CEA Vegetables: Consumer Willingness to Pay and Cost Studies

Miguel I. Gómez, Irin Nishi
Cornell University
Empire State Producers Expo, Syracuse January 18, 2017

Market for locally grown

- National market demand for “local food” has expanded from $1 billion to $7 billion in the last 9 years
- Consumer demand and sales for locally-sourced vegetables at Whole Foods have doubled since 2012
- *Locally grown* - top produce trend for 2015 – National Restaurant Association

New York State Greenhouse Vegetables

	2012	2007
Production Operations	435	201
Wholesale Value (millions)	27.4	17.7
Acres of greenhouses	114	69

Growth in greenhouse vegetables, 54% increase in value in 5 years

Ranks 2nd in U.S. for greenhouse vegetables

USDA NASS, Census of Agriculture

Consumers Willingness to Pay for Local CEA Vegetables: The Case of Tomato and Lettuce

- To measure differences in consumer willingness to pay for lettuce and tomatoes with:
  - Different origins (New York State vs. Out-of-State) and
  - Grown under different production systems (CEA vs. field-grown)

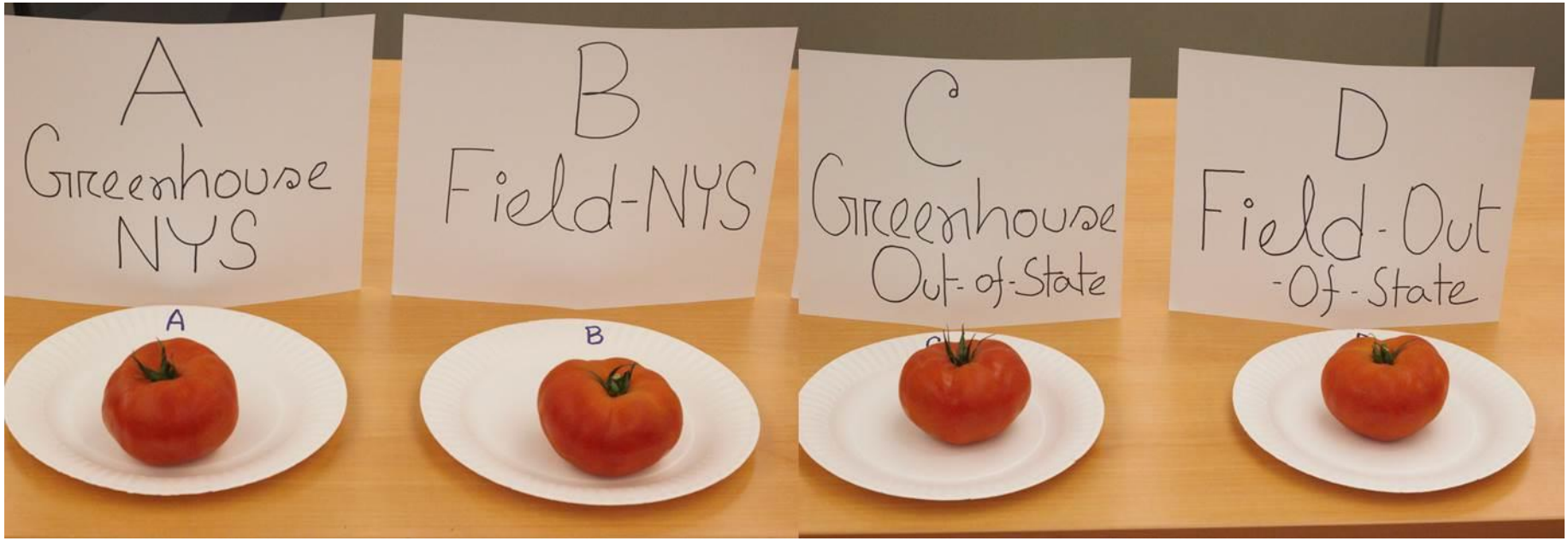
- To examine whether more detailed information about origin and production system affects consumer willingness to pay

Controlled Experiment

Experimental Procedures

- Subjects were presented 4 categories of tomatoes and 4 categories of lettuce (CEA-NYS, field-NYS, CEA-out-of-state and field-out-of-state)
- Subjects indicated their maximum WTP for 8 ounces of each tomato and 8 ounces of each lettuce type
- They also completed a survey at the end of the experiment (demographic and behavior data)

Beefstake Tomato and Baby Lettuce Mix


A
Greenhouse
NYS
B
Field-NYS
C
Greenhouse
Out-of-State
D
Field-Out
-Of-State
A
B


A
Greenhouse
NYS
B
Field-NYS
C
Greenhouse
Out-of-State
D
Field-Out
-Of-State

Experimental Procedures: Data

- Tomato: 428 observations from 107 subjects
- Lettuce: 444 observations from 111 subjects

- 6 experimental sessions in total:
  - Session 1, 2 & 3: subjects were informed about the production systems and origins of the tomatoes and lettuce
  - Session 4, 5 & 6: subjects received more information regarding the production systems and origins (availability, food miles and job opportunity) of tomatoes and lettuce

Sessions Without Information

Tomato types

Tomato A: Greenhouse-grown in New York State (NYS)

Tomato B: Field-grown in New York State (NYS)

Tomato C: Greenhouse-grown in Out-of-State

Tomato D: Field-grown in Out-of-State

Sessions With Information

Greenhouse-grown in New York State (NYS)

Greenhouses allow growers to control growing conditions to produce NYS-grown tomatoes available year round

Tomatoes produced within NYS travel on average 150 miles to market

Generate NYS jobs year round (1 job per 40 tons harvested)

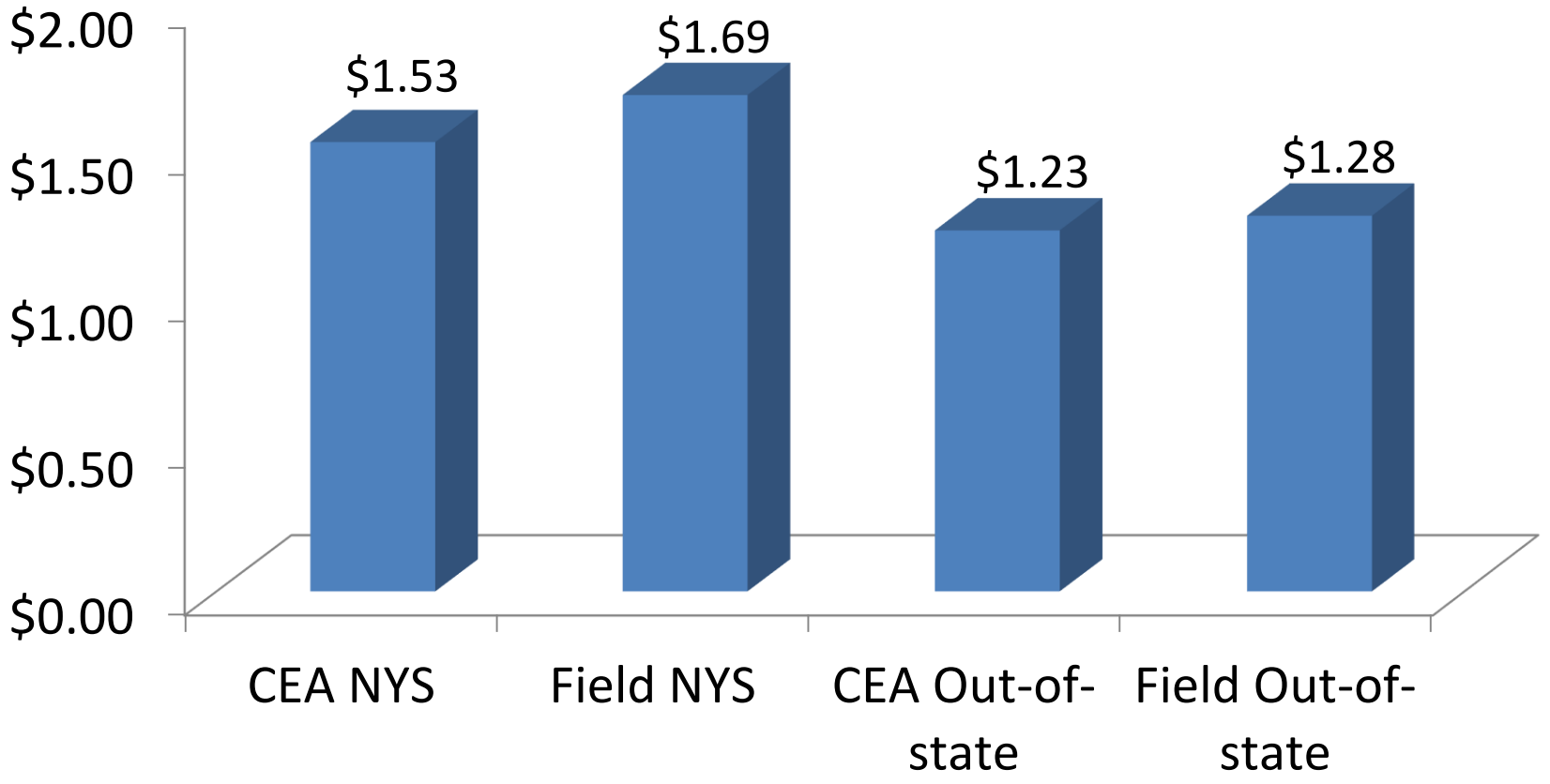
Field-grown in New York State (NYS)

Less control over growing conditions, so NYS-grown tomatoes available five months of the year

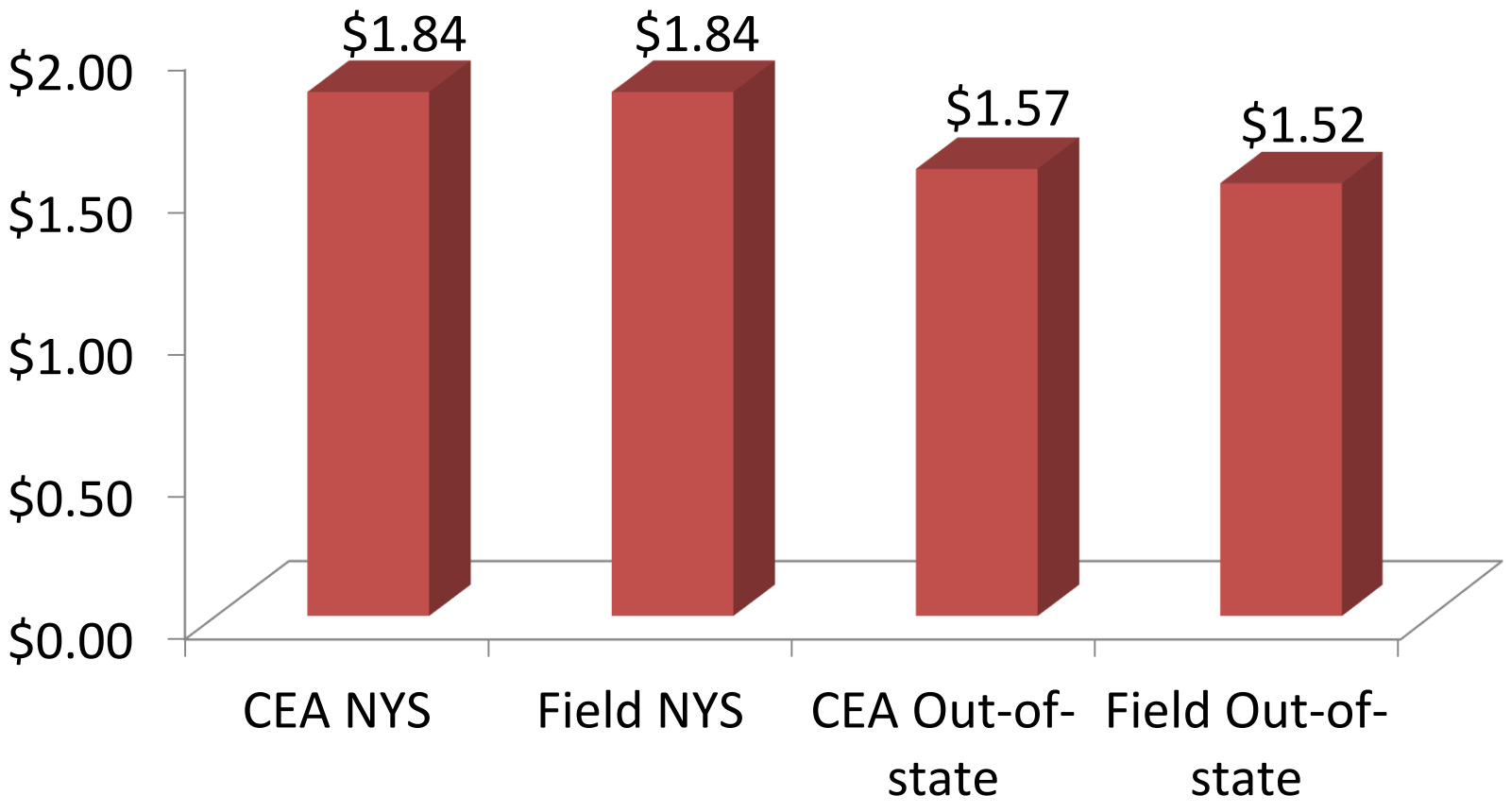
Tomatoes produced within NYS travel on average 150 miles to market

Generate NYS jobs five months of the year (about 1 job per 40 tons harvested)

Average WTP: Beefstake Tomato



Average WTP: Baby Lettuce Mix



Results: Price Premiums

	Tomato	Lettuce
NYS vs. Out-of-state	$0.36	$0.27
CEA vs. Field	No difference	No difference
Info vs. No-info	No difference	No difference

Cost Studies for CEA Vegetables – Interactive Online Tools

- An interactive spreadsheet tool will estimate the capital investment and operating expenses for building and operating a year-round CEA vegetable facility in NYS

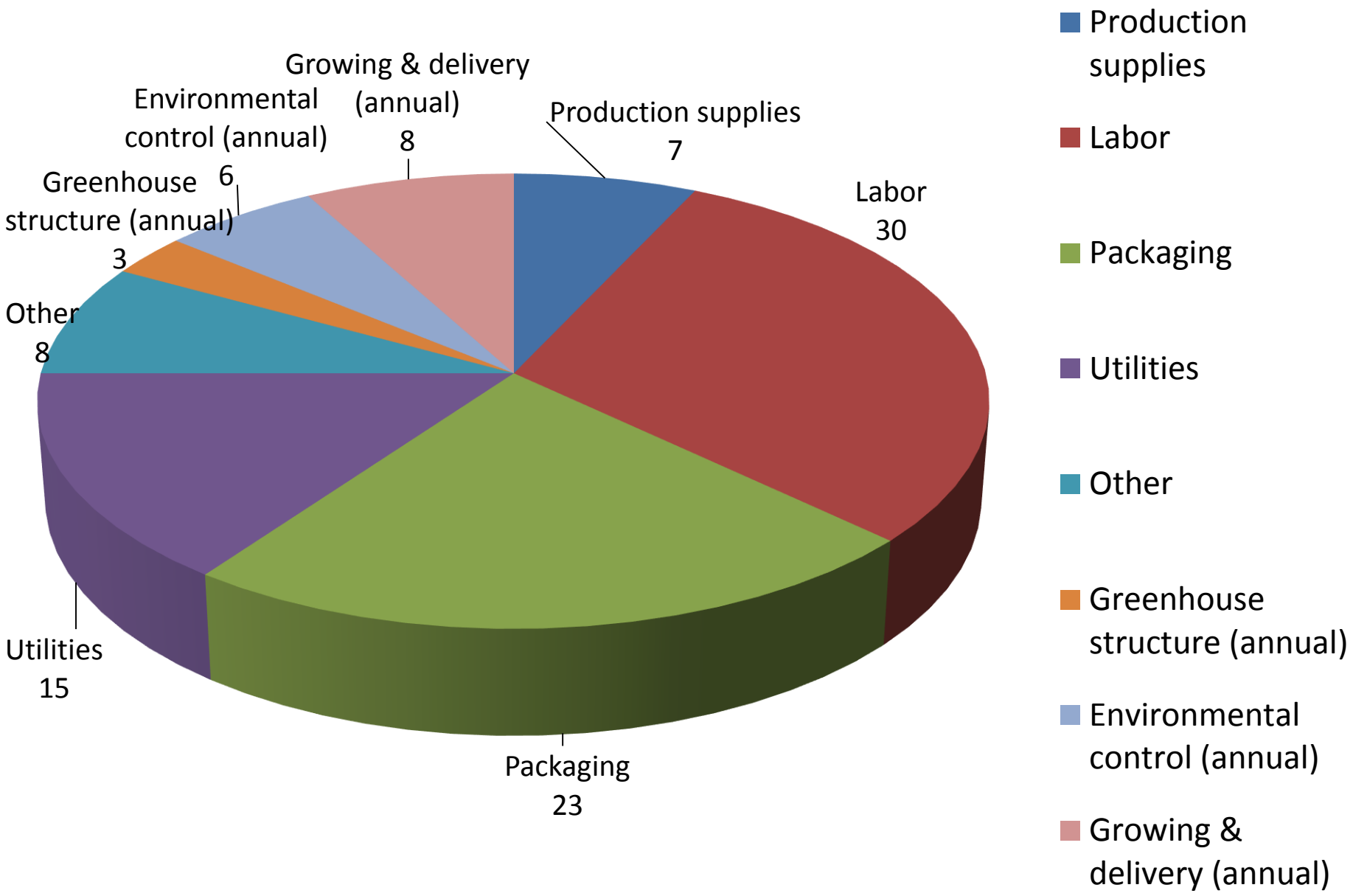
- The spreadsheet will allow users to modify certain parameters (e.g. price, labor costs, energy costs) to simulate impacts on return on investments

Cost Studies for CEA Vegetables – Interactive Online Tools

Major costs can be divided into different categories.

- Fixed cost:
  - Greenhouse Structure
  - Environmental control equipment
  - Growing and delivery
- Variable cost:
  - Production supplies
  - Labor
  - Utility
  - Packaging

Example: Lettuce Cost Study



Interactive Spreadsheet: Assumptions

Lettuce Interactive Spreadsheet Tool

This Excel Spreadsheet tool is designed to assist producerss of Greenhouse vegetables. It allows you to modify the inputs of a model farm. It will clculate fixed cost, variable cost and rate of return for different inputs and price. The tables and figures in this spreadsheet are ***dynamic*** and will change as the variables are modified.

Guide on using this tool:

Spreadsheet	Explanation
Production	This spreadsheet includes data or information used to calculate the amount of total production for different sizes and spacing of Greenhouse. ***Growers*** can make changes to the data in this spreadsheet by inputting their own area, space efficiency, square feet week etc.
Energy	This spreadsheet includes parameters used to calculate total amount of light and heating use for a Greenhouse. ***Researchers*** can make changes to the value of different parameters to do sensitivity
Cost estimatio	This spreadsheet shows the detailed inputs where growers can make different choice to calculate variable cost, fixed cost, rate of return, etc. for a Greenhouse.
Outcomes	This spreadsheet shows the output (variable cost, fixed cost, rate of return) under different threshold. The thresholds ae : 1. Threshold$_1$: with lightening and fuel oil 2. Threshold$_2$: without lighting and fuel oil 3. Threshold$_3$: with lighting and natural gas 4. Threshold$_4$: without lighting and natural gas

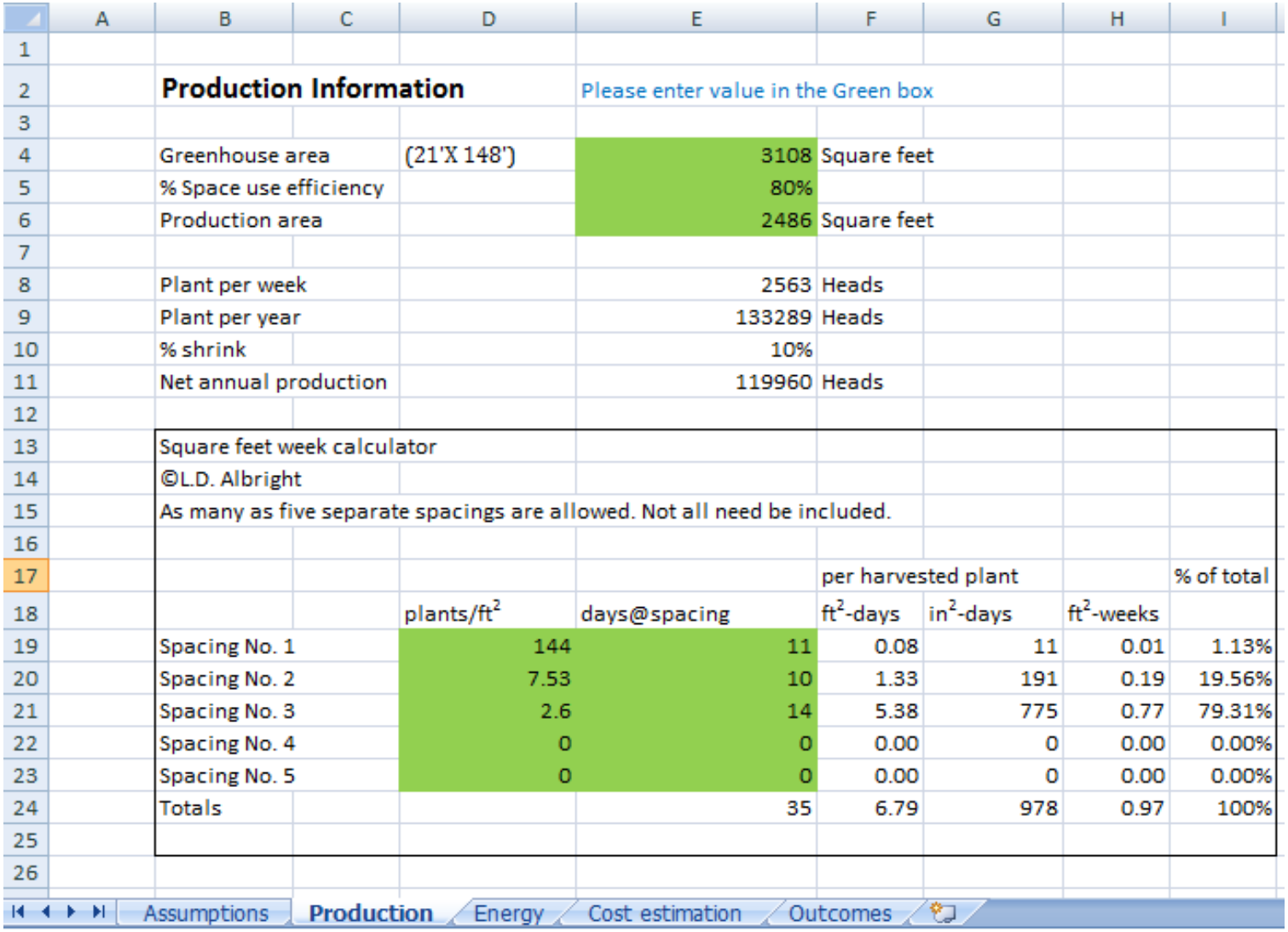
Notes:

[1] Revenue calculated on a per head basis.

Number of turns equals the number of crops harvested in one year. Expect a maximum of 10

Assumptions | Production | Energy | Cost estimation | Outcomes

Interactive Spreadsheet: Production



	A	B	C	D	E	F	G	H	I
1									
2		**Production Information**			Please enter value in the Green box				
3									
4		Greenhouse area		(21'X 148')	3108	Square feet			
5		% Space use efficiency			80%				
6		Production area			2486	Square feet			
7									
8		Plant per week			2563	Heads			
9		Plant per year			133289	Heads			
10		% shrink			10%				
11		Net annual production			119960	Heads			
12									
13		Square feet week calculator							
14		©L.D. Albright							
15		As many as five separate spacings are allowed. Not all need be included.							
16									
17						per harvested plant			% of total
18				plants/ft^2	days@spacing	ft^2-days	in^2-days	ft^2-weeks	
19		Spacing No. 1		144	11	0.08	11	0.01	1.13%
20		Spacing No. 2		7.53	10	1.33	191	0.19	19.56%
21		Spacing No. 3		2.6	14	5.38	775	0.77	79.31%
22		Spacing No. 4		0	0	0.00	0	0.00	0.00%
23		Spacing No. 5		0	0	0.00	0	0.00	0.00%
24		Totals			35	6.79	978	0.97	100%
25									
26									

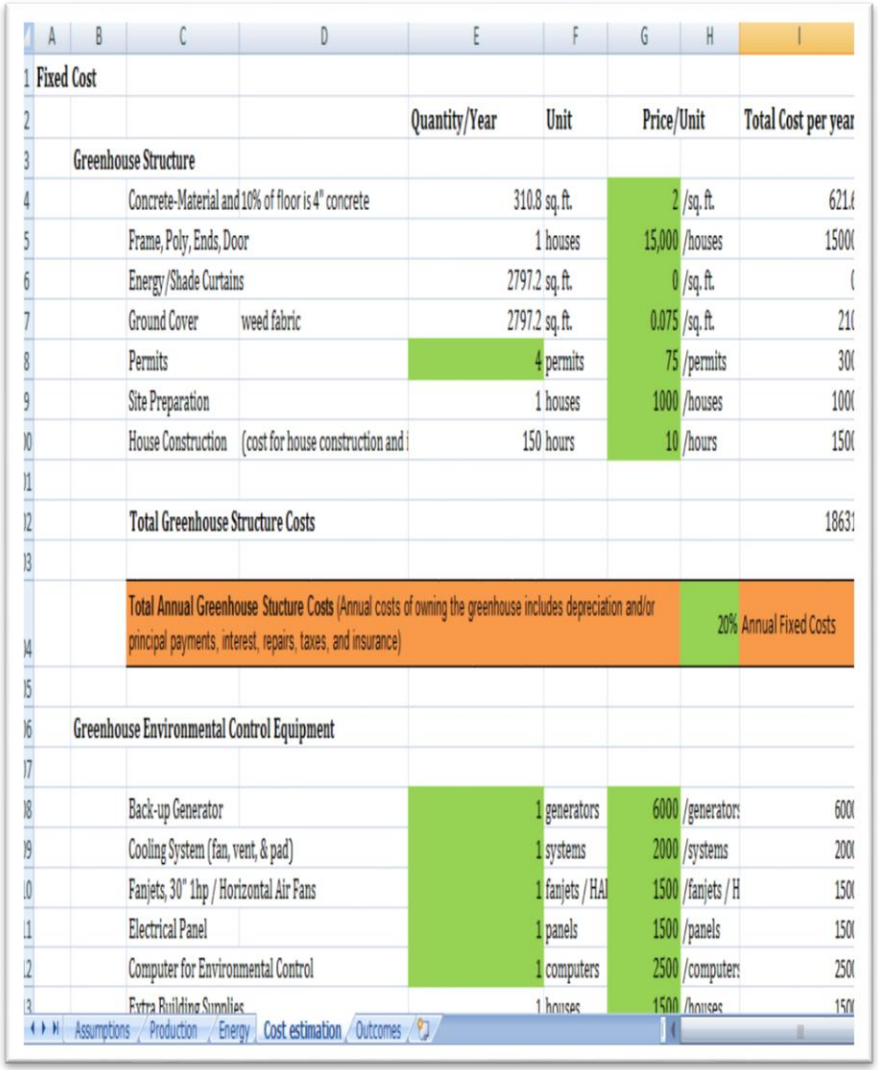
Assumptions | **Production** | Energy | Cost estimation | Outcomes

Interactive Spreadsheet: Energy

	A	B	C	D	E	F	G	H
1								
2		**Lighting**	Please enter value in the Green box					
3								
4		Number of lamps in Greenhouse				20	lamps	
5		Watt consumption per lamp				1000	watt	
6		Hours operated per year				2340	hour	
7		Total Kwh				46800	Kwh	
8								
9								
10		**Heating cost**		The folowing formula will help yo get a reasonably accurate estima				
11								
12		Heating Cost (electricity) = 0.0056XSAXDDXFC					131442	
13		Heating Cost (propane)= 0.00028XSAXDDXFC					10814	
14		Heating Cost (nauaral gas)= 0.00026XSAXDDXFC					30957	
15		Heating Cost (fuel oil)= 0.00018XSAXDDXFC					230	
16								
17		SA (Surface area of the Greenhouse)					5304	Square feet
18		DD (Heating degree days)					4023	Degree days
19		FC (Cost of fuel):						
20				Electricity			1.1	$/kwh
21				Liquid Propane			1.81	$/gallon
22				Natural Gas			5.58	$/1000 cubic feet
23				Fuel Oil			0.06	$/gallon
24								
25								
26								

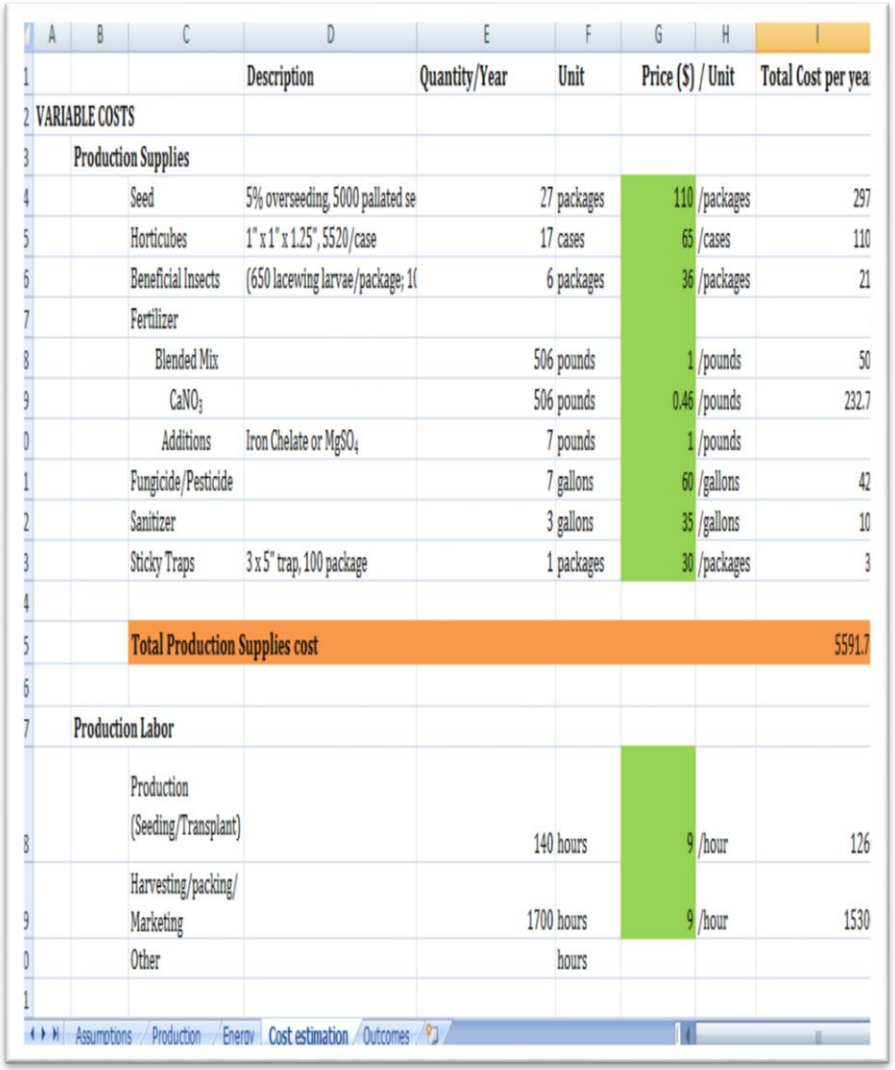
Assumptions | Production | **Energy** | Cost estimation | Outcomes

Interactive Spreadsheet: Cost Estimates



Fixed Cost						
		Quantity/Year	Unit	Price/Unit		Total Cost per year
Greenhouse Structure						
Concrete-Material and 10% of floor is 4" concrete		310.8	sq. ft.	2	/sq. ft.	621.6
Frame, Poly, Ends, Door		1	houses	15,000	/houses	15000
Energy/Shade Curtains		2797.2	sq. ft.	0	/sq. ft.	0
Ground Cover	weed fabric	2797.2	sq. ft.	0.075	/sq. ft.	210
Permits		4	permits	75	/permits	300
Site Preparation		1	houses	1000	/houses	1000
House Construction	(cost for house construction and	150	hours	10	/hours	1500
Total Greenhouse Structure Costs						1863
Total Annual Greenhouse Stucture Costs (Annual costs of owning the greenhouse includes depreciation and/or principal payments, interest, repairs, taxes, and insurance)				20%	Annual Fixed Costs	
Greenhouse Environmental Control Equipment						
Back-up Generator		1	generators	6000	/generators	6000
Cooling System (fan, vent, & pad)		1	systems	2000	/systems	2000
Fanjets, 30" 1hp / Horizontal Air Fans		1	fanjets / HA	1500	/fanjets / H	1500
Electrical Panel		1	panels	1500	/panels	1500
Computer for Environmental Control		1	computers	2500	/computers	2500
Extra Building Supplies		1	houses	1500	/houses	1500

Assumptions | Production | Energy | Cost estimation | Outcomes

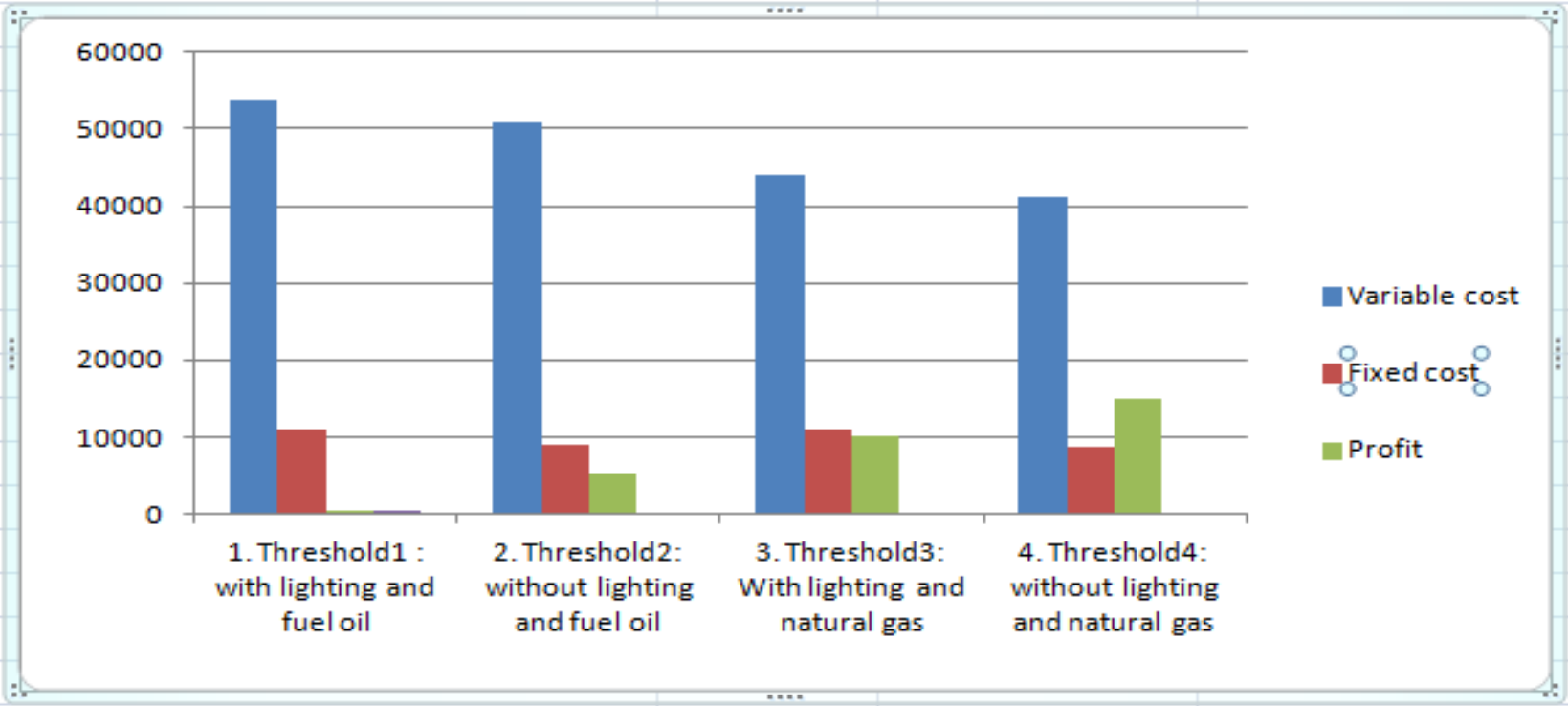


	Description	Quantity/Year	Unit	Price ($) / Unit		Total Cost per yea
VARIABLE COSTS						
Production Supplies						
Seed	5% overseeding, 5000 pallated se		27 packages	110	/packages	297
Horticubes	1" x 1" x 1.25", 5520/case		17 cases	65	/cases	110
Beneficial Insects	(650 lacewing larvae/package; 1(		6 packages	35	/packages	21
Fertilizer						
Blended Mix			506 pounds	1	/pounds	50
$CaNO_3$			506 pounds	0.46	/pounds	232.7
Additions	Iron Chelate or $MgSO_4$		7 pounds	1	/pounds	
Fungicide/Pesticide			7 gallons	60	/gallons	42
Sanitizer			3 gallons	35	/gallons	10
Sticky Traps	3 x 5" trap, 100 package		1 packages	30	/packages	3
Total Production Supplies cost						5591.7
Production Labor						
Production (Seeding/Transplant)			140 hours	9	/hour	126
Harvesting/packing/ Marketing			1700 hours	9	/hour	1530
Other			hours			

Assumptions | Production | Energy | Cost estimation | Outcomes

Interactive Spreadsheet: Outcomes

	A	B	C	D
1				
2		Vaiable cost	Annual Fixed cost	Profit
3	1. Threshold1 : with lighting and fuel oil	53684	10989	326
4	2. Threshold2: without lighting and fuel oil	50804	8909	5286
5	3. Threshold3: With lighting and natural gas	44011	10889	10099
6	4. Threshold4: without lighting and natural gas	41131	8809	15059
7				



Assumptions | Production | Energy | Cost estimation | **Outcomes**

Thank you!
Questions, Comments?

mig7@cornell.edu