

FOOD21

Building a Resilient and Sustainable Food Economy for the Pittsburgh Region



MAKING YOUR LIFE BETTER.

A Discussion Paper

Prepared on Behalf of Peoples by Hollymead Capital LLC

July 2018

FROM THE AUTHORS

Since the inception of the modern food industry and the period marking the post-world war period, there has never been a time when consumers have been so far in front of the food industry's directions.

After nearly forty years of disassembling the regional and local food system in favor of a global, industrialized system relying on low energy costs and the industrialization of growing our food to processing and distributing it, the system has been pushed to its limits. What we eat is decided by the market. Every time a consumer buys a product or orders something, they are voting for what they want. For decades, the industry has dictated consumer preferences through mass merchandising, media and branding. But starting around 2010, the power of the industry to manage consumer choice has steadily and rapidly broken down.

Today, with the surge of the Millennial generation, consumers rely on peer to peer networks, expanding their awareness and setting a new direction which is not at all within the structure that Big Food has constructed. Here's what they are saying:

- Food should be *clean*. It should be free of chemicals and additives to the extent possible.
- Food should be *local*. Food available to consumers should be grown, processed and distributed as close to the consumer as possible.
- Food should be *complex*, reflect the diversity of our communities, and be flavorful.
- Food should be *produced in a way that mirrors our values*.
- Food should be *authentic* and not genetically modified without warning.

Many of these preferences are advancing all around us. Restaurants earnestly seek to promote their "clean label" commitments. Grocery chains concurrently seek to increase the quantity and diversity of locally made and processed products throughout the store. Attention is being paid to the health benefits – and the health risks – in all food products, as food is seen as the gateway to better health. One size no longer fits all, and artificial differences lose to real ones in consumers' eyes.

We start here because all of us need to understand that today we are at the point of inflection between the industrialized distant and remote food system built over the last forty years and where the food system of the 21st Century will have to go. No longer are we building solutions ahead of the market – the market is pushing us very hard to build solutions as issues arise. We have to be faster, deeper, and closer to where we live. The plan we prepared for Peoples is called "**Food21**". It has multiple parts but is intended to reflect the unified and comprehensive approach that is required if we are to meet this opportunity head on. It draws its **inspiration** from the incredible work of the people of the Netherlands to reinvent their nation as a leader in a resilient and sustainable food economy. Their story – and indeed their success in this transformation – has inspired this call to action. Over a short period of time and with much imagination the Dutch are now one of the leading agricultural economies of the world.

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SECTION ONE

INTRODUCTION

Peoples is pleased to present this White Paper, **Food21: Building a Resilient and Sustainable Food System for the Pittsburgh Region.**

As one of the leading providers of energy in our region for well over one hundred years and as a committed contributor to the economic health and well-being of the region, we believe there are very important and critically underappreciated needs for connecting our food economy to our energy resources.

Over the course of the last six months, we have been engaging in a discussion within and outside of our company to find the points of convergence where innovations in energy can increase our regional food economy, reduce our dependence on imported food, and expand the local food business while strengthening our agricultural community.

We come to this with a set of goals this strategy will embrace:

- Job growth and economic development
- Clean, efficient, and cost effective energy use
- Focus on the inclusivity of all
- Environmentally responsible development
- Meeting basic human needs in providing nutritional food
- Providing a development model that is financially sustainable through normal market exchanges

Job growth and economic development

Over 20% of the workforce in our region is directly employed in a food-related business. There are over 73,000 food businesses located in our region and that does not include businesses who primarily do business with food customers – from retail to the farm. There are

also new demands for the workforce of the 21st century in the food sector: training with knowledge about food safety, managing complex technologies while moving food safely, and efficiency while using and introducing new year-round applications of advanced systems in service to the growing of food itself.

Clean, efficient, and cost effective energy use

Our current industrial food system is wasteful on multiple levels. The cost of moving our food from one end of the continent to the other when we can produce much of what we need within 100 miles of home is but one demonstrated problem. In order to offset this, we believe that energy producers and distributors need to apply the latest technologies that can produce what we need year-round and do it efficiently.

Environmentally responsible development

The challenges of our changing climate also require that we make changes in the growing, processing and distribution of food. It is a \$7 billion part of our regional economy. Clean and efficient energy solutions and systems that conserve water and improve air quality are all integral to the food system of the 21st Century.

Meeting basic human needs through nutritional food

Peoples has long supported efforts in our communities to reduce hunger, improve health outcomes through better eating, and ensure that all of our residents are given access to food. We believe that the approach outlined here can ensure not only increased economic opportunity but also a way to make good food available year-round, freshly harvested, and distributed to all of our neighborhoods. We will put special focus on neighborhoods that, to this point, have been left behind.

Sustainable development through the market

At long last, the market is moving quickly toward wanting a higher share of their grocery basket to include items that have their origins in our region. Consumer preference for locally grown food now outstrips demand for organic produce. All major retailers and an increasing number of distributors are actively seeking out local fresh and processed food.

The Plan of Action discussed here builds on much of the work that has been carried on by the Netherlands and how they supercharged their small economy by using advances in growing systems and land management.¹

We are proposing that the Pittsburgh corporate and foundation communities develop a network of commercial-scale, controlled environment agricultural (CEA) facilities with attendant business enterprises in local food. These will be deployed over the region and operated as privately owned and managed businesses. This paper discusses the technology options currently available to us.

Second, Peoples is proposing to support the development of the local food value chain by working with private, public, and non-profit sectors. This will be a long-term commitment and a continuation of our company's historic effort to grow businesses in our local economy.

Third, we are calling for the formation of an institute that will bring together the best in class from the private sector, universities, non-profits, and government to expand the regional food economy while increasing the workforce – both in numbers and in technological expertise.

We look forward to working with you and creating a vital part of western Pennsylvania's future!

Morgan O'Brien



*President & CEO
Peoples*



SECTION TWO

OUR REGIONAL FOOD SYSTEM

Our Regional Food System – Making The Case

For purposes of this report, we are looking at the characteristics, challenges, and opportunities in the **Pittsburgh Food Shed**. We define this region as being primarily the counties in southwestern Pennsylvania around Pittsburgh, but also recognize the broader region that begins in the north around Cleveland, Erie and Buffalo and extends downward to northern West Virginia, western Maryland and southeastern Ohio. Broadly defined, this is the **Eastern Lake Erie Food Shed**.²

A National Context

The American retail landscape is characterized by leading food retailers such as Walmart, Kroger, and Costco. Walmart (excluding Walmart International and Sam’s Club) generated net sales amounting to \$307.83 billion in 2017 and operated 4,672 stores nationwide. Total grocery store sales were \$626.98 billion. Produce is an important part of this plan, and it represents 22.11 percent of all grocery sales. It is the second largest category after meats, fish, and poultry at 27.42 percent (<https://www.statista.com/statistics/237147/share-of-total-sales-of-supermarkets-within-the-us-by-department/>)

Shoppers in the United States made about 1.5 trips to grocery stores on average per week in 2017. Surveys have shown that U.S. consumers tend to spend the most on groceries at warehouse clubs such as Costco, with an average of about \$89 per shopping trip. Even though online grocery shopping has existed for years, the vast majority of consumers still prefer to buy groceries in stores.

Based on those figures, the at home purchases of food would break into these categories.

The 2017 US Census counted **12,805,537 people** in Pennsylvania (<https://www.census.gov/quickfacts/PA>). It is comprised of **4,961,929 households** with 2.49 people per household. Food is a large industry with total retail and food service sales in the United States amounting to \$5.32 trillion in 2017. The food retail industry comprises foods sold at food retailers such as grocery stores, mass merchandisers, drug stores, convenience stores, and foodservice facilities.

The Pittsburgh Food Shed includes ten counties comprising Southwestern Pennsylvania – Lawrence, Beaver, Butler, Westmoreland, Allegheny, Washington, Greene, Fayette, Somerset and Indiana counties. Within these counties are approximately 2.4 million people,

Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average, July 2014
(Monthly to Annual Total)

	Thrifty	Low-Cost	Moderate Cost Plan	Liberal Plan
Family of 2	390.90	476.50	593.70	715.30
10% add	39	48	59	72
For 2.49 per family	429.90	524.50	652.70	787.30
TOTAL ANNUAL	5,158.80	6,294.0	7,832.40	9,447.60

Please note these figures are for at home purchases and do not include restaurant sales.

73,000 food businesses, and 12,000 active farms. The gross economic activity in this region around food is estimated to be \$6.5 billion (SPC, 2015). Employment in the food sector is approximately 20% of the region's total workforce (SPC).³ Direct purchases of locally grown food are estimated to be about \$14 million.⁴

Existing methods of procuring food has the region importing over 80% of all the food consumed – both fresh and processed. Imported fresh produce alone accounts for over 90% of all produce consumed. Meat and poultry are the same or higher. The distance food travels to our region varies, but conservatively the average transport distance is more than 1,000 miles. During the winter months, much of the fresh produce in grocery and supermarkets comes from either the southwest, California, or outside the United States with most of that coming from Mexico and farther.

Despite the dependence on imported food of all kinds, the region has over 1,300,00 acres under cultivation per the USDA. Of the crops grown, over 90% fall into two primary areas – corn and soybeans. Neither the bulk of the corn nor the soybeans are harvested for human consumption. Rather they are trucked out of the region and sent to processing plants – primarily in the Midwest – for conversion into industrial products such as plastics and bio-fuels (ethanol).⁵

The farms – which average less than 110 acres each – are committed mostly to these commodity crops, leaving little good news for growers in terms of their financial sustainability. USDA estimates that the average on-farm income in the Pittsburgh Food Shed was below \$30,000 in 2017, and all but a handful of farms rely on off-farm income to survive.

With so much of the region under the management and stewardship of our farmers, their economic well-being represents a challenge to our environment as well. Well run farms are critical to water management, preventing soil erosion, and reducing air pollution. There are a number of farms now in farmland preservation programs but, in many cases, it has come too late to limit nitrate excess, suburban sprawl, and the conversion of open farmland to paved subdivisions and strip malls.⁶



On the food production and processing front, we estimate that there are approximately 500 business establishments that are processing, making, or providing value-add products. The vast majority of these businesses are family-owned and often in the second or even third generation of ownership. Retailers who are seeking locally owned food producers will routinely point this out, and, despite a growing sentiment among consumers for locally owned and produced food products, it is a challenge to find them at a level of expertise and commercial scale capable of being included into the large distribution channels.

On the flip side, however, there is a lot of evidence to suggest that there is an established and growing movement of food producers and developers who are emerging in the region. Food enterprise development is often identified as one of the most active categories from organizations that help local businesses.⁷ While there is much to be excited about in this trend, it requires the development of infrastructure support including co-packers, market developers, and well-organized sources of raw materials.⁸ The absence of these resources complicates the region's ability to sustain and grow farms and farm-businesses while meeting the demands of the end markets.



Another important and often overlooked aspect of the region's food economy is how it impacts a broad range of participants in the workforce. The cited number of jobs (over 20% of total regional employment) in this sector shows how widespread it is. What is not obvious is how many of the jobs are entry level and provide needed starting points for individuals with less than a college education to enter the workforce. The food sector is often the first or second work experience of well over 50% of the population. Building a strong, robust, and expanding food sector directly affects the economic well-being of literally thousands of people entering the workforce for the first time. It is also one of the best sectors for people who have different employment barriers to break out of their cycle of poverty and hopelessness.

The importance of a local food sector in ensuring access to good, fresh, nutritional food is also an area of much concern and importance. A significant lesson in the research on the nutritional quality of fresh food is the excessive length of time it takes to move from field, farm, and ultimately to the market and consumer. This lag time often means that the nutritional benefits of the produce plummet significantly.

Finally, there is the basic need to reduce hunger and access to food in our communities – both urban and rural. The USDA designates areas as food deserts because of lack of access to nutritional foods. In general, there is far too much dependence on our

regional anti-hunger programs or the donations of random surpluses and a tendency to mirror our large food system's dependence on imported food. A vigorous and well managed regional food system focusing on building abundance can be equitably shared. This system can and should be designed to address these shortfalls in both access, as well as in providing locally raised and produced foods to support and feed our neighbors in need.

Building A Regional Approach

Given both the significance and opportunities we see before us, we believe that the time is now to move the importance of our food economy to the front of the line.

This approach begins with the leadership of Peoples. Peoples is in a unique position to see all sides of the regional economic system. Because of its diverse commercial and residential customer base across all income levels, it is ideally suited to become a co-convenor and a leader in building a new paradigm. In 2017, Peoples began to look at the relationship between energy and food. It also began to study breakthrough thinking in other places – particularly the Netherlands. Based on this review, Peoples concluded that by applying their engineering and energy expertise they could contribute to the development of a year-round agriculture effort which we now call Controlled Environment Agriculture ("CEA").

Peoples knows that this will require **investment and partnerships**. To that end, discussions began with the business, non-profit, public, and academic communities. The results of these discussions have led to the formulation of a comprehensive business strategy which is embodied in this paper.

Food21

The strategy, which we are calling **Food21**, is a comprehensive and market-based approach.

The first step is building large scale, commercial food production center(s) in the region using the most advanced thinking and engineering in CEA that is

available commercially. The goal is to bring as much fresh and year-round produce to market as possible and to directly address the trade imbalance that exists with imported fruits and vegetables. We believe that new technologies enable bringing a wide range of fresh and nutritious products to markets – both for direct consumption by consumers and for the region’s food producers, processors, logistics industry, and value-added manufacturers.

The second step is building a value chain that works directly with area growers, food processors, and producers as we seek to improve their overall operating and financial results. The goal is to make area farms more resilient, sustainable, and to help food businesses gain significant footholds in regional markets. Ideally, their products will effectively meet the ever-growing demand for locally sourced and manufactured food products.

The third step is to establish a **regional institute** which keeps the new system current on technology and changes in development, as well as monitoring and measuring the overall benefits to the food economy and the region’s health and well-being. There are a number of offshoots from CEA projects to attract entities that feed off the needs and opportunities in the wake of an established CEA system. These opportunities will be explained later in the report. Working in conjunction with economic development officials throughout the state can bring additional financial resources to the efforts undertaken. Some of our initial efforts should be assisting various economic development organizations already present in our communities. We are stronger together; this strategy is greatly enhanced when there is collaboration and participation with all sectors of the existing food system.

Benefits of the Food21 Strategy

- ✓ Food Safety
- ✓ Transparency
- ✓ Lower transportation costs
- ✓ Fresher, longer shelf life
- ✓ Faster growing cycle
- ✓ Supporting hunger programs
- ✓ Supporting local development institute
- ✓ Building locally owned food businesses
- ✓ Supporting farmers with low cost organic nutrients
- ✓ Lower energy inputs with CHP
- ✓ Job growth and good paying jobs
- ✓ Beneficial environmental impact

SECTION THREE

THE NEW URBAN FARM – 21ST CENTURY CONTROLLED ENVIRONMENT AGRICULTURE

Building the New Urban Farm; 21ST Century Controlled Environment Agriculture

As stated earlier in this report, the Pittsburgh region is a net importer of the food that it needs to sustain itself. It is hoped that we can demonstrate to the readers of this report the enormous power of Controlled Environment Agriculture (CEA) to impact desired outcomes in communities. Done properly, CEA becomes a catalyst that attracts and compounds additional food production options that will continue to conflagrate within the local ecosystem, improving food availability, supporting increased levels of nutrition, and providing more economic and employment options. In the 1900's, 42% of the United States population lived and worked on farms. Farming was the backbone of the economy, and "Mom and Pop" operations were literally stretched across the countryside. Now, only 1.2 percent of Americans farm, and their average age is 59 years. We now leave it to these aging and somewhat isolated people to shoulder developments in technology, pesticide use, and heavy machinery.

Concerned parents, seeing negative trends for farming, shipped their children to big cities, colleges, and universities seeking a perceived better life. While no one can question the motives of these parents, the country now finds itself at a crossroads that demands our collective attention. Over decades, food-producing farms have been narrowed in scope. They once produced food crops for direct sale to the consumer. Now, the farms that still exist have been reduced to growing America's "big three crops" of corn, wheat, and soybeans. As small farms began to fail, large corporate farms got even bigger, and corporate farming became the norm. Until the local food movement began and gained strength, many large wholesalers of food would



**The food industry should nourish communities
as much as it does the stomach.**

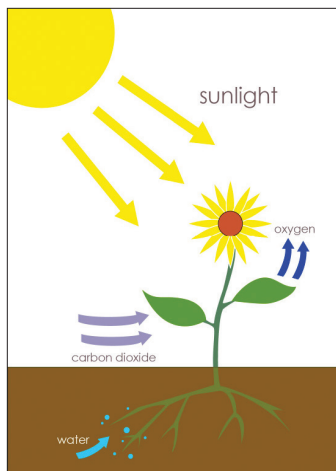
not even consider purchasing from farms with less than 1,000 acres.

The average size of the 2.1 million American Farms today is 434 acres (USDA 2012 Census of Agriculture data) making the average farm undesirable to many of the leading market wholesalers of food. While celebrity chefs and some grocers are emphasizing local food, the dominant means of supply are from large corporate farms. Additionally, on these farms, mono cropping has robbed the soils of healthy substrate, and this is occurring at a time when the world has a need to produce 70 percent more food by 2050. Despite these challenges, consumers still seek reduced chemical reliance, lower prices, year-round availability, more productive output, and a reduced reliance on genetically modified foods. Add the need for decreased water consumption, and the future of farming is even more challenging. CEA allows smaller acreage to now compete with much larger farms; CEA production with its intensive growing capability reached land parity two years ago.

It is predicted that as soon as next year, 2019, the United States will import 45 percent more food than previous years from outside the country. In spite of the data readily available from the USDA, Americans have currently lost track of the importance of food to their local economies and nutritional needs. We have outsourced a lot of the food industry, yet it remains the most robust source of employment we can offer to the full range of our society. Food is important for a multitude of reasons. Twenty-eight percent of the American economy is somehow tied to food's production, logistics, storage, consumption, or development. While twenty-eight percent is a large number, ironically and tragically, many people and communities still cannot afford food without supplemental assistance or go hungry.

It will not be easy to convince today's youth to return to field farming until we can make farms more productive and competitively capable. CEA levels the playing field with larger farms. With 1,000 acres being a minimum farm size for the interest of wholesalers, a CEA intensive facility placed on available acres is 100 times more productive than an existing farm (provided it is a vertical farm). This claim is due to the extension of growing season, intensive methodology, nutrient delivery, faster harvest times, and the superiority of LED-regulated growing.

There are wide ranges of structures that are called controlled environment projects: conventional greenhouses, hoop houses, row covers, Dutch styled greenhouses, former



industrial buildings, newly constructed metal or concrete structures, as well as fully automated structures run by computers. The means of achieving photosynthesis at these facilities can be the sun, fluorescent lights, metal halide bulbs,

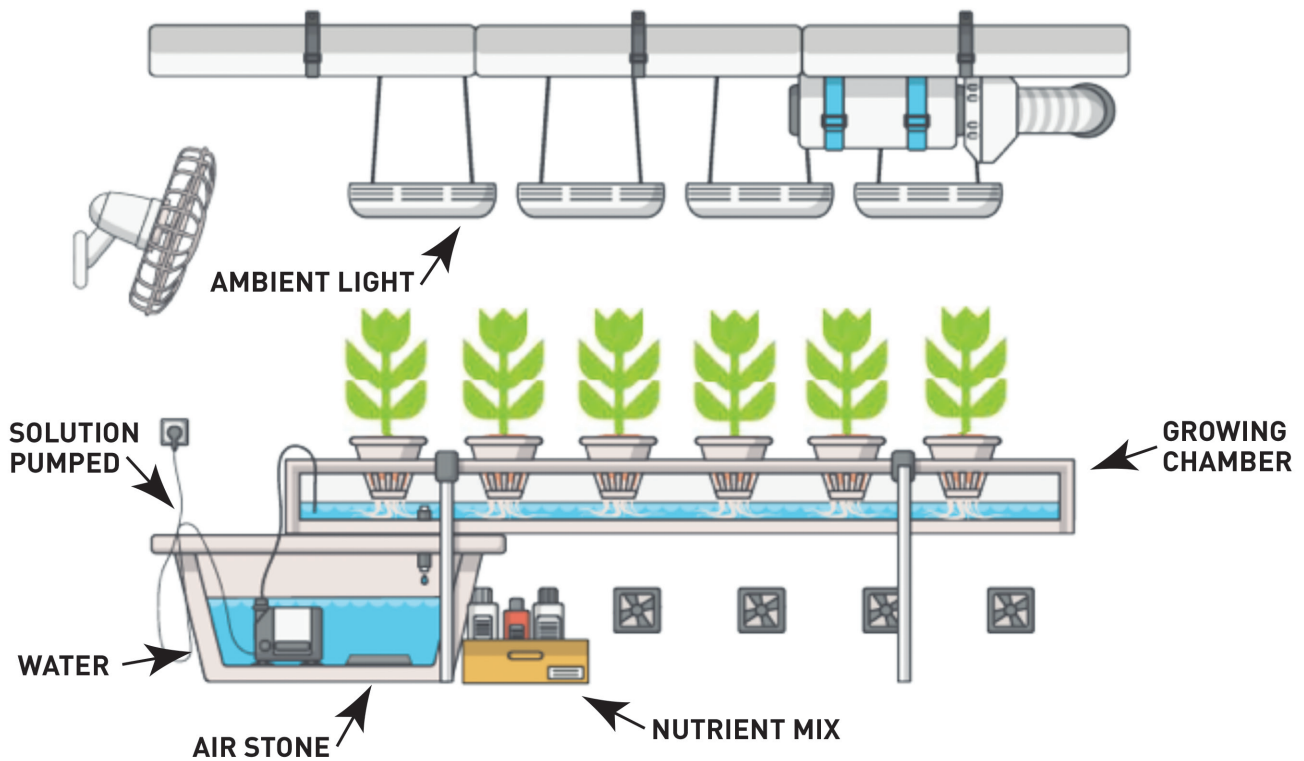
or LED lights. For purposes of this paper, **controlled environments will be facilities that will operate all year, growing a range of crops and getting a head start for the coming year's field plantings (if that is a desired hybrid activity)**. The benefits of these controlled environments are to reduce pests, improve quality, provide longer growing seasons, promote faster crop cycles, or to grow crops in places where they would not normally survive the local climate. While the tools of controlled environments can benefit all structures mentioned, an important segregation should be those structures controlling environmental conditions that would limit seasonal productivity. Controlled environments should also be attempting to address temperature, air quality, CO2 levels, airflow, and lighting.

University of Arizona plant scientist and professor emeritus Merle Jensen labeled controlled environment agriculture the "birth of an agricultural revolution. A popular response to today's consumer demand for fresh, healthy, locally grown vegetables, the concept of greenhouse crop production is expanding and now makes a nearly \$12 billion contribution to the production food chain."

Adding, "Twenty-five years ago, the only people who wanted to talk to me about greenhouse growing were the marijuana cultivators, but that's all changed now." As early as 1965, Jensen thought it a good idea to try putting air and heat into 150-foot-long row covers and adding water and fertilizer through what he initially termed a "dew hose," which we know today as drip irrigation.

Large-scale growers are converting portions of their fields to controlled environments, and smaller farms are adapting glasshouse technology. Even backyard vegetable growers are setting up mini-operations to keep out pests, lower irrigation costs, harness sunlight, and maintain a year-round operation that can avoid freezing temperatures for as long as possible.

It's not a new concept. The earliest protected-environment food production is believed to be off-season cucumbers grown "under transparent stone" for the Roman Emperor Tiberius. Egyptians and Babylonians grew edible munchies in water gardens some 3,000 years ago, as noted in historical archives.



Recent advancements in CEA are some of the most far reaching in all of modern agriculture. CEA is a vastly improved business model, however there are a number of growers and farmers that are justifiably concerned about the capital that is initially required. Concern about costs and being inexperienced in raising private equity or venture capital has been a big contributor to people sizing and using the technology ineffectively. Their greatest mistake has been building facilities that have been too small. This has resulted in not having large enough scale to grow enough product to be profitable. This is especially true in Aquaponics and Hydroponics, not only in facility size, but where staff or technical support is needed for intensive growing.

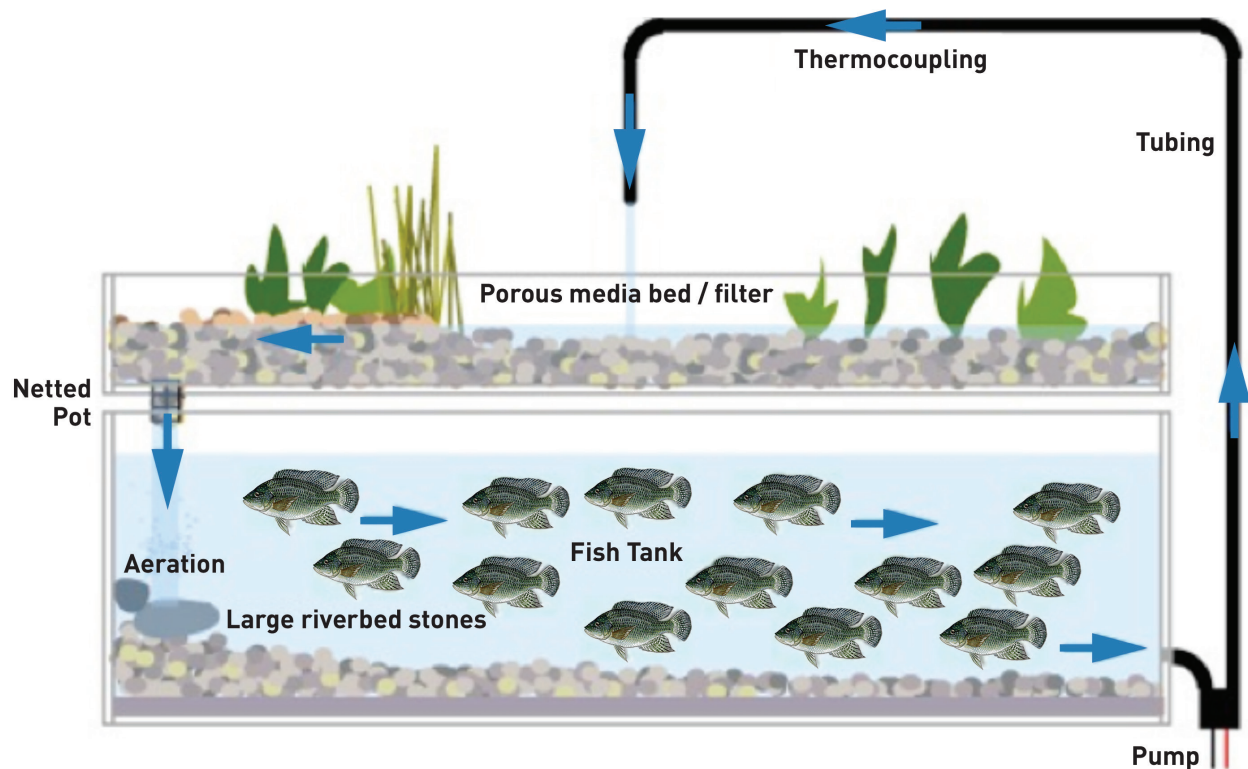
Growing Systems

Hydroponics – Hydroponics is a system of growing plants that does not require the use of soils. Some Hydroponics systems can use substrate that may include peat moss, clay pellets, rockwool, perlite, coco-core, or vermiculite. All plants require the nutrients nitrogen, phosphorus, and potassium(NPK).

In hydroponics, instead of getting these key nutrients from the soil, they are supplied by chemical companies who instruct farms on how to inject these nutrients in water that is flowed underneath the plants via a “raft system.” A raft system representation might look like the diagram above.

There are several types of Hydroponic growing: There is the Nutrient Film technique, the Deep-water culture method, Aeroponics, Ebb and Flow, and Drip systems. Hydroponics is a good choice for all types of growers depending on opinions of what constitutes an organic product. It is a great choice because it offers the ability to meticulously control the variables that effect how well plant choices grow. A fine-tuned hydroponic system can easily surpass a soil-based system in plant quality and amount of produce yielded.

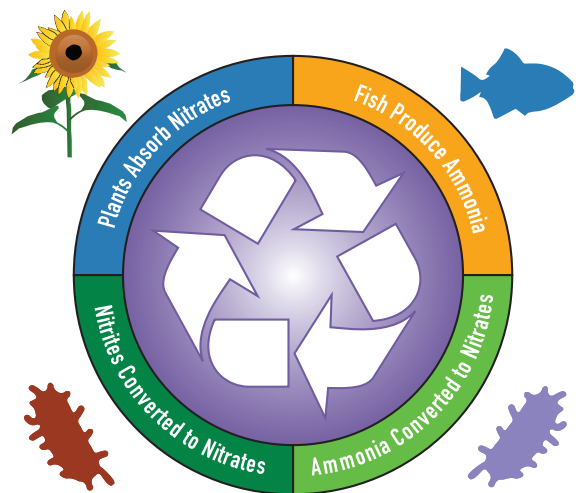
Hydroponics, like Aquaponics and Aeroponics, allows a grower to produce uniformly attractive vegetables in an environment that controls many of the factors that impact the quality or market value of a plant. These methods also allow faster growth rates that can be



up to a 50 percent improvement. Hydroponics, like the other growing methods are very efficient users of space, water, and location. These methods are water-saving while also being an effective use of nutrients. This form of growing does not have weeds, has fewer pests, and is a better use of labor.

Aquaponics – Instead of infusing water with chemical nutrients as in Hydroponics, Aquaponics uses the nutrients derived from fish excretion, soil, and composting to grow vegetables. As mentioned, the method and knowledge of culturing fish and growing vegetables are ancient. The technology is effective and embodies the sustainable management of water, waste, and energy. These methods result in a local, non-contaminated environment capable of producing enhanced quality food. These products have improved taste profiles over Hydroponics and the soil-depleted, pesticide infused methods being used throughout the country on non-organic farms. Employing Recirculating Aquaculture Systems (RAS), farms deliver nutrient-dense, organic produce along with very high quality, contamination free fish.

In Aquaponics, water is not eliminated but is constantly filtered, cleaned, and balanced as it recirculates consistently throughout the system from fish to plants. Aquaponics is a biologically integrated system that links aquaculture with agriculture. This ancient method was revived when fish shortages and the need for more edible plants occurred. The first modern Aquaponics platform was developed at the University of the Virgin



Islands in the early seventies, in an attempt to reduce the amount of wastewater produced by fish farms. This was accomplished by uniting the nutrient cycle between fish and plants.

In an Aquaponics system, the fish nutrient (waste) is the main engine for all other growth in the system. As fish feed and breathe, they produce carbon, ammonia, and solid wastes that would normally be filtered out of a standard fish farm by rapidly replacing the water. A tank in a 24-hour cycle has had its water removed, cleaned, and recirculated 24 times in the course of a day. This process delivers water free of nitrates and contaminants.

Aquaponics uses some of the same grow-out rack systems that Hydroponics does. Some people consider Aquaponics a Hydroponics method because it does not use soil in the conventional sense. This grow method is preferred by some because it is a closer approximation of growing in soil-based farms and has a greater amount of microbial activity. Because of the presence of fish, there is more positive bacteria available, resulting in improved substrate capacity. This system has the added benefit of producing high-quality fish to eat and fish fertilizer as a result of the fish growing activities. Hydroponics is currently the most widely used of the systems because of ease. The added aquaculture knowledge required in Aquaponics is intimidating to some, but as overfishing continues to be a problem, Aquaponics is gaining in popularity and for market demand.

Just like there are problems getting fresh produce to certain areas, there is similarly a problem with our fish supply. Worldwide, 90% of our lakes and oceans are overfished and now those bodies of water hold only 10% of the biomass of fish they once held. According to the UN's Food and Agricultural Organization (FAO), 32% of the world's fish stocks are exploited beyond their sustainable limits. Up to 90% of all large predatory fish such as cod, sharks, halibut, swordfish, marlin, grouper and tuna have been depleted. As a result, the need for fish will drive aquaponics to become a diverse and cost-effective food producer.

Aeroponics – Like Aquaponics and Hydroponics, Aeroponics is grown without soil. Like the other two systems the orientation can be vertical, horizontal, or raft oriented, and are commonly stacked like other vertical systems. The facility is controlled and has the same environmental demands as the others but has increased HVAC requirements to remove aspirated nutrient. In these growing methods, the roots of a plant are sprayed with water that has nutrients in the mixture. This mixture provides the basic NPK nutrients needed by plants. Aeroponics is the newest of the technologies and fewer of these systems are being used around the country. Aeroponics is the most complex of the new growing systems and uses a sprinkler system infrastructure that requires constant and careful attention. The working environment around this type of system needs to be carefully monitored because aspirated nutrients can pose health hazards for workers.

The aeroponic system is a fairly easy concept to understand, but its application is challenging. The purpose of the roots hanging in midair is to get the maximum amount of oxygen possible. The high volume of oxygen the roots get allows the plants to grow faster than they would otherwise, which is the main benefit for this type of design. There is typically very little if any growing medium used while exposing all the roots. The plants are suspended either by small baskets, or closed cell foam plugs, that compress around the plants' stems. These baskets or foam plugs fit in small holes at the top of the growing chamber. The roots hang down inside the growing chamber where they get sprayed with nutrient solution from mister heads at regular short cycles. The regular watering cycles keep the roots moist, as well as providing the nutrients the plants need to grow.

Besides being a bit more expensive to build, there are some downsides to Aeroponic systems. The plant roots hanging in midair makes them more vulnerable to drying out if there is any interruption in the watering cycle. Therefore, even temporary power outages (for any reason) can cause plants to die much faster than other types of hydroponic systems. The mister/

sprinkler heads also routinely clog from the buildup of dissolved mineral elements in the nutrient solution, causing uneven nutrient application. Of all the systems, Aeroponics has a reduced margin for error, especially in the true, high-pressure versions.

The growing chamber that contains the roots should be light proof, and almost air tight, although roots still need to be oxygenated. Water should not be allowed to spill out, nor should pesticides be allowed to enter. The root chamber is designed to hold humidity. Ultimately the roots need to have plenty of moisture, oxygen, and nutrients. A well-designed Aeroponic system provides an accurate balance of all three of these elements simultaneously. Lastly, a major factor in Aeroponic systems is the water droplet size. Roots sprayed with a fine mist will grow much faster and have more surface area to absorb nutrients and oxygen with the roots sprayed in small streams of water from several small sprinkler heads. In the contentious and continuing debate of what will be categorized as organic and what will not, Aeroponics was rejected. Since consumers buy both organic and non-organic products, this report does not need to crown a “winner” of the technologies. We also realize that different crops and production levels may require different technologies.

Soil Based Greenhouses – The oldest source of greenhouse growing in the United States is soil based. In most greenhouses, plants are grown in pots and, in some cases, directly in the ground’s surface. While this practice is widespread in countries like the Netherlands, American growing is predominately done in soil that is held in racks, raised beds, or hanging from metal rods that hold them above the ground. Soil can be a challenge to work with in greenhouses. Because of increased microbial activity, soil can impart favorable or unfavorable tastes in the plants.

Although soil is readily available in the majority of places where a greenhouse would be located, many people, including commercial growers, are starting to move away from soil as a growing medium. This trend has been increasing over the past few decades.

Soils in different regions or even within the same field can be quite different. The way the soil will be used, and the supplements needed, vary widely from one soil to another. This introduces variables that are not always easily rectified.

Any instructions or suggestions for growing techniques for plants in a greenhouse soil-based system would be very general or of limited value because of the wide variations in the conditions created in the soil or soil-based media. Soil is expensive and heavy to transport. If soil is harvested for greenhouse use and not replaced, the usable soil can be consumed in a few years.

Soils can harbor diseases and insects. Introduction of insects and diseases to the greenhouse environment is undesirable. Effective heat or chemical treatment of soil is not available for small growers and hobby growers and is being phased out for commercial growers. Heat treatment is very expensive and ineffective if not done correctly.

The greenhouse grower has many choices in plant growing systems. The choice of system will depend on the plants to be grown, the size of the system and the financial and time investment the grower wishes to make. Many growers will try a variety of growing systems over time, finally settling on a system that works well for their variety of plants, and with which they experience success. Farmers for a multitude of reasons will choose the system that best suits their desired outcome.

Choices – For purposes of this report there is no need to make a choice between the growing technologies. Food needs are diverse, and all of the technologies will most likely have to be used.

Hydroponics, the most widely used method has great appeal because the nutrients come in convenient combinations from chemical companies that can more easily be understood by users. In Hydroponics, farmers don’t need to have an understanding of fish husbandry as in Aquaponics. Some will choose Aquaponics because the system constantly recirculates (commonly called recirculating aquaculture systems or RAS for

short), and there is little to no release of additional nitrates. In Hydroponics the used and extra nitrates will have to be released into the sewer system. While this release will be substantially less than for field farmers, it is still a nitrate release and can contribute to the excessive nitrates in soil. This is a well-established environmental issue.

As it has existed for years, there will continue to be soil-based farming in CEA operations and greenhouses. With the world needing to increase its food production by 70% before 2050, (High Level Expert Forum - How to Feed the World in 2050, Office of the Director, Agricultural Development Economics Division, Economic and Social Development Department, Viale delle Terme di Caracalla, 00153 Rome, Italy) a range of options will be needed. We continue to support soil based growing, and we do not see a competitive scenario with field farming occurring in Pennsylvania because the dominant focus will be on crops not grown in the state. Working closely together under the umbrella of a CEA Institute, healthy aquaculture nutrient can be exchanged, with farmers significantly reducing their need for chemical enhancements to the soils.

Hydroponics will be used in cases where farmers decide to have a simpler method of growing plants. Inherently closer in approximation to soil based growing, the ultimate selection has more to do with a farmer's view of the world than it does on the inherent features of the technologies. From a pure productivity per square foot of surface area used, Hydroponics, Aquaponics, and Aeroponics are the most productive of the growing technologies. This is largely due to a plant's root systems not having to fight for nutrients, allowing a grower to place them closer to each other. This allows for more plants without the risk of reducing plant maturation size. LED lights are used in all three types of growing approaches. These systems can also be used under greenhouse glass if desired, but productivity is less uniform. Unfortunately for traditionalists, with the continued advancements in LED lights (they are improving every six months like computers) certain crops are destined to be grown in controlled environments.

The nexus of food and energy: CEA meets CHP – solving the energy challenge

While CEA will be an expanding part of our food culture, one of its barriers can be energy consumption for both electrical needs and space heating/cooling. In fact, commercial CEA facilities can use 200,000 kWh to 2 megawatts of energy because of their electrical needs. The electricity use varies with the volume of food production and is directly related to grow-lighting and numerous pumps employed to move water.

Space heating and cooling can also be expensive. Using electricity for space heating (or most heating uses) is one of the most inefficient ways to use electricity and is therefore costly. Typical greenhouse and high tunnel farming usually take advantage of the traditional growing season and sometimes extend the season with natural gas, propane, or oil heaters. Greenhouses can also take advantage of heated pipes in the soil bed or beneath growing trays to keep root systems warm. Often these systems can be heated via traditional boilers. These systems (along with coal-heated boilers) would be familiar to anyone working in this industry throughout the mid-20th century.

The critical aspect of CEA's success is its large crop production. Unlike all traditional farming and greenhouses, it is capable of exponential and continuous food production 365 days of the year, in effect creating multiple growing seasons within a single year. It is this production that creates both profit and sustainability. For a CEA facility to be the most profitable and sustainable, it needs to utilize an energy system that is low-cost and "flexible." The system that is needed is a Combined Heat & Power (CHP) system, and it is the type of system employed by current European growers in many of their CEA facilities. The Europeans, mostly the Dutch and Belgians, have realized that production and CHP, using natural gas and biogas, are interlinked, and that CHP is necessary to be cost-effective in their agriculture initiative. This realization is not understood by most of America's agricultural industry. Only now, with some European companies like the Belgian company Intergrow

expanding their operations and developing CEA facilities in the USA, is this realization beginning to dawn.

CHP, also called co-generation, is a technology that has been employed in America for many years in large institutional, commercial, and industrial operations, and within individual buildings. It burns natural gas or other gases in a turbine to create electricity. The steam or waste heat given off by its operation can be used for heating needs. The steam can also be leached of its heat, producing chilled water for cooling needs. Unlike electricity taken from the grid, CHP produces all energy on site. It is reasonable to expect such a system providing joint energy applications to operate at or greater than 80-85% efficiency, a large improvement over the national average of 35-40% for energy services when separately provided. This more efficient use of such combined energy applications is a major asset for CEA facilities. Furthermore, the western Pennsylvania region possesses some of the most abundant and economical natural gas resources in North America. All of these factors contribute to an important energy cost advantage.

CHP systems can be as large as entire rooms or smaller than refrigerators; their size is dependent on the energy needs of any given operation. When a CHP system is of a smaller size, it is often termed a "micro-turbine." For CEA, these turbines deliver yet another advantage. The burning of natural gas creates carbon dioxide. An enhanced CHP system can "scrub out" the gas and pump it to the plants to stimulate growth. The plants use the carbon dioxide for photosynthesis and produce oxygen. Production is thus increased in a clean, environmental system.

An enhanced CHP system can also operate on biogas. A CEA system could expand to a point where it may create enough vegetation waste to create biogas and power its own operation. This is especially true if, over time, alternative energy sources like solar and wind turbines would be added to the energy mix. The end result would be an energy independent CEA facility that could then sell a percentage of its biogas to the natural gas utility, creating another revenue stream. The purchasing utility might then resell the gas at a higher market

value because it is a renewable resource. If the CEA industry greatly expands, it raises other environmental opportunities. Can some gas utilities replace the volume of gas they use from drilled wells with biogas? If this is the case, could the utility discontinue expensive pipelines that gather gas from wells?

Some of the above questions can only be answered years from now. But it is inevitable that Peoples will be assisting its communities in supporting the development of an emerging customer group and the realignment of energy use.

Beyond protection from the weather, Controlled Environment Agriculture (CEA) has season-extending benefits that are of immediate benefit to farmers. Two years ago, CEA reached field parity, meaning crops grown in CEA's could match pricing (provided they have scale) with soil-based farm fields. They can accomplish their goals without concern about weather disruptions. Field growing and, especially, crops that have to be shipped across the country, have no built-in price advantages as a result. There is a shortage of long haul truckers, and this is a problem for cities that have food shipped from California. CEA is a means of requiring less long-haul truckers because the food is local. Improvements in LED technology and new plant light "recipes" (the exact light required for maximum photosynthesis and plant growth) are improving so rapidly that CEA is exceeding initial estimates of production. With these continued improvements CEA operators can afford to price their products for wider appeal to customers that want greater access to produce.

As we view possibilities on where to begin regional CEA efforts, we should consider a campus approach to CEA production and the seasonal growing possibilities that are made possible through the use of grow towers and raised bed gardens outside of the production facility. From an employment standpoint, this creates 130 full time employees and is expandable to 190 full time jobs when all phases of the projects come together. A fuller explanation of the model follows in Section Four.

SECTION FOUR

A MODEL FOR REGIONAL CEA DEVELOPMENT

InCity Farms

A model CEA/CHCP Campus – InCity Farm

The InCity Farm model has been designed and developed by InCity Farm LLC (one of the co-authors of this paper). InCity Farm employs a broad team of professionals and is being considered by Peoples as the lead development organization for a CEA launch. The company has existing members with experience in these kinds of growing operations as well as professional food system experience. The company has a strong intention to put these facilities in disinvested urban and rural communities as a means of creating jobs and bringing healthy food options to them while simultaneously supplying the commercial food system. To accomplish this, the company piloted its own system, created needed corporate relations and is building a national infrastructure to spread its operation around

the country. The company, while still an emerging enterprise, has garnered interest and requests from forty-two cities.

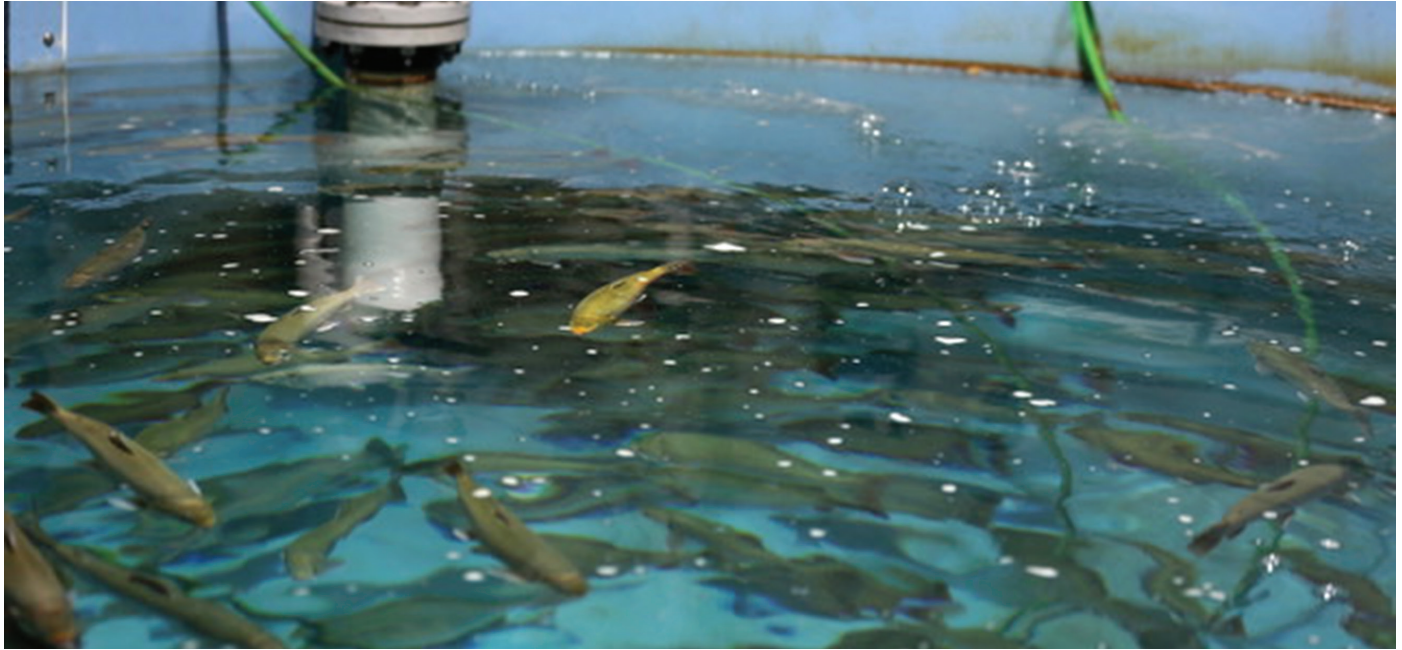
The company's minimum footprint for a location is 7.5 acres. In the example shown below, the company purchased 12 acres of property in Wellston, Missouri and was given a favorable price to acquire another 7.5 acres for a total of 19.5. In the example, the company is using the entire property in two phases of development. In the first part of the development, InCity takes the 175,000 square feet of building and breaks it out into its functional parts. In phase two of its project, it adds a greenhouse for controlled research and development as well as outdoor grow towers and raised bed grow systems to take advantage of favorable seasonal growing.



Aquaponics Operations

A site plan functional outline of a facility being constructed in Saint Louis.





InCity Farms aims to train local residents in skills necessary to be providers of food at commercial scale and volume. They target 90 percent of the employees at their facilities to be from the city where the facility resides. The company believes in training people and then giving them the jobs, they were trained to do. Because of the wide expansion the company plans, additional career opportunities will occur, creating career paths otherwise not available in these communities.

Through the Holding Company operation, information technology exchanges will flow among wholesalers, retailers and feeding organizations. In turn, this information will be shared with production and shipping facilities. This network can be local or become part of regional supply chains. The Holding Company further functions as a corporate office that supports all locations and is another layer of experienced management should unexpected needs arise. The example of the Wellston, Missouri location has garnered national attention and is set to become an emphasized project of HUD.

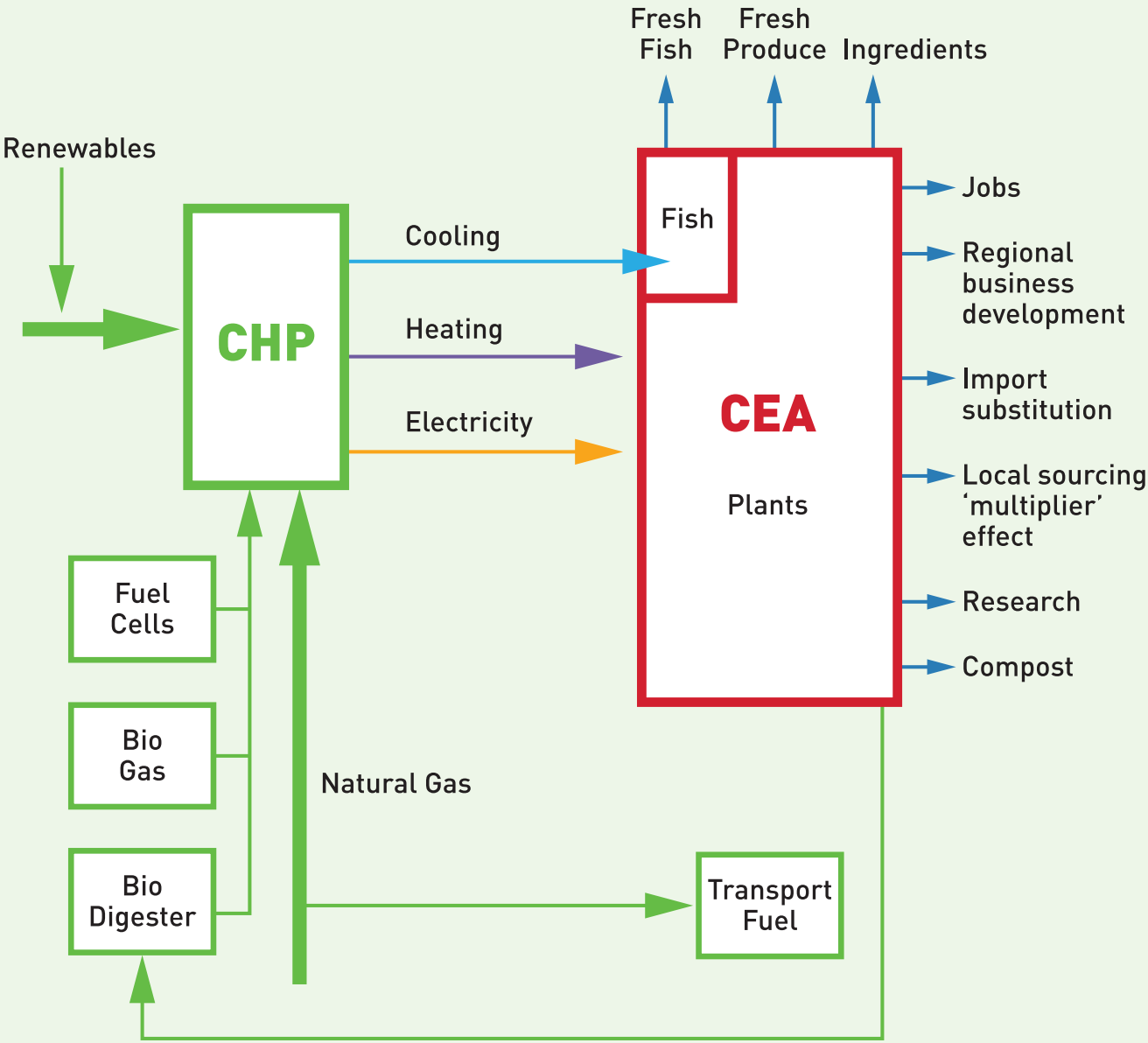
These facilities have an eye towards the future in using Recirculating Aquaculture Systems (RAS) so that they

do not contribute to contaminating water, or produce excess nitrates that add to excessive algae growth or other negative water impacts. Fully on-site, the facility will grow, process, and clean the fish and plants that it produces. The waste that is produced by the company will have valuable uses in the growing process, and will actually have revenue streams attached to them. The company is led by people who believe in Biomimicry.

Biomimicry is an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies. The goal is to create products, processes, and policies—new ways of living—that are well-adapted to life on earth over the long term. The core idea is that nature has already solved many of the problems with which we now grapple. Animals, plants, and microbes are the consummate engineers. After billions of years of research and development, failures are fossils, and what surrounds us is the secret to survival.

In phase one, the production capabilities of this system will produce 500,000 pounds of fish annually, and three million plants per month ranging from leafy greens, microgreens, peppers, melons, tomatoes, cucumbers, strawberries, and other crops.

Combined Heating Cooling & Power Systems (CHP) and Controlled Environment Agriculture (CEA)



SECTION FIVE

USING CEA DEVELOPMENT TO POWER THE FOOD VALUE CHAIN YEAR-ROUND

Powering the Food Value Chain

At the center of the local strategy is the development of regional CEA facilities that can generate substantial harvest year-round. But the simple existence of these centers does not make a food system. So, the second part of our discussion focuses on the pre- and post-harvest relationships that form around the CEA and that can grow and expand because of the CEA.

As noted earlier, our region has hundreds of food manufacturing and processing businesses. We estimate that, in the Peoples service area alone, there are 500 such businesses. The entire regional food supply chain supports 73,137 businesses employing 198,000 people (Dun and Bradstreet, Aug. 2014).⁹

We also have relationships with major grocery and food service broad liners with distribution centers within fifty miles of Pittsburgh (Sysco, Reinhart, US Food Service, GFS to name four) as well as dozens of smaller regional specialty distributors. All of these are an integral part of the value chain that we seek to develop and grow.

We will start working immediately to present our plan to this network of distributors and work to “pre-position” their volume and specific produce requirements for the future. Ultimately, a local produce “Category Management” function will be created that provides real time data to local chefs, wholesalers, and retailers.

Post-harvest refers to the systems needed to effectively preserve and package agriculture products once they are picked and to get them safely into the market. This term also refers to the marketing, sales and distribution of these foods.

One of the critical findings of the Southwestern Pennsylvania Commission (SPC) in 2015 and later confirmed by a series of meetings and interviews with



small, regional food makers is that, in general, the “infrastructure” to support a growing regional food economy is weak. Unlike other urban centers near Pittsburgh, there has been little attention paid to the food sector. The groups we have interviewed before and during the preparation of this report all indicate a need for more processing capacity, better supply chain linkages, stronger go-to-market support and sales functions and flexible capital to take businesses to scale.

Managing the Value Chain

The description we are using for business activity in this sector is called by USDA and others ‘Value Chain Coordination’.¹⁰ A food value chain is described by USDA as, “... a business model in which producers and buyers of agricultural products form strategic alliances with other supply chain actors, such as aggregators, processors, distributors, retailers, and consumers,

to enhance financial returns through product differentiation that advances social or environmental values. Value chains are formed intentionally on the central principle that transparent and trusting relationships between supply chain partners can produce positive, win-win outcomes for all parties involved. Partners in these business alliances recognize that creating maximum value for their products depends on interdependence, collaboration, and mutual support. The financial rewards accrued through these value chain alliances are shared equitably among partners.”¹¹

According to the USDA¹² the role of Value Chain management is (emphasis added):

- **Identify and connect** key stakeholders through referral services and other forms of short-term or one-off engagement. This “**public interest broker**” role is key to the development of food value chains because many businesses are stepping outside their normal channels to find new collaborators.
- **Build the necessary relationships** across the food value chain by engaging key stakeholders, maintaining communications channels, and fostering a trusting environment.
- Work with food value chain members to **build capacity** through education and training programs.
- **Raise policy issues** and partner with others to address policies and procurement requirements.
- **Identify and pursue resources** such as grants, loans, and services to support value chain collaborators as they develop their enterprise.
- As a **resource prospector**, value chain coordinators can also utilize grants and other external resources to test new business models and thus lower the financial risk of the businesses engaged in the value chain.

This activity was emphasized in a recent publication from the Federal Reserve Bank of St. Louis in their 2017 book, *Harvesting Opportunity: The Power of Regional Food System Investments*. Among their conclusions is that value chain coordination creates demand for

infrastructure and promotes regional collaboration as a path forward. In the early stages of market and value chain coordination the authors conclude that “Investing in people to focus on market development – long before sales revenue is sufficient to cover it – is essential.”¹³

This will create a business model that can grow all sectors of the regional food economy, creating new opportunities for existing farms, distributors, food aggregators and manufacturers, and food entrepreneurs of all kinds.

The value chain model also emphasizes ways to create options for increasing community involvement and community benefit. Coordinating food assets in ways that can serve individuals, neighborhoods and regions in all phases of the food system can bring new economic development and mitigate some of the causes and effects of food deserts¹⁴ in our communities.

In the case of an InCity Controlled Environment Agriculture (CEA) farm, this step can be managed with great efficiency and speed. This is because there is a single growing location and plants and fish can be harvested at both their peak flavor and nutrition points and then quickly delivered to local customers. With the InCity Farm model, this can also mean creating marketing systems that develop robust regional food sales channels for partners across the region.

The “InCity Farms Pittsburgh” will develop its own independent sales program but will also reach out to willing farm organizations and growers to find ways to “raise the tide for all boats.” InCity Farms CEA will grow a limited range of produce and fish year-round but can also work to help market seasonally grown crops from existing farms. This may be as simple as including links to area small-farm marketing cooperatives such as Penn’s Corner Farm Alliance¹⁵ on the InCity Farm web site and marketing materials. It is also possible that shared logistics options can be developed.

Creating an inventory of other regional supplier/growers and their capacities helps all involved. These operations are sometimes already organized (as with the Penn’s Corner Farm Alliance). For these and other



independent operators, information about their growing capacities can be included in the marketing strategies of the InCity farm operations. In this case, a larger InCity facility could act as an aggregator, and even a category manager for certain crops grown both at InCity and on seasonal farms in the area to market the full range of availability better than individual operations can on their own.

An outreach program will be initiated from the start to integrate existing producers and processors, distributors, buyers and business-to-business (B2B) customers with the possibilities of the InCity Farms model. A shared vision of what is possible – growing new markets for locally sourced InCity CEA farm foods - should excite regional food product manufacturers, processors and buyers and create new markets for local

growers. Presenting the InCity Farm as an opportunity to serve fresh, local grown food year-round as well as to launch and grow new food products and brands using locally grown ingredients offers regional businesses new opportunities to expand.

Programs aimed at providing early and effective linkages to existing regional food product manufacturers and processors will be key. Reliable year-round sourcing of regionally grown foods will allow those players to plan their markets more effectively and provide the InCity Farm operations with quality partners and effective forecasts for demand. It is believed that mutual planning with these groups will benefit all involved as well as minimize waste.

Engaging food manufacturers and buyers will also allow efficient transportation planning. Network management will include aggregation of information about customers' in-house and contract transportation capabilities. Advance coordination will maximize environmental and cost-saving opportunities.

Third-party distributors represent an integral part of the conversation and will be welcomed into the InCity Farms discussion early. These firms represent a significant value proposition for customers, not only in transportation but in marketing and sales. It is anticipated that a network manager can also serve as a sales liaison at distributor sales shows, for both value-added products emerging from the network and fresh foods from the CEA network.

The outreach to area food processors and businesses will be comprehensive. The Produce Marketing Association reports local food sales totaled about \$12 billion in 2014, up from just \$5 billion in 2008, citing information from the U.S. Department of Agriculture. USDA predicts the market value for locally produced food could hit \$20 billion by 2019¹⁶. InCity Farm will create education and marketing opportunities for area food businesses to learn about sourcing locally grown products year-round to support their own food businesses. In the case of food product groups like members of the Pittsburgh Food and Beverage Network and other regional food manufacturing companies,

they can have the ability to pre-order locally grown ingredients to match their own production schedules.

An active education program for food manufacturers in the region will be developed so that these companies understand the opportunities that sourcing from the InCity CEA represents.

InCity Farms will also work with restaurant and hospitality groups, so they can utilize the system to pre-order InCity produce to match their own schedule. This will ensure freshness and uniformity.

When appropriate, product manufacturing capacity can be identified at existing food manufacturers or partner facilities, and every effort will be made to help those facilities utilize InCity grown produce to add to their existing product lines and grow their business models. We will also help market InCity Farm products in ways that connect these third-party contract food manufacturers with food entrepreneurs wanting to utilize InCity grown foods.

The InCity Farm team has begun establishing relationships with a number of the groups discussed. A larger outreach effort will be undertaken as the project moves forward.

Linkages to business and community affiliates. Developing a CEA network in the region.

To maximize the economic and community development opportunities a regional Controlled Environment Agriculture (CEA) network can deliver, effective linkages need to be developed with a wide range of business and community affiliates.

The team will undertake an asset mapping strategy that will begin prior to the launch of the first CEA facility. During this phase, potential customers/users of the foods coming out of the InCity Farm operations will be identified and brought into the network as appropriate. Some discussions with major distributors are already underway. The team will develop a list of likely plants and fish to be grown at InCity and survey regional food

companies to see if these fit their needs. While it will be too early to discuss price, we can certainly capture (1) interest of buyers and (2) ways their supply chains move current product to them. In many cases this will help develop information and strategies for distributors to increase their share of local content and increase sales. With customers not served by distributor-partners we can gain information about their current suppliers and expand our distributor network. It is also possible that many of these possible customers will prefer a self-pick-up option, in which case a 'will call' capacity can be considered for the InCity operations.

The goal of the CEA network will be to develop markets and bridge sales gaps wherever they are identified. Early communication efforts to build working linkages around a 'common good' will be key. While many pre-existing regional food links are now in place, collaboration around a specific new project can bring out new people, new networks, and new energies in the region.

We propose organizing an initial network of interested people and organizations into a voluntary group supporting a regional CEA development plan across the Peoples service territory. This arrangement would help focus discussions on developing this opportunity, while at the same time marketing the InCity Farm capacity to and through existing food and beverage networks across the region.





Our team would provide early-stage network services such as administration, internal communications and marketing for members, and focused external communications representing the project in the media when appropriate. As the project matures, face-to-face gatherings can be scheduled and managed by the CEA network.

All of these groups will be welcome to participate in educational and business development events held in conjunction with the opening of the InCity Farm and ongoing programs that develop the food business climate in the region. It is anticipated that several additional InCity Farm sites will be developed in the region. Collaboration with these business and community affiliates will be important to that process.

Developing incubation and acceleration centers

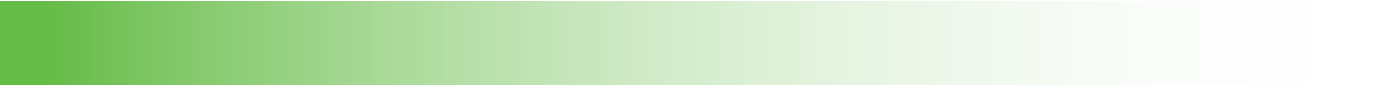
As part of the value chain coordination role, the InCity team will reach out to all existing incubation and acceleration centers in the region. We will do this to make sure our referral network is as valuable and complete as possible, allowing us to direct inbound food entrepreneurs to the appropriate resources. In this

case, resources can include educational institutions, NGO operations, and for-profit suppliers. We will also use these links to “push” information about the InCity Farm and its regional food network partners out to the training and incubation centers. This “information hub” approach can provide a valuable broad-view, from training through production not typically found in the more focused training and acceleration centers.

Incubation and acceleration centers can include knowledge-groups like the emerging Pittsburgh Region Food and Beverage Network.¹⁷ Having close ties to the emerging InCity Farms will allow the network to plan for new product opportunities in collaboration with the growing operation.

Knowledge of CEA grown foods and connections to seasonally grown foods from the region’s farms can create a ‘category manager’ role for the InCity team that helps with marketing and sales in ways individual operations might not be able to on their own.

In the world of food product development there are production steps that lead from early stage through large scale product manufacturing. Each of these must be mastered before moving up.



Much of the focus nationally has been on creating educational entry points for new food entrepreneurs to become trained in food safety, procurement, food labeling, and certifications for home and hourly rental kitchens.

The InCity Farms team will actively partner with existing education and food incubation programs that offer this early stage training. It would be a goal of our team to ‘grow our own customers’ from within this group by making sure all the related programs were aware of the opportunity the InCity Farms team represents. There are a number of good early stage development programs available in the region, including Chatham’s Eden Hall campus, the Smallman Gallery, etc.

There are also a number of mid-tier contract manufacturers that will take on the task of manufacturing a product for outside parties, but the products must meet their minimum orders, which can be prohibitive for small food businesses. The InCity Farm team is actively looking for this group to become customers – and also as food manufacturing referral sites.

We believe a significant hurdle for smaller scale food businesses and food entrepreneurs is the dearth of small-batch, professionally managed contract food manufacturing services. It is anticipated that some InCity Farm mid-tier co-packing customers will have excess production capacity to meet this demand. This capacity will be identified and marketed first. It may be that there is also appropriate unused capacity in the region that the CEA network can help revitalize and bring into network service.

As a major new food grower in the region, with ties to many food product manufacturers and manufacturing centers, the InCity team will be able to play a key ‘matchmaker’ role among food entrepreneurs and service providers. Pre-launch work will include researching the needs for food product aggregation and additional small-batch contract food manufacturing capacity.

The main goal of a facility like this would be value-added food product manufacturing capacity to serve the small-batch artisan food markets. This type of food

product manufacturing capacity specifically assists local food businesses and food entrepreneurs to expand their sales markets, by giving them the opportunity to have products professionally made for them in smaller quantities under their brand names using their recipes. With the right marketing approach, this capacity can serve to grow neighborhood businesses, and the food economy region-wide.

Restaurants and food businesses in the region could have their own brands produced at smaller scale. This specifically could support the many family and independent restaurants, taverns, and food companies in neighborhoods and communities in the region, while serving as a ‘built-in’ market for InCity grown foods.

An additional focus for a processing/stabilizing capacity could be dealing with the issue of produce ‘seconds’ coming from area seasonal farms and perhaps InCity Farm. “Seconds” are produce that is cosmetically imperfect but nutritionally valuable. Seconds can be harvested and minimally processed into value-added food products such as jams and spreads, or ingredients for use in other products, maximizing facility value while minimizing waste.

If the need for a contract food manufacturing facility develops, the facility could serve multiple purposes if designed appropriately. These could include job training for targeted adults, career education for youth, and employment opportunities for people with disabilities.

A facility of this type would also serve as an “intake funnel” for the larger contract food manufacturers and food businesses in the network. Products and brands that would otherwise be too small to match up with requirements of the larger facilities could start in the smaller facility. As they grew, opportunities to introduce them to the next levels of third party production would be available as well as introductions to partner firms interested in making strategic investments in the growing brands. A production facility of this capacity would grow both small emerging food businesses and also benefit the medium and large food companies in the region.



The next stages of planning will need to include research into the current and future needs for additional small-batch aggregation and manufacturing capacities.

The new CEA network would be an ideal format in which to create regional understandings and partnerships to launch these types of facilities.

Strengthening distribution and end market applications

Sales and marketing for the InCity Farms network output should begin early. The goal is 100% utilization and zero waste. In the early stages, the sales and marketing efforts are anticipated to follow a business-to-business (B2B) approach with a priority to member organizations.

Distribution partners will be identified and integrated into the network. Their B2B sales capacities will be identified and marketing will be targeted to their strengths.

A prime goal would be to welcome fresh food distributors with roots in the region and coverage that matches closely with Peoples.¹⁸ Understanding their

needs early will help optimize development of the CEA facilities.

Where gaps in the infrastructure may appear, the InCity Farm network will work to develop resources to alleviate those gaps.

Importantly, the InCity Farm team will actively assist in the development of education and outreach programs aimed at B2B sales to food businesses that seek to increase the local content of ingredients in their sales.

Overall, the vital role that the InCity Farm team will play will be to identify and bridge sales gaps, minimize sales friction and to grow sales for the InCity Farm and partner organizations.

Our model links current producers and processors, develops needed acceleration/production capacity, and strengthens distribution and sales options. This serves multiple region-wide goals. Included in these would be regional, urban/rural, and neighborhood economic development, job growth and training options, environmental responsibility, and creating solutions for improving basic human needs and revenue generation across the region.

Summary

InCity Farms – in particular the post-harvest opportunities this new facility represents – creates a significant new opportunity to grow the entire food business ecosystem in southwestern Pennsylvania. Small farms and food businesses would see a direct benefit through the increased focus on locally grown foods.

While the demand for locally sourced foods is strong, currently there is a limited supply due to seasonality, current business models and infrastructure.

The role the InCity team can play in value chain coordination is vital. Utilizing this 'hub' facility to aggregate food and food services will create many new food business and employment opportunities. According to the Southwestern Pennsylvania Commission (SPC), "Growth in the local food supply could have ripple effects across many economic sectors and all of the SPC counties. An analysis using Implan modeling software shows that 30,000 more jobs could be created in the region if activity in the food supply chain expanded by 10 percent."¹⁹



In their summary, including barriers and opportunities, the SPC cites the following:

- Higher margin, value-added products and processing offer viable options for increasing sales and income for local producers, according to research from the USDA.
- Increasing demand for food from counties with emerging economies offers opportunities for producers and food manufacturers in Southwestern Pennsylvania.
- There are numerous organizations across the ten counties that focus on serving parts of the local food value chain or organizations representing a statewide trade group. However, there are no efforts to build regional businesses or groups directed towards value-added processing.

The InCity Farm can bring year-round, locally grown foods to market while helping grow the local/regional food business economy year-round. Job opportunities will grow in all sectors of the food business supply chain, and new employment opportunities and job training programs will be developed. It is anticipated that post-harvest opportunities developed around the InCity Farm will create a net 'export' market for foods grown in the greater Pittsburgh region and exported elsewhere.

New aggregation and production facilities can be efficiently developed as new demand is added over time.

SECTION SIX

BUILDING FOR OUR FUTURE Food21 INSTITUTE FOR FOOD AND AGRICULTURE

Food21 Institute – Building a CEA Future for the region

Lastly, Peoples is proposing that, as we build these initiatives in urban agriculture and strengthening and expanding our local food economy, we capitalize on what we are learning to develop a truly 21st century food system for our region and communities.

To that end, we seek to form an institute where best practices, technology innovations and entrepreneurship can come together. In Pittsburgh, our history is full of successful examples in bio-science, robotics, software, advanced manufacturing, medicine and others. Over the last several years we have been partners in establishing the Energy Innovation Center (EIC),²⁰ which is becoming an important gathering point for industry, academia, and the larger regional community.

As we noted earlier in this report, much work has been done around the country in advancing the development of CEA technology. The lessons of how the Netherlands has become so advanced are important. There was no silver bullet in their achievements, but rather a complete and iterative process of development, application and more development. We think that the importance of what this effort represents deserves to have a place where we all can continue to grow and learn.

We see the institute as serving several important purposes.

First, it will serve as a gathering point for companies, academics, technology developers, foundations and community thought leaders to discuss and share the ideas and opportunities that come from advancing the way we grow, process and distribute healthy food to our region and beyond. As far as we know, this would be the only

such center of its kind with a specific focus around the development of advances in the fields of food and energy.

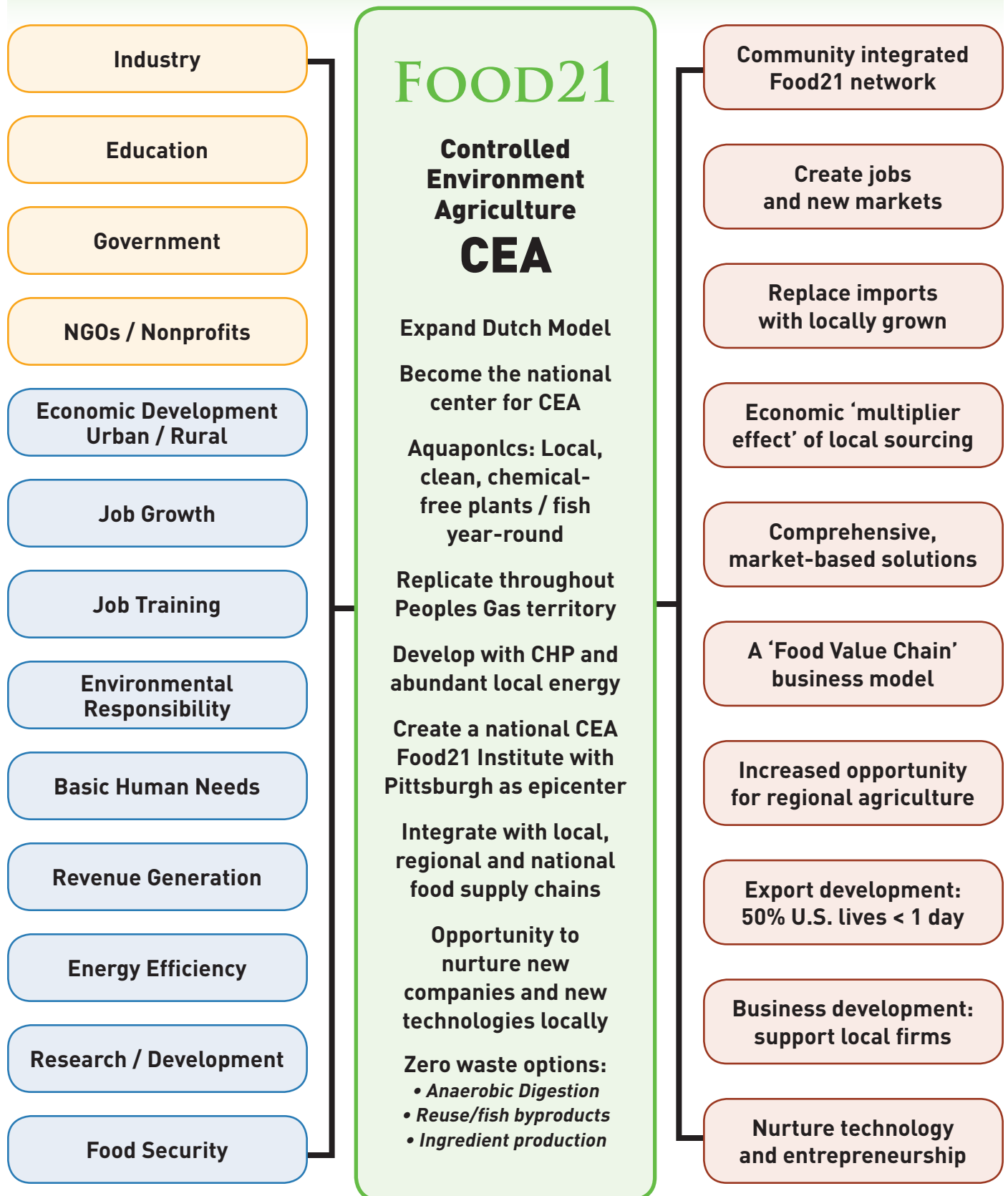
Second, the institute will develop a center for technical assistance²¹ that will make what we are doing and what we know about CEA, CHP and value chains available to our communities and businesses. Peoples will take the first step and commit engineering and technical resources to aid such a center. Peoples has already identified over 300 greenhouses, garden centers, and warehouses that could possibly be used as CEA sites. Peoples will look to support efforts to increase efficiencies, improve sustainability and extend the production capacities of these and any such CEA facilities that could be developed in the future. Providing a resource center for assistance to area farms, non-profits, and community development efforts would advance all of our interests.

Third, starting in 2019, we will bring together our friends and colleagues and initiate a conference to discuss CEA, CHP, fuel cells, alternative energies, and value chain development.

Following the release of this report, Peoples and Hollymead Capital will seek to engage aligned institutions, who share our views and commitment, to continuing the development of CEA and the opportunities that come from it in growing the vitality of our regional food system.

We think the future of our region's food system can be exceptionally bright and everyone who is a part of it – from our region's farming community to the neighborhood grocery – can prosper and grow while meeting this most basic of human needs.

Leveraging natural assets and markets. Pittsburgh and the future of food.



ABOUT THE AUTHORS

This project was carried out by Hollymead Capital under the guidance and direction of Peoples. Hollymead Capital was established to advance socially responsible solutions, grow our local economy through the acquisition of succession risk businesses in important sectors of our economy and provide capital solutions to businesses.

The primary contributors to this report are:

Joe Bute. Joe is the founder and managing partner of Hollymead. He has over twenty years of front-line experience in community development having worked in Chicago, Oakland CA and Pittsburgh in leadership positions. His work has covered areas of youth development, job training, economic development, real estate development and enterprise development. Beyond that, he has another twenty years of successful experience in lower middle market investing and is currently a partner with Hollymead Capital Advisors which is a general partner in regional food businesses. His work in the region's food system is also well-known. He led the team that designed the business model for the Republic Food Enterprise Center, taught food enterprise at Chatham University's Food Studies program and is an executive in residence at the David Berg Center, University of Pittsburgh, with a focus on regional food systems.

Glenn Ford. Glenn is Founder and CEO of Praxis Foods. Glenn used his advanced degrees in Economics and Business Management to reach senior levels of Fortune 100 companies. He formed Praxis Holding Company and InCity Farms to use the necessity of food as a means of assisting inner cities and rural communities. In addition to having been an investment banker, he has held positions with Indiana National Bank, American Hospital/Baxter Healthcare, EDS, and PepsiCo where he led a domestic and international team in new concept development. While doing turnaround work he simultaneously taught business courses at Saint Thomas University, Concordia College, and for the

SBA's Emerging Leaders program. Using experience in infrastructure development, his responsibilities included managing the scientific products division of American Hospital and its supply chain management and logistics.

Rick Terrien. Rick is the founder and principal of Artisan Food Networks. His career has focused on developing new business markets and new products. Past recognition includes recognition for the United States Small Business New Product of the Year by the National Society of Professional Engineers. He was also recognized as one of Fast Company Magazine's 'Fast 50', now called the World's 50 Most Innovative Companies, and twice awarded the Wisconsin Governor's New Product of the Year Award. He is an inventor with multiple patents in environmental systems. He has over 10 years of experience developing artisan-scale food value chains, with a focus on sustainability, and was the business development director for the launch and growth of the Wisconsin Innovation Kitchen.

Footnotes

- ¹ A good place to start to understand our vision for the region can be found in the September, 2017 issue of National Geographic entitled "This Tiny Country Feeds the World". It is an insightful discussion of how the Dutch transformed their agriculture to a year-round and sustainable model – so much so that they are now one of the leading exporters of food for the world.
- ² This region comprises the eastern counties of Ohio starting at Cuyahoga (Cleveland) on the north and the western counties of Pennsylvania starting at Erie. Generally, this is the Allegheny Plateau. It enjoys a temperate climate, good access to water and is within approximately one day's drive to over half the population of the United States.
- ³ Southwestern Pennsylvania Commission. Local Food System Investments to Transform Communities, 2015. This report was compiled by staff at the SPC after reviewing all available public sources as well as conducting ten county-level planning meetings on the regional food system. It is available at www.spcregion.org and can be readily downloaded.
- ⁴ Regional Food Infrastructure Network (RFIN). This report was completed for the Pennsylvania Association for Sustainable Agriculture (PASA) in 2008. At the time it estimated that for all of western Pennsylvania, farmers sold approximately \$13 million directly to consumers. While an exact number is not known, most efforts to quantify all sales of farm products to local consumers, distributors and retailers would indicate that no more than 2-4% of the total spending in food in the region will have come from local sources. This is fairly consistent in studies that have been done in other urban-rural regions of the eastern United States.
- ⁵ USDA, 2012 Agricultural Census. The next census was completed in 2017 and will become available to the public in late 2018.
- ⁶ The vast majority of farms in the region require off-farm income in order to survive. Recent articles in the regional press have documented the stress on western Pennsylvania dairies with the closing of the Dean's processing facility in Sharpsville.
- ⁷ The team has had discussions with local and regional funding organizations such as KIVA, Bridgeway Capital and several Small Business Development Centers – all of whom report that when they invite early stage entrepreneurs and businesses to workshops the groups are always well represented by food enterprises.
- ⁸ One interesting case study is Pittsburgh Pickle Company. This local start-up has had great success in getting their excellent products into retail channels and working with Sysco for distribution. Yet they reported frustration at the ability to source quality, consistent and locally grown produce – particularly cucumbers. Today during the off-season they have to import their cucumbers from Mexico and experience a high rate of waste due to spoilage.
- ⁹ Southwest Pennsylvania Commission. Local Food Supply Chain Initiative in Southwestern Pennsylvania (1-4)
- ¹⁰ Value Chain: "A **value chain** is a set of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market." https://en.wikipedia.org/wiki/Value_chain
- ¹¹ Food Value Chains: Creating Shared Value to Enhance Marketing Success. U.S. Dept. of Agriculture, Agricultural Marketing Service, March 2014.
- ¹² Role of Value Chain Coordinator. "Value Chains. Creating Shared Value to Enhance Marketing Success. July 2014. USDA
- ¹³ Harvesting Opportunity: The Power of Regional Food System Investments to Transform Communities. Chapter 8. Use it or Lose It: Local Food, Regional Processing and the Perils of Unused Capacity
- ¹⁴ Food deserts are defined as parts of the country void of fresh fruit, vegetables, and other healthful whole foods, usually found in impoverished areas. This is largely due to a lack of grocery stores, farmers' markets, and healthy food providers. American Nutrition Association Nutrition Digest. Vol. 38, No. 2.
- ¹⁵ Penn's Corner Farm Alliance is a co-operative of approximately 60 area farms. The co-operative provides distribution and sales support to its members primarily around fresh, in-season produce which is sold to area restaurants, a regional CSA and at Farmer's Markets in the city. The InCity Farm team will seek to work with them, align production capacity to enhance their farm members as well as help them promote their own private label of shelf-stable items.
- ¹⁶ Produce Retailer. August 8, 2017. 'Demand For Local Continues to Grow'.
- ¹⁷ Pittsburgh Food & Beverage Network is an informal association of over 35 food and beverage makers in the greater Pittsburgh region. It has been forming gradually and building a structure around peer-to-peer support and resource sharing. The group's goal is to have about 100 members by 2019 which would represent about 25% of all food manufacturers in the region.
- ¹⁸ At least two significant produce distributors in the region have been identified and discussion has begun with them to determine their interest in entering into growing contracts for the year.
- ¹⁹ Southwestern Pennsylvania Commission. Local Food Supply Chain Initiative in Southwestern Pennsylvania. Chapter 6
- ²⁰ The Energy Innovation Center recently opened in Pittsburgh. This was developed as a joint venture between the university, public sector and private sector to support and grow energy technology companies. Peoples is also using this as a CHP demonstration site.
- ²¹ Since this effort has begun, Peoples has been meeting with and offering assistance to community based businesses and community organizations that have been operating or developing greenhouses and other year-round growing facilities. The Institute will offer technical assistance. One of the first intensive efforts will be with the Mathieson Center of Bidwell Training Center, a 40,000 square foot greenhouse that is primarily used for instruction in horticulture. A CHP project along with development of a new enterprise effort will be targeted here.

APPENDIX: Agriculture in the Netherlands

Barry Kukovich, Contributor

The impetus for Peoples' interest in Controlled Environmental Agriculture derives completely from current farming practices in the Netherlands. Two decades ago, the Dutch made a commitment to environmentally sustainable agriculture. Today, the Netherlands is the world's second greatest exporter of food (as measured in value) behind the United States.

To accomplish this astounding achievement, they blended together greenhouse construction methods, farming methodologies, lighting technologies, robotics, bio-sciences, chemistry, carbon capture, and energy production. Their organizational model for advancement was based on America's own Silicon Valley.

This new agricultural model has almost eliminated the use of pesticides, uses 90% less water, grows crops throughout the entire year and is capable of food production vastly greater than traditional farming methods. Whether it is done aeroponically, hydroponically, or aquaponically, it can be accomplished without soil depletion.

There is an increasingly critical need to recognize and emulate their achievement. The need is focused by the simple truth of the world's expanding population, projected to reach 10 billion by the year 2050. According to Dr. Ernst van den Ende, the Dean of Wageningen University & Research, the world's top agricultural research institution, "The planet must produce more food in the next four decades than all farmers in history have harvested over the past 8,000 years."

The Dutch have given us a model to solve the food production problem. Essentially, many more "Hollands" need to be developed both worldwide and in the USA. Why not develop these new agricultural resources in our region of Pennsylvania, Ohio, and Appalachia? Peoples Gas drives its business on several assumptions. One of these assumptions is that "our company is healthier if the communities we serve are healthier." To that end, we continue to commit resources throughout our service territory both to stimulate economic development and job growth and to serve immediate social needs

like supporting food programs. When confronted with the Dutch agricultural model, we cannot help but recognize how our business and our outlook of social responsibility intertwine with it.

"Controlled" is the key word for us in Controlled Environmental Agriculture (CEA). The Dutch success is based on controlling the environment within its vast array of greenhouses. The threats that farming has faced during the past centuries have been eliminated. The economic tightrope that farmers walk upon every year and every growing season is gone. It's been replaced with a path to economic stability and sustainability.

This has been accomplished by controlling the environment. Pests have largely been eliminated, mostly without pesticides, and soil depletion is no longer a concern. Even personal danger to the farmer, traditionally one of the world's most dangerous and injurious occupations, has been almost eliminated. But the greatest control is in regard to the weather. Under greenhouse glass, the weather no longer threatens crops with drought or too much rainfall. There is no longer a threat to plants from too much cold or too much heat. This accomplishment is due to the use of energy and, specifically, the energy of natural gas and the use of Combined Heat & Power (CHP).

CHP is the cornerstone of CEA's success. The Dutch use natural gas and biogas to serve their electrical, heating and cooling needs. They also use it for carbon production to feed plant growth. By doing so, they have developed the most economic system possible to push the production of food that ensures profitability and sustainability. In addition, they have accomplished all this in an environmentally sound system. At Peoples, we recognize this use of natural gas and CHP as a building block for what will become modern agriculture. The natural gas industry must be a necessary partner in building the new agriculture today.

APPENDIX: Community Inclusion – The Opportunities and Benefits of this Strategy

Rick Terrien, Contributor

There are missing voices in our food system. The inner-city resident, the rural farmer who doesn't grow soybeans, wheat, or corn, and those not immediately skilled can gain skills in a great environment. While everyone in our society eats, not everyone gains financially or enjoys the employment benefit from the provision, storage, or logistics of food. New regional foods systems have the ability to become the catalyst activity that promotes the reestablishment of food grown within distances allowing maximum nutrition and jobs. Our urban communities have been excluded from one of the most valuable means of income, which is production. These communities, provided with new tools, will have the ability to work themselves out of challenging circumstances and the chance to provide for their families.

Simply providing services to a community minded Controlled Environmental Agriculture (CEA) facility should provide products, services, and job growth. These are some of the needs that can be met via InCity neighborhoods:

- Hatcheries
- Food Processors
- Composting Sites
- Anaerobic Digesters
- Vermiculture Protein Collectors
- Fish Breeders
- LED Assemblers
- Laundry Services
- Organic Fertilizer Providers
- Bee Keeping
- Equipment Repair
- Pest Control
- Pollinators
- Accountants
- Lawyers

- Truck Drivers
- Lawn Services
- Environmental Testing
- Greenhouse Assembly
- Precision Plumbing
- Co-Packing Operations
- Bakers
- Cleaning & Maintenance

There are also brands that can be created in these communities that can sit on retail shelves, be sold at farmers markets, and be used at local restaurants. This list is by no means complete:

- Salad Dressing
- Coffee
- Prepared Foods
- Baked Goods
- Breads
- Cheese
- Infusion Products
- Yogurts
- Mushrooms
- Juices
- Jams and Jellies
- Baby Foods
- Ice Cream
- Seasonings
- Cleaning Products

APPENDIX: The Power of Collaboration to Remake Regional Economies

Glenn Ford, Contributor

There is already proof in Pennsylvania of the merits of collaboration. However, there are other efforts that have been relatively beneficial but are operating in silos. If these efforts could work in concert and be expanded, it would create a progressive leap for the state. As we consider several options, we should not feel we are limited to sales only in our state. Neighboring states that continue to ignore the power of food will be attractive customers who will merit additional exploration by Pennsylvania producers. Pennsylvania has the advantage of having one-third of the United States population within 500 miles. While the CEA Food Institute will focus on the needs of Pennsylvania at its core, Peoples' service territory in West Virginia and Kentucky will be included as well.

The opportunity to be a food exporter brings multiple benefits to the lifestyles of all in the state. Efforts will be more effective if they are connected to the institute. Our territory is a large one, but it imports the majority of its food from across the nation and foreign countries. The state literally does not feed itself based upon the amount of food grown. The University of Pennsylvania already demonstrated an excellent example of import substitution: The university shifted over 10 percent of its annual expenditures to purchasing locally, injecting an estimated \$80 million into the west Philadelphia economy in 2006-2007.

The Labor Participation rate of Pennsylvania is 62.4 percent. In determining the labor health of a community, it is important to look at both the labor participation rate and the unemployment rate. The participation rate and unemployment rate gauge the health of the U.S. job market. The key difference between the two indicators is that the participation rate measures the percentage of Americans who are in the labor force, while the unemployment rate measures the percentage within the labor force who are currently without a job. Many economists argue that the labor force decline is the result of low-skilled workers who have lost jobs to outsourcing or automation, having no success finding new employment and, therefore, dropping out of the labor force entirely. For this

reason, economists feel the participation rate is a more accurate measure of the job market than the unemployment rate, which only considers those in the labor force. An unemployment rate of 5% means only five out of one hundred workers **in the labor force** are without jobs, but it does not consider those unemployed workers who have given up looking altogether, even though they desire to work.

As Americans we are a truly independent people, and we pride ourselves on our rugged individualism. We do not mean to change the country's zeitgeist, but the 21st century requires a fresh look at how to accomplish our best outcomes. Some regions have worked decades and not accomplished much in changing their food systems. Any region in the nation, and certainly western Pennsylvania could dramatically improve both the speed and range of progress by embracing a collaborative effort in which unique individual talents are harnessed to accomplish a collective and greater mission. There is an old saying that says, "If you want to go fast, go alone, but if you want to go big, bring others." We choose to go big.

Peoples is proposing a regional effort to direct our food economy. As a community participant, we believe CEA farming can be a monumental tool to bring employment and better nutrition to some of the 37.6 percent of our population looking for greater opportunity, as well as allowing all of us to eat better in a more prosperous community. We can capitalize on this basic, self-evident truth of creating equal opportunity, accomplishing more, and becoming better tomorrow than we are today. The tools in our hands to accomplish this are food and commerce. We propose a regional conference and ongoing dialogue concerning the direction of our local food economy. This conference will be convened in concert with the initiation of our corporate strategy to develop a CEA network as described in this report.

Because the challenges involve all aspects of an economic system – production, distribution, workforce, advances in technology, and capital development – we believe that a dialogue among all the affected parties should begin in 2019 while we begin to build this capacity and its networks.

To that end, we would propose co-hosting a conference in the spring of 2019 in partnership with others.

The central theme will be “building a resilient and sustainable food economy for the Pittsburgh region.” Coming out of this discussion, if not before, we would support the formation of an institute to serve as a gathering point for research, technology, innovation, training and education in both the private and public sectors. This institute would allow for both experimentation and evaluation of various approaches that increase the role of a regional food system in our region. We would want this to be a way to gather best practices and ideas from areas not only throughout the United States but also across the globe. Our whole journey in this conversation began with the inspiration of the innovations undertaken by the people of the Netherlands to completely transform their food system and reinvent how agriculture plays a bigger role in a prosperous economy.

The best examples of transformation in our own country are the histories of Detroit in the automotive industry and Pittsburgh in the steel industry. Other more recent clusters that continue to be immensely successful include healthcare, pharmaceuticals, medical devices, the Silicon Valley, and gaming. It is our belief that any region that marshals the most resources around a common vision will see the most benefit. More than a cluster, we can take the steps to the next stage, which is a collaborative and colocation economy that brings exponential advantage to participating enterprises through the interworking of the entities, the institute, and its efforts.

How did other clusters begin?

Silicon Valley – The Silicon Valley that we know today did not develop until after World War II. Fredrick Terman created an industrial park on 660 acres of the University of Stanford’s land which was leased to electronics and other high technology companies on a long-term basis. Hewlett-Packard and the Varian Brothers were among the first tenants. Terman also brought with him vast government capital for scientific research. This provided income to Stanford and created

an agglomeration in what was the beginning of a tech industry.

At first, industry came to Palo Alto to have access to the expertise at Stanford. Later, the level of technical expertise in the area’s industry exceeded the academic expertise of Stanford. At that point, the electronics industry expanded to nearby cities including Mountain View, and, later, Sunnyvale. Terman is a pioneer of what we consider today to be an “entrepreneurial incubator.”

Silicon Valley overtook Route 128 in terms of both profits and innovation in the 1980s, largely because the firms of Route 128 remained too attached to the basic research paradigm. Companies like Digital (DEC), Sun, and Symbolics methodically generated new systems including Digital’s legendary minicomputer, Wang’s pioneering word processors, the LOGO programming language, and the interactive-fiction Colossal Cave Text adventure. But they didn’t recombine into smaller, more agile startups that could yield more consumer-oriented products. In addition to the millions in government contracts, venture capitalists were willing to fund companies in a very speculative and hands-off manner, leaving the founders with ownership and control of the companies. The Fairchild Semiconductor flopped as soon as the founders sold their controlling interest to investors. Per the investors Martin Kenney and Urs von Burg, “What was important was the decision to fund businesses that have no clear route to profitability or significant exit.” This encouraged bubbles of various shapes and sizes, and we’ve seen at least two since the 1990s. But a decade later, people remember the undervaluation of Amazon, Google, and eBay more than they remember the overvaluation of Pets.com, 1-800-Flowers, and pretty much every .com. In essence the government, existing industry, and patient venture capital funded the effort.

Medical Alley in Minnesota – Not as famous as Silicon Valley is Medical Alley in Minnesota. Minnesota is home to more than 500 medical companies and health care organizations; most of them located in a geographic swath that starts in Duluth and cuts through the Twin Cities area to Rochester. This industry is Minnesota’s

leading employer and is still growing faster than any other. Consider the case of C. Walton Lillehei, Ph.D., M.D., the University of Minnesota's "Father of Open-Heart Surgery." In January 1957 Lillehei's surgical team used direct heart stimulation to successfully treat heart block in a young girl operated on for closure of a ventricular septal defect. The team even developed a method of attaching the device without opening the chest. By feeding the wire through a hollow needle to the heart, they saved patients who experienced sudden heart block in the days following surgery.

Still, the solution was unsatisfactory because the device had to be plugged into an electrical source, limiting patients' mobility and leaving them at risk of a power failure or accidental electrocution. That was when Earl Bakken "happened by," on his way to fix the EKG. "The hospital electricians wouldn't go into the operating room, so we found a young man with an electronics repair business and gave him a part-time contract to repair our devices. I remember Earl Bakken always got the job done right away," Lillehei says. "I described the problem to him and he said sure, he thought he could do it. So I arranged for him to see the heart block procedure in the dog lab with one of my residents, Vincent Gott. Six weeks later he was back with a box, 4 inches square by 2 inches high, and it worked great in the dog laboratory. We were soon equipping all our heart-block patients with the device, which they wore in a holster." The two formed a company called Medtronic, Inc. Like the Silicon Valley example, Medtronic relied on the University of Minnesota to train future employees. From that humble beginning arose a number of entities that either supported Medtronic or formed companies to cover areas that did not. This included relationships with a clinic in Rochester Minnesota formed by two brothers. The Mayos maintained an "open-door" policy to other members of the medical profession. During operations,

the brothers always discussed their procedures for the benefit of visitors. As the numbers of visiting surgeons grew, movable, elevated metal stands were positioned to allow a better view of operations from the sidelines. Over the operating tables, large adjustable mirrors provided a complete view of the operating field. This demand for advanced medical training led the Mayos to establish the country's first graduate program in clinical medicine. As their practice grew, the Mayos encouraged their medical staff to develop clinical specialties. Each physician devoted attention to a particular area of medicine, and all physicians combined skills to provide superior patient care. This specialization led to the development of new surgical disciplines, including orthopedics, neurosurgery, ophthalmology, thoracic surgery, and dental surgery.

The Mayo brothers routinely visited other medical centers around the world to learn more about new procedures and ideas. They brought their findings back to Rochester to implement. Soon, the growth of ideas attracted a group of investors who bet on the emerging companies that were offshoots of these businesses. So an entire industry was formed by the efforts and interaction of the Mayo Clinic, Medtronic, and the University of Minnesota.

The point of these two examples is to demonstrate the humble beginnings of two industries that continue to dominate their states, bringing billions of dollars to their communities. There is no reason why Pennsylvania could not be the Silicon Valley of Controlled Environment Agriculture. The factors in becoming an important industry cluster are (1) a pressing need; (2) an available workforce; (3) a collaborative environment; (4) informed and reasonable investors; and (5) government or municipal support in promoting the efforts.





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