Agriculture Market Evaluation

Advancing Agriculture Energy Technologies (AAET), Agriculture Technical Services, and Greenhouse Lighting and Systems Engineering (GLASE) Consortium

Baseline Period (2018-2019)

Appendices to the Final Report

Prepared for:

New York State Energy Research and Development Authority

Albany, New York

Judeen Byrne, Project Manager

Carley Murray, Senior Project Manager

Kyle Monsees, Assistant Project Manager

Prepared by:

Navigant Consulting, Inc., n/k/a Guidehouse Inc.

Boulder, Colorado

Beth Davis, Associate Director

Cherish Smith, Associate Director

Brent Barkett, Director

APPRISE

Princeton, New Jersey

David Carroll, Managing Director

Dan Bausch, Project Director

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Appendix A: Additional Findings

The Market Evaluation Team presented the results to NYSERDA Staff and the GLASE Consortium team on September 26, 2019 and September 30, 2019. This appendix contains the additional findings from the surveys the Market Evaluation Team completed as part of the market evaluation of NYSERDA's Agriculture Initiatives: Advancing Agriculture Energy Technologies (AAET), Agriculture Technical Services, and Greenhouse Lighting and Systems Engineering (GLASE) Consortium. These additional findings also contain additional data analysis that NYSERDA requested during the presentation.

A.1 AAET Additional Findings

Additional findings for AAET from the Non-Participant Farms Survey are included in this section. These findings include:

- Table 1: Awareness of energy efficient technologies (pre-defined list) by type of agriculture operation. NYSERDA Staff requested this data view because many technologies are only applicable to some types of agriculture operations.
- Table 2: Other energy efficient technologies (open-ended question) by type of agriculture operation. NYSERDA Staff requested this data view because many technologies are only applicable to some types of agriculture operations.
- Table 3: Installed technology by type of agriculture operation. NYSERDA Staff requested this data view because many technologies are only applicable to some types of agriculture operations.
- Two additional findings in slide format

Table 1. AAET: For each type of technology listed below, please indicate if you are aware of that technology by Which of the following does your agricultural operation have across all your New York State locations?[a]

Source: Navigant analysis of Non-Participant Farms survey data

	LED lighting and/or LED lighting controls	Efficient ventilation (e.g., building or barn)	Variable frequency drive (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	High efficiency motor	Engine block heater timer	Compressed air efficiency improvements	Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	Energy-free livestock watering system	Plate cooler (e.g., well water heat exchanger)	Energy curtain (e.g., shade curtain, night cover)
Dairy cows (n=10)	100%	80%	90%	40%	60%	30%	50%	80%	30%	80%	0%
Beef cattle (n=14)	93%	50%	50%	36%	57%	7%	64%	71%	29%	7%	21%
Chickens (n=12)	83%	58%	42%	42%	50%	17%	58%	75%	25%	17%	25%
Pigs (n=6)	83%	67%	67%	33%	67%	17%	50%	83%	17%	50%	33%
Vineyard (n=20)	95%	40%	50%	50%	40%	15%	55%	75%	0%	0%	0%
Orchard (n=13)	92%	31%	62%	31%	31%	23%	62%	54%	0%	8%	15%
Greenhouse (n=12)	92%	75%	42%	42%	33%	17%	75%	75%	0%	0%	75%
Vegetable farm (not a greenhouse) (n=21)	95%	43%	48%	48%	48%	19%	76%	76%	5%	5%	24%
Other (n=41)	100%	46%	54%	44%	41%	10%	56%	68%	2%	5%	5%

[a]Both of these questions were multiple response questions.

Table 2. AAET: What other energy efficient technologies specific to agriculture are you aware of that were not asked about? by Which of the following does your agricultural operation have across all your New York State locations?[a]

Source: Navigant analysis of Non-Participant Farms survey data

	Dairy cows	Beef cattle	Chickens	Pigs	Vineyard	Orchard	Greenhouse	Vegetable farm	Other
Ag Waste convert to Power, Winery produced CO2 collection and re-use					1%				
Anaerobic digestion, alternative energy								1%	1%
Biogas		1%							1%
Cooling tower for river discharge.									1%
fuel efficiency		1%	1%						
Geothermal heating and cooling					4%		1%		
Heat Pumps									1%
bio-fuel production and use, converting diesel to bio-fuel, radiant heating					1%				
Insulation					1%	1%			
Photovoltaic			1%		1%		1%	1%	4%
Radiant heated floors; HRV; BIPV; systems controls							1%		
Renewable cooling system of harvesting ice.									1%
simple timers to cycle motors and appliances off for short periods of time							1%	1%	
solar	6%	4%	5%	4%	4%	2%	1%	5%	9%
wind						1%			4%
solar power paired with battery operated tools/fence chargers					1%	1%			1%
heat exchanger, highly efficient on demand hot water	1%		1%	1%		1%		1%	1%
Recyclable					1%				

	Dairy cows	Beef cattle	Chickens	Pigs	Vineyard	Orchard	Greenhouse	Vegetable farm	Other
Steam reclamation, burner efficiency, heating chamber insulation, non friction vacuum pumps, vacuum sensor and woods monitoring systems									
Stop Start for motors.	1%								

[a]The question about technology was open ended and the question about type of operation was a multiple response question.

Table 3. AAET: Which of the following energy efficient technologies have you installed? by Which of the following does your agricultural operation have across all your New York State locations?[a]

Source: Navigant analysis of Non-Participant Farms survey data

	LED lighting and/or LED lighting controls	Efficient ventilation (building or barn)	Variable frequency drive (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	High efficiency motors	Engine block heater timer	Compressed air efficiency improvements	Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient Water heater)	Energy-free livestock watering system	Plate cooler (e.g., well water heat exchanger)	Energy curtain (e.g., shade curtain, night cover)
Dairy cows (n=10)	60%	30%	30%	10%	30%	20%	40%	60%	10%	40%	0%
Beef cattle (n=12)	92%	8%	8%	25%	25%	8%	50%	50%	25%	8%	8%
Chickens (n=10)	70%	20%	10%	20%	20%	10%	50%	60%	20%	10%	20%
Pigs (n=6)	67%	17%	0%	17%	33%	17%	33%	83%	17%	17%	17%
Vineyard (n=18)	94%	11%	22%	0%	6%	0%	11%	50%	0%	0%	0%

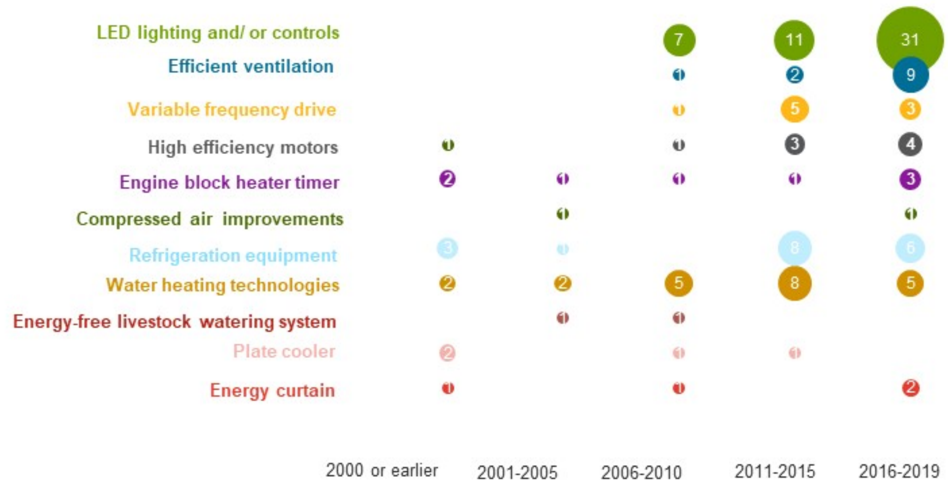
	LED lighting and/or LED lighting controls	Efficient ventilation (building or barn)	Variable frequency drive (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	High efficiency motors	Engine block heater timer	Compressed air efficiency improvements	Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient Water heater)	Energy-free livestock watering system	Plate cooler (e.g., well water heat exchanger)	Energy curtain (e.g., shade curtain, night cover)
Orchard (n=10)	80%	30%	20%	0%	10%	0%	40%	20%	0%	0%	20%
Greenhouse (n=12)	83%	17%	0%	8%	0%	0%	50%	25%	0%	0%	50%
Vegetable farm (not a greenhouse) (n=15)	80%	13%	20%	13%	20%	0%	33%	40%	7%	0%	27%
Other (n=33)	91%	15%	12%	21%	21%	0%	27%	42%	3%	0%	3%

[a] Both of these questions were multiple response questions.

Initiative: AAET

Additional Findings

This question asks about which energy efficient technologies you may have installed or implemented. For each type of technology, please indicate the year you installed or implemented.



*Numbers represent frequency of installed technologies of 82 Non-Participant Farms surveyed

** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*

Source: Navigant analysis of Non-Participant Farms survey data

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Initiative: AAET

Additional Findings

Please indicate whether you have received federal incentives, state incentives, utility incentives, or no incentives to implement technology.

Category	Utility Incentive	State (NYSERDA) Incentive	No Incentive
LED lighting and/or LED lighting controls	13%	0%	57%
Water heating technologies	4%	2%	32%
Refrigeration equipment	1%	2%	20%
Efficient ventilation	0%	1%	13%
Engine block heater timer	1%	1%	11%
Variable frequency drive (VFD) on pump or fan motors	2%	1%	11%
High efficiency motor	0%	1%	12%
Energy curtain	0%	0%	7%
Energy-free livestock watering system	0%	0%	4%
Plate cooler	1%	0%	4%
Compressed air efficiency improvements	1%	0%	1%

*N=82
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
No federal incentives were used for any of the technologies.
Percentages represent the proportion of respondents that responded, "Yes".
Source: Navigant analysis of Non-Participant Farms survey data

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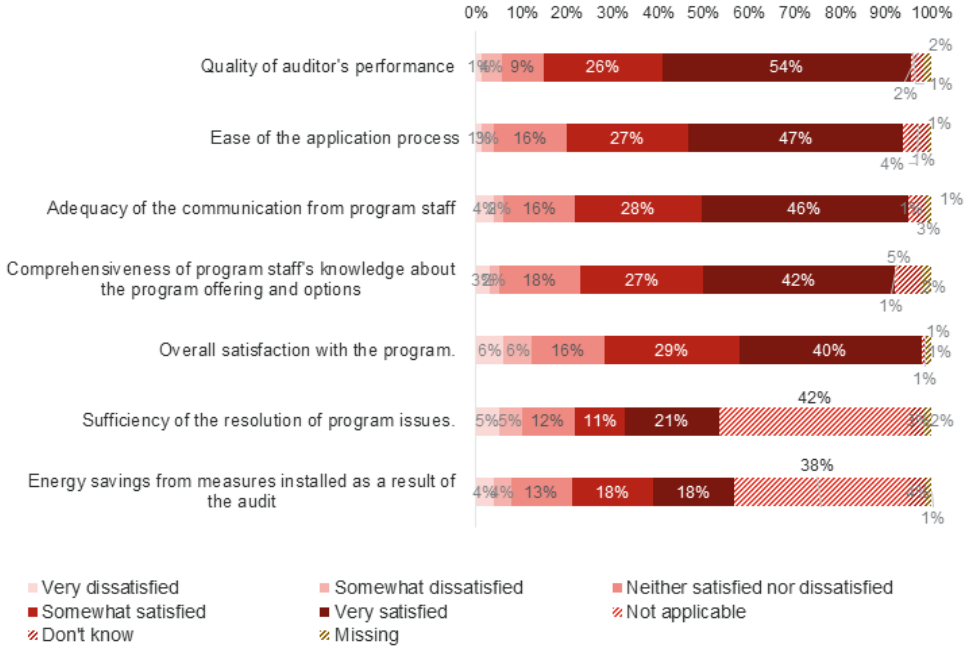
A.2 Agriculture Technical Services Additional Findings

Additional findings for AAET from the FlexTech Ag Energy Audit Participants Survey are included in this section. These findings include: level of satisfaction with various program elements, percent of respondents that would recommend the program to a colleague, and awareness of and participation in financial resources. The information is contained in individual slides in this section.

Initiative: Ag Technical Services

Additional Findings

On a scale of 1 to 5, please indicate your level of satisfaction.



*N=180

Source: Navigant analysis of FlexTech Ag Energy Audit Participants survey data

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Initiative: Ag Technical Services

Additional Findings

87%

would recommend the NYSERDA Agriculture Energy Audit Program to a colleague

*N=180
Source: Navigant analysis of FlexTech Ag Energy Audit Participants survey data

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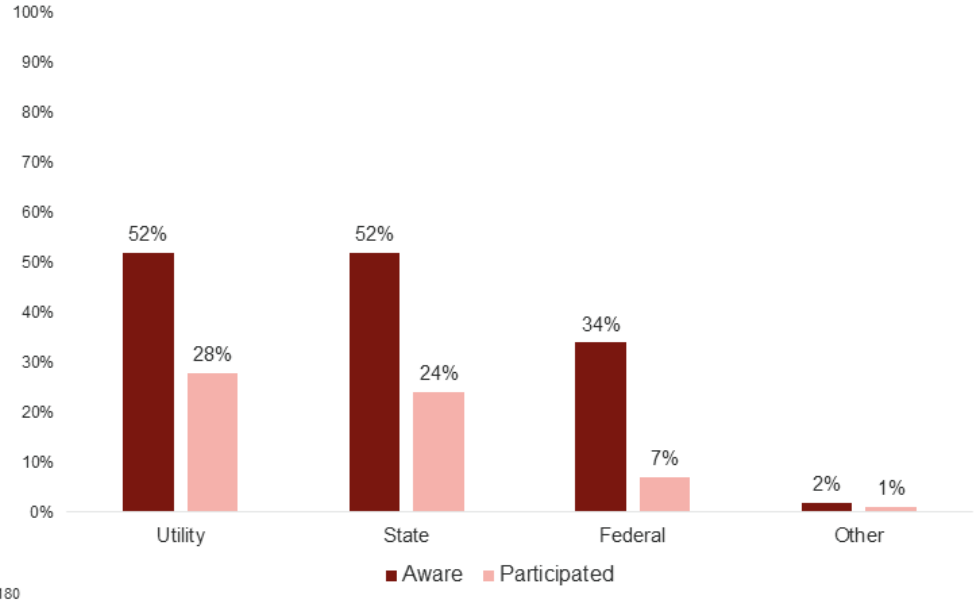
Initiative: Ag Technical Services

Additional Findings

Which of the financial resources below are you aware of for installing energy efficient technologies in the agriculture sector?

Other than the audit, have you ever participated in an energy efficiency program or received financial incentives from any of the following sources for an agriculture-related project?



*N=180

** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*

Percentages represent the proportion of respondents that responded, "Yes".

Source: Navigant analysis of Flex Tech Ag Energy Audit Participants survey data

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A.3 GLASE Consortium Additional Findings

Additional findings for the GLASE Consortium from the Non-Participant Lighting Manufacturers Survey, Non-Participant Controlled Environment Agriculture Auxiliary Service Providers Survey, and Non-Participant Controlled Environment Agriculture Facilities Survey are included in this section. These findings include: awareness of the GLASE Consortium, GLASE Consortium benefits, GLASE Consortium barriers, GLASE Consortium research areas, other consortia, and CEA facility details. The information is contained in individual slides in this section.

Initiative: GLASE

Additional Findings

Awareness of GLASE

Initiative: GLASE

Additional Findings

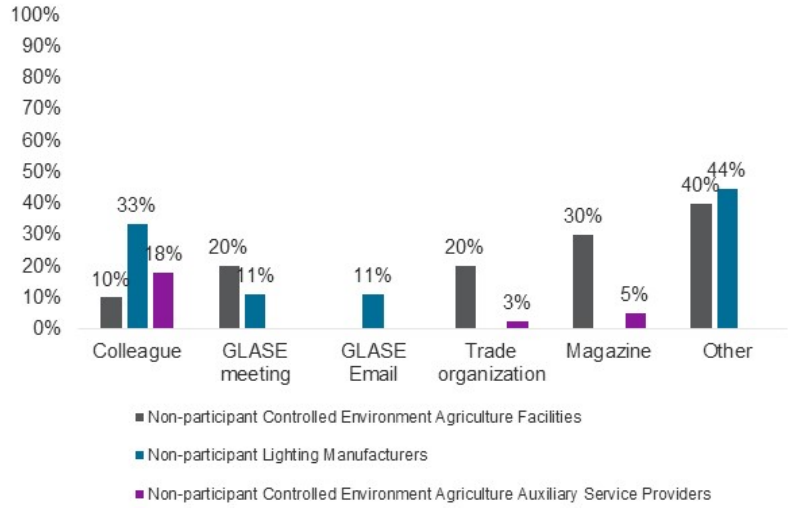
Top figure: Percentages represent the proportion of respondents that responded, "Yes".

Bottom figure: Other responses included a scientist and RPI.

Awareness of GLASE

Have you heard of the Greenhouse Lighting and Systems Engineering (GLASE) Consortium?

How did you hear about the GLASE Consortium?



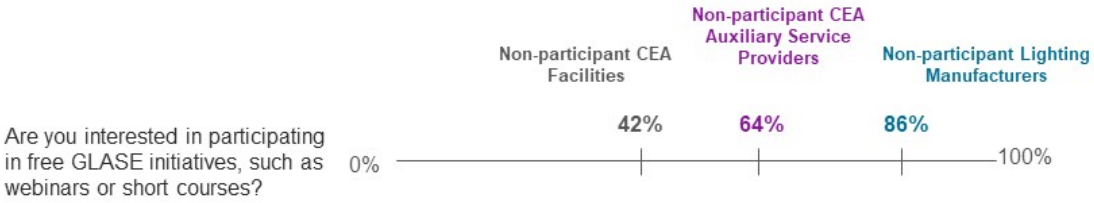
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

NAVIGANT

Initiative: GLASE

Additional Findings

GLASE Interest



Percentages represent the proportion of respondents that responded, "Yes".
Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

NAVIGANT

Initiative: GLASE

Additional Findings

GLASE Benefits

Initiative: GLASE

Additional Findings

GLASE Benefits

Which of the following benefits of the GLASE Consortium would you find attractive?

Category	Non-Participant Controlled Environment Agriculture Facilities
Review of GLASE's case studies, technical reports, and proof-of-concept trials before you decide on upgrades	52%
Talk directly to GLASE's team of horticultural researchers	46%
Leverage GLASE's leading-edge innovations in integrated CO2, lighting, and shade control systems to save operational costs	46%
Use of membership to guide GLASE's research agenda	29%
Other	2%
None	37%

*N=52
Other responses included review what they offer and see what would help.
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Facilities survey data

NAVIGANT

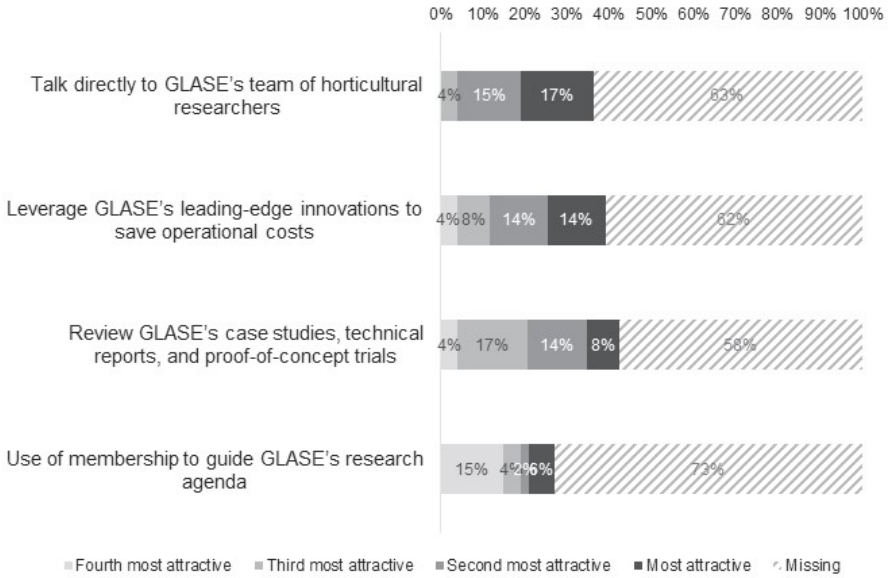
Initiative: GLASE

Additional Findings

GLASE Benefits

Please rank the benefits to indicate which is the most attractive.

Non-Participant Controlled Environment Agriculture Facilities



*N=52

Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Facilities survey data

NAVIGANT

Initiative: GLASE

Additional Findings

GLASE Benefits

Which of the following benefits of the GLASE Consortium would you find attractive?

Category	Non-Participant CEA Auxiliary Service Providers
Access to GLASE research data	20%
Access to GLASE members, including agricultural producers	20%
Potential GLASE best practices endorsement	18%
Access to energy modeling engine developed by GLASE for greenhouses and indoor farms	17%
Quarterly technical reports	17%
None	4%
Other benefits	3%

*N=39
Other response included information on lessons learned and market research on crop and buying trends, reference materials, and networking opportunities.
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Auxiliary Service Providers survey data

NAVIGANT

Initiative: GLASE

Additional Findings

GLASE Benefits

Please rank the benefits to indicate which is the most attractive.

Non-Participant Controlled Environment Agriculture Auxiliary Service Providers

*N=39

Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Auxiliary Service Providers survey data

NAVIGANT

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Initiative: GLASE

Additional Findings

GLASE Benefits

Which of the following benefits of the GLASE Consortium would you find attractive?

Category	Non-Participant Lighting Manufacturers
Access to agricultural producers through trade shows and the GLASE newsletter	81%
Validating the effectiveness of your products by vetting them with GLASE's trusted research team	81%
Direct access to researchers specializing in lighting needs and lighting advancements in the agricultural sector	76%
Access to GLASE-developed intellectual properties and technologies	71%
Other benefit	14%
None	5%

*N=21
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
Percentages represent the proportion of respondents that responded, "Yes".
Source: Navigant analysis of Non-Participant Lighting Manufacturers survey data

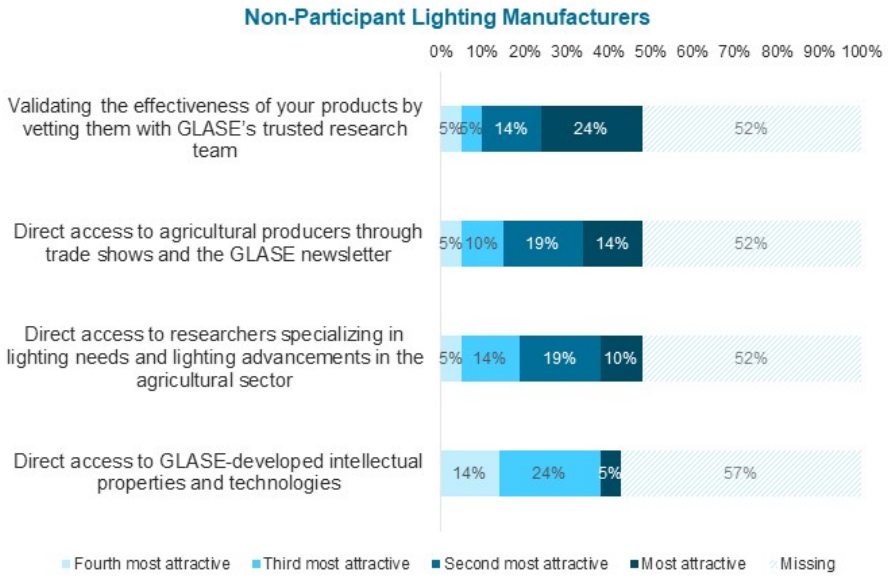
NAVIGANT

Initiative: GLASE

Additional Findings

GLASE Benefits

Please rank the benefits to indicate which is the most attractive.



*N=21
Source: Navigant analysis of Non-Participant Lighting Manufacturers survey data

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Initiative: GLASE

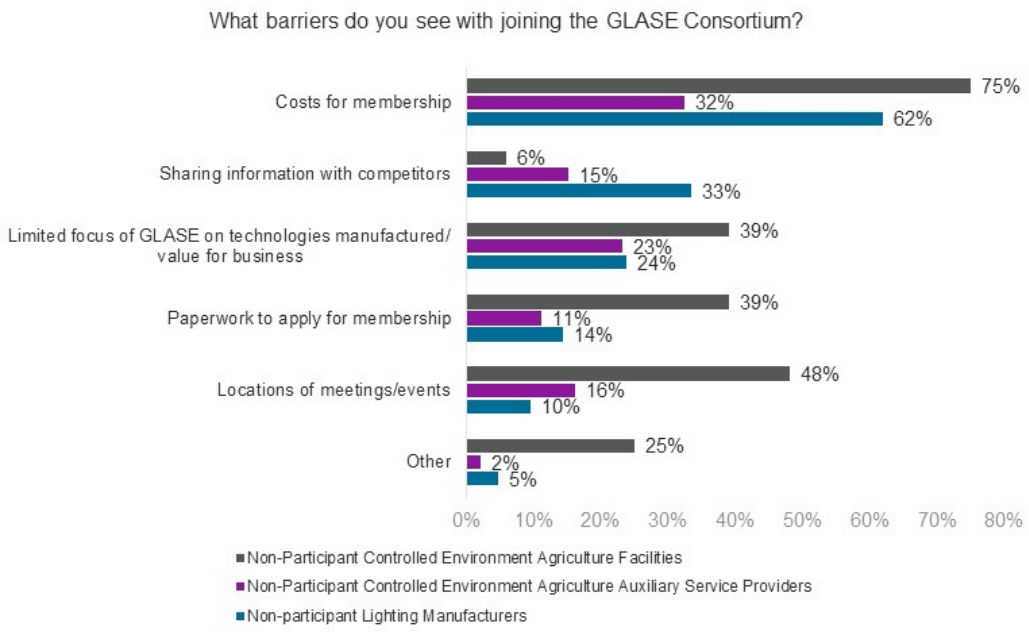
Additional Findings

GLASE Barriers

Initiative: GLASE

Additional Findings

GLASE Barriers



Other responses included a lack of perceived value.
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

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Initiative: GLASE

Additional Findings

GLASE Research Areas

Initiative: GLASE

Additional Findings

GLASE Research Areas

GLASE is exploring different research areas as part of its work. Which of these research areas would be of interest to you?

Category	Non-Participant Controlled Environment Agriculture Facilities	Non-Participant Lighting Manufacturers	Non-Participant CEA Auxiliary Service Providers
Experiments with lighting and control systems	39%	33%	17%
Engineering and modeling of technologies and facilities	39%	19%	17%
Piloting and demonstrating technologies in facilities	33%	10%	15%
The development of high efficiency dynamic LED systems	31%	19%	14%
Energy efficacy and radiometry	27%	10%	12%
Carbon dioxide enrichment studies	23%	14%	12%
Spectrum or irradiance optimization and plant sensing	17%	29%	12%
Other	14%		1%

Other responses included general plant physiology and utility rebates in facilities switching from HPS to LED

* This was a multiple response question, so the total number of answer choices selected for a question can be *greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*

Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

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Initiative: GLASE

Additional Findings

Other Consortia

Initiative: GLASE

Additional Findings

Consortia Membership

	Non-participant CEA Facilities	Non-participant CEA Auxiliary Providers	Non-participant Lighting Manufacturers
Are you currently a member of any consortia that you pay to belong to?	25%	26%	29%
What is the name of the consortia you belong to?	• Eastern NY Horticultural Program through Cornell • Farm Bureau • Long Island Flower Growers • Nursery and Landscape Association • NYS Floral Industries • NYS Vegetable Growers Association • Perennial Plant Association	• American Hydroponic Society • AWEA, SEIA • Mulch and Soil Council • National Plant Board • NY Farm Association • NYC Ag Collective • National Greenhouse Manufacturers Association	• COREF, NJMAA • General Plant Horticulture Association • National Greenhouse Manufacturer Association
What benefits do the consortia you belong to offer?	• Education classes • Association's affect on government • Network with other farmers	• Access to university research • Advocacy group • Annual meetings • Marketing	• Access to the market end user

Percentages represent the proportion of respondents that responded, "Yes".

Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

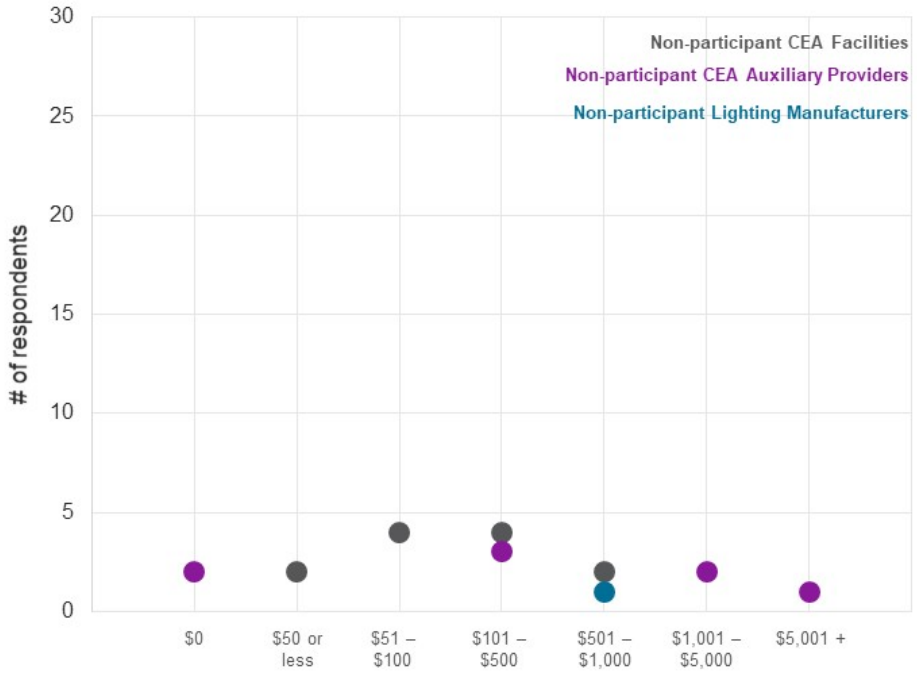
Initiative: GLASE

Additional Findings

Count of respondents.
Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

Consortia Membership

What is the annual cost you pay to be a member in the consortia you belong to?



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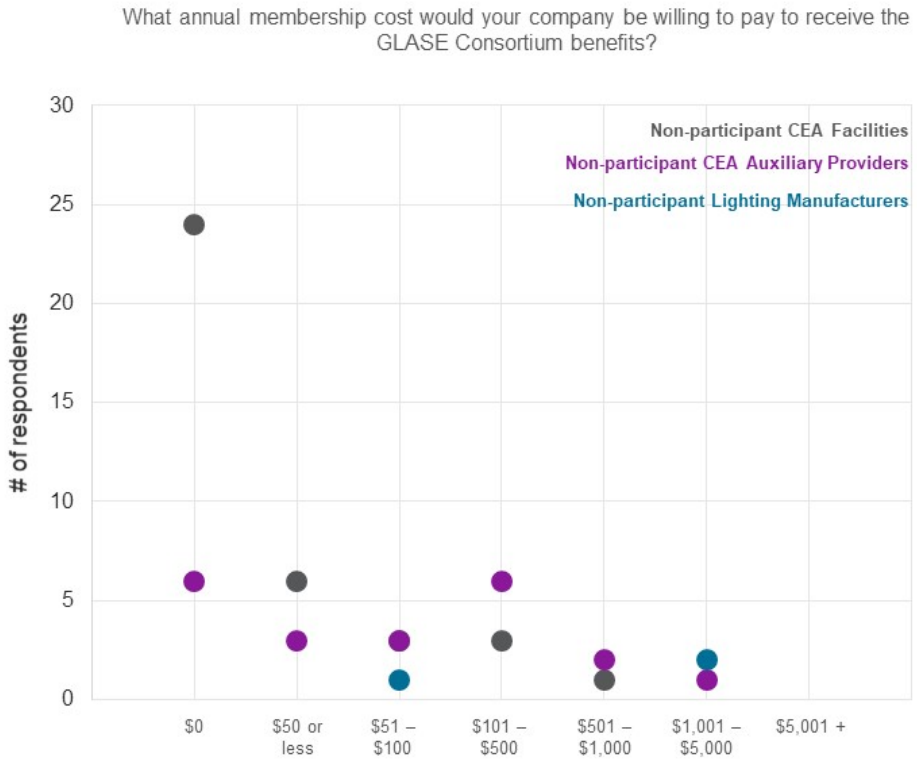
Additional Findings

Count of respondents.
Source: Navigant analysis of Non-Participant Lighting Manufacturers (n=21), Non-Participant Controlled Environment Agriculture Facilities (n=52), and Non-Participant Controlled Environment Agriculture Auxiliary Service Providers (n=39), survey data

Consortia Membership



Note: One non-participant CEA facility selected $51-$100; however, the grey circle is under the blue circle on the graphic.

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Initiative: GLASE

Additional Findings

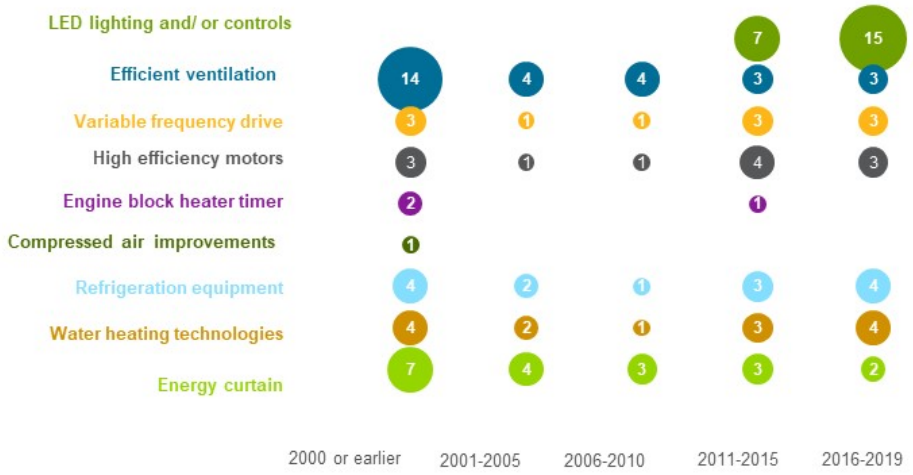
CEA Facility Details

Initiative: GLASE

Additional Findings

CEA Installed Technologies

This question asks about which energy efficient technologies you may have installed or implemented. For each type of technology, please indicate the year you installed or implemented.



*Numbers represent frequency of installed technologies of 52 Controlled Environment Agriculture Facilities surveyed
Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Facilities survey data

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Initiative: GLASE

Additional Findings

Lighting and Control System Upgrades

Which of the following factors, if any, are important to your company when considering lighting and control system upgrades to your facilities?

Non-Participant Controlled Environment Agriculture Facilities

Category	Non-Participant CEA Facilities
Energy efficiency of the equipment	77%
Upfront costs for the equipment/project	71%
Payback period	64%
Ease of use	64%
Light brightness, color, and range	54%
Impact on crop yield	52%
Lighting heat output	21%
Lighting equipment appearance	17%
Other	15%

*N=52
Other responses included longevity and maintenance costs.
** This was a multiple response question, so the total number of answer choices selected for a question can be greater than the number of respondents that answered the question. This can cause the total response percentages to exceed 100%.*
Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Facilities survey data

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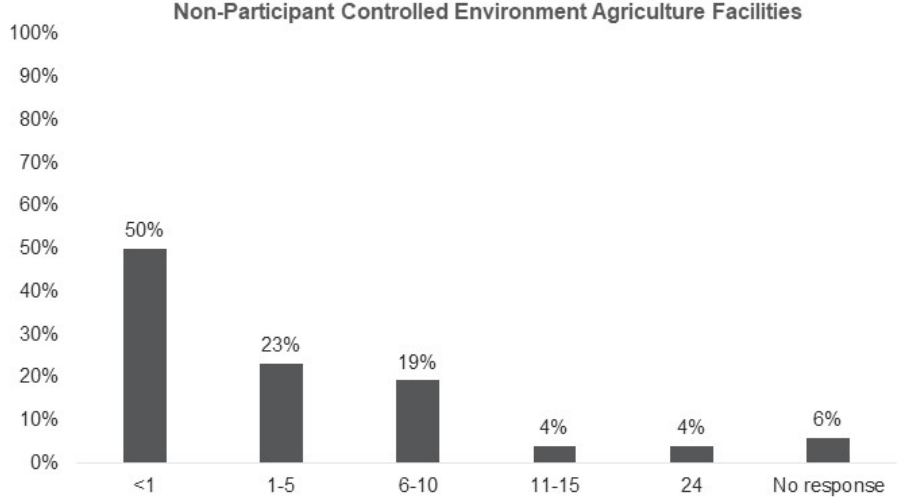
Initiative: GLASE

Additional Findings

Lighting Specifications

During the time of year when the lighting usage is highest in your controlled environmental agriculture facilities, what would you estimate is the average number of hours per day that the lights are on?

Non-Participant Controlled Environment Agriculture Facilities



*N=52

Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Facilities survey data

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Initiative: GLASE

Additional Findings

Facility Specifications

How much electricity (in kWh) do you estimate your controlled environmental agriculture facility typically uses per month? If you have multiple controlled environmental agriculture facilities, please estimate an average.

Electricity usage (kWh) per month

0 kWh (11 respondents)
2,600 kWh (1)
4,000 kWh (1)
19,000 kWh (1)
Uses least amount of kWh during this time (1)

0 kWh (8 respondents)
2,600 kWh (1)
4,000 kWh (1)
32,000 kWh (1)
Uses most amount of kWh during this time (1)

*N=52
Source: Navigant analysis of Non-Participant Controlled Environment Agriculture Facilities survey data

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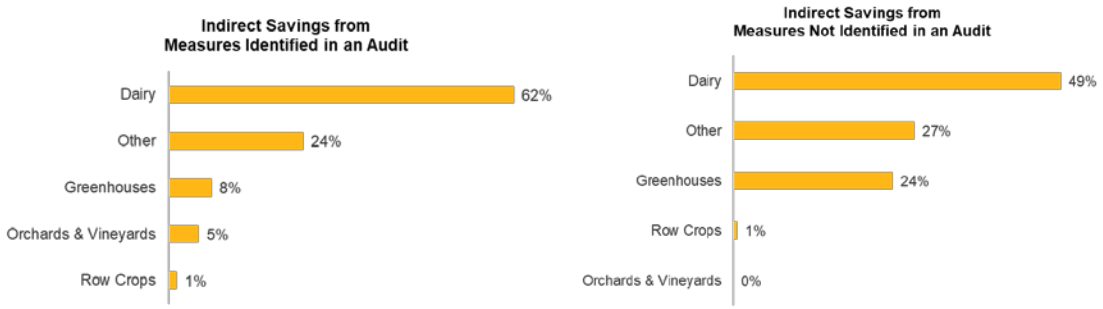
A.4 Indirect Impacts Additional Findings

In addition to the findings contained in the Final Report, the Market Evaluation Team has included additional detailed findings on the indirect impacts in this section. Navigant summarized the total indirect impact savings breakdown by farm sector for both measures identified and not identified within the audits administered through the Ag Technical Services initiative (Figure 2). The dairy sector is the primary means for which indirect savings are occurring, followed by the other category as the second largest contributor. The other category includes all New York farm types that do not fall into the sectors of dairy, greenhouses, orchards and vineyards, and row crops.[1]

Figure 1. Indirect Savings by Farm Sector

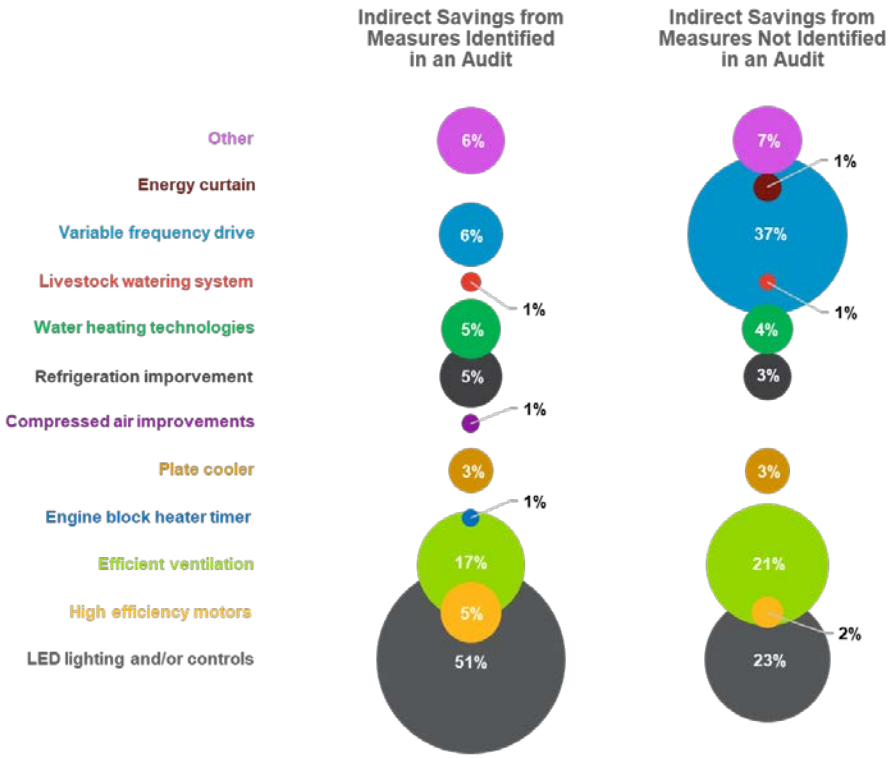


Source: Navigant analysis of FlexTech Ag Energy Audit Participants survey data

Figure 3 presents the indirect impact by measure end use. Lighting is a primary measure that farmers elected to install without program assistance, whether identified in the audit or not identified in the audit. Efficient ventilation and variable frequency drives are also largely impactful end uses.

[1] NYSERDA identified dairy, orchards and vineyards, row crops and greenhouses as primary sectors of focus in the Indirect Impacts methodology. Therefore, all other farm types outside of these sectors was placed in the "other" category.

Figure 2. Indirect Savings by Measure End Use [2]



Source: Navigant analysis of FlexTech Ag Energy Audit Participants survey data

[2] Prominent measures that contributed to the 'Other' measure category include: building envelope improvements, HVAC upgrades, commissioning/maintenance/cleaning, and miscellaneous equipment.

There were several instances of various renewable energy technologies installed where indirect savings were identified. However, these projects were not quantified as a part of the indirect savings evaluation. There were no instances where a renewable technology was recommended through an audit and then installed without EnSave assistance. There were six instances where farms installed renewable technologies that were not discussed as a part of their respective audits. Three of these six projects were solar photovoltaic (PV) installations, two were solar hot water installations, and one was a biomass boiler installation. Of these six renewable projects, four of these participants indicated they installed their respective renewable projects due to NYSERDA influence. These projects included two of the solar PV installations, one of the solar hot water installations, and the biomass boiler installation.

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Appendix B: NYSERDA AAET & GLASE Consortium Market Evaluation Research Questions

To: Carley Murray, NYSERDA

From: Emily Merchant, Beth Davis, Navigant Consulting

Date: June 14, 2018

Re: NYSERDA AAET & GLASE Consortium Market Evaluation Research Questions

Between March and June of 2018 Navigant Consulting worked with NYSERDA and Erico Mattos of the GLASE Consortium (GLASE) to determine which questions should be prioritized for the AAET & GLASE market evaluation in 2018 and beyond. Navigant used the evaluation plan contained in the RFP from NYSERDA as the foundation for building out the market evaluation questions. Navigant developed a spreadsheet using the following information from the evaluation plan: testable hypotheses, goals prior to exit, Table 6: Outputs, Outcomes, and Indicators (All Initiative Segments), Table 7: Evaluation Objectives and Main Research Questions, and text from the Evaluation Methodology section. The purpose of the spreadsheet was to map the questions in Table 7 and the text in the Evaluation Methodology section to a testable hypothesis, goal prior to exit, and indicator in Table 6.

Upon developing the spreadsheet, Navigant distributed the spreadsheet to NYSERDA and key members of the GLASE Consortium to get feedback on the priority of each question, which questions should be added or removed, and clarification on the evaluation plan. First, Navigant met with Carley Murray from NYSERDA to prioritize the research questions and receive clarification on the indicators in Table 6, questions in Table 7, and text in the Evaluation Methodology section. Next, Navigant and NYSERDA met with Erico Mattos of the GLASE Consortium to prioritize the GLASE questions and clarify what the GLASE Consortium will collect versus what Navigant and NYSERDA will collect. Finally, Carley Murray met with NYSERDA program staff to discuss the AAET and Technical Services questions, including which questions are high priority, which questions should be added, and which questions should be removed.

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Table 1 below summarizes the questions that Navigant will collect, Table 2 summarizes the questions that NYSERDA will collect, and Table 3 summarizes the questions that GLASE will collect. Each row represents a research question and it is mapped to one of the three initiatives (AAET, Technical Services, or GLASE), a testable hypothesis, a goal prior to exit, and an indicator. The Market Actors column shows the source of the information to address each of the questions. The final column shows whether the question is a priority in 2018 and beyond or in 2019 and beyond. The questions that are a priority in 2019 and beyond refer to NYSERDA information materials that will not be ready in time for the 2018 market evaluation. For example, the best practice guides and case studies will not be ready until 2019. The tables below may be modified to accommodate for a shift in research priorities or to address the needs of the indirect impacts analysis.

Navigant does not plan to collect information on the indicator "Reduction in greenhouse electricity use per kg of biomass produced at pilot locations" or the indicator "Reduction in greenhouse electricity use per kg of biomass produced in NYS." These two indicators are listed under Table 3 as being collected by GLASE. Navigant had multiple conversations with Carley Murray of NYSERDA and Erico Mattos of the GLASE Consortium and ultimately decided that these two indicators would require too many questions in the survey questionnaire to get valuable information. GLASE will collect this information for the pilot sites.

Table 4: Market Evaluation Questions Collected by Navigant Consulting

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
AAET	If underutilized/emerging EE technologies and processes are identified and proven effective, with guidance on financing, farmers will adopt technologies	Reliable market sources compile, develop and maintain current information on clean energy technologies for use by local information-exchange networks.	Number of market sources that compile, develop, and maintain current information on clean energy technologies used by local information-exchange networks	Do you compile, develop, or maintain current information on clean energy technologies that are used in local information-exchanges networks?	Equipment Vendors/Suppliers	2019 & beyond
			List of underutilized or emerging technologies identified	What underutilized or emerging technologies in the agriculture sector are you aware of?	Participant Farms, Non-Participant Farms, Equipment Vendors/Suppliers	2018 & beyond
			Number of farmers confident energy efficiency measures shall produce promised benefits	Are you confident that energy efficiency measures deliver on their promised benefits?	Participant Farms, Non-Participant Farms, Equipment Vendors/Suppliers	2018 & beyond
			List of perceived barriers and benefits identified by farmers	What are your perceived barriers and benefits to adopting clean energy technologies?	Participant Farms, Non-Participant Farms, Equipment Vendors/Suppliers	2018 & beyond
			Number of farmers requesting information or training on implementing energy efficiency and GHG reducing projects?	Have you sought out information or training on implementing energy efficiency and GHG reducing projects?	Participant Farms, Non-Participant Farms	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
			Number of demonstration sites that continued to utilize installed technology after the demonstration period	Do you continue to utilize the installed technology?	Participant Farms	2019 & beyond
			Number of case studies, feasibility studies, economic impact assessments, or any combination of the three developed	Awareness, perception, and knowledge of NYSERDA informational materials (use cases, feasibility studies, etc.)	Participant Farms, Non-Participant Farms, Greenhouse Growers	2019 & beyond
				How many farmers utilized a best practice guide, business case scenarios, etc. created by NYSERDA?	Participant Farms, Non-Participant Farms, FlexTech Participants, Greenhouse Growers	2019 & beyond
				Where did the farm receive the NYSERDA materials from?	Participant Farms, Non-Participant Farms, FlexTech Participants, Greenhouse Growers	2019 & beyond
				Improved ability for capital investment planning and asset management because of NYSERDA informative materials	Participant Farms, Non-Participant Farms, FlexTech Participants, Greenhouse Growers	2019 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
		Advanced technologies are installed by farms outside of demonstration projects.	Number of farms outside of demonstration projects installing advanced technologies	Have you installed advanced technologies?	Non-Participant Farms	2018 & beyond
				What advanced technologies have you installed?	Non-Participant Farms	2018 & beyond
			Number of underutilized or emerging technologies by type, implemented as a result of the dissemination of NYSERDA's informational materials	How many underutilized or emerging technologies by type, have you implemented as a result of the dissemination of NYSERDA's informational materials?	Participant Farms, Non-Participant Farms, FlexTech Participants	2018 & beyond
			Number of farms outside of demonstration sites knowledgeable of energy efficiency opportunities for underutilized and emerging technologies	What is your knowledge of energy efficiency opportunities for underutilized and emerging technologies?	Non-Participant Farms	2018 & beyond
		Agriculture vendors and suppliers use energy efficiency as a tool to sell their products.	Number of agriculture vendors and suppliers that use energy efficiency as a tool to sell their products.	Do you use energy efficiency as a tool to sell your products?	Equipment Vendors/Suppliers	2019 & beyond
			Number of farms aware of federal incentives and assistance programs	Are you aware of federal incentives and assistance programs?	Participant Farms, Non-Participant Farms	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
			Number of farms utilizing external financial resources, including utility programs, to implement energy efficiency measures	Do you utilize external financial resources, including utility programs, to implement energy efficiency measures?	Participant Farms, Non-Participant Farms	2018 & beyond
			Number of farms utilizing external financial resources, including utility programs, to implement process improvements	Do you utilize external financial resources, including utility programs, to implement process improvements?	Participant Farms, Non-Participant Farms	2018 & beyond
			Number of farms utilizing external financial resources, including utility programs, to implement advanced technology measures	Do you utilize external financial resources, including utility programs, to implement advanced technology measures?	Participant Farms, Non-Participant Farms	2018 & beyond
			Number and percent of farmers aware of Utility programs	Are you aware of utility programs?	Participant Farms, Non-Participant Farms	2018 & beyond
			Number of farms participating in federal incentive and assistance programs	Have you ever participated in a federal incentive or assistance program?	Participant Farms, Non-Participant Farms	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
Technical Services	If end-users are provided technical resources they will have greater confidence and understanding of the value of EE, leading to projects being implemented	NYSERDA best practice materials are incorporated in other best practice efforts that lack this information (e.g., Cornell Cooperative Extension)	Number of energy efficient measures or process improvements, by type, implemented as a result of the dissemination of NYSERDA's informational materials	How many energy efficient measures or process improvements, by type, have you implemented as a result of the dissemination of NYSERDA's informational materials?	Participant Farms, Non-Participant Farms, FlexTech Participants	2018 & beyond
			Number of entities that incorporate NYSERDA best practice materials into their best practice efforts (e.g., Cornell Cooperative Extension)	Does your organization incorporate NYSERDA best practice materials into your existing best practice efforts?	Equipment Vendors/Suppliers	2019 & beyond
			Number of farms participating in peer-to-peer sharing of Best Practice Guides (sharing with other farms after initial receipt)	Have you shared NYSERDA Best Practice Guides with other farmers?	Participant Farms, Non-Participant Farms, FlexTech Participants	2019 & beyond
			Number of Best Practice Guides disseminated by suppliers/vendors	Have you disseminated Best Practice Guides?	Equipment Vendors/Suppliers	2019 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
			Number of Best Practice Guides disseminated by a third-party stakeholder (any organization active in the Agricultural sector that is not a farm owner/operator or farm equipment supplier/vendor)	How many Best Practice Guides have you disseminated?	Equipment Vendors/Suppliers	2019 & beyond
			Number of farms including Agriculture Best Practices into (re)investment plan	Have you included Agriculture Best Practices into your (re)investment plan?	Non-Participant Farms, FlexTech Participants	2019 & beyond
			Number of farms that found the information in the best practice guides useful/valuable	Did you find the information in the Best Practice Guides useful/valuable?	Non-Participant Farms, FlexTech Participants	2019 & beyond
			Number of farms that acted to implement a change based on a best practice guide	Did you implement a change based on a best practice guide?	Non-Participant Farms, FlexTech Participants	2019 & beyond
		List of qualified energy-focused firms is used as a reference and resource by the marketplace without	Number of market actors that use the list of qualified energy-focused firms as a reference and resource without NYSERDA assistance	Do you use the list of qualified energy-focused firms as a reference and resource?	Non-Participant Farms, FlexTech Participants, Equipment Vendors/Suppliers	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
		NYSERDA assistance.	Number of business chain participants that are knowledgeable about energy and process efficiency	What is your knowledge of energy and process efficiency?	Equipment Vendors/Suppliers	2019 & beyond
			Number of business chain participants that value energy and process efficiency	Do you value energy and process efficiency?	Equipment Vendors/Suppliers	2019 & beyond
			Number of business chain participants that support energy and process efficiency services to farmers	Do you provide energy and process efficiency services to farmers?	Equipment Vendors/Suppliers	2019 & beyond
				How many energy-focused firms are currently servicing in the agricultural sector within NYS?	Participant Farms, Non-Participant Farms, FlexTech Participants, Equipment Vendors/Suppliers, Secondary Data	2018 & beyond
			Number of business chain participants that use energy efficiency information from NYSERDA to sell their products and services	Do you use energy efficiency information from NYSERDA to sell your products and services?	Equipment Vendors/Suppliers	2019 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
GLASE	If a customer has a plan showing potential energy savings, project costs, and ROI they will be motivated to choose EE	Consultants, energy service companies, and other energy-focused firms embrace the piloted business models and incorporate these models as a standard service.	Number of consultants, energy service companies, and other energy-focused firms who embrace the piloted business models and incorporate these models as a standard service.	Have you embraced the piloted business models and incorporated these models as a standard service?	Equipment Vendors/Suppliers, Greenhouse Aux. Providers	2018 & beyond
	If greenhouses operators implement technologies to control lighting, ventilation and CO2 systems they will save 70-86% on electricity	Availability of products in the market that can reduce electricity costs and result in savings in greenhouses between 70-86%	Number of products available in the market that can reduce electricity costs and result in savings in greenhouses between 70-86%	What solutions (product/systems) are available in the market that can increase electricity use efficiency and result in profitability increase in greenhouses?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Secondary Data	2018 & beyond
	If the Consortium successfully disseminates information, paid memberships will occur and it will be self sustaining	The Consortium is self-funded via partnerships, memberships, trainings/services, and royalties/ licenses of patentable products.	Number of paid Consortium memberships	What is your awareness of the Consortium?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
				Are you willing to participate in GLASE initiatives (e.g. Consortium webinars and short courses, visitors viewing/ downloading content from the GLASE Consortium website, etc.)?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond
				Are you willing to pay to become a member of the Consortium?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond
				How did you hear about the Consortium?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond

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Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
				Are the offered GLASE Consortium benefits attractive?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond
				What would you like to receive from the Consortium?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond
				Where do you get your technology/market information from?	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
				Perceived benefits of and barriers to adopting Consortium products and services or joining the Consortium	Lighting Chip Manuf., Lighting Fixture Manuf., Greenhouse Aux. Providers, Greenhouse Growers, Grocery Retailers	2018 & beyond
	If the Consortium successfully forms teams with cross-cutting expertise in greenhouse controls then those teams will help growers implement packaged energy solutions	Up to 25% indirect savings from market penetration of control systems and lighting technologies in NY tomato & greenhouse acreage	Average market penetration of improved technologies in New York greenhouse acreage in the lettuce and tomato sectors	Have you installed improved technologies in your CEA facility?	Greenhouse Growers	2018 & beyond
				What is the acreage of your CEA facility?	Greenhouse Growers	2018 & beyond
				What is the total acreage of CEA facilities in NYS?	Secondary Data	2018 & beyond
			None	What is the total number of greenhouse square footage in NYS, by crop, using a product or service produced by GLASE, segmented by building type (existing or new construction) and crop type?	Greenhouse Growers	2018 & beyond
				Crop (lettuce, strawberry, tomato, some combination of the three, or other as additional crops are introduced after early interventions)	Greenhouse Growers	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
	None	None	None	What lighting is currently used in the greenhouse?	Greenhouse Growers	2018 & beyond
				What time of year is the greenhouse lighting usage highest?	Greenhouse Growers	2018 & beyond
				During the time of year the greenhouse lighting usage is highest, what is the average number of hours per day that the lights are on?	Greenhouse Growers	2018 & beyond
				How much energy is currently used in greenhouses? (NYSERDA will disaggregate per measure if data is available)	Greenhouse Growers	2018 & beyond
				What other energy related measures are used (ventilation, white wash, shade cloth, etc.)?	Greenhouse Growers	2018 & beyond
				Needs in the agricultural sector related to lighting and controls systems.	Greenhouse Aux. Providers, Greenhouse Growers	2018 & beyond
				Interest in locally sourced, sustainably grown, high quality food products	Grocery Retailers	2018 & beyond
				Current practices of grocery retail suppliers	Grocery Retailers	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicator	Question	Market Actors	Priority
				Demand from their customers for the kind of agricultural products GLASE technology would be able to help produce	Grocery Retailers	2018 & beyond

Table 5: Market Evaluation Questions Collected by NYSERDA

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicators	Question	Market Actors	Priority
AAET	If underutilized/emerging EE technologies and processes are identified and proven effective, with guidance on financing, farmers will adopt technologies	Reliable market sources compile, develop and maintain current information on clean energy technologies for use by local information-exchange networks.	Number of demonstration projects and technologies demonstrated	How many projects and technologies were demonstrated?	Collected by NYSERDA	2018 & beyond
			Number of open houses hosted	How many open houses have been hosted?	Collected by NYSERDA	2018 & beyond
			Number of case studies, feasibility studies, economic impact assessments, or any combination of the three developed	How many case studies, feasibility studies, and economic impact assessments have been developed?	Collected by NYSERDA	2018 & beyond
		Agriculture vendors and suppliers use energy efficiency as a tool to sell their products.	Number and percent of farmers participating in Utility program, by program and measure incented	How many farmers are participating in a Utility program, by program and measure incented?	Collected by NYSERDA	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicators	Question	Market Actors	Priority
			Savings from Utility program participation by farmers, by program and savings type (MWh or MMBtu)	What are the savings from farms participating in Utility program participation, by program and savings type (MWh or MMBtu)?	Collected by NYSERDA	2018 & beyond
Technical Services	If end-users are provided technical resources they will have greater confidence and understanding of the value of EE, leading to projects being implemented	NYSERDA best practice materials are incorporated in other best practice efforts that lack this information (e.g., Cornell Cooperative Extension)	Number of physical Best Practice Guides distributed by NYSERDA	How many physical Best Practice Guides were distributed by NYSERDA?	Collected by NYSERDA	2019 & beyond
			Number of digital Best Practice Guides distributed (downloaded from website) by NYSERDA	How many digital Best Practice Guides distributed (downloaded from website) by NYSERDA	Collected by NYSERDA	2019 & beyond

Table 6: Market Evaluation Questions Collected by GLASE

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicators	Question	Market Actors	Priority
GLASE	If greenhouses operators implement technologies to control lighting, ventilation and CO2 systems they will	Availability of products in the market that can reduce electricity	Reduction in greenhouse electricity use per kg of biomass produced at pilot locations	How much electricity has been saved per kg of biomass produced in pilot locations?	Greenhouse Growers, Collected by GLASE/ NYSERDA	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicators	Question	Market Actors	Priority
	save 70-86% on electricity	costs and result in savings in greenhouses between 70-86%		What is the greenhouse area, in acres, used for pilot testing?	Collected by GLASE/ NYSERDA	2018 & beyond
			None	How many greenhouses have adopted LASSI, the Consortium's baseline product?	Collected by GLASE/ NYSERDA	2018 & beyond
	If influential manufacturers and end-users are involved in the Consortium as partners/demonstration sites it will accelerate the adoption of EE technologies in greenhouses	Demonstrated electricity savings are achieved through greenhouse system solutions. Up to 4 hardware/ software products and 3 services are commercialized and 8 provisional patents are filed by the Consortium by the end of the program	Number of Royalties or Licenses from patentable products generating revenue for the Consortium	How many Royalties or Licenses from patentable products/systems are generating revenue for the Consortium?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of product variations tested in pilot systems	How many product/systems variations have been tested in pilot systems?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of provisional patents filed	How many provisional patents have been filed?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of products developed	How many products/systems have been developed?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of services developed	Have many services have been developed?	Collected by GLASE/ NYSERDA	2018 & beyond

Initiative	Testable Hypothesis	Goal Prior to Exit	Indicators	Question	Market Actors	Priority
	If the Consortium successfully disseminates information, paid memberships will occur and it will be self sustaining	The Consortium is self-funded via partnerships, memberships, trainings/services, and royalties/ licenses of patentable products.	Number of paid Consortium memberships	How many paid Consortium memberships are there?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of trainings held (i.e. webinars, short courses, etc.)	How many trainings have been held (e.g., webinars, short courses)?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of fee-based trainings and services offered by the Consortium	How many fee-based trainings and services are offered by the Consortium?	Collected by GLASE/ NYSERDA	2018 & beyond
			Year 8 projected Consortium cash flows	What are the Year 8 projected Consortium cash flows?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of case studies developed	How many case studies have been developed?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of fact sheets developed	How many fact sheets have been developed?	Collected by GLASE/ NYSERDA	2018 & beyond
			Number of social media products developed	How many social media products have been developed?	Collected by GLASE/ NYSERDA	2018 & beyond
	If the Consortium successfully forms teams with cross-cutting expertise in greenhouse controls then those teams will help growers implement packaged energy solutions	Up to 25% indirect savings from market penetration of control systems and lighting technologies in NY tomato & greenhouse acreage	Reduction in greenhouse electricity use per kg of biomass produced in NYS	How much electricity has been saved per kg of biomass produced in NYS?	Collected by GLASE/ NYSERDA	2018 & beyond

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Appendix C: NYSERDA AAET, Tech Services, and GLASE Consortium Market Evaluation Sample Design

To: Carley Murray, Judeen Byrne, NYSERDA

From: Jordan Mann, Cherish Smith, and Beth Davis, Navigant Consulting Inc.

Date: September 17, 2018

Re: **NYSERDA AAET, Tech Services, and GLASE Consortium Market Evaluation Sample Design**

The purpose of this memo is to outline the sample design methodology Navigant Consulting Inc. (Navigant) will employ to evaluate NYSERDA's agriculture initiatives, Advancing Agriculture Energy Technologies (AAET), the Agriculture component of Commercial: Technical Services, and Greenhouse Lighting and Systems Engineering (GLASE) Consortium.

1. Background

The evaluation of the NYSERDA Agricultural initiatives is designed to assess the hypotheses that the increased availability of comprehensive technical information about energy efficiency improvements, especially those that may involve underutilized or emerging technologies, their benefits, and how to finance them, shall result in the increased knowledge and adoption of energy efficient measures by farm and greenhouse owners. Key performance metrics and indicators have been developed to track the progress of this market adoption and transformation.

As part of this effort, Navigant was tasked by NYSERDA to develop and implement strategies to select appropriate samples for primary data collection. NYSERDA had developed an initial sample design approach and sample sizes. Navigant has reviewed this information, along with contact information provided by NYSERDA and the GLASE Consortium (GLASE), to refine the sample design approach and sample sizes.

2. Objectives

The goals of the primary data collection are included in the Final AAET & GLASE Evaluation Plan: Market Evaluation dated June 14, 2018.

3. Survey Approach

To achieve the objectives, Navigant will conduct surveys for the following target groups in 2018. Additional groups will be added in 2019 under AAET (demonstration farm sites and farm equipment suppliers and vendors).

AAET

- Non-participant farms

Agriculture Technical Services

- Agriculture Technical Services participants (possibly, including this group is under discussion)

GLASE

- Non-participant lighting chip manufacturers
- Non-participant lighting fixture manufactures
- Non-participant greenhouse auxiliary service providers
- Non-participant greenhouse owners
- Non-participant grocery retailers

While the AAET survey effort will target all New York State farms, emphasis in the study shall be placed on four sub-sectors that require higher levels of energy usage: dairy farms, greenhouses, vegetable farms and vineyards.

Navigant has established a survey approach to garner a higher response rate and reduce bias. Navigant would also like to ensure the survey efforts are efficient and provide an opportunity for NYSERDA and Navigant to test survey approaches that are most effective and that would be

useful for future years if NYSERDA decides to continue the surveys. Navigant has developed the following survey approach for 2018 (Table 1).

Table 7. Survey Approach

Step	Description	Approach	Timeline
1	Complete five phone interviews with each target group	Navigant will use Qualtrics as the survey tool and add notes from discussion Navigant will use this approach to test the survey guide and obtain data from the market	2 weeks
2	Update the survey guide after the interviews	Navigant will update the survey guide (in Qualtrics) after interviews if needed	1 week
3	Send a postcard and email with online link to population	Population based on contact information (email and/or physical address) obtained from Infogroup data, Tax data and contact lists provided by NYSERDA and GLASE	1-2 weeks
	Send postcard (only to non-participant farms and non-participant greenhouses)	Postcard will be sent to all with a mailing address Postcard will contain agriculture related messaging (on front) and provide the survey details (on back) Postcard should contain recognizable trusted agriculture organization in the NY market (e.g., NYSERDA, Cornell University, RPI, New York Farm Bureau, USDA, Dairy Farmers of America) Strong industry connection will help increase response rates, given strong relationships in the sector are critical Postcard should include online survey link	
	Send email	Email will be sent to all with an email address Email should contain strong agriculture related messaging (in subject line) and provide the survey details (in email body) Email should contain recognizable trusted agriculture organization in the NY market (e.g., NYSERDA, Cornell University, RPI, New York Farm Bureau, USDA, Dairy Farmers of America) Email subject line will be important to solicit high response rates Due to the low number of email addresses, postcards will be primary contact approach	
4	Survey random sample of non-respondents by phone	Survey random sample on non-respondents by phone in cases where response rates are low, or in cases where we suspect self-selection bias will occur (e.g., non-participants) Surveyor will use their judgement on number of calls/times of day	12 weeks (or per other guidance

Step	Description	Approach	Timeline
		Phone survey will use the online Qualtrics platform to complete the survey, thus not having to reprogram the surveys and transfer the data The survey house will receive random sample from Navigant	from APPRISE)

Navigant will work to field the surveys during a time that is best for each market actor. Based on experience with the farms in other markets, it is best to field those surveys between growing seasons when growers have less time constraints. However, due to the timing of the 2018 study, fielding the non-participant farm surveys outside of the growing season may be difficult. This approach could be applied for the follow-up studies.

Navigant has not assumed any monetary incentives for the target groups who complete the survey. If response rates are lacking, Navigant would discuss the use of incentives with NYSERDA to bolster the response rates. Based on previous experience in the agriculture sector, an incentive (including a non-monetary incentive) can be influential to agriculture market actors.

Navigant has developed this proposed sample design approach to provide an opportunity to understand which approach may work best to target non-participant farm and greenhouse owners, and that solicits a high response rate, reduces self-selection bias and cost. Any lessons learned this year may be applied in subsequent years. Navigant will also coordinate with the GLASE consortium to ensure there are no overlapping survey efforts.

4. Sample Design

Navigant has reviewed target group contact information provided by NYSERDA and GLASE including InfoGroup data for the NAICS codes, contact lists from Erico Mathos of the GLASE initiative supplemented by contact information from NavResearch, and contact lists from NYSERDA (Table 2). Based upon this review, Navigant has updated the estimated population size and proposed the following sample design approach (Table 3).[3]

[3] Navigant has used the following data sources to develop the sample design: "Agriculture Data 7-10-18.xlsx," "Contact List with kmo and jlz review.xlsx," "agpull2017(v2).xlsx" (AAET: Non-Participant Farm Survey, GLASE:

Table 8. Target Group Corresponding Data Sources and Number of Contacts

Initiative	Target Group	Census Data*	InfoGroup	Tax Data	GLASE & NAVResearch Contact Lists
AAET	Non-participant farms	35,537	2,595	30,366	22
Ag Tech Services	Ag Tech Services Participants	Data not yet available			
GLASE	Non-participant lighting chip manufacturers	N/A	0	0	29
	Non-participant lighting fixture manufactures	N/A	0	0	28
	Non-participant greenhouse auxiliary service providers	N/A	168	0	30
	Non-participant greenhouse owners	2,001	177	605	22
	Non-participant grocery retailers	N/A	12,820	0	0

*USDA, Agriculture Census Data for New York, https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/New_York/st36_1_001_001.pdfand https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/New_York/st36_1_041_041.pdf

Non-Participant Greenhouse Owners, Service Providers and Grocery Retailers); "GLASE Industry Contacts.xlsx," "GLASE Industry Contacts_CM 07.17.18.xlsx" (GLASE: Lighting Chip and Fixture Manufacturers).

Table 9. Sample Design Approach

Initiative	Target Group	NYSERDA		Navigant		Expected Sampling Confidence & Precision	Primary Sampling Unit	Stratification
		Estimated Population Size*	Target Sample Size	Sample Frame Size**	Target Sample Size			
AAET	Non-participant farms [4]	35,000	68	32,883	80	90/10	Farm	Category of farm, targeting dairy farms, greenhouses, vegetable farms and vineyards
Ag Tech Services	Ag Tech Services Participants	N/A	N/A	TBD	TBD	TBD	Participant	TBD
GLASE	Non-participant lighting chip manufacturers	62	23	29	14	85/15	Manufacturers	N/A
	Non-participant lighting fixture manufactures	1,110	68	28	21	90/10	Manufacturers	N/A [5]
	Non-participant greenhouse auxiliary service providers	625	68	198	70	90/10	Service Provider	N/A [6]

[4] Non-participant farms include greenhouses and will be targeted for both the AAET and Ag Technical Services – Best Practice Guide survey.
[5] Navigant did not stratify by primary industry served (as indicated in the Final AAET & GLASE Evaluation Plan: Market Evaluation) because the contact list developed by GLASE and NavResearch target the key lighting manufactures, of various sales volumes in the industry.
[6] Navigant did not stratify by primary industry served (as indicated in the Final AAET & GLASE Evaluation Plan: Market Evaluation) because Infogroup data did not provide detailed information on industry services.

Memorandum

Initiative	Target Group	NYSERDA		Navigant		Expected Sampling Confidence & Precision	Primary Sampling Unit	Stratification
		Estimated Population Size*	Target Sample Size	Sample Frame Size**	Target Sample Size			
	Non-participant greenhouse owners[7]	2,257	67	804	70	90/10	Greenhouses	N/A[8]
	Non-participant grocery retailers	22,000	68	12,820	100	90/10	Retailer	Primary industry served

*NYSERDA estimated population size from the NYERDA RFP for the AAET & GLASE Market Evaluation, Table 10. Overview of Primary Data Collection Activities.

**The Sample Frame Size includes all contacts listed in InfoGroup data for the applicable NAICS codes, contact lists from Erico Mathos of the GLASE initiative supplemented by contact information from NavResearch, and contact lists from NYSERDA. The Sample Frame Size does not account for the presence (or lack thereof) of valid email or physical addresses.

[7] The sample frame size for greenhouses is counted under Non-Participant Greenhouse Owners and Non-Participant Farm target groups.
[8] Navigant did not stratify by category of greenhouse crop (as indicated in the Final AAET & GLASE Evaluation Plan: Market Evaluation) because Infogroup data did not provide any information about the type of crop.

Memorandum

Navigant has developed the following quotas by category of farm for the AAET Non-Participant Farm Survey (Table 4).

Table 10. AAET Non-Participant Farm Sample Design Quotas

Initiative	Target Group	Navigant	
		Sample Frame Size**	Target Sample Size
AAET	Dairy Farms	381	10
	Greenhouses	199	10
	Vineyards	353	10
	Vegetable Farms	21	10
	Other	1,563	40

**The Sample Frame Size includes all contacts listed in InfoGroup data for the applicable NAICS codes, contact lists from Erico Mathos of the GLASE initiative supplemented by contact information from NavResearch, and contact lists from NYSERDA. The Sample Frame Size does not account for the presence (or lack thereof) of valid email or physical addresses.

Navigant designed a sample to target 90% confidence and 10% absolute precision for each binary question (e.g., yes/no response) for each target group and 90% confidence with 10% relative precision for numeric responses. For numeric responses with low values it may not be feasible to achieve 90% confidence with 10% relative precision. Table 5 shows the type of question, confidence and precision target, and an example for the three types of questions being asked.

Table 11. Confidence and Precision by Question Type

Type of Question	Confidence/ Precision	Example Question
Binary	90/10 absolute	Do you use energy efficiency as a tool to sell your products?
Numeric	90/10 relative	How much energy is currently used in greenhouses?
Open ended	n/a	What are your perceived barriers and benefits to adopting clean energy technologies?

Navigant will attempt to sample at least 14 of the 29 lighting chip manufactures due to the small population available. Navigant will also continue to work with GLASE to identify the appropriate service provider contacts and approach for surveying auxiliary service providers. Similar to non-participant farmers and greenhouse owners, Navigant will ask respondents to refer peers for

survey efforts. Navigant will develop a separate sample for non-participant farms and greenhouses to administer separate AAET and GLASE surveys.

Given Navigant will send postcards and/or emails with a link to the survey to the entire population with a mailing address and/or email address, ideally the target number of participants will exceed the target sample size. In cases, where responses are low, Navigant will compare the characteristics of the respondents (e.g., farm/greenhouse type, size and/or sales) to New York state population using census data and the target sample to identify segments that may be underrepresented and to target for phone surveys.

NAVIGANT
A Guidehouse Company

Appendix D: Final Survey Instruments

[AAET-Tech Services] Non-Participant Farms Survey

AAET-Tech Services-GLASE Market Evaluation

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

FINAL: January 23, 2019

1. Introduction

This document includes Navigant's proposed sampling methodology and draft survey instrument for the [AAET-Technical Services] Non-Participant Farms Survey.

Navigant will utilize Qualtrics to administer the online survey. APPRISE will complete surveys over the phone. The survey will be tested in advance of full deployment and may be modified after deployment to enhance the number of completed interviews. Compiled survey results will be presented to NYSERDA and summarized in the final report. Table 1 identifies the survey characteristics.

Table 12: Survey Characteristics

Characteristics	Description
Statement of purpose	To understand farmers' awareness of energy efficient technologies in the agriculture sector, incentives available for energy efficient technologies, and NYSERDA informational materials geared towards the agriculture sector.
Qualified respondent	A grower or farmer that has not participated in a NYSERDA agriculture program or demonstration site
Target number of completes	80
Estimated survey length	15 minutes
Survey timeline	Q4 2018 – Q1 2019

1.1 Draft of E-mail Language – Online Survey

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with this short survey

Reply to: NYSERDAsurvey@navigant.com

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to understand the awareness of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are reaching out to agricultural producers like you to ask for your participation in a short survey.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers, and to improve its programs and resources that support the agricultural industry in New York State.

If you are interested in participating, click on the link below and enter your PIN number. The survey should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

Take the Survey

PIN number:

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact me at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe

1.2 Draft of E-mail Language – Phone Survey

From: Navigant/APPRISE

Sent: Date/timestamp

To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with a short survey

Reply to: Navigant/APPRISE

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to understand the awareness of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are reaching out to agricultural producers like you to ask for your participation in a short survey.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers, and to improve its programs and resources that support the agricultural industry in New York State.

Do you have time either this week or next for a brief interview on the topic? The interview should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Sincerely,

[Navigant/APPRISE Contact Information]

2. Survey

1. Welcome to the survey!
   This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA). Your input and information will help NYSERDA to better understand the types of energy efficient technologies and resources used in New York State's agricultural sector, and to improve its programs and resources that support the agricultural industry in New York State.

   The survey should take you less than 15 minutes to complete. You can go back to previous responses at any point during the survey. However, you will not be able to leave the survey and return later once you begin. All of your responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

   If you have questions while you are taking the survey, please e-mail NYSERDAsurvey@navigant.com.

   Click the grey and white arrow on the bottom right to begin the survey.
2. How did you hear about this survey? **[PROGRAMMER: ALLOW MULTIPLE RESPONSES]**
   1. Postcard
   2. E-mail
   3. Phone call
   97. Other **[FILL IN]**

3. If you have a 7-digit PIN number, please enter it below. If not, proceed to the next question. **[OPTIONAL]**
   1. **[RECORD NUMBER]**

4. Is your agricultural operation (e.g., farm, dairy, greenhouse, vineyard) or part of your operation located in New York State?
   1. Yes
   2. No **[SKIP TO TERMINATE]**
   3. My business is not an agricultural operation. **[SKIP TO TERMINATE]**

5. What is the zip code of your primary location in New York State?
   1. **[RECORD NUMBER]**

6. What is the name of your agricultural operation? **[REQUIRED]**

Note: Your survey responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable. The purpose of this question is to track who already took the survey.

1. **[OPEN ENDED RESPONSE]**

7. Which of the following does your agricultural operation have across all your New York State locations? Select all that apply.
   1. Dairy cows
   2. Beef cattle
   3. Chickens
   4. Pigs
   5. Vineyard
   6. Orchard
   7. Greenhouse
   8. Vegetable farm (not a greenhouse)
   97. Other **[FILL IN]**
   99. None **[MUTUALLY EXCLUSIVE]**

8. **[IF Q7 = 10, SKIP TO TERMINATE. OTHERWISE, DISPLAY OPTIONS BASED ON RESPONSES GREATER THAN ZERO FOR Q7]** How many of the following does your agricultural operation have across all your New York State locations?
   1. Dairy cows (# of cows) **[RECORD NUMBER]**
   2. Beef cattle (# of cattle) **[RECORD NUMBER]**
   3. Chickens (# of birds) **[RECORD NUMBER]**
   4. Pigs (# of pigs) **[RECORD NUMBER]**
   5. Vineyard (# of acres) **[RECORD NUMBER]**
   6. Orchard (# of acres) **[RECORD NUMBER]**
   7. Greenhouse (# of square feet) **[RECORD NUMBER]**
   8. Vegetable farm – not a greenhouse (# of acres) **[RECORD NUMBER]**
   97. Other **[OPEN ENDED]**

9. Have you heard of NYSERDA's Agriculture Energy Audits program?
   For reference: https://www.nyserda.ny.gov/All-Programs/Programs/Agriculture-Energy-Audit
   1. Yes
   2. No

10. **[IF Q9 = Yes, CONTINUE. OTHERWISE, SKIP TO Q11]** Have you participated in NYSERDA's Agriculture Energy Audits program?
    1. Yes **[SKIP TO TERMINATE 2]**
    2. No

11. ***This question was not included in 2018-19.*** Which of the following NYSERDA informational materials related to agriculture have you come across?

    If you have come across any of the informational materials, did you take an action upon hearing about it? An example of an action is installing LEDs after hearing about their energy savings potential in a NYSERDA best practice guide.

NYSERDA informational material	Have you come across it?	Did you take an action upon hearing about it?
Best practice guide	[Yes/No]	[Yes/No/Not Applicable]
Case study	[Yes/No]	[Yes/No/Not Applicable]
Feasibility study	[Yes/No]	[Yes/No/Not Applicable]
Business case scenario	[Yes/No]	[Yes/No/Not Applicable]
Demonstration site	[Yes/No]	[Yes/No/Not Applicable]
Agriculture energy audit	[Yes/No]	[Yes/No/Not Applicable]
Other	[Yes/No]	[Yes/No/Not Applicable]

12. **[If Q9 = YES, CONTINUE. OTHERWISE, SKIP TO Q15]** Where did you receive the information about NYSERDA's agriculture energy audits?
    [OPEN ENDED RESPONSE]

13. ***This question was not included in 2018-19.*** **[If Q11 = YES FOR ANY NYSERDA INFORMATIONAL MATERIALS, CONTINUE. OTHERWISE, SKIP TO Q15]** Where did you receive the NYSERDA informational materials from?
    1. **[OPEN ENDED RESPONSE]**

14. **[If Q9 = YES, CONTINUE. OTHERWISE, SKIP TO Q15]** You mentioned having heard of NYSERDA's Agriculture Energy Audits program. Did you take any actions to upgrade your facilities as a result of learning about the program?
    1. Yes
    2. No

15. ***This question was not included in 2018-19.*** Have you incorporated any of the technologies or processes referenced in the NYSERDA informational materials into your capital investment plan?

    A capital investment plan outlines the assets that a business plans on purchasing in the upcoming years to help further their business objectives or increase productivity.
    1. Yes
    2. No
    3. Don't Know

16. ***This question was not included in 2018-19.*** **[IF Q11_Best Practice Guide_Have You Come Across it = YES, CONTINUE. OTHERWISE, SKIP TO Q22]** Have you shared NYSERDA best practice guides with other farmers?

1. Yes
2. No

17. ***This question was not included in 2018-19.*** **[IF Q16 = YES, CONTINUE, OTHERWISE SKIP TO Q22]** Who did you share the NYSERDA best practice guide with?
    1. **[OPEN ENDED RESPONSE]**

18. ***This question was not included in 2018-19.*** In what venue did you share the NYSERDA best practice guide?
    1. **[OPEN ENDED RESPONSE]**

19. ***This question was not included in 2018-19.*** Did you find the information in the best practice guides useful or valuable?
    1. Yes
    2. No

20. ***This question was not included in 2018-19.*** **[IF Q19 = YES, CONTINUE. OTHERWISE, SKIP TO Q22]** Why did you find the information in the best practice guides useful or valuable?
    1. **[OPEN ENDED RESPONSE]**

21. ***This question was not included in 2018-19.*** **[IF Q19 = NO, CONTINUE. OTHERWISE, SKIP TO Q22]** Why did you not find the information in the best practice guides useful or valuable?
    1. **[OPEN ENDED RESPONSE]**

22. The next set of questions is going to ask you about your awareness and implementation of different energy efficient technologies.

23. For each type of technology listed below, please indicate if you are aware of that technology or are not aware of that technology.

Technology	Aware of Technology? [Dropdown: Yes/No/Don't Know]
23_1. LED lighting and/or LED lighting controls	1. Yes 2. No 98.Don't Know
23_2. Efficient ventilation (building or barn)	1. Yes 2. No 98.Don't Know
23_3. Variable frequency drive (VFD) on pump or fan motors (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	1. Yes 2. No 98.Don't Know

23_4. High efficiency motors	1. Yes 2. No 98.Don't Know
23_5. Engine block heater timer	1. Yes 2. No 98.Don't Know
23_6. Compressed air efficiency improvements	1. Yes 2. No 98.Don't Know
23_7. Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	1. Yes 2. No 98.Don't Know
23_8. Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	1. Yes 2. No 98.Don't Know
23_9. **[SHOW IF Q7=1, 2, 3, or 4]** Energy-free livestock watering system	1. Yes 2. No 98.Don't Know
23_10. **[SHOW IF Q7=1]** Plate cooler (e.g., well water heat exchanger)	1. Yes 2. No 98.Don't Know
23_11. **[SHOW IF Q7=7]** Energy curtain (e.g., shade curtain, night cover)	1. Yes 2. No 98.Don't Know

24. What other energy efficient technologies specific to agriculture are you aware of that were not asked about?
    1. **[OPEN ENDED RESPONSE]**

25. On a scale of 1 to 5 with 1 being not confident at all and 5 being very confident, how confident are you that energy efficient technologies like the ones we just discussed live up to each of the following promised benefits?

Benefit	Confidence of Promised Benefit
25_1. Energy bill savings	[Scale of 1 to 5]
25_2. Operational and maintenance savings	[Scale of 1 to 5]
25_3. Improved performance	[Scale of 1 to 5]
25_4. Increased reliability	[Scale of 1 to 5]

26. What benefits do you see with adopting energy efficient technologies? *Select all that apply.*
    1. Lower energy bills
    2. Lower operation and maintenance costs
    3. Increased crop yield
    4. Improved crop quality
    5. Improved equipment reliability
    6. Environmental sustainability
    97. Other **[FILL IN]**

27. What barriers, if any, do you see with adopting energy efficient technologies? *Select all that apply.*
    1. Upfront costs
    2. Length of payback period
    3. Time or effort to learn about new technologies
    4. Performance or reliability of technologies
    97. Other **[FILL IN]**

28. Have you sought out information or training on implementing energy efficient technologies?
    1. Yes
    2. No
    98. Don't Know

29. Which of the financial resources below are you aware of for installing energy efficient technologies in the agriculture sector? *Select all that apply.*
    1. Federal incentives and assistance programs, such as the USDA Environmental Quality Incentives Program or USDA Rural Energy for America Program
    2. State incentives and assistance programs, such as programs offered by NYSERDA
    3. Utility programs, such as energy efficiency programs offered by National Grid, New York State Electric and Gas, Rochester Gas & Electric, Central Hudson Gas & Electric, or Con Edison.
    1. Other **[FILL IN]**
    99. None **[MUTUALLY EXCLUSIVE]**

30. **[IF Q29 = NONE, SKIP TO Q31. OTHERWISE, CONTINUE]** Have you ever participated in an energy efficiency program or received financial incentives from any of the following sources for an agriculture-related project?

Energy Efficiency Program Type	Yes (1)	No (2)
30_1. Federal	☐	☐
30_2. State (NYSERDA)	☐	☐
30_3. Utility	☐	☐
30_97. Other **[FILL IN]**	☐	☐

31. **[IF Q23 = NO FOR ALL TECHNOLOGIES SKIP TO Q35. PROGRAMMER: USE MENU FROM Q23, ONLY INCLUDE Q23 ANSWERS THAT EQUAL YES.]** This question asks about which energy efficient technologies you may have installed or implemented. For each type of technology, please indicate if you have installed or implemented that technology on any of your agricultural operations or facilities in New York State. Please also include the year that you installed or implemented the technology. If you installed the technology in multiple years, please list each year.

Technology	Installed in Facility? [Dropdown: Yes/No/Don't Know]	Year(s) Installed? [OPTIONAL]
31_1. LED lighting and/or LED lighting controls	1. Yes 2. No 99.Don't Know	[Text field]
31_2. Efficient ventilation (building or barn)	1. Yes 2. No 99.Don't Know	[Text field]
31_3. Variable frequency drive (VFD) on pump or fan motors (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	1. Yes 2. No 99.Don't Know	[Text field]
31_4. High efficiency motors	1. Yes 2. No 99.Don't Know	[Text field]
31_5. Engine block heater timer	1. Yes 2. No 99.Don't Know	[Text field]
31_6. Compressed air efficiency improvements	1. Yes 2. No 99.Don't Know	[Text field]
31_7. Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	1. Yes 2. No 99.Don't Know	[Text field]
31_8. Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	1. Yes 2. No 99.Don't Know	[Text field]
31_9. **[SHOW IF Q7=1, 2, 3, or 4]** Energy-free livestock watering system	1. Yes 2. No 99.Don't Know	[Text field]
31_10. **[SHOW IF Q7=1]** Plate cooler (e.g., well water heat exchanger)	1. Yes 2. No 99.Don't Know	[Text field]
31_11. **[SHOW IF Q7=7]** Energy curtain (e.g., shade curtain, night cover)	1. Yes 2. No 99.Don't Know	[Text field]
31_97. Other **[FILL IN]**	1. Yes 2. No 99.Don't Know	[Text field]

32. ***This question was not included in 2018-19.*** **[IF Q11 = YES FOR ANY NYSERDA INFORMATIONAL MATERIALS, CONTINUE. OTHERWISE, SKIP TO Q33. PROGRAMMER: USE MENU FROM Q31, ONLY INCLUDE Q31 ANSWERS THAT EQUAL YES]** How many of the following energy efficient technologies did you install due to hearing about NYSERDA informational materials geared towards the agriculture sector (e.g., a best practice guide, case study, feasibility study, business case scenario, agriculture energy audit, or demonstration site)?

Which NYSERDA informational material lead you to this decision?

Technology	Installed Quantity	What lead you to this decision? [Dropdown]
LED lighting and/or LED lighting controls	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Efficient ventilation (building or barn)	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Variable frequency drive (VFD) on pump or fan motors (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
High efficiency motors	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Engine block heater timer	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Compressed air efficiency improvements	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
[SHOW IF Q7=1, 2, 3, or 4] Energy-free livestock watering system	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
[SHOW IF Q7=1] Plate cooler (e.g., well water heat exchanger)	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
[SHOW IF Q7=7] Energy curtain (e.g., shade curtain, night cover)	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]
Other **[FILL IN]**	[Record Number]	[Best practice guide, Case study, Feasibility study, Business case scenario, demonstration site, agriculture energy audit, other]

33. **[IF Q15= YES, CONTINUE. OTHERWISE, SKIP TO Q34. ONLY INCLUDE TECHNOLOGIES WHERE Q31=YES FOR INSTALLED IN FACILITY]** You previously indicated that you took an action to upgrade your facilities as a result of learning about NYSERDA's Agricultural Energy Audit program. For each type of technology you have implemented, please indicate if you installed or implemented that technology as a result of learning about NYSERDA's Agricultural Energy Audits.

Technology	Installed Quantity
33_1. LED lighting and/or LED lighting controls	[Record Number]
33_2. Efficient ventilation (building or barn)	[Record Number]
33_3. Variable frequency drive (VFD) on pump or fan motors (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	[Record Number]
33_4. Engine block heater timer	[Record Number]
33_6. Compressed air efficiency improvements	[Record Number]
33_7. Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	[Record Number]
33_8. Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	[Record Number]
33_9. **[SHOW IF Q7=1, 2, 3, or 4]** Energy-free livestock watering system	[Record Number]
33_10. **[SHOW IF Q7=1]** Plate cooler (e.g., well water heat exchanger)	[Record Number]
33_11. **[SHOW IF Q7=7]** Energy curtain (e.g., shade curtain, night cover)	[Record Number]
33_97. Other **[FILL IN]**	[Record Number]

34. **[IF Q31 = NO FOR ALL TECHNOLOGIES SKIP TO Q35. PROGRAMMER: USE MENU FROM Q31, ONLY INCLUDE Q31 ANSWERS THAT EQUAL YES. ONLY INCLUDE COLUMNS WHERE Q30=YES, DISREGARD OTHER]** You previously indicated that you participated in an energy efficiency program or received financial incentives for an agriculture-related project. For each type of technology you have implemented, please indicate if you received federal incentives, state incentives, utility incentives, or no incentives to implement that technology. *Check all that apply.*

Technology	No Incentive Used (1)	Federal Incentive (2)	State Incentive (3)	Utility Incentive
34_1. LED lighting and/or LED lighting controls	☐	☐	☐	☐
34_2. Efficient ventilation (building or barn)	☐	☐	☐	☐
34_3. Variable frequency drive (VFD) on pump or fan motors (e.g., transfer pump, vacuum pump, well pump, irrigation pump)	☐	☐	☐	☐
34_4. High efficiency motors	☐	☐	☐	☐
34_5. Engine block heater timer	☐	☐	☐	☐
34_6. Compressed air efficiency improvements	☐	☐	☐	☐
34_7. Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	☐	☐	☐	☐
34_8. Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	☐	☐	☐	☐
34_9. **[SHOW IF Q7=1, 2, 3, or 4]** Energy-free livestock watering system	☐	☐	☐	☐

Technology	No Incentive Used (1)	Federal Incentive (2)	State Incentive (3)	Utility Incentive
34_10. **[SHOW IF Q7=1]** Plate cooler (e.g., well water heat exchanger)	☐	☐	☐	☐
34_11. **[SHOW IF Q7=7]** Energy curtain (e.g., shade curtain, night cover)	☐	☐	☐	☐
34_97. Other **[FILL IN]**	☐	☐	☐	☐

35. Is there anyone in the agriculture sector in New York State that we should talk to (e.g., lighting manufacturers, greenhouse growers, farmers, consultants, energy auditors, or utility representatives) about energy efficiency opportunities in the agriculture sector? If so, please provide their contact information (e.g., company, name, phone number, and e-mail).
    1. Name **[RECORD]**
    2. Company **[RECORD]**
    3. Phone number **[RECORD]**
    4. E-mail **[RECORD]**

36. Are you interested in receiving more information from NYSERDA about energy efficiency resources (e.g., best practice guides or case studies)? If so, please provide your contact information below.
    1. Name **[RECORD]**
    2. Company **[RECORD]**
    3. Phone number **[RECORD]**
    4. E-mail **[RECORD]**

TERMINATE: We appreciate your interest in taking the survey, but we are only reaching out to agricultural operations in New York State. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com.

TERMINATE 2: We appreciate your interest in taking the survey, however we are currently only reaching out to companies that have not participated in NYSERDA's agriculture energy audit program. You may be contacted later for another survey about your past or current participation in NYSERDA's agriculture energy audit program. Thank you for your time. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com.

CLOSE: This concludes the survey. Thank you for your participation. If you have any questions about this survey or how your responses to this survey will be used, please contact: NYSERDAsurvey@navigant.com.

NAVIGANT
A Guidehouse Company

[Tech Services] FlexTech Energy Audit Participants Survey

AAET-Tech Services-GLASE Market Evaluation

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

FINAL: July 10, 2019

1. Introduction

This document includes Navigant's proposed sampling methodology and draft survey instrument for the [Technical Services] FlexTech Energy Audit Participants Survey.

Navigant will utilize Qualtrics to administer the online survey. E-mail will be the primary method for recruiting participants to take the survey, followed by phone calls if the desired completion rate is not achieved through e-mails alone. The survey will be taken online via Qualtrics. The survey will be tested in advance of full deployment and may be modified after deployment to enhance the number of completed interviews. Compiled survey results will be presented to NYSERDA and summarized in the final report. Table 1 identifies the survey characteristics.

Table 13: Survey Characteristics

Characteristics	Description
Statement of purpose	To understand farmers' awareness of energy efficient technologies in the agriculture sector, incentives available for energy efficient technologies, and NYSERDA informational materials geared towards the agriculture sector. To estimate indirect impacts.
Qualified respondent	A grower or farmer that has participated in the NYSERDA FlexTech Energy Audit Program under the CEF and transition funding period and it has been over a year since their participation
Target number of completes	78
Estimated survey length	15 minutes
Survey timeline	Q2 2019 – Q3 2019
Question categories	Characterization/screening: Q1 - Q15, Q37 - Q38. Market research: Q16 - Q25. Direct impacts: Q26 - 27. Indirect impacts: Q28 - Q31

1.1 Draft of E-mail Language – Online Survey (Initial E-mail)

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: Complete a short survey about your participation in NYSERDA's Agriculture Energy Audit Program

Reply to: NYSERDAsurvey@navigant.com

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE Inc. to understand the awareness and use of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are conducting a short survey with farmers and agricultural producers that participated in NYSERDA's Agriculture Energy Audit Program.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers and to improve its programs and resources that support the agricultural industry in New York State. According to our records, you or your organization participated in the NYSERDA Agriculture Energy Audit Program and I am writing to ask for your participation in this important survey.

To participate in the survey, please click on the link below. The survey should take less than 10 minutes to complete. Your participation in this research effort would be greatly appreciated.

Take the Survey

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact me at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

1.2 Draft of E-mail Language – Online Survey (Reminder E-mail)

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: Reminder: Complete a short survey about your participation in NYSERDA's Agriculture Energy Audit Program

Reply to: NYSERDAsurvey@navigant.com

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Dear [Contact Name],

A few days ago we reached out to you about how the New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE Inc. to understand the awareness and use of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are conducting a short survey with farmers and agricultural producers that participated in NYSERDA's Agriculture Energy Audit Program.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers and to improve its programs and resources that support the agricultural industry in New York State. According to our records, you or your organization participated in the NYSERDA Agriculture Energy Audit Program and I am writing to ask for your participation in this important survey.

To participate in the survey, please click on the link below. The survey should take less than 10 minutes to complete. Your participation in this research effort would be greatly appreciated.

Take the Survey

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact me at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

1.3 Draft of E-mail Language – Phone Survey (Initial E-mail)

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: Complete a short survey about your participation in NYSERDA's Agriculture Energy Audit Program

Reply to: NYSERDAsurvey@navigant.com

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE Inc. to understand the awareness and use of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are conducting a short survey with farmers and agricultural producers that participated in NYSERDA's Agriculture Energy Audit Program.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers and to improve its programs and resources that support the agricultural industry in New York State. According to our records, you or your organization participated in the NYSERDA Agriculture Energy Audit Program and I am writing to ask for your participation in this important survey.

Do you have time either this week or next week for a brief interview? The interview should take less than 10 minutes to complete. Your participation in this research effort would be greatly appreciated.

If you have questions about the legitimacy or purpose of the study, contact me at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

2. Survey

1. Welcome to the survey!
   This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA). Your input and information will help NYSERDA to better understand the types of energy efficient technologies and resources used in New York State's agricultural sector, and to improve its programs and resources that support the agricultural industry in New York State. As part of this research, NYSERDA is reaching out to past participants of their Agriculture Energy Audit Program.

   The survey should take you less than 15 minutes to complete. You can go back to previous responses at any point during the survey by clicking the back arrow on the bottom left of the screen. You can return to the survey at a later time by going back to the survey URL. All of your responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

   If you have questions while you are taking the survey, please e-mail NYSERDAsurvey@navigant.com.

   Click the grey and white arrow on the bottom right to begin the survey.

2. How did you hear about this survey? **[PROGRAMMER: ALLOW MULTIPLE RESPONSES]**
   1. E-mail
   2. Phone call
   97. Other **[FILL IN]**

3. **[PIN question deleted]**

4. According to our records, you or your organization participated in the NYSERDA Agriculture Energy Audit Program in **[PIPE IN YEAR FROM DATE FROM IN FEAT]** for your facility located at **[PIPE IN ADDRESS FROM FEAT]**. Is that correct?
   1. Yes
   2. No **[SKIP TO TERMINATE 1]**

5. Are you the person at your organization that was most involved in the NYSERDA agriculture energy audit?
   1. Yes
   2. No

6. Are you familiar with the technologies in that facility that consume energy (e.g., lights, heating systems, or cooling systems)?
    1. Yes **[SKIP TO Q8]**
    2. No **[SKIP TO Q7]**

7. Can you provide the contact information for the person at your organization that was most involved in the NYSERDA agriculture energy audit and is familiar with the technologies in that facility that consume energy? Please provide their name, phone number, and e-mail address if possible.
    1. **[OPEN ENDED RESPONSE]**

    [SKIP TO TERMINATE 2]

8. On a scale of 1 to 5 with '1' being Very Dissatisfied, '2' being Somewhat Dissatisfied, '3' being Neither Satisfied nor Dissatisfied, '4' being Somewhat Satisfied and '5' being Very Satisfied, please indicate your level of satisfaction with the following NYSERDA Agriculture Energy Audit Program elements:

NYSERDA Program Element	1 Very Dissatisfied	2 Somewhat Dissatisfied	3 Neither Satisfied nor Dissatisfied	4 Somewhat Satisfied	5 Very Satisfied	97 Not Applicable	98 Don't Know	99 Prefer Not to Answer
8_1. Ease of application								
8_2. Quality of auditor's								
8_3. Energy savings from measures installed as a result of the audit (if applicable)								
8_4. Adequacy of the communication from program staff								
8_5. Comprehensiveness of program staff's knowledge about the program offering and options								
8_6. Sufficiency of the resolution of program issues								
8_7. Overall Satisfaction with								

9. **[IF Q8 = 1 OR 2 FOR ANY ITEMS]** Please further explain or elaborate on any Dissatisfaction ratings (indicated by a '1' or a '2') noted in the table above.
    1. **[OPEN ENDED RESPONSE]**

10. Would you recommend the NYSERDA Agriculture Energy Audit Program to a colleague?
    1. Yes

2. No

11. **[IF Q10 = YES, CONTINUE. OTHERWISE, SKIP TO Q12]** Why would you recommend the NYSERDA Agriculture Energy Audit Program to a colleague?
    1. **[OPEN ENDED RESPONSE]**

12. **[IF Q10 = NO, CONTINUE. OTHERWISE, SKIP TO Q13]** Why would you not recommend the NYSERDA Agriculture Energy Audit Program to a colleague?
    1. **[OPEN ENDED RESPONSE]**

13. Is the agricultural facility located at **[PIPE IN ADDRESS FROM FEAT]** still operational?
    1. Yes
    2. No, it is no longer operational. **[SKIP TO TERMINATE 3]**

14. Which of the following does your agricultural operation located at **[PIPE IN ADDRESS FROM FEAT]** have? Select all that apply.
    1. Dairy cows
    2. Beef cattle
    3. Chickens
    4. Pigs
    5. Vineyard
    6. Orchard
    7. Greenhouse
    8. Vegetable farm (not a greenhouse)
    9. Other **[FILL IN]**
    10. None **[MUTUALLY EXCLUSIVE; SKIP TO TERMINATE]**

15. **[IF Q14 = 10, SKIP TO TERMINATE. OTHERWISE, DISPLAY OPTIONS BASED ON RESPONSES GREATER THAN ZERO FOR Q14]** How many of the following does your agricultural operation located at **[PIPE IN ADDRESS FROM FEAT]** have?
    9. Dairy cows (# of cows) **[RECORD NUMBER]**
    10. Beef cattle (# of cattle) **[RECORD NUMBER]**
    11. Chickens (# of birds) **[RECORD NUMBER]**
    12. Pigs (# of pigs) **[RECORD NUMBER]**
    13. Vineyard (# of acres) **[RECORD NUMBER]**
    14. Orchard (# of acres) **[RECORD NUMBER]**
    15. Greenhouse (# of square feet) **[RECORD NUMBER]**
    16. Vegetable farm – not a greenhouse (# of acres) **[RECORD NUMBER]**
    17. Other **[OPEN ENDED]**

16. ***This question was not included in 2018-19.*** The next set of questions is going to ask you about whether you have come across NYSERDA informational materials related to agriculture.

17. ***This question was not included in 2018-19.*** Which of the following NYSERDA informational materials related to agriculture have you come across?

If you have come across any of the informational materials, did you take an action upon hearing about it? An example of an action is installing LEDs after hearing about their energy savings potential in a NYSERDA best practice guide.

NYSERDA informational material	Have you come across it?	Did you take an action upon hearing about it?
Best practice guide	[Yes/No]	[Yes/No/Not Applicable]
Case study	[Yes/No]	[Yes/No/Not Applicable]
Feasibility study	[Yes/No]	[Yes/No/Not Applicable]
Business case scenario	[Yes/No]	[Yes/No/Not Applicable]
Demonstration site	[Yes/No]	[Yes/No/Not Applicable]
Other **[FILL IN]**	[Yes/No]	[Yes/No/Not Applicable]

18. ***This question was not included in 2018-19.*** **[If Q17= YES FOR ANY NYSERDA INFORMATIONAL MATERIALS, CONTINUE. OTHERWISE, SKIP TO Q26]** Where did you receive the NYSERDA informational materials from?
    2. **[OPEN ENDED RESPONSE]**

19. ***This question was not included in 2018-19.*** Have you incorporated any of the technologies or processes referenced in the NYSERDA informational materials into your capital investment plan?

    A capital investment plan outlines the assets that a business plans on purchasing in the upcoming years to help further their business objectives or increase productivity.
    4. Yes
    5. No
    6. Don't Know

20. ***This question was not included in 2018-19.*** **[IF Q17_Best Practice Guide_Have You Come Across it = YES, CONTINUE. OTHERWISE, SKIP TO Q26]** Have you shared NYSERDA best practice guides with other farmers?
    3. Yes
    4. No

21. ***This question was not included in 2018-19.*** **[IF Q20 = YES, CONTINUE, OTHERWISE SKIP TO Q26]** Who did you share the NYSERDA best practice guide with?
    1. **[OPEN ENDED RESPONSE]**

22. ***This question was not included in 2018-19.*** In what venue did you share the NYSERDA best practice guide?
    1. **[OPEN ENDED RESPONSE]**

23. ***This question was not included in 2018-19.*** Did you find the information in the best practice guides useful or valuable?
    3. Yes

4. No

24. *This question was not included in 2018-19.* **[IF Q23 = YES, CONTINUE. OTHERWISE, SKIP TO Q26]** Why did you find the information in the best practice guides useful or valuable?
    1. **[OPEN ENDED RESPONSE]**

25. *This question was not included in 2018-19.* **[IF Q23 = NO, CONTINUE. OTHERWISE, SKIP TO Q26]** Why did you not find the information in the best practice guides useful or valuable?
    1. **[OPEN ENDED RESPONSE]**

26. The next set of questions is going to ask you about which energy efficient technologies you have implemented since receiving the NYSERDA energy audit.

27. Our records indicate that you installed the following technologies after you participated in NYSERDA's Agriculture Energy Audit Program. For each technology, please confirm if you have or have not installed or implemented that technology in your facility. Please also include the year that you installed or implemented the technology. **[PROGRAMMER: FILL IN TECHNOLOGY LIST BASED ON PIN NUMBER FOR TECHNOLOGIES INSTALLED ACCORDING TO FEAT].**

Technology	Installed in Facility? *[Dropdown: Yes/No/Don't Know]*	Year(s) Installed? *[OPTIONAL]*
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Yes/No/Don't Know]**	**[Open Ended]**

28. Our records indicate that the following technologies were recommended to you as part of NYSERDA's Agriculture Energy Audit Program, but you did not install them as of EnSave's last contact with you. For each technology, please indicate if you have or have not installed or implemented that technology in your facility since the technology was recommended to you. If you have installed or implemented a technology, please also include the year that you installed or implemented the technology. **[PROGRAMMER: FILL IN TECHNOLOGY LIST BASED ON PIN NUMBER FOR TECHNOLOGIES NOT INSTALLED ACCORDING TO FEAT].**

Technology	Installed in Facility? *[Dropdown: Did Not Install/Installed/Don't Know]*	Year(s) Installed? *[OPTIONAL]*
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**
[Fill in from FEAT]	**[Did Not Install/Installed/Don't Know]**	**[Open Ended]**

29. Have you installed any other energy efficient technologies in your agriculture facility that were not suggested in the audit?
    1. Yes
    2. No

30. **[IF Q29 = Yes, CONTINUE. OTHERWISE, SKIP TO Q33]** Please describe the energy efficient technologies you installed, including the year of installation.
    1. **[OPEN ENDED RESPONSE]**

31. Was your decision to install the additional technology(s) that were not suggested in the audit influenced in any way by your participation in NYSERDA's Agriculture Energy Audit Program?
    1. Yes
    2. No

32. Was your decision to install the additional technology(s) influenced in any way by receiving NYSERDA informational materials (e.g., best practice guides or case studies)?
    1. Yes
    2. No

33. Which of the financial resources below are you aware of for installing energy efficient technologies in the agriculture sector? *Select all that apply.*
    4. Federal incentives and assistance programs, such as the USDA Environmental Quality Incentives Program or USDA Rural Energy for America Program
    5. State incentives and assistance programs, such as programs offered by NYSERDA
    6. Utility programs, such as energy efficiency programs offered by National Grid, New York State Electric and Gas, Rochester Gas & Electric, Central Hudson Gas & Electric, or Con Edison.
    7. Other **[FILL IN]**
    8. None **[MUTUALLY EXCLUSIVE]**

34. **[IF Q33 = NONE, SKIP TO Q37. OTHERWISE, CONTINUE]** Other than the audit, have you ever participated in an energy efficiency program or received financial incentives from any of the following sources for an agriculture-related project?

Energy Efficiency Program Type	Yes (1)	No (2)
34_1. Federal	☐	☐
34_2. State (including NYSERDA)	☐	☐
34_3. Utility	☐	☐
34_4. Other **[FILL IN]**	☐	☐

35. **[IF Q27_Installed in Facility = NO FOR ALL TECHNOLOGIES SKIP TO Q37. PROGRAMMER: USE MENU FROM Q27_Installed in Facility = Yes, ONLY INCLUDE Q27_Installed in Facility ANSWERS THAT EQUAL YES. ONLY INCLUDE COLUMNS WHERE Q34=YES, DISREGARD OTHER]** For each type of technology you indicated you installed or implemented as a result of the NYSERDA audit, please indicate if you received federal incentives, state incentives, utility incentives, or no incentives to implement that technology. *Check all that apply.*

Technology	No Incentive Used (1)	Federal Incentive (2)	State Incentive (3)	Utility Incentive (4)
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐

36. **[IF Q28_Installed in Facility = NO FOR ALL TECHNOLOGIES SKIP TO Q37. PROGRAMMER: USE MENU FROM Q28_Installed in Facility = YES, ONLY INCLUDE Q28_Installed in Facility ANSWERS THAT EQUAL YES. ONLY INCLUDE COLUMNS WHERE Q34=YES, DISREGARD OTHER]** For each type of technology you indicated that you installed or implemented after EnSave's last contact with, please indicate if you received federal incentives, state incentives, utility incentives, or no incentives to implement that technology. *Check all that apply.*

Technology	No Incentive Used (1)	Federal Incentive (2)	State Incentive (3)	Utility Incentive (4)
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐
[Fill in from FEAT]	☐	☐	☐	☐

37. Is there anyone in the agriculture sector in New York State that we should talk to (e.g., lighting manufacturers, greenhouse growers, farmers, consultants, energy auditors, or utility representatives) about energy efficiency opportunities in the agriculture sector? If so, please provide their contact information (e.g., company, name, phone number, and e-mail).
    1. Name **[RECORD]**
    2. Company **[RECORD]**
    3. Phone number **[RECORD]**
    4. E-mail **[RECORD]**

38. Are you interested in receiving more information from NYSERDA about energy efficiency resources (e.g., best practice guides or case studies)? If so, please provide your contact information below.
    1. Name **[RECORD]**
    2. Company **[RECORD]**
    3. Phone number **[RECORD]**
    4. E-mail **[RECORD]**

TERMINATE 1: We appreciate your interest in taking the survey, however we are currently only reaching out to farmers and agricultural producers that have participated in NYSERDA's Agriculture Energy Audit Program. Thank you for your time. If you think you are receiving this message in error, please contact: NYSERDAsurvey@navigant.com.

TERMINATE 2: We appreciate your interest in taking the survey. This survey is intended for someone in your organization familiar with the NYSERDA Agriculture Energy Audit Program and the technologies in your facility that consume energy. We request that you please forward the survey to someone in your organization who is familiar with this. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 3: We appreciate your interest in taking the survey, but we are only reaching out to agricultural facilities in New York State that are currently in operation. If you think you are receiving this message in error, please contact: NYSERDAsurvey@navigant.com.

CLOSE: This concludes the survey. Thank you for your participation. If you have any questions about this survey or how your responses to this survey will be used, please contact: NYSERDAsurvey@navigant.com.

NAVIGANT
A Guidehouse Company

[GLASE] Non-Participant Lighting Chip, Fixture, and Controls Manufacturers Survey

AAET-Tech Services-GLASE Market Evaluation

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

FINAL: December 5, 2018

1. Introduction

This document includes Navigant's proposed sampling methodology and draft survey instrument for the [GLASE] Lighting Chip, Fixture, and Controls Manufacturers Survey.

Navigant will utilize Qualtrics to administer the online survey. APPRISE will complete surveys over the phone. The survey will be tested in advance of full deployment and may be modified after deployment to enhance the number of completed interviews. Compiled survey results will be presented to NYSERDA and summarized in the final report. Table 1 below identifies the survey characteristics.

Table 14: Survey Characteristics

Characteristics	Description
Statement of purpose	Gauge awareness of the GLASE Consortium, identify benefits and barriers to joining the GLASE Consortium, and gauge interest in joining the GLASE Consortium
Qualified respondent	Works for a company that manufactures LED chips, fixtures or lighting controls
Target number of completes	35
Estimated survey length	15 minutes
Survey timeline	Q4 2018 – Q1 2019

1.1 Draft of E-mail Language – Online Survey

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with this short survey

Reply to: NYSERDAsurvey@navigant.com

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to research lighting technologies that can be used in agricultural facilities, such as greenhouses and other controlled environment facilities where produce is grown. **As part of this research, we are reaching out to key lighting technology manufacturers like you to ask for your participation in a short survey.** This research will help NYSERDA to understand the lighting technology market and what resources are needed to support the use of efficient lighting technology in New York State's agricultural sector.

If you are interested in participating, click on the link below and enter your PIN number. The survey should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

Click here to take the survey

PIN number:

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

1.2 Draft of E-mail language – Phone Survey

From: Navigant/APPRISE

Sent: Date/timestamp

To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with a short interview

Reply to: Navigant/APPRISE

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to research lighting technologies that can be used in agricultural facilities, such as greenhouses and other controlled environment facilities where produce is grown. **As part of this research, we are reaching out to key lighting technology manufacturers like you to ask for your participation in a short survey.** This research will help NYSERDA to understand the lighting technology market and what resources are needed to support the use of efficient lighting technology in New York State's agricultural sector.

Do you have time either this week or next week for a brief interview on the topic? The interview should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Sincerely,

[Navigant/APPRISE Contact Information]

2. Survey

1. Welcome to the survey!

   This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA). Your input and information will help NYSERDA to understand the lighting technology market and what resources are needed to support the use of efficient lighting technology in New York State's agricultural sector.

   The survey should take you less than 15 minutes to complete. You can go back to previous responses at any point during the survey. However, you will not be able to leave the survey and return later once you begin. All of your responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

   If you have questions while you are taking the survey, please e-mail NYSERDAsurvey@navigant.com.

   Click the grey and white arrow on the bottom right to begin the survey.

2. How did you hear about this survey? **[PROGRAMMER: ALLOW MULTIPLE RESPONSES]**
   1. E-mail
   2. Phone call
   97. Other **[FILL IN]**

3. If you have a 7-digit PIN number, please enter it below. If not, please proceed to the next question. **[OPTIONAL]**
   1. **[RECORD NUMBER]**

4. Does your company manufacture lighting equipment or technology that can be used in greenhouses or other controlled environment agriculture facilities?
   1. Yes
   2. No **[SKIP TO TERMINATE]**

5. Which of the following technologies does your company manufacture? *Select all that apply*.
    1. LED fixtures
    2. LED chips/packages
    3. Lighting sensors and controls
    97. Other **[FILL IN]**

6. Do you sell this equipment in New York State, either to distributors or directly to customers?
    1. Yes
    2. No **[SKIP TO TERMINATE]**

7. Do you sell directly, through distributors, or both?
    1. Directly
    2. Through distributors
    3. Both

8. What is the name of your company? **[REQUIRED]**

    Note: Your survey responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable. The purpose of this question is to track who takes the survey.

    1. **[OPEN ENDED RESPONSE]**

9. Approximately how many full time equivalent employees work at your entire company?
    1. Less than 20
    2. 21 to 99
    3. 100 to 499
    4. 500 or more
    98. Don't know
    99. Prefer not to answer

10. What would you say is the most important lighting technology or system to increase the **energy efficiency** of greenhouses and other controlled environment agriculture facilities?
    1. **[OPEN ENDED RESPONSE]**

11. What would you say is the most important lighting technology or system to increase the **profitability** of greenhouses and other controlled environment agriculture facilities?
    1. **[OPEN ENDED RESPONSE]**

12. Have you heard of the *Greenhouse Lighting and Systems Engineering (GLASE) Consortium*?
    1. Yes
    2. No

Q39. GLASE is a partnership between Cornell University, Rensselaer Polytechnic Institute, the New York State Energy Research and Development Authority (NYSERDA), and other industry partners. The purpose of GLASE is to support the development of advanced lighting and control systems that are tailored to the needs of crops grown in controlled environment agriculture facilities, such as greenhouses. GLASE extends to all areas of the controlled environment agriculture lighting environment, integrating advances in LED light engineering, carbon dioxide enrichment, and lighting control systems.

13. **[IF Q12 = YES, CONTINUE. OTHERISE, SKIP TO Q16]** Is your company currently a member of the GLASE Consortium?
    1. Yes **[SKIP TO TERMINATE 2]**
    2. No

14. **[IF Q12 = YES, CONTINUE. OTHERISE, SKIP TO Q16]** How did you hear about the GLASE Consortium?
    1. GLASE meeting
    2. GLASE webinar
    3. GLASE e-mail
    4. Magazine
    5. Trade organization
    6. Colleague
    97. Other (please describe) **[FILL IN]**

15. Are you interested in participating in free GLASE initiatives, such as webinars or short courses? For example, GLASE recently put on a free webinar called "Funding Opportunities for Controlled Environment Agriculture Energy Efficiency."
    1. Yes
    2. No

16. Which of the following benefits of the GLASE Consortium would you find attractive? *Select all that apply.*
    1. Direct access to researchers specializing in lighting needs and lighting advancements in the agricultural sector
    2. Access to GLASE-developed intellectual properties and technologies
    3. Access to agricultural producers through trade shows and the GLASE newsletter

4. Validating the effectiveness of your products by vetting them with GLASE's trusted research team
97. Other benefit **[FILL IN]**
99. None **[MUTUALLY EXCLUSIVE]**

16_B. GLASE is exploring different research areas as part of its work. Which of these research areas would be of interest to you? *Select all that apply.* **[PROGRAMMER: SET LIST TO RANDOMIZE EACH TIME, EXCLUDING OTHER]**

5. The development of high efficiency dynamic LED systems
6. Spectrum or irradiance optimization and plant sensing
7. Energy efficacy and radiometry
8. Carbon dioxide enrichment studies
9. Experiments with lighting and control systems
10. Engineering and modeling of technologies and facilities
11. Piloting and demonstrating technologies in facilities
97. Other **[FILL IN]**

17. **[IF Q17 = 6 OR ONLY ONE OPTION WAS SELECTED, SKIP TO Q20. OTHERWISE, CONTINUE.]** You indicated you find the benefits listed below attractive. Please rank the benefits to indicate which is the most attractive, followed by the second most, etc. Drag the benefits to rank them in the order of attractiveness, with the most attractive at the top. **[PROGRAM AS RANK ORDER, CARRY FORWARD SELECTIONS FROM Q17]**

1. Direct access to researchers specializing in lighting needs and lighting advancements in the agricultural sector
2. Access to GLASE-developed intellectual properties and technologies
3. Access to agricultural producers through trade shows and the GLASE newsletter
4. Validating the effectiveness of your products by vetting them with GLASE's trusted research team
97. Other benefit **[FILL IN]**

18. What would you like to receive from the GLASE Consortium that is not currently provided or available?
    1. **[OPEN ENDED RESPONSE]**

19. Are you currently a member of any consortia that you pay to belong to?
    1. Yes
    2. No

20. **[IF Q21 = YES, CONTINUE. OTHERISE, SKIP TO Q25]** What is the name of the consortia you pay to belong to?
    1. **[OPEN ENDED RESPONSE]**

21. What benefits do the consortia you belong to offer?
    1. **[OPEN ENDED RESPONSE]**

22. What is the annual cost you pay to be a member in the consortia you belong to?
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

23. What annual membership cost would your company be willing to pay to receive the GLASE Consortium benefits? *Your best estimate is fine.*
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

24. **[IF Q9 = 1 AND Q25 < 5,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q27]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $5,000?
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

25. **[IF Q9 = 2 AND Q25 < 7,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q28]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $7,000?
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

26. **[IF Q9 = 3 AND Q25 < 15,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q29]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $15,000?
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

27. **[IF Q9 = 4 AND Q25 < 30,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q30]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $30,000?
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

28. What barriers, if any, do you see with joining the GLASE Consortium? *Select all that apply.*
    1. Costs for membership

2. Paperwork to apply for membership
3. Sharing information with competitors
4. Limited focus of GLASE on technologies we manufacture
5. Locations of meetings/events
97. Other (specify)

29. Where do you get information on the latest agriculture technologies, market updates, and news?
    1. **[OPEN ENDED RESPONSE]**

30. Is there anyone in the controlled environment agriculture industry in New York State that we should talk to (e.g., lighting manufacturers, greenhouse growers, consultants, energy auditors, or utility representatives) about energy efficiency opportunities in the agriculture sector? If so, please provide their contact information (e.g., company, name, phone number, and e-mail).
    1. **[OPEN ENDED RESPONSE]**

31. What contractors do you work with in New York State that install your lighting products in agriculture facilities?
    1. **[OPEN ENDED RESPONSE]**

32. Are you interested in receiving more information from NYSERDA about energy efficiency resources (e.g., best practice guides or case studies)? If so, please provide your contact information below.
    1. Name **[RECORD]**
    2. Company **[RECORD]**
    3. Phone number **[RECORD]**
    4. E-mail **[RECORD]**

TERMINATE: We appreciate your interest in taking the survey, but we are only reaching out to companies that manufacture and sell lighting equipment or technology that can be used in agriculture facilities in New York State. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 2: We appreciate your interest in taking the survey, but we are only reaching out to companies that are not currently members of the GLASE Consortium. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

CLOSE: This concludes the survey. Thank you for your participation. If you have any questions about this survey or how your responses to this survey will be used, please contact: NYSERDAsurvey@navigant.com.

NAVIGANT
A Guidehouse Company

[GLASE] Non-Participant Controlled Environment Agriculture Auxiliary Providers Survey

AAET-Tech Services-GLASE Market Evaluation

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

FINAL: January 23, 2019

1. Introduction

This document includes Navigant's proposed sampling methodology and draft survey instrument for the [GLASE] Non-Participant Controlled Environment Agriculture (CEA) Auxiliary Providers Survey.

Navigant will utilize Qualtrics to administer the online survey. APPRISE will complete surveys over the phone. The survey will be tested in advance of full deployment and may be modified after deployment to enhance the number of completed interviews. Compiled survey results will be presented to NYSERDA and summarized in the final report. Table 1 identifies the survey characteristics.

Characteristics	Description
Statement of purpose	Gauge the awareness of and interest in the Greenhouse Lighting Systems and Engineering (GLASE) Consortium. Ask about energy efficiency technologies available in the market, including benefits and barriers to adoption.
Qualified respondent	Individual who works at a company that provides services or products designed to improve energy efficiency in controlled environment agriculture facilities. [taken directly from email from Erico]
Target number of completes	70
Estimated survey length	15 minutes
Survey timeline	Q4 2018 – Q1 2019

1.1 Draft of E-mail Language – Online Survey

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with this short survey

Reply to: NYSERDAsurvey@navigant.com

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to conduct research on companies that provide services to agricultural companies and clients in New York State. **As part of this research, we are reaching out to select companies like you to ask for your participation in a short survey.** This research will help NYSERDA to understand the types of services companies like yours provide to New York State's agricultural sector, and what resources are needed to support your industry.

If you are interested in participating, click on the link below and enter your PIN number. The survey should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

Take the Survey

PIN number:

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

1.2 Draft of E-mail Language – Phone Survey

From: Navigant/APPRISE

Sent: Date/timestamp

To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with a short interview

Reply to: Navigant/APPRISE

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to conduct research on companies that provide services to agricultural companies and clients in New York State. **As part of this research, we are reaching out to select companies like you to ask for your participation in a short survey.** This research will help NYSERDA to understand the types of services companies like yours provide to New York State's agricultural sector, and what resources are needed to support your industry.

Do you have time either this week or next week for a brief interview? The interview should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Sincerely,

[Navigant/APPRISE Contact Information]

2. Survey

1. Welcome to the survey!

   This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA). Your input and information will help NYSERDA to understand the types of services companies like yours provide to New York State's agricultural sector and what resources are needed to support your industry.

   The survey should take you less than 15 minutes to complete. You can go back to previous responses at any point during the survey. However, you will not be able to leave the survey and return once you begin. All of your responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

   If you have questions while you are taking the survey, please e-mail NYSERDAsurvey@navigant.com.

   Click the grey and white arrow on the bottom right to begin the survey.

2. How did you hear about this survey? **[PROGRAMMER: ALLOW MULTIPLE RESPONSES]**
   1. E-mail
   2. Phone call
   97. Other **[FILL IN]**

3. If you have a 7-digit PIN number, please enter it below. If not, proceed to the next question. **[OPTIONAL]**
   1. **[RECORD NUMBER]**

4. Do you work with or provide services or products to agricultural customers that operate greenhouses or other controlled environment agriculture facilities in New York State?
   1. Yes
   2. No **[SKIP TO TERMINATE]**

5. Which of the following best describes the main services your company provides agricultural customers that operate greenhouses or other controlled environment agriculture facilities in New York State? Please select one.

   1. Consulting services
   2. Legal services

3. Energy audits
4. Insurance
5. Utility services (e.g., water, electricity, gas)
6. Marketing services
7. Supplier or distributor
97. Other **[FILL IN]**
99. My company does not provide services in New York State. **[SKIP TO TERMINATE]**

6. What is the name of your company? **[REQUIRED]**

Note: Your survey responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable. The purpose of this question is to track who takes the survey.

1. **[OPEN ENDED RESPONSE]**

7. Approximately how many full time equivalent employees work at your entire company?
    1. Less than 20
    2. 21 to 99
    3. 100 to 499
    4. 500 or more
    98. Don't know

8. Are you familiar with energy-related technologies used by controlled environment agriculture facilities, such as lighting and heating systems?
    1. Yes
    2. No

9. **[IF Q8 = 1, CONTINUE. OTHERWISE, SKIP TO Q12]** What products and systems are available in the market that can increase the **energy efficiency** of controlled environment agriculture facilities, such as greenhouses?
    1. **[OPEN ENDED RESPONSE]**

10. What products and systems are available in the market that can increase the **profitability** of controlled environment agriculture facilities?
    1. **[OPEN ENDED RESPONSE]**

11. What do you think is important for facility owners to consider when looking into energy efficient lighting and control system upgrades?

1. **[OPEN ENDED RESPONSE]**

12. Have you heard of the *Greenhouse Lighting and Systems Engineering (GLASE) Consortium*?
    1. Yes
    2. No

13. GLASE is a partnership between Cornell University, Rensselaer Polytechnic Institute, the New York State Energy Research and Development Authority (NYSERDA), and other industry partners. The purpose of GLASE is to support the development of advanced lighting and control systems that are tailored to the needs of crops grown in controlled environment agriculture facilities, such as greenhouses. GLASE extends to all areas of the controlled environment agriculture lighting environment, integrating advances in LED light engineering, carbon dioxide enrichment, and lighting control systems.

14. **[IF Q12 = YES, CONTINUE. OTHERISE, SKIP TO Q16]** Is your company currently a member of the GLASE Consortium?
    1. Yes **[SKIP TO TERMINATE 2]**
    2. No

15. **[IF Q12 = YES, CONTINUE. OTHERISE, SKIP TO Q16]** How did you hear about the GLASE Consortium?
    1. **[OPEN ENDED RESPONSE]**

16. Are you interested in participating in free GLASE initiatives, such as webinars or short courses? For example, GLASE recently put on a webinar called "Funding Opportunities for Controlled Environment Agriculture Energy Efficiency."

    1. Yes
    2. No

17. Which of the following benefits of the GLASE Consortium would you find attractive? *Select all that apply.*
    1. Access to GLASE members, including agricultural producers
    2. Quarterly technical reports
    3. Access to GLASE research data
    4. Access to energy modeling engine developed by GLASE for greenhouses and indoor farms
    5. Potential GLASE best practices endorsement
    97. Other benefits **[FILL IN]**
    99. None **[MUTUALLY EXCLUSIVE]**

18. **[IF Q17 = 7 OR ONLY ONE OPTION WAS SELECTED, SKIP TO Q19. OTHERWISE, CONTINUE.]** You indicated you find the benefits listed below attractive. Please rank the benefits to indicate which is the

most attractive, followed by the second most, etc. Drag the benefits to rank them in the order of attractiveness, with the most attractive at the top. **[PROGRAM AS RANK ORDER, CARRY FORWARD SELECTIONS FROM Q17]**

1. Access to GLASE members, including agricultural producers
2. Quarterly technical reports
3. Access to GLASE research data
4. Access to energy modeling engine developed by GLASE for greenhouses and indoor farms
5. Potential GLASE best practices endorsement

97. Other benefits **[FILL IN]**

19. GLASE is exploring different research areas as part of its work. Which of these research areas would be of interest to you? *Select all that apply.* **[PROGRAMMER: SET LIST TO RANDOMIZE EACH TIME, EXCLUDING OTHER]**
    1. The development of high efficiency dynamic LED systems
    2. Spectrum or irradiance optimization and plant sensing
    3. Energy efficacy and radiometry
    4. Carbon dioxide enrichment studies
    5. Experiments with lighting and control systems
    6. Engineering and modeling of technologies and facilities
    7. Piloting and demonstrating technologies in facilities

    97. Other **[FILL IN]**

20. What would you like to receive from the GLASE Consortium that is not already provided?
    1. **[OPEN ENDED RESPONSE]**

21. Are you currently a member of any consortia that you pay to belong to?
    1. Yes
    2. No

22. **[IF Q21 = YES, CONTINUE. OTHERISE, SKIP TO Q25]** What is the name of the consortia you pay to belong to?
    1. **[OPEN ENDED RESPONSE]**

23. What benefits do the consortia you belong to offer?
    1. **[OPEN ENDED RESPONSE]**

24. What is the annual cost you pay to be a member in the consortia you belong to?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

25. What annual membership cost would your company be willing to pay to receive the GLASE Consortium benefits? *Your best estimate is fine.*
    1. **[OPEN ENDED RESPONSE, NUMBER ONLY]**
    2. Don't know

26. **[IF Q7 = 1 AND Q25 < 5,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q27]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $5,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

27. **[IF Q7 = 2 AND Q25 < 7,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q28]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $7,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

28. **[IF Q7 = 3 AND Q25 < 15,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q29]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $15,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

29. **[IF Q7 = 4 AND Q25 < 30,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q30]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $30,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

30. What barriers do you see with joining the GLASE Consortium?
    1. Costs for membership
    2. Paperwork to apply for membership
    3. Sharing information with competitors
    4. Limited focus of GLASE on technologies we manufacture
    5. Locations of meetings/events
    97. Other (fill in)

31. What benefits do you see with adopting lighting and control systems developed by the GLASE Consortium?

    The GLASE Consortium is actively working on advanced energy-efficient lighting and control systems for controlled environment agriculture, designing high efficiency and dynamic LED systems, and pinpointing spectral combinations and intensities to optimize crop growth and biological efficacy.

1. **[OPEN ENDED RESPONSE]**

32. What barriers do you see with adopting lighting and control systems developed by the GLASE Consortium?
    1. **[OPEN ENDED RESPONSE]**

33. Where do you get information on the latest agriculture technologies, market updates, and news?
    1. **[OPEN ENDED RESPONSE]**

34. Is there anyone in the controlled environment agriculture industry in New York State that we should talk to (e.g., lighting manufacturers, greenhouse growers, consultants, energy auditors, or utility representatives) about energy efficiency opportunities in the agriculture sector? If so, please provide their contact information (e.g., company, name, phone number, and e-mail).
    1. **[OPEN ENDED RESPONSE]**

35. Which companies are you aware of that also provide services to agriculture companies in New York State?
    1. **[OPEN ENDED RESPONSE]**

36. Are you interested in receiving more information from NYSERDA about energy efficiency resources (e.g., best practice guides or case studies)? If so, please provide your contact information below.
    1. Name **[RECORD]**
    4. Company **[RECORD]**
    2. Phone number **[RECORD]**
    3. E-mail **[RECORD]**

TERMINATE: We appreciate your interest in taking the survey, but we are only reaching out to companies that provide services to agricultural operations in New York State and are not already members of the GLASE Consortium. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 2: We appreciate your interest in taking the survey, but we are only reaching out to companies that are not currently members of the GLASE Consortium. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

CLOSE: This concludes the survey. Thank you for your participation. If you have any questions about this survey or how your responses to this survey will be used, please contact: NYSERDAsurvey@navigant.com.

NAVIGANT
A Guidehouse Company

[GLASE] Non-Participant Controlled Environment Agriculture Facilities Survey

AAET-Tech Services-GLASE Market Evaluation

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

FINAL: January 23, 2019

1. Introduction

This document includes Navigant's proposed sampling methodology and draft survey instrument for the [GLASE] Non-Participant Controlled Environment Agriculture (CEA) Facilities Survey.

Navigant will utilize Qualtrics to administer the online survey. APPRISE will complete surveys over the phone. The survey will be tested in advance of full deployment and may be modified after deployment to enhance the number of completed interviews. Compiled survey results will be presented to NYSERDA and summarized in the final report. Table 1 identifies the survey characteristics.

Characteristics	Description
Statement of purpose	To understand controlled environment agriculture (CEA) growers' awareness of energy efficient technologies in the agriculture sector and gauge the awareness of and interest in the Greenhouse Lighting Systems and Engineering (GLASE) Consortium.
Qualified respondent	Controlled environment agriculture facility operating in New York State that is not currently a member of the GLASE Consortium.
Target number of completes	70
Estimated survey length	15 minutes
Survey timeline	Q4 2018 – Q1 2019

1.1 Draft of E-mail Language – Online Survey

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with this short survey

Reply to: NYSERDAsurvey@navigant.com

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to understand the awareness of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are reaching out to owners of greenhouses and controlled environment facilities where agricultural products are grown to ask for your participation in a short survey.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers, and to improve its programs and resources that support the agricultural industry in New York State.

If you are interested in participating, click on the link below and enter your PIN number. The survey should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

Take the Survey

PIN number:

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

1.2 Draft of E-mail Language – Phone Survey

From: Navigant/APPRISE

Sent: Date/timestamp

To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape agriculture energy efficiency in New York State with a short interview

Reply to: Navigant/APPRISE

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to understand the awareness of different energy technologies and resources in New York State's agriculture sector. **As part of this research, we are reaching out to owners of greenhouses and controlled environment facilities where agricultural products are grown to ask for your participation in a short survey.** This research will help NYSERDA to better understand the types of energy efficient technologies that are used by agriculture producers, and to improve its programs and resources that support the agricultural industry in New York State.

Do you have time either this week or next week for a brief interview on the topic? The interview should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Sincerely,

[Navigant/APPRISE Contact Information]

2. Survey

1. Welcome to the survey!
   This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA). Your input and information will help NYSERDA to better understand the types of energy efficient technologies and resources used in New York State's agricultural sector, and to improve its programs and resources that support the agricultural industry in New York State.

   The survey should take you less than 15 minutes to complete. You can go back to previous responses at any point during the survey. However, you will not be able to leave the survey and return later once you begin. All of your responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

   If you have questions while you are taking the survey, please e-mail NYSERDAsurvey@navigant.com.

   Click the grey and white arrow on the bottom right to begin the survey.

2. How did you hear about this survey? *Select all that apply.* **[PROGRAMMER: ALLOW MULTIPLE RESPONSES]**
   2. Postcard
   3. E-mail
   4. Phone call
   97. Other **[FILL IN]**

3. If you have a 7-digit PIN number, please enter it below. If not, proceed to the next question. **[OPTIONAL]**
   1. **[RECORD NUMBER]**

4. Does your company own or operate controlled environmental agriculture facilities, like greenhouses, in New York State where agricultural products are grown in a temperature-controlled environment?
   1. Yes
   2. No **[SKIP TO TERMINATE]**

5. How many controlled environmental agriculture facilities does your organization own or operate in New York State? Your best estimate is fine.
   1. **[RECORD NUMBER]**

6. What is the zip code of your primary or largest controlled environmental agriculture facility in New York State?
    1. **[RECORD NUMBER]**

7. What is the name of your company? **[REQUIRED]**

    Note: Your survey responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable. The purpose of this question is to track who already took the survey.

    1. **[OPEN ENDED RESPONSE]**

8. What types of crops do you grow in your controlled environmental agriculture facility or facilities located in New York State? *Select all that apply.* **[PROGRAMMER: SET LIST TO RANDOMIZE EACH TIME, EXCLUDING OTHER]**
    1. Leafy greens
    2. Lettuce
    3. Microgreens
    4. Ornamental
    5. Spinach
    6. Strawberries
    7. Tomatoes
    8. Cucumbers
    9. Peppers
    10. Herbs
    97. Other **[FILL IN]**

9. What is the total canopy area in square feet across all of your controlled environmental agriculture facilities in New York State? *For reference, 1 acre equals 43,560 square feet. Your best approximation is fine.*
    1. **[RECORD NUMBER]**
    2. Don't know

10. What type of lighting technologies are used in any of your controlled environmental agriculture facilities in New York State? *Select all that apply.*
    1. Fluorescent (e.g., linear, circline, cold cathode, compact, or induction)
    2. Halogen
    3. High or low pressure sodium
    4. Incandescent
    5. LED (e.g., screw-in, tube, or fixture/troffer)
    6. Mercury vapor
    7. Metal halide (e.g., pulse-start or standard)
    8. Natural lighting
    97. Other **[FILL IN]**

98. Don't know
99. No lighting is used in the controlled environmental agriculture facility/facilities

11. **[IF Q10 = 1, CONTINUE. OTHERWISE, SKIP TO Q12]** What type of **florescent** lighting technologies are used in any of your controlled environmental agriculture facilities in New York State? *Select all that apply.*
    1. Linear fluorescent T12
    2. Linear fluorescent T8
    3. Linear fluorescent T5
    4. Circline fluorescent
    5. Cold cathode fluorescent
    6. Compact fluorescent (CFL)
    97. Other **[FILL IN]**
    98. Don't know

12. **[IF Q10 = 3, CONTINUE. OTHERWISE, SKIP TO Q13]** What type of **high or low pressure sodium** lighting technologies are used in any of your controlled environmental agriculture facilities in New York State? *Select all that apply.*
    1. High pressure sodium
    2. Low pressure sodium
    97. Other **[FILL IN]**
    98. Don't know

13. **[IF Q10 = 5, CONTINUE. OTHERWISE, SKIP TO Q14]** What type of **LED** lighting technologies are used in any of your controlled environmental agriculture facilities in New York State? *Select all that apply.*
    1. Screw-in LED
    2. Tube LED
    3. LED fixture or troffer
    97. Other **[FILL IN]**
    98. Don't know

14. **[IF Q10 = 7, CONTINUE. OTHERWISE, SKIP TO Q15]** What type of **metal halide** lighting technologies are used in any of your controlled environmental agriculture facilities in New York State? *Select all that apply.*
    1. Pulse-start metal halide
    2. Standard metal halide
    97. Other **[FILL IN]**
    98. Don't know

15. **[If Q10 = 11, SKIP TO Q17. OTHERWISE, CONTINUE]** What time of year is the lighting usage highest in your controlled environmental agriculture facilities in New York State?
    1. January-March
    2. April-June
    97. July-August
    98. September-December

16. During the time of year when the lighting usage is highest in your controlled environmental agriculture facilities, what would you estimate is the average number of hours per day that the lights are on?
    1. **[RECORD NUMBER BETWEEN 0-24]**
    98. Don't know

17. How much electricity (in kWh) do you estimate your controlled environmental agriculture facility typically uses per month between November and February? If you have multiple controlled environmental agriculture facilities, please estimate an average.
    1. **[RECORD NUMBER]**
    98. Don't know

18. How much electricity (in kWh) do you estimate your controlled environmental agriculture facility typically uses per month between March and October? If you have multiple controlled environmental agriculture facilities, please estimate an average.
    1. **[RECORD NUMBER]**
    98. Don't know

19. Which of the following factors, if any, are important to your company when considering lighting and control system upgrades to your facilities? *Select all that apply.*
    1. Upfront costs for the equipment/project
    2. Payback period
    3. Energy efficiency of the equipment
    4. Light brightness, color, and range
    5. Lighting heat output
    6. Lighting equipment appearance
    7. Impact on crop yield
    8. Ease of use
    97. Other, please describe:

20. Where does your company get information on the latest agriculture technologies, market updates, and news?
    1. **[OPEN ENDED RESPONSE]**

21. This question asks about which energy efficient technologies you may have installed or implemented in your controlled environment agriculture facilities in New York State. For each type of technology, please indicate if you have installed or implemented that technology in any of your facilities in New York State. Please also include the year that you installed or

implemented the technology. If you installed the technology in multiple years, please list each year.

Technology	Installed in Facility [Bubbles: Yes/No/Don't Know]	Year(s) Installed? [OPTIONAL]
21_1. LED lighting and/or LED lighting controls	1. Yes 2. No 98.Don't Know	[Text field]
21_2. Efficient ventilation (building or barn)	1. Yes 2. No 98.Don't Know	[Text field]
21_3. Variable frequency drive (VFD) on pumps or fan motors (e.g., on transfer pumps, vacuum pumps, well pumps, or irrigation pumps)	1. Yes 2. No 98.Don't Know	[Text field]
21_4. High efficiency motors	1. Yes 2. No 98.Don't Know	[Text field]
21_5. Engine block heater timer	1. Yes 2. No 98.Don't Know	[Text field]
21_6. Compressed air efficiency improvements	1. Yes 2. No 98.Don't Know	[Text field]
21_7. Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment)	1. Yes 2. No 98.Don't Know	[Text field]
21_8. Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater)	1. Yes 2. No 98.Don't Know	[Text field]
21_9. Energy curtain (e.g., shade curtain or night cover)	1. Yes 2. No 98.Don't Know	[Text field]
21_97. Other **[FILL IN]**	1. Yes 2. No 98.Don't Know	[Text field]

22. Have you heard of NYSERDA's Agriculture Energy Audits program?
For reference: https://www.nyserda.ny.gov/All-Programs/Programs/Agriculture-Energy-Audit
    1. Yes
    2. No

23. **[IF Q22 = YES, CONTINUE. OTHERISE, SKIP TO Q24]** Have you participated in NYSERDA's Agriculture Energy Audits program?
    1. Yes **[SKIP TO TERMINATE 3]**
    2. No

24. Have you heard of the *Greenhouse Lighting and Systems Engineering (GLASE) Consortium*?
    3. Yes
    4. No

25. GLASE is a partnership between Cornell University, Rensselaer Polytechnic Institute, the New York State Energy Research and Development Authority (NYSERDA), and other industry partners. The purpose of GLASE is to support the development of advanced lighting and control systems that are tailored to the needs of crops grown in controlled environment agriculture facilities, such as greenhouses. GLASE extends to all areas of the controlled environment agriculture lighting environment, integrating advances in LED light engineering, carbon dioxide enrichment, and lighting control systems.

26. **[IF Q24 = YES, CONTINUE. OTHERISE, SKIP TO Q28]** Is your company currently a member of the GLASE Consortium?
    1. Yes **[SKIP TO TERMINATE 2]**
    2. No

27. **[IF Q24 = YES, CONTINUE. OTHERISE, SKIP TO Q28]** How did you hear about the GLASE Consortium?
    1. GLASE meeting
    2. GLASE webinar
    3. GLASE e-mail
    4. Magazine
    5. Trade organization
    6. Colleague
    97. Other (please describe) **[FILL IN]**

28. Are you interested in participating in free GLASE initiatives, such as webinars or short courses? For example, GLASE recently put on a webinar called "Funding Opportunities for Controlled Environment Agriculture Energy Efficiency."

    1. Yes
    2. No

29. Which of the following benefits of the GLASE Consortium would you find attractive? *Select all that apply*.
    1. Talk directly to GLASE's team of horticultural researchers
    2. Review GLASE's case studies, technical reports, and proof-of-concept trials before you decide on upgrades
    3. Use of membership to guide GLASE's research agenda
    4. Leverage GLASE's leading-edge innovations in integrated CO_2, lighting, and shade control systems to save operational costs
    97. Other Benefit **[FILL IN]**

98. None **[MUTUALLY EXCLUSIVE]**

30. **[IF Q29 = 6 OR ONLY ONE OPTION WAS SELECTED, SKIP TO Q32. OTHERWISE, CONTINUE.]** You indicated you find the benefits listed below attractive. Please rank the benefits to indicate which is the most attractive, followed by the second most, etc. Drag the benefits to rank them in the order of attractiveness, with the most attractive at the top. **[PROGRAM AS RANK ORDER, CARRY FORWARD RESPONSES FROM Q29]**
    1. Talk directly to GLASE's team of horticultural researchers
    2. Review GLASE's case studies, technical reports, and proof-of-concept trials before you decide on upgrades
    3. Use of membership to guide GLASE's research agenda
    4. Leverage GLASE's leading-edge innovations in integrated CO_2, lighting, and shade control systems to save operational costs
    97. Other benefit **[FILL IN]**

31. GLASE is exploring different research areas as part of its work. Which of these research areas would be of interest to you? *Select all that apply.* **[PROGRAMMER: SET LIST TO RANDOMIZE EACH TIME, EXCLUDING OTHER]**
    1. The development of high efficiency dynamic LED systems
    2. Spectrum or irradiance optimization and plant sensing
    3. Energy efficacy and radiometry
    4. Carbon dioxide enrichment studies
    5. Experiments with lighting and control systems
    6. Engineering and modeling of technologies and facilities
    7. Piloting and demonstrating technologies in facilities
    8. Other **[FILL IN]**

32. What would you like to receive from the GLASE Consortium that is not currently provided or available?
    1. **[OPEN ENDED RESPONSE]**

33. Are you currently a member of any consortia that you pay to belong to?
    1. Yes
    2. No

34. **[IF Q33 = YES, CONTINUE. OTHERISE, SKIP TO Q37]** What is the name of the consortia you pay to belong to?
    1. **[OPEN ENDED RESPONSE]**

35. What benefits do the consortia you belong to offer?
    1. **[OPEN ENDED RESPONSE]**

36. What is the annual cost you pay to be a member in the consortia you belong to?
    1. **[OPEN ENDED RESPONSE]**
    98. Don't know

37. What annual membership cost would your company be willing to pay to receive the GLASE Consortium benefits? *Your best estimate is fine.*
    4. **[OPEN ENDED RESPONSE, NUMBER ONLY]**
    5. Don't know

38. **[IF Q37 < 3,000 or Don't know, CONTINUE. OTHERWISE, SKIP TO Q39]** What benefits would your company need to receive to join the GLASE Consortium if the cost of annual membership was $3,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

39. What barriers, if any, do you see with joining the GLASE Consortium? *Select all that apply.*
    4. Costs for membership
    5. Paperwork to apply for membership
    6. Sharing information with competitors
    7. Limited focus of GLASE on technologies we manufacture
    8. Locations of meetings/events
    97. Other (specify)

40. What benefits do you see with adopting lighting and control systems developed by the GLASE Consortium?

    The GLASE Consortium is actively working on advanced energy-efficient lighting and control systems for controlled environment agriculture, designing high efficiency and dynamic LED systems, and pinpointing spectral combinations and intensities to optimize crop growth and biological efficacy.

    1. **[OPEN ENDED RESPONSE]**

41. What barriers do you see with adopting lighting and control systems developed by the GLASE Consortium?
    1. **[OPEN ENDED RESPONSE]**

42. ***This question was not included in 2018-19.*** Is your facility using a product or service produced by the GLASE Consortium?
    - GLASE Product/Service #1
    - GLASE Product Service #2
    - GLASE Product/Service #3

1. Yes
2. No
3. Don't know

43. Does anyone sell or service your greenhouse/CEA systems or provide energy efficient solutions to greenhouses/CEA facilities that you are aware of? If so, please provide their contact information (e.g., company, name, phone number, and e-mail). We are interested in speaking with service providers as part of this research effort.
    1. **[OPEN ENDED RESPONSE]**

44. Are you interested in receiving more information from NYSERDA about energy efficiency resources (e.g., best practice guides or case studies)? If so, please provide your contact information below.
    1. Name **[RECORD]**
    4. Company **[RECORD]**
    2. Phone number **[RECORD]**
    3. E-mail **[RECORD]**

TERMINATE: We appreciate your interest in taking the survey, but we are only reaching out to companies that operate controlled environment agriculture facilities in New York State. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 2: We appreciate your interest in taking the survey, but we are only reaching out to companies that are not currently members of the GLASE Consortium. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 3: We appreciate your interest in taking the survey, however we are currently only reaching out to companies that have not participated in NYSERDA's agriculture energy audit program. You may be contacted later for another survey about your past or current participation in NYSERDA's agriculture energy audit program. Thank you for your time. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com.

CLOSE: This concludes the survey. Thank you for your participation. If you have any questions about this survey or how your responses to this survey will be used, please contact: NYSERDAsurvey@navigant.com.

NAVIGANT
A Guidehouse Company

[GLASE] Non-Participant Retailers Survey

AAET-Tech Services-GLASE Market Evaluation

Prepared for:

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Submitted by:
Navigant Consulting, Inc.
1375 Walnut Street
Suite 100
Boulder, CO 80302

303.728.2500
navigant.com

FINAL: January 31, 2019

1. Introduction

This document includes Navigant's proposed sampling methodology and draft survey instrument for the [GLASE] Non-Participant Retailers Survey.

Navigant will utilize Qualtrics to administer the online survey. APPRISE will complete surveys over the phone. The survey will be tested in advance of full deployment and may be modified after deployment to enhance the number of completed interviews. Compiled survey results will be presented to NYSERDA and summarized in the final report. Table 1 identifies the survey characteristics.

Characteristics	Description
Statement of purpose	Gauge the awareness of and interest in the Greenhouse Lighting Systems and Engineering (GLASE) Consortium. Ask about energy efficiency technologies, including benefits and barriers to adoption.
Qualified respondent	Retailers with locations in New York State
Target number of completes	100
Estimated survey length	15 minutes
Survey timeline	Q4 2018 – Q1 2019

1.1 Draft of E-mail Language – Online Survey

From: Judeen Byrne <noreply@qemailserver.com>
Sent: Wednesday, September 12, 2018 11:46 AM
To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape energy efficiency in New York State with this short survey

Reply to: NYSERDAsurvey@navigant.com

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to understand how grocery and food retailers select produce to sell and what factors are important when choosing produce suppliers. **As part of this research, we are**

reaching out to grocery and food retailers like you who sell produce to ask for your participation in a short survey. This research will help NYSERDA to better understand your industry and what resources are needed to support produce supply in New York State.

If you are familiar with how your store or company selects produce to sell to your customers and you would like to participate, please click on the link below and enter your PIN number. If someone else in your organization is familiar with how your store or company selects the produce you sell to customers, we request that you please forward this e-mail to them. The survey should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

Take the Survey

PIN number:

If you encounter technical difficulties while taking the survey, contact NYSERDAsurvey@navigant.com. If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514.Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Thank you for your time and participation with this important research effort.

Sincerely,

Judeen Byrne

NYSERDA

judeen.byrne@nyserda.ny.gov

518-862-1090 extension 3514

Follow this link to the Survey

[Survey Link]

Follow the link to opt out of future emails:

[Opt out / click here to unsubscribe]

1.2 Draft of E-mail Language – Phone Survey

From: Navigant/APPRISE

Sent: Date/timestamp

To: John Doe <john.doe@gmail.com>
Subject: NYSERDA wants to hear from you – help shape energy efficiency in New York State with this short survey

Reply to: Navigant/APPRISE

Dear [Contact Name],

The New York State Energy Research and Development Authority (NYSERDA) is partnering with Navigant Consulting and APPRISE to understand how grocery and food retailers select produce to sell and what factors are important when choosing produce suppliers. **As part of this research, we are reaching out to grocery and food retailers like you who sell produce to ask for your participation in a short survey.** This research will help NYSERDA to better understand your industry and what resources are needed to support produce supply in New York State.

If you are familiar with how your store or company selects produce to sell to your customers and you would like to participate, do you have time either this week or next week for a brief interview? If someone else in your organization is familiar with how your store or company selects the produce you sell to customers, we request that you please forward this e-mail to them. The survey should take less than 15 minutes to complete. Your participation in this research effort would be greatly appreciated.

If you have questions about the legitimacy or purpose of the study, contact Judeen Byrne from NYSERDA at judeen.byrne@nyserda.ny.gov or 518-862-1090 extension 3514. Responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

Sincerely,

[Navigant/APPRISE Contact Information]

2. Survey

1. Welcome to the survey!

   This survey is being conducted on behalf of the New York State Energy Research and Development Authority (NYSERDA). Your input and information will help NYSERDA to understand how grocery and food retailers select produce to sell and what factors are important when choosing produce suppliers.

   The survey should take you less than 15 minutes to complete. You can go back to previous responses at any point during the survey. However, you will not be able to leave the survey and return once you begin. All of your responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable.

   If you have questions while you are taking the survey, please e-mail NYSERDAsurvey@navigant.com.

   Click the grey and white arrow on the bottom right to begin the survey.

2. How did you hear about this survey? **[PROGRAMMER: ALLOW MULTIPLE RESPONSES]**
   1. E-mail
   2. Phone call
   3. Other **[FILL IN]**

3. If you have a 7-digit PIN number, please enter it below. If not, proceed to the next question. **[OPTIONAL]**
   1. **[RECORD NUMBER]**

4. Does your company have grocery or food retail locations in New York State that sell produce?
   1. Yes
   2. No **[SKIP TO TERMINATE]**

5. Are you familiar with how your company selects produce to sell and what factors are important when choosing suppliers?
   1. Yes
   2. No **[SKIP TO Q37]**

6. What category of retail best describes your company?
   1. Grocery store
   2. Convenience store
   4. Other **[FILL IN]**

7. Which of the following best describes your company?

1. A national retail chain with many locations around the country.
2. A regional retail chain with many locations in the New York State area.
3. A retail store that is not part of a chain or franchise.

8. What is the name of your company? **[REQUIRED FIELD]**

Note: Your survey responses will be kept confidential to the extent permitted by law and reported in aggregate without individual respondents or firms identifiable. The purpose of this question is to track who already took the survey.

1. **[OPEN ENDED RESPONSE]**

9. Approximately how many full time equivalent employees work at your entire company?
   1. Less than 20
   2. 21 to 99
   3. 100 to 499
   4. 500 or more
   98. Don't know

The next several questions ask you about how your company approaches purchasing produce from suppliers.

10. **[IF Q7 = 1 OR 2, CONTINUE. OTHERWISE, SKIP TO Q11]** Who makes decisions related to selecting produce suppliers for your local stores in New York State?
    1. Decisions are made at the corporate level only.
    2. Decisions are made at the regional level only.
    3. Each store location makes the decision.

11. When considering a produce supplier, how important are the following for your company? **[PROGRAMMER: MAKE THE OPTIONS BELOW A TABLE]**
    1. Their prices **[Not important, Not Very important, Somewhat important, Very important]**
    2. Their product quality **[Not, Not Very, Somewhat, Very]**
    3. Their sustainability practices **[Not, Not Very, Somewhat, Very]**
    4. Their ability to supply locally sourced products **[Not, Not Very, Somewhat, Very]**

12. Does your company have any requirements related to the technology that your produce suppliers use to grow, store, or maintain the product they supply to you?
    1. Yes
    2. No
    3. Don't know

13. How important is it to your company that produce suppliers adopt new technologies to enhance the quality of the product and ensure consistent, year-long supply?
    1. Very important
    2. Somewhat important
    3. Not very important
    4. Not important

14. In the last year, would you say that customer demand for locally sourced produce has increased, decreased, or stayed about the same as one year ago?
    1. Increased
    2. Decreased
    3. Stayed the same

15. Does your company have retail locations that sell produce grown in controlled environmental agriculture facilities like greenhouses?
    1. Yes
    2. No
    3. Don't know

16. How interested is your company in resources to connect with potential suppliers of produce?
    1. Very interested
    2. Somewhat interested
    3. Not very interested
    4. Not interested

17. Have you heard of the Greenhouse Lighting and Systems Engineering (GLASE) Consortium?
    1. Yes
    2. No

18. GLASE is a partnership between Cornell University, Rensselaer Polytechnic Institute, the New York State Energy Research and Development Authority (NYSERDA), and other industry partners. The purpose of GLASE is to support the development of advanced lighting and control systems that are tailored to the needs of crops grown in controlled environment agriculture facilities, such as greenhouses. GLASE extends to all areas of the controlled environment agriculture lighting environment, integrating advances in LED light engineering, carbon dioxide enrichment, and lighting control systems.

19. **[IF Q17 = YES, CONTINUE. OTHERISE, SKIP TO Q21]** Is your company currently a member of the GLASE Consortium?
    1. Yes **[SKIP TO TERMINATE 3]**
    2. No

20. **[IF Q17 = YES, CONTINUE. OTHERISE, SKIP TO Q21]** How did you hear about the GLASE Consortium?
    1. GLASE meeting
    2. GLASE webinar

3. GLASE e-mail
4. Magazine
5. Trade organization
6. Colleague
7. Other (please describe) **[FILL IN]**

21. Which of the following benefits of the GLASE Consortium would you find attractive? *Select all that apply*.
    1. Direct access to local produce suppliers, farmers, and growers
    2. Supporting local farmers and produce suppliers
    3. Learning about new practices, research, and technology in agricultural production
    4. Other benefit **[FILL IN]**
    5. None **[MUTUALLY EXCLUSIVE]**

22. **[IF Q21 = 5 OR ONLY ONE OPTION WAS SELECTED, SKIP TO Q23. OTHERWISE, CONTINUE.]** You indicated you find the benefits listed below attractive. Please rank the benefits to indicate which is the most attractive, followed by the second most, etc. Drag the benefits to rank them in the order of attractiveness, with the most attractive at the top. **[PROGRAM AS RANK ORDER, CARRY FORWARD SELECTIONS FROM Q21]**
    1. Direct access to local produce suppliers, farmers, and growers
    2. Supporting local farmers and produce suppliers
    3. Learning about new practices, research, and technology in agricultural production
    4. Other benefit **[FILL IN]**

23. GLASE is exploring different research areas as part of its work. Which of these research areas would be of interest to you? *Select all that apply*. **[PROGRAMMER: SET LIST TO RANDOMIZE EACH TIME, EXCLUDING OTHER]**
    1. The development of high efficiency dynamic LED systems
    2. Spectrum or irradiance optimization and plant sensing
    3. Energy efficacy and radiometry
    4. Carbon dioxide enrichment studies
    5. Experiments with lighting and control systems
    6. Engineering and modeling of technologies and facilities
    7. Piloting and demonstrating technologies in facilities
    8. Other **[FILL IN]**

24. What would you like to receive from the GLASE Consortium that is not already provided?
    1. **[OPEN ENDED RESPONSE]**

25. Are you currently a member of any consortia that you pay to belong to?
    1. Yes
    2. No

26. **[IF Q25 = YES, CONTINUE. OTHERISE, SKIP TO Q29]** What is the name of the consortia you pay to belong to?
    1. **[OPEN ENDED RESPONSE]**

27. What benefits do the consortia you belong to offer?
    1. **[OPEN ENDED RESPONSE]**

28. What is the annual cost you pay to be a member in the consortia you belong to?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

29. What annual membership cost would your company be willing to pay to receive the GLASE Consortium benefits? *Your best estimate is fine.*
    1. **[OPEN ENDED RESPONSE, NUMBER ONLY]**
    2. Don't know

30. **[IF Q9 = 1 AND Q29 < 5,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q31]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $5,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

31. **[IF Q9 = 2 AND Q29 < 7,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q32]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $7,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

32. **[IF Q9 = 3 AND Q29 < 15,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q33]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $15,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

33. **[IF Q9 = 4 AND Q29 < 30,000 or = Don't know, CONTINUE. OTHERISE, SKIP TO Q34]** What benefits would your company need to receive to join the GLASE Consortium if the annual membership cost was $30,000?
    1. **[OPEN ENDED RESPONSE]**
    2. Don't know

34. What barriers, if any, do you see with joining the GLASE Consortium? *Select all that apply.*
    1. Costs for membership
    2. Paperwork to apply for membership
    3. Sharing information with competitors
    4. Limited focus of GLASE on technologies we manufacture
    5. Locations of meetings/events
    6. Other (specify)

35. We are interested in the relationship between retailers and the agricultural community in New York State. Is there anyone in the agriculture industry or who works with the agriculture industry in New York State that we should talk to (e.g., other retailers, lighting manufacturers, greenhouse growers, consultants, energy auditors, or utility representatives) about energy efficiency opportunities in the agriculture sector? If so, please provide their contact information (e.g., company, name, phone number, and e-mail).
    1. **[OPEN ENDED RESPONSE]**

36. Are you interested in receiving more information from NYSERDA about energy efficiency resources (e.g., best practice guides or case studies)? If so, please provide your contact information below.
    1. Name **[RECORD]**
    2. Company **[RECORD]**
    3. Phone number **[RECORD]**
    4. E-mail **[RECORD]**

    [SKIP TO CLOSE]

37. Can you provide contact information for the person at your company who is familiar with how your company selects produce to sell and what factors are important when choosing suppliers? *If you don't know, click the forward button to proceed.*
    1. Name **[RECORD]**
    2. Phone number **[RECORD]**
    3. E-mail **[RECORD]**

    [SKIP TO TERMINATE 2]

TERMINATE: We appreciate your interest in taking the survey, but we are only reaching out to retailers who sell produce in New York State. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 2: We appreciate your interest in taking the survey. This survey is intended for someone in your organization familiar with how your store or company selects the produce you sell to customers. We request that you please forward the survey to someone in your organization who is familiar with this. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

TERMINATE 3: We appreciate your interest in taking the survey, but we are only reaching out to companies that are not currently members of the GLASE Consortium. If you think you are receiving this in error, please contact: NYSERDAsurvey@navigant.com. Thank you.

CLOSE: This concludes the survey. Thank you for your participation. If you have any questions about this survey or how your responses to this survey will be used, please contact: NYSERDAsurvey@navigant.com.

Appendix E: Final Postcards

NYSERDA staff designed the postcards. A New York State professional printing, mailing & marketing vendor printed and mailed the postcards.

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17 Columbia Circle
Albany, NY 12203-6399

We Want To Hear From You

To complete the survey, please visit:
https://tinyurl.com/NYSERDAsurvey2

Your unique PIN:

Questions?

Contact Judeen Byrne at NYSERDA
judeen.byrne@nyserda.ny.gov
518-862-1090 x3514

For technical issues with survey, please email: **NYSERDAsurvey@navigant.com**

AG-survfarm-pc-1-v2 12/18


We Want to Hear from You
Participate in a very important survey of controlled environment agriculture facilities (like greenhouses) in New York State.
The New York State Energy Research and Development Authority (NYSERDA) is conducting a study with Navigant and APPRISE to understand the awareness of different energy technologies and resources in New York State's agriculture sector. We are reaching out to key agricultural producers to participate in a short survey.
Your input and information will help NYSERDA improve its programs and resources that support the agricultural industry in New York State.
The survey should take less than 15 minutes.
https://tinyurl.com/NYSERDAsurvey7
Your unique PIN:
Responses will be kept confidential to the extent permitted by law and reported in aggregate without identifying individual respondents or firms.
NEW YORK
STATE OF
OPPORTUNITY.
NYSERDA

NEW YORK STATE OF OPPORTUNITY. | NYSERDA
17 Columbia Circle
Albany, NY 12203-6399

We Want To Hear From You

To complete the survey, please visit:
https://tinyurl.com/NYSERDAsurvey7

Your unique PIN:

Questions?

Contact Judeen Byrne at NYSERDA
judeen.byrne@nyserda.ny.gov
518-862-1090 x3514

For technical issues with survey, please email: **NYSERDAsurvey@navigant.com**

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Appendix F: NYSERDA Agriculture Market Evaluation: Survey Methodology and Disposition

To: Judeen Byrne, NYSERDA

From: Beth Davis, Emily Merchant, and Jordan Mann, Navigant

Date: October 9, 2019

Re: **NYSERDA Agriculture Market Evaluation: Survey methodology and disposition**

The purpose of this memo is to outline the methodology Navigant employed to complete surveys as part of the Agriculture Market Evaluation. The market evaluation covered the following NYSERDA agriculture initiatives: Advancing Agriculture Energy Technologies (AAET), the Agriculture component of Commercial: Technical Services, and Greenhouse Lighting (Agriculture Technical Services) and Greenhouse Lighting and Systems Engineering (GLASE) Consortium.

1. Market Evaluation Surveys Overview

The market evaluation team, Navigant and APPRISE[9], completed 381 surveys with market actors between October 2018 and August 2019 (see Table 1). Most surveys targeted market actors who had not participated in a NYSERDA agriculture initiative (i.e., non-participants). The exception was for the FlexTech Agriculture Energy Audit Participants Survey, which targeted farms who had participated in a NYSERDA FlexTech Agriculture Energy Audit (i.e., participants). The team completed surveys with the following market actor groups:

AAET

- Non-Participant Farms Survey

Agriculture Technical Services

- FlexTech Agriculture Energy Audit Participants Survey

GLASE Consortium (GLASE)

[9] APPRISE was the phone survey contractor for this evaluation.

- Non-Participant Lighting Manufacturers Survey (includes Non-Participant Lighting Chip Manufacturers and Non-Participant Lighting Fixture Manufacturers)
- Non-Participant Controlled Environment Agriculture (CEA) Auxiliary Service Providers Survey
- Non-Participant CEA Facilities Survey
- Non-Participant Grocery Retailers Survey[10]

Table 15. Completed Surveys by Market Actor Group

Market Actor Group	Completed Surveys
Non-Participant Farms Survey	82
FlexTech Agriculture Energy Audit Participants Survey	180
Non-Participant Lighting Manufacturers Survey	21
Non-Participant Controlled Environment Agriculture (CEA) Auxiliary Service Providers Survey	39
Non-Participant CEA Facilities Survey	52
Non-Participant Grocery Retailers Survey[11]	7
Total	381

Source: Market evaluation team

The market evaluation team programmed all surveys using Qualtrics[12], an online survey platform. Respondents could complete the survey at their convenience using a link provided via the various outreach methods (e.g., email, postcard, organization's online post). APPRISE also called contacts and completed the survey over the phone with respondents if desired by respondents. APPRISE used the online survey link to complete the survey on the phone. Therefore, all survey responses were collected in the same format via Qualtrics.

For all surveys, the market evaluation team conducted pre-tests to test the survey outreach scripts and survey instrument. The team adjusted the scripts and survey instruments as needed based on the response and feedback received during the pre-tests.

[10] The market evaluation team started this survey, drafted the survey instrument, identified a sample frame, and completed seven pre-tests, but the team did not proceed after the pre-test because the GLASE leadership team decided to not include retailers as a focus for the GLASE Consortium.

[11] The market evaluation team started this survey, drafted the survey instrument, identified a sample frame, and completed seven pre-tests, but the team did not proceed after the pre-test because the GLASE leadership team decided to not include retailers as a focus for the GLASE Consortium. The market evaluation team did not analyze the data from these responses.

[12] www.qualtrics.com/Survey-Platform/Features

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2. Non-Participant Farms Survey

The market evaluation team completed 82 surveys with non-participant farms, which exceeded the target of 80 surveys. Table 2 details the survey characteristics, including the purpose of the survey, definition of a qualified respondent, targeted number of completes, achieved number of completes, median time in survey, and survey timeline.

Table 16. Non-Participant Farms Survey: Survey Characteristics

Characteristic	Description
Statement of purpose	To understand farmers' awareness of energy efficient technologies in the agriculture sector, incentives available for energy efficient technologies, and NYSERDA informational materials geared towards the agriculture sector.
Qualified respondent	A grower or farmer that has not participated in a NYSERDA agriculture program or demonstration site
Target number of completes	80
Completed surveys	82
Survey length (median)	9.2 minutes
Survey timeline	Q4 2018 – Q1 2019

Source: Market evaluation team

According to the 2017 Census of Agriculture, there are 33,438 farms in New York.[13] The sample frame for this market actor group included 29,537 records. The sample frame was primarily from InfoGroup data and New York State (NYS) tax data and was supplemented by NYSERDA and GLASE contacts. Due to the large sample frame and this market actor group being a hard to reach segment, the team developed a rigorous survey process.

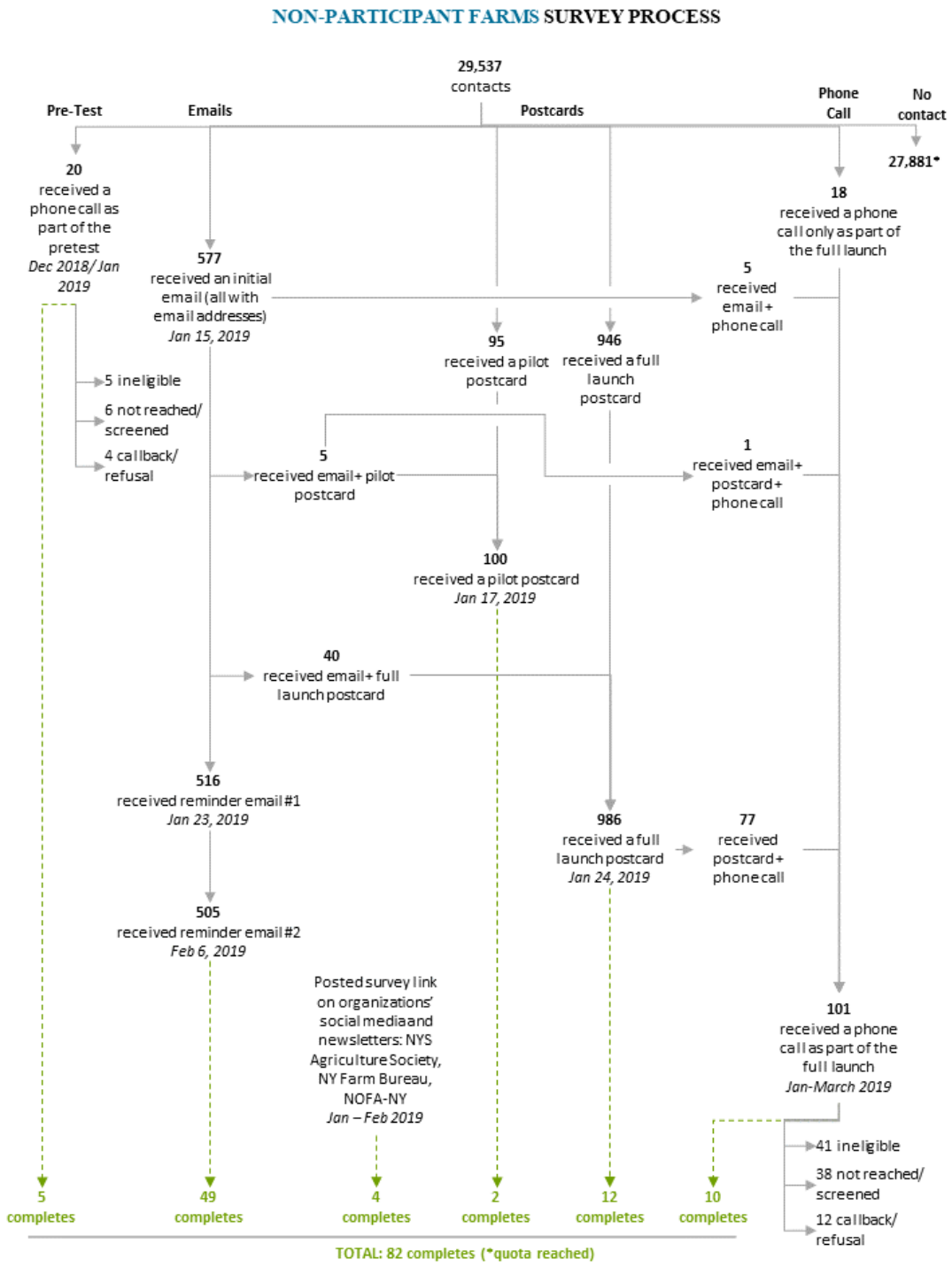
Figure 1 shows the Non-Participant Farms Survey process. The market evaluation team used a variety of outreach methods to solicit participation in the survey: phone calls, e-mails, postcards, and partnerships with trade organizations, including the NYS Agriculture Society, the NY Farm Bureau, and the Northeast

[13] 2017 Census of Agriculture, State Profile, New York, Available at https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/New_York/cp99036.pdf (accessed on September 10, 2019)

Organic Farming Association of New York (NOFA-NY). The market evaluation team contacted 20 farms for a pre-test (phone only). The pre-test led to five completed surveys which were included in the total survey completes. The additional sample received an email, postcard and/or phone call.

Due to the response rate achieved through the first round of sample, the market evaluation team did not need to send any additional postcards or contact any additional farms via telephone.

Figure 3. Non-Participant Farms Survey Process



Source: Market evaluation team

Survey disposition

Table 3 is a summary of the response rates by recruitment strategy for the Non-Participant Farms Survey. The phone surveys had the highest completion rate, followed by e-mail. Table 4 is the survey disposition for the phone surveys. The market evaluation team reached the targeted number of completes for the Non-Participant Farms Survey faster than any other non-participant market actor group, likely due to the use of multiple recruitment strategies, large sample frame available, and quality of the contact information.

Table 17. Non-Participant Farms Survey: Survey Recruitment Methods

Method	Contacted	Completes	Completion Rate	Notes
Postcards	1,086	14	1%	3.3% of postcards sent were returned
E-mail	577	49	8%	
Phone	121	15	12%	Includes both the Pre-Test and the Full Launch
Other	N/A	4	N/A	NY Farm Bureau newsletter: 3, NYS Ag Society Facebook post: 1

Note: Many farms were contacted via multiple methods. The completes are counted by the method in which they completed the survey – after receiving a postcard, online from an e-mail link, over the phone, or from a link due to an organizations' outreach. Refer to Figure 1 for details.

Source: Market evaluation team

Table 18. Non-Participant Farms Survey: Survey Disposition for the Phone Outreach (Pre-Test and Full Launch)

Disposition Results	Count	Percent
Total Sample Released	121	100%
Ineligible	*46*	
Ineligible - Screened Out Online	1	1%
Ineligible - Not in NY	1	1%
Ineligible - No Agriculture/Farm	19	16%
Ineligible – Program Participant	4	3%
Duplicate	1	1%
Nonworking Number	20	17%
Not Reached/Screened	*44*	
No Answer	16	13%

Disposition Results	Count	Percent
Left Message	26	21%
Not Available	2	2%
Eligible	*31*	
Callback	2	2%
Refusal	14	12%
Complete	15	12%
Summary		
Eligibility Rate		40%
Cooperation Rate		48%
Response Rate (AAPOR #3 – Assumes not reached are eligible at same portion as those reached)[14]		31%

Source: Market evaluation team

Survey challenges

The market evaluation team was able to reach the targeted number of completes with this market actor group quicker than any other non-participant surveys conducted in 2018-2019. However, the survey still had challenges. A summary of the challenges experienced during the survey deployment includes the following:

- **Survey timeframe**: The market evaluation team administered the survey over the winter because it is a less busy time of year for farmers; however, this strategy ended up resulting in a longer survey timeframe because many of the contacts were out of the office.
- **Duplicate contacts between sample sources**: The market evaluation team relied on New York State (NYS) tax data, InfoGroup data, and NYSERDA and GLASE contact data for developing the sample frame. The NYS tax data and InfoGroup data had overlapping contact information, which created challenges during the sample development because the market evaluation team only wanted to sample each company once.

[14] AAPOR values were calculated using the standard formulas developed by the Association for Public Opinion Research (AAPOR). AAPOR defines six different types of response rates. https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf

- **No phone numbers in NYS tax data**: The NYS tax data contained business name, address, NAICS code, and other miscellaneous information but it did not include contact information; therefore, the research team had to do a reverse lookup for phone numbers based on addresses. Both the InfoGroup[15] data and NYSERDA and GLASE contact data contained business name, address, and contact information (name, phone number, and e-mail).
- **InfoGroup data only had e-mails for 25% of contacts**: The InfoGroup data, which was a data source used for the sample frame, only had e-mail addresses for 25% of the contacts. The market evaluation team sent e-mails to all contacts with e-mails.

3. FlexTech Agriculture Energy Audit Participants Survey

The market evaluation team completed 180 surveys with NYSERDA FlexTech Agriculture Energy Audit participants, which exceeded the target of 78 surveys. The market evaluation team exceeded the goal by such a significant margin due to guidance from NYSERDA to try and achieve as close to a census of participants as possible, which is consistent with other measure adoption rate (MAR) survey efforts. Table 5 details the survey characteristics, including the purpose of the survey, definition of a qualified respondent, targeted number of completes, achieved number of completes, median time in survey, and survey timeline.

Table 19. FlexTech Agriculture Energy Audit Participants Survey: Survey Characteristics

Characteristics	Description
Statement of purpose	To understand farmers' awareness of energy efficient technologies in the agriculture sector, incentives available for energy efficient technologies, and NYSERDA informational materials geared towards the agriculture sector. To estimate indirect impacts.
Qualified respondent	A grower or farmer that has participated in the NYSERDA FlexTech Agriculture Energy Audit Program under the Clean Energy Fund and transition funding period and it has been over a year since their participation
Target number of completes	78

[15] InfoGroup is a database of contact information by region that is available for purchase. NYSERDA has access to InfoGroup data for NYS.

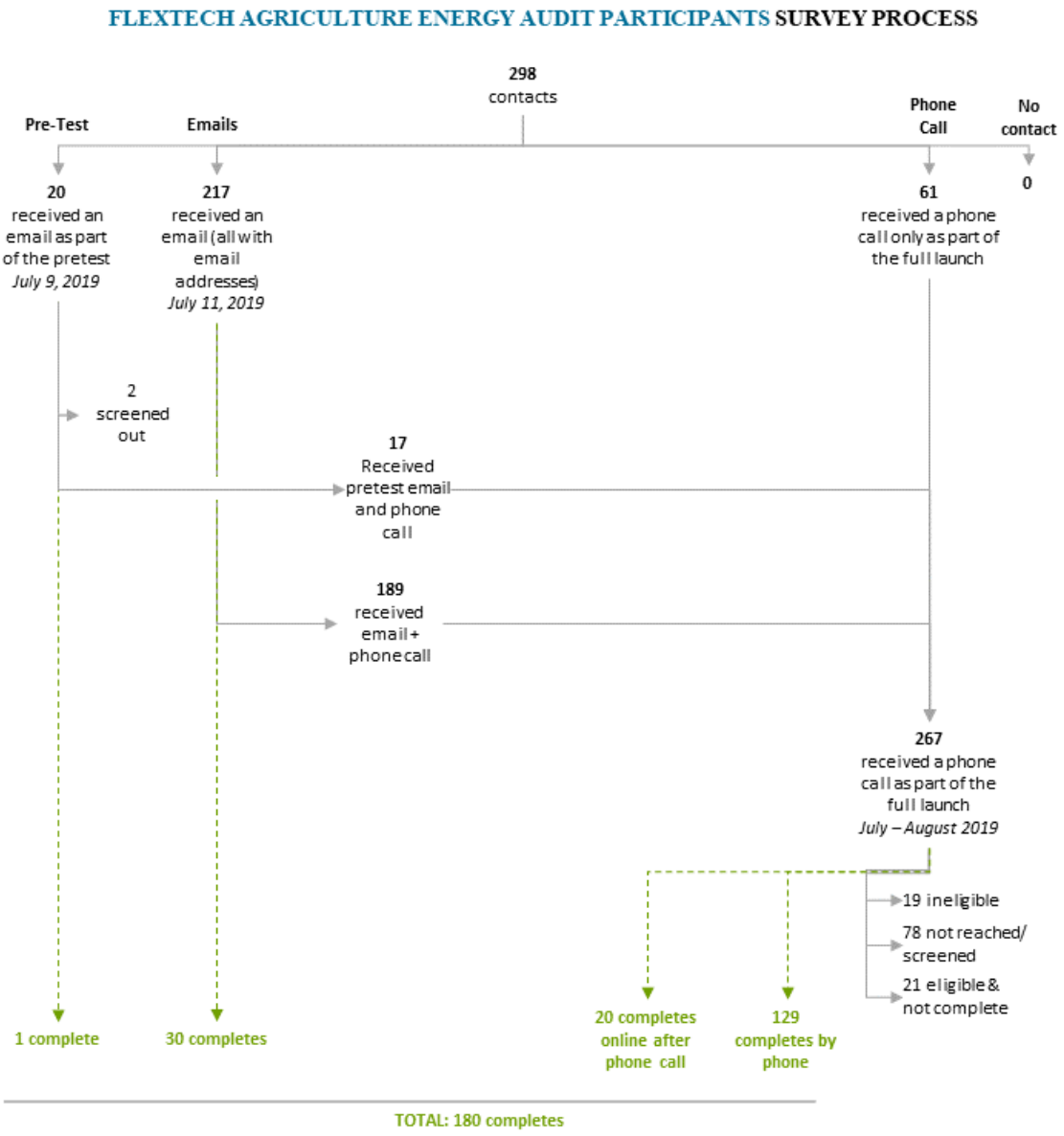
Characteristics	Description
Completed surveys	180
Survey length (median)	8.6 minutes
Survey timeline	Q2 2019 – Q3 2019

Source: Market evaluation team

The sample frame for this group was the NYSERDA FlexTech program participation data. Figure 2 shows the FlexTech Agriculture Energy Audit Participant Survey process. The market evaluation team used emails and phone calls to solicit participation in the survey.

The market evaluation team attempted to reach all contacts. The market evaluation team contacted 20 participants for a pre-test (e-mail only). The pre-test led to one completed survey which was included in the total survey completes. The market evaluation team also completed a full e-mail rollout to 217 contacts. All contacts with an e-mail address received an e-mail. After two weeks of launching the survey over e-mail, the market evaluation team supplemented e-mail outreach with phone calls to 267 contacts. The reason why the entire sample frame of 298 contacts was not released for the phone survey outreach is because some people had already taken the survey online.

Figure 4. FlexTech Agriculture Energy Audit Participants Survey Process



Source: Market evaluation team

Survey disposition

Table 6 is a summary of the response rates by recruitment strategy for the FlexTech Agriculture Energy Audit Participants Survey. The phone surveys had the highest completion rate, followed by e-mail. Table 7 is the survey disposition for the phone surveys.

Table 20. FlexTech Agriculture Energy Audit Participants Survey: Survey Recruitment Methods

Method	Contacted	Completes	Completion Rate
E-mail	237	51	22%
Phone	267	129	48%

Note: Many contacts received both an email and a phone call. The completes are counted by the method in which they completed the survey – online from an e-mail link or over the phone. Refer to Figure 2 for details.

Source: Market evaluation team

Table 21. FlexTech Agriculture Energy Audit Participants Survey: Survey Disposition for the Phone Outreach

Disposition Results	Count	%
Total Sample Released	267	100%
Ineligible	*19*	*7%*
Terminated - Ag. Facility No Longer Operational	6	2%
Terminated – Does not Recall Participation	2	1%
Ineligible - Out of Business	1	0%
Nonworking Number	2	1%
Ineligible - Screened Out Online	8	3%
Not Reached/Screened	*78*	*29%*
Left Message	56	21%
No Answer	11	4%
Not Available	2	1%
Scheduled Callback	0	0%
General Callback	3	1%
Soft Refusal	4	1%
Hard Refusal	2	1%
Eligible & Not Complete	*21*	*8%*
Left Message	5	2%
No Answer	2	1%

Not Available	0	0%
General Callback	7	3%
Scheduled Callback	1	0%
Soft Refusal	1	0%
Hard Refusal	4	1%
Partial Complete	1	0%
Eligible & Complete	*149*	*56%*
Complete - Online after Phone Call	20	7%
Complete - Phone	129	48%
Summary		
Eligibility Rate		90%
Response Rate (AAPOR #3) - Phone & Online Completes		62%
Response Rate (AAPOR #3) - Phone Completes		59%

Source: Market evaluation team

Survey challenges

This survey did not encounter any notable challenges. The survey deployment went smoothly because a higher percentage (93%) of the sample frame had e-mails and all respondents were aware of NYSERDA because they had previously participated in a FlexTech Agriculture Energy Audit. The only challenge was that the market evaluation team reached out to some people who had participated in a FlexTech Agriculture Energy Audit as far back as 2016, which may have impacted their ability to recall what energy efficiency measures they installed in the past three years. In addition, participants were more responsive to phone calls than e-mails, and phone calls are more time intensive to deploy than an email survey.

4. Non-Participant Lighting Manufacturers Survey

The market evaluation team completed 21 surveys with non-participant lighting manufacturers, which fell short of the original target of 35 surveys. However, the target was based on an initial understanding of the population and the market evaluation team is confident that the survey completes cover a majority of the key companies in this market actor group. Table 8 details the survey characteristics, including the purpose of the survey, definition of a qualified respondent, targeted number of completes, achieved number of completes, median time in survey, and survey timeline.

Table 22. Non-Participant Lighting Manufacturers Survey: Survey Characteristics

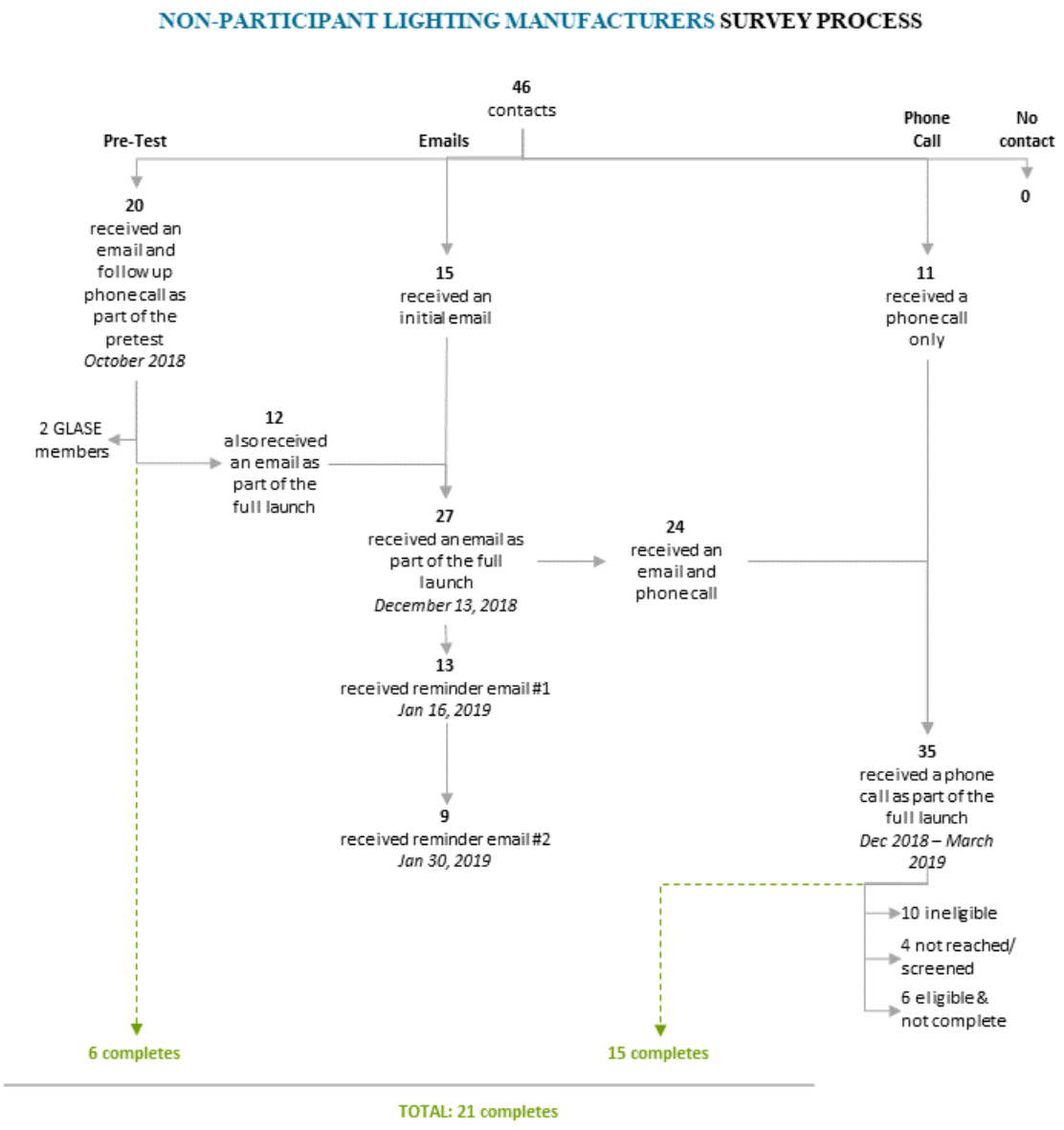
Characteristics	Description
Statement of purpose	Gauge awareness of the GLASE Consortium, identify benefits and barriers to joining the GLASE Consortium, and gauge interest in joining the GLASE Consortium
Qualified respondent	Works for a company that manufactures LED chips, fixtures or lighting controls to CEA facilities
Target number of completes	35
Completed surveys	21
Survey length (median)	30.1 minutes
Survey timeline	Q4 2018 – Q1 2019

Source: Market evaluation team

The sample frame for this group included both GLASE contacts and Navigant Research contacts. The small sample frame is due to the limited number of LED lighting manufacturers that sell products to CEA facilities. Figure 3 shows the Non-Participant Lighting Manufacturers Survey process. The market evaluation team used emails and phone calls to solicit participation in the survey.

The market evaluation team attempted to reach all contacts. The market evaluation team contacted 20 lighting manufacturers for a pre-test (e-mail and phone). The pre-test led to six completed surveys which were included in the total survey completes. The additional 26 contacts received an email and/or phone call depending on the contact information available. The market evaluation team sent emails to all contacts with an email address.

Figure 5. Non-Participant Lighting Manufacturers Survey Process



Source: Market evaluation team

Survey disposition

Table 9 is a summary of the response rates by recruitment strategy for the Non-Participant Lighting Manufacturers Survey. All surveys were completed over the phone. Table 10 is the survey disposition for the phone surveys.

Table 23. Non-Participant Lighting Manufacturers Survey: Survey Recruitment Methods

Method	Contacted	Completes	Completion Rate
E-mail	35	0	0%
Phone	55	21	38%

Note: Many contacts received both an email and a phone call. The completes are counted by the method in which they completed the survey – online from an e-mail link or over the phone. For this group, all surveys were completed over the phone even though respondents received emails and phone calls. One contact did not get a phone call because they were screened out via email. Refer to Figure 3 for details.
Source: Market evaluation team

Table 24. Non-Participant Lighting Manufacturers Survey: Survey Disposition for the Phone Outreach (excludes the Pre-Test)

Disposition Results	Count	Percent
Total Sample	35	100%
Ineligible	***10***	
Ineligible - Does Not Manufacturing Lighting Technology	5	14%
Ineligible - Does Not Manuf. Lighting Applicable for CEA	3	9%
Ineligible - GLASE Participant	2	6%
Not Reached/Screened	***4***	
Left Message/No Answer/Not Available - Reach Max Attempts	4	11%
Eligible	***21***	
Left Message/No Answer/Not Available – Reach Max Attempts	5	14%
Partial Complete	1	3%
Complete	15	43%
Summary		
Eligibility Rate		68%
Cooperation Rate		71%

Response Rate (AAPOR #3 – Assumes not reached are eligible at same portion as those reached)	63%
Response Rate (AAPOR #5 – Assumes not reached are not eligible)	71%

Note: The Total Sample count (35 contacts) for this survey excludes the pre-test. This table is also only for the APPRISE phone calls. APPRISE completed 10 of the 20 pre-tests. Navigant completed the other 10 pre-tests.

Source: Market evaluation team

Survey challenges

This survey was one of the most challenging to complete due to the following reasons:

- **Limited number of companies in the market**: There are not many LED lighting manufacturers that sell products to CEA facilities, which resulted in a limited sample frame. The market evaluation team was able to leverage Navigant Research and GLASE contacts, which helped to boost the success rate with reaching the high priority companies.
- **Identifying the right contact at each company**: Many of the lighting manufacturing companies (e.g., GE) have thousands of employees with locations all over the world, making it challenging to identify the right contact. The Navigant Research and GLASE contacts helped with this obstacle.
- **Completing the survey with contacts once they were identified**: People that work at lighting manufacturer companies are typically time constrained, and they are often contacted by researchers, which makes it difficult to reach them for surveys. The Navigant Research and GLASE contacts helped with this obstacle.

5. Non-Participant CEA Auxiliary Service Providers Survey

The market evaluation team completed 39 surveys with non-participant CEA auxiliary service providers, which fell short of the original target of 70 surveys. However, the target was based on an initial estimate of the population and the market evaluation team is confident that the survey completes cover a majority of the key companies in this market actor group. Table 11 details the survey characteristics, including the purpose of the survey, definition of a qualified respondent, targeted number of completes, achieved number of completes, median time in survey, and survey timeline.

Table 25. Non-Participant CEA Auxiliary Service Providers Survey: Survey Characteristics

Characteristics	Description
Statement of purpose	Gauge the awareness of and interest in the Greenhouse Lighting Systems and Engineering (GLASE) Consortium. Ask about energy efficiency technologies available in the market, including benefits and barriers to adoption.
Qualified respondent	Individual who works at a company that provides services or products designed to improve energy efficiency in controlled environment agriculture facilities.
Target number of completes	70
Completed Surveys	39
Survey length (median)	15.3 minutes
Survey timeline	Q4 2018 – Q2 2019

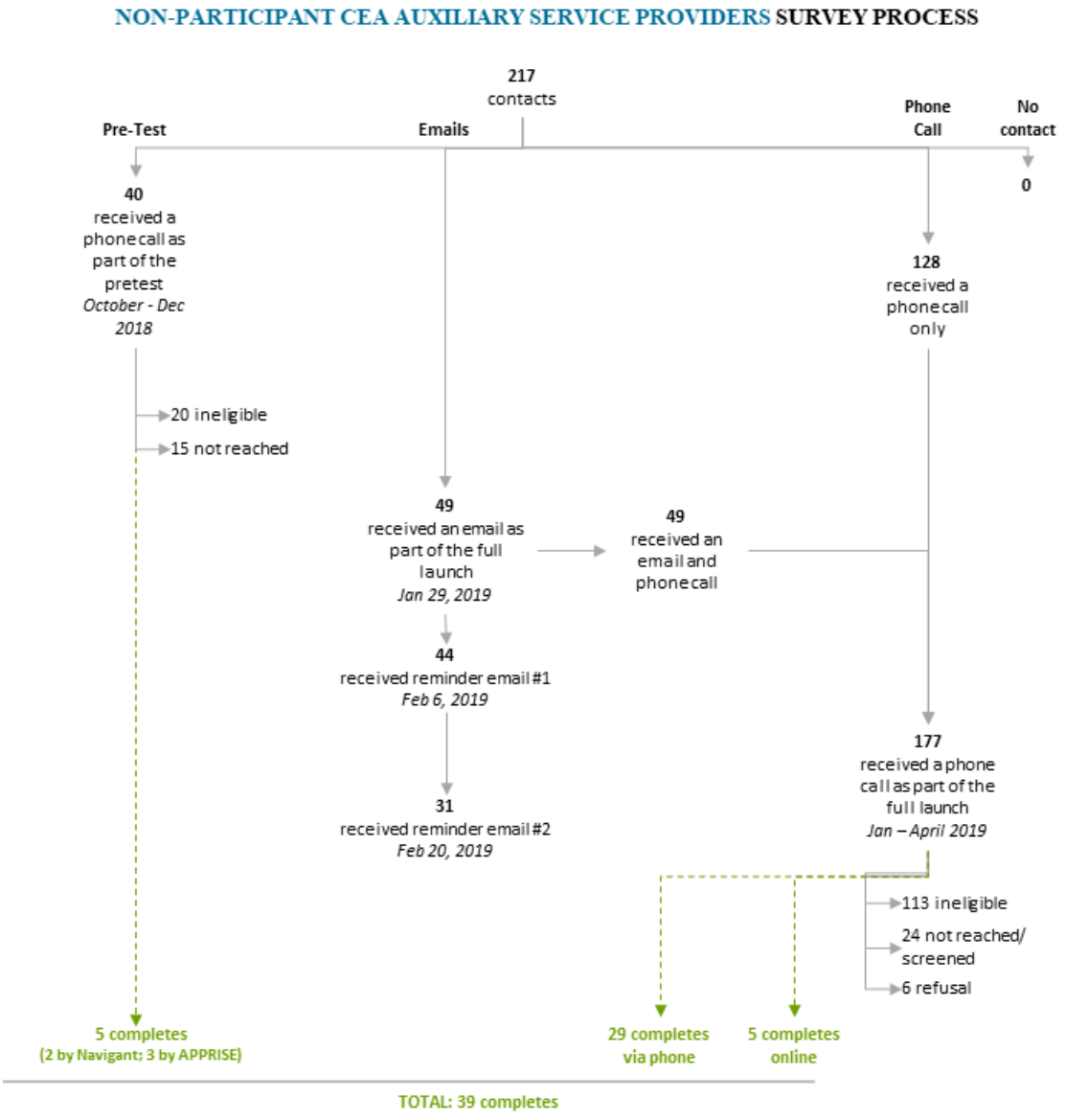
Source: Market evaluation team

The sample frame for this group included InfoGroup data, supplemented by EnSave[16] contacts, GLASE contacts, contacts from secondary research, and market evaluation team contacts. Figure 4 shows the Non-Participant CEA Auxiliary Service Providers Survey process. The market evaluation team used emails and phone calls to solicit participation in the survey.

The market evaluation team attempted to reach all contacts. The market evaluation team contacted 40 service providers for a pre-test (phone only). The pre-test led to five completed surveys which were included in the total survey completes. The additional 177 contacts received an email and/or phone call depending on the contact information available. The market evaluation team sent emails to all contacts with an email address.

[16] EnSave is a company that implements energy efficiency programs across the country, including many agriculture energy efficiency programs. EnSave is the implementer for the NYSERDA FlexTech Agriculture Energy Audit Program.

Figure 6. Non-Participant Auxiliary Service Providers Survey Process



Source: Market evaluation team

Survey disposition

Table 12 is a summary of the response rates by recruitment strategy for the Non-Participant CEA Auxiliary Service Providers Survey. The phone surveys had the highest completion rate, followed by e-mail. Table 13 is the survey disposition for the phone surveys.

Table 26. Participant CEA Auxiliary Service Providers Survey: Survey Recruitment Methods

Method	Contacted	Completes	Completion Rate
E-mail	49	5	10%
Phone	217	34	16%

Note: The completes via email were after the market evaluation team called the contact.
Source: Market evaluation team

Table 27. Participant CEA Auxiliary Service Providers Survey: Survey Disposition for the Phone Outreach (Pre-Test and Full Launch – APPRISE only)

Disposition Results	Count	Percent
Total Sample Released	215	100%
Ineligible	***136***	
Ineligible - Screened Out Online	5	2%
Ineligible - No Business/Customers in NY	10	5%
Ineligible - Not a Service Provider to CEA/AG	93	43%
Ineligible - GLASE Member	3	1%
Ineligible - Interviewed as Lighting Manufacturer	2	1%
Duplicate	2	1%
Nonworking Number	14	7%
Out of Business	6	3%
Wrong Company	1	0%
Not Reached/Screened	***33***	
No Answer / Left Message / MAX Attempts	33	15%
Eligible	***46***	
Not Available / Busy / MAX Attempts	3	1%
Refusal	6	3%
Completed Online	5	2%
Complete	32	15%
Summary		
Eligibility Rate		25%
Cooperation Rate		80%
Response Rate (AAPOR #3)		68%

Note: The total count (215) for phone outreach is from APPRISE's outreach to 128 contacts who only received a phone call, 49 contacts that received a phone call and an email, and 38 pre-test phone calls. Navigant completed two pre-test phone calls.
Source: Market evaluation team

Survey challenges

A summary of the challenges experienced during the survey deployment includes the following:

- **Challenging to identify a list of CEA service providers**: The primary challenge with this market actor group was in identifying companies that provide services to CEA facilities in NYS. The market evaluation team expected that the InfoGroup data may include companies that do not work with CEA facilities. Therefore, the market evaluation team added a question to the Non-Participant CEA Facilities Survey that asked about other companies in the agriculture industry in NYS. The market evaluation team also researched past attendees of CEA conferences and webinars to boost the sample frame. This resulted in a few additional contacts that were added to the non-participant CEA auxiliary service providers sample frame.
- **Many CEA facilities do not work with service providers**: The market evaluation team learned in the Non-Participant CEA Facilities Survey that few CEA facilities work with service providers. Many of the CEA facilities that do work with service providers listed the same one or two greenhouse suppliers.

6. Non-Participant CEA Facilities Survey

The market evaluation team completed 52 surveys with non-participant CEA facilities, which fell short of the original goal of 70 surveys. Table 14 details the survey characteristics, including the purpose of the survey, definition of a qualified respondent, targeted number of completes, achieved number of completes, median time in survey, and survey timeline.

Table 28. Non-Participant CEA Facilities Survey: Survey Characteristics

Characteristics	Description
Statement of purpose	To understand controlled environment agriculture (CEA) growers' awareness of energy efficient technologies in the agriculture sector and gauge the awareness of and interest in the Greenhouse Lighting Systems and Engineering (GLASE) Consortium.
Qualified respondent	Controlled environment agriculture facility operating in NYS that is not currently a member of the GLASE Consortium.
Target number of completes	70

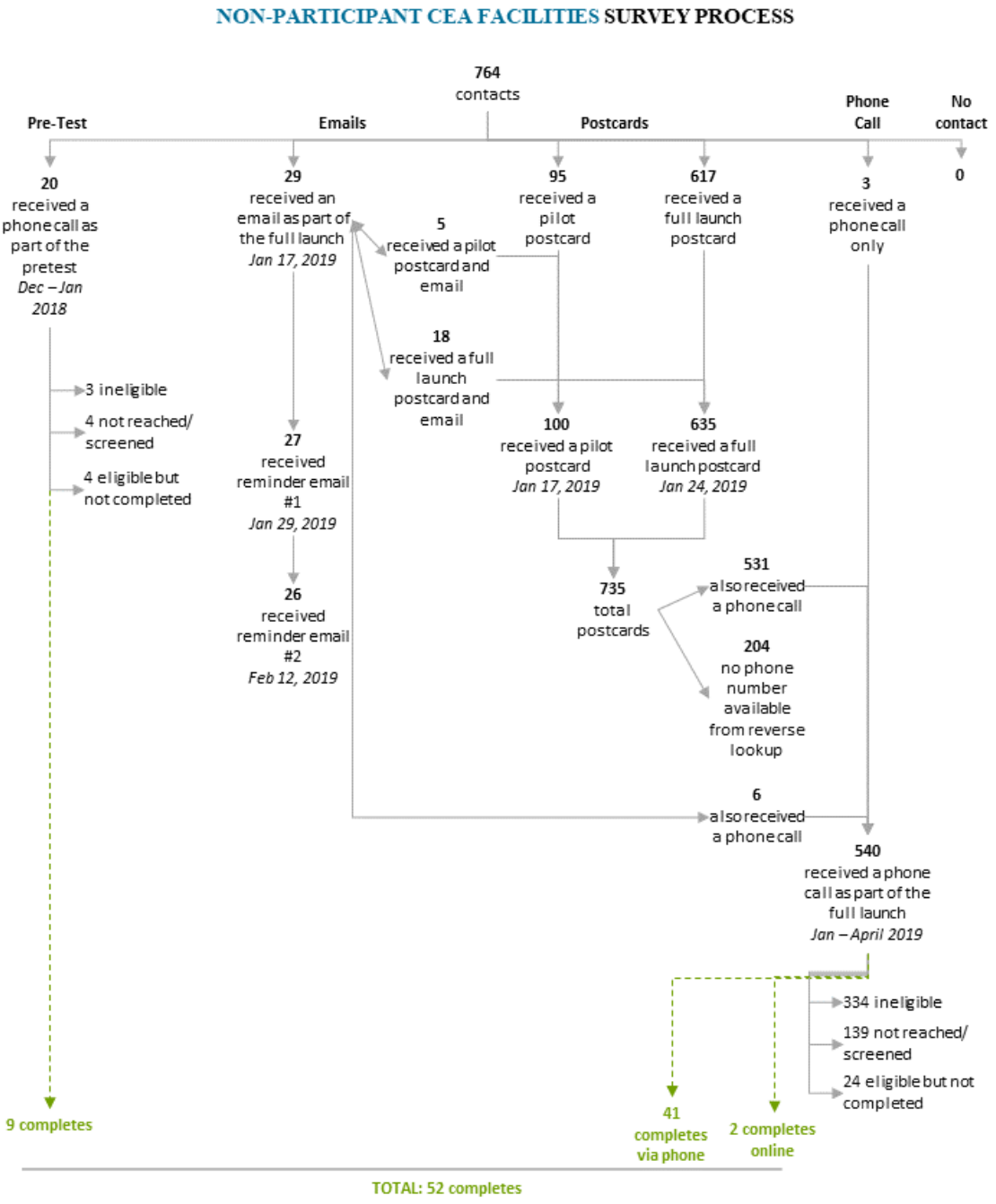
Characteristics	Description
Completed Surveys	52
Survey length (median)	18.9 minutes
Survey timeline	Q4 2018 – Q2 2019

Source: Market evaluation team

The sample frame included InfoGroup data and NYS tax data supplemented by NYSERDA and GLASE contacts. The sample was a subset of the Non-Participant Farm Survey sample; the greenhouses/CEA facilities in the overall sample were divided to either receive the Non-Participant Farms Survey or the Non-Participant CEA Facilities Survey. Figure 5 shows the Non-Participant CEA Facilities Survey process. The market evaluation team used emails, post cards, and phone calls to solicit participation in the survey.

The market evaluation team attempted to reach all contacts. The market evaluation team contacted 20 CEA facilities for a pre-test (phone only). The pre-test led to nine completed surveys which were included in the total survey completes. The additional contacts received an email, postcard, and/or phone call depending on the contact information available. The market evaluation team sent emails to all contacts with an email address.

Figure 7. Non-Participant CEA Facilities Survey Process



Source: Market evaluation team

Survey disposition

Table 15 is a summary of the response rates by recruitment strategy for the Non-Participant CEA Facilities Survey. The phone surveys had the highest completion rate. Table 16 is the survey disposition for the phone surveys.

Table 29. Non-Participant CEA Facilities Survey: Survey Recruitment Methods

Method	Contacted	Completes	Completion Rate	Notes
Postcards	735	1	<1%	6.2% of postcards sent were returned
E-mail	29	0	0%	
Phone	560	51	9%	

Note: All respondents with completed surveys received a phone call. Two respondents completed the survey on their own online (one respondent noted hearing about the survey from a postcard and completed online (counted as postcard in the table above); the other heard about the survey from a phone call and completed the survey online (counted as phone in the table above)).
Source: Market evaluation team

Table 30. Non-Participant CEA Facilities Survey: Survey Disposition for the Phone Outreach (Pre-test and Full Launch)

Disposition Results	Count	Percent
Total Sample Available for Calling	560	100%
Ineligible	***337***	
Ineligible - Not in NY	7	1%
Ineligible - Not CEA	170	30%
Ineligible - NYSERDA Audit Participant	11	2%
Duplicate	20	4%
Nonworking Number	102	18%
Out of Business	17	3%
Wrong Number	10	2%
Not Reached/Screened	***143***	
No Answer / Left Message / MAX Attempts	81	14%
Refusal	62	11%
Eligible	***80***	
Not Available / Busy / MAX Attempts	13	2%
General Callback	6	1%
Soft Refusal	7	1%

Disposition Results	Count	Percent
Partial Complete (Dropped off)	2	0%
Completed Online	2	0%
Complete	50	9%
Summary		
Eligibility Rate		19%
Cooperation Rate		65%
Response Rate (AAPOR #3)		48%

Note: The total sample available for calling (560 contacts) is the count of the pre-test sample (20 contacts) plus the full launch sample (540 contacts).
Source: Market evaluation team

Survey challenges

A summary of the challenges experienced during the survey deployment includes the following:

- **Small sample frame**: The sample frame for this group was only 764 contacts due to needing to assign some of the CEA facilities the non-participant farms survey instead of the non-participant CEA facilities survey. The market evaluation team reached out to all CEA facilities identified through the NYS tax data and InfoGroup data, thus exhausting the sample frame.
- **Survey timeframe overlapped with offseason**: Many of the CEA facilities asked the team to call back in March or April when things start picking up for them again. The market evaluation team concluded that December-March is considered the offseason for some CEA facilities in NYS.
- **High percentage of postcards were returned**: Interestingly almost twice as many postcards sent to CEA facilities were returned as compared to postcards sent to farms. The takeaway from this is that the CEA facilities contact information was not as reliable as the farms (both the address and facility type).
- **Lower response rate than farms**: The market evaluation team experienced a lower response rate for CEA facilities than non-participant farms, likely due to finding that many of the companies in the CEA facilities sample were not CEA facilities. In addition, the timeframe of the survey overlapped with a downtime for CEA facilities in NYS.

- **Higher ineligibility rate than expected**: The market evaluation team found that many of the companies identified in the NYS tax data and InfoGroup data were either not CEA facilities at all or did not have locations in NYS.
- **No phone numbers for NYS tax data**: The NYS tax data, which was a data source used for the sample frame, did not have phone numbers listed so the market evaluation team had to do a reverse lookup based on address.

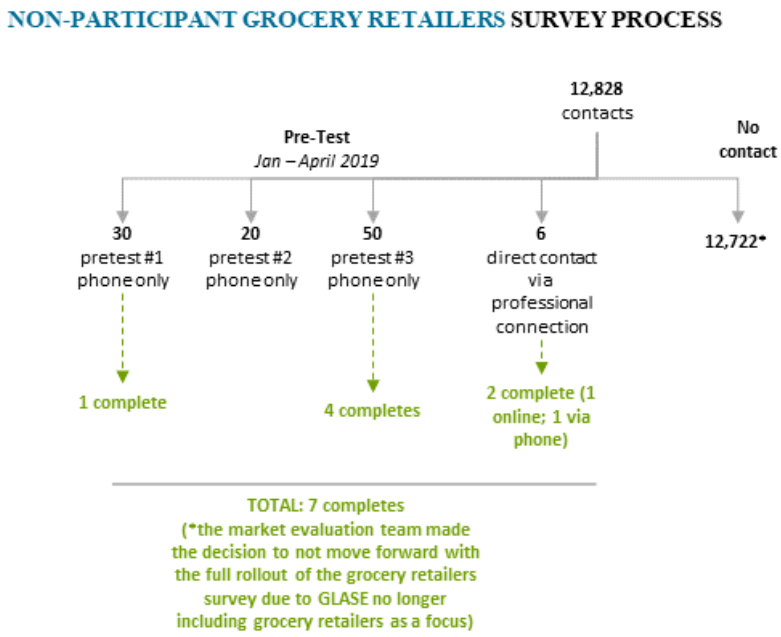
7. Non-Participant Grocery Retailers Survey

The market evaluation team intended to complete 100 surveys with non-participant grocery retailers. However, the team closed the survey after achieving seven completes due to the GLASE Consortium deciding to no longer include this market actor as a focus.[17]

The sample frame for this group included InfoGroup data and professional contacts. Figure 6 shows the Non-Participant Grocery Retailers Survey process. The market evaluation team conducted a pre-test with 106 contacts (e-mail and phone) over the course of four waves (wave 1 = 30 contacts, wave 2 = 20 contacts, wave 3 = 50 contacts, and wave 4 = 6 contacts). The pre-test led to seven completed surveys. The market evaluation team completed multiple waves of pre-tests because it was more difficult than expected to get the desired five completes during the pre-test.

[17] Depending on the direction of the GLASE Consortium, there may still be value in engaging produce managers in the discussion of energy efficiency in CEA facilities. If this is a strategy in the future, working with the Product Marketing Association may be one way to reach produce managers. Produce Marketing Association is a trade organization representing companies from every segment of the global fresh produce and floral supply chain. PMA helps members grow by providing connections that expand business opportunities and increase sales and consumption. Members of the team met with the executive director of the PMA at a conference in April of 2019. Other ways to reach this group may be through an article in a trade magazine, a newsletter, or a talk at the PMA conference.

Figure 8. Non-Participant Grocery Retailers Survey Process



Source: Market evaluation team

Survey disposition

Table 17 is a summary of the response rates by recruitment strategy for the Non-Participant Grocery Retailers Survey. Table 18 is the survey disposition for the phone surveys.

Table 31. Non-Participant Grocery Retailers Survey: Survey Recruitment Methods

Method	Contacted	Completes	Completion Rate
Phone	105*	6	6%
E-mail	6	1	17%

**One respondent completed the survey online before being contacted by phone.*
Source: Market evaluation team

Table 32. Non-Participant Grocery Retailers Survey: Survey Disposition for the Phone Outreach

Disposition Results	Count	Percent
Total Pre-test Sample	105*	100%
Ineligible	***46***	
Ineligible - Not Retailer	13	12%
Ineligible - No Produce	17	16%
Ineligible - Out of Business	1	1%
Non-Working Number	15	14%
Not Reached/Screened	***22***	
No Answer / Left Message	20	19%
Gatekeeper Refusal	2	2%
Eligible	***37***	
Refusal	15	14%
Not Available	15	14%
Unable to Direct Call to Right Person	1	1%
Complete	6	6%
Summary		
Eligibility Rate		45%
Cooperation Rate		16%
Response Rate (AAPOR #3)		13%

**One respondent completed the survey online before being contacted by phone.*
Source: Market evaluation team

Survey challenges

Surveys with this market actor group proved the most difficult due to the following reasons:

- **Complex organizations**: Many of the grocery retailers were large chains with hundreds of locations and thousands of employees. Therefore, it was difficult to identify the right contact for administering the survey (via a web search or the phone directory). Often the correct contact was not in NYS and worked in a corporate headquarters in another state. In addition, the market evaluation team encountered many retailers that refused to provide the contact information for their produce managers.
- **Time constrained contacts**: Produce managers and people in a management positions at a grocery retail chain are often very time constrained, making it difficult to reach them even with their contact information.

- **GLASE shifted focus for this market actor group during the pre-test**: Partway through the pre-test the market evaluation team learned that GLASE was narrowing its focus to just grocery retailers instead of all retailers (e.g., home improvement stores, convenience stores, and grocery stores). A few weeks later, after the Produce Marketing Association conference, the market evaluation team learned that GLASE was no longer going to market the GLASE Consortium to grocery retailers.
- **Grocery stores listed more than once in InfoGroup data**: The market evaluation team wanted each grocery retailer to take the survey once, thus the team had to remove duplicates from the sample frame.

8. Sampling Summary

The market evaluation team submitted the sample design methodology to NYSERDA in a memo dated September 17, 2018; it will be included as an appendix in the final report. This section provides updated details around the process the market evaluation team used to pull the sample for the surveys.

Non-Participant Farms Survey and the Non-Participant CEA Facilities Survey

The sample process for the Non-Participant Farms Survey and the Non-Participant CEA Facilities Survey followed the same approach. The sample frame included data from a variety of data sources, including Infogroup data, NYS tax data, NYSERDA contacts, and GLASE contacts. These data sources were combined and then filtered based on the following criteria:

- Only farms of interest were included. See Table 19 and Table 20 for a summary of the NAICS codes included in the sample frame.
- NYSERDA program participants were excluded.
- Contacts on the "do not call" list[18] were excluded.
- GLASE members were excluded.

After combining and filtering contacts, the market evaluation team removed duplicate addresses. Where duplicate addresses existed, the first record from the data source was used.

[18] NYS customers that request to not be contacted for NYSERDA initiatives get added to the do not call list. The research team took this into account when developing the sample for each survey.

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Table 33. NAICS Codes Included for the Non-Participant Farms Survey

NAICS Code	NAICS Code Description
11115001	CORN FARMING
11121901	OTHER VEGETABLE (EXCEPT POTATO) & MELON FARMING
11121902	OTHER VEGETABLE (EXCEPT POTATO) & MELON FARMING
11199803	ALL OTHER MISCELLANEOUS CROP FARMING
11199807	ALL OTHER MISCELLANEOUS CROP FARMING
11142103	NURSERY & TREE PRODUCTION
11133902	OTHER NONCITRUS FRUIT FARMING
11299013	ALL OTHER ANIMAL PRODUCTION
11199801	ALL OTHER MISCELLANEOUS CROP FARMING
11212001	DAIRY CATTLE & MILK PRODUCTION
11212002	DAIRY CATTLE & MILK PRODUCTION
11292001	HORSE & OTHER EQUINE PRODUCTION
11141902	OTHER FOOD CROPS GROWN UNDER COVER
11142102	NURSERY & TREE PRODUCTION
11142104	NURSERY & TREE PRODUCTION
11142106	NURSERY & TREE PRODUCTION
11199808	ALL OTHER MISCELLANEOUS CROP FARMING
11234001	POULTRY HATCHERIES
11142202	FLORICULTURE PRODUCTION
11211101	BEEF CATTLE RANCHING & FARMING
11199806	ALL OTHER MISCELLANEOUS CROP FARMING
11114001	WHEAT FARMING
11211201	CATTLE FEEDLOTS
11133201	GRAPE VINEYARDS
11299003	ALL OTHER ANIMAL PRODUCTION
11299017	ALL OTHER ANIMAL PRODUCTION
11291001	APICULTURE
11141101	MUSHROOM PRODUCTION
11133103	APPLE ORCHARDS
11199802	ALL OTHER MISCELLANEOUS CROP FARMING
11299006	ALL OTHER ANIMAL PRODUCTION
11199809	ALL OTHER MISCELLANEOUS CROP FARMING
11299001	ALL OTHER ANIMAL PRODUCTION

NAICS Code	NAICS Code Description
11299014	ALL OTHER ANIMAL PRODUCTION
11133101	APPLE ORCHARDS
11211103	BEEF CATTLE RANCHING & FARMING
11299004	ALL OTHER ANIMAL PRODUCTION
11119901	ALL OTHER GRAIN FARMING
11133401	BERRY (EXCEPT STRAWBERRY) FARMING
11199804	ALL OTHER MISCELLANEOUS CROP FARMING
11239004	OTHER POULTRY PRODUCTION
11241003	SHEEP FARMING
11299002	ALL OTHER ANIMAL PRODUCTION
11133901	OTHER NONCITRUS FRUIT FARMING
11121101	POTATO FARMING
11133104	APPLE ORCHARDS
11133502	TREE NUT FARMING
11221002	HOG & PIG FARMING
11231001	CHICKEN EGG PRODUCTION
11232001	BROILERS & OTHER MEAT TYPE CHICKEN PRODUCTION
11239001	OTHER POULTRY PRODUCTION
11239005	OTHER POULTRY PRODUCTION
11241002	SHEEP FARMING
11251901	OTHER AQUACULTURE
11251906	OTHER AQUACULTURE
11293004	FUR-BEARING ANIMAL & RABBIT PRODUCTION
11299007	ALL OTHER ANIMAL PRODUCTION
11299015	ALL OTHER ANIMAL PRODUCTION
31213001	WINERIES
31213002	WINERIES

Source: Market evaluation team

Table 34. NAICS Codes Included for the Non-Participant CEA Facilities Survey

NAICS Code	NAICS Code Description
11142103	NURSERY & TREE PRODUCTION
11141902	OTHER FOOD CROPS GROWN UNDER COVER
11142102	NURSERY & TREE PRODUCTION
11142104	NURSERY & TREE PRODUCTION
11142106	NURSERY & TREE PRODUCTION
11142103	NURSERY & TREE PRODUCTION

Source: Market evaluation team

Agriculture Technical Services FlexTech Energy Audit Participants Survey

The market evaluation team compiled a sample frame from data provided by EnSave for the FlexTech Agriculture Energy Audit Participants Survey. The market evaluation team applied the following criteria to select eligible participants for the sample frame:

- Participants that received an audit under the Clean Energy Fund (CEF) and transition funding period more than one year ago (participated by May 1, 2018)
- Participants that had a project status of 13 – Application Closed - Not Implementing, 14 – Application Closed – Unresponsive, or 15 – Application Closed - Project Completion
- Participant that had a valid email address

After developing the sample frame, the market evaluation team created quotas, listed in Table 21, by farm type. These quotas helped ensure that the team had an accurate representation of farm types.

Table 35: FlexTech Agriculture Energy Audit Participants Survey Sample Frame

Farm Type	Population Size	Sample Quota
Dairy	169	40
Other	77	20
Greenhouses	25	10
Row Crops	6	3
Orchards & Vineyards	21	5
Total	**298**	**78**

Note: The Market evaluation team originally estimated the sample quota from a population size of 333; however, some contacts were not ultimately in the sample due to duplicate contacts.
Source: Market evaluation team

Non-Participant Lighting Manufacturers

The sample frame was compiled from lists from GLASE and Navigant Research contacts lists. The market evaluation team attempted to reach all manufacturers in the sample frame. The evaluation plan was initially developed such that there would be a specific target for lighting chip manufacturers and a specific target for lighting fixture manufacturers. Upon completing secondary research and reviewing the GLASE and Navigant Research contact lists, the market evaluation team determined that there was too much crossover between lighting fixture manufacturers and lighting chip manufacturers to separate them. As a result, the market evaluation research team treated this market actor group as one entity instead of two.

Non-Participant CEA Auxiliary Service Providers

The data sources for this group included Infogroup data, GLASE contacts, EnSave contacts, secondary research, and market evaluation team contacts. Table 22 summarizes the NAICS codes that the market evaluation team used from the InfoGroup data when developing the sample frame.

Table 36. NAICS Codes Included for Non-Participant CEA Auxiliary Service Providers Survey

NAICS Code	NAICS Code Description
11511501	FARM LABOR CONTRACTORS & CREW LEADERS
11511606	FARM MANAGEMENT SERVICES
11511604	FARM MANAGEMENT SERVICES
52429802	ALL OTHER INSURANCE RELATED ACTIVITIES
54161203	HUMAN RESOURCES CONSULTING SERVICES
54161117	ADMINISTRATIVE & GENERAL MGMT CONSULTING SERVICES
54161831	OTHER MANAGEMENT CONSULTING SERVICES
54169010	OTHER SCIENTIFIC & TECHNICAL CONSULTING SERVICES
54169043	OTHER SCIENTIFIC & TECHNICAL CONSULTING SERVICES
92614003	AGRICULTURAL MARKET & COMMODITY REGULATION
92614004	AGRICULTURAL MARKET & COMMODITY REGULATION

Source: Market evaluation team

Non-Participant Grocery Retailers

The primary data source for this group was InfoGroup data, which was supplemented by the market evaluation team's personal contacts and outreach. The market evaluation team initially used a broad definition of retailers when developing the sample, per guidance from GLASE. For example, the market evaluation team included NAICS codes for grocery retailers, home improvement stores that sell ornamental plants, convenience stores, and specialty food stores. Partway through the pre-test, the market evaluation team heard from the GLASE leadership team that they were narrowing their focus to just grocery retailers; therefore, the market evaluation team shifted their focus in the pre-test to just grocery stores, which equated to NAICS code 44511003 (SUPERMARKETS/OTHER GROCERY - EXC CONVENIENCE STRS).

Appendix G: Secondary Research Findings to Support the Market Evaluation of NYSERDA's Agriculture Initiatives

To: Judeen Byrne, Carley Murray, NYSERDA

From: Courtney Marshall, Emily Merchant, and Beth Davis, Navigant Consulting, Inc.

Date: February 12, 2019

Re: **Secondary Research Findings to Support the Market Evaluation of NYSERDA's Agriculture Initiatives**

The purpose of this memo is to summarize findings from secondary research conducted by Navigant Consulting Inc. (Navigant) in support of evaluating three NYSERDA agriculture initiatives: Advancing Agriculture Energy Technologies (AAET), the Agriculture component of Commercial: Technical Services, and Greenhouse Lighting and Systems Engineering (GLASE) Consortium. The secondary research highlighted in this memo will supplement the primary research findings from conducting surveys with market actors in 2018-early 2019.

9. Methodology

Navigant started the secondary research with the secondary sources mentioned in the work plan and supplemented them with Navigant's industry knowledge of other resources. Table 1 provides a summary of the sources used in Navigant's secondary research, as well as a description of how the sources were used. Where applicable, all secondary research sources are cited in this report using footnotes.

Table 37: Secondary Research Sources

Source	Application
Argus Controls, (2015). *Indoor Crop Production: Feeding the Future.* http://arguscontrols.com/articles/indoor-crop-production-feeding-the-future/	Comprehensive overview of the relationship between technology and agriculture; the current state and prospects for automation and robotics in the indoor agriculture industry. Used to understand underutilized and emerging technologies.
J. Nelson and B. Bugbee, (2014). *Economic Analysis of Greenhouse Lighting: Light Emitting Diodes vs. High Intensity Discharge Fixtures.* http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0099010	Provides an economic analysis of greenhouse lighting and the efficiencies of various lighting applications. Used for understanding lighting and energy efficiency for greenhouses.

Source	Application
T. Schmit, (2014). *Agriculture-Based Economic Development in New York State: The Contribution of Agriculture to the New York Economy*. http://publications.dyson.cornell.edu/outreach/extensionpdf/2014/Cornell-Dyson-eb1404.pdf	Market overview of agriculture and economic development in New York State (NYS). Used to understand market developments within the agricultural sector.
UMassAmherst, (2010). *Massachusetts Greenhouse Industry Best Management Practices Guide*. https://ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual	Understanding of energy use in greenhouses based on case studies conducted by the Massachusetts Farm Bureau and the MA Department of Agricultural Resources.
USDA, (2012). *Census of Agriculture, State Profile: New York*. https://www.agcensus.usda.gov/Publications/2012/Online_Resources/County_Profiles/New_York/cp99036.pdf	Census data for NYS agriculture used for understanding the agriculture economy in New York.[19]
The Official Website of New York State, (2018), *Agriculture and Farmland Protection Program*. https://www.agriculture.ny.gov/ap/agservices/farmprotect.html	Census data for NYS agriculture used for understanding energy efficiency within New York's agricultural programs.
Agrilyst, (2017). *State of Indoor Farming*. https://www.agrilyst.com/stateofindoorfarming2017/	A recent report by Agrylist that provides a comprehensive overview of the state of the indoor farming industry. Used to understand perceived barriers and drivers of the indoor agriculture market.
Denver Environmental Health, (2017). *Cannabis Environmental Best Management Practices Guide*. https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/MJ%20Sustainability/Draft%20Cannabis%20Environmental%20BMP%20Guide.pdf	A best practices guide created by an interdisciplinary collaborative sustainability work group for providing sector-specific sustainability resources and guidance to the local cannabis industry. Used to understand energy efficiency in greenhouses.
H. Resh, (2017). *Hobby Hydroponics* https://books.google.com/books?id=d1TGtAEACAAJ&source=gbs_book_other_versions	Best practices for indoor plant care and how to provide adequate light, temperatures, etc. to obtain productive plants. Used for understanding lighting efficiency.
Navigant Research, C. Marshall, (2018). *How to Keep Indoor Agriculture Businesses Competitive*. https://www.navigantresearch.com/news-and-views/how-to-keep-indoor-agriculture-businesses-competitive	Blog article that discusses prominent challenges to the indoor farming industry. Supported findings on barriers to the indoor agriculture sector and recommendations for securing indoor farming businesses.

[19] The National Agriculture Statistics Service plans to release the 2017 Census of Agriculture beginning in February 2019. https://www.nass.usda.gov/AgCensus/FAQ/2017/index.php (2018)

Source	Application
Navigant Research, C. Marshall, (2018). *Energy Efficiency for Indoor Farming*. https://www.navigantresearch.com/reports/energy-efficiency-for-indoor-farming	A comprehensive review of energy efficient solutions for indoor farming. The study examines the market issues, including drivers, challenges, and production and facility types, associated with energy efficient technologies for indoor agriculture.
The New York State Energy Research and Development Authority, (2017). *Clean Energy Fund Investment Plan: Agriculture*. https://www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Agriculture-Chapter.pdf	In-depth review of advancing agriculture energy technologies. Used to understand underutilized and emerging technologies.
NYSERDA Department of Public Service, (2018). *New Efficiency: New York*. https://www.nyserda.ny.gov/-/media/Files/Publications/New-Efficiency-New-York.pdf	Comprehensive review of NYS energy efficiency programs and initiatives. Used to understand how energy is being utilized and identify ways to reduce energy consumed by NYS agriculture.
EnSave, Inc., (2015). *Energy Efficiency in New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities*. https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf	NYSERDA's summary of energy efficiency programs and research opportunities. Used to understand the current state of NYS' agriculture industry and baseline energy use by sector.
NYSERDA, (2018). *New York State Dairy Farm Report*. No hyperlink available, Word version of report provided to Navigant on July 13, 2018.	Summary of the dairy industry in New York State. Used to understand the current state of NYS' dairy industry.
Farm Credit East, N. Mattson, (2017). *Controlled Environment Agriculture*. https://www.farmcrediteast.com/-/media/farm-credit-east/News/2017/Files/KXP-November-2017.ashx?la=en	A high-level overview of Controlled Environment Agriculture (CEA) and related agricultural practices active within NYS. Used to understand current CEA activities within NYS agriculture and weigh in on the perceived barriers and benefits to implementing energy efficient technologies.
AG Web Powered by Farm Journal, (2018). *Milk Prices Drop After Years of Profits for Farmers*. https://www.agweb.com/article/milk-prices-drop-after-years-of-profits-for-farmers-naa-associated-press/	News article describing potential causes of price drops in US dairy prices. Used to understand market conditions and challenges US dairy farmers are currently facing.

Source: Navigant literature review

10. Market Overview

According to the 2012 USDA Census, New York State (NYS) has over 35,500 farms, with farm sizes averaging 202 acres.[20] The agriculture industry in NYS can be broken down into the following five sectors:

1. Fruit and vegetable
2. Greenhouse and nursery
3. Grain, oilseed, and other crops
4. Dairy
5. Beef, poultry, and other animal production

These five categories represent 3% of total industrial sales across the state, generating roughly $5.4 billion in sales in 2012.[21] Of these products sold, crop sales (sectors 1-3) represent 42% of the market value, while livestock sales (sectors 4-5) represent 58%.[22] NYS is among the nation's top 10 producers of grapes, maple syrup, orchard crops, and vegetables.[23] However, dairy represents the majority of NYS' agricultural economy (accounting for over $2.4 billion in milk sales in 2012), and NYS ranks 3rd in the nation for milk sold from cows.[24] NYS has over 5,000 family farms milking more than 600,0000 cows.[25]

Table 2 represents the 2012 agriculture industry sales in NYS by sector. Milk from cows accounts for 45% of total annual sales followed by grains, oilseeds, dry beans, and peas (16%); cattle and calves (8%); and nursery, greenhouse, floriculture, & sod (8%).[26]

[20] https://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_County_Level/New_York/st36_2_001_001.pdf (2012)

[21] http://publications.dyson.cornell.edu/outreach/extensionpdf/2014/Cornell-Dyson-eb1404.pdf (2014)

[22] http://publications.dyson.cornell.edu/outreach/extensionpdf/2014/Cornell-Dyson-eb1404.pdf (2014)

[23] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

[24] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

[25] New York State Farm Information memo received from NYSERDA on July 17, 2018

[26] https://www.agcensus.usda.gov/Publications/2012/ (2012)

Table 38: 2012 Agriculture Industry Sales by Subsector in NYS

Sector	Value of Sales
Milk from cows	$2,417,398
Grains, oilseeds, dry beans, & peas	$855,891
Cattle & calves	$449,497
Nursery, greenhouse, floriculture, & sod	$413,277
Vegetables, melons, potatoes, & sweet potatoes	$364,135
Fruits, tree nuts, and berries	$307,644
Other crops & hay	$301,438
Poultry & eggs	$144,663
Horses, ponies, mules, burros, & donkeys	$58,211
Hogs & pigs	$38,999
Other animals & animal products	$19,845
Sheep, goats, wool, mohair, & milk	$19,249
Aquaculture	$18,036
Cut Christmas trees & short rotation woody crops	$6,843

Source: USDA-NASS Census of Agriculture 2012

Energy consumption accounts for 9% of NYS farm expenses, which is equivalent to $450 million in annual expenses. However, total energy costs vary from farm to farm. Approximately 45% of dairy farms spend between $5,000 and $25,000 annually on utilities, which includes electricity, phone, internet and water, while roughly 10% spend greater than $25,000.[27] The 2015 EnSave report found that baseline energy use is best understood by average energy usage per farm, by season, and aggregate energy usage by farm type. Of NYS's top grossing subsectors, dairy remains the only sector with sufficient datasets for determining baseline energy use. Findings for this sector reveal that fluid milk production represents the largest energy consumer for NYS dairies, primarily as electricity. During the summertime peak, dairy farms consume between 36 and 52 GWh, with the average dairy farm consuming between 174,537 kWh and 212,281 kWh annually, and between 16,808 kWh and 20,443 kWh during the summer peak.[28]

[27] The New York State Energy Research and Development Authority, (2017). Clean Energy Fund Investment Plan: Agriculture. https://www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Agriculture-Chapter.pdf. Information taken from United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) census data for 2012.

[28] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

Baseline energy use in vegetable, orchard, vineyard and greenhouse operations depends on the types of crops produced and the associated production requirements. According to the 2015 EnSave report on agriculture energy efficiency opportunities in NYS, a larger sample size and further research is needed to quantify the baseline energy use and potential energy savings associated with greenhouses. Table 3 displays the average annual electricity use per site according to audits conducted through NYSERDA's Agriculture Energy Efficiency Program (AEEP).[29]

Table 39: Average Annual Electricity Use per Site by Category

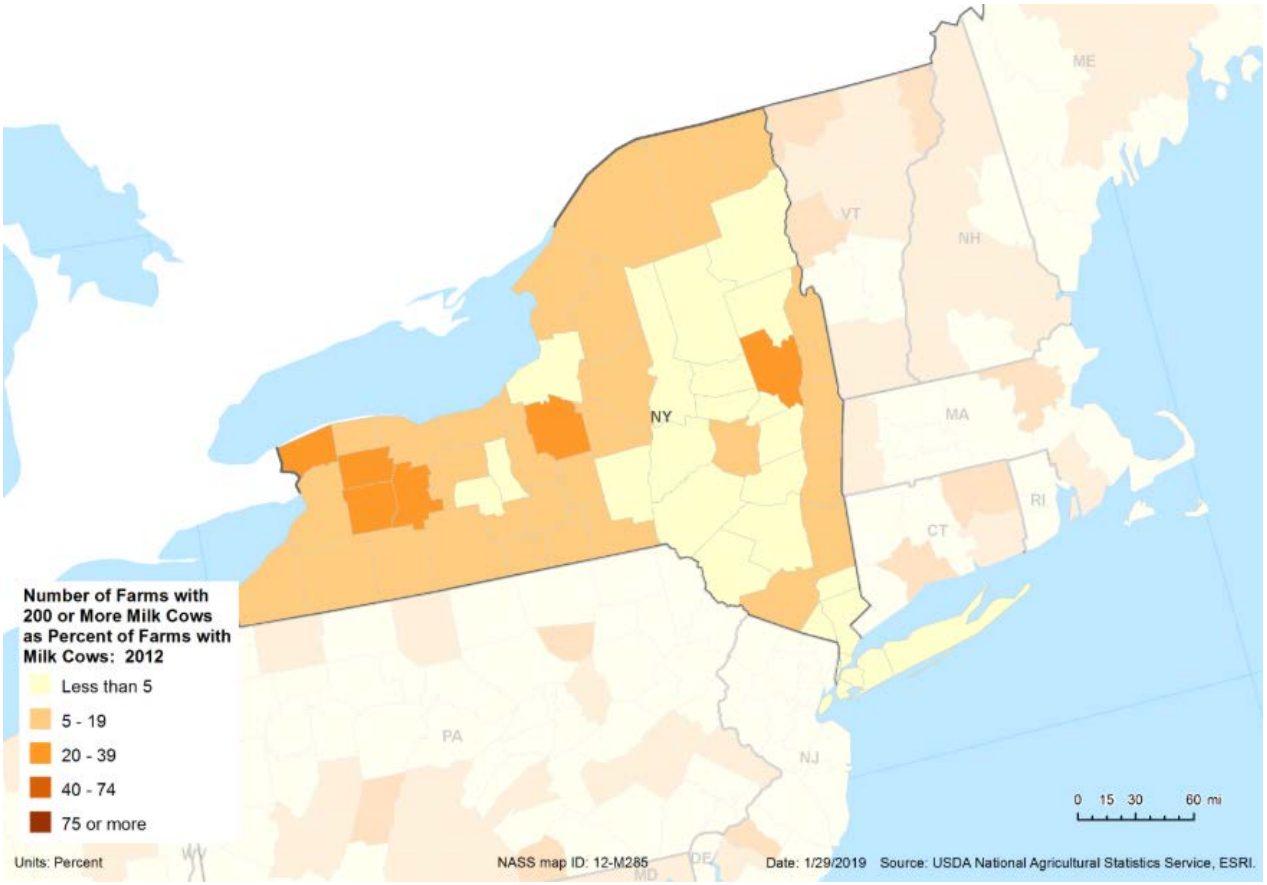
Category	Average Annual Energy Use (kWh)
Dairy	174,537 – 212,281
Vegetable	84,890 – 107,203
Orchards and vineyards	167,529 – 219,843

Source: EnSave, Inc.

The USDA Ag Census was last conducted in 2012. Figure 1 and Figure 2 present snapshots of the data available through the census. Twenty to 39% of the dairies in Niagara, Genesee, Wyoming, Livingston, Onondaga, and Saratoga counties have 200 or more milk cows. Also, six counties in New York have more than 1,000 farms: St. Lawrence, Oneida, Steuben, Cattaraugus, Chautauqua, and Erie.

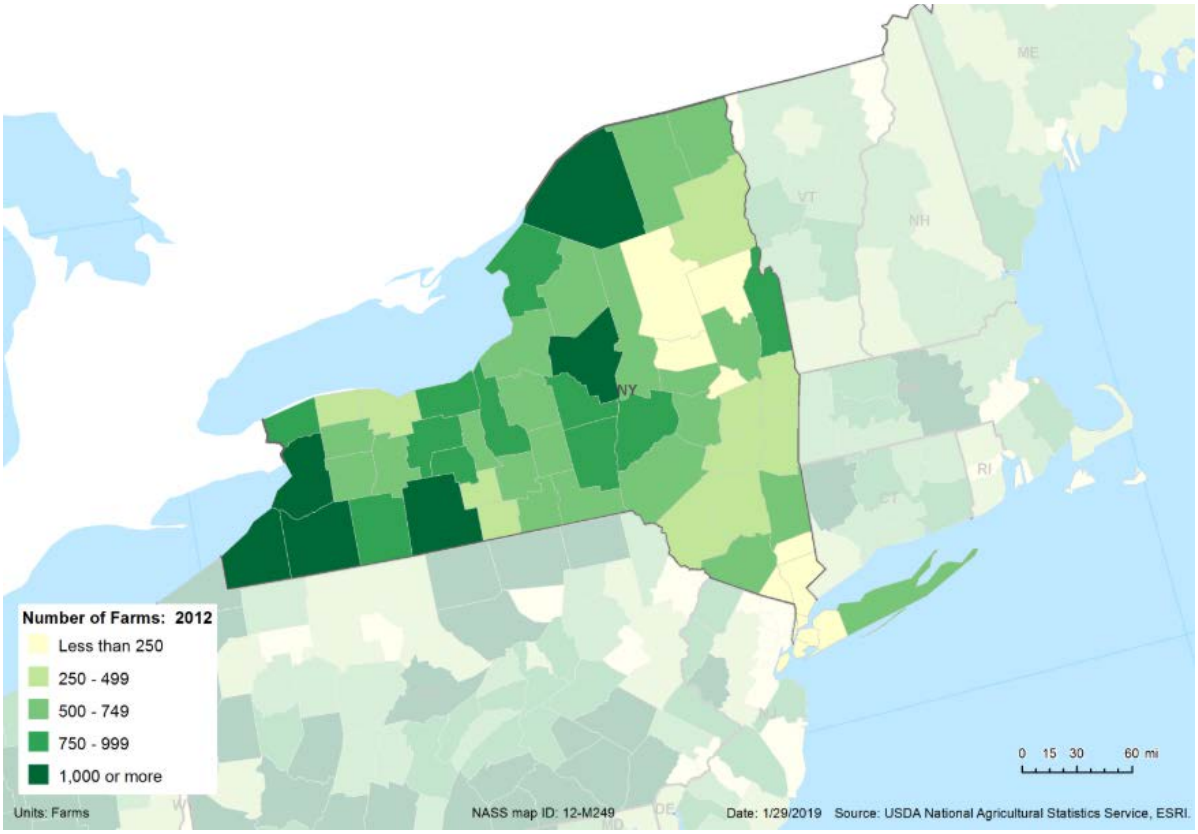
[29] Ibid

Figure 9: Number of Farms with 200 or More Milk Cows as a Percent of Farms with Milk Cows



Source: USDA Ag Census

Figure 10: Number of Farms in NYS



Source: USDA Ag Census

The NYS agriculture sector was heavily impacted by the following storms in the past ten years: Hurricane Irene in August of 2011, Tropical Storm Lee in September of 2011, and Hurricane Sandy in October of 2012. Examples of impacts include submerged crops, washing away access roads to fields, and livestock deaths. These events are just a few of the many external forces that the NYS agriculture sector must deal with to stay afloat, forcing the famers with greater resiliency to persevere and the rest to succumb to external forces.[30]

11. Secondary Research Findings

This section includes Navigant's secondary research findings for the research questions that address the goals prior to program exit and testable hypotheses in the work plan. See Table 4 for a summary of the

[30] https://www.nytimes.com/2011/08/31/nyregion/after-irene-upstate-new-york-farmers-suffer-in-flood-plain.html (2011)

goals prior to program exit by initiative. The section provides the research question in ***green text*** and then provides information related to the research question. The findings summarized in this section are intended to supplement the primary research findings gathered from the surveys with market actors in 2018-early 2019. The secondary research findings in this section are grouped by NYSERDA's three agriculture initiatives: AAET, Technical Services, and the GLASE Consortium (GLASE).

Table 40: Goals Prior to Program Exit by Initiative

Initiative	Goals Prior to Exit
Advancing Agricultural Energy Technologies	• Reliable market sources compile, develop and maintain current information on advanced clean energy technologies for use by local information-exchange networks. • Advanced technologies are installed by farms outside of demonstration projects. • Agriculture vendors and suppliers use energy efficiency as a tool to sell their products.
Technical Services	• Consultants, energy service companies, and other energy-focused firms embrace the piloted business models and incorporate these models as a standard service. • List of qualified energy-focused firms is used as a reference and resource by the marketplace without NYSERDA assistance. • Information provided by NYSERDA on clean energy best practices is incorporated in to other best practice efforts that currently lack this information. For the agriculture sector, this means NY Farm Bureau, Cornell Cooperative Extension and stakeholders trusted by the agriculture community incorporate clean energy best practices in to their activities.
GLASE	• Availability of products in the marketplace that can reduce electricity costs (and concomitant carbon emissions). Savings in an individual greenhouse up to 70 to 86% (depending on New York climate zone) are targeted. • The Consortium is self-funding through partnerships, membership fees, fee-based trainings and services, and royalties and licenses of patentable products. • Demonstrated electricity savings are achieved through synergistic solutions for greenhouse systems. Up to four hardware and software products and up to three services shall be commercialized at program's end. There are approximately eight provisional patents filed by the Consortium. • In addition to the direct savings from the pilots, there are indirect savings resulting from market penetration of improved control systems and lighting technologies in New York tomato and lettuce greenhouse acreage of at least 25%.

AAET

This section summarizes Navigant's secondary research findings for the research questions related to the AAET agriculture initiative.

What are underutilized or emerging technologies in the agriculture sector?

In 2015, EnSave conducted a study for NYSERDA on energy efficiency opportunities in NYS agriculture, and identified a variety of underutilized and emerging technologies that have high energy savings potential. Table 4 provides a summary of the underutilized and emerging technologies in NYS broken out by the following sectors: dairy, greenhouse, poultry, swine, vegetable, orchard, and vineyard. As shown in Table 4, some technologies have untapped potential in multiple sectors (e.g., variable frequency drives for ventilation fans in greenhouse, poultry, and swine operations) and some technologies have untapped potential in only one sector (e.g., LED lighting in greenhouse operations).[31]

Table 41: Underutilized or Emerging Technologies by Sector

Sector	Measures
Dairy	• Occupancy sensors • Thermostatically controlled outlet • Compressed air leak detection • Radiant tube heaters • Evaporator fan controls • Ozone laundry
Greenhouse	• Thermostatic controls • Thermostatically controlled outlet • Shade curtains • Bench heating systems • LED lighting • Variable frequency drives (VFDs) for ventilation fans • Evaporative cooling • Geothermal heat pumps • Dynamic temperature control
Poultry	• VFDs for ventilation fans • Radiant tube heaters
Swine	• VFDs for ventilation fans
Vegetable	• Well pump variable speed drives • Electronic expansion valves • Outside air economizers
Orchard	• Well pump variable speed drives • Electronic expansion valves • Outside air economizers

[31] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

Sector	Measures
Vineyard	• Well pump variable speed drives • Ozone laundry • Electronic expansion valves • Outside air economizers

Source: EnSave, Inc.

Additional Discussion on Underutilized and Emerging Technology Opportunities

Greenhouse glass technologies, from a building envelope perspective, are an important and underutilized solution for achieving energy efficiency in greenhouses. Two layers of inflated polyethylene diffuse the sunlight and provide more uniform lighting to the grow environment. The downside to diffused glass is that it transmits less light and needs to be replaced more often. However, diffused glass is less expensive compared to other glazed options and provides more insulation. Thus, diffused glass could result in high energy savings for certain greenhouse growers depending on the local climate and amount of natural sunlight.[32]

Advanced sensors and data analytics are solutions for the indoor agricultural market that some may consider either underutilized or emerging, depending on the application. The capabilities of these technologies allow growers to optimize controlled environments by monitoring and controlling crucial influencers such as carbon dioxide (CO_2) and oxygen levels, light output, humidity, and temperature. Similarly, energy efficient heating, ventilation, and air conditioning (HVAC) systems are solutions for indoor farmers that teeter between underutilized and emerging, depending on where the farm sits on the technology spectrum.

Robotics and artificial intelligence (AI) are on the far end of the technology spectrum as they are some of the latest emerging technologies to enter the indoor farming market. Machines that replace manual labor create more space for indoor cultivation and may also reduce demands on HVAC systems that were once used to provide ambient environments for workers. Robotics and AI are also technologies that can offer around the clock care and provide real time data to better manage indoor farming operations. While these solutions are in a very early adoption phase, industry participants expect to see more of these offerings within the next three to five years.[33]

[32] https://ag.umass.edu/greenhouse-floriculture/greenhouse-best-management-practices-bmp-manual (2010)

[33] https://www.engadget.com/2018/10/03/future-indoor-agriculture-vertical-farms-robots/ (2018)

Ozone laundry is a relatively new energy efficient technology for the agricultural sector. The method of sterilizing equipment is primarily applicable to dairy farms where daily sanitations needs can be met by reducing chemical detergents and hot water used during the washing process.

What are the perceived benefits and barriers to farmers with implementing energy efficient technologies in the agriculture sector?

Benefits

The 2015 EnSave report found that benefits to adopting energy efficient technologies include operation and maintenance (O&M) savings, higher yields, better quality, reduced labor costs, quicker turnaround of production, better ability to meet consumer demand, less pesticides and fertilizers applied (creating an opportunity to go organic and charge a premium price), healthier livestock, and increased water efficiency.[34] These benefits are applicable to a range of agricultural activities for mid- to large-scale producers, yet farmers stand to gain the most through O&M savings. Energy saved from more efficient technologies reduces the cost of utilities, meaning farmers spend less each month on energy bills. However, the effectiveness of each technology, and thus the degree of savings, depends on the individual farm size and management style. Therefore, not all benefits are created equal and farmers should adopt a set of best practices to compliment technological upgrades to reap the full benefits of newer equipment.[35]

Barriers

Lack of awareness of the technology, upfront costs, and interoperability are perceived barriers to adopting energy efficient technologies within the agriculture sector. More research is needed to prove both the quantitative and qualitative benefits (especially regarding LED lighting for greenhouses) of efficient technologies. Without proven data, farmers remain hesitant to make expensive upgrades.[36] The GLASE Consortium is helping to minimize farmers' doubt in the effectiveness of LEDs in controlled environments by designing technologies that address the limitations of LEDs over traditional lighting technologies like high intensity discharge fixtures. Examples of GLASE Consortium research areas include: designing LEDs that provide the light spectrum and intensity of natural light without the added

[34] http://arguscontrols.com/articles/indoor-crop-production-feeding-the-future/ (2015)

[35] https://www.navigantresearch.com/reports/energy-efficiency-for-indoor-farming (2018)

[36] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

heat, developing green LED technology, and developing LED drivers that regulate temperature and energy consumption.[37]

Most farm productions operate as a high-risk, low margin enterprise. Dairy and cash field crops are dealing with pricing that is close to cost of production. Thus, a primary barrier to establishing or expanding farming operations is the high level of capital investment required. This challenge is compounded by market volatility and unpredictable weather patterns, making sustainable and reliable production difficult to ensure. The decision to implement energy efficient technologies often falls second to ensuring stable production.[38] Adopting energy efficient technologies also requires understanding the balance of capital expense and operating expense. A feasibility study can be used to assess the financial potential of a given farm, which is difficult to do in an industry where it can take up to seven years before farms begin turning a profit.[39]

CEA farmers in urban areas must compete with high-priced real estate and utility costs; however, general challenges most pervasive to the indoor agriculture industry include first cost, energy efficiency, space utilization, labor costs, and successful business models. Making the most out of limited space is fundamental to indoor farming. If farmers are unable to achieve efficient space utilization, their production often fails to make a profit. Maximizing space means producing quality or nutrient-dense produce using every square inch of the building space by either vertically stacking or converting underutilized space for growing purposes; thus, the trend towards replacing manual labor with robotics. However, this is a very cost-intensive process that is not feasible for most indoor farms, particularly those that have not been around for more than five years.

Labor costs represent a primary barrier to both livestock and plant farming operations and are the primary operating cost for most agriculture facilities. Increased labor wages have encouraged farmers to adopt robotics and AI technologies in recent years, a transition that may save famers money in the near to long term.

[37] https://glase.org/research/ (2019)

[38] https://www.farmcrediteast.com/-/media/farm-credit-east/News/2017/Files/KXP-November-2017.ashx?la=en (2017)

[39] https://www.agrilyst.com/stateofindoorfarming2017/ (2017)

Since 2006 the price of milk and the number of dairy farms in NYS has steadily decreased. For example, between 2006 and 2016 the number of dairy farms decreased by 23%.[40] International trade may be affecting these trends because China, once a major buyer of dairy, has started reducing its imports and focusing on domestic production instead. Increased supply in the European Union (EU) is also weighing on US prices as the EU lifted milk production caps in April of 2015.[41] Reports of increased milk production in the US compounds the issue of price. Despite the number of farms that have left the dairy industry, New York is still the third most-productive dairy state. Milk production was up 2.1% nationwide and 1.9% in NYS in August 2017, year-over-year, adding more milk to an already saturated market.[42] These market challenges represent significant barriers to adopting energy efficient technologies as farmers struggle to remain viable and competitive.

Technical Services

This section summarizes Navigant's secondary research findings for the research questions related to the Technical Services agriculture initiative. The purpose of the Technical Services initiative is to provide site-specific technical assistance and analysis in hopes of resulting in the implementation of energy efficiency measures. [43]The Technical Services initiative serves the agriculture sector through the Agriculture Energy Audit Program where a Flexible Technical Assistance (FlexTech) Consultant goes onsite and conducts an energy audit to identify electric and gas energy efficiency measures.[44]

How many energy-focused firms are currently servicing the agriculture sector within NYS?

As a proxy to answer this question, Navigant summarized data from InfoGroup and industry contacts from the GLASE Consortium. The InfoGroup data includes firms with the following standard industrial classification (SIC)[45] information:

[40] https://www.democratandchronicle.com/story/news/politics/albany/2018/03/08/why-low-milk-prices-really-bad-new-york-farms/384592002/ (2018)

[41] https://www.agweb.com/article/milk-prices-drop-after-years-of-profits-for-farmers-naa-associated-press/ (2015)

[42] https://www.farmcrediteast.com/-/media/farm-credit-east/News/2017/Files/KXP-November-2017.ashx?la=en (2017)

[43] https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00Pt0000005x8YZEAY (2018)

[44] https://www.nyserda.ny.gov/Business%20and%20Industry/Agriculture (2019)

[45] The team used SIC codes for this exercise because these codes/descriptions better aligned to the needs of the study.

Table 42: SIC Codes Used in InfoGroup Data

Primary SIC Code	Primary SIC Description
076104	AGRICULTURAL TECHNICIANS
076203	FARMING SERVICE
076204	FARM MANAGEMENT SERVICE
641118	FARM & RANCH INSURANCE
874212	ENERGY CONSERVATION & MGMT CONSULTANTS
874255	UTILITY BILL CONSULTANTS
874805	PUBLIC UTILITY CONSULTANTS
874820	AGRICULTURAL CONSULTANTS
874848	FARM MANAGEMENT SYSTEMS
874849	DAIRY CONSULTANTS
964101	FEDERAL GOVERNMENT-AGRICULTURAL PROGRAMS
964102	STATE GOVERNMENT-AGRICULTURAL PROGRAMS

These two data sets contained 190 firms that are identified as auxiliary service providers. Examples of auxiliary service providers in the agriculture sector include: regulatory agencies, energy audit companies, utility companies, greenhouse manufactures, trade publications, research centers and universities. The auxiliary service provider companies were combined into the categories in Table 5. Navigant recognizes that InfoGroup data and GLASE industry contacts for auxiliary service providers are not a census of all the auxiliary providers serving NYS; thus, this should be viewed as a conservative estimate of the number of firms active in NYS.

Table 43: Number of Auxiliary Service Providers Potentially Servicing the Agriculture Sector in NYS

Firms	Account
Consulting	124
Farm Management	28
Other*	38
Total	**190**

**Other includes entities outside of consulting and farm management that interact with or support the agriculture sector, such as state and federal government organizations, insurance companies, news agencies, and testing laboratories.*

Source: InfoGroup data and GLASE industry contacts compiled by Navigant

GLASE

This section summarizes Navigant's secondary research findings for the research questions related to the GLASE Consortium.

What solutions (product/systems) are available in the market that can increase electricity use efficiency and result in profitability increase in greenhouses? What energy related measures are used (ventilation, white wash, shade cloth, etc.)?

Lighting

One of the predominant solutions available in the market to increase energy efficiency in greenhouses is lighting, which includes first leveraging natural lighting and then supplementing with energy efficient artificial lighting (e.g., LEDs). For new construction projects, it is important for farms to work with a design team of engineers and horticulturists prior to the building phase to ensure the maximization of natural light. These stakeholders will understand which building materials (e.g. glass vs. plastic film windows) will be most effective at insulating and naturally lighting the building. This process will also help reduce costs when it comes to implementing a lighting system, in which case LED fixtures are the obvious choice when it comes to energy efficiency. LED lighting lasts up to three times longer than standard lighting technologies (e.g., high intensity discharge lighting and T-8 fluorescent lighting), uses about one-third the energy of standard high intensity discharge (HID) fixtures and uses about half the energy of T-8 fluorescent fixtures.

Growers can make more efficient use of light in the plant canopy by using a reflector. Reflectors come in three basic forms: parabolic, horizontal, and conical. Lighting is more efficient when using a reflective cover on the walls surrounding (hydroponic) units to reflect light back onto the plants from different angles.[46]

HVAC

Several commercially viable options exist on the market for HVAC technologies specific to greenhouses. Facilities with higher cooling demands, whether due to climate or production type, tend to fall into two categories: refrigerant cooling or evaporative cooling systems. Geographical location is a major factor when deciding which system to implement. For instance, facilities located in warmer, more humid environments tend to utilize refrigerant cooling systems as these technologies remove humidity, whereas facilities operating in hot, arid climates run evaporative cooling systems, which add humidity to a space. This is not a hard-fast rule, but more of a logical tendency.[47]

Variable refrigerant flow (VRF) systems is an example of an HVAC technology available in the market with high energy savings potential for greenhouses. VRF systems transfer heat by distributing refrigerant to multiple heating or cooling coils instead of distributing hot or cold air or water. The ability to control the amount of refrigerant to each indoor unit allows the system to simultaneously provide heating in one zone and cooling in another. This is an important feature for housing production types with various grow cycles, such as leafy greens. Cultivation for these production types may have different heating and cooling demands, in which case the ability of VRF systems to recover heat from one zone and provide it to another without the use of a compressor makes for a high efficient application for these facilities. The efficiency of VRF systems is attributable to the technology's simultaneous heating and cooling capabilities, which allow for zoning and individual temperature control. Thus, these systems are well suited for mixed-mode applications, where the HVAC system is serving both plant and human environments. Additionally, VRF compressors are inverter-driven and can operate at variable speeds. As a result, they are much more efficient in part-load conditions compared to compressors in chillers or unitary units.[48]

[46] https://books.google.com/books?id=d1TGtAEACAAJ&source=gbs_book_other_versions (2017)

[47] https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/MJ%20Sustainability/Draft%20Cannabis%20Environmental%20BMP%20Guide.pdf (2017)

[48] https://www.navigantresearch.com/reports/energy-efficiency-for-indoor-farming (2018)

The 2015 EnSave report identified outside air economizers (OAE) as another example of an HVAC technology available in the market with high energy savings potential for greenhouses. OAE systems (also called air-side economizers or free coolers) use cold outside air to offset cooling and refrigeration loads, thereby reducing compressor runtime and reducing energy usage. This technology has existed for decades but has not been widely adopted within the agricultural industry. Existing refrigeration systems can be retrofitted with OAEs to draw outside air when the appropriate outside temperatures are reached. This technology is particularly well suited to climates with cold winters, and manufacturers have reported that customers in the New England area are able to utilize OAEs up to 130 days per year. Producers of eggs, dairy products, potatoes, vegetables, and fruit crops within NYS could potentially benefit from using outside air economizers.[49]

Other

Additional energy efficiency measures that greenhouses can implement to reduce their energy consumption are below:[50, 51]

- **Retractable energy curtains**: The benefit of retractable energy curtains is to shade the crops during sunny days and block heat radiation at night when heat is needed to maintain a certain temperature setpoint.
- **Plastic film**: Covering greenhouses in plastic film, such as polyethylene, results in energy savings due to the added insulation. In addition, the plastic film diffuses the incoming light which improves the penetration of light hitting the plants.
- **Horizontal airflow fans**: The purpose of horizontal airflow fans is to mix the air to improve the uniformity of temperature, humidity, and carbon dioxide in the greenhouse.
- **Wall insulation**: Installing insulation in the side walls and end walls of a greenhouse reduces the amount of heat loss through the greenhouse.

[49] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

[50] http://flor.hrt.msu.edu/assets/EnergyConservationforGreenhouses.pdf (2011)

[51] https://www.navigantresearch.com/reports/energy-efficiency-for-indoor-farming (2018)

- **Air sealing**: Using an infrared sensor to identify where air is leaking in the greenhouses can improve the energy efficiency of greenhouses since less energy is required to heat the same volume of air.
- **Energy efficient heating system**: Replacing an inefficient heating system with an efficient heating system can drastically reduce the energy consumed in a greenhouse. Examples of energy efficient heating systems used in greenhouses include condensing boilers, direct-fire unit heater, combined heat and power systems, and heat pumps.
- **Controls**: There are significant electricity saving opportunities in advanced control systems for greenhouses to regulate ventilation, lighting, and CO_2 supplementation. Electricity savings of 70% to 86% (depending on NYS climate zone) are possible through synergistic control of these parameters.

What is the total acreage of Controlled Environment Agriculture (CEA) facilities in NYS?

NYS had approximately 123 horticulture operations (i.e., food crops grown under protection) covering 4.4 million square feet as of 2014.[52] However, horticulture operation does not necessarily equate to Controlled Environment Agriculture (CEA), which is a technologically advanced method, often with hydroponics, for cultivating vegetables and small fruits indoors. There is no one definition of what constitutes CEA; however, more broadly, it represents the range in technology between protected cultivation and highly sophisticated greenhouses with control of temperature, light, relative humidity, and carbon dioxide.[53] Thus, the exact number of CEA operations depends on one's definition of the term. NYSERDA maintains a database of completed CEA projects for the state. As of 2018, this list contains only Gotham Greens Farms LLC, the nation's first commercial hydroponic rooftop farm, which covers 15,000 square feet.[54]

[52] https://www.agcensus.usda.gov/Publications/2012/Online_Resources/Custom_Summaries/State_Specific_Horticulture/LargeNY.pdf (2014)

[53] https://www.farmcrediteast.com/-/media/farm-credit-east/News/2017/Files/KXP-November-2017.ashx?la=en (2017)

[54] https://www.nyserda.ny.gov/Business-and-Industry/Agriculture/CEA-Completed-Projects (2019)

How much energy is currently used in greenhouses?

Energy use in greenhouses is comprised of space heating, lighting, ventilation, cold storage, and irrigation, with ventilation representing the majority of energy consumption followed by cold storage.[55] As the 2015 EnSave report notes, data on energy use for greenhouses is limited and greenhouse operations are diverse making it difficult to have a general sense for baseline energy use. A 2015 University of Massachusetts – Amherst article on energy use in greenhouses notes that a typical greenhouse uses 75% of its annual energy consumption for heating, 15% for electricity, and 10% for vehicles.[56]

What are the needs in the agricultural sector related to lighting and controls systems?

Light intensity and output are fundamental to efficient greenhouses. Selecting lighting options in greenhouse applications is often based on the cost to deliver photons to the plant canopy surface. This analysis includes two parameters: 1) the fundamental fixture efficiency, measured as micromoles of photosynthetic photons per joule of energy input, and 2) the canopy photosynthetic (400–700 nm) photon flux (PPF) capture efficiency, which is the fraction of photons transferred to the plant leaves. Photosynthesis and plant growth is determined by moles of photons. Thus, it is important to compare lighting efficiency based on photon efficiency, with units of micromoles of photosynthetic photons per joule of energy input. This is especially important with LEDs where the most electrically efficient colors are in the deep red and blue wavelengths.

Growers are interested in paybacks that deal with capital expenditures or upfront costs for installing newer equipment. Installation costs for lighting include wiring for fixtures and physically hanging the fixture. Generally, the cost of installation is similar for LED and HID (e.g., high pressure sodium) fixtures, although installation costs can be reduced by fewer, higher wattage fixtures. The annual maintenance costs are small relative to the cost of the electricity, and these costs are better established for high pressure sodium fixtures than for LED fixtures. Maintenance costs are largely determined by the life expectancy of the fixture.[57]

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[55] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Other-Technical-Reports/energy-efficiency-in-new-york-state-agriculture.pdf (2015)

[56] A List of Energy & Agriculture Grants & Greenhouse Energy Resources, https://ag.umass.edu/greenhouse-floriculture/fact-sheets/list-of-energy-agriculture-grants-greenhouse-energy-resources (2015)

[57] http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0099010 (2014)

Appendix H: NYSERDA Agriculture Initiatives: Indirect Impacts Methodology

To: Judeen Byrne and Carley Murray, NYSERDA

From: Cherish Smith, Matt Rankins, Beth Davis, Navigant Consulting, Inc.

Date: September 17, 2018 (Original); October 7, 2019 (Update)

Re: **NYSERDA Agriculture Initiatives: Indirect Impacts Methodology**

The purpose of this memo is to outline the methodology Navigant Consulting Inc. (Navigant) will employ to assess indirect impacts or savings from NYSERDA's agriculture initiatives: Advancing Agriculture Energy Technologies (AAET), the Agriculture component of Commercial: Technical Services, and Greenhouse Lighting and Systems Engineering (GLASE) Consortium.

Important to note that Navigant originally drafted this memo on September 17, 2018. The team updated the memo on October 7, 2019 for the Ag Technical Services – Audits initiative only, because this was the focus in 2019. Therefore, content regarding other initiatives: AAET, Ag Technical Services – Best Practices, and the GLASE Consortium (GLASE) may be outdated, and will be updated in 2020 or whenever NYSERDA plans to measure the market progress.

1. Background

Navigant has developed a specific methodology (e.g., variables and algorithm), to describe how data, including, but not limited to the indicators outlined in the evaluation plan, results from pilot projects, and other information shall be used to assess the indirect savings or market activity that is attributable to NYSERDA's initiatives.

Navigant will establish a baseline and credible forecast of the availability and adoption of underutilized and emerging technologies and energy efficient greenhouse lighting and controls among manufacturers, suppliers, and service providers, which shall allow NYSERDA to quantify long-term, indirect energy savings impacts (i.e., market effects) attributable to the AAET, Ag Technical Services, and GLASE initiatives in 2019 through 2030. While the interviews with manufacturers, suppliers, and farmers shall qualitatively investigate perceptions of market trends, industry best practice for quantifying market effects requires a more structured, robust forecasting approach. Toward that end, Navigant has developed a

market adoption approach to be implemented and updated throughout the course of this evaluation to assess the indirect savings occurring in this space.

2. Objectives

Navigant reviewed the program logic model to gain insight into barriers and opportunities within the market, and gain an in-depth understanding of initiative theory and market transformation efforts, intended near- and long- term outcomes, and confirm the following:

- Linkages between identified activities and outcomes are logically consistent
- Current set of market progress indicators are comprehensive
- Current set of market progress indicators are measurable
- Current set of market progress indicators are reflective of market transformation

Based upon the review, Navigant plans to complete the indirect savings task in three parts:

1. Establish market adoption baseline
2. Develop market adoption forecast
3. Assess market adoption progress

3. Indirect Savings Methodology

Navigant will first **establish the market adoption baseline** for each NYSERDA initiative. Next, Navigant will **forecast market adoption** or savings that occur above the baseline that are not directly incented by utility programs or directly claimed but are a result of NYSERDA's initiatives (i.e., market effects). Finally, Navigant will **assess market adoption progress** against the forecast, and refine the market forecast throughout out the course of the evaluation and period for which market effects are to accrue.

Market Adoption Baseline

Navigant will assume the following market adoption baselines for the NYSERDA initiatives: AAET, Ag Technical Services, and GLASE.

AAET

1. **Key Question**: What are the energy savings (i.e., what energy saving equipment has been installed/practices have been implemented) because of NYSERDA's demonstration sites from non-participants?
2. **Baseline**: Zero because no demonstrations sites are active in 2018 (prior to NYSERDA's impact in the market)

Ag Technical Services (Best Practice Guides)

3. **Key Question**: What are the energy savings (i.e., what energy saving equipment has been installed/practices have been implemented) because of NYSERDA's best practices guides from non-participants?
4. **Baseline**: Zero because no best practice guides are available in 2018 (prior to NYSERDA's impact in the market)

Ag Technical Services (Ag Audits)

5. **Key Question**: What are the energy savings (i.e., what energy saving equipment has been installed/practices have been implemented) because of NYSERDA's audit after contact with and tracking by EnSave? This will include participants only above and beyond what is being tracked by EnSave, both those who installed measures identified in the audit without EnSave administrative assistance and those who installed measures not identified in the audit. This information should be tracked through the FlexTech surveys. In addition, non-participants may go on to install measures attributable to NYSERDA as result of word-of-mouth (e.g., a neighbor had an audit and shared information). This information should be tracked through non-participant farm surveys.

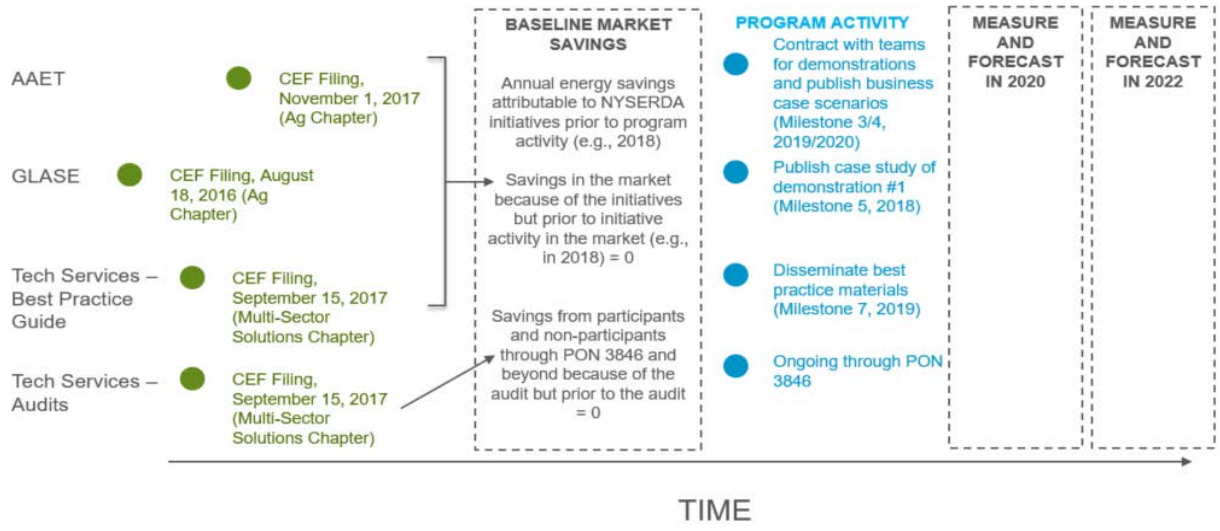
6. **Baseline**: The indirect savings for this portion of the program will be above and beyond savings tracked through the program for participants. Therefore, a market baseline is not applicable in this case. The baseline for each action will be zero, assuming the participant and non-participants would not have taken an action without NYSERDA's audit.

GLASE

1. **Key Question**: What are the energy savings (i.e., what energy saving equipment has been installed/practices have been implemented) because of the GLASE Consortium from non-participants?
2. **Baseline**: Zero because the Consortium is only starting to become active in 2018 (prior to NYSERDA's impact in the market)

Figure 1 summarizes the assumptions for baseline market savings and outlines the timeline for measuring indirect savings and updating the indirect savings forecast.

Figure 11. Indirect Savings Approach



Market Adoption Forecast

Navigant has developed a high-level methodology to forecast indirect impacts starting in 2019 through 2030. Navigant has completed an initial review of the NYSERDA indirect savings model (i.e., Budgets and Benefits (BAB) tool) assumptions and methodology, and will update this model as needed to further refine estimates.

Table 1 outlines the scope of the market adoption forecast.

Table 44. Market Adoption Forecast Scope[58]

Initiative	Component	Definition
All	Geographic Region	New York
	Timeline	2019/2020 - 2030
AAET	Sector	Dairy Farms

[58] The Market Adoption Forecast Scope reflects the scope as outlined in the NYSERDA BAB tools for AAET, Ag Technical Services and GLASE initiatives. Navigant plans to follow this scope to forecast and assess market adoption progress for indirect savings.

Initiative	Component	Definition
	Measure Scope	Ozone laundry, VFD for ventilation fans, conductive cow cooling, evaporative cow cooling, electric expansion valve, geothermal heat pump
	Output	MWh Cumulative Annual, CO2 Emission Reduction (metric tons) Cumulative Annual
Ag Technical Services	Sector	Dairy, Orchards & Vineyards, Row Crops, Greenhouses, Other[59]
	Measure Scope	LED lighting and/or LED lighting controls, Efficient ventilation (building or barn), Variable frequency drive (VFD) on pump or fan motors (e.g., transfer pump, vacuum pump, well pump, irrigation pump), High efficiency motors, Engine block heater timer, Compressed air efficiency improvements, Refrigeration equipment (e.g., scroll compressor, energy star equipment, or other cooling equipment), Water heating technologies (e.g., tank insulation, heat recovery unit, or efficient water heater), Energy-free livestock watering system, Plate cooler (e.g., well water heat exchanger), Energy curtain (e.g., shade curtain, night cover), Other
	Output	MWh Cumulative Annual, MMBtu Cumulative Annual, CO2 Emission Reduction (metric tons) Cumulative Annual
GLASE	Sector	Controlled environment agriculture (CEA), including Lettuce, Tomato, Floriculture, Pharma sub-sectors
	Measure Scope	CEA lighting control strategies, including no control, timer, basic LASSI, and LASSI + CO2; CEA lighting efficiency improvements
	Output	MWh Cumulative Annual, CO2 Emission Reduction (metric tons) Cumulative Annual

Forecast market adoption. Navigant utilized the NYSERDA BAB tool and indirect savings methodology developed for AAET, Ag Technical Services, and GLASE initiatives to assign deemed values to responses on the indicators (e.g., number of energy efficient measures or process improvements, by type, implemented because of the dissemination of NYSERDA's information materials) to forecast indirect savings.[60] Navigant has completed a review of the NYSERDA BAB tool for each initiative and has outlined the assumptions and methodology contained within. Navigant will work with the GLASE staff to update the GLASE BAB tool.

[59] The "Other" sector category contains all NY farms not included in the above sectors.

[60] Navigant plans to utilize the following tools for each initiative "BAB for NEIS Advancing Agriculture Energy Technologies post greenlight.xlsx" (AAET), "BAB for NEIS for Ag TA and BP revised 8.16.17.xlsx" (Ag Technical Services), and "Agriculture - Best Practices in Farm Management - GLASE BAB - 2016-08-18.xlsx" (GLASE).

AAET

The AAET BAB tool forecasts indirect savings, using the following methodology:

- Assume total average annual energy use per cow
- Assume total number of cows per farm
- Calculate total average energy use per farm
- Assume average annual energy use per end use (e.g., milk production, ventilation, etc.)
- Determine energy savings for target underutilized or emerging technologies as assessed on demonstration sites (e.g., ozone laundry, VFD ventilation, etc.)
- Calculate energy savings compared to average energy use of a dairy farm based on number of cows or "head count"
- Forecast number of farms to adopt improved technologies attributable to NYSERDA to determine total initiative indirect savings

Figure 2 outlines the methodology NYSERDA uses to forecast indirect savings attributable to AAET.

Figure 12. AAET Indirect Savings Calculation Methodology

$$(1)\quad \frac{\text{Avg. Annual Energy Use}}{\text{Cow}} \times \frac{\text{Avg. Number of Cows}}{\text{Farm}} = \frac{\text{Avg. Annual Energy Use}}{\text{Farm}}$$

$$(2)\quad \frac{\text{Avg. Annual Energy Use}}{\text{Farm}} \times \text{Percent Energy Use Attributed to Applicable End Use (e.g., milk production, ventilation, etc.)} \times \text{Percent Energy Savings Attributed to Technology Improvements (e.g., ozone laundry, VFD installs, etc.)} \times \text{Number of Farms Implementing Technologies Attributable to NYSERDA} = \text{Annual Indirect Savings}$$

Table 2 outlines the AAET indirect savings calculation key assumptions, current data sources, and research Navigant will complete to update assumptions to forecast market adoption.

Table 45. AAET Indirect Savings Calculation Key Assumptions[61]

Key Assumption	Current Assumption	Current Source	Navigant Forecast Data Source	Survey Question in Table 6
Average Annual Energy Use per Cow	600-1200 kWh	NYSERDA Report Energy Efficiency in New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities	n/a	n/a
Average Number of Cows per Farm	25-750 cows	NYSERDA Program Staff	Non-Participant Farm Survey	8
Average Annual Energy Use per Farm	175 – 212 MWh (Based on number of cows on farm)	NYSERDA Report Energy Efficiency in New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities	n/a	n/a
Percent Energy Use Attributed to Applicable End Use (e.g., milk production, ventilation, etc.)	10-26% (Varies by end use)	NYSERDA Report Energy Efficiency in New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities	n/a	n/a
Percent Energy Savings Attributed to Technology Improvements (e.g., ozone laundry, VFD installs, etc.)	10-20% (Varies by technology)	NYSERDA Demonstration Sites	n/a	n/a
Number of Farms Implementing Technologies Attributable to NYSERDA	15 – 45 (Varies by technology)	NYSERDA Program Staff	Non-Participant Farm Surveys + Market Actor Surveys to inform market adoption rate	11,19,23,31,32

[61] N/a indicates Navigant does not intend to update the current data source for the applicable key assumption.

Ag Technical Services

Best Practices

The Ag Technical Services Best Practices BAB tool forecasts indirect savings, using the following methodology:

- Assume total average annual energy use per farm by sector (e.g., dairy, greenhouses, orchards and vineyards, row crops).
- Assume number of farms receiving best practices guides
- Assume average percent savings identified as a result of best practice guide
- Assume percent of best practices implemented
- Calculate average savings per farm implementing best practices
- Forecast number of farms to implement best practices attributable to NYSERDA to determine total initiative indirect savings

Figure 3 outlines the methodology NYSERDA uses to forecast indirect savings attributable to Ag Technical Services Best Practices.

Figure 13. Ag Technical Services Best Practices Indirect Savings Calculation Methodology

$$1.)\ \textbf{Annual Indirect Savings} = \left(\begin{matrix}Avg\ Annual\ Energy\\ Use\ per\ Farm\end{matrix}\right) * \left(\begin{matrix}\%\ Avg\ Savings\ Identified\\ Attributed\ to\ BP\ Guide\end{matrix}\right) * \left(\begin{matrix}Number\ of\ Farms\ Implementing\\ BP\ Attributable\ to\ NYSERDA\end{matrix}\right)$$

Table 3 outlines the Ag Technical Services Best Practices indirect savings calculation key assumptions, current data sources, and research Navigant will complete to update assumptions to forecast market adoption.

Table 46. Ag Technical Services Best Practices Indirect Savings Calculation Key Assumptions[62]

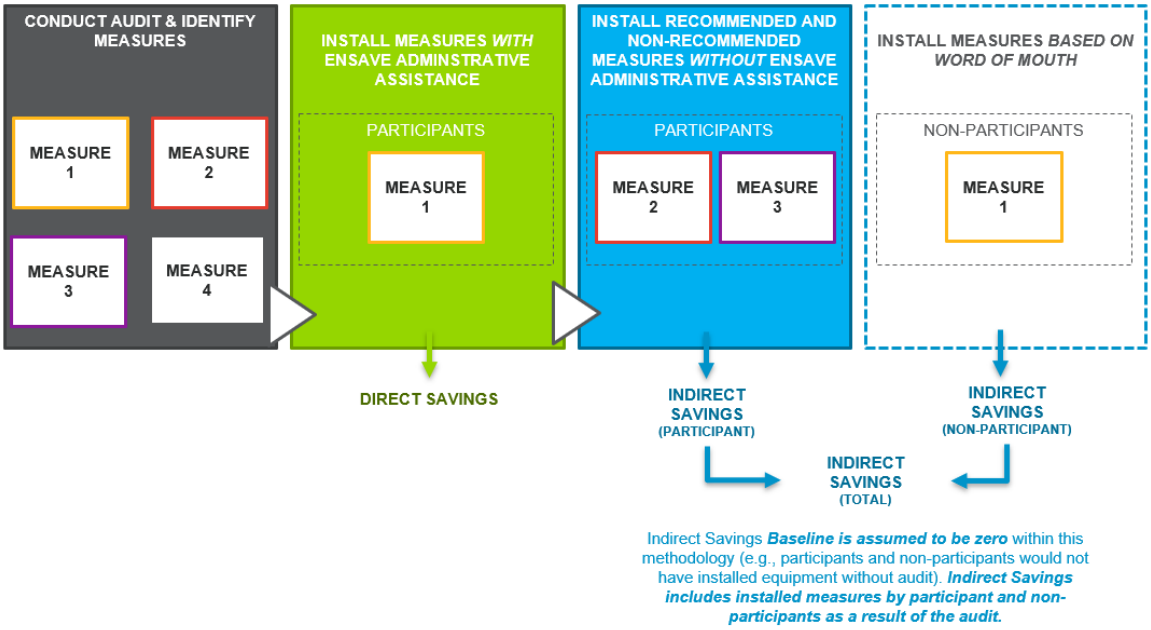
Key Assumption	Current Assumption	Current Source	Navigant Forecast Data Source	Survey Question in Table 6
Average Annual Energy Use per Farm (e.g., dairy, greenhouses, orchards and vineyards, row crops)	85-219 MWh (Varies by crop type)	NYSERDA Report Energy Efficiency in New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities	n/a	n/a
Number of Farms Receiving Best Practice Guide	464 – 1,085 (Varies by crop type; Assume 20% of farms receive guide over 5 years)	NYSERDA Program Staff	n/a	n/a
Average Percent Savings Identified Attributed to Best Practice Guide	10%	NYSERDA Program Staff	Non-Participant Farm Survey	7,8,31
Percent Best Practices Implemented	20%	NYSERDA Program Staff	Non-Participant Farm Survey	32
Number of Farms Implementing Best Practices Attributable to NYSERDA	0 – 40 (Varies by crop type; Assumes 5% additional farms installing, 50% of farms will share with neighbor; 10% of those farms will implement)	NYSERDA Program Staff	Non-Participant Farm Surveys + Market Actor Surveys to inform market adoption rate	11,19,23,32

Audits

[62] N/a indicates Navigant does not intend to update the current data source for the applicable key assumption.

Once an audit is conducted through Ag Technical Services initiative, EnSave assists with installation of measures and application of utility incentives (if applicable). This activity is counted as direct savings. Any additional measures installed outside of this touch point, or after EnSave, are counted towards indirect savings. This activity typically occurs within the second year after the audit has been completed. Navigant will be asking questions for the direct and indirect savings in the survey with non-participant farms, FlexTech participants and will work with NYSERDA to develop the survey questions for this Study. Figure 4 outlines the direct and indirect savings approach for Ag Technical Services Audits initiative.

Figure 14. Ag Technical Services Audits Savings Approach



The Ag Technical Services Audits BAB tool forecasts only direct savings and not indirect savings. Based on the methodology outlined for direct savings, and discussion with NYSERDA, Navigant used the following methodology to forecast indirect savings:

- Assume total average annual energy use per farm by sector (i.e., dairy, greenhouses, orchards and vineyards, row crops, and other[63]).

[63] The "Other" sector category contains all NY farms not included in the above sectors.

- Calculate average savings per farm implementing measures attributable to audit by technology (e.g., ozone laundry, etc.)
- Forecast number of farms to implement measures attributable to NYSERDA to determine total initiative indirect savings

Figure 5 outlines the methodology Navigant used to forecast indirect savings attributable to Ag Technical Services Audits.

Figure 15. Ag Technical Services Audits Indirect Savings Calculation Methodology

$$(1)\quad \frac{\text{Avg. Annual Energy Use}}{\text{Farm}} \times \text{Avg. Percent Savings Implemented Attributed to Audit} \times \text{Number of Farms Implementing Measures Attributed to Audit} = \text{Annual Indirect Savings}$$

Table 4 outlines the Ag Technical Services Audits indirect savings calculation key assumptions, current data sources, and research Navigant will complete to update assumptions to forecast market adoption.

Table 47. Ag Technical Services Audits Indirect Savings Calculation Key Assumptions[64]

Key Assumption	Original Assumption	Original Source	Updated Assumption	Updated Source (Navigant)	Navigant Forecast Data Source	Survey Question[65]
Number of NYS Farms	2,322 – 5,427 (Number of farms varies by sector)	2012 Census of Agriculture: New York State and County Data	2,322 – 21,723 (Number of farms varies by sector)	2012 & 2017 Census of Agriculture: New York State and County Data	n/a	n/a
Average Annual Energy Use per Farm	85-219 MWh (Varies by crop type)	NYSERDA Report Energy Efficiency in	85-333 MWh (Varies by crop type)	NYSERDA Report Energy Efficiency in	n/a	n/a

[64] N/a indicates Navigant does not intend to update the current data source for the applicable key assumption.

[65] Navigant worked with NYSERDA to develop survey questions for the Ag Technical Services – Audit initiative to assess indirect impacts.

Key Assumption	Original Assumption	Original Source	Updated Assumption	Updated Source (Navigant)	Navigant Forecast Data Source	Survey Question[65]
(e.g., dairy, orchards & vineyards, row crops)		New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities		New York State Agriculture: Summary of Energy Efficiency Programs and Research Opportunities		
Average Percent Savings Attributed to Audit	10%	BAB Tool / NYSERDA Program Staff	0 – 9% (Savings / Total Farm Energy Usage, Varies by sector and type of indirect impact)	Calculated percent based on savings in EnSave Database	n/a[66]	n/a
Percent of Neighboring Farms that will Implement	10%	BAB Tool / NYSERDA Program Staff	10%	BAB Tool / NYSERDA Program Staff	Non-Participant Farm Survey[67]	11,14
Number of Farms to Receive an Energy Audit	164	BAB Tool / NYSERDA Program Staff	298	Category totals from "Navigant Pull List Roll Up 2.28.2019.xlsx" provided by EnSave	n/a[68]	n/a

[66] Navigant did not update the forecast for the average percent savings attributed to audit based on 2018 EnSave data, but will review this data in future years to identify trends and will update accordingly.

[67] Navigant did not update the forecast for the percent of neighboring farms that will implement based on 2018-2019 Non-Participant Farm Survey data, but will review this data in future years to identify trends and will update accordingly.

[68] Navigant did not update the forecast for the number of farms to receive an audit based on 2018 EnSave data, but will work with NYSERDA and EnSave to update forecast in future years.

GLASE

The GLASE BAB tool forecasts indirect savings, using the following methodology:

- Determine average square footage (acres) per greenhouse
- Identify total baseline average annual energy use for lighting
- Determine average annual energy use for lighting based on baseline control strategy and lighting efficiency
- Calculate energy savings comparing baseline and improved energy use based on controls strategy and lighting efficiency
- Forecast number of greenhouses implementing technologies attributable to NYSERDA to determine total initiative indirect savings

Figure 6 outlines the methodology NYSERDA uses to forecast indirect savings attributable to GLASE.

Figure 16. GLASE Indirect Savings Calculation Methodology

$$(1)\quad \frac{\text{Square Footage (Acres)}}{\text{Greenhouse}} \times \frac{\textit{Baseline} \text{ Avg. Annual Energy Use}}{\text{Acre}} = \frac{\textit{Baseline} \text{ Avg. Annual Lighting Energy Use}}{\text{Greenhouse}}$$

$$(2)\quad \frac{\textit{Baseline} \text{ Avg. Annual Lighting Energy Use}}{\text{Greenhouse}} - \frac{\textit{Improved} \text{ Avg. Annual Lighting Energy Use}}{\text{Greenhouse}} \times \text{Number of Greenhouses Implementing Technologies Attributable to NYSERDA} = \text{Annual Indirect Savings}$$

Table 5 outlines the GLASE indirect savings calculation key assumptions, current data sources, and research Navigant will complete to update assumptions to forecast market adoption.

Table 48. GLASE Indirect Savings Calculation Key Assumptions[69]

Key Assumption	Current Assumption	Current Source	Navigant Forecast Data Source	Survey Question in Table 6
Square Footage (Acres) per Greenhouse	6,000 square feet (Small greenhouse) 20,000 square feet (Commercial greenhouse)	GLASE Pilot Site	Non-Participant Greenhouse Surveys	9
Baseline Average Annual Lighting Energy Use per Acre	1,533-46,501 MWh/acre/year (Varies by crop, control strategy, and lighting efficiency)	Cornell Data	Non-Participant Greenhouse Surveys	10
Improved Average Annual Lighting Energy Use per Greenhouse	130-7,324 MWh/acre/year (Varies by crop, control strategy, and lighting efficiency)	Cornell Data	n/a	n/a
Number of Greenhouses Implementing Technologies Attributable to NYSERDA	25% market adoption rate	NYSERDA Program Staff	Non-Participant Greenhouse Surveys + Market Actor Surveys to inform market adoption rate	8,10,20,21,24

Table 6 outlines the key qualitative and quantitative questions Navigant will utilize to update the key assumptions in the market adoption framework to calibrate the indirect savings forecast.

Table 49. Market Adoption Non-Participant Survey Questions

Initiative	Question Number	Market Progress Indicator/Key Assumption	Question	Primary Research
AAET & Ag Technical Services	11	Number of case studies, feasibility studies, economic impact assessments, or any combination of the three developed	Which of the following NYSERDA informational materials related to agriculture have you come across? If you have come across any of the informational	Non-Participant Farm Survey

[69] N/a indicates Navigant does not intend to update the current data source for the applicable key assumption.

Initiative	Question Number	Market Progress Indicator/Key Assumption	Question	Primary Research
		(Initiative Attribution)	materials, did you take an action upon hearing about it? An example of an action is installing LEDs after hearing about their energy savings potential in a NYSERDA best practice guide.	
	19	Number of farms that found the information in the best practice guides useful/valuable **(Initiative Attribution)**	Did you find the information in the best practice guides useful or valuable?	
	23	Number of farms outside of demonstration sites knowledgeable of energy efficiency opportunities for underutilized and emerging technologies **(Initiative Attribution)**	For each type of technology listed below, please indicate if you are aware of that technology or are not aware of that technology. [List underutilized and emerging technologies]	
	7	Number of farms outside of demonstration projects installing advanced technologies as a result of the dissemination of NYSERDA's informational materials **(Current Adoption/ Initiative Impacts)**	Which of the following does your agricultural operation have across all your New York State locations? Select all that apply. [List of various livestock and crops]	
	8		How many of the following does your business have across all of your New York locations? [List of various livestock and crops]	
	31		This question asks about which energy efficient technologies you may have installed or implemented. For each type of technology, please indicate if you have installed or implemented that technology on any of your agricultural operations or	

Initiative	Question Number	Market Progress Indicator/Key Assumption	Question	Primary Research
			facilities in New York State. Please also include the year that you installed or implemented the technology. If you installed the technology in multiple years, please list each year. [List underutilized and emerging technologies]	
	32		How many of the following energy efficient technologies did you install due to hearing about NYSERDA informational materials geared towards the agriculture sector (e.g., a best practice guide, case study, feasibility study, business case scenario, agriculture energy audit, or demonstration site)? [List underutilized and emerging technologies]	
GLASE	24	Number of paid Consortium memberships **(Program Attribution)**	Have you heard of the Greenhouse Lighting and Systems Engineering (GLASE) Consortium?	Non-Participant Greenhouse/CEA Surveys
	20		Where does your company get information on the latest agriculture technologies, market updates, and news?	
	9		What is the total canopy area in square feet across all of your controlled environmental agriculture facilities in New York State? For reference, 1 acre equals 43,560 square feet. Your best approximation is fine.	

Initiative	Question Number	Market Progress Indicator/Key Assumption	Question	Primary Research
	8		What types of crops do you grow in your controlled environmental agriculture facility or facilities located in New York State? Select all that apply.	
	10	Average market penetration of improved technologies in New York greenhouse acreage in the lettuce and tomato sectors **(Current Adoption/ Initiative Impacts)**	What type of lighting technologies are used in any of your controlled environmental agriculture facilities in New York State? Select all that apply.	
	21		This question asks about which energy efficient technologies you may have installed or implemented in your controlled environment agriculture facilities in New York State. For each type of technology, please indicate if you have installed or implemented that technology in any of your facilities in New York State. Please also include the year that you installed or implemented the technology. If you installed the technology in multiple years, please list each year.	

Conduct Market Actor Interviews. In addition to non-participant surveys, Navigant will also conduct interviews with key market actor groups, including vendor and suppliers for the AAET and Ag Technical Services initiatives and lighting chip and fixture manufacturers for the GLASE initiative as a secondary data point for estimating indirect savings, in addition to corroborating the forecasted market adoption. The interviews will assess initiative attribution and the prospective indirect savings by asking about market share by underutilized or emerging technology with and without the program (e.g., if the program were to end in 2019, what would the trajectory of technology market share look like). The qualitative insight from the interviews will provide important context behind the more quantitative market adoption forecast. Table 7 outlines the key qualitative and quantitative questions Navigant will ask market actors.

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Table 50. Market Adoption Market Actor Survey Questions

Initiative	Market Progress Indicator/Key Assumption	Question	Primary Research
AAET & Ag Technical Services	Number of entities that incorporate NYSERDA best practice materials into their best practice efforts (e.g., Cornell Cooperative Extension) **(Program Attribution)**	Does your organization incorporate NYSERDA best practice materials into your existing best practice efforts?	Market Actor Surveys
	Number of Best Practice Guides disseminated by suppliers/vendors **(Program Attribution)**	Have you disseminated Best Practice Guides?	
		How many Best Practice Guides have you disseminated?	
	Number of agriculture vendors and suppliers that use energy efficiency as a tool to sell their products. **(Current Adoption/Initiative Impacts)**	Do you use energy efficiency as a tool to sell your products?	
	Number of consultants, energy service companies, and other energy-focused firms who embrace the piloted business models and incorporate these models as a standard service. (**Current Adoption/Initiative Impacts)**	Have you embraced the piloted business models and incorporated these models as a standard service?	
	Market share attributable to NYSERDA initiatives **(Initiative Impacts)**	If NYSERDA AAET initiative continued through 2030, what do you predict for NY market share for the following advanced technologies as a result of NYSERDA initiatives over the following 10 years? (Provide a list of target technologies by year)	
		If NYSERDA AAET initiative ended in 2019, what do you predict for NY market share for the following advanced technologies as a result of NYSERDA initiatives over the following 10 years? (Provide a list of target technologies by year)	
GLASE		What is your awareness of the Consortium?	Non-Participan

Initiative	Market Progress Indicator/Key Assumption	Question	Primary Research
	Number of Paid Consortium memberships **(Program Attribution)**	Where do you get your technology/market information from?	t Greenhou se/CEA Surveys
	Number of consultants, energy service companies, and other energy-focused firms who embrace the piloted technologies and incorporate these technologies as a standard service. (**Current Adoption/Initiative Impacts)**	Have you embraced the piloted technologies and incorporated these technologies as a standard service?	
	Average market penetration of improved technologies in New York greenhouse acreage in the lettuce and tomato sectors **(Initiative Impacts)**	If NYSERDA AAET initiative ended in 2019, what do you predict for NY market share for the following advanced technologies as a result of NYSERDA initiatives over the following 10 years? (Provide a list of target technologies by year)	
		If NYSERDA AAET initiative continued through 2030, what do you predict for NY market share for the following advanced technologies as a result of NYSERDA initiatives over the following 10 years? (Provide a list of target technologies by year)	

Structured Expert Judgement. Navigant will identify 1-3 subject matter experts in the New York agriculture industry to review the non-participant and market survey data, and market adoption forecast to further refine the forecast and triangulate a point estimate of indirect savings, along with an estimated range of savings.

The market adoption forecast model would be updated throughout the evaluation lifecycle, based on updates to market progress indicators.

Market Adoption Progress

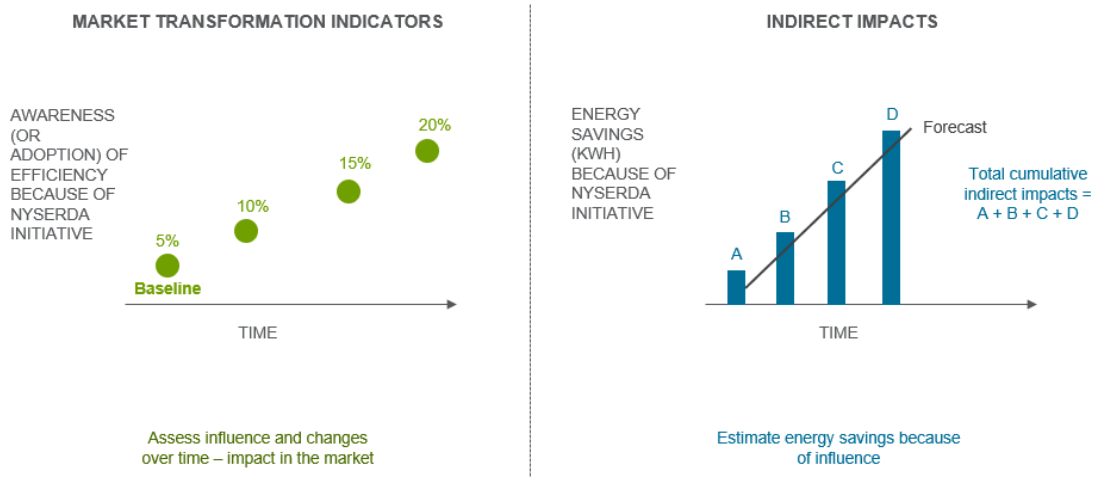
In addition to a forecast of indirect savings, Navigant will utilize market progress indicators, and assign deemed savings for market activity outside of and as a result of initiatives, and ultimately assess indirect savings impacts over the study period, starting in in 2019 for Ag Technical Services – Audits and in 2020

for each of the other initiatives or after sufficient time has elapsed for indirect savings to accrue. Navigant will assess savings based on feedback received in non-participant and market actor surveys on market progress indicators (and as outlined in the Market Adoption Forecast Section). For example, for the Ag Technical Services – Audits initiative we used the following methodology to assess market adoption progress in 2018-2019:

- Asked participants which technologies they installed (including both measures identified in the audit and measures not identified in the audit) due to NYSERDA audits without EnSave assistance (FlexTech participant survey)
- Asked non-participants which technologies they installed due to word-of-mouth or information shared by participants (non-participant farm survey)
- Assigned average deemed savings (determined by the FEAT database) based upon categories of measure technologies installed
- Determined the percent savings for participants and non-participants and applied to the participant and non-participant populations respectively

In addition to a point estimate of savings for each initiative, AAET, Ag Technical Services, and GLASE, Navigant will establish estimated savings for the market adoption progress updates, and use this information to calibrate the forecast for future years. Figure 7 outlines the approach for measuring market transformation indicators and indirect impacts.

Figure 17. Market Transformation Indicators and Indirect Impacts



4. Timeline

The timeline, Table 8, lays out expected start timeframe and cadence for each task. This timeline is approximate, and adjustments are possible based on the completion of initiative activity and feedback from NYSERDA.

Table 51. Indirect Savings Timeline

Agriculture Initiatives	Establish Market Adoption Baseline	Update Market Adoption Forecast	Assess Market Adoption Progress
AAET	0	Use AAET BAB Tool; Update inputs	Ask non-participants which technologies they installed due to NYSERDA demonstration sites; Assign deemed savings
Ag Technical Services – Best Practices	0	Use Ag Technical Services BAB; Update inputs	Ask non-participants which technologies they installed due to NYSERDA informational materials (e.g., best practice guide); Assign deemed savings
Ag Technical Services - Audits	0 (Due to starting indirect savings assessment in 2018	No Ag Technical Services BAB assumptions; Proposed a methodology based on the BAB	Ask participant which technologies they installed due to NYSERDA audits; ask non-participants technologies they installed due to NYSERDA audits; Assign deemed savings

Agriculture Initiatives	Establish Market Adoption Baseline	Update Market Adoption Forecast	Assess Market Adoption Progress
	for participants in 2018 and later)[70]		
GLASE	0	Use GLASE BAB Tool; Update inputs	Ask non-participants which technologies they installed due to GLASE Consortium information; Assign deemed savings
TIMELINE	**2018**	**Initial forecast in 2019 for Ag Technical Services – Audits and in 2020 for all other initiatives; Calibrate forecast in 2019 for Ag Technical Services – Audits and in 2022 for all other initiatives**	**Assess progress in 2019 and 2021 for Ag Technical Services – Audits and in 2020 and 2022 for all other initiatives**

[70] Navigant will work with NYSERDA to identify the appropriate time lag for conducting the participant survey to allow enough time for indirect savings to accrue (e.g., conduct participant survey in 2020 for participants who received an audit in 2018).

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Appendix I: Roadmap for Future Market Evaluation with the Agriculture Sector

Approaches to Future Survey Efforts with the Agriculture Sector

Based on experience surveying various agriculture market actor groups in New York State, the Market Evaluation Team suggests the following approaches (e.g., how to reach the market actors, when to reach the market actors, the survey population source, and suggested changes to survey instruments) for agriculture market actors. The Market Evaluation Team suggests these approaches to streamline data collection efforts and improve market feedback. In addition to these suggestions, the Market Evaluation Team recommends considering other innovative outreach strategies like farm dinners, on-site data collection, or data collection at conferences.

Non-Participant Farms

- *How to reach this group*: The non-participant farms responded to emails (8% completion rate), postcards (1% completion rate), postings on farm organizations' social media pages and newsletters (completion rate not applicable), and phone calls (12% completion rate). The largest number of completes were from emails. The suggested outreach strategy for this group is to use various outreach methods – **emails, postcards, postings on farm organizations' social media pages and newsletters, and phone calls** because all methods were successful. In addition, using a variety of methods allows the Market Evaluation Team to get feedback from farmers who have internet access (email, postcard with online survey address, and posting on social media) and do not have internet access (phone calls).
- *When to reach this group*: NYSERDA staff suggested that winter would be the best time to reach this group because winter is a less busy time of year for farmers. However, many of the contacts were not reachable in winter because it is a less busy time for them and they are away from their farm (e.g., on vacation). NYSERDA staff suggested not contacting farms during harvest time which is September through early October. Another suggestion was to reach farmers on rainy days.
- *Suggested survey population source (no change from the 2018-2019 survey effort)*: InfoGroup data, NYS tax data, NYSERDA contacts, GLASE Consortium contacts

- *Suggested changes to the survey instrument:* The Market Evaluation Team recommends two changes to the survey instruments for this group:
    - After Question #22 (The next set of questions is going to ask you about your awareness and implementation of different energy efficient technologies) add a question if the respondents use technology types. Then, based on those responses, only ask if respondents are aware of a sub-set of the technology list (i.e., the technologies that they use). For example, if a facility does not use compressed air, then they would not be asked if they are aware of compressed air efficiency improvements.
    - The Market Evaluation Team identified additional measure categories that could be used in future years' surveys to improve the "other" category in the Indirect Impacts Tool to better refine the indirect impact estimates. These categories include:
        - Weatherization
        - HVAC Upgrades
        - Insulation
        - Window Upgrades
        - Commissioning
        - Maintenance/Cleaning
        - Reverse Osmosis Machines
        - Thermostats/Timers
        - Robotic Milking System

      The Market Evaluation Team should consider the pros and cons to adding additional measures to the surveys. Pros include having more clarity into the measures installed by the market and improving the indirect impacts estimates. Cons include longer questions in the surveys.

<u>Agriculture Energy Audit Participants</u>

- *How to reach this group*: The Market Evaluation Team had success reaching this group through both emails (22% completion rate) and phone calls (48% completion rate) and would suggest **both email and phone calls in the future**.
- *When to reach this group*: The Market Evaluation Team completed this survey in the summer (July – August). This timeframe seemed to work well as the survey deployment

went smoothly, though this was likely because this was the only group that had participated in a NYSERDA initiative, so they were more likely to respond to a survey from NYSERDA.

- *Suggested survey population source (no change from the 2018-2019 survey effort):* Participant data provided by EnSave, the implementer of the Agriculture Energy Audit Program.
- *Suggested changes to the survey instrument:* The Market Evaluation Team identified additional measure categories that could be used in future years' surveys to improve the "other" category in the Indirect Impacts Tool to better refine the indirect impact estimates. These categories include:
    - Weatherization
    - HVAC Upgrades
    - Insulation
    - Window Upgrades
    - Commissioning
    - Maintenance/Cleaning
    - Reverse Osmosis Machines
    - Thermostats/Timers
    - Robotic Milking System

    The Market Evaluation Team should consider the pros and cons to adding additional measures to the surveys. Pros include having more clarity into the measures installed by the market and improving the indirect impacts estimates. Cons include longer questions in the surveys.

<u>Non-Participant Lighting Manufacturers</u>

- *How to reach this group*: All surveys with the non-participant lighting manufacturers were completed over the phone. Therefore, the Market Evaluation team suggests only contacting this group **via phone in the future**.
- *When to reach this group*: The GLASE Consortium suggested reaching this group during the summer because it is not a time when supplemental light is used in greenhouses. However, our evaluation timing missed the summer time frame, so we reached out to manufacturers in October – March. Any future outreach to this group may be better in the summer, per the GLASE Consortium's suggestion.

- *Suggested survey population source (no change from the 2018-2019 survey effort):* GLASE Consortium and Navigant Research contacts
- *Suggested changes to the survey instrument:* None

Non-Participant Controlled Environment Agriculture (CEA) Auxiliary Service Providers[71]

- *How to reach this group*: Most surveys with the non-participant controlled environment agriculture auxiliary service providers were completed over the phone; however, a few contacts chose to complete the survey online after being contacted by phone. Therefore, the Market Evaluation Team suggests only contacting this group **via phone in the future**.
- *When to reach this group*: The GLASE Consortium did not have opinions on when to reach this group. The Market Evaluation Team completed the surveys with this group in October – April.
- *Suggested survey population source (update from the 2018-2019 survey effort):* In order to target only service providers that work with the agriculture sector, use the list of respondents this year as the survey population.
- *Suggested changes to the survey instrument:* None

Non-Participant CEA Facilities

- *How to reach this group*: The non-participant CEA facilities completed all but one of the surveys over the phone. Therefore, the Market Evaluation Team suggests only contacting this group **via phone in the future**.
- *When to reach this group*: The GLASE Consortium suggested reaching this group in November through February. They suggested that spring and early summer are likely the worst times to reach this group. The Market Evaluation Team completed the surveys with this group December – April. The surveys time frame went through April because many of the CEA facilities asked the team to call back in March or April when things start picking up for them again. The market evaluation team concluded that December-March is considered the offseason for some CEA facilities in NYS.
- *Suggested survey population source (update from the 2018-2019 survey effort):* The Market Evaluation Team may consider the target of the Controlled Environment Agriculture (CEA)

[71] A qualified respondent for this market actor group is an individual who works at a company that provides services or products designed to improve energy efficiency in controlled environment agriculture facilities.

facility population to be more specific high-tech CEA facilities based on comments from the GLASE Consortium during the findings presentation or use other sources for this population such as the Nursery Growers and Greenhouse data set provided by the New York State Department of Agriculture and Markets[72].

- *Suggested changes to the survey instrument:* Before Question #21 (This question asks about which energy efficient technologies you may have installed or implemented in your controlled environment agriculture facilities in New York State) add a question if the respondents use technology types. Then, based on those responses, only ask if respondents are aware of a sub-set of the technology list (i.e., the technologies that they use). For example, if a facility does not use compressed air, then they would not be asked if they are aware of compressed air efficiency improvements.

Non-Participant Grocery Retailers

- *How to reach this group*: The market evaluation team intended to complete 100 surveys with non-participant grocery retailers. However, the team closed the survey after achieving seven completes due to the GLASE Consortium deciding to no longer include this market actor as a focus. The decision from the GLASE Consortium came after attending a Produce Marketing Association (PMA)[73] conference and realizing that the current benefits of the GLASE Consortium were greater to other groups than to grocery retailers. Depending on the direction of the GLASE Consortium, there may still be value in engaging produce managers in the discussion of energy efficiency in CEA facilities. If this is a strategy in the future, working with the Produce Marketing Association may be one way to reach produce managers. Produce Marketing Association is a trade organization representing companies from every segment of the global fresh produce and floral supply chain. PMA helps members grow by providing connections that expand business opportunities and increase sales and consumption. Members of the team met with the executive director of the PMA at a conference in April of 2019. Other ways to reach this group may be through an article in a trade magazine, a newsletter, or a talk at the PMA conference.

[72] New York State, Nursery Growers and Greenhouse, data provided by New York State Department of Agriculture and Markets, available at https://data.ny.gov/Economic-Development/Nursery-Growers-and-Greenhouse/qke7-n4w8

[73] Produce Marketing Association, accessed at https://www.pma.com/.

- *When to reach this group*: The GLASE Consortium did not have opinions on when to reach this group.
- *Suggested survey population source (update from the 2018-2019 survey effort):* Produce Marketing Association (see the text on "*How to reach this group*" above for information on the Produce Marketing Association.)
- *Suggested changes to the survey instrument:* None

Improvements to the Indirect Impacts[74] Tool

The Market Evaluation Team notes one suggested change to the Indirect Impacts Tool. The Budgets and Benefits (BAB) tool assumed all demonstration sites would be in the dairy sector, thus the Indirect Impacts Tool currently has that assumption as well. The indirect impacts resulting from demonstration sites are attributable to the AAET Initiative. Therefore, the AAET methodology in Indirect Impacts Tool will likely need to be modified to address the actual versus modeled type of demonstration sites.

[74] Indirect impacts are energy savings and other benefits resulting from measure adoption associated with indirect program influence.