

Interactive Business Tool for CEA vegetables: Lettuce & Tomato



Miguel I. Gómez, Neil Mattson, Irin Nishi

Cornell University

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Interactive Online Tools- Cost Studies for CEA Vegetables

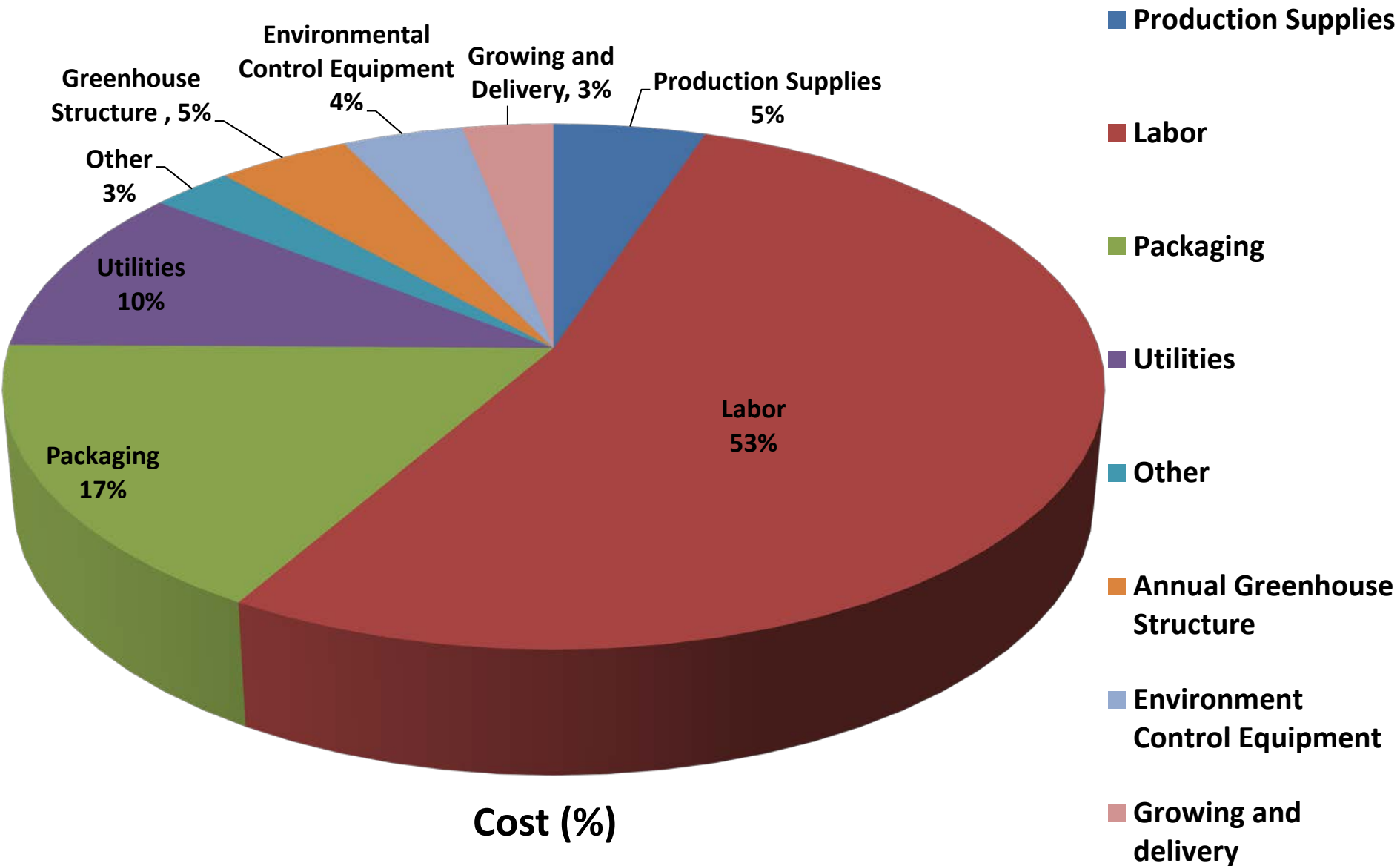
- An interactive spreadsheet tool estimates the capital investment and operating expenses for building and operating a year-round CEA vegetable facility in NYS
- The spreadsheet allows users to modify key parameters (e.g. price, labor costs, energy costs) to simulate impacts on return on investments

Cost Studies for CEA Vegetables – Interactive Online Tools

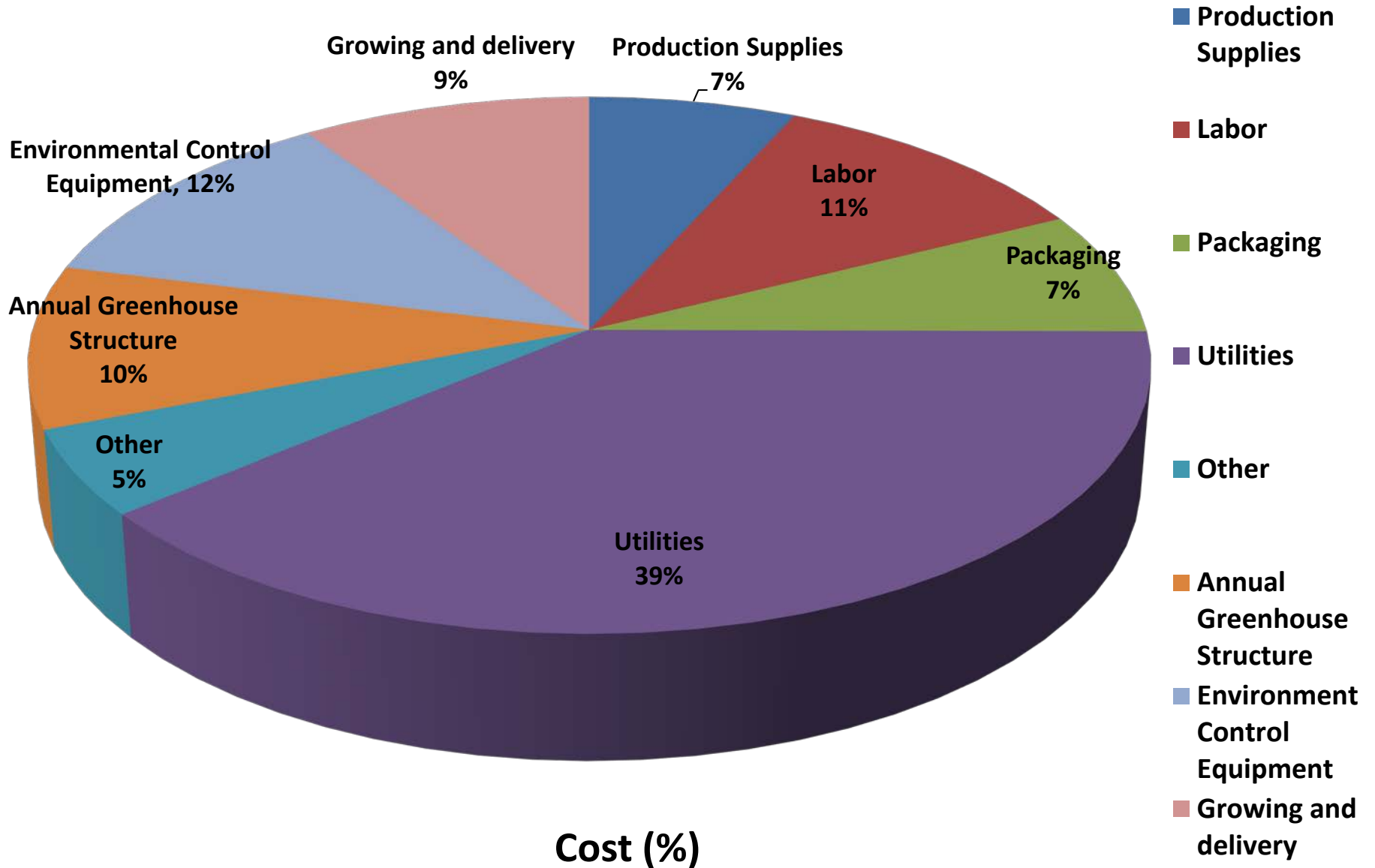
Major costs can be divided into two categories.

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

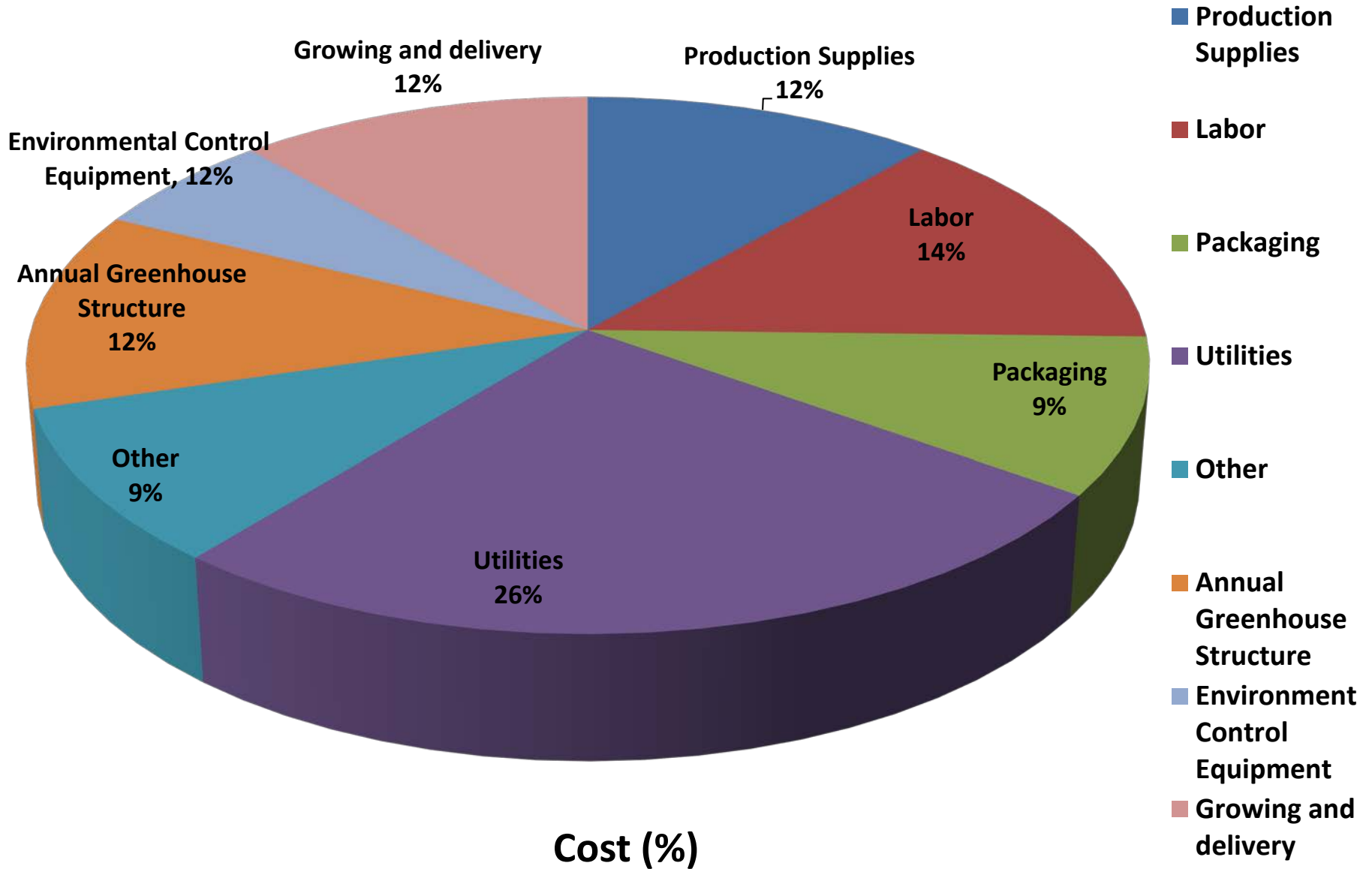
Example: Lettuce Cost Studies



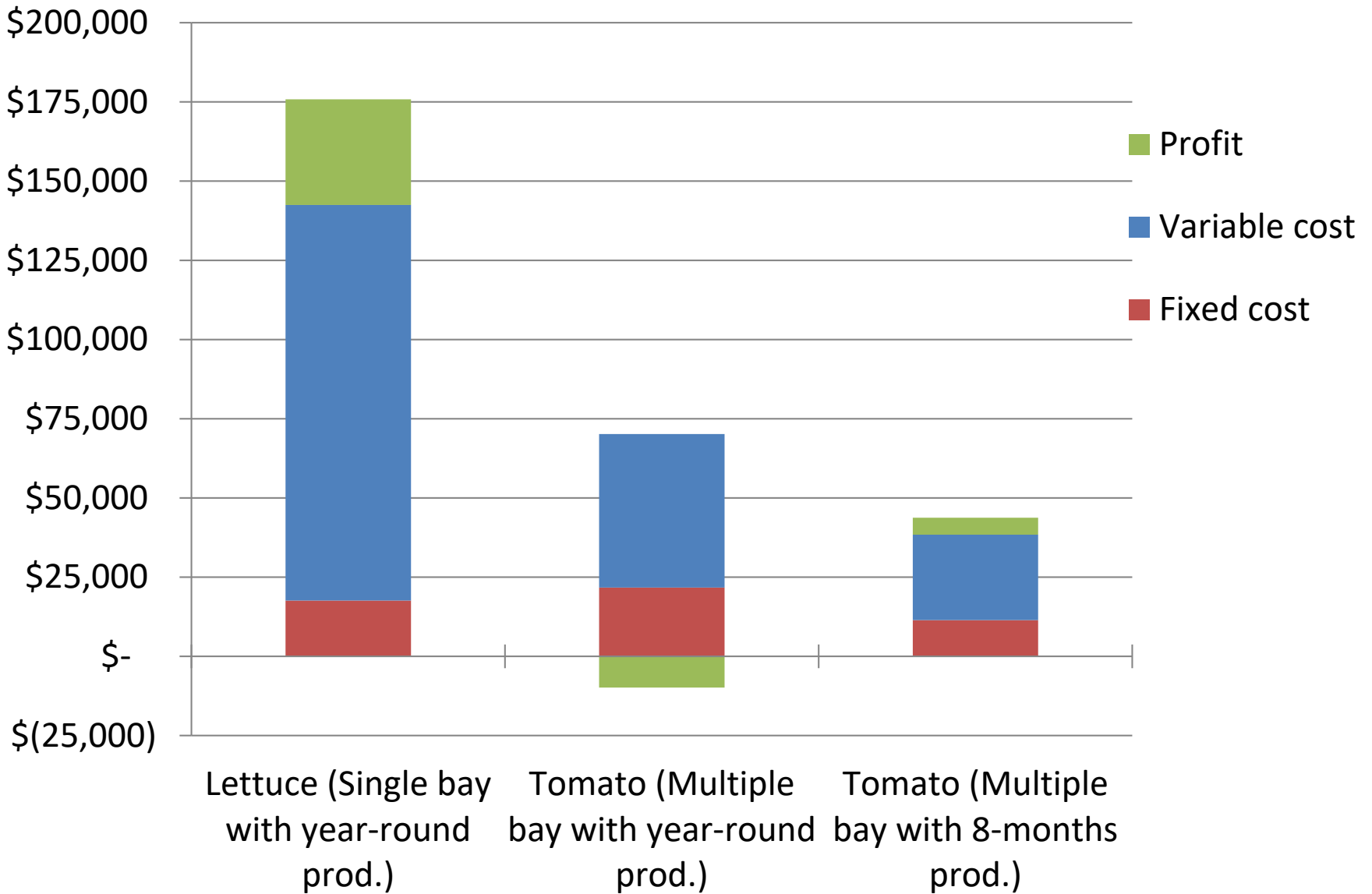
Example: Tomato Cost Studies (year-round production)



Example: Tomato Cost Studies (8-months production)



Comparison of Costs and Profit



Lettuce Interactive Spreadsheet: Assumptions tab

Lettuce Interactive Spreadsheet Tool	
<p>This Lettuce Interactive Spreadsheet Tool estimates the capital investment and operating expenses for building and operating a year-round Controlled Environment vegetable facility in NYS. This tool allows the user to modify the key inputs and then to have an estimate of the revenue, expenses, and profitability of a model Greenhouse operation. The tables and figures in this spreadsheet change as the variables are modified. The user's own management system, available resources, and location can affect the performance of the operation. Thus, the user should experiment with their own yields, inputs, and prices to develop a budget that will accurately represent their own operation.</p>	
<p>Guidelines for using this tool:</p> <ol style="list-style-type: none"> 1. Input your data for the variables in the <i>Inputs</i> tab; 2. Make different input choices for the parameters and input costs of the items in the <i>Cost estimates</i> tab; 3. Open the <i>Results</i> tab to view the total costs, revenue, and profits of a Greenhouse operation based on the previous inputs; 4. Open the <i>Analysis</i> tab to compare profits under different scenarios. The function of each tab is described below. 	
Spreadsheet	Explanation
Inputs	This spreadsheet requires information on production area, spacing, lighting, heating, and labor. The numbers in the blue box are prepopulated but user can make changes to the blue box to reflect their own operation. They can observe the resulting production and energy specifications in the yellow box.
Cost estimates	This spreadsheet includes items needed to calculate the variable costs and the fixed costs of a Greenhouse operation. User can make different choices for fuel use, lighting, and growing system. They can change parameters and costs of the items in the blue box to calculate the variable costs and the fixed costs for their operation.
Results	This spreadsheet presents the total revenue, expenses and annual operating profit. Total annual costs and profitability are calculated on a per head, per square foot, per house, and per acre basis. These results are based on the inputs user provide in the blue box mentioned above and those results can change as the parameters change.
Analysis	<p>The analysis tab reflects profits under an alternative price and yield. User can conduct sensitivity analysis under different assumptions to compare different scenarios.</p> <ol style="list-style-type: none"> 1. Analysis with 20% Increase and 20% Decrease in Labor cost 2. Analysis with 20% Increase and 20% Decrease in Utility cost 3. Analysis with 20% Increase and 20% Decrease in Packaging cost
Notes:	
<ol style="list-style-type: none"> 1 Four options are available for user to choose the type of Greenhouse. User can choose the type they wish to build. 2 Square feet week calculator is used for space efficiency and continuous production. Supplemental 	

➔ The assumptions tab explains how this interactive spreadsheet works and what assumptions are made

➔ The tables and figures change as the variables are modified

➔ Five tabs: Assumptions, Inputs, Cost estimates, Results and Analysis

Lettuce Interactive Spreadsheet: Inputs tab

J37 fx

*** Please enter information in the Blue box

Choose type of Greenhouse ¹ :		No. of bay	
<input checked="" type="radio"/>	Freestanding Gable		1
<input type="radio"/>	Freestanding Quonset		1
<input type="radio"/>	Gutter Connected Gable		5
<input type="radio"/>	Gutter Connected Quonset		2

Production		Greenhouse dimension	
	Width	30	feet
	Length	100	feet
	Radius of the roof	3	feet
	Height	10	feet
	Space use efficiency	90%	
	Concrete-% of floor	10%	
	Overseeding	5%	
	Shrink	10%	
	Price ²¹	1.35	per head

Production and Energy specification based on the information provided in the Blue box:	
Greenhouse area	3000 sq. feet
Surface Area	5912 sq. feet
Net production area	2700 sq. feet
Plant harvested (week)	2783 heads
Plant harvested (year)	144716 heads
Seed	151952
Net annual production	130244 heads
Annual heating load	1910 GJ
Annual heating load	1810 MMBtu
Fuel use:	
Propane	23,319 gal
Natural gas	21,297 therms
Fuel oil	15,256 gal
Pond pump energy	32,100 kWh
Pond pump energy	3.75 kW

Please enter value in the Blue box on the spacing and time in each crop production stage. Remember that your greenhouse environment and lighting will impact length of time in each production stage, the numbers below should be average values from across the year

Spacing no.	plants/ft ²	days@spacing	per harvested plant	
				ft ² -weeks
1	144	11		0.01
2	7.53	10		0.19
3	2.6	14		0.77
4	0	0		0.00
5	0	0		0.00
Totals			35	0.97

Reference:
[Square-foot: weeks calculator- Louis A. Albright, CEA Program Director, Professor, Dept. of Biological and Environmental](#)

Lighting ³	
Number of lamps in Greenhouse	20 lamps
Watt consumption per lamp	1000 watt
Hours operated per year	2340 hour

Assumptions **Inputs** Cost estimates Results Analysis

The Inputs tab requires data on Production (greenhouse dimension, space use efficiency, etc.) and Spacing (no. of plants, days at spacing, etc.)



Users require to provide information in the blue box and can see the resulting production characteristics in the yellow box



Lettuce Interactive Spreadsheet: Inputs (cont.)

	A	B	C	D	E	F	G	H
40								
41								
42		The energy model below can only be used by NYS user. User from other states please select location as "Other state" in the box below:						
43			Location ⁴	NYS				
44		Ideally use energy model from Cornell CEA or other model or use the following formula to get a reasonably accurate estimate to help in making decisions relative to the size of the greenhouse or type of heating						
45								
46		Heating⁵	Glazing material	glass				
47			Custom u-value	1.0	Btu/(sqft*degF*h)			
48			Custom transmittance	90%				
49			Air changes per hour	1.0	ACH			
50			ASHRAE Climate Zone	4A				
51			Greenhouse air temperature	70	F			
52			Evapotranspiration latent load	10	W/ft2			
53			Greenhouse RH%	70%				
54		Boiler efficiency	85%					
55								
56								
57								
58		Labor⁶	Seed/ Transplant/Harvest/ Package	26	hrs/per thousand			
59			Delivering to market	3	hrs/per thousand			
60			Production management	2	hrs/per thousand			
61			Other (Marketing, Maintenance, etc.)	1	hrs/per thousand			
62								
63								
64								
65		Others⁷	No. of Pelleted seed	5000	/per package			
66			No. of Horticultubes	5520	/per case			
67			No. of beneficial insects	650	/per package			
68			Sq. feet covered per insects	0.9	/Sq. feet			
69			Clamshell per case	344	/case			
70			Clamshell per box	12	/box			
71			Labels per roll	2500	/roll			
72								
73								
74								
75								
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80								
81								
82								
83								

➔ The inputs tab also requires data on Lighting, Heating, Labor, etc.

➔ Users can change parameters to reflect their light use, heating cost, and labor needed for operating a Greenhouse

➔ The inputs here are linked to the cost estimates tab which reflect in variable costs, fixed costs, and in return on investments

Lettuce Interactive Spreadsheet: Cost Estimates tab

*** Please enter information in the Blue box

	Quantity/Year	Unit	Price (\$)/Unit	Total Cost per year	
VARIABLE COSTS⁸					
Production Supplies					
Seed (package)	31	packages	110	3,410	
Horticultures	27	cases	65	1,755	
Beneficial Insects ⁹	6	packages	40	240	
Fertilizer					
Blended Mix	489	pounds	1	489	
CaNO ₃	489	pounds	0.46	225	
Additions	7	pounds	1	7	
Fungicide/Pesticide ¹⁰	7	gallons	60	420	
Sanitizer	5	gallons	35	175	
Sticky Traps ¹¹	1	packages	30	30	
Total Production Supplies cost				6,751	
Production Labor					
Seed/ Transplant/Harvest/ Package	3386	hours/year	13	44,022	
Delivering to market	391	hours/year	12	4,689	
Production management	260	hours/year	13	3,386	
Other (Marketing, Maintenance, etc.)	130	hours/year	12	1,563	
Fringe benefit ¹²			30%	16,098	
Total Production Labor				69,759	
Packaging Costs					
Clamshell	190	cases	80	15,200	
Box	5427	box	1	5,427	
Labels	27	roll	50	1,350	
Total Packaging Costs				21,977	
Utilities					
¹³ Fuel choice only for NYS user (choose one):					
<input type="radio"/> Liquid Propane	-	gal	2.48	\$/gallon	-
<input checked="" type="radio"/> Natural Gas	21,297	therms	0.55	\$/therm	11,713
<input type="radio"/> Fuel Oil	-	gal	2.38	\$/gallon	-

Cost estimates tab includes items needed to calculate the variable costs and fixed costs of a Greenhouse

Variable costs include categories like Production supplies, Labor, Packaging, etc.

Users can modify the cost for items in the blue box and can see the sub total under each category

Lettuce Interactive Spreadsheet: Cost Estimates (cont.)

	A	B	C	D	E	F	G	H
85								
86								
87	Fixed Costs¹⁶							
88				Quantity/Year	Unit	Price/Unit		Total Cost per year
89	Greenhouse Structure							
90		Concrete		300	sq. ft.	2	/sq. ft.	600
91		Frame, Ends, Door		1	houses	15,000	/houses	15,000
92		Glazing material (Glass/poly/ double poly)		1	houses	5,000	/houses	5,000
93		Energy/Shade Curtains		2,700	sq. ft.	4	/sq. ft.	10,800
94		Ground Cover		2,700	sq. ft.	0.075	/sq. ft.	203
95		Permits		4	permits	80	/permits	320
96		Site Preparation		1	houses	1000	/houses	1,000
97		House Construction		150	hours	10	/hours	1,500
98								
99	Total Greenhouse Structure Costs							34,423
100								
101		Total Annual Greenhouse Structure Costs²⁰ (Annual costs of owning the greenhouse includes depreciation and/or principal payments, interest, repairs, taxes, and insurance)				20%		6,885
102								
103	Greenhouse Environmental Control Equipment							
104								
105		Back-up Generator		1	generators	6000	/generators	6,000
106		Cooling System (fan, vent, & pad)		1	systems	2000	/systems	2,000
107		Fanjets, 30" 1hp / Horizontal Air Fans		1	fanjets / HAF	1500	/fanjets / HAF	1,500
108		Electrical Panel		1	panels	1500	/panels	1,500
109		Computer for Environmental Control		1	computers	2500	/computers	2,500
110		Extra Building Supplies		1	houses	1500	/houses	1,500
111		Heating System (reflects utility choice from above)						
112		Liquid Propane		1	heaters	2500	/heaters	-
113		Natural Gas		1	heaters	2000	/heaters	2,000
114		Fuel Oil		1	heaters	2000	/heaters	-
115		Poly Inflation Kit		1	kits	150	/kits	150
116		Low Voltage Wiring Package		1	packages	400	/packages	400
117		Protective Equipment (PPE)		1	sets	50	/sets	50
118		Grow Lights ¹⁷						
119		<input type="radio"/> None						-
120		<input checked="" type="radio"/> Yes		20	Lights	460	/Lights	9,200
121								
122								
123	Total Greenhouse Environmental Control Equipment Costs							26,800
124								

➔ Fixed costs include categories like Greenhouse Structure, Environmental Control Equipment, etc.

➔ Users can make different choices to different parameters to reflect their operation

➔ Users can modify the cost and quantity for items in the blue box and can see the sub total under each category

Lettuce Interactive Spreadsheet: Results tab

	A	B	C	D	E	F	
1							
2							
3							
4							
5		Total Annual Revenue and Expenses					
6							
7		REVENUE					
8			Price per Head		\$1.35		
9			Total Heads Sold		130,244		
10							
11			Annual Revenue			\$175,829	
12							
13		EXPENSES					
14			Variable cost		\$124,868		
15			Annual Fixed costs		\$17,628		
16							
17			Total Annual Expenses			\$142,496	
18							
19		Annual Operating Profit					\$33,333
20							
21							
22			Variable Costs (\$)	Fixed Costs (\$)	Total Annual Costs (\$)	Annual Profit (\$)	
23							
24		Per Head	0.96	0.14	1.09	0.26	
25		Per Square Foot	42	6	47	11	
26		Per House	124,868	17,628	142,496	33,333	
27		Acre (43,560 sq. ft./acre)	1,813,090	255,951	2,069,041	484,002	
28							
29							
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40							
41							



The results tab includes the total revenue, expenses and annual operating profit.



Total annual costs and profitability are calculated on per head, per square foot, per house, per acre basis.



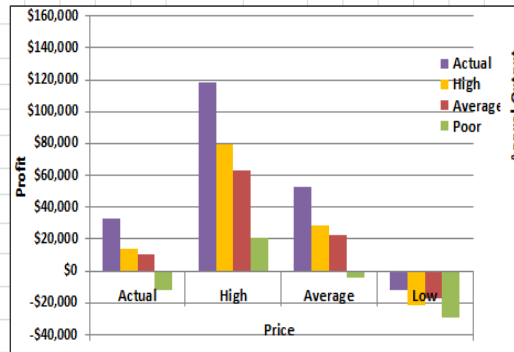
These results change as the parameters change

Lettuce Interactive Spreadsheet: Sensitivity Analysis

Annual Profit Based On Different Assumptions

With Natural Gas and light

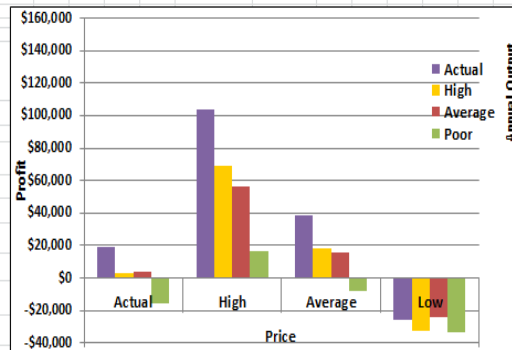
		Price				
		Actual	High	Average	Low	
Annual Output	Actual	130,244	\$33,333	\$117,992	\$52,870	-\$12,252
	High	101,275	\$13,792	\$79,620	\$28,983	-\$21,655
	Average	80,262	\$10,634	\$62,805	\$22,674	-\$17,457
	Poor	49,982	-\$11,551	\$20,938	-\$4,053	-\$29,045



The sensitivity analysis tab reflects profits under alternative price and yield.

With 20% Increase in Labor Cost

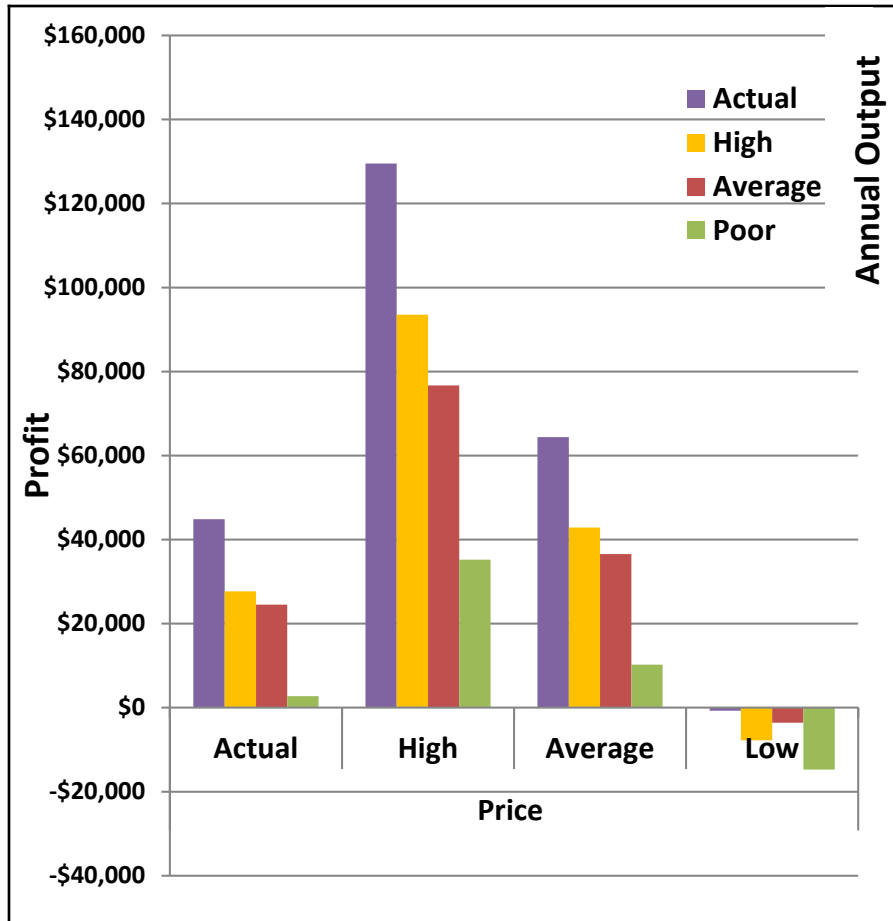
		Price				
		Actual	High	Average	Low	
Annual Output	Actual	130,244	\$19,382	\$104,040	\$38,918	-\$26,204
	High	101,275	\$3,016	\$68,845	\$18,207	-\$32,430
	Average	80,262	\$4,021	\$56,191	\$16,060	-\$24,071
	Poor	49,982	-\$15,669	\$16,819	-\$8,172	-\$33,163



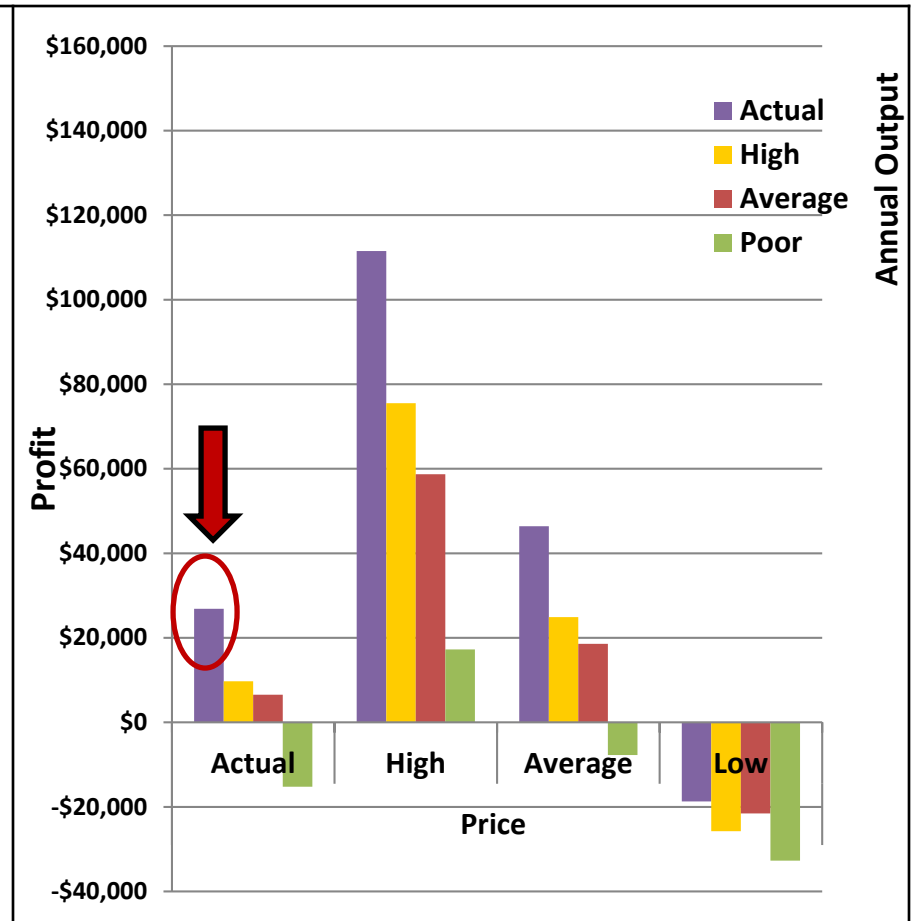
Users can conduct sensitivity analysis under different assumptions

Lettuce Sensitivity Analysis tab (cont.)

With Natural Gas



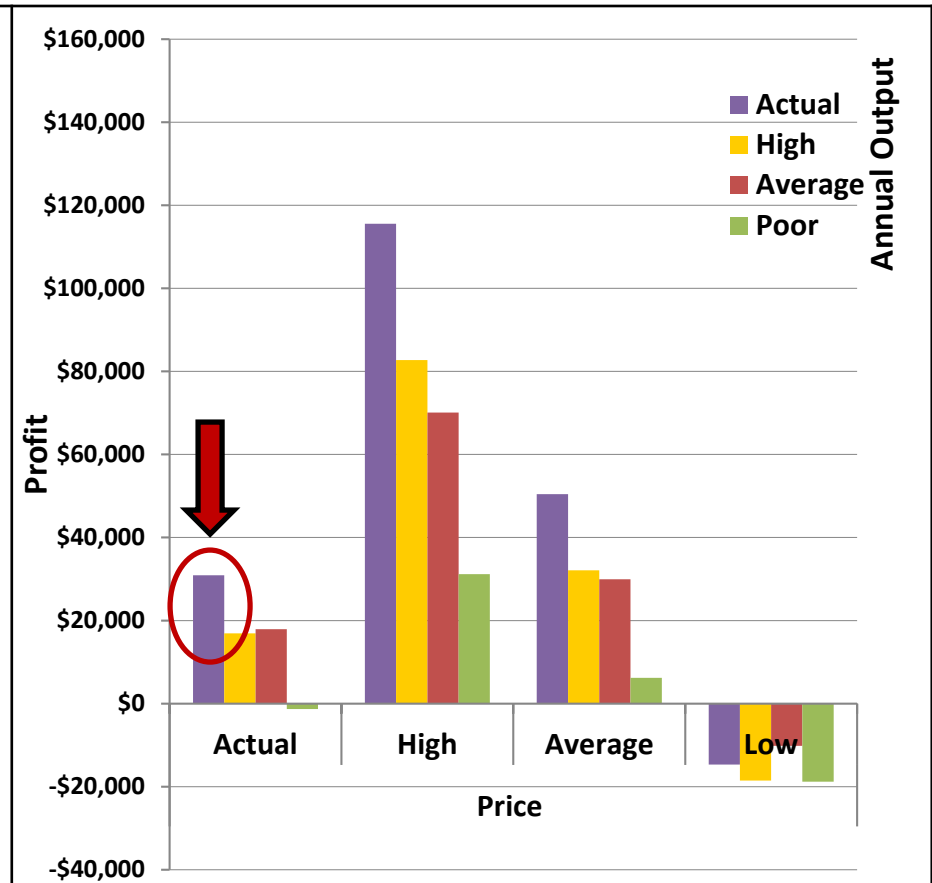
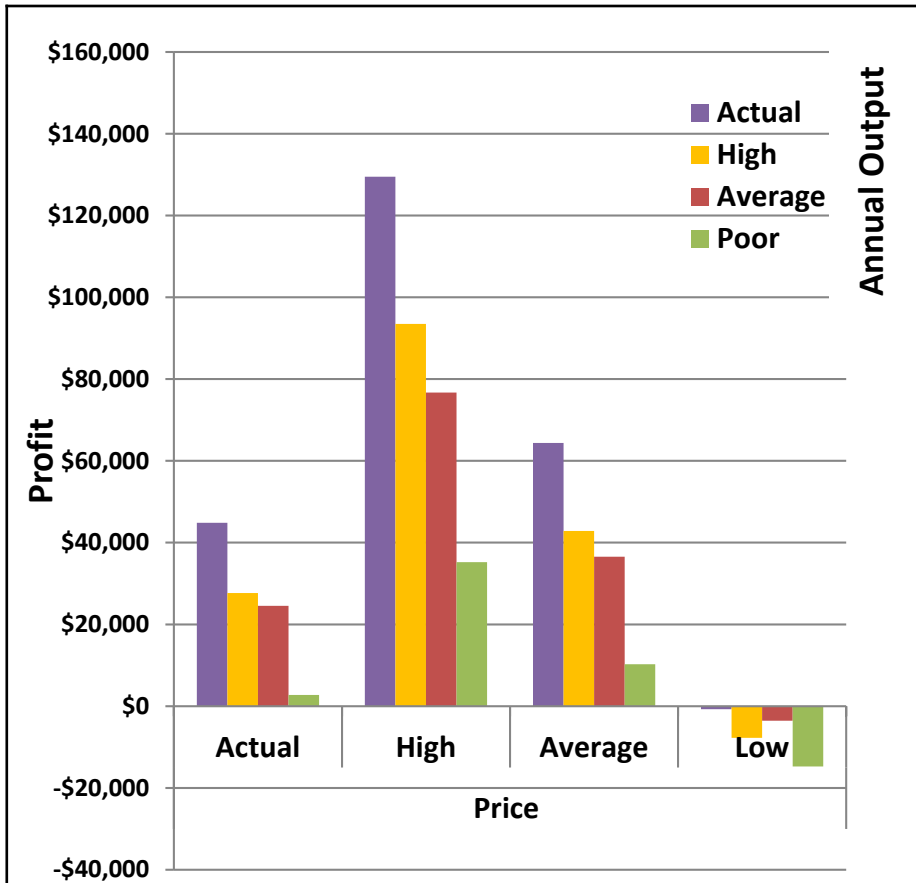
With Fuel Oil:
Actual Profit decreases by 40%



Lettuce Sensitivity Analysis tab (cont.)

Baseline (with natural gas)

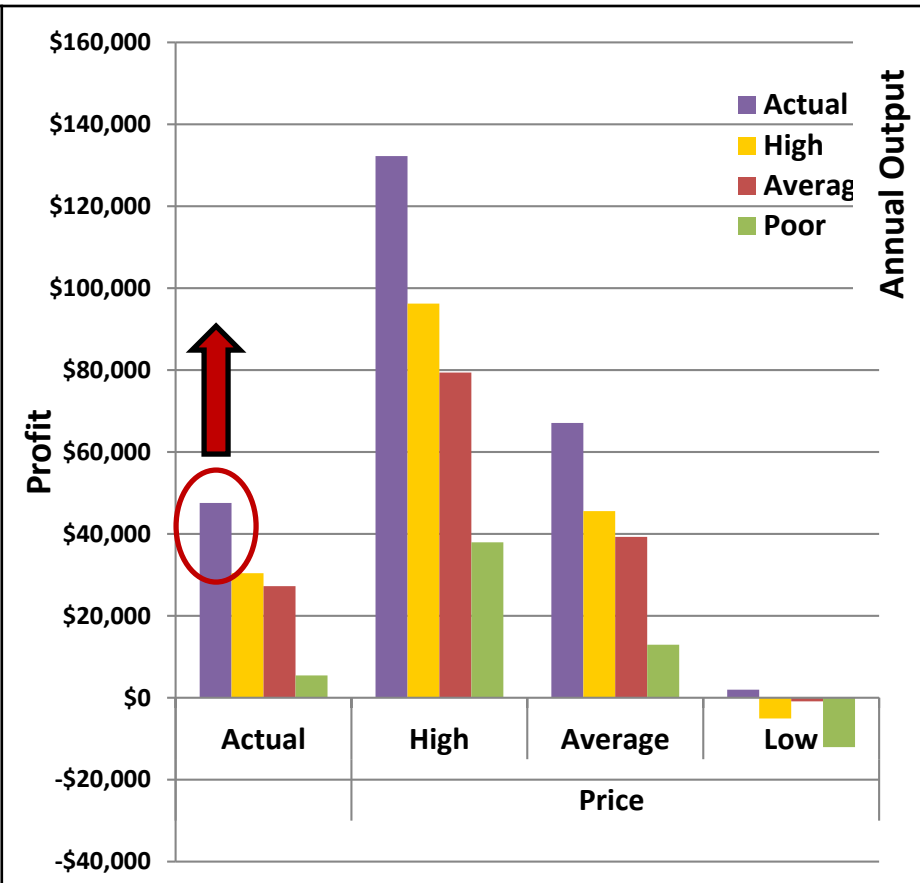
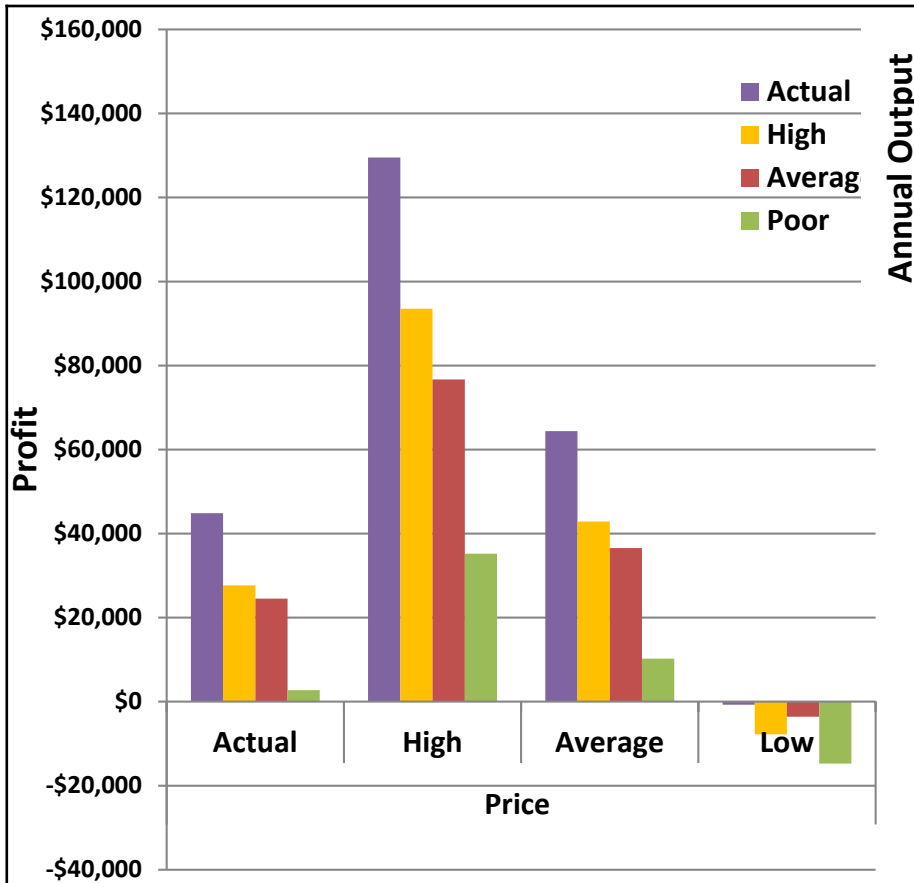
With 20% Increase in Labor cost:
Actual Profit decreases by 30%



Lettuce Sensitivity Analysis tab (cont.)

Baseline (with natural gas)

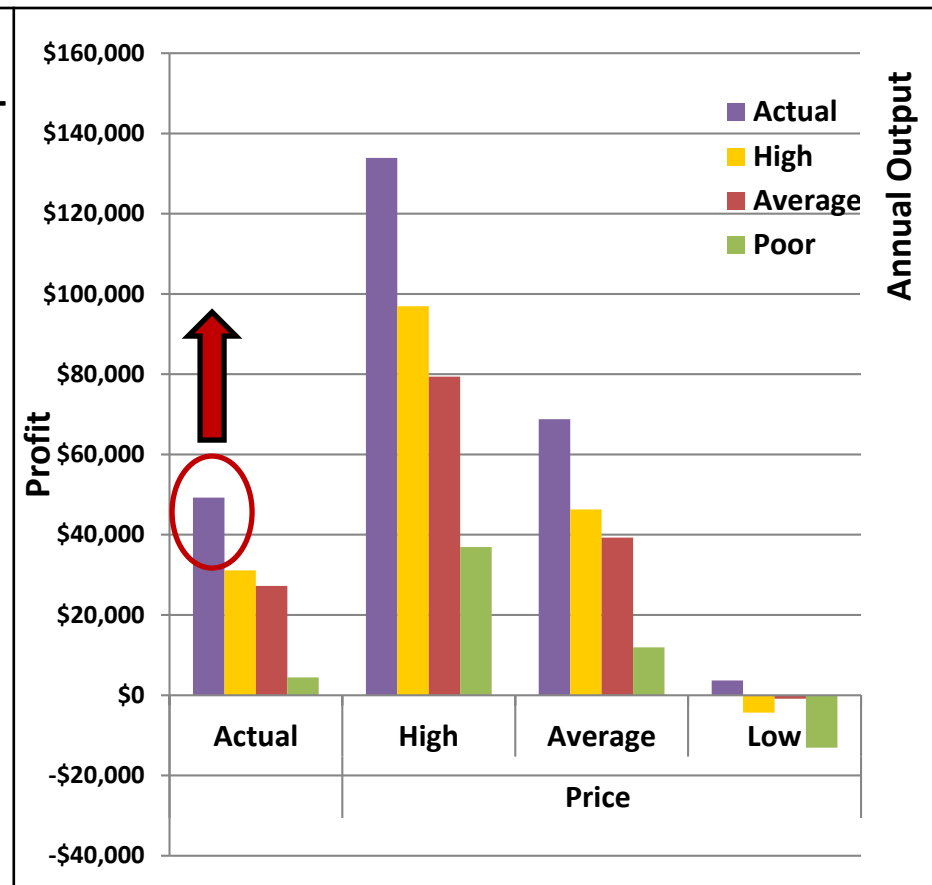
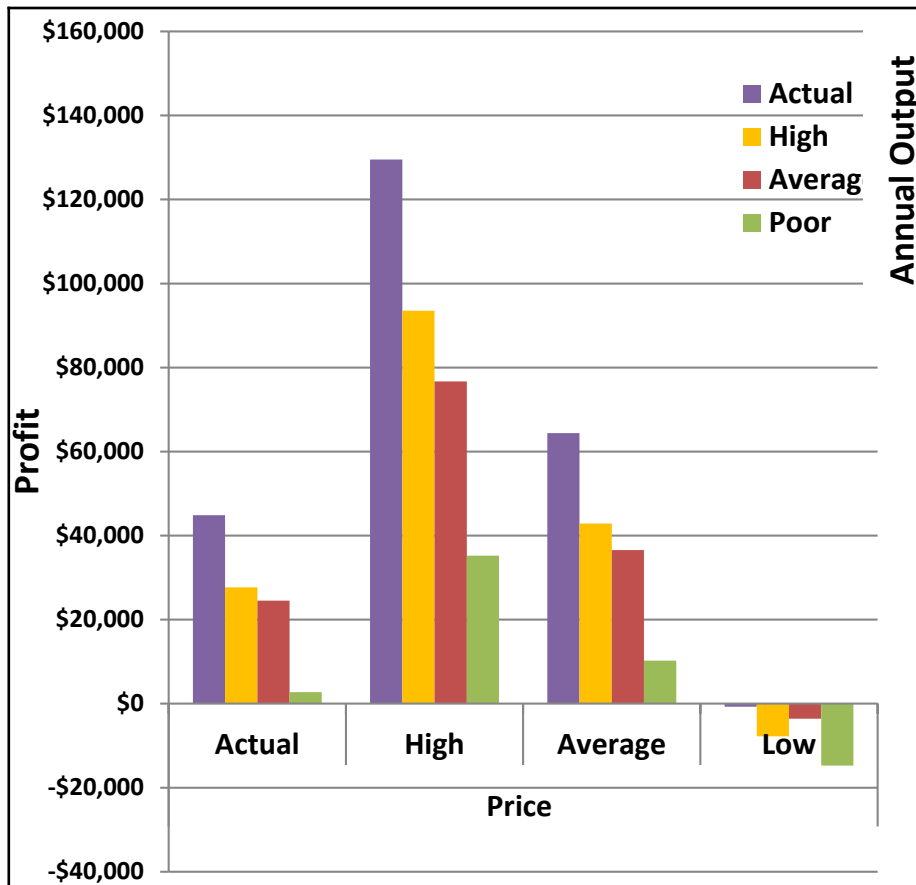
With 20% Decrease in Utility cost:
Actual Profit increases by 6%



Lettuce Sensitivity Analysis tab (cont.)

Baseline (with natural gas)

With 20% Decrease in Packaging cost:
Actual Profit increases by 10%



Conclusions

- For lettuce, labor (53%), packaging (17%), and utilities (10%) share the biggest costs in a greenhouse operation
- For tomato, utilities (39%), labor (11%), production supplies (7%) and packaging (7%) are the biggest variable costs in a year round greenhouse operation
- In a 8-month tomato production scenario, utilities (26%), labor (14%) and production supplies (12%) are the biggest variable costs

Conclusions (cont.)

- Growers' particular management systems, available resources, and location can affect the performance of the operation
- Users should experiment with their own yields, inputs, and prices to develop a budget that will accurately represent their own operation
- We are willing to share the beta version of the Interactive tools to get feedback from the users

Thank you!
Questions, Comments?

mig7@cornell.edu