Cornell University
College of Agriculture and Life Sciences

MEETING REPORT

7/21/2016

CEA Advisory Board summary

CIFS

The CEA Advisory Board convened July 21st, 2016 to share and develop committee progress towards three-year plans for Capital Formation, Education, R&D and Policy/Association. Participants also heard updates on: 1) recent expansion of CEA research and market activity in NYS, 2) federal and state policy and funding activities and 3) current educational efforts. More than 50 attendees participated.

CEA ADVISORY BOARD SUMMARY

At the close of the December 2015 CEA Advisory Board meeting, new Committees on Capital Formation, Education, R&D and Policy/Association were formed and each chairperson accepted the charge of securing four to five members and identifying goals (short-, medium-, long-term) to achieve the vision of their desired **"NYS CEA Future State."** They were encouraged to imagine the future state and then to work backwards to achieve that vision. This group of dedicated professionals met in early April to review the status of their efforts. The July Advisory Board meeting was organized to optimize development efforts of the committees, by gaining feedback from members of the Advisory Board and identifying gaps that may still exist.

Decision

Based on output from the July CEA Advisory Board Meeting, participants re-affirmed the need to create a Strategic Plan for CEA Commercialization in NYS. This should serve as the basis for an integrated, compelling platform to be presented to a range of critical stakeholders including, but not limited to, NYS regulators to communicate the transformative nature of CEA for the state; representatives of sources of significant capital investment; and potential supporters for the new trade association. Thus, the overarching goal of the CEA Advisory Board remains the development of a Strategic Plan for CEA in New York State, and then beyond.

Action Items

- Gather and refine a comprehensive set of profitability models and standards for ongoing investment decisions in CEA production for investors and for NYS. For instance, project NYS potential jobs, revenues and assets in production facilities and skills, industry infrastructure and R&D from large-scale CEA, as well as from small-scale CEA. Consider inclusion of additional quantitative analyses to characterize the CEA market potential:
  - Quantify the size of the market that can be served by NYS with CEA
  - Quantify and demonstrate whether or not turnkey systems for startup of CEA producers provide a faster ROI and basis for growth than large installations
  - Compare state funding commitments to commercialize CEA with Dept of Ag & Markets budgets to sustain traditional farming
  - Describe how the Netherlands, Japan and Ontario are ahead of the US in commercializing CEA, but NYS can leapfrog
  - Explain why ROI for CEA would be faster than for nanotech
  - Consider how CEA is better for farms and agriculture than land leases from farmers by solar developers
- Articulate the pipeline of educational preparation from high school BOCES and Ptech programs to Associate Degree programs to 4-year programs, as well as the role of certificate programs to prepare and maintain a vigorous workforce. Leverage existing programs and the ability to transfer from one program to the next in circumstances that warrant development of technical mastery and industry leadership. Align these resources with the needs of industry positions and organizational levels, both in skill sets and volume. Install a state-of-the-art CEA pilot structure at a NYS institution serving an onsite-cafeteria
- Apply for a USDA ROADMAP grant to develop: 1) a network of multi-institutional university, government and industry CEA R&D experts and 2) a plan which identifies specific, future research areas of inquiry
- Establish an industry association for producers, investors, suppliers, operators and marketers; decide on exact roles the association will play and how it will operate
- Develop a well-delineated marketing and promotional plan for a range of stakeholders from capital investors, state regulators, new and existing producers, and consumers whose value system facilitates retail purchasing decisions

ONE | OVERVIEW OF COMMITTEE PROGRESS

CAPITAL FORMATION

	Capital Formation Presentation
Purpose	Educate and captivate financing sources
Mission	To educate financial markets on and stimulate demand for debt and equity investment opportunities in the indoor agriculture industry
Vision	By 12/31/19, Capital Formation Committee envisions a well-developed group of financing sources focused on CEA, to include banks and other debt providers as well as equity sources focused on projects of all sizes and for sponsors of all types – family farmers to multi-site organizations
Goals	1. Add committee members including government and NGO 2. Benchmark study (design financial analysis of operating and return metrics for indoor agriculture segmented by type of structure, altitude, product category, labor cost, size of operation) – need to find people who will do research (potentially, graduate students in Dyson/Johnson school) 3. Educate the financial community (small farmer educated in CEA will be important for his/her CEA loan qualification) 4. Identify and promote new technologies identified by R&D Committee and others, which will be of interest to AgTech investors (involve Cornell faculty) 5. Facility tours for interested financiers (e.g., Ontario, Canada; Netherlands) 6. Encourage creation of specialty groups and investment vehicles (e.g., loan pool)

Advisory Board Feedback

The Advisory Board discussion identified the need for taking some actions in parallel. For instance, there was a suggestion not to wait until the benchmarking study was completed to make progress on educating the financial industry of CEA opportunities. Therefore, three primary steps were articulated, in addition to initiating the benchmarking study:

- Develop a communication tool, or "pitchbook," to be used with bankers and VC; establish a smaller working group to create this
- Identify USDA and state funding to become a robust finance community like renewable energy is now; secure a connection to the USDA loan division
- Create a Marketing Committee, potentially incorporating Cornell MBA students, and create a LinkedIn Group

EDUCATION & TRAINING

	Education Committee Presentation
Goals	1. Establish CEA Certificate and Associate Degree programs at different institutions which is responsive to industry technical needs 2. Establish CEA Master's Degree program at Cornell 3. Seek direct connections with high school programs that directly address CEA through BOCES, PTech, and other high school agricultural programs 4. Work closely with R&D Committee: Coordinate research programs in applied food production, renewable energy and clean water programs
Progress	1. 5 NYS institutions currently on education committee 2. Associate degree program base curriculum has been established 3. Work in progress to develop base curriculum for Master's program

Advisory Board Feedback

Advisory Board participants were enthused about the educational possibilities in CEA and excellent progress was achieved in this realm. Stakeholders realize that a pipeline of workers representing different training levels and skills is required (e.g. Associate, Bachelor's, Master's and beyond.) There appeared to be agreement that establishing an Associate Degree program is the first priority of the Education Committee and if this is delayed or not possible, a Certificate Program should be advanced. A Certificate Program for CEA offers the benefit that it could be offered to people who want to become employable in the field aside from their formal education. Tempering this was the recognition by experienced faculty from SUNY Cobleskill that keeping a program sufficiently varied in curriculum components ensures that students are equipped to secure a position in another field if a company folds or the CEA industry does not thrive as anticipated.

Much of the remaining feedback centered around specific aspects of curriculum development and ways to promote awareness of CEA as a part of today's agribusiness landscape.

Curriculum Development: Hands-on experience is critical at each educational level Advisory Board participants emphasized that a training facility is critical for students to acquire hands-on, practical skills. One of the proposed solutions was to take small systems into secondary school systems, including through BOCES programs, with CEA producers who are interested. If it works, they should try growing in a bigger facility. One of the challenges mentioned, however, is that traditional public school is not designed to conduct a hands-on program and a lot of schools do not have access to greenhouse-testbed equipment for training exercises. Greenhouses at a school can also be used for students to locally produce their products grown in the facility. The facility should be for research purposes and geared more toward technology development and commercialization. Several participants emphasized the importance of building modern greenhouses to learn in the university.

Curriculum Development: Opportunities in secondary education Some of the positives with this type of program is that there is interaction with industry and business partners, creating opportunities for unique partnerships to fulfill partner needs and integrate the curriculum from public high school. Some suggestions were to make the Ag/CEA pathway to start out in high schools, possibly through BOCES programs, so that students can see and gain experience in the industry. Pat Michel shared that his students in the Ag PTECH program are also able to problem solve with businesses, such as completing a marketing campaign project with Beech-Nut.

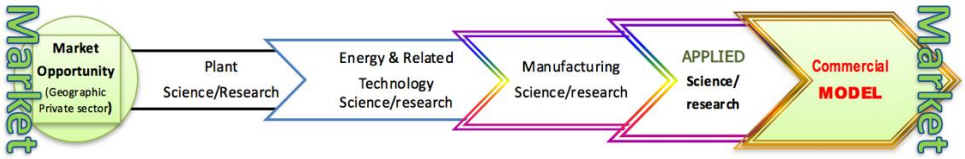
Some concerns were brought up. In the past there was a limitation on internship opportunities and a lack of support at the administrative level. There need to be viable CEA career opportunities in place to motivate students to follow this career path. CEA needs to consider how to get buy-in from younger students and the curriculum could give credits to students for completing internships.

Curriculum Development: Multidisciplinary integration at the university level A participant mentioned that technology-oriented students, such as Computer Science majors, do not consider greenhouses for application and technology. CEA has to find a way to get the idea of greenhouse to students, so if they are interested, they can somehow get CEA certified but continue in their major field. (technological option of indoor ag). Cornell's plant science program would like to teach an integrated CEA skill-set (e.g. plant science, computer science, engineering, including lighting, food science, including food safety and security).

Promoting Awareness: Building the pipeline of talent Advisory Board participants suggested promoting small farms and provide tours for children growing up, so they can start to learn how farms operate and get the concept when they are young. To further expand the awareness of CEA, one idea was to have a teaching-training program for public school teachers to teach about CEA to students, which have multiplier effect in reaching thousands of students.

RESEARCH & DEVELOPMENT

	R&D Committee Presentation
Vision	Create a market and technology-driven CEA model by applying innovative research in markets, products, processes & related technologies
Goals	1. Market driven research – working on the right products based on market demand, economic viability and support; based on interviews with retailers/produce buyers to determine needs and wish list for CEA products 2. Partnerships with other science and research entities for application in the next generation CEA model, such as on energy with Binghamton and lighting with RPI 3. Commercializing/ proof next generation CEA with cost effective growing techniques and synergistic technologies
Considerations	Information research project on best technology from other countries applicable in the US to commercialize CEA Suggested partnership among Cornell, RPI, and MIT



The R&D Committee aims to provide a global perspective of dynamic knowledge and information network/ database targeted to best practices which is done by benchmarking, defining standards, prototyping, commercialization + translation, and evaluating operating costs.

Some of the barriers include energy costs, analytical methods, crop/stage analytics. The current market demand is to obtain highest quality with lowest cost of production. This Committee recommends beginning by surveying unmet needs of produce buyers and culinary professionals.

Advisory Board Feedback

Based on participant feedback, the three-year R&D plan is to be cross-disciplinary and to include transference of applications from other industries (e.g. aerospace). The following areas were identified as important to the R&D program:

1. Environment: buildings, sensing & control, precision agriculture, heating, plant-innovative lighting (e.g., to control pests, to improve nutritional quality)
2. Plant Sciences: various crop species, nutritional quality, plant signals
3. Food safety & shelf-life
4. A recommendation was made to apply for funding from a USDA Roadmap Grant.

POLICY & PROFESSIONAL ASSOCIATION

	Policy/Association
Goal	1. Develop a state (or national/international) CEA industry trade association, which includes all segments of the industry and serves as a nexus for collaboration and to advocate for the industry statewide 2. Develop a charter, with stakeholder engagement
Considerations	• Lobbying and collective representation • Industry Best Management Practices (BMPs) • Inter/Intra industry synergies • Financial offset guidance • Dues and member participation requirements • Prime convener for CEA and across connected industry verticals • Talent and technology transfer and work force development • Sustainability and social responsibility • Possible labeling standard • Compliance support
Other thoughts	NYS-centric "CEA Global" association could have a mission that supports selling produce to the northeast US and selling systems & technology to the world

Advisory Board Feedback

1. Invite Dave Grusenmeyer, Executive Director, NY Farm Viability Institute to participate in the development of the association (and to future stakeholder meetings) and to provide guidance
2. Consider engaging with Cornell Dining to expand experience and presence on the Cornell campus

TWO | CURRENT CEA ACTIVITIES

Neil Mattson provided a summary of Cornell progress since the last CEA meeting in December 2015.

Neil shared the news of the opening of a new 60,000 sf Gotham Greens facility in Queens. This facility is the largest of their four facilities, and it has received $1 million in NYSERDA funding for energy-efficient technologies.

Neil reminded the group that there is an anticipated significant increase in CEA construction in NYS. Three regions in NYS have been awarded upstate revitalization initiative (URI) funding, which are Central New York, Finger Lakes, and Southern Tier. All three regions include food and agriculture. The Southern Tier initiative includes the Southern Tier Agriculture Development Fund (STAD-F) loans and capital for farmers who invest in CEA, as well as the Plant Science Innovation and Business Development Center at Cornell University.

For Cornell CEA Advisory Board, the mailing list has expanded from 48 to 90, an advisory board website has been established, and four committees have been formed (Capital – Bill Vogelgesang, Education – Tim Madden and Wil Hemker, Policy – Keith Sernick and Joe Berman, and Research & Development – George Slilaty). The committee co-chairs meeting was held on April 1.

Neil provided an overview on his activities including sabbatical at UC Davis where he did research on LED light spectrum and prepared an undergraduate course on Hydroponic Production. He participated in a NSF Workshop on urban agriculture and an NSF/USDA INFEWS solicitation to which his team submitted a $3M, 3-year proposal. He also participated in NAS Forum on Solid State Lighting, XPrize Visioneering workshop on Food & AG, as well as in 4th annual Indoor Ag Conference in Las Vegas.

Neil updated the group on the progress made in the Specialty Crop Block Grant, 2-year project (Dec 2015-2017), and Spring 2016 – Consumer Willingness to Pay Studies for Tomatoes and Lettuce that included six auctions with 150 participants comparing categories such as in-state CEA, out-of-state CEA, in-state field, and out-of-state field. Neil also briefly mentioned about the testing for greenhouse performance of HPS vs LED lamps.

His vision is for New York to become the food capital of the East Coast by making smart, strategic investments in agriculture, plant sciences, food processing and added value innovation.

Growth in Upstate CEA: Intergrow's Pursuit

Mr. Dirk Biemans provided an overview of Intergrow, a NYS hydroponic greenhouse tomato producer since 1998. Their main facility is located just south of Lake Ontario in Albion, NY. The company has a total of 70 acres of greenhouse under glass in New York – 45 acres of tomato on vines, 3 acres of cherry tomatoes and 22 acres of beefsteaks. The crops are year-round, locally-grown with lights. Intergrow aims to become more sustainable by using rainwater collected from the greenhouse for irrigation and biomass fuel to light their greenhouse. Their drip irrigation system feeds water directly to the roots of the plants and excess water is re-circulated making it a closed system. They have energy curtains that automatically open and close in accordance with fluctuating temperature, saving 50% of heating. To reduce carbon emissions, they recover CO_2 from their low emissions boiler and recycle it into the greenhouse, which improves photosynthesis and yield.

Intergrow's 2.4 MW combined heat and power generator further reduces environmental impact. Dirk shared about their stringent monitoring for quality and safety, as well as challenges and opportunities for their expansion plans. Challenges include finding the right property, approval process at the local level and finding educated staff in the field, such as interns. Opportunities are strong dollar, limited hydro infrastructure in

Canada, year-round local-supply is in demand, and greenhouse sector is growing. Every aspect of the growth cycle is closely monitored including pollination, water recycling, greenhouse temperature, and eco-friendly pest control. Stringent inspection process throughout packing and shipping to ensure consistent quality to customers.

Their tomatoes are picked at the peak of ripeness and delivered within 24 h of harvest for freshest product. Using their own fleet of temperature controlled reefer trucks and drivers ensures safe and on-time delivery. Intergrow's products are global GAP certified by Primus Labs and USDA. All products include GS-1 data-bar for traceability and meet all PTI case/ pallet label requirements.

Their sources of funding include local bank, Job Development Authority direct loan program (job creation, MWBE contractors), and their equity. Some incentives include Empire State Development (ESD), which provides tax incentives based on job creation and retention, NYSERDA for new construction, process and energy efficiency, and local utility (capital investment, utility infrastructure).

Consumer Willingness-to-Pay for Local CEA Vegetables: The Case of Tomato and Lettuce Study

Irin Nishi provided an update on her project with Dr. Miguel Gomez where they study different origins (NYS vs out-of-state) and different production systems (CEA vs field-grown) of beefsteak tomato and baby lettuce on consumer-willingness-to-pay (WTP). Her result from more than 200 total subjects shows that higher price for both tomato and lettuce was obtained by providing information regarding origins of the produce. Consumers are found to be willing to pay a premium price for local produce (18% for NYS tomato, 19% for NYS lettuce), while production systems do not affect their WTP. Approximately half of the subjects were given further information about origins and production systems. While providing detailed information about the production systems/ origins does not affect consumer WTP for lettuce, consumer WTP decreases for tomatoes. The study is still being conducted to explore the findings.

Baby Leaf Spinach: Consumer Preferences

Two Cornell MBA students, Ziad Jarjouhi and Serdar Mizrakci, presented their results on evaluating consumer response on benefit statements of locally-grown, hydroponic baby spinach. They conducted field interviews with grocery shoppers in Wegmans and GreenStar in Ithaca, a survey of over 100, NYS residents for consumer attitude towards spinach, and a blind taste test of hydroponic vs Wegmans organic. Their interview, which aims to identify problems or opportunities that consumers describe as important that they are seeking to solve while shopping for spinach, resulted in a wide response ranging from "it's just a spinach bro" to "willing to pay a premium."

From the survey responses where consumers were asked to rate nine different benefit statements, nutrition was found to be the most credible and desirable attribute although it was lacking in uniqueness. Their correlation analysis reveals that consumers rated health-benefit claims to be an extremely important attribute compared to taste although they found that consumers are sensitive to taste and texture. Quality and benefits are found to be more important than production method, and the benefit claims have stronger impact on consumer when they are coupled together. For example, they found a stronger claim for credibility when the pesticide-free claim was coupled with the local claim. Similarly, when the claims mention local and fresh, the claim was found to be more desirable. Blind taste tests with 100 consumers revealed a strong preference (62 to 38) for local hydroponic baby spinach over west-coast field-grown baby spinach.

THREE | NEW CAPABILITIES

Agrilyst: Data analytics for CEA

Ms. Allison Kopf introduced Agrilyst, a software company that provides decision support software to help growers make more proactive decisions. The software integrates sensing and control, marketplace, non-tech inputs, drones and robotics, compliance for analytics (yield metrics, forecasts, recipes, reports), insights (academic research, benchmarking, standards), management (crop production, workforce, labor), and risk mitigation (pests, food safety, compliance). Allison mentioned that the lack of software technology caused growers to spend large amounts of time collecting and analyzing data. Also since the data are fragmented, growers might miss revenue-generating opportunities, and reactive decision making has a high risk of potential things that could go wrong.

In an industry-wide survey of 100+ growers in collaboration with Cornell CEA, they found that 10% of labor hours is spent collecting and analyzing data, 93% farmers believe that they can increase crop yield with data analytics on the farm, and 53% want to purchase farm management software this year. Agrilyst ROI results from cutting data hours, cost savings, and potential yield increase. The system is able to show a snapshot of performance, research and recommendation (alert system) for growers. The company was formed in April 2015, with $1.5M seed funding, venture capital, also through NYS. Funding sources include Brooklyn Bridge Ventures, Metamorphic Ventures, B^2, Taurus Ventures, BAI Corporation. Agrilyst has just expanded internationally.

Heliohex and HortLED: Shining the Right Light

Entrepreneurs Adam Milam (Heliohex) and Alex Bodell (HortLED) discussed LED shortcomings, the opportunity for greater levels of lighting control, Cornell as a leading institute and the willingness to facilitate going forward. Horticultural lighting is bigger than business dynamics, and cost-effective business models are needed. One approach is to target the short-term market by developing cost-effective LED lighting systems without sophisticated/expensive features. Another approach is to add value with LEDs, for example capitalizing on spectrum-specific desired plant effects such as flowering, controlled plant height, or phytonutrients. The panel brought up interesting points including most growers do not go through the entire process before selection, and there are not yet industry standards for labelling/reporting. Currently standards are being put together, including safety. Broad spectrum LED is currently regarded as the best choice.

Attendees from RPI's LESA (Tessa Pocock and Bob Karlicek) noted:

- Repeated growth trials with several lights have yielded interesting results regarding anthocyanin nutritional content of lettuce. One light source was capable of increasing anthocyanin content 16x with 24 hours light exposure.
- Stadium lighting, headlights, and consumer lighting are low margin so manufacturer's looking at higher value niche markets (such as horticultural lighting) to maintain profitability.
- Chip manufacturing is a highly competitive sector with margins below 7%

FIVE | EDUCATIONAL PANEL: PREPARING OUR WORKFORCE

Six representatives from different educational institutions from high school to University provided an overview of their programs and initiatives related to CEA/Agriculture, which included a farm-to-bistro initiative, a hands-on hydroponic class, marketing of produce in a farmer's market and school dining halls.

TC3 provides four programs in farming and food systems with a bistro in downtown Ithaca (Coltivare) and a student farm near campus. A Ptech (high school BOCES) program currently has 41 business partners, while the AgTech program has 21 partners and they are looking for more partners. 51 students starting in 9th grade are currently enrolled in the program. At SUNY Cobleskill, which provides Associate and Bachelor's degree, there is a large interest in soilless agriculture. They currently have 22 hydroponics students and in their 2nd year in new greenhouse facilities. Morrisville has operated a CEA greenhouse for educational purposes. Their curriculum includes aquaponics, hydroponics, renewable energy, horticulture, and food. Students market their food to college dining hall and restaurants. A SUNY Broome representative brought up NYSUNY 2020 Grant. SUNY Broom is exploring CEA as a potential part of a production, manufacturing and supply chain emphasis. RPI has observed that engineering students are coming to plant science.

SIX | EMERGING FUNDING AND REGULATORY OPPORTUNITIES

Upstate Revitalization Initiative

Ms. Adriana Condarco-Quesada gave a description regarding changes in the NYS regional economic development activities, including how each region now has a Council to understand better and develop a strategic plan in each respective region. She explained that there is a $1.5 billion funding called the Upstate Revitalization Initiative or URI for economic development that was given to three regions based on the high impact project, potential for job and income growth, transformative income, and investment ratio. For the Southern Tier, one of the recipients of the URI, there are plans for a Binghamton-area innovation ecosystem, food and agriculture industry, advanced manufacturing industry, as well as an enhanced Southern Tier innovation culture. Part of the plan is to build a Cornell Plant Science Innovation Center that includes collaborative space, laboratory support, and a greenhouse. The Southern Tier received $500M in funding in a 4-year timeline. Opportunities for CEA include alignment with URI/ regional priorities, application support, and private enterprise partners.

Growing Certified Organic in Hydroponic and Aquaponics Systems

Ms. Sarah Costin mentioned that the NOP Organic Rule has not yet been modified for aquaponics and hydroponic crop producers. She highlighted that certified organic hydroponic/aquaponics production is possible and that organic growing is process-based, in which producers need to submit an organic system plan (OSP) and products with the USDA organic seal indicate that the product has been 3rd -party verified. In her presentation, she provided examples of procedures, list of substances and prohibited materials in crop production, which pose challenges to organic producers. She also went through the list of regulations, audit trace and mass balance, as well as steps for organic certification.

APPENDIX | COMMITTEE MEMBERS

Capital Committee Members chaired by Bill Vogelgesang

- Tom Cosgrove, Farm Credit East, Enfield, CT
- Derek Denckla, Co-Chair, Slow Money NYC, New York, NY
- Felicia Fowlkes, Food & Agribusiness Finance, MetLife Investments, Chantilly, VA
- Nick Houshower, Equilibrium Capital, San Francisco, CA
- Josh Johnson, Food & Agribusiness, NBH Bank, Denver, CO
- Chris Laughton, Farm Credit East, Enfield, CT
- Roger Saillant, Gardner, Saratoga Springs, NY
- Bill Vogelgesang, EPOCH Pi, Cleveland, OH, Chair

Education Committee Members co-chaired by Tim Madden and Wil Hemker

- Neil Mattson, Co-Director Cornell CEA Program & Founder CEA Industry Ad. Board
- Julie Stafford, Industry Liaison Cornell Institute for Food Systems
- Tim Madden, CEA Fresh Farms & Co-Chair Education Subcomittee
- Wil Hemker, CEA Fresh Farms & Co-Chair Education Subcomittee
- Patrick Michel, District Superintendent HFM Board of Cooperative Education for three NY State Counties
- Kristy Shafer, Principal, HFM BOCE Agriculture Pathways School
- James Dutcher, Assoc. VP SUNY Cobleskill
- George Crosby, Prof. Animal & Plant Science SUNY Cobleskill
- Christopher Nyberg, Dean SUNY Morrisville School of Agriculture & Sustainability
- Deborah Walliser, Founder & CEO of GotProduce
- Anastasia Urtz, Vice President, Division of College-Affiliated Enterprises & Asset Management SUNY Onondaga CC
- Michael Metzgar, Associate Vice President, Economic & Workforce Development SUNY Onondaga CC
- Shaunna Jagneaux, Project Director, Economic & Workforce Development SUNY Onondaga CC

R&D Committee Members chaired by George Slilaty

- Neil Mattson, Cornell CEA
- Amy Cimino, Wegmans
- Marc Lower, Live Better Foods
- Kanad Ghose, Binghamton University, Smart Energy Group
- Debra Morello, SUNY Broome, Applied Technologies and Training
- Kevin Killmeier, Custom Fabrication

Policy/Association Committee Members co-chaired by Keith Sernick and Joe Berman

- Joseph Berman
- Keith Sernick, State Street Advisers