target couples with an annual income of >US\$75,000.³⁶

Baby boomers are looking for healthier lifestyles³⁷ and 70% of these households spend time and/or money on gardening. Moreover, Philadelphia is within the national average of percentage adult participation in gardening, making it a suitable destination for the launch of your products.

City	Percentage
Philadelphia, PA	64.30%
Boston, MA	66.40%
Chicago, IL	58.80%
Eugene-Springfield, OR	84.20%
Madison, WI	75.90%
New York, NY	48.40%
Portland, OR	74.70%
Washington, DC	57.70%

Table 1: Adult participation in gardening activities per city³⁸

³³ Miller, R, and K Washington. "Baby-Boomer Consumers." In *Consumer Behaviour* 2013. New York: EPM Communications, 2013. 256.

³⁴ Ibid

³⁵ Ibid

³⁶ National Gardening Association, 2013. Garden Market Research." National Gardening Association: Garden Market Research. <<http://www.gardenresearch.com/index.php>>. [Accessed 13 July 2013].

³⁷ Global Market Research and Analysis for Industries, Countries, and Consumers." *Global Market Research and Analysis for Industries, Countries, and Consumers*.

³⁸ Global Market Research and Analysis for Industries, Countries, and Consumers." Global Market Research and Analysis for Industries, Countries, and Consumers. N.p., n.d. Web. 30 May 2013.

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Placement: Why Garden Centres and How?

Garden centres record their largest customer segment to be ABC1 (upper socio-economic group, homeowners and over 35 years of age)³⁹. In 2011, baby boomers accounted for US\$6.2 billion in garden centres sales and this is expected to nearly double by 2021⁴⁰. Moreover, garden centres state that 84% of their customers seek a more do-it-yourself approach, which would suit Green Towers' products.⁴¹

US garden centres have a combined annual revenue of US\$30 billion.⁴² However, sales have been decreasing since 2011 forcing garden centres to look for interesting and new products that would differentiate themselves and re-capture their customer base.⁴³

Strategy

- Start with Henninger Nursery, a family nursery located in Pennsylvania, where you would have the opportunity to sell the story surrounding Green Towers' products
- Subsequently approach Waterloo Gardens and Earl May
- As you expand across the country you could consider Armstrong Garden Centre

Price

Our survey identified a baby boomer willingness to pay up to US\$10,000 for a shipping container greenhouse including delivery and installation. This is significantly higher than the products offered by Green Towers' competitor Bioponica, which sells smaller systems at between US\$149 and US\$2,000. At a premium, Green Towers has to focus on improved features such as design, ease of use, customer service, and increased output.

Promotion to Baby Boomers

Baby boomers account for a third of all TV, online and social media users.⁴⁴ Additionally, 76% of baby boomers trust peer recommendation as the number one way to receive information about new products.⁴⁵ As such, Facebook "like" and "share" campaigns are likely

³⁹ "Retail Space to Let | Hilltop." Retail Concessions | Concession Stands | Garden Centres.

<http://www.firstfranchise.com/retail-space-available/hilltop-garden-centre>

⁴⁰ Ryder, A. "Gardening's true value - Canadian Garden Centre & Nursery." Canadian Garden Centre & Nursery. <http://www.canadiangardencentre.ca/content/view/2688/>

⁴¹ Appleby Matthew, 2011. Consumer trend reports aims to frame garden centre strategy. HorticultureWeek [online.] Available at: <http://www.hortweek.com/news/1084123/Consumer-trend-report-aims-frame-garden-centre-strategy/> [Accessed: 19.07.2013]

⁴² "100 top garden centers in America - Garden Center Magazine." Garden Center Magazine - Industry news, retail resources for garden center owners, commercial growers, plant retailers.

<http://www.gardencentermagazine.com/garden-center-0511-top-100-independent-retailers.aspx>

⁴³ "Market Gardening Industry: Market Research Reports, Statistics and Analysis." ReportLinker.

<http://www.reportlinker.com/ci02008/Market-Gardening.html>

⁴⁴ Miller, R, and K Washington. "Baby-Boomer Consumers." In Consumer Behaviour 2013. New York: EPM Communications, 2013. 257.

⁴⁵ Appleby Matthew, 2011. Consumer trend reports aims to frame garden centre strategy. HorticultureWeek [online.] Available at: <http://www.hortweek.com/news/1084123/Consumer-trend-report-aims-frame-garden-centre-strategy/> [Accessed: 19.07.2013]

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to be successful. Moreover, as 93% of baby boomers are on email⁴⁶ we advise creating an e-newsletter with product updates and information on aquaponics.

With regards to magazines, Better Homes and Gardens is a trusted source of information, with the fourth largest readership in US (just under 36,000,000).⁴⁷ Pennsylvania Gardener is another magazine that offers short-run local launch promotion opportunities. Instead of spending budget on advertising it would be beneficial to take advantage of free PR that highlights the company, marketing its products as fun, do-it-yourself systems through which you will learn more about gardening and will benefit from fresh and healthy food.

⁴⁶ Miller, R, and K Washington. "Baby-Boomer Consumers." In *Consumer Behaviour* 2013. New York: EPM Communications, 2013. 258.

⁴⁷ Meredith Travel Marketing. "Better Homes and Gardens Audience Profile. N.p., n.d. Web. 12 July 2013. <http://www.meredith.com/magazine/Better_Homes_and_Gardens>. [Accessed 13 July 2013].

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4. Consultation and Hardware Design Customisation

Despite a clear opportunity to market the standardized product, a significant number of market segments require hardware customization to adequately fit their environment. This chapter provides recommendations to facilitate approaching restaurants and universities.

4.1 Restaurants

Restaurants operate on small profit margins, with the US national average varying between \$21,600 and \$36,000 per annum.⁴⁸ It is therefore crucial for restaurants to ensure operational costs are kept at a minimum, as well as to differentiate themselves through local or hyper-local food sourcing.⁴⁹

Potential product opportunities that may arise through product differentiation include the transformation of basements into micro-farms. This will enable a reduction in costs through producing expensive micro-greens (US\$30-50/lbs⁵⁰) in an aquaponic system, overcoming problems of distribution and short shelf life⁵¹. Such systems are either already in place in restaurants, such as the Red Fox Inn,⁵² or have received interest, for example by the ThinkFoodGroup⁵³. Another opportunity is the installation of design focused micro-green bars as centrepieces in restaurants to appeal to consumers' local food predilections.

Based on initial cost estimates, a system of this sort would retail to restaurants at an approximate US\$10,000 installation price. However, this price varies depending on the ROI period and the effective cost saving through such a system. This further underlines the importance of the sustainability of such a system.

⁴⁸ Locsin Aurelio, 2013. "The Average Profit Margin for a Restaurant." Houston Chronicle. Available at: <http://smallbusiness.chron.com/average-profit-margin-restaurant-13477.html> [Accessed 23 July 2013].

⁴⁹ Fishler Alex, 2012. "Is local farming still a food trend in 2012? More than ever" PBS. N.p., n.d. Available at: www.pbs.org/food/features/food-trends-2012-local-farming/ [Accessed 23 July 2013].

⁵⁰ Treadwell Danielle, 2013. "Microgreens: A New Specialty Crop." University of Florida. N.p., n.d. Available at: <http://edis.ifas.ufl.edu/hs1164> [Accessed 23 July 2013].

⁵¹ Jackson Cheryl, 2013. "Some restaurants using on-site soilless gardens to grow food" Chicago Tribune [online]. Available at: http://articles.chicagotribune.com/2013-05-17/business/ct-biz-0517-green-eats-20130517_1_microgreens-gardens-more-restaurants [Accessed 10 July 2013].

⁵² The complete Interview can be read in Appendix II-B.

⁵³ The complete Interview can be read in Appendix II-D

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4.2 Universities

To reach peripheral areas of campuses, universities are currently extending their offering through food trucks⁵⁴ to compete with off-campus food services. Therefore, a mobile greenhouse or food truck that is optimised for the sale of sandwiches, featuring "on the spot grown ingredients", successfully fulfils a need, considering the popularity of sandwiches among students.⁵⁵

The initial focus on universities may further open doors to enter into the US food truck market as a whole, which accounts for US\$1.2 billion in revenue.⁵⁶ Smaller universities or high schools should be targeted first, as larger universities tend to outsource their food services to caterers.⁵⁷

According to the high degree of customization a price range for this offering cannot be defined. However, new food trucks are on the market for US\$25,000 upwards.⁵⁸ As the fully functional food truck is tailored for sandwich offerings, the recommended price has to be at the lower end of this price range.

⁵⁴ Tanaka, S 2012, 'Food Trucks: The Newest Rivalry on College Campuses', Wall Street Journal - Eastern Edition, 22 August, Business Source Complete, EBSCOhost, [Accessed 13 July 2013].

⁵⁵ Mintel 2012, 'Trendwatch', *Convenience Store News*, 48, 12, p. 170, Business Source Complete, EBSCOhost, [Accessed 13 July 2013].

⁵⁶ Fuhrmann Ryan, 2013. 'The Cost of Starting a Food Truck' [online]. Available at: <http://www.investopedia.com/financial-edge/0912/the-cost-of-starting-a-food-truck.aspx> [Accessed 21 July 2013].

⁵⁷ Food Management, 2012. 'Princeton Review – 2011 Best Campus Food Ranking' [online]. Business Source Complete, EBSCOhost, [Accessed 13 July 2013].

⁵⁸ Fuhrmann Ryan, 2013. 'The Cost of Starting a Food Truck' [online]. Available at: <http://www.investopedia.com/financial-edge/0912/the-cost-of-starting-a-food-truck.aspx> [Accessed 21 July 2013].

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5. Social Impact

At the initial meeting with Green Towers, it was made clear that making a social impact was at the heart of the business. The company expressed an interest in developing a business model similar to that of TOMS, where for every specified number of greenhouses sold, one would be donated to a social cause. After carefully reviewing this model, we recommend that Green Towers considers adopting a revenue-dependent social contribution e.g. for every US\$10,000 made, US\$1,000 is donated in equipment or time and expertise.

This essentially increases the scope of Green Towers' outreach as it would no longer depend uniquely on the sale of its greenhouses, but rather on all business activities. Furthermore, it gives the company the flexibility of customising the way it gives back to communities, so that it is sure to be adding value where and how it is most needed (e.g. product design).

5.1 Mobilisation for International Humanitarian Aid

Using greenhouses for food production after a humanitarian emergency presents a number of challenges. While experts⁵⁹ articulate positive interest in the product, there are concerns about delivery time, transportation logistics and production volume. The need for aid is not predictable, requiring well-stocked greenhouses to be on constant standby and, therefore, long-term management. Logistically, the cost of shipping and transporting the container units to remote areas would likely exceed the cost of purchasing food from a nearer location. Furthermore, concerns were expressed about each greenhouse's production capacity considering the scale of need after a humanitarian emergency.

A number of other options are, however, perhaps more viable for Green Towers, including collaboration with organisations already on the ground in refugee camps as well as urban slums, where both water and space are scarce resources.

Numerous aid agencies such as UNRWA⁶⁰, FAO⁶¹ and BYSPOKES⁶² have introduced aquaponics, for example, in Palestinian refugee camps. Tenants have embraced having their own micro-farms, increasing their nutritional intake and reducing dependency on the expensive produce otherwise available. Green Towers would add value by collaborating with an existing organisation to train communities to design and build aquaponic living walls that could hang in small spaces and grow vegetation that would not be affected by the harsh environmental conditions.

Green Towers could equally assist in training farmers whose crops were devastated by disaster to build aquaponic greenhouses onsite from locally accessed containers. Units could then be used by farmers as seedling labs where the seeds would be able to germinate under

⁵⁹ For the complete interview see Appendix II-K.

⁶⁰ UNRWA. *United Nations Relief and Works Agency*. 2013. <http://www.unrwa.org/> [Accessed 20 July 2013].

⁶¹ FAO. "Food and Agriculture Agency." FAO. 2013. http://www.fao.org/fileadmin/user_upload/emergencies/docs/Food%20Security%20Watch%20January%202013_Final.pdf [Accessed 20 July 2013].

⁶² Byspokes. *Sustainable agriculture development and consultancy*. 2013. http://www.byspokes.org/?page_id=452 [Accessed 20 July 2013].

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prime conditions, making up for lost productivity during the time that fields are aerated and disinfected⁶³.

5.2 Acting locally: more immediate options

An interview with Danny Gerber,⁶⁴ Director of the Urban Nutrition Initiative at the University of Pennsylvania, indicated strong demand for educational programmes that teach school children about health and nutrition, increasingly through aquaponic systems. Targeting schools located in areas where obesity and diabetes are prominent, and especially schools within low-income communities, is an attainable way for Green Towers to give back in its infancy. While donating a greenhouse along with prepared lesson plans would increase awareness about healthy choices, it could equally act as a means for the school to raise funds, selling the grown produce to sponsor activities that cannot be subsidised.

There are over 350 Native American reservations in the US where many people lack adequate nutrition and where there remain significant social challenges.⁶⁵ The introduction of greenhouses along with training workshops for children and adults would help bring back the sense of community that has often been described as lost,⁶⁶ as well as promote making better food choices. Most reservations do not have the right conditions for growing crops and processed food is cheaper and more accessible than fresh produce.⁶⁷ For this reason, workshops should incorporate fun interactive cooking classes to ensure that people adopt better diets.

2,938 words

⁶³ Source: interview see Appendix II-K

⁶⁴ For the complete interview see Appendix II-L.

⁶⁵ Native American Aid. *Native American Aid*. 2013.

http://www.nrcprograms.org/site/PageServer?pagename=naa_livingconditions [Accessed 20 July 2013].

⁶⁶ Aquaponics World. *Food Forever Farms*. 2013. http://aquaponicsworld.net/Aquaponics_World_Index.html [Accessed 20 July 2013].

⁶⁷ United States Department of Agriculture Food and Nutrition Services. *USDA*. 2013. <http://www.fns.usda.gov/fdd/programs/fdpir/>. [Accessed 20 July 2013].

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ACADEMIC VITA

Dustin Betz

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Education

The Pennsylvania State University, University Park, PA – Class of 2014

Eberly College of Science – Plant Biology B.S.

Schreyer Honors College

Engineering Entrepreneurship | Horticulture minors

Honors and Awards

Penn State Sustainability Institute Reinvention Fund – Author of funded proposal January 2014

Penn State's Dow Sustainability Innovation Student Challenge Award – 2nd Place December 2013

Thought For Food, sponsored by Syngenta – Fellow May 2013

TOMS Start Something That Matters – Fellow June 2013

Dell Social Innovation Challenge – Semi-Finalist February 2013

College of Agriculture's 2012 Ag Springboard – 1st Place team founder & leader November 2012

Penn State MNE Innovation Challenge – funded awardee & team leader October 2012

Penn State Ag60, an Agripreneurship 'Elevator Pitch' competition – Winner April 2012

Member of National Society of Collegiate Scholars, University Park chapter 2011—present

Vice President, member Cumberland Valley high school National Honors Society 2009—2010

Eagle Scout—Boy Scouts of America, Troop 51 of Camp Hill, PA December 2009

Association Memberships/Activities

New Leaf Initiative—State College startup incubator & co-working office Spring 2012—present

The co.space – State College home for social innovators (resident) Summer 2013—present

Penn State Sustainable Agriculture Club Spring 2012—present

PSU Organic Community Garden—elected 'plot enforcement' officer Spring—Fall 2012

Green It Together, Runkle Hall Zero-Waste Initiative Spring 2012

Professional Experience

Anderson Plant Cell Wall Dynamics Lab, Penn State University June 2013—present

Undergraduate Research and Teaching Assistant –

- Assisted Ph.D. student Daniel McClosky in screening and characterization of small molecule fluorescent dye combinatorial moiety libraries for their usefulness in labeling of plant cell wall components
- Taught two lab sections for Dr. Anderson's general introductory plant biology course (BIOL 127)

Grozinger Honeybee Research Lab, Penn State University March—August 2012

Undergraduate Research Assistant –

- Assisted Ph.D. student Gabe Villar in his summer 2012 field and laboratory studies of drone & worker honeybee physiological receptivity to queen mandibular pheromone, as well as in developing experimental design & notation systems for real-time quantitative characterization of in-hive drone aggregation events
- Practiced general beekeeping field work and maintenance of the lab's Langstroth honeybee hives

Sophia's On Market, Camp Hill, PA 2005—August 2010

Open Kitchen Line Cook – Summer '11, Winter '12

- Worked to provide a delectable quality dining experience for all customers
- Performed many culinary duties requiring efficient communication with superiors and coworkers