The ‘Low-Down’ on Vertical Farming

Henry Gordon-Smith

#AUSVEG17
#HortConnections
Presentation Outline

Introduction & Timeline
Definition & Components
Market Drivers
Economics
Case Studies
Failures
Planning for Success
Who am I?

**AGRITUDE**

Founder 2011

Co-Founder 2013

Managing Director 2014

Founding Member 2015

Co-Founder 2017

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@Agriculture  @AVerticalFarm  @BluePlanetHydro  @NYCAgTech  @AgTech_X  @Agri_Tect
Timeline of Vertical Farming

600 BC – Hanging Gardens of Babylon Constructed

627 - The theory of hydroponic gardening first introduced

1909 - The earliest drawing of a vertical farm was published in Life Magazine

1940 - Hydroponic systems were used in the Pacific during World War II

1975 – First NFT System Developed

2009 - Sky Greens Farm built in Singapore

2007 – Spread Co. vertical farm built in Japan

2010 - DARPA builds a vertical farm in Texas for vaccines

2012 - Farmed Here and Local Garden facilities constructed (both closed down now)

2010 - Dr. Dickson Despommier publishes The Vertical Farm

2015 - Total Aero farms funding surpasses $30mm

2016 - LED lighting efficiency reaches new heights

2017 - AVF membership grows to 10 multinationals & 77 business members

*Sample of events. Not comprehensive.
AVF Map

@AVerticalFarm

https://vertical-farming.net/
Definition & Components

**Vertical farming** is the practice of producing food in vertically stacked layers, vertically inclined surfaces and/or integrated in other structures.

Some **major components** include Structure, Hydroponic Systems, Lighting, HVAC, Building Shell, Storage, Processing, Distribution, Biosecurity, and Automation.

@aerofarms  #HortConnections2017  http://aerofarms.com/
Growing pains: Why supermarkets are struggling to source local products

Sales of fruits, vegetables and even meats grown close to the consumer will surge to $20 billion by 2019, according to USDA.

The Future of Young Farmers is Vertical

Farms, land in farms, and average acres per farm, 1850–2012

Million farms/hundred acres/billion acres

Haitz’s Law

http://physics.stackexchange.com/questions/139217/formulas-for-haitzs-law

#HortConnections
## Global Market Drivers for Vertical Farming

<table>
<thead>
<tr>
<th></th>
<th>USA (California)</th>
<th>USA (North East)</th>
<th>Central Europe</th>
<th>Northern Europe</th>
<th>MENA</th>
<th>Russia</th>
<th>India</th>
<th>East Asia</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Scarcity</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<tr>
<td>Transparency/Cleanliness</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Limited Arable Land</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Unfavorable Weather for Agriculture</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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</tr>
<tr>
<td>Demand for Local</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
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<td>✔</td>
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<tr>
<td>Market penetration</td>
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<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Agricultural Independence</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Henry Gordon-Smith
## Economics

### Source:

Shigeharu Shimamura  
MIRAI, CO., LTD

### And Presented by:

Chieri Kubota,  
The University of Arizona

<table>
<thead>
<tr>
<th>Items</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building size (modular building)</td>
<td>1,300 m² (14,000 ft²) footprint (1,100 m² or 12,000 ft² footprint for 4,536 m² production area)</td>
</tr>
<tr>
<td>Crop</td>
<td>Leafy lettuce (10,080 heads per day, 100 g per head)</td>
</tr>
</tbody>
</table>
| Nutrient delivery and lighting systems | NFT  
Combination of LEDs and white fluorescent lamps                      |
| Other facilities                     | Office space, packing area, storage, cold storage (200 m²)          |
| Other equipment                      | Cooling/heating, seedling production systems, irrigation tanks and injection systems, climate controller etc. |
| Equipment/facility life              | Production systems for 7 years; 15 years for other equipment; 20 years for the building |

## Balance estimate

### Items

<table>
<thead>
<tr>
<th>Items</th>
<th>Income/Expense</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual gross sales</td>
<td>~$4.1 M (331M Yen)</td>
<td>~$5.68/lb (10% product loss)</td>
</tr>
<tr>
<td>Annual costs (total)</td>
<td>~$3.4 M (274M Yen)</td>
<td>~$4.70/lb</td>
</tr>
<tr>
<td>Investment return</td>
<td></td>
<td>6th year</td>
</tr>
</tbody>
</table>

1 lb = 0.45 kg
## Economics II

### Capital Costs:

$7.4$ Million ($590$mm Yen)

**Source:**
Shigeharu Shimamura
MIRAI, CO., LTD

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### Annual operation costs: 3.4 million US dollars ($274$M Yen)

<table>
<thead>
<tr>
<th>Items</th>
<th>Costs</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and wages</td>
<td>71.3M Yen</td>
<td>Two full time workers + hourly laborers (210 h/day, $10/h)</td>
</tr>
<tr>
<td>Materials</td>
<td>15.4M Yen</td>
<td>Packing materials, seeds, light bulbs, fertilizers, chemicals, etc.</td>
</tr>
<tr>
<td>Utilities</td>
<td>72.6M Yen</td>
<td>369MW/month power use + water use</td>
</tr>
<tr>
<td>Transportation and shipping</td>
<td>6.0M Yen</td>
<td></td>
</tr>
<tr>
<td>Other costs</td>
<td>49.2 M Yen</td>
<td>Facility/equipment maintenance, consulting</td>
</tr>
<tr>
<td>Depreciation</td>
<td>59.2 M Yen</td>
<td></td>
</tr>
</tbody>
</table>

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[Source](http://www.mirai.co.jp/)
Case Study: Shenandoah Growers

www.fluence.science/shenandoah-growers/
Largest Organic Herb Grower in U.S. Transforms with Fluence
Case Study: Sky Greens

www.skygreens.com
Case Study: Urban Produce

@UrbanProduceLLC

http://urbanproduce.com/
Case Study: INFARM

@INFARMBerlin

https://infarm.de/
Vertical Farming Graveyard

Podponics  Local Garden  FarmedHere  Verticulture

Find out why: https://youtu.be/1mB_8TE-t2E
Know Before You Grow

Operator or Technology?
Market Research
Pilot
Create a new product
Have a back up plan (and budget for it)
Invest in Vertical Farming
Contact
Henry@Agritecture.com

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