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Seedling - A Circular Economic Agricultural & Hydrogen Utility

Seedling LLC is happy to share our attached Business_Overview that highlights our efforts toward installing regional public-private partnerships that transition organic fractionated municipal solid waste (OFMSW, aka food-waste) into both agricultural and zero emissions transportation assets for use by regional municipalities, universities, and partners. In the attached document viewers will find an overview to the Seedling system of technologies, featuring three scaled installations that produce between ~50kg & 1,270kg of hydrogen fuel per day. These installations rely on industry-available technologies and feature no technological barrier of entry beyond that of tailoring precision fertilizers to regional soils & crops (featured as an appendix to the document, coauthored grant materials for fertilizer development). Each installation aims to provide municipalities with a reliable source of hydrogen fuel for zero emissions fuel cell electric fleets (waste collection, mass-transit, governmental operations). In addition, Seedling's own distribution channel of hydrogen fuel cell electric mobile food solutions acts as a distributed generation microgrid for municipalities and partners during a crisis; each truck providing in excess of 60kwh in vehicle-to-grid support for the duration of 10-hours between fueling.
To fund these installations, Seedling works with federal, state, county, and municipal funding sources to leverage economic development bonds; paired with investment from university partners and private industry. We are seeking a preliminary investment of $9M for a SEED-150 installation (or $15M for a SEED-270) in partnership with a leading agricultural university in California.

Further inquiry into investment and technology partners can be sent to contact@seedling-PHL.com.

Thank you,
Travis Andren

President | Seedling LLC.
Chairman | D3 Designs Inc.
Adjunct Professor | Thomas Jefferson University
Palo Alto, CA

Additional submitted attachment is included below.

Seedling

Circular Economic Agriculture

2019 BUSINESS OVERVIEW

SEEDLING LLC.
CONSHOHOCKEN, PA
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Q3 2019

Contents:

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Additional information may be available upon request.

ABBREVIATIONS:

A
AD Anaerobic Digestion
Ag Agriculture
AgTech Agricultural Technologies

B
Bar Barometric Pressure
BEV Battery Electric Vehicle
BTU British Thermal Unit

C
CAPEX | CapEx Capital Expenditure
CEA Controlled Environment Agriculture
CHP Cogenerative Heat and Power
CO_2 Carbon Dioxide
CT Connecticut
Cu. Ft. Cubic Foot

D
D3 Diagnose. Design. Develop. D3 Designs Inc.
DOE Department Of Energy (US)
DOT Department Of Transportation (US)
DVO DVO Digesters

E
E Equity percentage
e. electricity
ea. each
EWG Environmental Working Group

F
FCEV Fuel Cell Electric Vehicle
FCFT Fuel Cell Food Truck
FCB Fuel Cell Bus
FTA Federal Transit Authority (US)
Fert. Fertilizer
FT^2 | Ft^2 Square Foot
FT^3 | Ft^3 Cubic Foot

G
g. gram
Ga. Gallon
GH Greenhouse
GW GigaWatt
GWHr GigaWatts per Hour

H
H_2 Hydrogen
H35 California designation for 350Bar
H70 California designation for 700Bar
H_2O Water

I
IoT Internet of Things
IBM Computing Company
IP Intellectual Property
IPP Independant Power Provider
IG Instagram
Inc. Incorporated
IRR Initial Rate of Return

K
kg kilogram
kW | KW |KWHr. KiloWatt per Hour

L
LLC Limited Liability Company
LRG Large

M
M Million
MW MegaWatt
MWHr. MegaWatts per Hour
MCFC Molten Carbonate Fuel Cell
Mo. Month

N
Nm^3 | NM^3
N/A Not-Applicable, Not-Available
NIFA National Institute of Food and Agriculture (US)
NYC New York City

O
OECD Organization for Economic Co-operation and Development
OFMSW Organic Fractionated Municipal Solid Waste
OpEx | OPEX Operating Expenditure

P
PA Pennsylvania
PAFC Phosphoric Acid Fuel Cell
PGH Pittsburgh, PA
PHA Polyhydroxyalkanoates Bioplastic
PHL Philadelphia, PA
PLA Poly Lactic Acid, compostably polymer
PM_{10} Particles Per Million
POS Point Of Sale
PSU The Pennsylvania State University

R
R&D Research and Development

S
SEED An individual Seedling installation
SAM Serviceabl Available Market
SOM Servicable Obtainable Market
SSM Site-specific Crop Management
SCF Standard Cubic Foot
SO_2 Sulfur Dioxide
SM Small

T
T US Ton = 2,000 lbs | 907.2 kg
TAM Total Available Market (Global)

U
US | USA United States of America
USDA United States Department of Agriculture
USD United States Dollar

V
VRT Variable Rate input application Technology
VF Vertical Farming

W
W Watt
WHr. Watts per Hour

AUTHOR | TEAM

About the Author:

Travis Andren
MS. Environmental Policy Mgmt | BS. Industrial Design
Founder | President: Seedling LLC
Chairman | CEO: D3 Designs Inc.

Seedling LLC. has been designed by Travis Andren as a continuation of extensive peer-reviewed academic research in circular economic systems relating to renewable energy, agricultural, and environmentally sustainable economics.

Acquired by D3 Designs Inc. in Q1 of 2017, Seedling LLC has been showcased globally as a representation of innovative approaches to advanced energy technology applications, as well as an example of food-system innovations. Through knowledge-sharing partnerships with suppliers and academic institutions, Seedling is now seeking capital investment for preliminary installation activities.

Featured in: SEEDS & CHIPS, Angel Venture Fair, Fuel Cell Seminar & Energy Exposition, Indiegogo, Barnraiser, Food is... Wasted

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Seedling

Circular Economic Agriculture

ENABLING REGIONAL CIRCULAR ECONOMIES BY BRIDGING RURAL AND URBAN AGRICULTURE IN PUBLIC-PRIVATE PARTNERSHIPS FOR THE PROSPERITY OF PEOPLE AND PLANET.

INTRODUCTION

Circular Economy

An idea for a truly sustainable future that works without waste, in symbiosis with our environment and resources. A future where every product is designed for multiple cycles of use, and different material or manufacturing cycles are carefully aligned, so that the output of one process always feeds the input of another. Rather than seeing emissions, manufacturing byproducts, or damaged and unwanted goods as 'waste', in the circular economy they become raw material, nutrients for a new production cycle.
Moreover, shifting to the circular economy could **unlock an estimated $4.5 trillion in additional economic growth** by 2030 and could be the biggest economic revolution in 250 years.[1]
Yet the U.S. ranks 18th in recycling among Organization for Economic Co-operation and Development (OECD) countries, with $11.2 billion in recyclables landfilled as waste annually.[2] Adopting closed loop, circular methods is the best way for companies of all sizes and industries to eliminate waste and recapture its value.

D3 DESIGNS Inc.

Parent corporation to Seedling LLC., D3 Designs was founded in 2007 as an Industrial Design consultancy.
A simple philosophy and three-phase practice; Diagnose, Design, Develop; resonates through D3 Designed products and Seedling development. D3 Designs Inc. provides R&D support services to Seedling LLC. through product development, using performance generated data from each Seedling SEED. D3 Designs Inc. technologies within this document are marked with the D3 Designs Inc. logo within the subtitle bar, as shown above.

A Delaware benefit-corporation (S-Corp structure, US Citizen investment only), D3 Designs Inc. has a stated public benefit ***to directly or indirectly through the use of one or more subsidiary companies, work with a range of stakeholders, including but not limited to, individuals, businesses, foundations, community organizations, and governments to solve economic, transportation, water, energy, environmental, agricultural and other related problems resulting from climate change and urbanization.*** - In accordance with Delaware law, all stakeholders within the benefit-corporation agree to uphold this public benefit.

D3 Designs Inc. reports sustainable metrics and adherence to the benefit statement for all subsidiary companies using the GRI Global Sustainability Standards in biennial reporting to shareholders, in adherence to Delaware benefit corporation requirements.

D3 Designs Inc.'s board of directors mandates a continued majority ownership of Seedling LLC.

SEEDs

Each Seedling installation is referred to as a SEED. Each SEED is public-private partnership, which is modeled to include: a regional university; municipality (waste management company in lieu of municipal waste management); transit authority; private industry partners; and nonprofit organizations.
Within each SEED, Seedling LLC maintains 60% equity ownership. Regional interests share 30% equity ownership.. The remaining 10% equity is dedicated to a trust that represents the interest of the staff of the SEED location.
SEED-PSU is a planned partnership between Seedling and Pennsylvania State University. This small-scale installation will provide blockchain-precise formulation of fertilizer nutrient profiles that are responsive to regional soil nutrient profiles and crop selections. This R&D facility acts as the testable scale model for regional SEED installations globally.

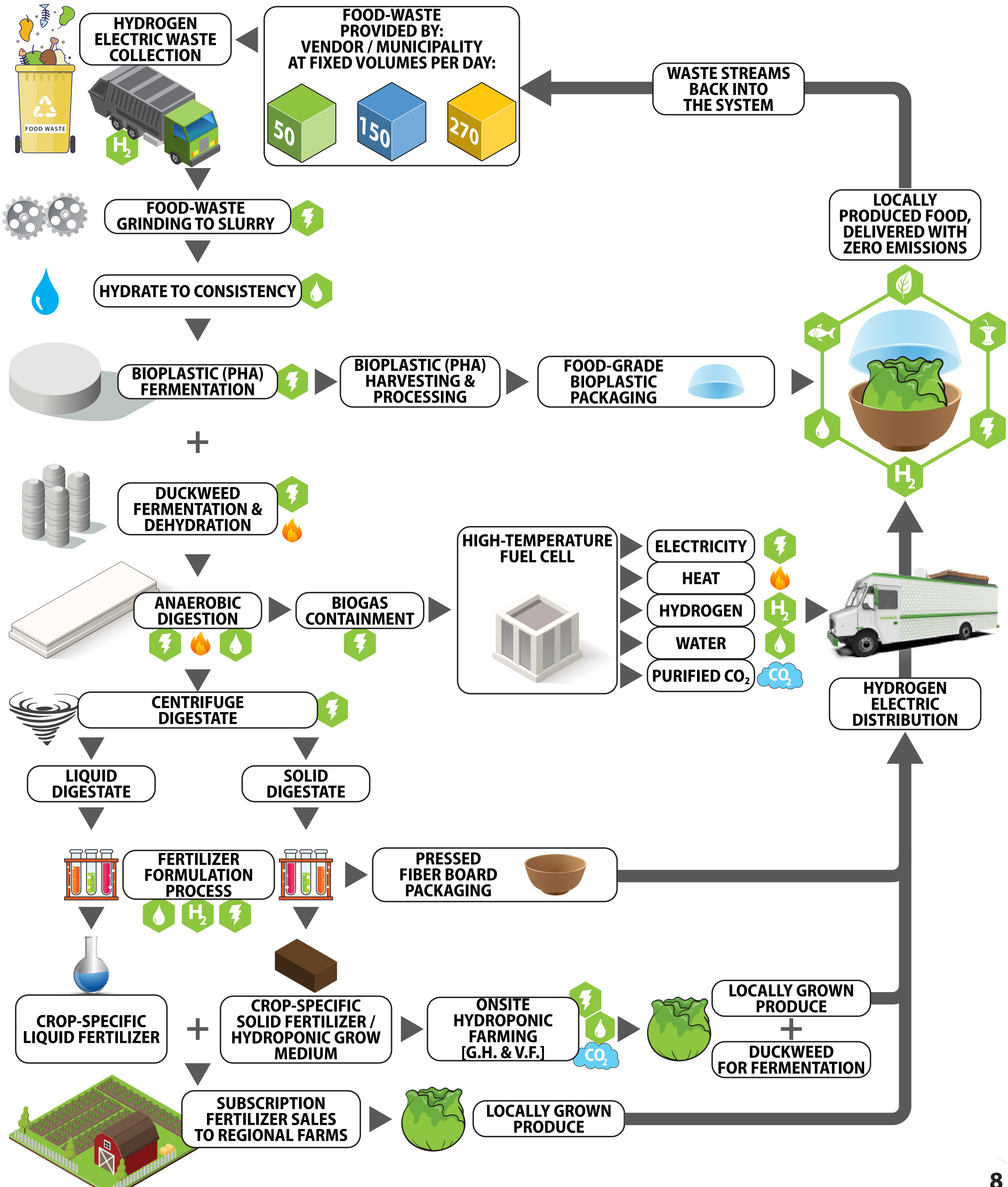
Roots LLC.

Roots LLC.* is a mobile food distribution leasing company that connects the SEED's mobile food vending equipment with regional chefs to provide direct-to-customer channels for food grown by Seedling fertilizer customers and the regional SEED. Roots LLC. is owned by D3 Designs Inc. and partners with each SEED location to provide brokerage services to the SEED.

[1] P. Lacy and J. Rutqvist, Waste to Wealth: The Circular Economy Advantage (London, United Kingdom, Palgrave Macmillan, 2015).
[2] C. MacKerron, Unfinished Business: The Case for Extended Producer Responsibility for Post-Consumer Packaging (San Francisco, CA, As You Sow, 2012).
* Roots LLC business filing pending.

INTRODUCTION

How Does a SEED Work?



MARKET TRENDS | PROBLEMS

Food-Waste

Exponential global population growth continues to place increasing pressure on agriculture and waste-management systems. In the United States, food waste is estimated at between 30-40 percent of the food supply. This estimate, based on USDA's Economic Research Service finding of 31 percent food loss at the retail and consumer levels, corresponded to approximately **133 billion pounds and $161 billion worth of food in 2010.**[3]

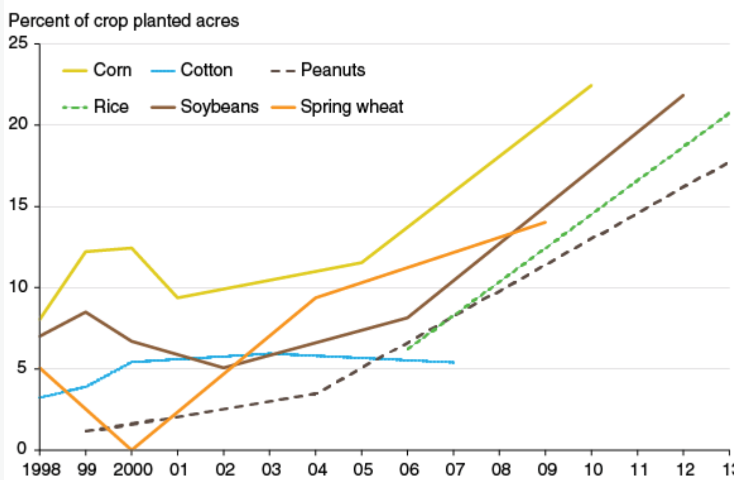
This amount of waste has far-reaching impacts on food security, resource conservation and climate change.

- The land, water, labor, energy and other inputs used in producing, processing, transporting, preparing, storing, and disposing of discarded food are pulled away from uses that may have been more beneficial to society – and generate impacts on the environment that may endanger the long-run health of the planet.
- Wholesome food that could have helped feed families in need is sent to landfills.
- Food waste, which is the single largest component going into municipal landfills, quickly generates methane, helping to make landfills the third largest source of methane in the United States.

Seedling proposes a systematic solution that utilizes organic fractionated municipal solid waste (OFMSW) as a source of organic nutrients and embodied energy, both assets that support an integrated systems that operate carbon-negative, while also providing regional farmers with a cost-effective source of organic fertilizer.

Precision Farming

VRT use has risen to about a fifth of planted acres of corn, peanuts, soybeans, and rice



USDA, Economic Research Service using data from USDA's Agricultural Resource Management Survey (ARMS) Phase II.

The USDA's National Institute of Food and Agriculture (NIFA) identifies site-specific crop management (SSM) using a variety of technologies to manage different parts of a field separately. Natural, inherent variability within fields means that mechanized farming could traditionally apply only crop treatments for "average" soil, nutrient, moisture, weed, and growth conditions.

Necessarily, this has led to over- and under-applications of herbicides, pesticides, irrigation, and fertilizers —except on those rare sites that are truly average. Chemical excesses from blanket applications, then, end up running off or leaching from fields into ground water and surface waters. Most current SSM practices use precise global positioning combined with location-specific measurements—either in-field data collection (such as soil variables or pest occurrence) or remotely sensed data (such as from aircraft or satellites)—to quantify spatially variable field conditions. Within-field operations, then, adjust treatments based on spatially referenced management decisions recorded on maps of management zones.[4]

Variable-Rate input application Technology (VRT) allows farmers to customize the application of fertilizer, chemicals, and pesticides using GPS data—often from yield and soil maps or guidance systems. Farmers use VRT to plant different types of seeds at different locations with a single pass of the tractor.[5] The chart above indicates increases in VRT utilization.

Seedling's precision fertilizer formulation responds to this market demand increase for soil-specific nutrient formulas. D3 Designs efforts toward in-field diagnostic hardware will inform the regional SEED of the customer-farmer's nutrient demands. Subscription fertilizer services fulfilled by the SEED delivers soil/crop specific organic fertilizers.

[3] USDA. Office of the Chief Economist, Frequently Asked Questions. https://www.usda.gov/oce/foodwaste/faqs.htm, 2018.
[4] USDA. NIFA, Precision Agriculture in Crop Production. https://nifa.usda.gov/precision-agriculture-crop-production. 2018.
[5] USDA. ERS. Schimmelpfennig, D., Precision Agriculture Technologies and Factors Affecting Their Adoption. https://www.ers.usda.gov/amber-waves/2016/december/precision-agriculture-technologies-and-factors-affecting-their-adoption/. December 05, 2016

MARKET TRENDS | PROBLEMS

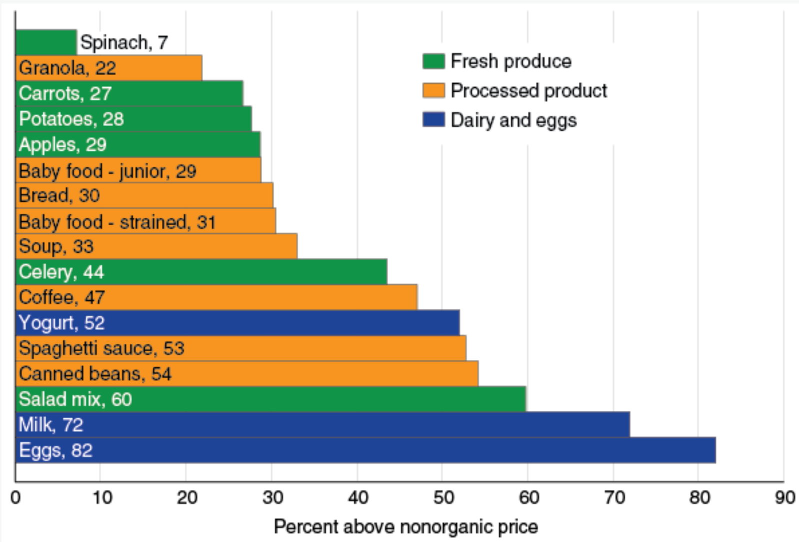
Organic Certification

There are several considerations in the argument for transitioning to organic agriculture. From an environmental standpoint, organic agriculture builds life in the soil while avoiding the use of toxic chemicals that can accumulate in soil, water, food and people. Non-organic farming relies on dwindling fossil fuel resources, while organic farmers build their own fertility into their systems, which improve over time and do not rely on outside inputs.

From an economic point of view, organic farming has been one of the **fastest-growing sectors of agriculture** for more than two decades—by **20 to 24 percent annually since 1990**—and allows farmers to reap up to **three times the profit** margins of non-organically raised meat and produce. [USDA average price premiums shown below.[6]]

According to the Economic Research Service of the U.S. Department of Agriculture and farmer interviews, obstacles to adoption by farmers include high managerial costs and risks of shifting to a new way of farming, limited awareness of organic farming systems, lack of marketing and infrastructure and inability to capture marketing economies and the fear of additional paperwork.

A period of three years is required for the transition from conventional to organic production, during which time products may be marketed as transitional or conventional but not as certified organic. During the transition period, growers may also experience reduced yields followed by a return to yields near or equal to conventional production.[7]



Source: USDA, Economic Research Service using 2010 Nielsen Homescan data.

Vertical Farming

As consumer confidence in agrochemical-based farming shifts toward organic certification, controlled environment agriculture (CEA) and urban farming offer regional solutions and yet face a myriad of economic, scientific, and societal challenges.

Advantages of vertical farming are numerous over traditional field/geoponic farming, including:

- Year-round crop production at 3x-30x land use efficiency (species dependent).
- Elimination of pesticides, herbicides, fungicides.
- Elimination of agricultural runoff.
- Significant reduction of fossil fuels associated with distribution miles (1,500 avg).
- No weather related crop failures.
- 70%-95% reduction in water usage.

Problems facing vertical farming are primarily associated with:

- Energy consumption / OpEx for artificial lighting
- Nutrient consumption / cost
- Labor costs

Seedling targets solutions in this space through generation of micro-grid electricity and precision nutrient formulation for automated farming systems. D3 Designs' hydroponic growing solutions featuring Seedling fertilizers and grow mediums offer vertical farming customers access to Seedling assets.

[6] USDA. ERS. Carlson, A. Investigating Retail Price Premiums for Organic Foods. https://www.ers.usda.gov/amber-waves/2016/may/investigating-retail-price-premiums-for-organic-foods/. May 24, 2016

[7] Rodale Institute. Dig Deeper: Transition to Organic. https://rodaleinstitute.org/transition-to-organic/. February 24th, 2014.

MARKET TRENDS | PROBLEMS

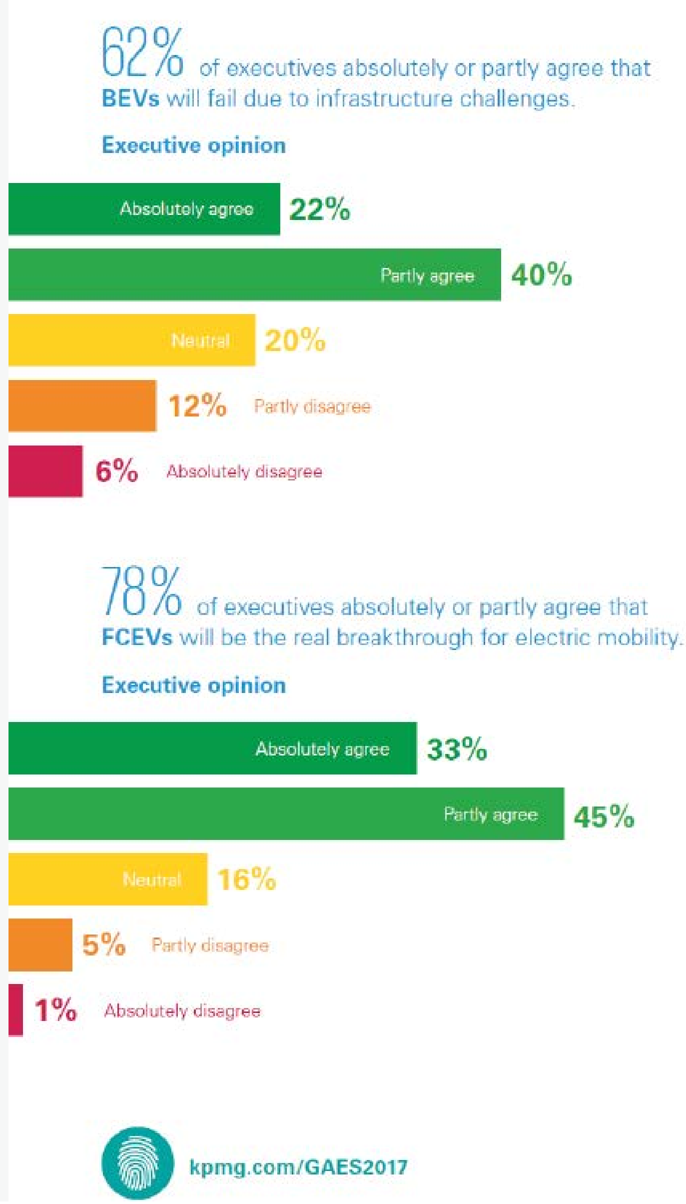
Zero Emissions Transportation

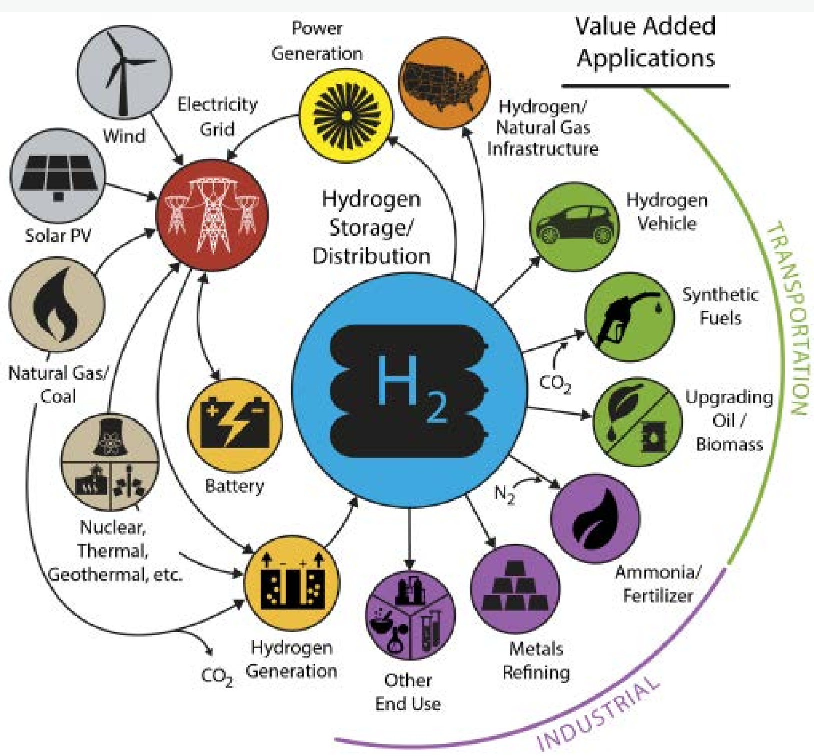
Even though battery electric mobility is commonly ranked as the most significant trend by automotive executives, the key issues with battery electric vehicles (BEVs) continue to be user-friendly charging infrastructure, operational range, and integration into an aging electrical grid prone to weather-associated outages.
Due to these concerns, **the majority (62%) of automotive executives believe that BEVs will fail.**

In contrast, **a significant majority (78%) of automotive executives believe that fuel cell electric vehicles (FCEV) will be the golden bullet of electric mobility** while also ranking it as a top 3 key trend. The faith in FCEVs can be explained by the ability of hydrogen infrastructure to solve the recharging problems associated with BEV infrastructure. Since refueling of hydrogen can be done quickly at a traditional gas station, making recharging times of 25-45 minutes for BEVs seem unreasonable.[8]

Additional benefits to hydrogen FCEVs beyond refueling times look toward hydrogen's offest of battery-associated mass in heavy duty applications. Specifically, operational cost benefit analysis from the DOE indicate operational benefits of FCEV over BEV forktrucks. Fleet vehicle and mass transit bus operational performance has been evaluated globally and indicates benefits in these use cases over BEV alternatives.
Continued development of municipal applications of hydrogen FCEVs is also yielding opportunities for vehicle-to-grid resiliency programs.

Each SEED's production of hydrogen fuel for zero-emissions distribution of food and fertilizer provides a market responsive supply of hydrogen fuel as electric transportation markets mature.
D3 Designs Inc.'s development of a FCEV food truck provides a market premium user experience and revenue channel for SEED-grown and brokered food.

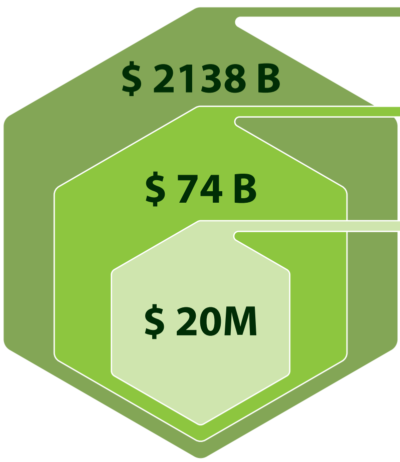




[8] KPMG. Global Automotive Executive Survey 2017. https://home.kpmg.com/xx/en/home/insights/2017/01/global-automotive-executive-survey-2017.html. Jan. 2017

MARKET SIZE

Collective Market Sizes



TAM

Global Organics	$ 320 B
Global Energy	$ 1,400 B
Global Hydrogen	$ 150 B
Global Aquaculture	$ 150 B
Global Fertilizer	$ 118 B

SAM

150 Mi. Radius PHL = 40,226,720 Population

SOM

SEED-PHL

270T	Food-waste intake/day
2.4 MW	Energy system
1,270 Kg	Hydrogen/day
25,000 Ft²	Vertical farm
50,000 Ft²	Greenhouse farm
~~196,000 Ga.~~	~~Aquaculture~~ [Pending]

Market Sample

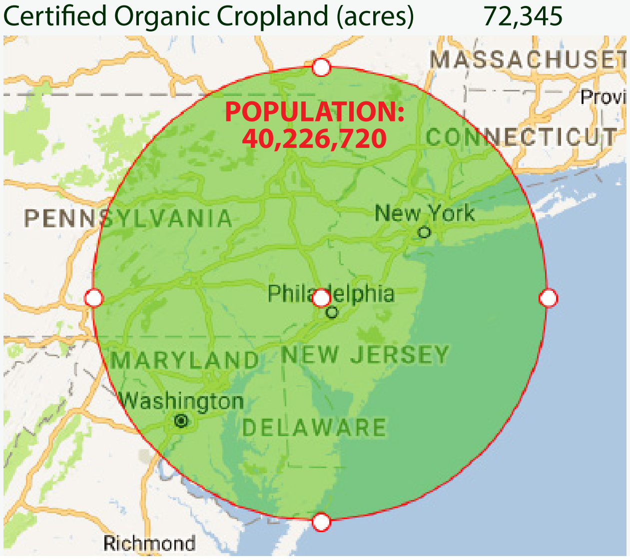
Organic sales in the U.S. totaled around **$49.4 billion in 2017**, reflecting new sales of almost $3.5 billion from the previous year. Organic food now accounts for more than **five percent of total food sales** in the U.S. Organic food sales increased by 6.4 percent from last year, blowing past the 1.1 percent growth rate in the overall food market. Sales of organic non-food products were up 7.4% in 2017.[9]

USA

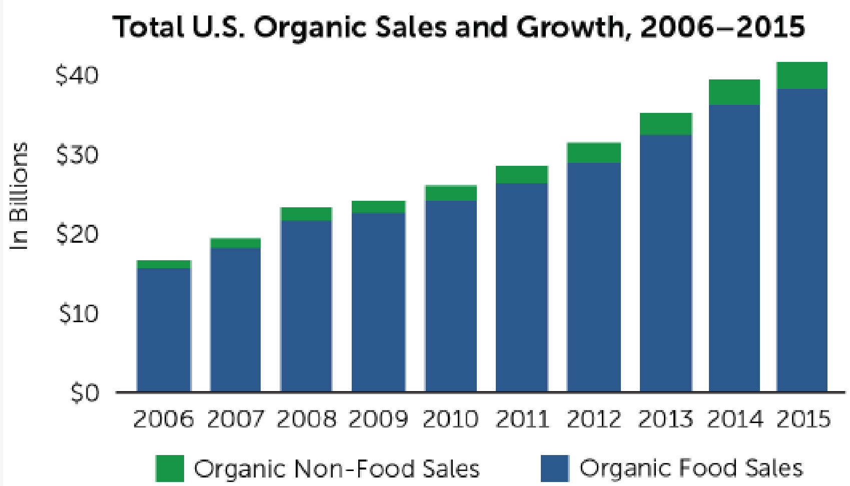
Certified Organic Farms (2016)	14,217
Certified Organic Cropland (acres)	2,714,498

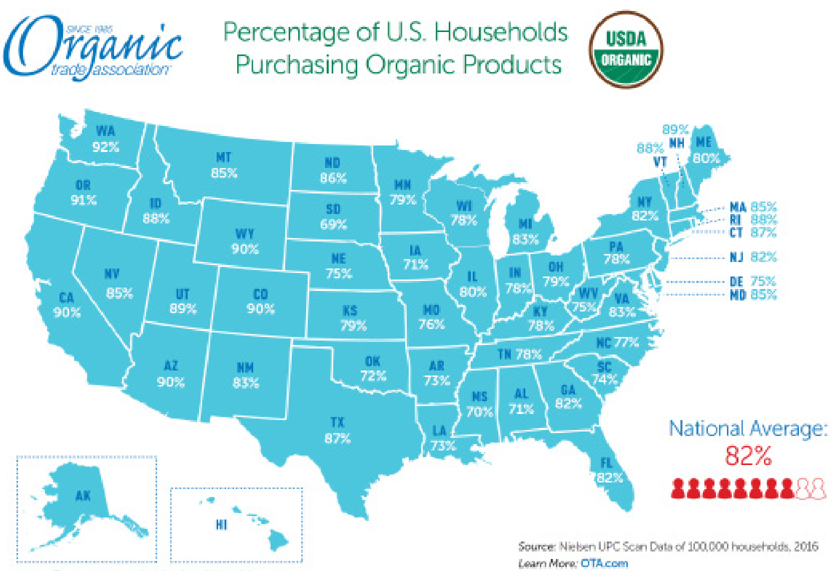
PHILADELPHIA, PA

Certified Organic Farms (2016)	803
Certified Organic Cropland (acres)	72,345



Organic Growth



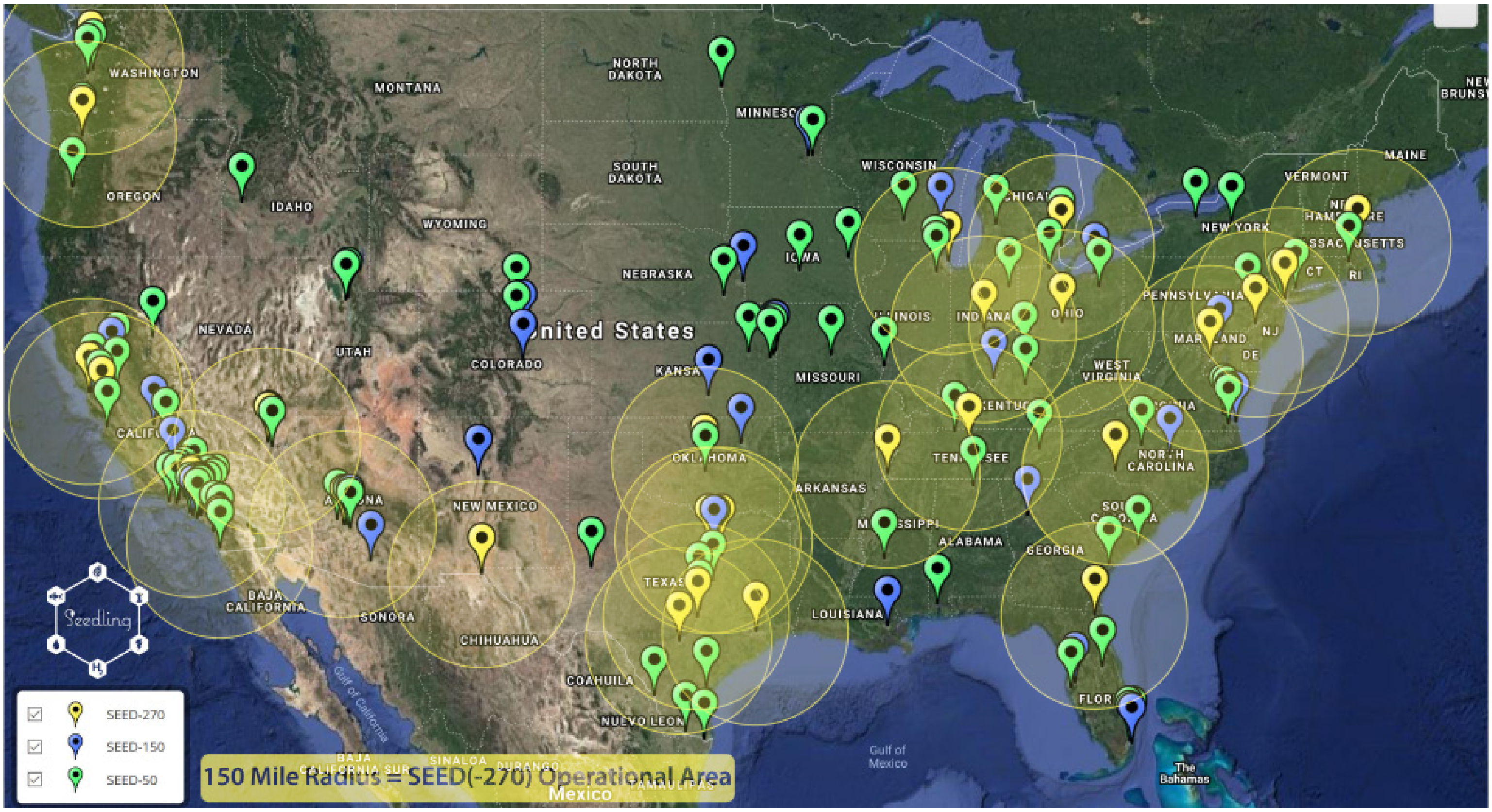


[9] OTA. U.S. Organic Industry Survey 2018. https://www.ota.com/resources/market-analysis.

MARKET SIZE

United States Food-Waste Market Sizes

40%: The amount of food wasted in total US food production. 33 Million Tons: The amount of food waste thrown away in 2010 —the largest component of MSW reaching landfills and incinerators. 4-10%: The amount of food you purchase that ends up as kitchen waste — 422g., the average amount of food-waste produced by each American daily.
SHOWN BELOW: 173 viable installation markets based on population X 422g of daily kitchen food-waste (4-10% of potential food-waste in each city).



50 **POPULATIONS: 150K-350K**

Honolulu	Madison	Santa Clarita	Mobile	Eugene
Santa Ana	Chandler	Birmingham	Cape Coral	Corona
Riverside	Buffalo	Oxnard	Shreveport	Cary
Corpus Christi	Lubbock	Fayetteville	Frisco	Springfield
Lexington	Scottsdale	Moreno Valley	Knoxville	Fort Collins
Stockton	Reno	Rochester	Worcester	Jackson
Henderson	Glendale	Glendale	Brownsville	Alexandria
Saint Paul	Gilbert	Huntington Beach	Vancouver	Hayward
St. Louis	Winston–Salem	Salt Lake City	Fort	Lancaster
Cincinnati	North Las Vegas	Grand Rapids	Lauderdale	Lakewood
Pittsburgh	Norfolk	Amarillo	Sioux Falls	Clarksville
Greensboro	Chesapeake	Yonkers	Ontario	Palmdale
Anchorage	Garland	Aurora	Chattanooga	Salinas
Plano	Irving	Montgomery	Providence	Springfield
Lincoln	Hialeah	Akron	Newport News	Hollywood
Orlando	Fremont	Little Rock	Rancho	Pasadena
Irvine	Boise	Huntsville	Cucamonga	Sunnyvale
Newark	Richmond	Augusta	Santa Rosa	Macon
Toledo	Baton Rouge	Port St. Lucie	Oceanside	Kansas City
Durham	Spokane	Grand Prairie	Salem	Pomona
Chula Vista	Des Moines	Columbus	Elk Grove	Escondido
Fort Wayne	Tacoma	Tallahassee	Garden Grove	
Jersey City	San Bernardino	Overland Park	Pembroke	
St. Petersburg	Modesto	Tempe	Pines	
Laredo	Fontana	McKinney	Peoria	

150 **POPULATIONS: 350K-650K**

Oklahoma City	Omaha
Las Vegas	Long Beach
Louisville	Virginia Beach
Baltimore	Oakland
Milwaukee	Minneapolis
Albuquerque	Tulsa
Tucson	Arlington
Fresno	Tampa
Mesa	New Orleans
Sacramento	Wichita
Atlanta	Cleveland
Kansas City	Bakersfield
Colorado Springs	Aurora
Miami	Anaheim
Raleigh	

270 **POPULATIONS: 650K+**

New York	San Francisco
Los Angeles	Charlotte
Chicago	Indianapolis
Houston	Seattle
Phoenix	Denver
Philadelphia	Washington
San Antonio	Boston
San Diego	El Paso
Dallas	Detroit
San Jose	Nashville
Austin	Portland
Jacksonville	Memphis
Fort Worth	
Columbus	

INSTALLATION SCALE MAY EXCEED MODELED INSTALLATION SIZES, BASED UPON POPULATION AND FOOD-WASTE COLLECTION OF OPERATIONAL RADIUS.

SEEDS: 5TH YR. OPERATION PROJECTIONS

SEED MARKET SIZE REQUIREMENTS:	50 — POPULATIONS: 150K-350K	150 — POPULATIONS: 350k-650k	270 — POPULATIONS: 650k+
OFMSW FOOD-WASTE INPUT	50 T/Day	150 T/Day	270 T/Day
[Philadelphia] Estimated CAPEX	$ 25,580,000	$ 43,970,000	$ 74,730,000
CAPEX | Site: Industrial Zoning	(YR 0:) $ 4,000,000	(YR 0:) $ 10,500,000	(YR 0:) $ 16,500,000
CAPEX | Fuel Cell | Electrolyzer	(YR 0:) $ 4,000,000	(YR 0:) $ 1,750,000 (Nel A-150 only)	(YR 0:) $ 0 (Lease)
	Doosan - 400kW | Nel A-150	FCEL: 1.4 MW (Leased) | Nel A-150	FCEL: 2.35 MW Tri-Gen (Leased)
CAPEX | AD | Fermentation | Build	(YR 0:) $ 5,500,000	(YR 0:) $ 7,500,000	(YR 0:) $ 12,100,000
CAPEX | VF Growing Footprint @ 5 Layer Height	(YR 0:) $ 3,250,000 | 4,500 ft^2	(YR 0:) $ 10,000,000 | 16,000 ft^2	(YR 0:) $ 20,000,000 | 32,000 ft^2
CAPEX | GH Growing Footprint	(YR 0:) $ 2,250,000 | 11,250 ft^2	(YR 0:) $ 4,000,000 | 40,000 ft^2	(YR 0:) $ 9,000,000 | 80,000 ft^2
CAPEX | Produce Processing | Packaging	(YR 0:) $ 1,250,000	(YR 0:) $ 2,000,000	(YR 0:) $ 3,000,000
CAPEX | Hydrological Processing	(YR 0:) $ 1,500,000	(YR 0:) $ 2,250,000	(YR 0:) $ 5,500,000
CAPEX | Roots LLC. Fuel Cell Food-Truck	(YR 0:) $ 850,000	(YR 0:) $ 2,550,000	(YR 0:) $ 5,100,000
CAPEX | H_2 Containment | Station	(YR 0:) $ 2,500,000	(YR 0:) $ 2,500,000	(YR 0:) $ 2,500,000
CAPEX | Distribution Vehicles	(YR 0:) $ 480,000	(YR 0:) $ 920,000	(YR 0:) $ 1,030,000
PRODUCTION | REVENUE: Year 5	$ 3,427,000	$11,528,000	$ 22,411000
Electricity Produced /Yr	3.110 GW	10.886 GW	18.273 GW
Carbon *Produced* (CO_2)/Yr	1,480 T	[Captured] 4,840 T	[Captured] 8,123 T
Carbon *Reduction* (CO_2)/Yr[01]	- 36,861 T	-112,770 T	-216,166 T
Fertilizer: FERTILIZER REVENUE:	$ 2,107,000	$ 6,192,000	$ 9,539,000
Produce: PRODUCE REVENUE:	$ 1,122,000	$ 4,965,000	$ 9,930,000
Brokerage: 4%-FERTILIZER REVENUE:	$ 84,000	$ 227,000	$ 382,000
Roots LLC FOOD-TRUCK LEASE: # FCFT | $	1 | $ 48,000	3 | $ 144,000	6 | $ 288,000
Hydrogen: Production/Day	48 kg	192 kg	1,270 kg
HYDROGEN REVENUE @ $3 GGE:	$ 66,000	$ 276,000	$ 2,333,000
SEED BALANCE @ Year 5			
REVENUE:	$ 3,427,000	$ 11,528,000	$ 22,472000
OPEX:	$ 3,090,000	$ 6,749,000	$ 13,132,000
EBITA:	$ 337,000	$ 4,779,000	$ 9,340,000
FUNDING SOURCES			
Grant Applicable (50 - 100%) +1-3 Years	(YR 0-2; 100%) $ 25,580,000	(YR 0-2; 50%:) $ 21,985,000	(YR 0-2, 50%:) $ 37,365,000
[County] Economic Development Bond	N/A Non-Profit	(YR 0:) $ 21,985,000 - $ 43,970,000	(YR 0:) $ 37,365,000 - $ 75,730,000
Economic Development Bond Payment / Year	N/A Non-Profit	$ 975,000 - $ 1,950,000	$ 1,657,000 - $ 3,315,000

INVESTMENT

Investment Round	Seed	Series A - Local	Series B - Local
Investment	$ 6,395,000	$10,000,000	$15,000,000
ROI [Grant v. Full Bond]	N/A Non-Profit ($219,800)	$ 3,339,300 - $ 4,864,200	$ 6,526,200 - $ 9,013,200
(30% Equity) Return @ 6.25Yr. investment	N/A Non-Profit (3.7%)	33.4% - 48.6%	43.5% - 60%
Subsequent Seed-investor IRR		$ 2,881,000 | 48% @ 6.25 Yr.	$ 5,407,920 | 90% @ 6.25 Yr.

[01] Watch My Waste. (Australia) 2018. https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/

SEED-50

Seedling

50

Min. STAFF | Job Creation:	20	
Exec. | Dir. | PhD.:	3	*[$ 132K]*
Mid-Level :	5	*[$ 66K - $ 96K]*
Entry-Level :	12	*[$ 50K]*

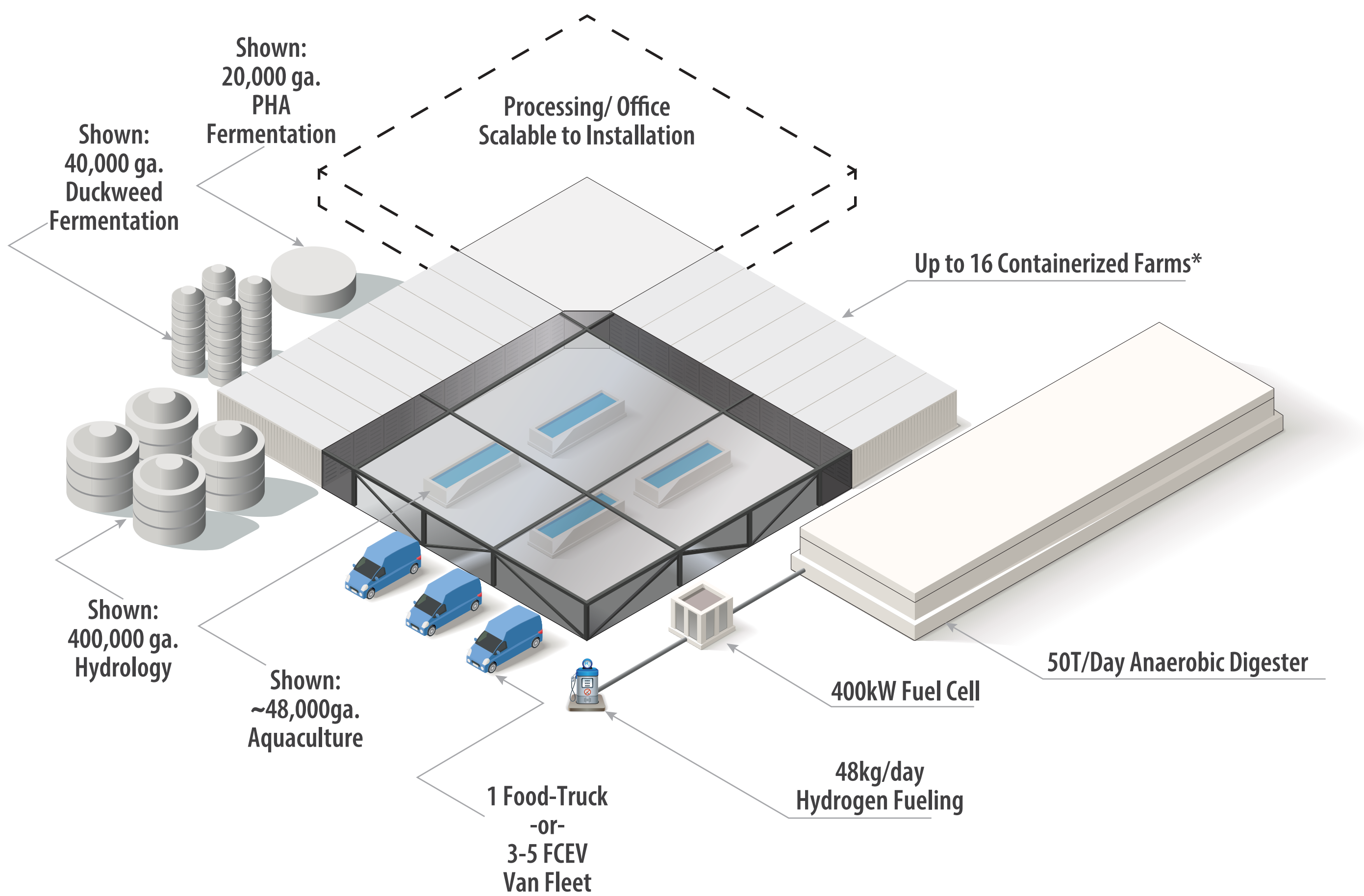
CITY POPULATIONS: 150K-350K

HYDROGEN PRODUCED: 48KG/DAY | 15.7T/YR.

POWER PRODUCED: 400KW/HR | 3.15GW/YR.

Food-Waste:	**50 T/DAY | 16,425 T/YR.**
CO2 Diverted:	**≥ 35,000 T/YR.**
Organic Fertilizer	
Solid:	**≥ 5,000 T/YR**
Liquid:	**≥ 700,000 Ga./YR**
PHA Bioplastic Option:	**≥ 800,000 Lb./YR**

TOTAL CROP GROWTH AREA:	**≤ 45,000 FT²**
TOTAL VF GROWTH AREA:	**35,000 FT²**
TOTAL GREENHOUSE AREA:	**10,000 FT²**
HYDROLOGY SYSTEM:	**≤ 450,000 GA.**
AQUACULTURE OPTION:	**+ 250,000 GA.**



* Containerized Farming Modules modeled as example only. Brick & mortar designed installations showcase greater hydroponic efficiencies.

SEED-50

Seedling

STAFF | Job Creation: 20
Exec. | Dir. | PhD. : 3 [$ 132K]
Mid-Level : 5 [$ 66K - $ 96K]
Entry-Level : 12 [$ 50K]

R&D configuration. | Future Full Automation R&D

	INSTALLATION 16 MO.	OPERATION YEAR 1	OPERATION YEAR 2	OPERATION YEAR 3	OPERATION YEAR 4	OPERATION YEAR 5
OFMSW Food-Waste Input	< 50 T/Day	50 T/Day	50 T/Day	50 T/Day	50 T/Day	50 T/Day
[Philadelphia] Estimated CAPEX	$ 25,580,000					
CAPEX | Site: Industrial Zoning	$ 4,000,000					
CAPEX | Doosan - 400kW | Nel A-150	$ 4,000,000					
CAPEX | AD | Fermentation | Build	$ 5,500,000					
CAPEX | VF Growing Footprint @ 5 Layer Height	$ 3,250,000	4,500 ft²	4,500 ft²	4,500 ft²	4,500 ft²	4,500 ft²
CAPEX | GH Growing Footprint	$ 2,250,000	11,250 ft²	11,250 ft²	11,250 ft²	11,250 ft²	11,250 ft²
CAPEX | Processing | Packaging	$ 1,250,000					
CAPEX | Hydrological Processing	$ 1,500,000					
CAPEX | Fuel Cell Food-Truck (# FCFT)	$ 850,000	(1 FCFT)	(1 FCFT)	(1 FCFT)	(1 FCFT)	(1 FCFT)
CAPEX | H_2 Containment | Station	$ 2,500,000					
CAPEX | Distribution Vehicles	$ 480,000					
PRODUCTION | REVENUE :	$ 0	$ 1,777,000	$ 2,556000	$ 2,859,000	$ 3,144,000	$ 3,427,000
Electricity Produced /Yr	0 GW	3.153 GW	3.153 GW	3.153 GW	3.153 GW	3.153 GW
Carbon *Produced* (CO_2)/Yr	(N/A)	1,480 T	1,480 T	1,480 T	1,480 T	1,480 T
Carbon *Reduction* (CO_2)/Yr[01]	(N/A)	- 36,861 T	- 36,861 T	- 36,861 T	- 36,861 T	- 36,861 T
Fertilizer: FERTILIZER REVENUE:	(N/A)	$ 932,000	$ 1,459,000	$ 1,675,000	$ 1,891,000	$ 2,107,000
Produce: PRODUCE REVENUE:	(N/A)	$ 694,000	$ 925,000	$ 1,003,000	$ 1,063,000	$ 1,122,000
Brokerage: 4%-FERTILIZER REVENUE:	(N/A)	$ 37,000	$ 58,000	$ 67,000	$ 76,000	$ 84,000
FOOD-TRUCK LEASE:	(N/A)	$ 48,000	$ 48,000	$ 48,000	$ 48,000	$ 48,000
Hydrogen: Production/Day	< 48 kg	48 kg	48 kg	48 kg	48 kg	48 kg
HYDROGEN REVENUE @ $3 GGE:	(N/A)	$ 66,000	$ 66,000	$ 66,000	$ 66,000	$ 66,000
SEED-50 BALANCE						
REVENUE:	$ 0	$ 1,777,000	$ 2,556000	$ 2,859,000	$ 3,144,000	$ 3,427,000
OPEX:	$ 4,904,000	$ 2,594,000	$ 2,550,000	$ 2,717,000	$ 2,896,000	$ 3,090,000
Salaries | Benefits | Taxes	$ 1,549,000	$ 2,107,000	$ 2,079,000	$ 2,245,000	$ 2,425,000	$ 2,619,000
Auto | Delivery | Travel	$ 360,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000
General Office | Admin	$ 372,000	$ 42,000	$ 42,000	$ 42,000	$ 42,000	$ 42,000
Accounting & Legal	$ 160,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000	$ 18,000
Advertising | Tradeshows	$ 145,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000	$ 60,000
Outside Services | Consultants	$ 1,575,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 24,000
Power System Lease	(N/A) $ 0	$ 0	$ 0	$ 0	$ 0	$ 0
Anaerobic Feedstock	$ 64,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000
Misc. [IT, Fees, Packaging, Insurance]	$ 680,000	$ 96,000	$ 87,000	$ 87,000	$ 87,000	$ 87,000
EBITA:	[$ 4,904,000]	[$ 817,000]	$ 6,000	$ 142,000	$ 248,000	$ 337,000
Grant Applicable (100%) +1-3 Yrs	$ 25,580,000					
Economic Development Bond (50% CAPEX)	N/A	N/A	N/A	N/A	N/A	N/A
Investment | Return [Grant Funded]	$ 6,395,000 | N/A	([$ 245,100])	($ 1,800)	($ 42,600)	($ 74,400)	($ 101,000)
(30% Equity) *Return @ 6.25Yr. investment*	N/A (3.7%)					

01 Watch My Waste. (Australia) 2018. https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/

SEED-150

STAFF | Job Creation:	34	
Exec. | Dir. | PhD.:	3	[$ 132K]
Mid-Level :	12	[$ 66K - $ 87K]
Entry-Level :	19	[$ 50K]

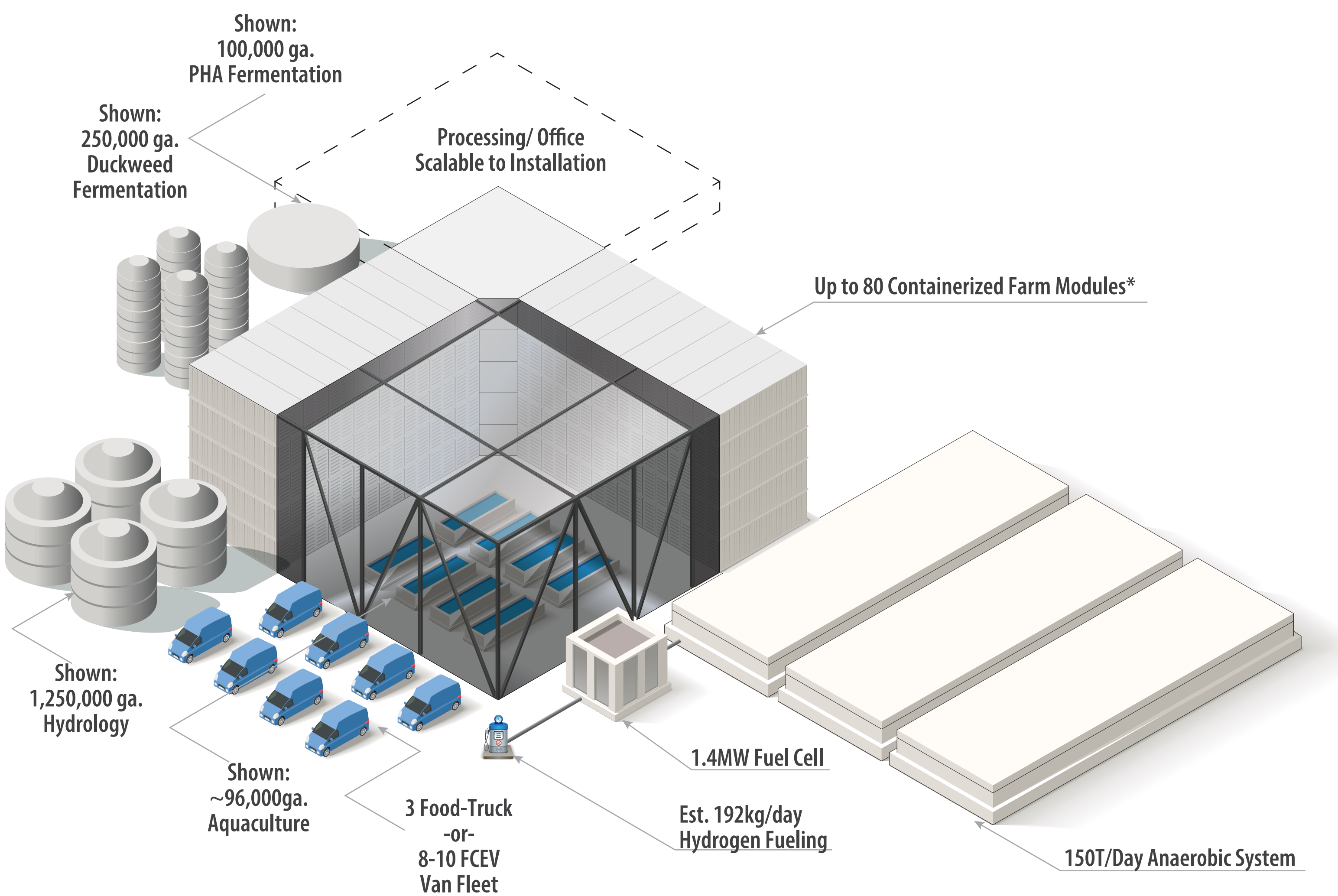
CITY POPULATIONS: 350K-650K

HYDROGEN PRODUCED: 192KG/DAY | 63.1T/YR.

POWER PRODUCED: 1,400KW/HR | 11.04GW/YR.

Food-Waste:	150 T/DAY | 49,275 T/YR.
CO2 Diverted:	≥ 110,000 T/YR.
Organic Fertilizer	
Solid:	≥ 16,000 T/YR
Liquid:	≥ 2,170,000 Ga./YR
PHA Bioplastic Option:	≥ 2,463,750 Lb./YR

TOTAL CROP GROWTH AREA:	≤ 125,000 FT^2
TOTAL VF GROWTH AREA:	85,000 FT^2
TOTAL GREENHOUSE AREA:	40,000 FT^2
HYDROLOGY SYSTEM:	≤ 1,250,000 GA.
AQUACULTURE OPTION:	+ 625,000 GA.



* Containerized Farming Modules modeled as example only. Brick & mortar designed installations showcase greater hydroponic efficiencies.

SEED-150

Seedling

Most flexible configuration. Post SEED-50 R&D Installation.

150

STAFF | Job Creation: **34**
Exec. | Dir. | PhD. : 3 *[$ 132K]*
Mid-Level : 12 *[$ 66K - $ 87K]*
Entry-Level : 19 *[$ 50K]*

	INSTALLATION 16 MO.	OPERATION YEAR 1	OPERATION YEAR 2	OPERATION YEAR 3	OPERATION YEAR 4	OPERATION YEAR 5
OFMSW Food-Waste Input	**< 150 T/Day**	**150 T/Day**	**150 T/Day**	**150 T/Day**	**150 T/Day**	**150 T/Day**
***[Philadelphia]* Estimated CAPEX**	**$ 43,970,000**					
CAPEX | Site: Industrial Zoning	$ 10,500,000					
CAPEX | FCEL: 1.4 MW (Leased) | Nel A-150	$ 1,750,000					
CAPEX | AD | Fermentation | Build	$ 7,500,000					
CAPEX | VF Growing Footprint @ 5 Layer Height	$ 10,000,000	16,000 ft^2	16,000 ft^2	16,000 ft^2	16,000 ft^2	16,000 ft^2
CAPEX | GH Growing Footprint	$ 4,000,000	40,000 ft^2	40,000 ft^2	40,000 ft^2	40,000 ft^2	40,000 ft^2
CAPEX | Processing | Packaging	$ 2,000,000					
CAPEX | Hydrological Processing	$ 2,250,000					
CAPEX | Fuel Cell Food-Truck (# FCFT)	$ 2,550,000	(3 FCFTs)	(3 FCFTs)	(3 FCFTs)	(3 FCFTs)	(3 FCFTs)
CAPEX | H_2 Containment | Station	$ 2,500,000					
CAPEX | Distribution Vehicles	$ 920,000					
PRODUCTION | REVENUE :	***$ 0***	***$ 8,353,000***	***$ 10,128,000***	***$ 10,736,000***	***$ 11,306,000***	***$11,528,000***
Electricity Produced /Yr	0 GW	11.037 GW	11.037 GW	11.037 GW	11.037 GW	11.037 GW
Carbon *Produced* (CO_2)/Yr	[Captured]	- 4,840 T	- 4,840 T	- 4,840 T	- 4,840 T	- 4,840 T
Carbon *Reduction* (CO_2)/Yr[01]	(N/A)	- 112,770 T	- 112,770 T	- 112,770 T	- 112,770 T	- 112,770 T
Fertilizer: FERTILIZER REVENUE:	(N/A)	$ 5,674,000	$ 5,998,000	$ 6,063,000	$ 6,127,000	$ 6,192,000
Produce: PRODUCE REVENUE:	(N/A)	$ 2,032,000	$ 3,470,000	$ 4,010,000	$ 4,514,000	$ 4,965,000
Brokerage: 4%-FERTILIZER REVENUE:	(N/A)	$ 227,000	$ 240,000	$ 243,000	$ 245,000	$ 227,000
FOOD-TRUCK LEASE:	(N/A)	$ 144,000	$ 144,000	$ 144,000	$ 144,000	$ 144,000
Hydrogen: Production/Day	< 192 kg	192 kg	192 kg	192 kg	192 kg	192 kg
HYDROGEN REVENUE @ $3 GGE:	(N/A)	$ 276,000	$ 276,000	$ 276,000	$ 276,000	$ 276,000
SEED-150 BALANCE						
REVENUE:	$ 0	$ 8,353,000	$ 10,128,000	$ 10,736,000	$ 11,306,000	$11,528,000
OPEX:	$ 5,086,000	$ 5,837,000	$ 6,036,000	$ 6,124,000	$ 6,424,000	$ 6,749,000
Salaries | Benefits | Taxes	$ 1,643,000	$ 3,174,000	$ 3,428,000	$ 3,494,000	$ 3,774,000	$ 4,076,000
Auto | Delivery | Travel	$ 350,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000	$ 60,000
General Office | Admin	$ 373,000	$ 124,000	$ 84,000	$ 84,000	$ 84,000	$ 72,000
Accounting & Legal	$ 160,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 60,000
Advertising | Tradeshows	$ 145,000	$ 190,000	$ 180,000	$ 180,000	$ 180,000	$ 60,000
Outside Services | Consultants	$ 1,600,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000	$ 90,000
Power System Lease	$ 0	$ 1,019,000	$ 1,039,000	$ 1,060,000	$ 1,081,000	$ 1,103,000
Anaerobic Feedstock	$ 45,000	$ 540,000	$ 540,000	$ 540,000	$ 540,000	$ 540,000
Misc. [IT, Fees, Packaging, Insurance]	$ 698,000	$ 407,000	$ 407,000	$ 407,000	$ 407,000	$ 407,000
EBITA:	[$ 4,214,000]	$ 2,516,000	$ 4,092,000	$ 4,612,000	$ 4,882,000	$ 4,779,000
Grant Applicable (50% CAPEX) +1-3 Yrs	*$ 21,985,000*					
Economic Development Bond (50% CAPEX)	$ 21,985,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000	$ 975,000
Investment* | *Return* *[Grant Funded]	$10,000,000 |	$462,300	$ 997,500	$ 1,091,100	$ 1,172,100	$ 1,141,200
(30% SEED Equity) ***Return @ 6.25Yr. Investment***	48.6%					

[01] Watch My Waste. (Australia) 2018. https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/

SEED-270

Seedling

STAFF | **Job Creation:**	**53**	
Exec. | Dir. | PhD. :	3	*[$ 132K]*
Mid-Level :	17	*[$ 66K - $ 87K]*
Entry-Level :	33	*[$ 50K]*

CITY POPULATIONS: 650K+

HYDROGEN PRODUCED: 1.27T/DAY | 417.2T/YR.

POWER PRODUCED: 2,350KW/HR | 18.53GW/YR.

Food-Waste:	**270 T/DAY | 88,695 T/YR.**
CO_2 Diverted:	**≥ 210,000 T/YR.**
Organic Fertilizer	
Solid:	**≥ 29,000 T/YR**
Liquid:	**≥ 3,900,000 Ga./YR**
PHA Bioplastic Option:	**≥ 4,434,750 Lb./YR**

TOTAL CROP GROWTH AREA:	**≤ 240,000 FT^2**
TOTAL VF GROWTH AREA:	**160,000 FT^2**
TOTAL GREENHOUSE AREA:	**80,000 FT^2**
HYDROLOGY SYSTEM:	**≤ 2,400,000 GA.**
AQUACULTURE OPTION:	**+ 1,200,000 GA.**

SEED-270

PHL Location offered $30+M bond from MontCo.

270

STAFF | Job Creation: 53
Exec. | Dir. | PhD. : 3 *[$ 132K]*
Mid-Level : 17 *[$ 66K - $ 87K]*
Entry-Level : 33 *[$ 50K]*

	INSTALLATION 16 MO.	OPERATION YEAR 1	OPERATION YEAR 2	OPERATION YEAR 3	OPERATION YEAR 4	OPERATION YEAR 5
OFMSW Food-Waste Input	< 270 T/Day	270 T/Day	270 T/Day	270 T/Day	270 T/Day	270 T/Day
[Philadelphia] Estimated CAPEX	**$ 74,730,000**					
CAPEX | Site: Industrial Zoning	$ 16,500,000					
CAPEX | FCEL: 2.35 MW Tri-Gen (Leased)	$ 0					
CAPEX | AD | Fermentation | Build	$ 12,100,000					
CAPEX | VF Growing Footprint @ 5 Layer Height	$ 20,000,000	32,000 ft²	32,000 ft²	32,000 ft²	32,000 ft²	32,000 ft²
CAPEX | GH Growing Footprint	$ 9,000,000	80,000 ft²	80,000 ft²	80,000 ft²	80,000 ft²	80,000 ft²
CAPEX | Processing | Packaging	$ 3,000,000					
CAPEX | Hydrological Processing	$ 5,500,000					
CAPEX | Fuel Cell Food-Truck (# FCFT)	$ 5,100,000	(6 FCFTs)	(6 FCFTs)	(6 FCFTs)	(6 FCFTs)	(6 FCFTs)
CAPEX | H_2 Containment | Station	$ 2,500,000					
CAPEX | Distribution Vehicles	$ 1,030,000					
PRODUCTION | REVENUE :	$ 0	$ 15,637,000	$ 19,118,000	$ 20,318,000	$ 21,447,000	$22,472000
Electricity Produced /Yr	0 GW	18.527 GW	18.527 GW	18.527 GW	18.527 GW	18.527 GW
Carbon *Produced* (CO_2)/Yr	*[PendingCapture]*	8,123 T	8,123 T	8,123 T	8,123 T	8,123 T
Carbon *Reduction* (CO_2)/Yr[01]	(N/A)	-216,166 T	-216,166 T	-216,166 T	-216,166 T	-216,166 T
Fertilizer: FERTILIZER REVENUE:		$ 8,606,000	$ 9,189,000	$ 9,305,000	$ 9,422,000	$ 9,539,000
Produce: PRODUCE REVENUE:		$ 4,066,000	$ 6,940,000	$ 8,020,000	$ 9,027,000	$ 9,930,000
Brokerage: 4%-FERTILIZER REVENUE:		$ 344,000	$ 368,000	$ 372,000	$ 377,000	$ 382,000
FOOD-TRUCK LEASE:		$ 288,000	$ 288,000	$ 288,000	$ 288,000	$ 288,000
Hydrogen: Production/Day	< 1,270 kg	1,270 kg	1,270 kg	1,270 kg	1,270 kg	1,270 kg
HYDROGEN REVENUE @ $3 GGE:		$ 2,333,000	$ 2,333,000	$ 2,333,000	$ 2,333,000	$ 2,333,000
SEED-270 BALANCE						
REVENUE:	$ 0	$ 15,637,000	$ 19,118,000	$ 20,318,000	$ 21,447,000	$22,472000
OPEX:	$ 5,720,000	$ 11,163,000	$ 11,556,000	$ 12,046,000	$ 12,569,000	$ 13,132,000
Salaries | Benefits | Taxes	$ 2,103,000	$ 4,674,000	$ 5,048,000	$ 5,452,000	$ 5,888,000	$ 6,359,000
Auto | Delivery | Travel	$ 350,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000
General Office | Admin	$ 374,000	$ 124,000	$ 124,000	$ 124,000	$ 124,000	$ 124,000
Accounting & Legal	$ 160,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000
Advertising | Tradeshows	$ 155,000	$ 190,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000
Outside Services | Consultants	$ 1,600,000	$ 135,000	$ 120,000	$ 120,000	$ 120,000	$ 120,000
Power System Lease	$ 0	$ 4,215,000	$ 4,299,000	$ 4,385,000	$ 4,473,000	$ 4,562,000
Anaerobic Feedstock	$ 81,000	$ 972,000	$ 972,000	$ 972,000	$ 972,000	$ 972,000
Misc. [IT, Fees, Packaging, Insurance]	$ 700,000	$ 493,000	$ 493,000	$ 493,000	$ 493,000	$ 493,000
EBITA:	[$ 5,720,000]	$ 4,474,000	$ 7,562,000	$ 8,272,000	$ 8,878,000	$ 9,340,000
Grant Applicable (50% CAPEX) +1-3 Yrs	*$ 37,365,000*					
Economic Development Bond (50% CAPEX)	$ 37,365,000	$ 1,657,000	$ 1,657,000	$ 1,657,000	$ 1,657,000	$ 1,657,000
***Investment | Return** [Grant Funded]*	$15,000,000 |	$845,100	$ 1,771,500	$ 1,984,500	$ 2,166,300	$ 2,304,900
(30% SEED Equity) ***Return @ 6.25Yr. Investment***	60%					

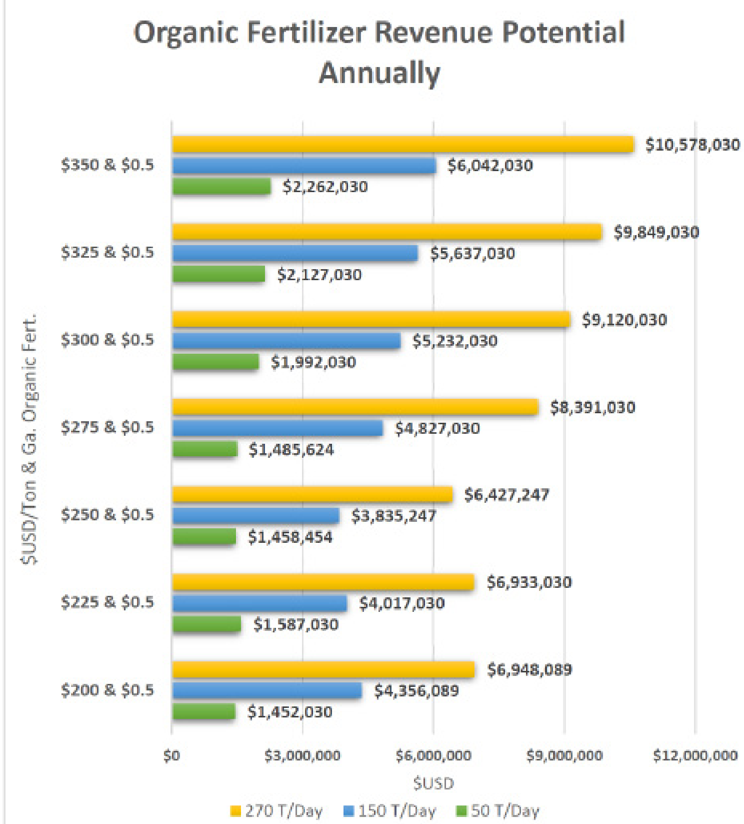
[01] Watch My Waste. (Australia) 2018. https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/

Value Proposition: Food-Waste

Key Partners
Our supply of OFMSW Food-waste is delivered daily on a per ton contractual cost agreement. Initial supplies of food-waste is pre-consumer, collected from grocers by Organix, who diverts 7M Tons of food-waste from 6,000 supermarkets in 34 states and Puerto Rico. [10]

Partnership | Customer Segment
As each SEED comes on-line as a private waste utility service, our produce customers (municipalities, grocers, restaurants, universities, food-service), fertilizer customers, and contractual partnerships with food-processors may yield new feed-stock streams.

Feed-stocks will first be evaluated for nutrient extraction, feedstock purity/sorting, and volume prior to contractual intake.



Dry Fertilizer = (Mass*0.30)*$)*30)*12) | Liquid Fertilizer = (Mass*.15)*0.125)*$)*30)*12)
Current USDA Market Price/T Organic Fertilizer: $200T-600T

Value Proposition: Organic Fertilizer

N %	P_2O_5 %	K_2O %	EXAMPLES (dried)
5.0	5.3	8.7	HOG WASTES
3.3	8.3	5.8	POULTRY MANURE
2.9	1.4	1.7	DAIRY MANURE
5.0	5.3	8.7	MIXED WASTES

Subscription Model
Each SEED provides a subscription fertilizer (solid & liquid) service to transitional organic farms for the duration of their transition (3-year target).
The subscription service formulates crop and soil responsive nutrient profiles specific to customer growing conditions. Soil samples utilizing in-field diagnostic sampling technologies will provide precise soil composition. This data is cloud-computed and paired with blockchain-driven formulations for next shipment to the farmer.

Hydroponics
Internal to each SEED will be the formulation of nutrient fertilizers specific to the crop species that are grown within the SEED's hydroponic farming operations.

Blockchain [See additional information in BLOCKCHAIN]
Providing farmers with unprecedented nutrient-content transparency, Seedling fertilizer is tailored through Blockchain data driven formulations. The data within this process provides regional data on food-waste content (Agri-chem), soil composition mapping, crop growth statistics (CEA), and process mapping of chemical composition outcomes.

Value Proposition: Packaging

Pressed fiber packaging is a common anaerobic digestion byproduct. This nutrient-stripped material can be formulated for food-grade packaging. Combined with poly lactic acid (PLA), an anaerobically digestible bioplastic, Seedling will provide the packaging and carton materials for SEED Produce distribution.
D3 Designs packaging solutions for Seedling produce will provide uniform, modular delivery & collection cartons for use by SEED Produce customers. Packaging is in D3 Diagnosis phase.

[10] Organix. Territory Service Area. 2018. http://www.organixrecycling.com/service-area.html

Key Activities | Key Resources

Fermentation

The potential for improving bioenergy yields from OFMSW Food-waste is through the inclusion of ***duckweed***, a fast-growing, simple, floating aquatic plant. This was evaluated by Penn State University's Eco-Machine™ by subjecting the dried biomass directly to anaerobic digestion, or sequentially to ethanol fermentation and then anaerobic digestion, after evaporating ethanol from the fermentation broth.

The combined bioethanol-biomethane process **yielded 70.4% more bioenergy from duckweed, than if anaerobic digestion had been run alone.**[11]

Rainier Biogas LLC, WA

Community/Ag digester, 1MW by Regenis Corp.

Anaerobic Digestion (AD)

Starting with a market-available example, Magic-Dirt™ is an anaerobically-digested dairy-farm waste, organic-certified, national brand sold at Wal-Mart. Their digestion and nutrient extraction is supplied by DVO Digesters of Chilton, WI. DVO is currently the preferred vendor for Seedling. Their experience in designing digesters for urban organics and food-waste processing has been represented in the largest installations in the United States and globally sought after.

Goshen, IN

Urban organics & dairy wastes, 3.3MW

Nutrient Recovery

Using a baseline of DVO nutrient recovery processes, tailored for organic certification, crop/soil-specific formulations for both liquid and solid nutrient recovery are to be developed in partnership with Penn State University within SEED-PSU. The sensored formulation processes combined with blockchain-managed data processing, will enable automation of subscription formulations as they are uploaded from the field.

Jerome, ID - Regenis Corp. Largest in North America

11M gal/42k M^3 cap, 4.5MW

Post Processing

Subscription shipments to regional farmers will be delivered in reusable market available containment systems and shipped through FCEV distribution to customers.

Manufacturing processes for organic hydro/geoponic grow mediums will coincide with D3 Designs' hydroponic systems using Seedling grow mediums and liquid nutrients. Analogous to injection molded bricks, these grow mediums will be packaged and sold to hydroponic farmers seeking organic certification.

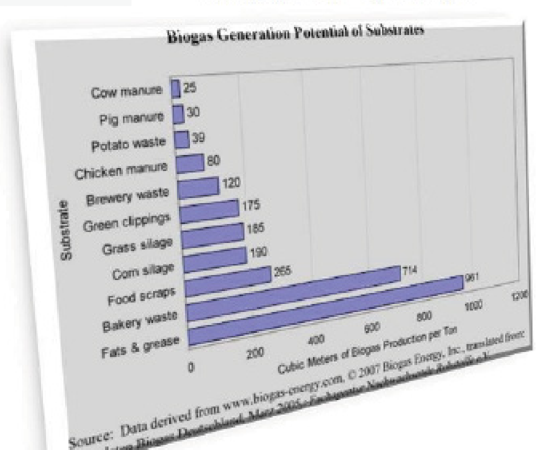
Regional supply to Magic-Dirt™ may be viable pending formulation testing and organic certification.

OFMSW Food-Waste

The selection of food-waste compared to other categories of substrates is directly related to volumetric biogas production per ton, societal health improvement[12,13], and environmental improvement of diversion from landfill.

SEED-CITIES

Operational partnerships supported through regional bond programs target evolutionary opportunities to transition urban centers into more responsible OFMSW Food-Waste collection practices. Opening new markets for silent FCEV refuse trucks that purchase hydrogen upon delivery to each SEED.



[11] The Pennsylvania State University. Bioresource Technology. 2018. https://www.engr.psu.edu/ce/enve/brennan/Publications/Peer-Reviewd%20Journals/Calicioglu%20and%20Brennan_Bioenergy%20from%20Duckweed_Bioresource%20Technol_2018.pdf

[12] Columbia University. Infectious Disease, Urban Health. 2014. https://www.mailman.columbia.edu/public-health-now/news/rats-new-york-and-diseases-they-carry

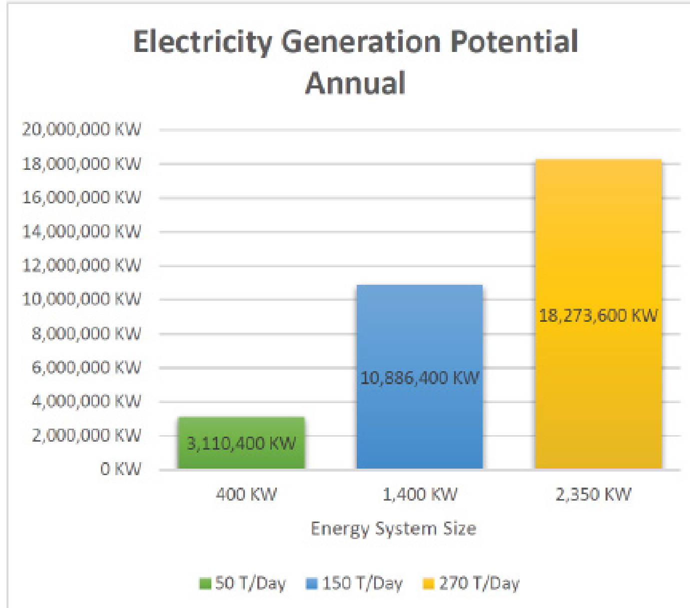
[13] Waste Today. "NYC plans to reduce rat population through waste management". 2017. http://www.wastetodaymagazine.com/article/nyc-announces-rat-reduction-plan/

Value Proposition: Microgrid Independence

Independent Power Provider
Filing as an Independent Power Provider (IPP) enables each SEED to provide contractual rates for excess electricity sales.
America loses $150 billion per year due to power outages that occur 285% more frequently than in 1985

The U.S. power grid, which could be considered the largest machine on earth, was built after World War II from designs dating back to Thomas Edison, using technology that primarily dates back to the '60s and '70s.
Its 7,000 power plants are connected by power lines that combined total more than 5 million miles, all managed by 3,300 utilities serving 150 million customers, according to industry group Edison Electric Institute. The whole system is valued at $876 billion.

A smarter grid could reduce costs of outages by about $49 billion per year and reduce carbon emissions by 12 to 18 percent by 2030. [14]



Redundant Reliability
Each SEED has designed-in redundancies including utility natural gas to back up biogas production. Hydrogen to back up natural gas. Utility power to back up microgrid energy production for critical systems.

Value Proposition: Multi-generation Technology

Cogenerative Heat & Power (CHP)
An energy production methodology that utilizes thermal energy in addition to electrical energy created by an energy system. CHP efficiencies in power generation have exceeded 85% efficiency, compared to a national electrical grid average of 26% efficiency. High-temperature fuel cell technologies (SOFC/MCFC/etc.) are commonly formatted to utilize heat production in the onboard reformation of fuel (thermochemical electrolysis/steam methane reforming, SMR) to extract hydrogen for power generation.

Carbon Capture
FuelCell Energy (Danbury, CT) feature-optional configurations for Carbon Capture that captures up to 90% CO_2 (in addition to 70% NOX destruction, and clean water production).[15] This purified CO_2 stream is an asset that is currently used in vertical farming systems to manipulate yield rates on crops. Seedling will both utilize and sell this asset to controlled environment agriculture (CEA) markets.

Hydrogen Production | SMR | Electrolysis
Production of a higher-value assets, hydrogen & food-crops, is prioritized over bulk energy sales to local utilities. IPP utility status acts as a production/demand buffer and emergency response capability. FuelCell Energy's Tri-Gen technology has been implemented in modeling of full-scale SEEDs (PHL & PGH). This technological configuration produces 1,270kg H_2/day in a configuration that cannot be turned off outside of service schedules. Alternatively, energy produced by a CHP fuel cell will be used in smaller scale SEEDs integrating SMR/Electrolysis for hydrogen production.

[14] International Business Times. Business: Aging US Power Grid.... 2014. https://www.ibtimes.com/aging-us-power-grid-blacks-out-more-any-other-developed-nation-1631086
[15] Fuel Cell Seminar. FuelCell Energy. Post-Combustion Carbon Dioxide Capture Using SureSource Fuel Cell. https://static1.squarespace.com/static/58487371b8a79b6d0248c0ac/t/5a149746652deab13d5febb2/1511298890121/FuelCell+Energy+carbon+capture+110817.pdf

Key Activities | Key Resources

High-Temperature Fuel Cell

Commercially tested and operated for decades, high temperature fuel cells provide precision performance with greater reliability, greater efficiency, and more capabilities than alternative combustion-based power generation means. Commonly paired with biogas/methane fuel processing, these technologies classify for renewable energy credits, grants, and incentives.

Seedling has selected two primary suppliers for these technologies, Doosan and FuelCell Energy:

Manufacturer	**Doosan**	**FuelCell Energy**	**FuelCell Energy**
Model	**PureCell 400** [16]	**Sure Source 1500** [17]	**Sure Source Hydrogen** [18]
Technology Molten Carbonate Solid Oxide Phosphoric Acid	**PAFC**	**MCFC**	**MCFC**
Power Output	**400/440 KW**	**1,400 KW**	**2,350 KW**
Gas Input: NG	**66 SCFM @ 1025 Btu/SCF**	**181 SCFM @ 930 Btu/SCF**	**372 SCFM @ 930 Btu/SCF**
Gas Input: Biogas	**124 SCFM @ 545 Btu/SCF**	**308 SCFM @ 545 Btu/SCF**	**634 SCFM @ 545 Btu/SCF**
Digester Size	**50T/Day**	**150T/Day**	**270T/Day**
Additional Output	**Thermal:** **0.64 MMBtu/h @ 250˚ F** **NOx: 0.01 lbs/MWh** **CO: 0.02 lbs/MWh** **VOC: 0.02 lbs/MWh** **SO_2: Negligible** **PM_{10}: Negligible** **$CO_{2(e)}$: 1,049 lbs/MWh** **$CO_{2(CHP)}$: 495 lbs/MWh**	**Thermal:** **2.216 MMBtu/h @ 250˚ F** **NOx: 0.01 lbs/MWh** **CO: TBD lbs/MWh** **VOC: Negligible** **SO_2: 0.0001 lb/MWh** **PM_{10}: 0.00002 lb/MWh** **$CO_{2(e)}$: 980 lb/MWh** **$CO_{2(CHP)}$: 520-680 lb/MWh**	**Thermal:** **.415 MMBtu/h @ 180˚ F** **NOx: 0.01 lbs/MWh** **CO: TBD lbs/MWh** **VOC: Negligible** **SO_2: 0.0001 lb/MWh** **PM_{10}: 0.00002 lb/MWh** **$CO_{2(e)}$: 980 lb/MWh** **$CO_{2(CHP)}$: 520-680 lb/MWh** **H_2: 1,270kg/day** **H_2O: 1 gpm**
Carbon Capture	**Not Featured**	**Available**	**Pending Availability**
Buy / Lease	**Buy**	**Buy / Lease** [Leases starting at $ 0.078/kWhr]	**Buy / Lease** [Leases starting at $ 0.078/kWhr & $ 7.00.kg H_2]

[16] Doosan. PureCell Model 400 Datasheet. 2018. http://www.doosanfuelcell.com/download/pdf/catalog/pafc-400kw_us_en.pdf
[17] FuelCell Energy. SureSource 1500 Spec Sheet. https://www.fuelcellenergy.com/wp-content/uploads/2017/02/Product-Spec-SureSource-1500.pdf
[18] FuelCell Energy. SureSource 3000 Spec Sheet. https://www.fuelcellenergy.com/wp-content/uploads/2017/02/Product-Spec-SureSource-3000.pdf | https://www.fuelcellenergy.com/wp-content/uploads/2017/02/Fuel-Cells-SureSource-Hydrogen.pdf

Value Proposition: Controlled Environment Agriculture (CEA)

Vertical Farming (VF)
Defined as the stacked configuration of hydroponic crop systems illuminated by electrified light sources, Vertical Farming has shown a dynamic relationship between benefits and problems, resulting in industry caution of business model success and market concern with energy consumption and nutrient composition and sourcing.
VF configurations have been modeled at scales ranging from micro in-home systems for microgreens, to shipping-container systems that cite production rates of over 500 heads of lettuce per week.[19] These configurations are convenient for modularity and small scale production (SEED-PSU), but suffer from performance limitations and economic restrictions associated with containment of growth systems within a small, containerized footprint.

Strengths:
- 90% yield
- 90% water reduction/recycling
- 3x-30x land-use efficiency
- Peak-harvest schedules | nutrient/terroir densities
- Food-mile reduction | GHG reduction
- Zero Pesticides | Zero Herbicides | Zero Fungicides
- Climate change resistant | Non-seasonal growth cycle

Weaknesses:
- High energy costs/consumption
- Limited crop-growth portfolio (photon availability)
- Nutrient demand/composition typically non-Organic
- Terroir reflective of practices (Opportunity)
- Conflicts with traditional farming

Greenhouse Hydroponics
This sun-fed, hydroponic configuration of CEA allows for reductions in energy costs associated with VF and provides a greater portfolio of large fruit-bearing crop species due to increased photon output associated with sunlight.
The benefits associated with the sun-fed configuration are weighed against the benefits of land-use efficiency within VF configurations. Seedling seeks brick-and-mortar structures that allow for roof-top greenhouses, to maximize the breadth of our portfolio of in-house grown crop species.
Advancements in combined electrified-lighting and greenhouse configurations are an area that Seedling intends to explore through our operations. The goal of this exploration is to advance the crop yield rates beyond sunlight cycles to provide increased production rates.

Aquaponics
In an effort to reduce external nutrient input, aquaculture systems are combined with hydroponic systems to utilize nutrient-enriched water (ammonia & others) from the aquaculture to supply hydroponic crops with nutrients.
This increase in complexity of systematic relationships, including aquaculture feed-stocks, health, water quality, species selection, and organic certification requirements has shown extreme market difficulties.

Seedling's inclusion of aquaculture within our model serves as an exploratory path toward regional waterway rejuvenation through native species growth programs. Additional research associated with the growth of crustaceans for nutrient ammendment[20], hydrological processing, and marketability will be subsequent phases of R&D for SEED-PSU.

Value Proposition: Brokerage Services

Key Partners | Customer Segment
Providing subscription fertilizer customers a channel to market at a rate between standard & organic, reduces the barrier of entry throughout their transitional period to organic certification. As an added service to fertilizer subscription, Seedling will include regional produce within a brokerage portfolio that is provided to the regional SEED's produce customers. Using Seedling's direct-to-customer channels and network of food-industry customers enables each SEED to provide support for customer farms during their fertilizer contract periods.

[19] Freight Farms. Freight Farms LGM Overview_One Pager_OCT. 2016. https://www.freightfarms.com/product-sheet-download
[20] Lin, Y., *Newcombe, C. E., and Brennan, R. A. 2018. "Crab shell amendments enhance the abundance and diversity of key microbial groups in sulfate-reducing columns treating acid mine drainage."

Revenue Stream: Hydroponic Produce

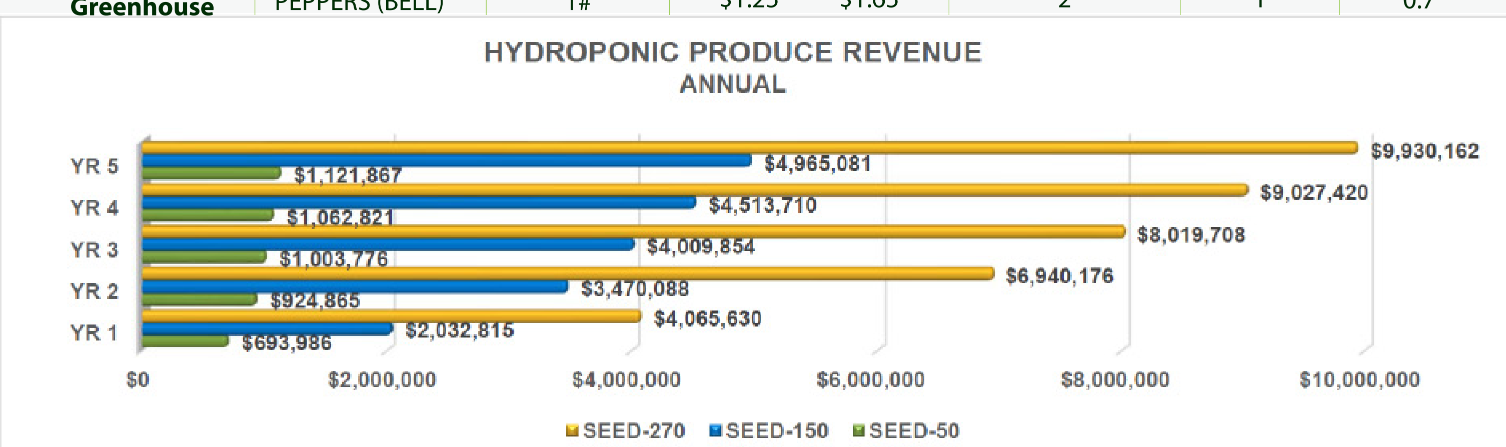
Energy Input | Hydroponic Area
The single greatest limiting factor to vertical farming is energy input.
Within hydroponic growing markets, technologies range from containers to wharehouses.
Containers (**200ft^2 growing**) are indicated, the power input rating ranges from 4.17KW to **8.34kW** based on growing configuration for **all contained technology**. Containers often achieve a **3 layer** growth efficiency. That factors at
0.0139 kW/ft^2/Hr **@ 1 layer @ <u>50%</u> power demand** (lighting: 12hr on / 12hr off)
Wharehouses are indicated, the power input rating is estimated at 0.0228KW/ft^2/Hr Flourescent & 0.0174KW/ft^2/LED [(21)], we factor this to: 0.0201kW/ft^2/Hr @ 1 layer @ <u>100%</u> power demand
WE USE 50% +0.017kW: **0.0122kWh/ft^2/Hr** **@ 1 layer @ <u>50%</u> power demand** (lighting: 12hr on / 12hr off)
Based upon a **<u>50%</u> power demand**, at **<u>5 layers</u>** in height, the ratio between fuel cell power system and farm is:

	50T/Day Food-Waste	150T/Day Food-Waste	270T/Day Food-Waste
Power Input to VF:	300 kW	1,000 kW	2,000 kW
Total Floor Area Minimum:	15,000 ft^2	48,000 ft^2	100,000 ft^2
VF Hydroponic Growing:	4,500 ft^2	16,000 ft^2	32,000 ft^2
Total VF Growing Area: (5 layers, species dependant)	35,000 ft^2	87,710 ft^2	160,000 ft^2
Rooftop CEA Greenhouse:	11,250 ft^2	40,000 ft^2	80,000 ft^2

Produce Yields
Seedling will target early-stage fertilizer formulations for crop species identified by the Environmental Working Group's (EWG) annual "Dirty Dozen" list of crops with the most intensive Ag-chem usage.[22]

The following modeled produce yields and market values are calculated based on available USDA and academic research. Growth-rates are averaged per species of plant based on tradtional soil-based farming practices over a single month.

	Produce Yields	Unit Size	WHOLESALE RATE PER UNIT[23] Low	High	STACKED LAYERS [X*LAND-USE][24] (24' Ceiling)	Units/Ft^2	Growth Rate/Mo.
Vertical Farm	LETTUCE (SM)	HEAD	$0.80	$1.00	5	4	1.1
	LETTUCE (LG)	HEAD	$0.85	$1.25	5	2	0.95
	SPINACH	1#	$1.25	$1.50	5	1	1.4
	BASIL	1#	$3.00	$5.00	5	1	0.8
Rooftop CEA Greenhouse	PEPPERS (BELL)	1#	$1.25	$1.65	2	1	0.7



[21] DOE. EERE. Energy Savings Potential of SSL in Horticultural Applications. December 2017. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=2ahUKEwiB6v-MoNvcAhVGhOAKHc0vDcIQFjABegQICRAC&url=https%3A%2F%2Fwww.researchgate.net%2Fprofile%2FP_Pattison%2Fpublication%2F322582144_Energy_Savings_Potential_of_SSL_in_Horticultural_Applications%2Flinks%2F5a6126720f7e9b6b8fd3ecb4%2FEnergy-Savings-Potential-of-SSL-in-Horticultural-Applications.pdf&usg=AOvVaw1BD3-ndWAfd4c1yE6BQ4O9
[22] EWG. EWG's 2018 Shopper's Guide to Pesticides in Produce™. 2018. https://www.ewg.org/foodnews/summary.php#highlights
[23] USDA. AMS. Specialty Crops - Custom Report - Organic Report. 2016. https://www.ams.usda.gov/market-news/fruits-vegetables
[24] Graff, G. Skyfarming. Pg. 70. 2011. https://uwspace.uwaterloo.ca/handle/10012/6586

Direct-To-Customer Brokerage | Roots LLC.

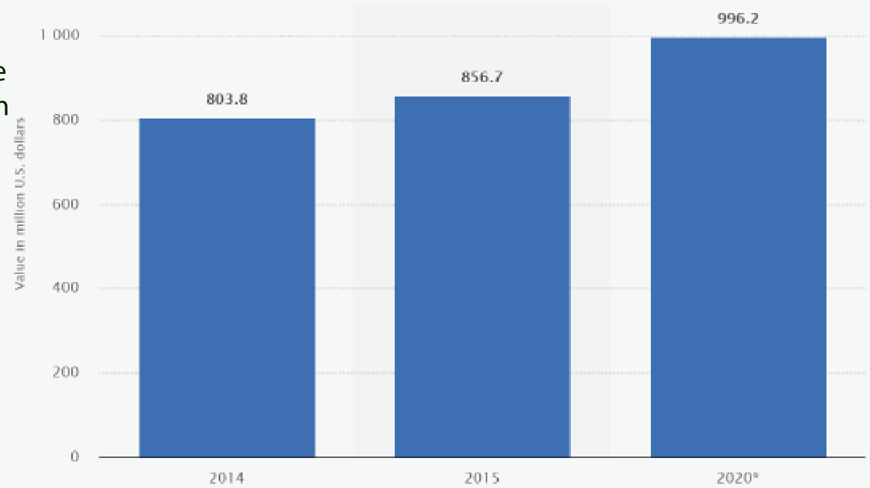
Food-Truck

The US Food-Truck market in 2017 had revenue of 960M which is a 7.3% growth rate over 5 years. The industry employs more than 14,000 workers within a fleet of over 4,000 trucks nationwide.[25]

In surveys of more than 200 truck purveyors, over 85% of full-time food trucks generate over $100,000 in annual gross revenue. Over half of the vendors that responded sold $150,000 or more from their mobile food units last year.[26]

However, food-trucks still remain a gamble with high upfront costs.

Statistica Conservative (Undervalued) Food-Truck Market Value[24]



Traditional Food Truck Start-up Costs[27]

Equipment	*Estimated Cost*
Food Truck + Wrap & Equipment	$25,000 – $100,000
Initial Product Inventory	$1,000 – $2,000
Permits and Licenses	$100 – $500
Website	Free – $5,000
Facebook / Twitter / IG	Free
Register / POS	$200 – $1,000
Uniforms / T-Shirts	$0 – $1,000
Paper Products (Plates / Napkins, etc.)	$200 – $300
Misc. Expenses (Decor)	$500 – $2000
Small-wares: Pots, Pans, etc.	$1000 – $2000
Fire Extinguisher	$100 – $300
Total Chef Cost Low End	**$28,100**
Total Chef Cost High End	**$114,100**

Food Truck On-Going Costs

Item	*Monthly Estimated Cost*
Commissary	$400 – $1,200
Phone / Internet	$100 – $200
Fuel	$500
Labor	???
Repairs	$1000
Food / Beverage Restock	???
Paper Product Restock	???
Total:	***???***

Roots LLC by D3 Designs

Food-Truck Producer: **Lightning Systems & Cruising Kitchens for D3 Designs Inc.**

Managed by: Roots LLC, a subsidiary of D3 Designs Inc.

Roots LLC leases the fuel cell food-trucks to regional chefs, provides contractual purveyourship services for the regional SEED and its fertilizer subscription customers.

Roots' transforms regional oil/lube facilities into leased food-truck centers, complete with commissary, hydrogen fueling station, and purveyourship of regionally grown produce and bioplastic & pressed fiber consumable goods.

Roots' truck-leasing chefs/restaurants may also be provided options to lease hydroponic farming plots within the regional SEED installation. Providing a reliable and consistent source of baseline produce at constant pricing.

Hosting between 3-5 food-trucks per Roots facility, this distribution channel allows for networked placement of SEED assets over an urban area. Lease models allow for Roots reallocation of food-trucks between markets.

The food-truck market today is highly variable and holds a low barrier to entry for ill-suited first-time business owners. Roots and Seedling ease this process through fixed rates of hydrogen fuel pricing (target $3GGE), fresh & local organic produce, hosting services that provide training, cleaning, and purveyourship services. By transitioning these mobile food services to compostable/bioplastics packaging, the waste-stream can be returned to the regional SEED.

Today, Chefs are left with questions. Roots & Seedling fixes this through a nimble & premium user experience. Targeting food-deserts through improved food-mobility.

[25] IBIS World. Food Trucks - US Market Research Report. 2017. https://www.ibisworld.com/industry-trends/specialized-market-research-reports/consumer-goods-services/food-service-drinking-places/food-trucks.html

[26] FoodTruckEmpire. Survey Results: What is the Average Income for a Food Truck Vendor? 2017. https://foodtruckempire.com/news/survey-income/

[27] FoodTruckEmpire. The Complete Breakdown of Food Truck Operation Costs. 2014. https://foodtruckempire.com/how-to/costs/

Direct-To-Customer Brokerage | Roots LLC.

DESIGNS

All-Electric Fuel Cell Food-Truck [R.E.C.E.S.S.]

Originally designed as a Regional Education Campaign for Environmentally Sustainable Solutions (R.E.C.E.S.S.), this all-electric drivetrain and electric cooking solution enables zero-emissions, silent delivery of produce to urban centers.

The truck **has a 50kg H_2 capacity & can operate at peak power (60-80kw) for 8hrs + drive 100 miles**. V2G potential enables a fleet of food-trucks to provide emergency power backup to key urban infrastructure (FEMA, Homeland Security, Red-Cross).

Cooking equipment is interchangable thanks to the lack of plumbed propane/Ng lines within the truck. As a zero-emissions solution it can operate closer to events, indoors, and without disturbance.

All 5 Channel Phases

The food-truck is a "perfect-channel":

1. Awareness - greater visibility at populated events.
2. Evaluation - Samples. Crowd conversation.
3. Purchase - Direct payment.
4. Delivery - Hand-off delivery
5. Follow-Up - Immediate end-customer feedback.

Key Activity: Hydrogen Gas Production

Energy Input | Electrolysis
For SEEDs that are sized to the Doosan PureCell 400 or the FuelCell Energy Sure Source 1500, pairing with secondary electrolysis systems for the production of hydrogen fuel is standard. For this we are citing Nel A-Range Alkaline Electrolysers. Performance may vary with alternative suppliers.
For SEEDs sized to the FuelCell Energy Sure Source Hydrogen, the production of 1,270kg/day H_2 is factored prior to the power rating of 2,350kW.

Nel A-Range Specifications[28]	Nel A-150	Nel A-300	Nel A-485
Capacity range per unit (Nm^3 H_2/hr)	50-150	150-300	300-485
Production capacity dynamic range	15 – 100% flow range	15 – 100% flow range	15 – 100% flow range
DC power consumption	3.8 – 4.4 kWh/Nm^3	3.8 – 4.4 kWh/Nm^3	3.8 – 4.4 kWh/Nm^3

1kg H_2 = 11.126 Nm^3
Avg. 1kg H_2 = 50kW Input

	50T/Day Food-Waste	150T/Day Food-Waste	270T/Day Food-Waste
Power Input to Electrolysis:	100 kW	400 kW	N/A kW
Hydrogen/Day Production:	**48 kg**	**192 kg**	**1,270 kg**
Hydrogen/Year Production:	**15,550 kg**	**62,200 kg**	**411,480 kg**
Asset Value/Year @ $3 GGE	**$93,000**	**$373,200**	**$2,468,880**
Estimated SEED Use/Day Material Handling	20 kg	50 kg	70 kg

Customer Segment: Hydrogen FCEVs

Contractual Fleet Customers | Mass Transit
The Department of Transportation (DOT) and Federal Transit Authority (FTA) have continued focus on the decarbonization of buss systems within the United States[29] offering millions in funding for No-Low Emissions bus programs (both buses and supporting infrastructure).

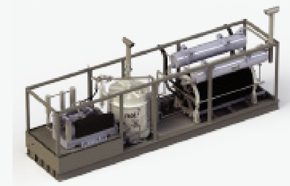
Ports | Heavy Duty
American ports are among the highest concentrations of diesel emissions pollution of all commercial operations. In Essex County, NJ alone the projected costs to regional health of citizens exceeds $500M/Yr.[30]. Hydrogen fuel cell applications for heavy duty use are specifically favorable due to power|weight ratios compared to battery solutions. These heavy duty applications are market available today. [Images[31]]

[28] Nel Hydrogen. A-Range – Tailored Solutions. 2018. http://nelhydrogen.com/product/electrolysers/#a-range-title
[29] FTA. Low or No Emission Program (Low-No Program) 2018 Notice of Funding. 2018. https://www.transit.dot.gov/funding/applying/notices-funding/low-or-no-emission-program-low-no-program-2018-notice-funding
[30] NJ DEP. Montorio. Port Pollution and Impacts on Communities in New Jersey. 2008. https://www.state.nj.us/dep/cleanair/hearings/pdf/Montorio.pdf
[31] DOE. Petrecky. Ground Support Equipment Demonstration. June 2017. https://www.hydrogen.energy.gov/pdfs/review16/mt011_petrecky_2016_o.pdf

Key Resource: Electrolyzer

For smaller scale or remote SEED installations, containerized electrolyzers may be selected for ease of installation.

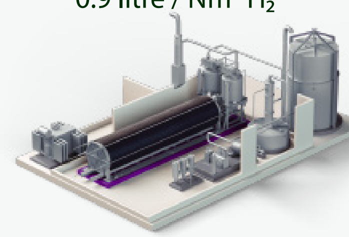
Nel C-Range Specifications[28]	Nel C-150	Nel C-300
Capacity range per unit (Nm^3 H_2/hr)	150	300
Production capacity dynamic range	15 – 100% flow range	15 – 100% flow range
DC power consumption	3.8 – 4.4 kWh/Nm^3	3.8 – 4.4 kWh/Nm^3
Feed water consumption	0.9 litre / Nm^3 H_2	0.9 litre / Nm^3 H_2



Nel A-Range Specifications[28]	Nel A-150	Nel A-300	Nel A-485
Capacity range per unit (Nm^3 H_2/hr)	50-150	150-300	300-485
Production capacity dynamic range	15 – 100% flow range	15 – 100% flow range	15 – 100% flow range
DC power consumption	3.8 – 4.4 kWh/Nm^3	3.8 – 4.4 kWh/Nm^3	3.8 – 4.4 kWh/Nm^3
Electrolyte	25% KOH aqueous solution	25% KOH aqueous	25% KOH aqueous
Feed water consumption	0.9 litre / Nm^3 H_2	0.9 litre / Nm^3 H_2	0.9 litre / Nm^3 H_2

1kg H_2 = 11.126 Nm^3

Avg. 1kg H_2 = 50kW Input



Key Resource | Channel : Hydrogen Fueling Station | Self Serve & Contract

350 Bar | 700 Bar

Hydrogen fuel for transportation is commonly dispensed at two pressure ratings, 350 Bar (H35) and 700 Bar (H70). Often H35 is dedicated to commercial applications like material handling, while H70 is dedicated to consumer vehicles, although this is changing with the launch of the Nikola hydrogen semi-truck (H70 only). This pressure difference is determined by storage and compression equipment at the fueling station. Seedling may choose to store this inventory throug cryogenic means for ease of distribution.

H35

H70

Self Serve & Contractual Sales

Partnering with fleet managers, each SEED provides contractual hydrogen sales to municipal garbage-collection fleets, municipal fleets, regional transit fleets, and Roots LLC food-truck fleets. Translating self-serve fueling stations from SEED to Roots locations provides for reduced tranfic congestion at the SEED facility, and allows for greater market service.

[28] Nel Hydrogen. A-Range – Tailored Solutions. 2018. http://nelhydrogen.com/product/electrolysers/#a-range-title

Key Activities: Bioremediation | Duckweed

Duckweeds have evolved the ability to rapidly remove minerals necessary for their growth from the water on which they float. When present, duckweeds also can remove many organic nutrients. These mineral and organic nutrients are converted into the substance of the plants, that is, their biomass. Research has shown that duckweeds are especially adept at removal of phosphates and nitrogen, particularly ammonia. The treatment of wastewater from agricultural operations requires the removal of great amounts of nitrogen and phosphate. These wastes are a growing problem around the world because of population growth and the trend of modern farming operations.[32] Seedling utilizes the growth of duckweed with our hydroponic waste water as a bioremediation process that produces duckweed biomass to aide in the anaerobic digestion process, while also pre-filtering our post-hydroponic water.

Value Proposition: Water Use Reduction

Traditional farming requires 20 times the water use of a recirculating system. Agricultural flood irrigation in large fields loses water to simple evaporation, run-off, and dispersion beyond the reach of plant roots. The agricultural industry is changing its practices to be more water-wise, but even the best drip irrigation only cuts flood irrigation losses by about one-fourth, nothing close to hydroponics which commonly achieves a **90% reduction in water consumption** compared to traditional farming.

In most hydroponic farming systems, water is recirculated. Run-off water that is not taken up by the plants is recaptured. Nutrients are constantly added by fish waste or fertilizer, and water returns to the plants. Every bit of water is reused over and over again, an impossibility in traditional, soil-based agriculture.
Since it is recirculated and recycled, water is never discharged in hydroponics or aquaponics. Water loss occurs in two main ways:

1) Evapo-transpiration

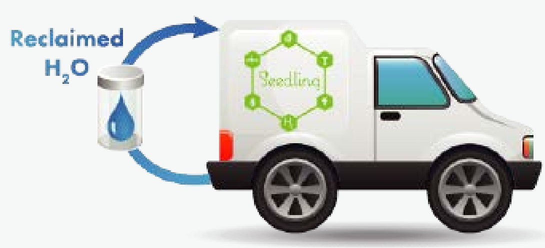
Evapo-transpiration is the use and evaporation of water through the plants. There is no way to eliminate evapo-transpiration; it is a necessary function of living plants! You can, however, keep it as efficient as biologically possible by making sure that your temperature range is suitable for the crops you are growing.

2) Leaks

Leaks sometimes form in the greenhouse irrigation system. This might be a broken pipe or split tubing, but it's most likely that a dripper has been displaced or a leaf is redirecting the water flow. Careful and frequent monitoring of the system is the best way to identify leaks. [33]

Value Proposition: Water Production

Stationary Water Production:
SEED installations at the scale of 270T/2.4MW will be producing a quoted 700,000 gallons per year of water from the stationary fuel cell system (Sure Source Hydrogen™). Although this water production is not scaled to match the hydroponic output of biomass, it will aide in reducing the volume of water that is consumed from local utilities.



Fuel Cell Electric Vehicle

Mobile Water Production:
FCEVs produce on average between 1-4 gallons per hour of operation. Design features within the Fuel Cell Food-Truck are currently exploring the recapture of this water for use within the cooking/cleaning operations of the food-truck.

[32] Cross, John. Practical Duckweed: Application Areas and Sponsors. 2015. http://www.mobot.org/jwcross/duckweed/practical_duckweed.htm
[33] Baptista, Perry. Water Use Efficiency in Hydroponics and Aquaponics. 2014. http://blog.zipgrow.com/water-use-efficiency-hydroponics-aquaponics/

PRELIMINARY SEEDs MAY NOT INCLUDE AQUACULTURE. PENDING FURTHER EVALUATION.

Value Proposition: Nutrient Preloading | Fish Revenue

Aquaponics, a term coined in the 1970s, has ancient roots in agriculture. The relationship between aquaculture and hydroponics, this symbiotic relationship encourages the waste matter that the fish produce to act as a nutrient source for the hydroponic plants. This process was deemed to be organically-certifiable by the USDA, providing that there is no direct contact between plant root systems and the aquaculture tanks. This requirement encourages filtration of solid materials, leaving the nutrient enriched water to flow through hydroponics.

Seedling's approach to this practice intends to utilize the aquaculture-enriched water sources, adding to it crop-specific nutrient profiles from our anaerobic fertilizer production processes.

Nutrient enrichment as a primary value proposition focuses efforts within aquaculture on the health of the species being grown, as well as the water quality both entering and exiting the aquaculture system. Species selection targets higher value choices of freshwater fish, starting with native species to the SEED's region.

Customer Relationships with regional Fish & Wildlife departments, universities, and non-profit aquatic conservation companies prioritizes waterway restocking of native species as a Phase 1 approach to new species integration into the SEED. Upon successful growth of native species, the species will be considered for market testing for human consumption.

Example From Edenworks NYC Demonstrating The Economic Viability Of Aquaponics Compared To Only Hydroponics.

Net Income	$$		as % of revenue	
	Aquaponics	Hydroponics	Aquaponics	Hydroponics
Revenue	10,483,200	10,240,000	100.0%	100.0%
Cost of goods sold				
Aquaculture labor	55,000	0	0.5%	0.0%
Fish feed or nutrient cost	175,088	33,279	1.7%	0.3%
Overhead costs				
Rent	704,791	694,590	6.7%	6.8%
Total variable costs	**934,879**	**727,869**	**8.9%**	**7.1%**
Non-variable costs	8,000,000	8,000,000	76.3%	78.1%
Total operating costs	8,934,879	8,727,869	85.2%	85.2%
EBITDA Margin	**1,548,321**	**1,512,131**	15%	15%

Value Proposition: Crustaceans | Shellfish | Soil Amendment

Chitin a naturally occurring compound specifically from fresh water crabs, is observed to have outstanding effect specifically on cucurbitaceae in controlling plant diseases, growth enhancement increasing size, color, vigour of the plant & it's fruits, leaves, etc.[34] Main commercial sources of chitin are shells of crustaceans such as shrimps, crabs, lobsters and krill that are supplied in large quantities by the shellfish processing industries. Extraction of chitin involves two steps, demineralisation and deproteinisation, which can be conducted by two methods, chemical or biological. Crayfish (Procambarus clarkii) by-products have also been used to recover chitin.[35]

If a SEED determines viability in farming crustaceans/shellfish for soil amendment additives to fertilizer, all species are intended to be grown in freshwater configurations. No saltwater species are currently being evaluated.

[34] Kumar, Surya et al. Effect of Freshwater Crab Shell Fog as Organic Fertilizers. International Journal of Agriculture and Food Science Technology.2014 https://www.researchgate.net/publication/301661131_Effect_of_Freshwater_Crab_shell_Fog_as_Organic_Fertilizers

[35] W. Arbia et al. Chitin Recovery Using Biological Methods. Food Technol. Biotechnol. 2013. https://hrcak.srce.hr/file/146860

AQUACULTURE

PRELIMINARY SEEDs MAY NOT INCLUDE AQUACULTURE. PENDING FURTHER EVALUATION.

Revenue Streams: Stocking Fish

Commonly grown stocking fish species within Pennsylvania include Yellow Perch and various types of Trout (Brown, Brook, Rainbow, etc.).

Stocking Prices In Pennsylvania:[36]

Yellow Perch

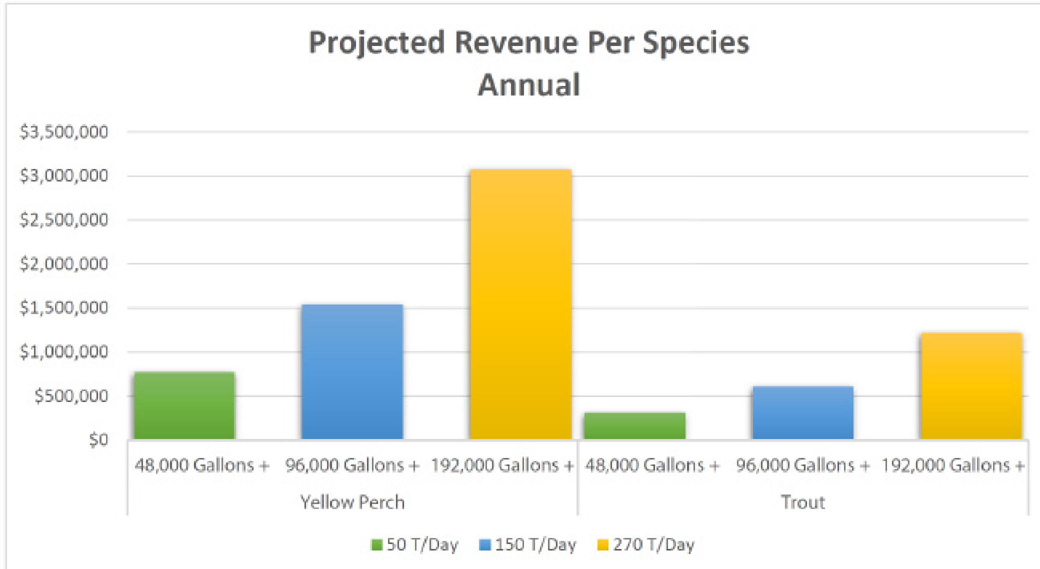
- Avg. growth 6”/gallon/90days
- Avg. price 6” @ $4.00/ea.

Trout

(varietal independent)

- Avg. growth 7”/gallon/160days
- Avg. price 7” @ $2.75/ea.

Common aquaculture tank sizes are in 12,000 gallon increments. Revenues shown (right) do not include tanks for hatch/spawning processes.



Revenue Stream: Red Claw Crayfish

Red Claw crayfish (Cherax quadricarinatus) are commercially grown in Australia, Mexico, and Argentina. This species is rarely tank-grown at commercial volumes. All estimates are based on earthen ponds, if a SEED pursued this species, ponds & tanks would be evaluated per SEED location.

The value to cost ratio is estimate to reflect within the enhanced value of the fertilizer from the biomass of the crayfish.

Growth Rates:[37]

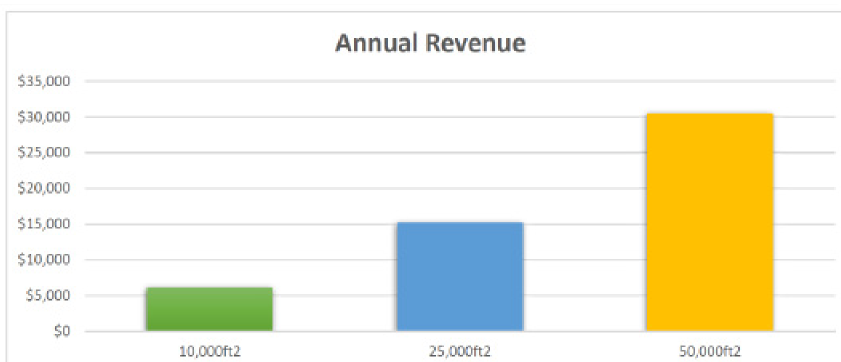
Market size = 65g

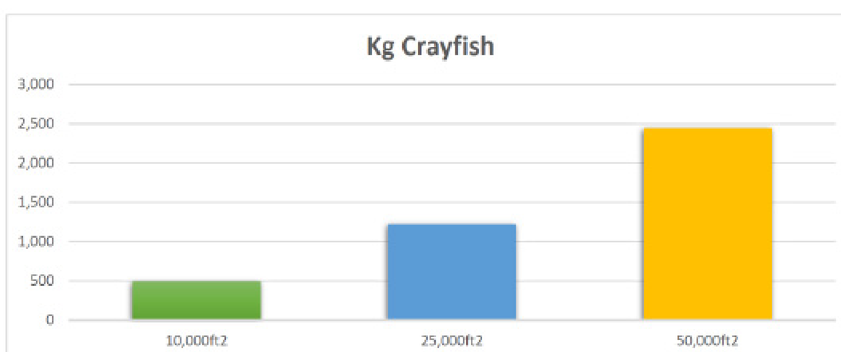
Market rate = $12.50/kg

Growth rate = 9 months (YR 2)

Volume rate = 394kg/1,000m^2 *

* = growth pond : juvenile pond = 5.7:1





[36] Zett’s Fish Farm. 2017 Catalog. 2017. zettsfish.com/wp-content/uploads/Zetts-catalog.pdf

[37] FAO. Cultured Aquatic Species Information Programme: Cherax quadricarinatus. 2018. http://www.fao.org/fishery/culturedspecies/Cherax_quadricarinatus/en

POLYHYDROXYALKANOATES (PHA) BIOPLASTICS

PHA Bioplastics

PHAs are biodegradable, readily compostable thermoplastics, produced by microbial fermentation of carbon-based feedstocks. The properties of PHA polymers are customizable to the application, depending on the specific combinations of different monomers incorporated into the polymer chain.

To demonstrate the potential of PHA bioplastics in the food service industry, which can be conveniently disposed at the point of use. All items are designed to decompose in industrial composting facilities, meaning they can be disposed of alongside food waste—eliminating the need for sorting, washing and separate bins.[37]

PACKAGING FILM	3 PVC	P4HB PBHH	• Flexible • Good moisture and oxygen barriers • Ductile
PLASTIC BAGS	4 LDPE	P(3HB-co-4HB) PBHH	• Flexible • Tough • Ductile
FOOD CONTAINERS	5 PP	PHBV	• Stiff • High operating temperature • Tough
DISPOSABLE CUTLERY	6 PS	PH3B PHBV	• Strong • Stiff • High softening temperature
MEDICAL SUTURES	7 PLA	P(3HB-co-4HB)	• Biocompatible • Resorbable • Strong

Current		Future
Refuse sacks, compost bin liners, carrier bags, gift bags, shrink wrap	Packaging	Bottles, laminated foils
Disposable gloves, disposable aprons, liners for coffee cups, foam packaging	Food service	Food containers and utensils
Mulching film, plant pots	Agriculture	Slow release of fertilizers etc into soil
Absorbable sutures, absorbable mesh, absorbable surgical film, composite mesh	Medical	Microencapsulation, slow release drug formulations, cartilage engineering, stents, wound dressings, bone plates, high performance filters, syringes, gowns, gloves
Phone case, furniture	Consumer Products	Sanitary goods, wipes, textiles, toys, cosmetics (microbeads), interior design
Plastic additives	Chemicals	Adhesives, paints, coatings, fine chemicals

Full Cycle Bioplastics

Business Model: Full Cycle co-locates with licensees who own the facilities, and recieves an upfront license fee, an equity carry, a rucurring PHA volume-based fee, with potential for additional revenue from (optional) O&M service contracts. Full Cycle is responsible for continuous optimization of the PHA production process and, where necessary, supports brokering PHA into the plastics supply chain. Each facility **footprint is small (1/2 to 3 acres)** and generates **incremental revenue of $75 to $500 per ton of waste processed** (assuming a PHA price of $1.50/bl.) CAPEX estimates are $15M to $50M, depending on scale, with a payback period of ~2 to 7 years.[38]

[37] Lingle, Rick. 2018. PHA bioplastics a 'tunable' solution for convenience food packaging. Plastics Today. https://www.plasticstoday.com/packaging/pha-bioplastics-tunable-solution-convenience-food-packaging/157388153458558
[38] Full Cycle Bioplastics. 2019. One-page business overview. Handout at Specialty Food Association's Winter Fancy Food Show, San Francisco, January 2019.

DATA | BLOCKCHAIN

Value Proposition: IoT | Precision Automation

Internet of Things (IOT) technologies revolutionize the supply chain with both operational efficiencies and revenue opportunities, enhanced further with data transparency. SEED-installed sensor-driven analytics on an IBM Hyperledger blockchain network, provides:

- IoT Automation For Anaerobic Optimization
- OFMSW Food-Waste Ag-Chem Toxicity Data
- Precision Fertilizer Nutrient Formulation & Automation
- Fertilizer Customer Soil Composition Data
- Energy System Optimization And Compliance
- CEA Atmospheric Control For Growth Optimization
- Food-safety Regulation Compliance
- Produce Nutrient Composition
- Organic-Certification Compliance
- Food-System Supply Chain Management | Asset Tracking
- Fleet Performance & Future Automation
- *Aquaculture Atmospheric Control (when applicable)*

IBM Hyperledger Food-Trust™ [36]

Integrating in the pioneering food-system work already conducted for the largest retailer of organic produce in the world, Wal-Mart, Hyperledger integration will allow regional SEEDs to integrate with regional farmers that sell through Wal-Mart channels. Additional retail opportunities showcasing Wal-Mart quality through packaged fertilizer offerings.

Value Proposition: Soil Mapping | Precision Nutrients

Seedling fertilizer subscription services will start with existing in-field and in-lab diagnostics of customer soil composition. Data collected on the following attributes will be logged within the blockchain:

- Soil Temperature
- Soil pH
- Soil Lime Requirement
- Soil Conductivity
- Soil Nitrogen (N)
- Soil Phophorus (P)
- Soil Potassium (K)
- Soil Magnesium
- Soil Calcium
- Soil Aluminum
- Soil Ammonia
- Soil Chloride
- Soil Copper
- Soil Iron
- Soil Manganese
- Soil Sulphur

Development of a wearable in-field soil diagnostic system is currently in the Diagnose phase within D3 Designs Inc. This system intends to meld in-field soil sample data with augmented reality evaluation of in-field conditions relating to pests and plant pathogens, as well as inputs from site-surveying drones capturing 3D/4K data of farm fields. The data from this diagnostic system will be blockchained and computed by the regional SEED for responsive automation of nutrient profiles within the next delivery of fertilizer.

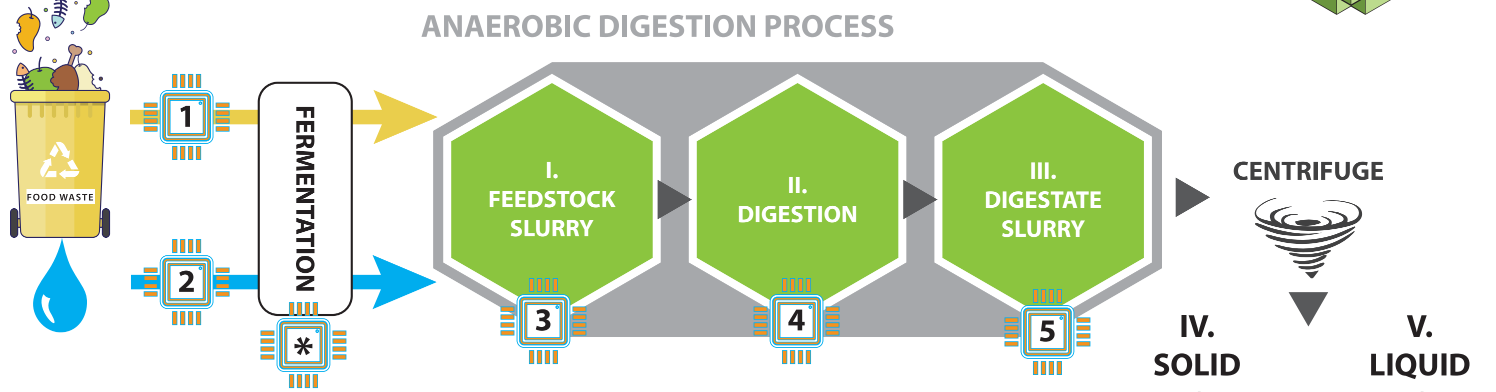
Value Proposition: Tokenized IP Exchange

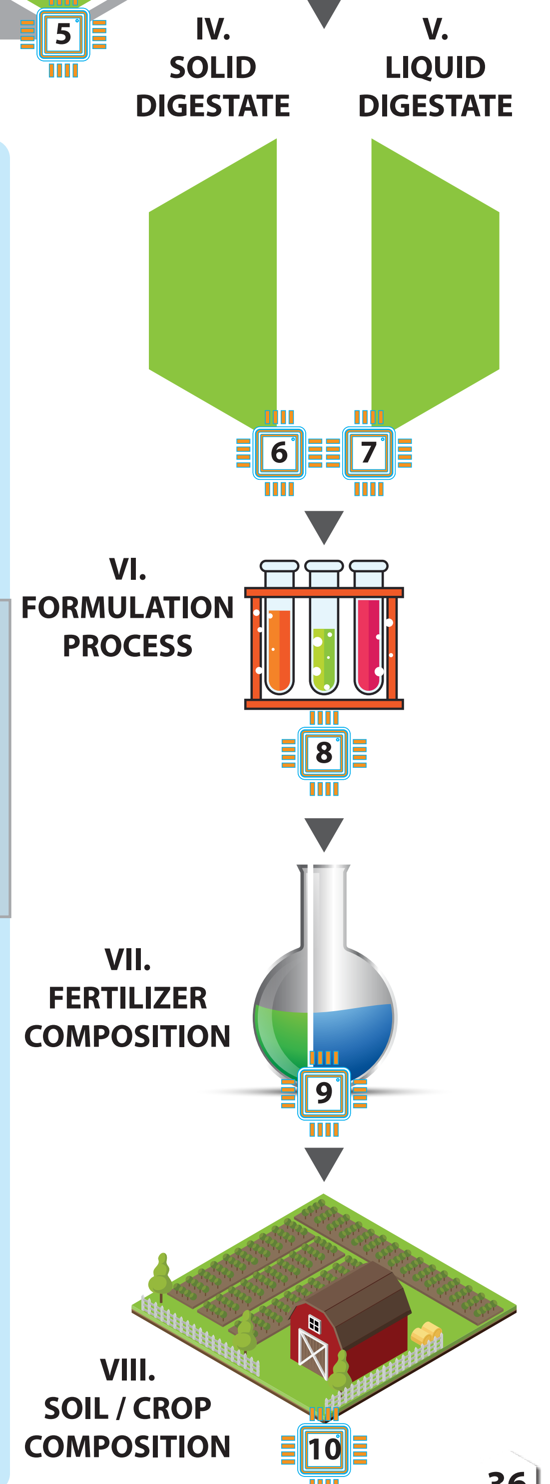
Development of an internal Utility Token is currently in Diagnose phase within D3 Designs Inc. The utility reflected in this token would represent IP exchange between SEED locations for utilization of patents in fertilizer formulation, technological equipment, software, and further technological developments at each SEED location.

[36] IBM. Blockchain - Solutions - Food-Trust. 2018. https://www.ibm.com/blockchain/solutions/food-trust

DATA | BLOCKCHAIN

Fertilizer & Biogas Blockchain Data Collection Flow Chart





SENSORS

1 **Food waste sensors: mass:volume, temperature, humidity, inorganics, metallics, etc.**

2 **Water sensors: full water profile. Precise data to be defined at later date.**

***** **Fermentation sensor systems will be determined at first SEED installation (SEED-PSU), reflective of bioplastics & duckweed fermentation activities.**

3 **Sensors for each substance contained in USDA-NOP UREC of Title 7: 205.601, 205.602, 205.603, 205.604, 205.605b** [USDA National Organic Program Unavoidable Residual Environmental Contaminants]

4 **SENSORS 3 + Biogas/Methane production & quality+ Bacterial content & dispersion**

5 **SENSORS 3 + SENSORS 10**

6 **SENSORS 3 + SENSORS 10 (as applicable to solid sampling)**

7 **SENSORS 3 + SENSORS 10 (as applicable to liquid sampling)**

8 **SENSORS 3 + SENSORS 10**

9 **SENSORS 3 + SENSORS 10 X Time (Degradation Factoring)**

10 **In-Field Soil Tests for: Volume, Temperature, Humidity, pH, Lime Requirement, Conductivity, Nitrogen, Phosphorus, Potassium, Magnesium, Calcium, Aluminum, Ammonia, Chloride, Copper, Iron, Manganese, Sulfur.** [Informs VI. FORMULATION PROCESS]

INTELLECTUAL PROPERTY | EXIT

SEEDs

Data derived by a SEED installation remains property of that SEED-Location LLC and will be licensed for use by other SEED locations. Seedling LLC retains all rights to license data for use in any SEED location for as long as Seedling LLC retains an ownership share of SEEDs that produce and/or license the data. Examples of data are, but are not limited to:

- OFMSW Food-Waste Ag-Chem Toxicity Data
- Precision Fertilizer Nutrient Formulations
- Fertilizer Customer Soil Composition Data
- Energy System Optimization And Compliance
- CEA Atmospheric Control For Growth Optimization
- Food-safety Regulation Compliance Methodologies
- Produce Nutrient Composition
- Food-System Supply Chain Management | Asset Tracking
- Fleet Performance
- Aquaculture Atmospheric Control

SEEDs may not license data or intellectual property to any other company that is not parent or subsidiary to Seedling LLC. without written consent of the President of Seedling LLC, AND board approval from D3 Designs Inc.

Seedling LLC.

Seedling LLC will maintain all financial, operational performance, permitting, installation development, and all record keeping of all SEED locations, and subsidiary companies. All SEED location performance data will be compiled and reported through D3 Designs Inc. annual sustainable metric reporting.

D3 DESIGNS Inc.

D3 Designs Inc. retains all rights of ownership of all products designed and developed as a result of Seedling LLC and SEED installation operations.
D3 Designs Inc. retains all rights to performance data of D3 Designs' products for the duration of which they are owned or operated by a D3 Designs Inc. subsidiary.
D3 Designs Inc. will retain all rights to access all data derived by Seedling LLC or any SEED installation at any time for the purpose of research and development of product or business concept and product development.

INVESTMENT EXIT STRATEGIES

D3 Designs Inc. US Citizen investors must adhere to company by-laws and shareholder's agreements for the entire duration of ownership of shares within D3 Designs Inc.. Terms of investment are on a per-case basis in accordance with D3 Designs Inc. by-laws and the agreement of the board members at time of investment.

Seedling LLC. investment exit strategies are determined by performance of subsidiary SEED locations and associated capital. Seedling retains the right to buy-back shares are fair and determinate market price from any investor within Seedling LLC. business structure at any time.

SEED-*[Location]* LLC. investment exit strategies are determined by the performance of the SEED installation. In the event of economic failure, as determined by Seedling LLC, all capital equipment assets will be sold at auction and/or to the minority share investor within the SEED location. In this event, all intellectual property associated with SEED operations is retained property of Seedling LLC. and D3 Designs Inc.

SUBSEQUENT INFORMATION AVAILABLE UPON REQUEST.

SEND INQUIRY TO
CONTACT@SEEDLING-PHL.COM

USDA AFRI Sustainable Agricultural Systems
Coordinated Agricultural Projects (CAP)
Letter of Intent

Lead Project Director: Rachel A. Brennan, Ph.D., P.E.
Associate Professor of Environmental Engineering
Courtesy Assoc. Prof. of Agricultural and Biological Engr.
The Pennsylvania State University
rbrennan@engr.psu.edu

Lead Collaborating Investigator: Travis Andren
President
Seedling LLC.
travis.andren@seedling-phl.com

Program Area Priority:

Improve water and nitrogen and phosphorus nutrient use efficiency by 50 percent.

IMPROVING THE CIRCULAR ECONOMY OF SUSTAINABLE AGRICULTURE THROUGH BLOCKCHAIN MODELING: FOOD WASTE AS A FEEDSTOCK FOR THE PRODUCTION OF TAILORED ORGANIC FERTILIZERS, BIOFUELS, AND FOOD.

Rationale

Exponential global population growth continues to place increasing pressure on agriculture and waste-management systems, with USDA figures identifying annual food-waste from retail and consumers at an estimated 133 billion pounds. As consumer confidence in agrochemical-based farming shifts toward organic certification, controlled environment agriculture (CEA) and urban farming offer regional solutions and yet face a myriad of economic, scientific, and societal challenges.

We propose a systematic solution that utilizes organic fractionated municipal solid waste (OFMSW) as a source of organic nutrients and embodied energy, both assets that support an integrated CEA system that operates carbon-negative, while also providing regional farmers transitioning to organic certification with a cost-effective source of organic fertilizer that is formulated specifically to their growing conditions.

Hypothesis

The proposed work supports the installation of a scaled demonstration facility at a land-grant institution in collaboration with industrial partners and local farmers. Through blockchain decision modeling, food-waste will be systematically converted into organic fertilizers, crops, and biogas. Through sensor-driven analytics, the nutrient composition of fertilizers will be formulated and tracked to support both hydroponic growing systems as well as soil-responsive liquid and solid organic fertilizers. The use of blockchain will enable the collection of unprecedented data on fertilizer composition and efficacy for both hydroponics and geoponics. The biogas derived from food waste processing will be processed into heat, carbon dioxide, and hydrogen gas by an on-site energy system to support the formulation of fertilizers, the growth of CEA crops, and the distribution of these to regional customers through zero-emissions vehicles. By integrating with regional agricultural systems, this process will support both rural farmers and urban agricultural centers, thereby producing organic food at a greater economic advantage than existing vertical farms and greenhouses.

Objectives

Short-term goals to achieve operational stability and efficiency within the proposed integrated systems begins with: (1) the intake and processing of reoccurring volumes of OFMSW food waste into an onsite anaerobic digestion (AD) system to produce biogas; (2) utilization of AD biogas within stationary fuel cell technology to produce electricity for powering facility operations; and (3) the production of hydrogen gas for fuel cell electric vehicle delivery of products to customers.

Mid-term goals for the advancement of performance agriculture begins with (4) formulation of AD digestate into organic-certified fertilizers and grow mediums for geoponic and hydroponic agriculture. Aiding in this process will be the (5) documentation of sensor-driven analytics within a blockchain data encryption format, forming a database of fertilizer nutrient content, AD composition, and system performance metrics. This database of fertilizer formulations will enable (6) precision growth of an expansive portfolio of organic-certified hydroponic vegetation within an onsite CEA vertical farming system.

Long-term goals for the evaluation of installation performance and assessment of environmental impacts and scalability include: (7) quantifying environmental carbon reductions, improved nitrogen and water use efficiencies, and food system distribution reductions resulting from the installation's operations and diversion of OFMSW from landfills; (8) providing educational opportunities for community, K-12, and collegiate students through operation of the facility as a living lab at the campus Sustainability Experience Center and Student Farm; and (9) integration of lessons learned into regional large-format commercial installations.

Approach

Research collaborators in Agricultural and Biological Engineering will evaluate how seasonal fluctuations in OFMSW affect biogas production and energy system performance. Plant scientists will evaluate how macronutrient and micronutrient compositions of AD digestate materials can be strategically blended to promote hydroponic growth efficiencies within CEA systems. Together with Computer Scientists, participants from Ecosystem Science and Management will develop geoponic fertilizer formulations from AD digestate materials that are responsive to the soil microbiology and geochemistry at the Student Farm and regional farms through extension services. Operational performance of AD, CEA, energy production, and fertilizer formulation will be quantified by integrated sensors on a blockchain encryption network, providing precision data-tracking for responsive adjustments within the systems. By demonstrating this integrated systems approach to sustainable agriculture within a campus facility, variations in inputs (food waste) and outputs (energy, fertilizers, and food) can be thoroughly quantified to better understand the operational mechanisms which are critical to future full-scale implementation.

Outcomes

Diversion of food-waste from landfills into the agricultural value-chains provided by this approach will not only improve environmental sustainability, but also provide rural farmers with precision formulations of organic fertilizers to enable them to transition to organic certification. Fertilizer production volumes will scale in response to the food-waste processing capacity of the installation as well as the on-site utilization of nutrient streams for CEA production. Ultimately, food grown through CEA in this approach will replicate multi-acreage production rates at the commercial scale, without the use of pesticides, herbicides, and fungicides. It is envisioned that large-scale installations will offer organic hydroponic produce to urban consumers, increasing food-security and reducing food-desertification within densely populated urban centers. Through comprehensive precision analytics of CEA performance, opportunities to automate growth processes will provide lower cost food production.

Subsequent installations will further improve energy independence through onsite microgrid power generation. Production of renewable hydrogen for integration into regional transportation markets further reduces greenhouse gas emissions otherwise associated with global distribution. This comprehensive approach to regional improvements in agricultural throughput strengthens the nation's ability to fight hunger and ensure global food security while also reducing environmental impacts currently associated with food-waste.