

CHARACTERIZING NEW YORK STATE'S CLEANTECH ECOSYSTEM AND THE ROLE OF NYSERDA'S ICB PROGRAM

Final Report

Prepared For:

New York State Energy Research and Development Authority (NYSERDA)
Albany, NY

Patricia Gonzales, NYSERDA Project Manager

Prepared By:

Industrial Economics, Incorporated (IEc)
Cambridge, Massachusetts

Cynthia Manson, Project Manager

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1. Introduction

1A. Program Description

The Innovation Capacity and Business Development (ICBD) program (formerly Clean Energy Business Development) is one of four programs in NYSERDA's Technology and Market Development (T&MD) portfolio designed to develop the cleantech infrastructure in New York State (NYS).¹ ICBD seeks to develop a vibrant, self-sustaining cleantech innovation ecosystem that will accelerate the pace and scale of cleantech innovation in NYS.² The program lays out three goals in its 2017 Clean Energy Fund (CEF) Investment Plan:

- Accelerate the time to market for cleantech incubator client companies, which can range the full spectrum of hardware and software technologies in various stages of development.
- Evolve the operations and programming of the cleantech incubators so they are more focused on client-driven milestones and quickly able to address client company needs.
- Increase the ability of cleantech incubator client companies to raise seed and follow-on capital from investors and secure commercialization assistance from development partners.³

The ICBD program aims to help entrepreneurs and companies develop business skills and capacities that will enable them to advance technologies to market more rapidly and with greater success rates.

ICBD directs most of its financial resources toward partner organizations such as incubators and universities. This differentiates ICBD from NYSERDA's traditional research and development (R&D) programs, which have typically had direct relationships with companies, and have focused on technology/product development. Under the CEF, NYSERDA is continuing to grow existing cleantech innovation assets, including the key services of the ICBD program, which are business incubators, the Entrepreneurs in Residence (EIR) Program, and proof-of-concept centers (POCCs).

1B. Objectives and Methods of the MCA

This market characterization analysis (MCA) describes the market for ICBD services. At its core, ICBD's market comprises nascent, start-up and growth cleantech companies in NYS that sit within an entrepreneurial ecosystem; the conditions within this ecosystem can enable or constrain the success of entrepreneurs. Unlike traditional MCAs that examine production of and/or market demand for particular technologies or technology groups, this MCA measures the broader "market" of cleantech companies, and the entrepreneurial ecosystem that affects them. The MCA provides a picture of the current size and "vibrancy" of the overall market for cleantech, the resources available in the ecosystem, and the key factors that drive and/or form a barrier to market actors, affecting the pace and scale of cleantech

¹ The other programs include: Market Development; Workforce Development; and Environmental Monitoring, Evaluation, and Protection.

² Clean energy is a sub-set of the broader term cleantech, which is the term used throughout the report. The broader term "cleantech" is used throughout the MCA because several key reports and data sources relied on in the MCA use "cleantech", such as the Cleantech i3 database, and NYSERDA Innovation Metrics Reports (2013 and 2016). In addition, the latest CEF investment Plan for ICBD (Jan. 2017) uses the term "cleantech" as do several ICBD incubators use the broader category of cleantech to describe their area of focus. Cleantech is defined as "a new technology and/or related business models intended to provide solutions to global climate or resource challenges, or desire for energy independence, while offering competitive returns for customers and investors. Cleantech represents a diverse range of products, services, and processes, all intended to provide superior performance at lower costs, while reducing or eliminating negative ecological impact, at the same time as making more efficient and responsible use of natural resources." ² Kachan, 2010 "Definition and taxonomy of cleantech." Accessed online on 9.15.2015 at <http://www.kachan.com/about/cleaner-technology-definition-cleantech>

³ These goals reflect the latest CEF investment plan, published in January 2017. The MCA also provides information on some of the considerations of the ICBD program that were described in previous CEF investment plans, which are assumed to be still of interest. These include: mapping the technology-to-market pathway; identifying key market players, identifying gaps that are critical to the commercial success of early-stage/growth businesses; targeting gaps where NYSERDA can have an impact that is unlikely to be achieved by other entities; investing in organizations/institutions; implementing activities to leverage existing resources and focus new strategies to fill-in identified gaps; and linking companies to resources and increase awareness of the clean energy venture environment in NYS to attract both investment and entrepreneurs. NYSERDA, Jan. 2017, Clean Energy Fund Investment Plan: Innovation Capacity and Business Development Chapter. Accessed online Jan. 28, 2017 at: <https://www.nyserdera.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Innovation-Capacity-Business-Development.pdf>.

innovation in NYS. The ecosystem includes NYSERDA’s ICBD services, and the MCA helps to document ICBD’s role and contribution to the market.

Beyond the data collected, this MCA demonstrates an approach to measuring the baseline market for ICBD program services, providing actionable intelligence about current market conditions and needs that can inform ongoing program work. It also provides insight into options for measuring changes in entrepreneurial ecosystems, noting accessible indicators, metrics and data sources that can document program impacts. Appendix A provides a detailed summary of indicators and available data.⁴

The MCA employs four research methods: a desktop research and literature review; 68 in-depth interviews with a range of stakeholders (including cleantech companies, investors, business development service providers in NYS and other states, and large companies); an online survey completed by 311 stakeholders (emphasizing ICBD participants); and secondary data sources providing data to support quantitative metrics. The research occurred between 2015 and 2016, and reflects market conditions in those years. Section 4 of the Report, and Appendix B provide details on the methods and limitations of the research. Table 1 summarizes the study objectives, purpose, and methods.

Table 1. Study Objectives, Purpose, and Methods⁵

OBJECTIVE	PURPOSE	METHODS
Identify an effective way to measure the market for ICBD services (those offered to cleantech companies and entrepreneurs in NYS). Section 1D and Appendix A	<ul style="list-style-type: none"> Support the development of indicators for gathering market intelligence and baselines, by examining available indicators, metrics, and data sources. Identify indicators that can effectively track progress under the CEF, toward an environment that fosters cleantech business innovation and growth. 	Literature review; Metrics map (a list of indicators, metrics, and data sources); Compilation and analysis of secondary data sources.
Characterize the market for ICBD services. Section 2A.	<ul style="list-style-type: none"> Map and measure the number and characteristics of nascent, start-up and growth cleantech companies in NYS. 	Desktop research; Interviews with 68 stakeholders; Survey of 311 stakeholders; Quantitative data.
Articulate the key determinants of the market, and identify the critical resources in the entrepreneurial ecosystem that cleantech companies in NYS are able to access. Sections 2B, 2C, 2D	<ul style="list-style-type: none"> Provide intelligence on existing resources available to cleantech companies in NYS. Analyze available financial, human and intellectual property resources. Explore the landscape of ICBD and related incubator-type programs in NYS. Identify emerging geographic clusters of resources. 	Desktop research; Interviews with 68 stakeholders; Survey of 311 stakeholders; Quantitative data and analysis.
Gather stakeholder opinions on the drivers and barriers facing the market and that affect the ecosystem. Section 2E.	<ul style="list-style-type: none"> Gather direct knowledge from stakeholders on entrepreneurship conditions in NYS of relevance to cleantech. Identify barriers, gaps, and where further intervention is most needed. 	Interviews with 68 stakeholders; Survey of 311 stakeholders.
Document NYSERDA’s role in the NYS cleantech ecosystem and the initial outcomes achieved by companies and entrepreneurs that have received services from ICBD. Section 3.	<ul style="list-style-type: none"> Capture early indicators of the benefits and outcomes achieved by clients of ICBD-funded programs. Identify services that clients found most useful and additional services still needed. Provide baseline data for measuring future impacts of ICBD under the CEF. 	Interviews with 68 stakeholders; Survey of 311 stakeholders.

⁴ Previously, in the “Metrics Map” memo provided to NYSERDA, IEc identified 93 indicators, 360 metrics and many different data sources to support the measurement of NYS’s cleantech entrepreneurial ecosystem. The subsequent data collection and analysis conducted for the MCA enables us to considerably sharpen this list of indicators.

⁵ The objectives and purpose provided in the table reflect the structure and output of the MCA, which evolved since the work plan was last revised in 2015. The evolution was due to the research and analysis conducted and further refinement of the measurement approach taken throughout the project.

1C. Key Definitions Used to Measure the “Market” for ICBD Services and the NYS Cleantech Ecosystem

To know how the ICBD program is contributing to “the development of a vibrant, self-sustaining cleantech innovation ecosystem that will accelerate the pace and scale of cleantech innovation in NYS,” it is critical to identify a clear baseline description of that ecosystem. This section summarizes the key concepts, definitions, and indicators that describe the market for the ICBD program – that is, cleantech companies in NYS and the entrepreneurial ecosystem that enables or constrains them.⁶

The entrepreneurial ecosystem that is the focus of ICBD’s market efforts is defined as a “*dynamic group of highly interconnected actors, resources, and a range of institutional and infrastructural supports that promote an innovation economy.*”^{7,8} Figure 1 describes the elements that make up this ecosystem; black text identifies the key elements that are supported with quantitative data in this MCA, and gray text indicates elements that are described qualitatively.

- In the center of the ecosystem are the **early-stage cleantech companies in NYS** – the group of actors that the ICBD program mainly focuses on serving.^{9,10} Early-stage companies fall into one of the three following categories:
 - **Nascent companies:** individuals and/or teams that have a cleantech innovation, that have either recently incorporated (in the last three months) and/or that are participating in an established entrepreneurship program (such as a POCC or incubator). Most nascent companies are less than one year old.¹¹
 - **Start-up companies:** technology companies already growing, from one to five years old.
 - **Growth companies:** technology companies with growth potential, and from six to 20 years old.¹²
- **Cleantech focus:** companies that are primarily focused on cleantech as their main line of business or the main market application of their technology.¹³
- **New York State presence:** to have an identifiable role in the entrepreneurial ecosystem of NYS, the company has to be headquartered in, or have a significant operating presence in the state.

⁶ This section addresses Research Question 1 from the work plan: *Given the complexity of measuring dynamic entrepreneurial ecosystems as recognized in the literature, what is the most effective way of measuring the market for ICBD services, defined as nascent and existing clean energy companies and entrepreneurs in NYS?*

⁷ Isenberg Daniel, May 25, 2011, "Introducing the Entrepreneurship Ecosystem: Four Defining Characteristics" Forbes Magazine, accessed September 25, 2015

⁸ Mason Colin and Ross Brown, "Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship" OECD LEED Program, 2014.

⁹ The January 2017 CEF Investment Plan for the ICBD Program describes as its’ market focus “Entities working with and investing in seed-stage through start-up and growth-stage cleantech start-up companies in New York State”. Clean Energy Fund Investment Plan: Innovation Capacity and Business Development Chapter. Accessed online Jan. 28, 2017 at: <https://www.nysesda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Innovation-Capacity-Business-Development.pdf>.

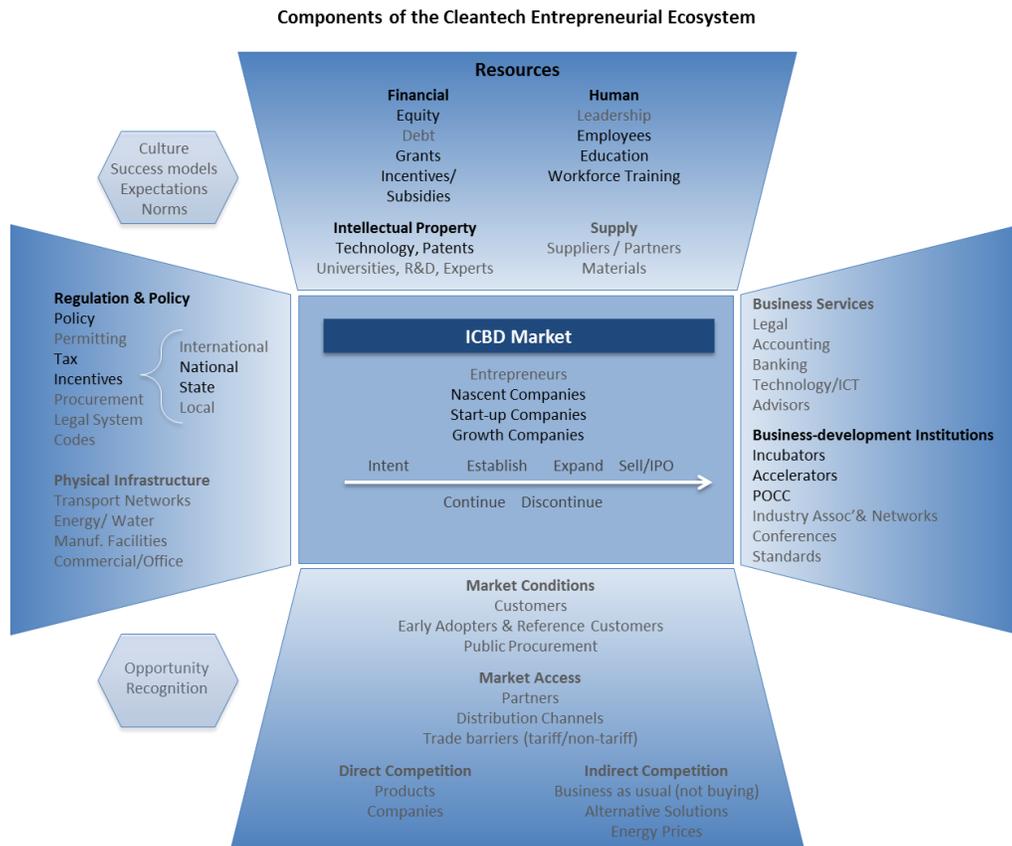
¹⁰ An additional population of *potential* cleantech entrepreneurs such as students or individual entrepreneurs that have a cleantech project in development also exists, but is difficult to document. The only reliable data collected on potential companies as part of this MCA were from survey respondents in NYSEDA-funded POCCs that had not yet incorporated a company.

¹¹ This MCA defines nascent companies as those incorporated in the last year (i.e., during 2016). Nascent companies are defined by the Global Entrepreneurship Monitor as “in the process of starting, less than 3 months old.” Global Entrepreneurship Monitor, 2017 “Key terminology.” Accessed online Jan. 21, 2017 at: <http://www.gemconsortium.org/wiki/1154>.

¹² IEC chose 20 years as the cut off because this is the approximate period in which cleantech came to be a category. Our interviews with a range of cleantech companies revealed that many such companies exist in NYS, are pursuing cleantech innovations, are accessing NYSEDA resources including ICBD programs, and make up an important part of the cleantech innovation ecosystem.

¹³ One of the challenges with measuring “cleantech companies” is not all of them self-identify as “cleantech,” and also that cleantech crosses over and draws upon technologies from other sectors. This is particularly so for companies in earlier stages (who are still exploring different markets) and/or those with technologies that may have multiple applications or end-markets; and for larger companies with many different business lines. IEC relied on the definitions of cleantech in existing datasets and reviewed them for consistent categorization of segments within the cleantech universe.

Figure 1. Overview of Components (Factors and Resources) Comprising the Cleantech Entrepreneurial Ecosystem



In the entrepreneurial ecosystem that surrounds these companies, **critical resources** are the financial resources (money), human resources (people), and intellectual property resources (ideas and technology) in NYS that entrepreneurs and companies use to establish and grow their business. These resources are provided by different actors, including investors, large companies, universities, service providers (lawyers, accountants, marketers, and event managers), mentors, and advisors. In addition, a healthy ecosystem may have one or more areas where resources are geographically concentrated, so that companies in those areas have access to proximate resources, including university or other research facilities, skilled workers, investor and other financial resources, and firms at different and complementary stages on the production and supply chain.

The **institutional and infrastructure support** that promotes cleantech innovation in NYS includes the initiatives and organizations that provide specific business “business development” services to nascent and start-up/growth companies, including incubators, accelerators, POCCs, and entrepreneurs-in-residence programs. These organizations provide a range of business development services such as office space, lab space, business planning, training, coaching, and networking/introductions.

To characterize this entrepreneurial ecosystem, it is important to consider not only the “number” of companies and describe available resources, but also document interdependencies and connections among these actors, and the drivers and barriers that affect size and “health” of populations. Finally, external factors can affect the broader economy and specific technology markets. This MCA examines these factors as **drivers** and **barriers** facing cleantech nascent and start-up/growth companies in NYS. Factors include regulatory, policy and incentive frameworks, prices for key commodities (e.g., fuel, energy, and water), manufacturing capabilities, access to markets and customers, and “entrepreneurial climate” or

cultural factors that can influence decisions to pursue entrepreneurship or to join an early-stage cleantech company.

In this context, ICBD's program aims to encourage entrepreneurs to form successful cleantech companies, and to accelerate commercialization efforts, generate revenue, grow employment and, ultimately, to apply their clean technologies to achieve system-wide benefits. Section 3 identifies a few **early signals of ICBD program impact** on the ecosystem, and provides some insights into the importance of different program services to participants, as provided by ICBD and other, complementary resources available in NYS.

Appendix A summarizes the key indicators used in this MCA to identify the baseline status and health of the existing entrepreneurial ecosystem in NYS.

1D. Key Limitations of the Research

This MCA represents a snapshot of the current cleantech ecosystem in NYS. While the MCA provides a relatively comprehensive overview of the NYS cleantech entrepreneurial ecosystem based on the best available data, it does not consider longitudinal patterns and trends, and does not capture all market activities and interconnections taking place. Limitations of the research methods employed in the MCA include:

- Definitions of cleantech and clean energy companies vary among data sources. To ensure consistency, IEC chose the broader term “cleantech”, and re-categorized data where needed, aligning with Kachan’s definition and list of cleantech segments.¹⁴ IEC also notes key differences between data sources that affect results, and highlights the clean-energy subset of data wherever possible.
- Eleven indicators initially targeted in the Work Plan did not have data readily available (e.g., number of business closings and university licenses in cleantech). To mitigate this, the MCA draws on a range of primary and secondary data sources, reflects extensive crosschecking of sources, and identifies key data gaps.¹⁵
- Primary data gathered for the study (interviews and survey) reflects the ecosystem in 2016, whereas quantitative data reflects a range of years depending on the source, from 2014-2016. The time period for the MCA should therefore be considered as the years 2014-2016. Time periods for the data presented are noted throughout.
- As the “ecosystem” metaphor infers, connections among resources, drivers, and barriers are important and can influence outcomes. Given data constraints, the study did not include a statistical analysis of these connections; instead, the MCA describes these connections qualitatively.
- This MCA does not include a formal benchmarking of the NYS ecosystem with other states or regions. Where data are available, the MCA does compare NYS parameters with those in other states, or with U.S. averages.

¹⁴ Kachan & Co. 2012. A new cleantech taxonomy.

¹⁵ Further discussion of data sources and indicators is provided in Appendix A.

2. Characterizing the NYS Cleantech Ecosystem

2A. The Population of NYS Early-Stage Cleantech Companies

This section describes the population of cleantech companies in NYS, including the stage of growth they have achieved (as indicated by years in operation), size (number of staff and revenues), geographic distribution, the cleantech market segments within which companies operate, and whether they have participated in a NYSERDA program. This represents a snapshot of early-stage cleantech companies currently active in NYS, recognizing that this population is far from static.

2A.1. Total Number of NYS Early-Stage Cleantech Companies¹⁶

To estimate the population of early-stage cleantech companies operating in NYS today, IEC combined and crosschecked company data from eight separate data sources, then supplemented these data with targeted web searches to address data gaps.¹⁷ Companies included in the combined dataset must be currently in operation, based in NYS, less than twenty years old, and focus on cleantech. The full dataset reflects both cleantech companies targeted by ICB (nascent, start-up and/or growth stage companies) and more mature entities that have been in operation for more than twenty years; but the analysis presented in the report focused on early-stage companies only. Because the dataset is built in part on secondary data, the number of companies for which any specific data point is available (e.g., number of employees, incorporation data) varies, and is noted in the text.

Table 2. Number of Early-Stage Cleantech Companies Identified in NYS by Stage of Growth

NASCENT COMPANIES (<1 YEAR OLD)	START-UP COMPANIES (1-5 YEARS OLD)	GROWTH COMPANIES (6-20 YEARS OLD)	MATURE COMPANIES (>21 YEARS OLD) ¹⁸
10	241	398	305
649 early-stage cleantech companies incorporated between 1997 and 2016 ¹⁹			305
954 cleantech companies identified (all stages)			

Source: Combined IEC dataset

Due to the limitations of data collection methods, the 954 companies identified likely understate the total universe of cleantech companies in New York. While it is impossible to determine with precision the total number of cleantech companies, IEC estimates that roughly 25% more cleantech companies in NYS might meet the criteria than are in the final count. This may include companies that: joined ICB incubators and POCCs after data were collected; moved to NYS or recently developed a substantial operating presence in NYS; are in “stealth” mode (i.e. not yet providing public information); have technologies licensed to, or joint ventures with larger companies; were classified in adjacent technology segments and/or not

¹⁶ This section answers Research Question 2 from the work plan: *Approximately how many nascent and existing cleantech companies and entrepreneurs are in NYS?*

¹⁷ The initial data sources used to populate the combined dataset were: the CEI Inventory Database (produced by Meister Consulting Group for NYSERDA in 2016); CBI Insights; Cleantech i3; EIR client data; lists of companies participating in five of the six NYSERDA-sponsored incubators (provided by incubator managers in July 2016); relevant companies that received R&D demonstration project funding from NYSERDA; contacts provided by NYSERDA for the IEC interviews; and relevant contacts suggested by Stage One participants of the IEC survey. IEC also checked each of these companies to verify that they were still in operation (such as an up-to-date website), and excluded several that appear to be dormant. In addition, the method excludes companies that had been acquired by an out-of-state or larger company that was not otherwise cleantech.

¹⁸ These companies were incorporated between 1823 and 1996 and are still in operation today. As mature companies, they are excluded from the analysis of characteristics of companies in Sections 2.B.3-5 below.

¹⁹ Included in the total of 649 companies were 26 companies for which incorporation dates could not be found, but that are enrolled in ICB-sponsored incubator programs. Given that they are in an incubator, IEC assumed that these companies are early-stage, and assigned them as 2015 start date.

promoting themselves as cleantech; or have current or potential cleantech applications but also have other substantial business lines.

Overall, however, this combined data set provides a strong indicator of the size of the universe, and IEc uses the estimate of 649 early-stage cleantech companies to describe the market that is the focus of the ICBD program.

2A.2 Potential (Not Yet Nascent) NYS Cleantech Companies and Entrepreneurial Activity

Entrepreneurs or teams that have not yet incorporated also represent an important part of the market for the ICBD program, because they are at the earliest stage of development and are often in need of resources and capacity building. However, reliable data about them are unavailable. Therefore, the MCA describes this population using partial data and anecdotes from the IEc survey and interviews, coupled with insights from secondary sources on broader patterns of entrepreneurship. For example, the IEc survey found that 25 (49%) of the participants in the two ICBD-funded POCCs expect to incorporate a company based on the technology they are developing in the POCC within the next three years, and an additional three intend to incorporate a company at “a later date.”

The Global Entrepreneurship Monitor (GEM) also offers some insights on overall patterns in entrepreneurship, as well as trends in NYS relative to the rest of the U.S.²⁰ The GEM uses the measure of “total early-stage entrepreneurial activity” (TEA), which represents the percentage of the 18-64 year-old population who are either nascent entrepreneurs or owner-managers of a new business.²¹ TEA rates reveal information about the rate at which individuals pursue entrepreneurial opportunities, how that varies over time, and how NYS compares with the rest of the U.S. in these patterns. The GEM study provides the following insights into the broader entrepreneurship environment in NYS relative to the U.S.:

- In 2015, GEM found that NYS has a total TEA rate of 10%, which is slightly lower than the U.S. average TEA rate of 12%. In comparison, California is on par with the national average at 12% TEA, and Florida leads at 17%.
- NYS entrepreneurial sectors are more heavily skewed towards “transforming” industries (i.e., manufacturing) than the rest of the U.S., which is more typically composed of consumer-oriented and business-services businesses.
- New York entrepreneurs are more likely to offer “innovative products or services” (measured as the percentage of TEA with new product/market combinations) compared to the U.S. average.

2A.3 Trends in Incorporations for NYS Early-Stage Cleantech Companies

The universe of early-stage cleantech companies in NYS is diverse in terms of company age. Figure 2 shows the total number of early-stage cleantech companies in NYS by year of incorporation.²² Not unexpectedly, recent incorporations are well represented among active companies, but companies older than 10 years also represent a significant portion of the universe. Among early-stage companies that are active today, the largest incorporation year was 2009; this time period followed the 2007-2008 financial crisis and coincided with the passage of federal stimulus packages, which is consistent with academic literature that suggests patterns of higher entrepreneurship rates occur during economic downturn.²³

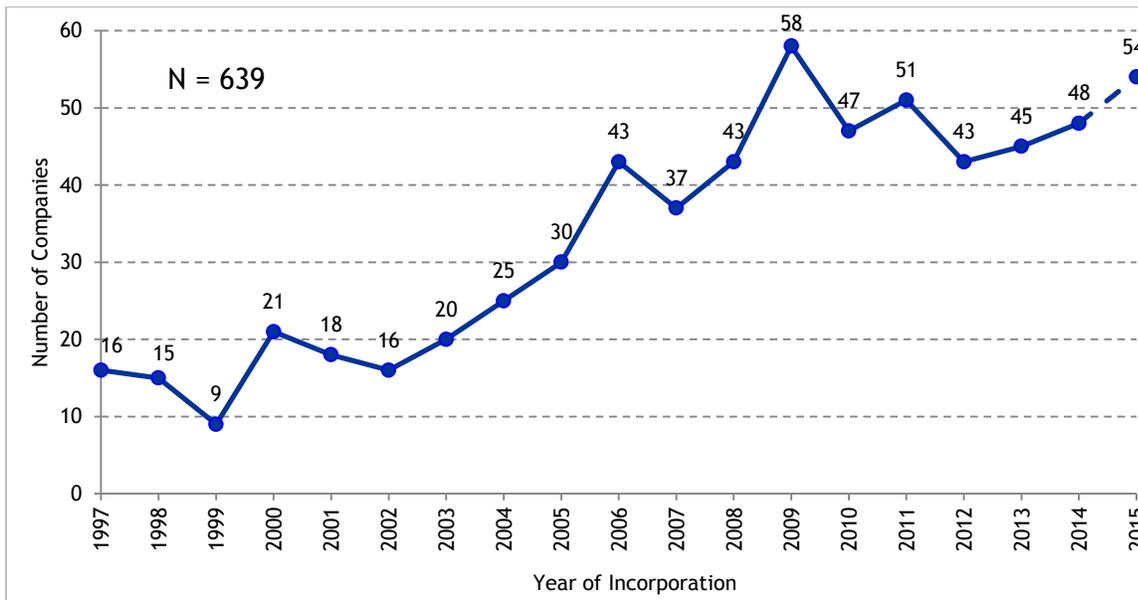
²⁰ Kelley, et. al. (2015) Global Entrepreneurship Monitor: 2015 United States Report.

²¹ The GEM TEA measure includes nascent companies (defined as “in the process of starting, less than 3 months old”) and new companies (defined as “3 to 42 months old”). Global Entrepreneurship Monitor, 2017 “Key terminology.” Accessed online Jan. 21, 2017 at: <http://www.gemconsortium.org/wiki/1154>

²² 2016 is not shown given that a subset of the data was collected from ICBD programs in mid-2016.

²³ This phenomenon appears due to the lack of other employment options; higher local unemployment rates are correlated with increased probability that individuals start businesses Fairlie, R. 2013. Entrepreneurship, Economic Conditions, and the Great Recession. Journal of Economics & Management Strategy, Volume 22, Issue 2 Summer 2013. Pages 207–23

Figure 2. Number of NYS Early-Stage Cleantech Companies by Year of Incorporation (1997-2015)²⁴



Source: IEC Combined Dataset

Another key indicator of “ecosystem health” is the rate at which companies fail, move out of the market, or merge. Because companies are not required to report closings, bankruptcies, or relocation out of state to any central data source, it was not feasible to conduct a comprehensive analysis of the rates at which cleantech companies are closing, merging, or relocating NYS operations. Our data review identified seven companies that had definitely closed, and five that had been acquired by larger companies, but these data are not comprehensive.

In absence of comprehensive state data, the GEM provides a more general indicator of these market dynamics; in 2015, the U.S. shows a slightly higher than average level of “business discontinuation” compared to similar countries.²⁵ GEM estimates that in 2015, 3.6% of the adult population closed a business in the previous year – these businesses include any and all small business – including technology, services, retailers and others, but are likely generally consistent with NYS patterns.²⁶

2A.4 Size of NYS Early-Stage Cleantech Companies²⁷

To measure the size of NYS early-stage cleantech companies, IEC employed two indicators: number of staff in full-time equivalents (FTEs) and annual revenue. Figure 3 shows the number of companies by staff size. For the subset of 517 companies in our combined data set where information was available:

²⁴ This figure includes the 18 incubator clients for which IEC could not find an incorporation date in year 2015. These were likely to have been incorporated in the 2014-2016 period given that they were participating in ICBID-sponsored cleantech incubators.

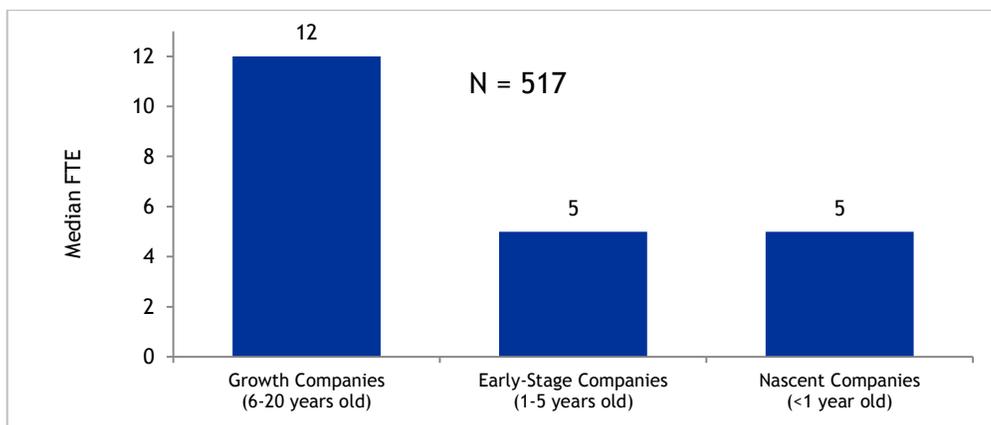
²⁵ The yearly Global Entrepreneurship Monitor (GEM) has been produced by an academic consortium since 1999. It studies two main dimensions: the entrepreneurial behavior and attitudes of individuals, and the national context and how that impacts entrepreneurship. In 2015, more than 190,000 individuals were surveyed across 62 economies, including 5,944 in the United States. National teams in each participating economy administer the surveys with central oversight by the GEM coordination team. The GEM U.S. team is based at Babson College in Massachusetts, in partnership with Baruch College, New York. See <http://www.gemconsortium.org/about/gem>

²⁶ Kelley, et. al. (2015) Global Entrepreneurship Monitor: 2015 United States Report, Page 18. This dataset includes all types of new companies, including service and small businesses, as well as technology companies. There is no percentage breakdown of these companies by type in the publicly available GEM data for NYS.

²⁷ Addresses Research Question 2.2: *At what stage of growth is the company/entrepreneur in currently? Since when?*

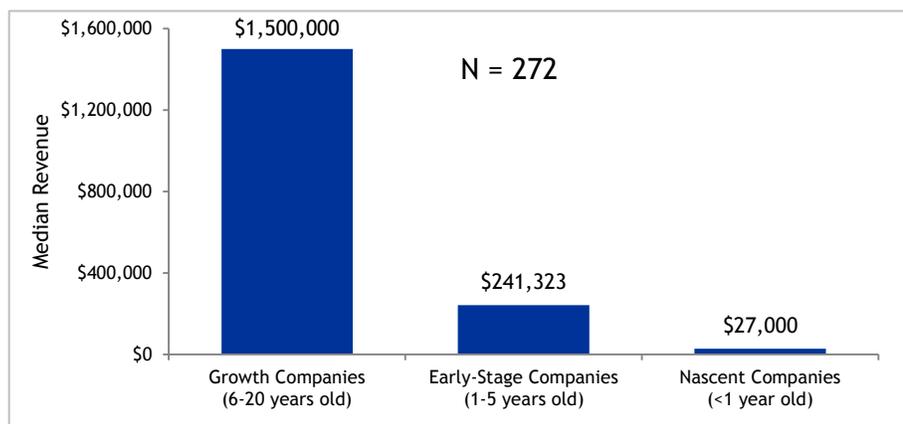
- Median staff size was six FTEs and the average staff size was 112 FTEs.
- Nascent companies (<1 year old) have a median staff size of 5, start-up companies (1-5 years old) have a median staff size of 5, and growth companies (6-20 years old) have a median staff size of 12.

Figure 3. Median FTE for NYS Early-Stage Cleantech Companies by Age of Company²⁸



Source: IEC Combined Dataset

Figure 4. Median Revenues of NYS Early-Stage Cleantech Companies by Age of Company



Source: IEC Combined Dataset

For the 272 companies in the dataset with revenue data, the median annual revenue was \$849,200 in 2016.²⁹ As with employment, revenues grow with company age. Figure 4 above shows the distribution of median revenues by nascent, early-stage and growth companies incorporation, with revenues growing as companies mature.

²⁸ Data on company FTEs were retrieved from multiple sources including Manta and LinkedIn, which provide a range of FTEs instead of the exact number. In the analysis for Figure 3, where the exact number of FTE was unavailable, the mid-point of the reported FTE ranges was used. For example, a company with 1-10 employees was assumed to have five employees. For nascent companies, FTE data was found for four companies, of which three of them have 1-10 employees. Consequently, the median number of FTEs among nascent companies may be an overestimate due to the use of a midpoint and limited data.

²⁹ The mean revenue figure was skewed by 38 companies that have annual revenues above \$10 million. See Table C1.1 and Figure C1.5 in Appendix C1 for a more detailed representation of company revenues for NYS early-stage companies.

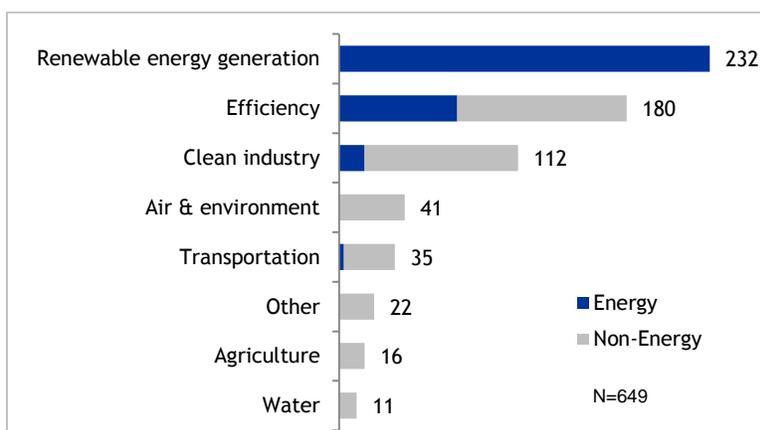
2A.5 Types of technologies being commercialized by NYS early-stage cleantech companies³⁰

Cleantech companies in NYS are developing and commercializing a number of technologies in different market segments. Analysis of the 649 cleantech companies indicates that:

- 232 (36%) focus on renewable energy generation (e.g., solar and batteries)
- 180 (28%) focus on energy efficiency (e.g., smart grid and green buildings)
- 112 (17%) are categorized in “clean industry” (e.g., Materials innovation)

Appendix C provides more details on the segments and sub-segments of companies. As Figure 5 below shows, energy-related markets and technologies dominate the cleantech market. Interviewees (including cleantech companies, investors, incubator directors and EIRs working in a range of cleantech sectors) confirmed this finding, identifying concentrations in energy storage/batteries and solar in NYS, as well as the state’s technical capabilities in nanotechnology and manufacturing, which enable these cleantech applications.

Figure 5. NYS Early-Stage Cleantech Companies Primary Clean Technology Segments



Source: IEC Combined Dataset

2A.6 Location of NYS Early-Stage Cleantech Companies³¹

Early-stage companies in the NYS cleantech ecosystem appear to be well-distributed geographically. The New York City region (which has a combined population of about 8.4 million), and New York City predictably have the largest number of early-stage cleantech companies (221 companies, or 34% of the total). An additional 56% of identified companies are spread across five regions (Capital Region/Northern Catskills, Western Finger Lakes, Long Island, Central NY, and Western NY regions). The remaining 11% of companies are located in three regions: Lower Hudson Valley, Eastern Adirondacks/Lake Champlain and Western Adirondacks/Eastern Lake Ontario, as seen in Figure 6. Interviews with 21 early-stage cleantech companies reveal that many choose locations based on founders’ existing residences and networks. Founders of non-New York City companies in particular are often connected professionally to universities or existing companies, and develop their businesses where they are already established.

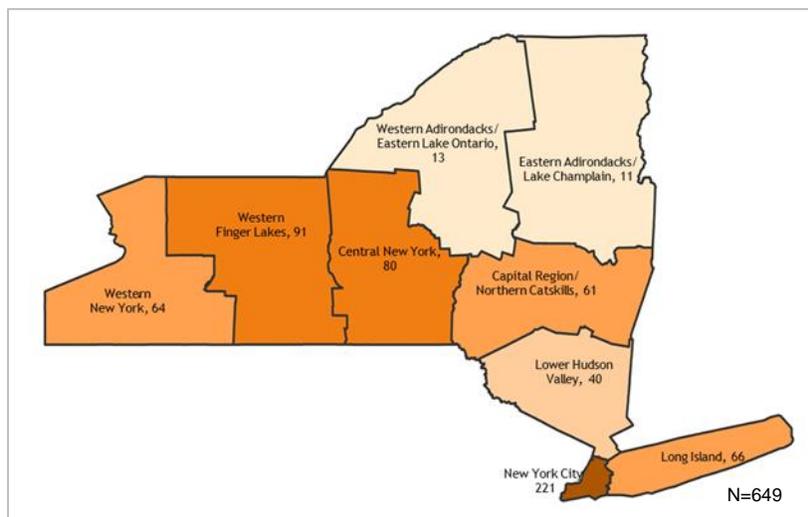
When the regional distribution of early-stage cleantech companies is normalized by regional population, the Capital/Northern Catskills, Western Finger Lakes, Central New York, and Western New York regions

³⁰ Addresses Research Question 2.1 *What types of clean technologies are they pursuing?* Note, the order of the research questions in the report was flipped, so that 2.2 (on stage of growth) comes before 2.1 (type of technology)

³¹ Addresses Research Question 2.3: *Where are early-stage cleantech companies located within NYS?*

all show higher concentrations, reflecting 298 early-stage cleantech companies located in these regions with a population of about 4.9 million.³²

Figure 6. Number of Cleantech Companies by NYS Region



Source: IEC Combined Dataset

2A.7 Participation of NYS Early-Stage Cleantech Companies in NYSERDA Programs³³

- According to our data, as of July 2016, roughly half of NYS early-stage cleantech companies (53% of the 649 total)³⁴ have participated in at least one NYSERDA program, such as an ICBD POCC or incubator, a PON, or another research and development program as tracked in the NYSERDA R&D Metrics database (38% of all NYS early-stage cleantech companies have participated in one program (including 167 who participated only in ICBD))
- 10% of all NYS early-stage cleantech companies have participated in two to five programs (including 32 ICBD participants), and
- 5% of all NYS early-stage cleantech companies have participated in more than five NYSERDA programs (including 5 who participated in ICBD and at least one other NYSERDA program) as shown in Table 3.³⁵
- 38% of all NYS early-stage cleantech companies have participated in one program (including 167 who participated only in ICBD)
- 10% of all NYS early-stage cleantech companies have participated in two to five programs (including 32 ICBD participants), and
- 5% of all NYS early-stage cleantech companies have participated in more than five NYSERDA programs (including 5 who participated in ICBD and at least one other NYSERDA program)

³² Population data by region generated using 2011-2015, ACS 5 Year Estimates from the U.S. Census Bureau.

³³ Addresses Research Question 2.4 *What percentage of these companies have participated in an ICBD program, and how?*

³⁴ It is likely that this total underestimates the total number of NYSERDA program participants. This total may be missing companies that participated in some NYSERDA programs that are currently not labelled as R&D or Business Development in the NYSERDA Metrics Database, and/or companies that were possibly misclassified as a contractor /service provider in that database. Additionally, this total may be missing companies that changed names since their participation in a NYSERDA program, or companies whose names are presented differently in the NYSERDA database. IEC did, however, manually search the NYSERDA Metrics Database for slight variations and abbreviations in company name spelling.s

³⁵ This percentage was calculated by comparing the lists of the companies sent to IEC by incubator, POCC, and EIR directors in July 2016 for the survey. One incubator did not provide the list of companies in the program to IEC, so the actual percentage may be higher.

Table 3. Number and Percent of Cleantech Companies in NYS Participating in NYSERDA Programs

AFFILIATION	NUMBER OF NYS CLEANTECH COMPANIES			PERCENT OF EARLY-STAGE CLEANTECH COMPANIES (N=649)
	Nascent (<1 year old)	Start-up (1-5 years old)	Growth (6-20 years old)	
ICBD Program Participants (current and graduates)	6	111	87	31%
NYSERDA Program Participants (including ICBD, PONs, others)	7	139	199	53%
Not affiliated	3	102	199	47%

Source: IEC Combined Dataset

2B. Critical Resources Supporting NYS Cleantech Companies

This section provides an overview of three critical categories of resources that are necessary to support entrepreneurial cleantech companies: financial, human, and intellectual property.³⁶ The health of the entrepreneurial ecosystem in NYS depends on the extent to which these resources exist in NYS and are accessible to NYS cleantech entrepreneurs.

Even if resources exist, two factors affect the extent to which they are accessible: the time needed to acquire them, and policies that encourage or discourage them.

To an entrepreneur, time is a critical resource. Time spent acquiring financial, human, and IP resources is part of growing a company, but inefficiencies and limited resources (a “weak ecosystem”) can divert time and resources from production, and ultimately can delay time to market for innovations. One key role for ICBD and similar programs may be to help client companies speed business development by connecting the right resources at the right time to companies. The ICBD program can also increase available resources directly (by providing funding, training and technical assistance), and indirectly (by helping attract more resources and by growing the network of individuals and organizations participating in it).

In addition to time, cleantech entrepreneurs often rely on supporting regulations, policies and various government interventions in the market (conversely, they can be negatively affected by regulations that increase barriers to cleantech development). The NYS goal to generate 50% renewable energy by 2030, and the Regional Greenhouse Gas Initiative (RGGI) goal of achieving an 80% reduction in GHG by 2050 represent national leadership in clean energy adoption; this helps to attract attention and a variety of resources to the sector into NYS. In addition, the Reforming the Energy Vision (REV) and Clean Energy Fund emphasis on leveraging private sector investments and increased focused on research and development also generate interest and attention from stakeholders. These policy drivers and initiatives are expected to support and grow the NYS cleantech entrepreneurial ecosystem over time; a key area of focus for NYSERDA and ICBD is ensuring both that these policies are implemented, and that other existing regulations and policies do not create cross-purpose barriers to cleantech.

Along with cleantech companies themselves, the resources available to entrepreneurs are often concentrated in geographic locations. In addition to identifying the statewide prevalence of key resources, this MCA examines the spatial distribution and concentration of key resources; Appendix E provides the details of this analysis, and presents an overview of how resources are arrayed across the state and where there are some indications of emerging concentrations of activities.

³⁶ This section addresses Research Question 3: *What critical resources are NYS’s cleantech companies and entrepreneurs able to access?*

2B.1 Financial Resources

Early-stage companies need financial capital to facilitate development and growth, but high risk and limited collateral can impede access. Companies operating in different market segments often have different financial needs, and sources of capital vary by growth stage and financial risk profile. For technology companies, some types of capital available (e.g., bank loans) are often more constrained than they are for other types of small business (e.g. retail or services) that have more standardized business models, better understood markets, and typically lower capital needs. While they have potentially higher returns, lenders often consider technology companies are higher risk, partly because they have higher capital needs and longer development times while facing newer and less certain markets. Loans therefore reflect higher growth expectations.³⁷

Consistent with this reality, the MCA survey respondents report using a variety of sources to gather additional financing – they draw from their own savings, their personal networks (raise start-up money from family, friends, employers or work colleagues), and in some cases, use credit cards or get bank loans. Many firms also “bootstrap” growth, relying on incoming revenue to support expansion. Of the respondents, 44% had not raised external financial capital of any type. Those who had raised external capital report a median time of less than one year to raise funds. However, interviewees suggested that raising equity capital takes longer than locating other sources. Indeed, access to financial resources remains a critical concern for entrepreneurial cleantech companies –interviewees and survey respondents uniformly cited “access to financial capital” as one of their most critical barriers and concerns.

IEc survey results and Clean Energy Inventory (CEI) data reveal that the most common external sources of capital for NYS cleantech companies are government grants, followed by equity from venture capitalists and angel investors.³⁸ Other sources of external equity-type capital include investments from friends and family members, and private equity funds. Companies often rely on multiple types of financial capital; the CEI project found that the median number of investments received by the companies surveyed was 2.5 rounds, and at least one company reported attracting 23 different investments in its 15-year history (many of those being grants).

2B.1.1 Government Incentives and Grants

Government funding for research and development is a key source of financing for early-stage technology companies, but governments also support innovation using tax credits, rebates, loan programs, and other incentive programs. Some resources aim to stimulate demand for technologies, often through rebates or tax incentives.³⁹ Other incentives target specific activities (e.g., job creation, workforce training, or technology commercialization).⁴⁰ For example, the DSIRE website lists 96 financial incentive programs available to New York companies and individuals for renewable energy. Of those, NYS provides 75%, and the federal government funds the remaining 25%. Figure 7 provides a partial summary of the magnitude, annual variation, and relative contribution of the different grant sources (for which IEC was able to find data) between 2014 and 2016. Appendix C2 provides more detail.

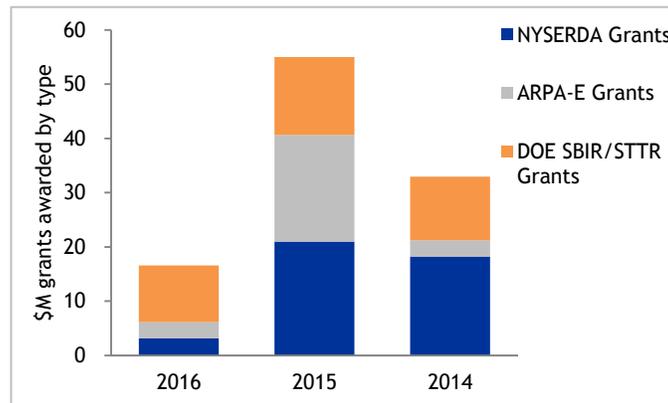
³⁷ Gompers and Lerner (1999)

³⁸ The Clean Energy Inventory data was gathered for NYSEDA by Meister Consulting Group in 2016. This data was made available to IEC for the ICBM MCA analysis and report.

³⁹ Appendix C2 provides the types of fiscal incentives available for renewables and clean energy, the majority of which are rebate programs made available through utilities to end-users. DSIRE (2017). Accessed online at <http://www.dsireusa.org/>

⁴⁰ Another example of a state program is the START-UP NY program which since 2013 has offered “new and expanding businesses the opportunity to operate tax-free for 10 years on or near eligible university or college campuses in NYS.” One condition of this program is that the company partners with a NYS college or university, for example, by participating in an established incubator. Another condition is that they commit to generating new employment in NYS, and a third is that they operate in an eligible industry segment – cleantech and renewable energy being one such industry. START-UP NY Program website, Accessed 1/20/2017 at: <https://startup.ny.gov/>

Figure 7. Summary of Data by Year for Financial Resources Allocated to NYS Cleantech Companies and Entrepreneurs 2013-2016 (\$M)



Sources: DOE, SBIR, NYSEKDA R&D Metrics database

Many interviewees confirmed the importance of NYSEKDA funding early in their development, both for the financial capital, and for a market signal that technologies and companies are promising. These signals and incentives may be relatively important in NYS, which has sales, income, and tax rates, that are considered higher and more complex than some other regions.⁴¹ Several interviewees noted these dynamics, and cited administrative complexity in accessing federal, state and NYSEKDA resources; several noted challenges even finding out about available opportunities.

The complexity of the NYS entrepreneurial ecosystem may unintentionally limit the availability of funding options for companies (or complicate the process of finding funding); this suggests that a valuable role for the ICBK program might be to help clients identify and access available incentives and resources.

2B.1.2 Venture Capital Investments

Providers of venture capital (VC) typically receive equity in return for their investment in relatively high-risk companies. VC funding includes angel investors (typically affluent individuals), professionally managed VC investment funds, corporate venture funds, and individual companies that invest equity.⁴² In addition, crowdfunding is emerging as a VC funding option.⁴³

The volume of VC investments is highly variable, responding to both the quality companies seeking capital in key sectors, but also to external drivers. VC and angel investors in particular tend to follow technology trends (so called “bandwagon effects”), making longitudinal analysis difficult.⁴⁴ Entrepreneurs

⁴¹ For example, NYS was rated 49 out of 50 in the annual “State Business Tax Climate Index” in 2017 by the Tax Foundation. NY is ranked well for corporate tax, but ranked poorly for property, sales, income and unemployment taxes. This index measures both tax rates and “how well states structure their tax systems.” Accessed online Jan. 22.2017 at <https://taxfoundation.org/publications/state-business-tax-climate-index/#previous-publications>

⁴² Venture capital is financing that investors provide to start-up companies and small businesses that are believed to have long-term growth potential. Typically it is structured as either equity (shares) in the company, or as convertible debt – debt that later converts to equity (which is usually counted as equity given its structure and conditions). Investopedia, “Venture Capital Definition.” Available at: <http://www.investopedia.com/terms/v/venturecapital.asp#ixzz4Vf4DnS4p>

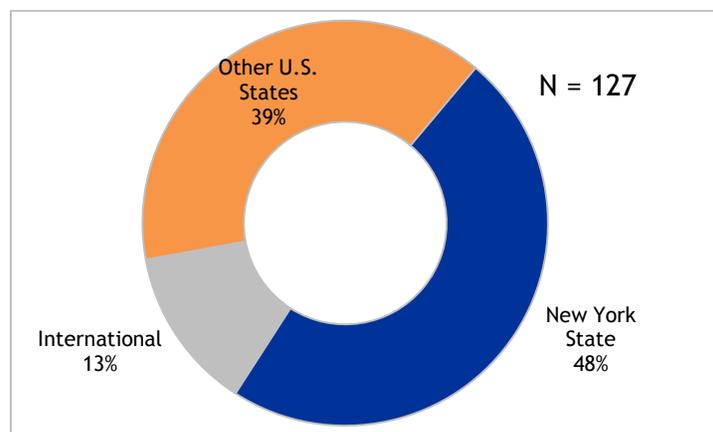
⁴³ This new source of capital has been driven by the 2012 Jumpstart Our Business Startups Act (JOBS) Act which enabled crowdfunding platforms to fundraise for equity. Title III of the Jumpstart Our Business Startups (JOBS) Act addresses crowdfunding, and the SEC adopted Title III final rules to permit companies to offer and sell securities through crowdfunding in October 2015. Start-ups are allowed to raise up to \$1 million in a 12-month period through this kind of crowdfunding. Private companies are required to issue financial statements to potential investors. See: <https://www.sec.gov/info/smallbus/sec/rcomplianceguide-051316.htm>

⁴⁴ Gompers and Lerner (1999) write that “During the past twenty years, commitments to the U.S. venture capital industry have grown dramatically. This growth has not been uniform: it has occurred in quite concentrated areas of the country and peaks in fundraising have been followed by major retrenchments.” They also state that “We find that regulatory changes affecting pension funds, capital gains tax rates, overall

and investors interviewed for this study confirmed that since a high point in the mid-2000s, cleantech investments have lost ground to technologies with lower capital intensity and faster commercialization cycles (e.g., software).^{45,46} Cleantech i3 records venture capital activity and their data show that from 2014 through 2016, at least 127 unique investors participated in NYS cleantech equity investment deals.⁴⁷ Appendix C2 provides a breakdown of these investors by type, with professionally managed venture capital funds making up the largest group.

Figure 8 shows the location of investors funding companies in New York.

Figure 8. Location of Equity Investors in NYS Cleantech between 2014 and 2016



Source: IEC analysis of Cleantech i3 data

While Cleantech i3 is based on self-reported data and is therefore not comprehensive, the database of investments reveals the following:

- A total of \$955 million was invested from 1999 through 2016 in 254 investment rounds, averaging 15 deals per year.
- The total number of rounds peaked in 2014 (at 44 deals); 2015 attracted the highest dollar amount in the period (\$209M).⁴⁸ Cleantech VC investment rounds averaged 3.1% per year of all NYS VC investment rounds between 1999 and 2016; and averaged 1.4% by amount of dollars raised.⁴⁹
- Of the 649 companies that IEC identified as operating in NYS, 283 companies (44%) attracted VC funding; and 59 of these companies (or 9%) had participated in the ICB program.
- The investments in 2014-2016 were heavily concentrated in companies operating in New York City; this pattern holds back to 1999. Some regions (Eastern and Western Adirondacks and Western NY) have few, if any, companies receiving VC investments.

economic growth, and research and development expenditures—as well as firm-specific performance and reputation—affect fundraising by venture capital.” <http://www.nber.org/papers/w6906.pdf>

⁴⁵ Benner, K. (2014) VCs Think Cleantech is a Dirty Word, Bloomberg Views. Accessed online Jan. 10, 2017 at <https://www.bloomberg.com/view/articles/2014-11-14/vcs-think-cleantech-is-a-dirty-word>

⁴⁶ Gaddy, Sivaram, Sullivan (2016) Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation, an MIT Energy Initiative Working Paper. Accessed online Jan. 10, 2017 at <https://energy.mit.edu/wp-content/uploads/2016/07/MITEI-WP-2016-06.pdf>

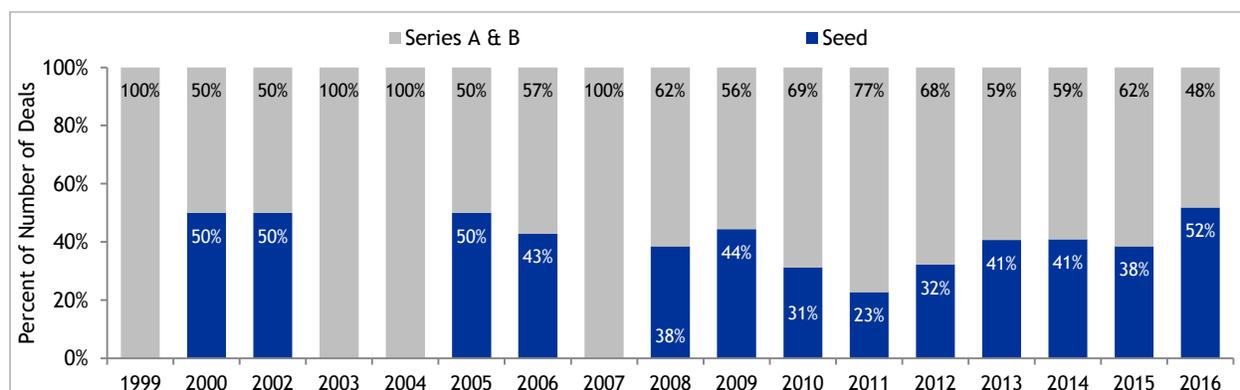
⁴⁷ IEC analysis of Cleantech i3 data, accessed Jan. 12, 2017.

⁴⁸ The 2015 peak was driven by five large Series B investments each over \$20M for a combined total of \$149M (or 71% of the total amounts raised for 2015)

⁴⁹ All NYS VC investment amounts from PwC/CB Insights MoneyTree™ Report, Accessed online Feb 25, 2017 at: <http://www.pwc.com/us/en/technology/moneytree/explorer.html#/>

Finally, seed-round investments represent a widely-used indicator of both capital availability and potential growth in the number and size of VC-backed companies.⁵⁰ Figure 9 shows that the number of seed-stage rounds went from zero in 2004 to over 50% of the deals in 2016. From 1999-2016, the median percentage of seed deals by number was 38%, and the median amount of each seed round raised was \$275,000. This suggests that equity investors are maintaining interest in early-stage cleantech companies in NYS, a positive indicator of long-term health in the entrepreneurial ecosystem.

Figure 9. VC Investment Deals Made Into NYS Cleantech Companies, 1999-2016, Shown by Percentage of Seed, and Series A and B Deals (Combined)



Source: IEC analysis of Cleantech i3 data

2B.1.3 Angel Investors and Crowdfunding Platforms

Angel investors (acting alone or in syndicated groups) are not well represented in Cleantech i3 and other data sets because they tend to be smaller and are less likely to report their activities publicly. However, angel investors are important to the entrepreneurial ecosystem because they typically invest closer to home – one study estimates that 75% to 80% of investments take place within the same state as the angel resides.⁵¹ However, the same study found that NYS was somewhat atypical: in 2015 angel investors made 58% of their investments (across all categories), in-state. Other states tend to have higher percentage of in-state investments by angels. This supports the view that NYS entrepreneurial companies are able to attract non-NYS based investors.⁵²

Data on cleantech investments using newer crowdfunding platforms are scarce, but CrowdExpert.com (which tracks activity across the top 35 investment crowdfunding platforms) estimates that start-up companies raised approximately \$1.2 billion on such platforms in 2015 across all of the U.S..⁵³ This compares to over \$58.8 billion invested by venture capital sources in 2015.⁵⁴

2B.1.4 Remaining Gaps in Financial Resources

While financial resources are available to companies and survey respondents report accessing them, it is less certain whether available resources are *sufficient* to help companies realize their full potential, either in number, or in average size of investment. In addition, our primary research confirmed that the process of accessing and obtaining financial resources (of all types) is both complex and time consuming for cleantech companies, and this can slow their progress.

⁵⁰ Sahlman, W. (1990) The Structure and Governance of Venture Capital Organizations. *Journal of Financial Economics*. Volume 27, Issue 2, Pages 473–521.

⁵¹ Angel Research Group and Pitchbook (2016) The Halo Report: Annual Report 2015. Accessed online Jan. 10, 2017 at www.angelresourceinstitute.org

⁵² Ibid.

⁵³ Crowd Expert (2017) Crowdfunding Industry Statistics 2015 2016. Accessed online at: <http://crowdexpert.com/crowdfunding-industry-statistics/>

⁵⁴ National Venture Capital Association (2016) \$58.8 Billion in Venture Capital Invested Across U.S. in 2015. Accessed online Jan. 11, 2017 at <http://nvca.org/pressreleases/58-8-billion-in-venture-capital-invested-across-u-s-in-2015-according-to-the-moneytree-report-2/>

- While early-stage deal numbers look healthy in aggregate, interviewees and survey respondents reported difficulties and delays in accessing such funds, particularly for government funding and “pre-seed” investments from angel investors.
- Several interviewees also noted difficulty obtaining *expansion or later-stage growth capital* – resources to build production (including plants) and sales functions. These significant capital investments are too large for VC sources, but needed before revenue and collateral are strong enough to access banks and other lenders at reasonable rates. While outside the scope of the ICBD program, other NYSERDA programs such as the NY Green Bank are working on addressing this gap.

While the ecosystem in NYS has a number of active investors and a range of resources, it appears that accessing those resources can be difficult for companies, with some regions and company growth stages revealing gaps in available resources. ICBD and other NYSERDA programs may be positioned to play a role in informing and connecting companies to existing sources of financial capital, helping them navigate this market more readily, and helping them access appropriate resources more efficiently. Doing so will help speed commercialization efforts and could attract additional resources to NYS, particularly to underserved regions within the state.

2B.2 Human Capital

Attracting, training, and retaining a competent and skilled workforce is critical to the success of both individual companies and the broader entrepreneurial ecosystem. A high-quality pool of “talent” is also critical to attract investors and create a team – management, legal, accounting, marketing, commercialization, and manufacturing skills are all needed.

Colleges and universities are key providers of technical skills in particular; NYS ranks second in the U.S. for the total number of STEM degrees granted by universities and colleges in 2015, though interviewees note that keeping students in NYS after graduation is a challenge.⁵⁵

According to the 2016 Clean Jobs Report, New York State supports 85,198 “clean jobs” employed by around 7,500 business establishments state-wide.⁵⁶ While this indicates a sizeable sector and large *potential* workforce for cleantech companies to access, most (82%) of the jobs identified are focused on energy efficiency, suggesting that an emphasis on implementing or installing established technologies (e.g., HVAC and lighting systems).

Survey responses and interviews with staff at cleantech companies suggest qualitatively, that the pool of talent to support growing companies may not meet current and future demand. This may be an area of focus for ICBD and other programs. Respondents identified difficulties in attracting needed human capital; 194 survey respondents identified lack of human capital as a barrier to cleantech entrepreneurship, as did 28 interviewees. This aligns with the 2016 Clean Jobs Report, which noted that 81 percent of businesses in New York find it “difficult” or “very difficult” to find qualified applicants for available positions. Companies report the most difficulty hiring managers, directors, and supervisors, as well as installation and engineering positions.

2B.3 Intellectual Property (IP) Resources

NYS has many innovators, and a rich history of technology development, manufacturing and deployment. The initial generators of NYS IP resources include:

- Universities and colleges: 425 institutions in NYS provide a primary engine for the development of intellectual capital and new technologies.⁵⁷

⁵⁵ SRI International (2015) NYSERDA Clean Energy Technologies Innovation Metrics Report. Page 6.

⁵⁶ The Clean Jobs Report of 2016 also found concentrations of clean jobs in the major urban areas of New York City, Long Island and the Lower Hudson Valley. BW Research Partnership and The Economic Advancement Research Institute. (May 2016). Clean Jobs New York Report.

⁵⁷ There are some 425 colleges and universities in NYS, many of which have a research as well as teaching focus. National Center for Education Statistics. Accessed online Jan. 16. 2017 at <https://nces.ed.gov/collegenavigator/?s=CT>

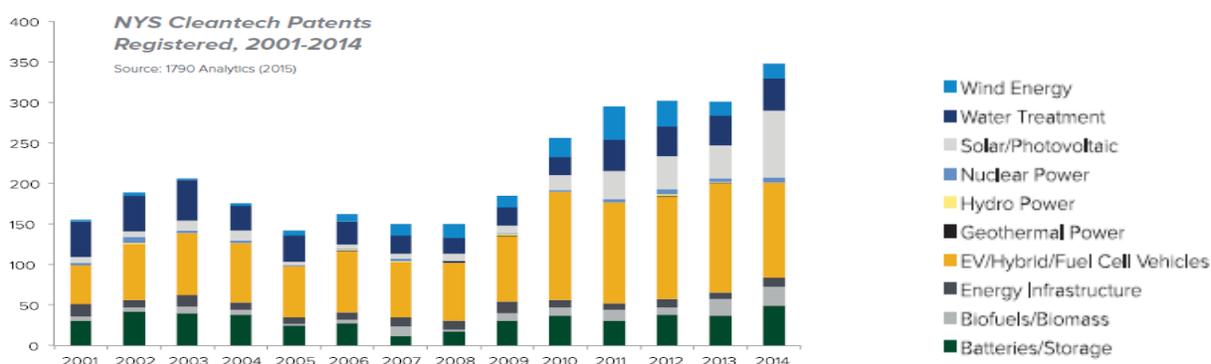
- Universities in NYS are adept at attracting industry and government-sponsored research funds, and generating technology license agreements and options for technologies created by faculty and staff.⁵⁸
- Large companies (such as IBM, GE and others), with large research and development facilities.

NYS also boasts a well-established system of law firms, university technology transfer offices, and other institutions that help innovators protect and commercialize their IP, using tools such as patents, trademarks and copyright filings.⁵⁹ In addition, New York City is a hub for financial, media, advertising and visual and performing arts sectors, all of which are characterized by high rates of innovation and change. Cleantech companies can also access such resources and activities.

2B.3.1 Patents

Patent applications and awards are a strong indicator of innovation, particularly in technology fields.⁶⁰ NYSERDA’s Innovations Metrics Report documents that from 2012 to 2014, NYS inventors registered some 927 cleantech patents, which ranks NYS in the top three states nationally in total number of cleantech patents awarded.⁶¹ NYS cleantech patent activity in electric vehicle/hybrid/fuel cell vehicles and solar technology is particularly high relative to cleantech patent activity in the rest of the U.S.⁶² Figure 10 reproduces the Innovations Metrics report summary of a subset of cleantech segments.

Figure 10. NYS Cleantech Patents Registered between 2001 and 2014



Source: 1790 Data reported in NYSERDA 2015 Innovation Metrics Report

The data supporting Figure 10. NYS Cleantech Patents Registered between 2001 and 2014 show that a mix of large companies and universities registered most of the patents obtained in the state. While only a few patents are registered to start-up companies and individual entrepreneurs, the overall pace of innovation and IP registration represents a robust “culture of innovation” that is a resource for entrepreneurs. Moreover, development of IP is a focus for many early-stage companies. Of the 87 companies IEC surveyed participating in POCCs, 58% had either filed or already been awarded a patent

⁵⁸ NYSERDA Clean Energy Technologies Innovation Metrics Report 2015 found that NYS universities rank 3rd in technology licenses in the country, explaining that the number of licenses and options executed is one indicator of a university’s commercial impact given that licenses are made to existing companies and start-ups. Page 27.

⁵⁹ Intellectual property (IP) includes inventions, literary and artistic works, and symbols, names and images used in commerce. World Intellectual Property Organization (WIPO), “What is Intellectual Property?” Accessed online 1.16.2017 at <http://www.wipo.int/about-ip/en/>

⁶⁰ Patents are usually filed for an invention at the front-end of the innovation process, and not for the launch or roll-out of a commercialized product or service (a process which can also be innovative). Some innovators choose not to patent their inventions for a variety of reasons, including the cost to file and defend the patent over time. Patents also tend to be more commonly used in technology hardware than in software and/or services Basulto, D. (2015) Patents are a Terrible Way to Measure Innovation. Accessed online at: https://www.washingtonpost.com/news/innovations/wp/2015/07/14/patents-are-a-terrible-way-to-measure-innovation/?utm_term=.ecd07204bdd3

⁶¹ SRI International (2015) NYSERDA Clean Energy Technologies Innovation Metrics Report. Page 17. Based on data from 1790 Analytics (2015)

⁶² SRI International (2015) NYSERDA Clean Energy Technologies Innovation Metrics Report. Page 18. Based on data from 1790 Analytics (2015)

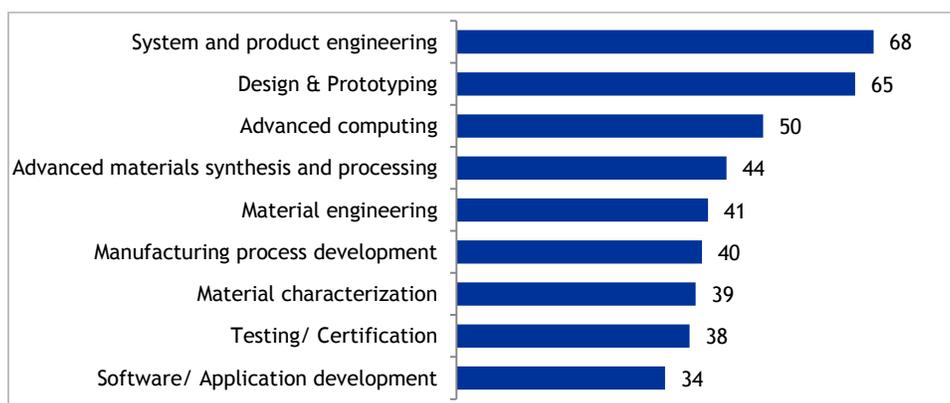
based on the research conducted during their time with the POCC. Another 21% expected to file a patent in the future based on work in the POCC; 21% did not expect to file a patent. Most POCC participants are at a very early stage in their technology and commercialization process.

The concentrations of patents among POCC participants are in *efficiency* (specifically green building, smart grid), *renewable energy generation* (batteries, solar, fuel cells, and waste-to-energy), and *clean industry* (materials innovation, equipment efficiency) segments, as shown in Appendix C1 in more detail. This differs from the distribution noted in the Innovation Metrics report as shown above, which covers patents from small and larger entities combined. On the other hand, the areas of specialization in NYS most often mentioned by survey-takers and interviewees were more consistent with these results, where *solar*, *advanced buildings* and *energy storage* were frequently mentioned.

2B.3.2 Technical Capabilities

A comprehensive data set of the technical capabilities of all NYS cleantech companies does not exist, but NYSERDA’s Clean Energy Inventory (CEI) study provides some insights into a part of the universe. The CEI survey of 137 cleantech supply-side companies (i.e. those in R&D, product development, and manufacturing) found that 78% (107) of respondents said their organization is involved in research and development, testing, or software services. Figure 11 provides the most commonly mentioned capabilities, with system and product engineering and design and prototyping most often mentioned as a capability in this group of NYS cleantech companies.⁶³

Figure 11. Supply Side Technical Capabilities in Supply-Side NYS Cleantech Companies⁶⁴



Source: NYSERDA CEI Inventory, Meister Consultants Group, 2016

Of particular relevance to early-stage cleantech companies is the testing and certification of technologies. Testing the safety, performance, reliability, durability, longevity and environmental impacts (or benefits) of an innovation is a key step in commercialization, and companies can access testing services provided by organizations such as Intertek’s Technology Testing Centers (for wind turbines and photovoltaics). CEI data show that 38 survey respondents list this technical skill. Some NYSERDA programs also help companies in specific sectors with technology development and testing.⁶⁵ While many interviewees mentioned testing and certification services as valuable and necessary in commercialization processes, two interviewees mentioned that these services tend to be slow to respond to requests, are expensive to access, and do not cover all types of technologies needing services, suggesting that additional resources or support in this area could improve cleantech company performance.

⁶³ Meister Consultants Group. (October 27, 2016). Slide 16. New York State Supply-Side Clean Energy Inventory Draft Report.

⁶⁴ Ibid.

⁶⁵ Such as New York Battery and Energy Storage Technology Consortium (NY-BEST™), the New York State Smart Grid Consortium, the Lighting Research Center.

2C. Business Development Resources for Cleantech Companies in NYS

Business development services for entrepreneurs and early-stage companies have proliferated in the late 2000s in NYS, as elsewhere. A number of different incubators, accelerators, EIR programs, and POCCs are offering services to start-up companies; these entities play a connecting role in the entrepreneurial ecosystem within many sub-regions in NYS.^{66,67} The programs are supported by a range of organizations, from economic development agencies, government innovation programs, foundations, universities, VC funds, and large companies.

IEc's research has identified 119 programs that offer start-up companies and entrepreneurs in NYS early-stage support as of January 2017; this includes the ICBD's nine incubators, POCCs, and EIR programs.⁶⁸ Of the 119 organizations identified:

- 66 are incubators, 28 are accelerators, three are POCCs, nine are entities that combine incubators and accelerators, one combines an accelerator and a POCC, and 12 are “other” programs (such as arts-technology programs that combine work-spaces with programming, or prizes combined with training).⁶⁹
- 19 organizations are focused on cleantech or clean energy, or have cleantech as one of their key areas of focus (and eight of these 19 receive funding through ICBD Programs). Of the 11 that are *not* ICBD funded: two are incubators, three are accelerators, two are “other” initiatives, two are POCCs, and two are combined incubator and accelerator programs.⁷⁰
- 50 (42%) of the organizations are open to any type of technology, and 50 (42%) are focused on other technology segments (such as Information, Communications Technologies, ICT) that could be considered adjacent to cleantech.
- For the 61 organizations with available data, the median number of companies or teams that have worked with these programs is 11. Some programs have as few as one company reported, while another incubator (Startup Health) had as many as 180 companies at one time.

Figure 12 maps the locations of the 119 entities, and shows some noticeable concentrations of incubators and accelerators in and around the large urban center of New York City.⁷¹ The figure shows that in some regions (e.g., Western Finger Lakes), ICBD programs appear to play a prominent role in local entrepreneurial ecosystems. In other regions (Central New York) it appears that a number of other resources are available to entrepreneurs, but the viability of many of these non-ICBD incubator and accelerator programs has not been assessed, and the landscape of services offered may fluctuate considerably over time.

⁶⁶ NBIA (2017) FAQs. Incubators are organizations designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services that could include physical space, capital, coaching, common services, and networking connections. Companies typically spend an average of two years in a business incubator. The National Business Incubation Association (NBIA) estimates that there were over 1,250 incubators in the United States as of October 2012. Accessed online Jan. 18, 2017 at http://www2.nbia.org/resource_library/faq/

⁶⁷ Hathaway, I (2016) *Accelerating Growth: Startup Accelerator Programs in the United States*, Brookings Institute. Accelerators support early-stage, growth-driven companies through education, mentorship, and financing. Start-ups enter accelerators for a fixed period of time, and as part of a cohort of companies. The accelerator experience is a process of intense, rapid, and immersive education aimed at accelerating the life cycle of young innovative companies, and typically culminates in a graduation or “demo day.” Accessed online Jan. 12, 2017 at <https://www.brookings.edu/research/accelerating-growth-startup-accelerator-programs-in-the-united-states/>

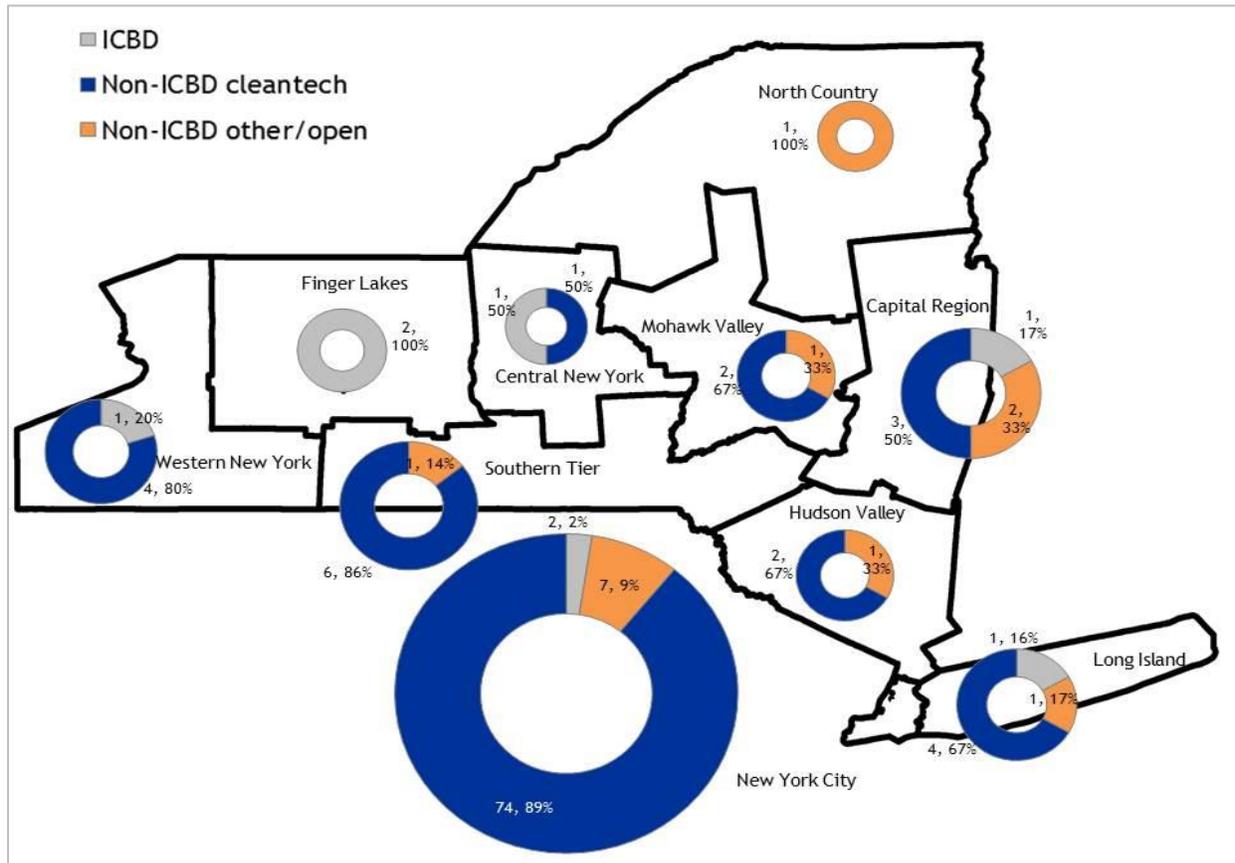
⁶⁸ IEc collected data from the websites of each of the 119 programs and classified them by start-date, location, technical specialty (if any), types of services offered, and number of companies (or teams) currently in the programs. In addition to the 118, there are also “accelerator-type” university programs, clubs, trainings, pitch-events, electronic platforms, and business-plan competitions (like NY-Prize) available to entrepreneurs, students and others (IEc did not collect data on all of these). Appendix C5 also lists non-NYS incubators dedicated to clean energy

⁶⁹ For this report, IEc researched incubators and accelerators in NYS using the following online sources in January 2017: <http://bianys.com/memberlists>; Cleantech Group i3 data; <http://www.digital.nyc/incubators>; <http://www.builtinnyc.com/2016/06/03/accelerators-incubators-nyc>; The Global Accelerator Network <http://gan.co/>; <http://www.nycedc.com/service/incubators-workspace-resources>; <http://www.seed-db.com/accelerators>

⁷⁰ The non-ICBD programs focused or partially focused on cleantech/ clean energy are: *Incubators*: Golden Technology Management, iCANny, Southern Tier High Technology Incubator; *Accelerators*: Green Worker Cooperative, New York State Certified Business Incubator, and FOOD-X; *POCCs*: NECEC - New York Innovation and Entrepreneurship Program; and *Other*: BMW iVENTURES, and NY Prize.

⁷¹ Appendix C5 shows the same set of 119 incubators allocated to regions classified into ten NYS regions, showing the Southern Tier.

Figure 12. Map of ICBD Funded and Non-ICBD Incubators, POCCs and Accelerators Operating in NYS as of 2016



Source: IEC Research based on the nine NY DEC regions

Within the cleantech ecosystem, NYSERDA is a relied-upon provider of business development services in NYS, especially in regions with smaller resource bases. Many interviewees cited NYSERDA programs as central to the New York cleantech ecosystem. Non-NYSERDA-sponsored business-development providers mentioned by more than one interviewee reflect a mix of federal, state and local initiatives operated by a variety of government, nonprofit and private sector organizations in and out of the state. These include Greater Rochester Enterprises, Empire State Development, the NSF i-Corps Program, and the New England Energy Council (NECEC) and its Cleantech Open business plan competition.

Overall, the presence of a large number of providers suggests a vibrant entrepreneurial culture – it also presents a coordinating and potential “branding” challenge for participating organizations, to ensure that the full suite of business needs across all sectors can be met. Again, not all of these programs will continue; this landscape could look very different in two to three years. This MCA does not include a comprehensive investigation into the services provided by all of the existing organizations, but the large number suggests that there may be opportunities for ICBD programs to connect their clients to – and leverage – existing business development resources in NYS. A more detailed investigation across providers may also identify service gaps in regions such as in western and northern NYS where there are some emerging technology clusters, but few business development programs.

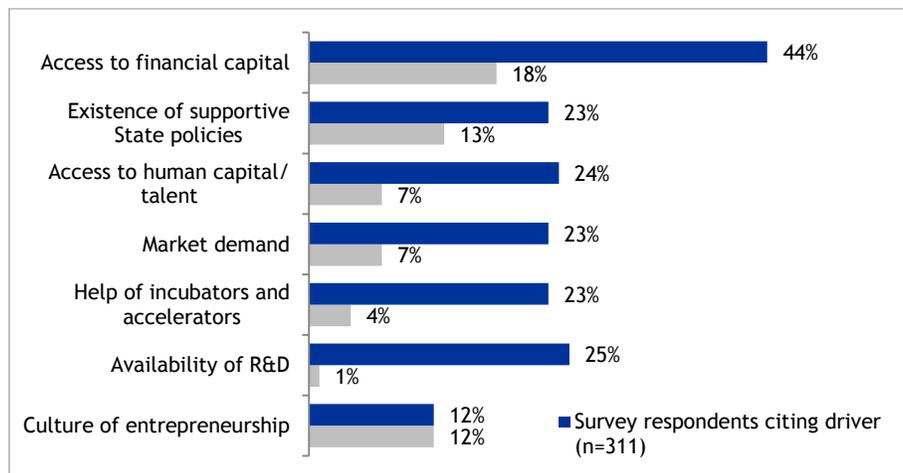
2D. Drivers and Barriers, Gaps and Needs in the NY Cleantech Ecosystem⁷²

2D.1 Barriers and Drivers for Companies in the NYS Cleantech Ecosystem

While many drivers and barriers enable and constrain cleantech companies in NYS, most are widely applicable to early-stage companies, regardless of sector or location. Survey and interview respondents most often cited the following drivers as enabling cleantech in NYS: access to financial resources, availability of research & development (technology), and access to human capital. The barriers identified as particularly pertinent to cleantech companies and entrepreneurs in NYS include: lack of access to financial resources, an unsupportive state regulatory framework, and the lack of supportive state policies.

Notably, the most commonly cited drivers and barriers differed somewhat between the interview respondents (who provided open-ended responses) and survey respondents (who selected responses from a list of options identified in the literature). Figure 13 summarizes the responses.⁷³

Figure 13. Key Drivers for NYS Cleantech Companies



Source: IEC Survey and Interviews

Not unexpectedly, access to financial resources was the most frequently cited driver *and* barrier of entrepreneurial success in both the survey and interviews, and was universally noted across NYS geographic regions. NYSERDA programs that either provide direct grants (through PONs) or help companies connect to sources of financial resources are particularly valued, according to interviewees. As a growth company based in New York City stated, “Without NYSERDA grants, we wouldn’t have been able to get out of the gate.”

Availability of R&D was the second most frequently identified driver in the survey (25%), but interviewees did not, conversely, identify it as a driver (1%). The discrepancy may reflect question formats in the survey (close-ended) and interviews (open-ended), or differences between the populations targeted by each; while the survey focused on entrepreneurs, interviews included investors, large companies, and providers of business development services.⁷⁴

Interviewees and survey respondents both described issues surrounding a “culture of entrepreneurship” in NYS and in cleantech. Interviewees described some factors that lead to this culture, such as increased

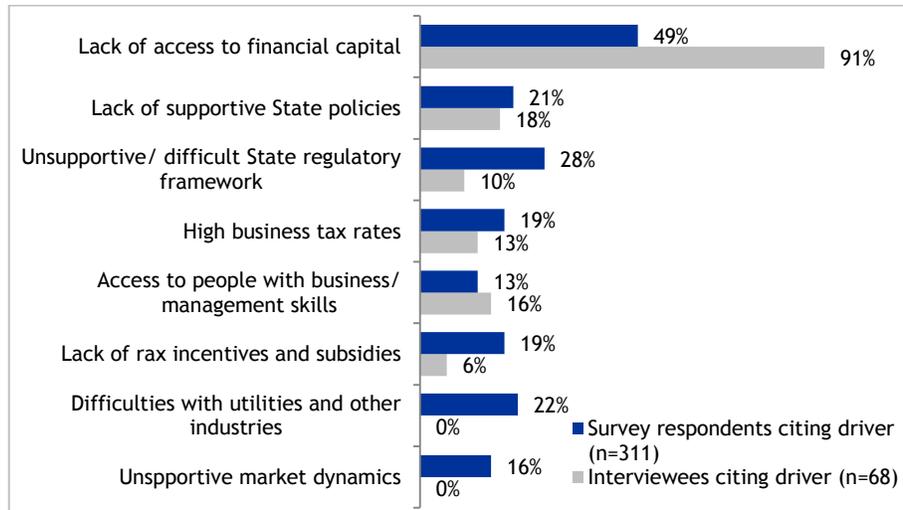
⁷²Addresses Research Question 4.1: *According to a sample of the stakeholders: What are the most important resource drivers and barriers for cleantech companies and entrepreneurs?* The work plan also had a separate Research Question 4.2: *What are the most important market and customer drivers and barriers for cleantech companies and entrepreneurs?* The responses to this question were integrated into Question 4.1.

⁷³The graphs show the top five most commonly cited drivers and barriers identified in the survey and the top five most commonly cited drivers and barriers identified in the interviews.

⁷⁴For example, one-quarter of survey respondents agreed that availability of R&D was an important driver when they saw it on the list, but interviewees might not have thought to mention this without the prompt.

media coverage of entrepreneurship (with TV shows such as “Shark Tank”), the existence of positive entrepreneurial role models, information available on the Internet, and shifts in career expectations within different generations. Interviewees, in particular, identified access to people with business or management skills as a key barrier (third, after lack of access to financial capital and lack of supportive state policies). These interviewees noted the challenge of unlocking the innovative research developed in universities; transitioning innovations out of the labs and into the market requires strong business management skills as well as good science. As an incubator participant stated, “*We need people who understand the translation from university labs to actual devices.*”

Figure 14. Key Barriers Facing NYS Cleantech Companies



Source: IEC Survey and Interviews

While drivers and barriers are fairly constant across cleantech sectors, responses reveal some geographic patterns. Survey respondents in the Western Finger Lakes and Western New York were less likely to identify supportive state policies as among the three most important drivers/barriers; New York City and Central New York respondents did not identify tax incentives and subsidies as a key driver. New York City was also the only region that listed access to human capital/talent as a top driver; most other regions cited it as a barrier. Several interviewees echoed the sentiments of a non-ICBD respondent in the Capital Region who described “*an upstate/downstate or City/non-City divide.*” Interviewees identified other differences in drivers/barriers across the State:

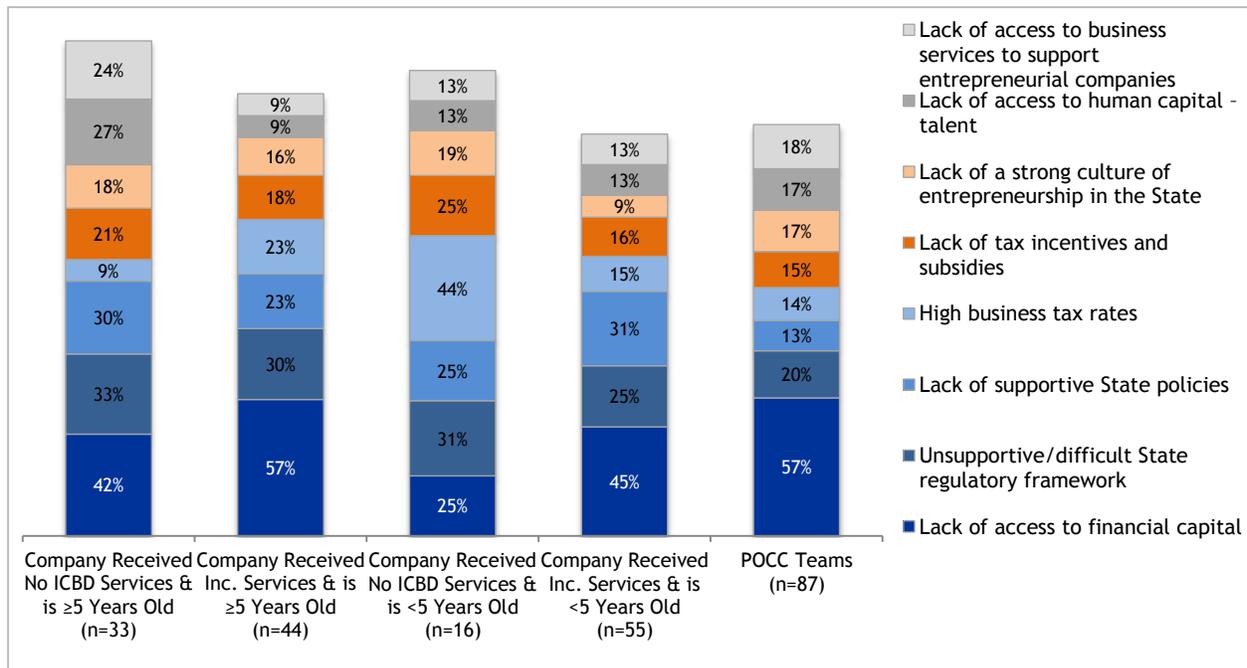
- No interviewees from the Lower Hudson Valley or Western New York identified access to financial capital as a driver, while interviewees from other regions mentioned it frequently. Access to financial capital ranked in the top three drivers for respondents in New York City, Central New York, and Western Finger Lakes. New York City and Central New York regions also tended to attract more financial capital from VC and grant funding.
- The existence of supportive state policies was noted most frequently by interviewees located in the Lower Hudson Valley, and by interviewees with operations located out of NYS (33% and 30%, respectively); it was not mentioned by interviewees from Central or Western New York.
- All three Lower Hudson Valley interviewees identified lack of access to human capital/talent as their top barrier, as did all four Central New York respondents, and the five Long Island respondents.⁷⁵

⁷⁵ 28 interviewees mentioned human resource skill gaps as a key barrier for NYS’s cleantech ecosystem. Of the 28 interviewees, 36% mentioned engineering and technical skills, 7% mentioned inexperience in commercialization, 57% management, 11% manufacturing, 32% entrepreneurship, and 4% micro-certification. 194 of 311 survey takers (62%) mentioned the lack of human capital as a barrier to cleantech entrepreneurship.

Interviewees in New York City (63%), the Capital Region (47%), and Western New York (50%) did not frequently identify human capital as a barrier.

It is also informative to look at the breakdown of barriers by **company age** and by whether the company received services from an **incubator or POCC**. While the previous discussion included interview and survey respondents, Figure 15 below focuses only on survey respondents and only on those from companies and POCC teams (but not service providers, government agencies, or universities).

Figure 15. Barriers by Survey Respondent Group (Companies and POCC Teams)



Source: IEC Survey

Differences across companies that did and did not receive services are particularly striking. Among companies that are less than five years old, 45% of the group that has received incubator services ranked access to finance as a top barrier, compared to just 25% of companies that have not received incubator services. One interpretation of this finding is that companies who otherwise have trouble raising capital tend to join incubators; another interpretation is that those participating in incubators join a community where raising investment capital is frequently discussed and emphasized by program staff in trainings and events. Current or former incubator clients (survey respondents) who indicated that they would have liked the incubator to provide other services, most frequently cited funding as a service they would have liked to receive, followed by networks – access to investors/clients.⁷⁶ Interview findings indicate that incubators are training participants on how to raise capital, but are not necessarily providing introductions to investors (to the extent that interviewees would have liked).

⁷⁶ Of the 127 current or former incubator clients, 54 (43%) indicated they would have liked the incubator to provide other services. Twenty-eight of those respondents (52%) specified funding as a service they would have liked to receive from the incubator, which was the most frequently mentioned. Networks - Access to investors/clients was mentioned by 10 respondents (19%).

2D.2 What is Most Needed to Accelerate the Productivity of the Ecosystem?⁷⁷

The critical resources identified by interviewees that are most needed to accelerate the ecosystem in NYS are consistent with their views on barriers and drivers: access to funding, ability to attract business talent/entrepreneurs, making different or more informed investments, more business guidance/mentoring/networking, leveraging existing resources, more incentives, and showcasing successes.^{78,79}

In terms of the most frequently cited response – access to financial capital – several interviewees stated that “patient capital” is required, given the long payback periods on cleantech investments. Another theme that emerged from the interviews was the importance of strengthening an entrepreneurial culture in NYS. While respondents recognized the difficulty of implementing culture shifts, they noted that the proliferation of incubators, accelerators, and other entrepreneurship training programs on college and university campuses (as described in Section 2D) is a start. One metric of success for these programs would be entrepreneurs staying in NYS. As a cleantech business development service provider (not affiliated with ICBD) stated, “*We have a lot of universities and engineering schools doing research, but there is a challenge in attracting talent into entrepreneurship, and whether young graduates stay in NY or not is another question.*”

In addition to the direct question posed in our interviews, the CEI survey posed a similar question: “In which parts of the value chain does your organization need *the most additional support* in the New York clean energy sector?” Respondents to the CEI survey were shown a list containing five support areas – end-product manufacturing and final assembly, software development, R&D and prototype development, component manufacturing, and analytical testing/other services – and were asked to rank these items. Though responses across areas were similar, end-product manufacturing/final assembly ranked highest, closely followed by component manufacturing, analytical testing/other services, and software development.

In total, the critical resources in the current entrepreneurial ecosystem in NYS appear to be capable of supporting an active and growing number of early-stage cleantech companies, though market actors have noted some difficulty ensuring that the resources are distributed and accessible, and have identified key drivers, barriers, and needs to address in improving ecosystem health. Section 3 examines NYSERDA’s role in addressing these factors, in particular with its ICBD program.

⁷⁷ Addresses Research Question 4.3: *According to a sample of the stakeholders, what is most needed to accelerate and expand the cleantech entrepreneurial ecosystem in NYS?*

⁷⁸ This question was not asked in the survey.

⁷⁹ Other options mentioned by just one respondent each included: favorable regulations, more efficient processes, and the state’s Governor.

3. NYSERDA's Role in the NYS Cleantech Ecosystem and ICBD Program Outcomes⁸⁰

While this MCA is not intended to be an impact evaluation, the ICBD program began in 2009 and is an active part of NYS's current entrepreneurial ecosystem. Therefore, the MCA also characterizes the program's role and identifies areas of strength and potential areas for refined focus going forward.

NYSERDA's ICBD program currently provides funding for six cleantech incubators, two POCC programs, and the EIR program. The programs provide services to entrepreneurs and companies at different stages in the development of their businesses. At the beginning of the POCC engagement, most participants have a "team" that believes they possess IP and a business model that warrants company formation; and at the end of the POCC program, if successful, the "team" has become a "business." Incubator clients tend to join programs already with an incorporated business that has already made some progress towards validating markets. The ICBD program is crafted to serve participants the types of services that are most needed and useful at their stage of growth and relative maturity, and likewise, to connect them to relevant resources.

The MCA survey reached 127 current or previous incubator clients, 87 current or previous POCC participants, and 85 current or previous recipients of EIR services.⁸¹ This effort provided information about the value of ICBD-funded business development services; this information serves to both characterize the role of ICBD in the current ecosystem, and to provide initial, qualitative indications of program effects.

NYSERDA's ICBD services are on the whole, highly valued by the participants in the study, with the following patterns:

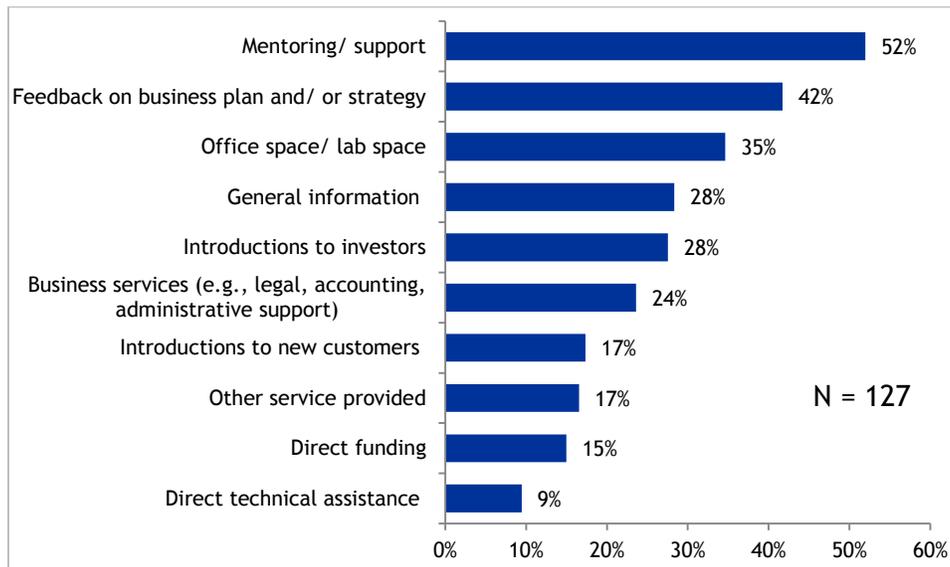
- Slightly over half of respondents who had participated in incubators (52%) identified mentoring/support as one of the three most valuable services, followed by feedback on business plan and/or strategy (42%) and office space/lab space (35%)
- Among POCC participant respondents, a strong majority stated that POCCs were "very important" or "extremely important" in introducing them to valuable business contacts (82%), helping them achieve their entrepreneurial goals (75%), and strengthening or reinforcing their desire to be entrepreneurs (67%).
- Slightly over half of respondents (53%) that are currently receiving or that previously received EIR services have participated in NYSERDA-sponsored networking events that their EIRs identified; 76% of these respondents report making valuable contacts during these networking events.
- According to survey respondents who were current or former ICBD program participants, incubators helped them realize first sales more quickly and/or increase their sales volume.

Figure 16 summarizes the findings for current and previous participants in NYSERDA-funded incubators. Top-ranked services are consistent across cleantech segments, and generally consistent across geographic regions, with some minor variations. Six regions noted mentoring/support most frequently, and all noted it in their top three. Respondents from New York City identified office space/lab space more frequently than mentoring/support, which reflects the fact that space is at a premium in this region. Respondents from the Capital Region most frequently identified general information as a useful service, although it should be noted that the incubator based in this region (in Albany) does not offer space to participants.

⁸⁰ Addresses Research Question 5: *To what extent have the incubators, POCCs and EIRS helped their clients attract funding, commercialize technologies, and increase their sales? (i.e., How do program participants value the services provided by the incubators, POCCs, and EIRs and what outcomes have they realized?)* The order of Research Questions 4 and 5 were flipped (from what was in the work plan) to enhance the flow of the MCA report.

⁸¹ Some respondents received more than one type of service.

Figure 16. Top Three Most Useful Services Survey Respondents Received from ICBF-Funded Incubators



Source: IEC Survey

3A. Initial outcomes achieved by clients of incubators, POCCs, and EIRs

The survey asked current and previous clients of NYSERDA-funded incubators, POCCs, and EIRs about the importance of their participation in these programs, and outcomes achieved. Overall, the survey findings suggest that ICBF’s services have helped companies and entrepreneurs accelerate and grow their sales, make connections with valuable business contacts, and achieve entrepreneurial goals.

- Incubators: Of the 58 current or former incubator clients who currently have sales, 27 had sales before joining an incubator and the other 31 realized their first sales after they joined.
 - Twenty respondents with pre-incubator sales reported an increase since joining the incubator (74%), six reported their sales had stayed about the same (22%), and one did not answer the question (4%). More than half believe the incubator was at least slightly influential in increasing their sales volume.⁸²
 - Sixteen companies who realized their first sales after joining the incubator believe the incubator accelerated their first sales; estimates ranged from less than six months up to two years.⁸³ Eleven did not know, and four believe it did not.
- POCCs: A strong majority of 87 current or former POCC participants stated that POCCs were very important or extremely important in the following areas: introducing them to valuable business contacts (82%), helping them achieve entrepreneurial goals (75%), and strengthening or reinforcing their desire to be entrepreneurs (67%).
- EIRs: Among 85 current or former recipients of EIR services, 47% stated their EIR was extremely or very important in helping achieve their entrepreneurial goals, 45% slightly or somewhat important, and 8% not at all important. Just over half (53%) have participated in a NYSERDA-sponsored

⁸² Eight of the 20 respondents who reported an increase in sales stated the incubator was “somewhat influential” in helping increase their sales volume. Three stated “very influential,” two “slightly influential,” and seven “not at all influential.”

⁸³ Seven companies credited the incubator with accelerating their first sales by six months to one year earlier, six companies stated the incubator accelerated their first sales by less than six months, and three stated the incubator accelerated their first sales by one to two years.

networking event that their EIR introduced them to;⁸⁴ of these, 76% made valuable contacts during these events.⁸⁵ Thirteen respondents have signed contracts with contacts that their EIR facilitated.⁸⁶

3B. Additional Business Development Services Needed According to Stakeholders⁸⁷

ICBD programs are well received by nearly all who participate, and by those that do not currently participate in such programs. The services that respondents recommended expanding beyond current levels are:

- Direct provision of financial resources;
- Networking and events;
- More connections to investors, customers, companies, and markets;
- Mentoring; and
- Business planning assistance.

Respondents offered differing opinions on specific changes in program focus/scope, funding priorities, or technology focus are needed to further assist cleantech companies in NYS.

The survey asked 127 current or former incubator clients: “*Are there any additional services that you wish the incubator had provided or would provide?*” Seventy-three companies (57%) responded “no,” confirming that the incubators are well-focused in the opinion of those who have participated. Figure 17 summarizes the suggestions of the remaining 54 respondents. While funding was most frequently mentioned, factors involving access to networks and markets – Networks – access to investors/clients (19%), market access (7%), and Networks – other entrepreneurs (7%) – collectively account for the second most frequent response. These findings are consistent regardless of how the data is parsed (i.e., by type of stakeholder, region, or cleantech sector).

Figure 18 below shows the top services noted by interviewees. Of the 17 interviewees who specified additional business development services they would like to receive, the most frequently mentioned services were mentoring (24%) and networking/events (24%), followed by help with business plans (18%) and introductions to investors (12%). These responses are consistent across stakeholder type, region, and cleantech segment.^{88,89} Similar to the survey respondents, the frequent mention by interviewees of networking events and introductions implies that they value the match-making role played by the incubators and seek more connections well-suited to their needs. As an EIR participant stated, “*For a small company it’s all about the relationships you develop with potential customers.*” Stated a VC interviewee, “*So much...is driven by the ecosystem, and by that I mean the people, so I think we need more events to bring people together to network.*”

⁸⁴ Thirty-one respondents have participated in between one and three events, 12 respondents have participated in four to six events, and the remaining two respondents have participated in more than six events.

⁸⁵ Valuable contacts include entrepreneurs (68%), mentors (41%), customers (35%), investors (29%), large companies (24%), manufacturers (18%), distributors (12%), suppliers (9%), and business partners (6%).

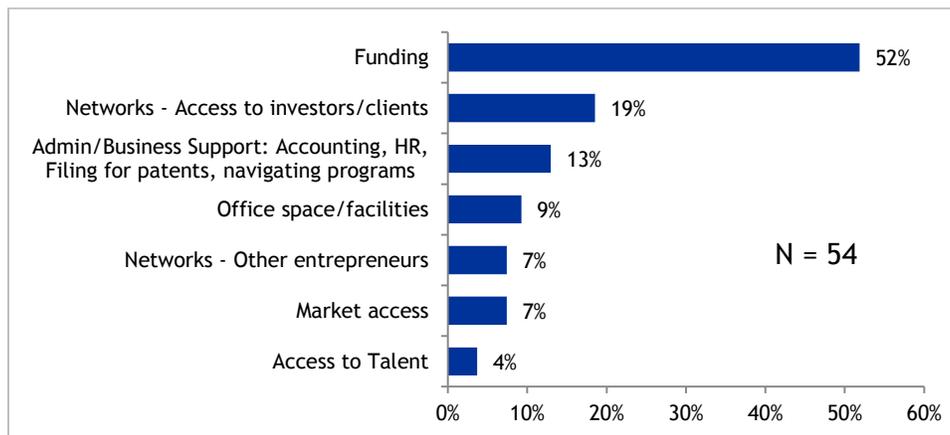
⁸⁶ Five signed contracts with a new customer, three with a business partner, two with a manufacturer, two with a large company, and four with others. Respondents were allowed to select more than one answer.

⁸⁷ Addresses Research Question 4.4: *According to a sample of the stakeholders, what services should ICBD and partners offer beyond their existing programs?*

⁸⁸ The bulk of these interviewees were classified under “Existing start-up companies in incubators/POCCs” in various stages of development, with a handful also spread out over “Incubator Directors & Key Program Staff,” “POCC Center Directors,” “EIRs,” “Economic Development Policy Officers NYS,” and “NY Clean energy business development service providers (not affiliated with ICBD).”

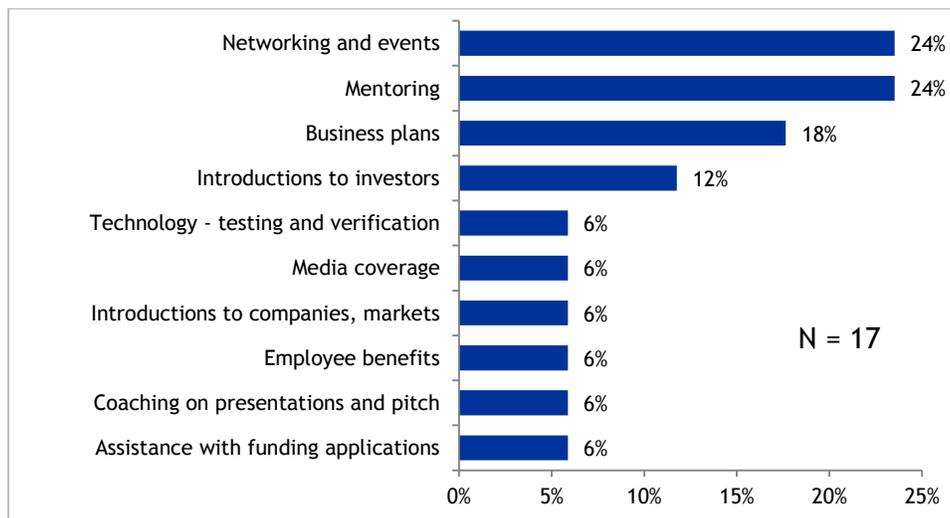
⁸⁹ In many instances, service providers stated what services are most needed from incubators, POCCs, etc., but did not indicate whether or not they are currently providing the service. The figure includes all responses except in cases where the respondent directly indicated that the service is currently offered.

Figure 17. Top additional business development services desired



Source: IEC Survey

Figure 18. Top Business Development Services Desired by Interview Respondents



Source: IEC Interviews

The interviews also asked respondents more open-ended questions to solicit ideas on what else NYSERDA’s ICBP program should do to support cleantech companies in NYS. While interviewees expressed a diverse range of opinions, a number of high-level themes emerged from their responses, which are discussed in order of most frequently mentioned to least frequently mentioned.⁹⁰ More details and additional insights from respondents can be found in Appendix D.

- **Adopt a more holistic and integrated approach to ICBP programming (n = 28).** For example, a POCC director stated, *“If someone goes through a POCC and hits certain milestones, they should have a stamp of approval and go to the top of the stack for a PON. They should map out all of NYSERDA’s programs, look at the overlaps, and identify gaps so they build things that flow well.”*
- **Focus on specific technology/segments for ICBP programming (n = 22).** Interview respondents voiced a wide variety of opinions about the technology areas where NYSERDA should place more or less focus. Some respondents stated that NYSERDA focuses too much on solar and manufacturing.

⁹⁰ A single interviewee may have identified multiple themes. High-level themes that were mentioned fewer than 12 times are not presented here.

Others stated that NYSERDA focuses too little on energy efficiency, biomass, and transportation. Still other respondents advocated for more focus on distributed generation, micro-grids, software, and water/energy. As one respondent stated, *“We need to funnel the funds to those that have the largest potential in a more streamlined manner”* and an incubator Director stated *“The POCCs and incubators are running out of steam because they are trying to do everything for everyone – they need to be more targeted and specialize.”* In contrast, others advocated for keeping programs technology agnostic given that early-stage companies don’t necessarily know yet which market segment they should belong.

- **Invest more strategically/change funding strategy (n = 21).** Relatedly, many interview respondents suggested that NYSERDA narrow its focus to fund a smaller number of companies with a greater chance of success. Other respondents encouraged NYSERDA to focus on developing clusters within NYS, focusing on areas with high potential that are not already developing (or well-developed) on their own. For example, a large company headquartered in NYS suggested, *“Maybe the State can pick one spot, and not spread out their investment too much. They should support a more central upcoming area, and not fund a balanced already self-sustaining area.”*

A number of respondents suggested that NYSERDA provide direct funding to companies on the commercialization pathway. One respondent suggested that NYSERDA could provide a \$100,000 grant to companies at the beginning of the commercialization process, which would enable companies to pursue SBIR and other federal funding. Others suggested that NYSERDA provide grants to companies after they hit certain milestones. Some respondents also noted that the ICB program not investing directly in companies contrasts with approaches taken by accelerators/incubators in other states even within NYS, such as the Massachusetts Clean Energy Center, or with the Connecticut Innovation Fund that co-invests alongside others. A respondent from upstate New York added that NYSERDA’s investment has a signalling effect, stating, *“If we go out and try to attract investors it’s difficult; they only come when NYSERDA is involved, and that’s because of NYSERDA’s name recognition and reputation. The private money is there but it needs to be co-invested alongside NYSERDA dollars.”*

- **Find and attract CEOs, entrepreneurs, companies and investors (n = 15).** Business development service providers and companies identified a need to find and attract companies, investors, and entrepreneurs. A POCC director suggested that NYSERDA should create *“a pool of potential CEOs,”* serial entrepreneurs who are interested in helping early-stage companies. A start-up company expanded suggesting that NYSERDA fund an entrepreneur fellowship program that attracted experienced entrepreneurs, paid them a stipend, and placed them in accelerators and companies. As far as attracting investors, one interviewee suggested that NYSERDA could develop targeted profiles of mid-stage cleantech companies and bring together a consortium of “non-traditional investors” to fund them. An interviewee from private equity suggested that NYSERDA could help companies to borrow money towards raising VC funds.

ICBD programs can (and to a certain extent already do) assist their clients by helping find or even fund directly such pre-seed financial resources, and preparing companies for fundraising with VC investors. They can also help clients to identify and connect with potential investors; and, advise them on deal terms and conditions.

- **Networking, events, connections, and relationships (n = 15).** Interviewees affirmed the value of NYSERDA’s networking events and highlighted NYSERDA’s role in forging connections within the cleantech ecosystem. Several respondents noted that relationships and connections are fundamental to building a well-functioning ecosystem. Overall, interviewees perceive high value in the networking events, although several respondents (with different backgrounds and affiliations) suggested that the ICB program could do even more to connect large companies, innovators, investors, universities, and economic development officers.

- **Disseminate information and success stories (n = 12).** Interviewees' suggestions in this area focused on the need to get the word out about ICBD services and success stories. One incubator director suggested that response letters to PON applicants (both successful and unsuccessful) should mention the availability of incubator services. Interviewees outside of the ICBD program expressed interest in learning more about ICBD programs. Interviewees also expressed a need for NYSERDA to communicate success stories to attract more companies and investors to NYS.
- **NYSERDA processes (n = 12).** Though more general to NYSERDA and not specific to the ICBD program, in 12 instances respondents provided feedback on NYSERDA's processes. Two specific areas identified were: providing more clarity about what NYSERDA will and will not fund; connecting between different NYSERDA programs; and implementing easier/less bureaucratic solicitation and contracting processes. Strong opinions were heard on this topic.

4. Methods

For this MCA IEC combined four main research methods: a literature review, interviews, survey and analysis of secondary data sources. This section briefly describes each method and its key limitations. Appendix B provides a more detailed description of the primary research steps and tools.

4A. Literature Review and Metrics Map

A literature review was conducted in 2015 to inform the scope, key concepts, indicators and potential data sources for the rest of the study, including literature on measuring entrepreneurship rates and ecosystems, cleantech, barriers and drivers, and outcomes. In addition, a detailed “Metrics Map” was created that gathered a wide range of 93 indicators, 360 metrics and many different data sources used in literature to describe entrepreneurial ecosystems and cleantech companies. The results of this literature review were presented in the memo and “Metrics Map” deliverable to NYSERDA. This work framed the rest of the data gathering for the study.

4B. Interviews and Interview Analysis

Interview steps:

Between January and November, 2016, IEC conducted 68 semi-structured interviews with ICBD program staff, incubator and POCC directors, entrepreneurs in residence, entrepreneurs, large companies, and investors. Appendix B provides details on the interview process, including the interview guides, and the themes by which the interviews were coded and analyzed.

Interview gaps and limitations:

Ultimately, we conducted five fewer interviews than initially intended with companies that had gone out of business and corporate research centers, due to low response rates. Additionally, interview questions did not fully align with survey questions, which limits the extent to which interview and survey results can be compared on the same themes, as noted in the analysis.

4C. Survey

Survey steps:

IEC conducted a survey to deepen the characterization of NYS’s cleantech entrepreneurial ecosystem, reaching a wider group of stakeholders. The survey collected data on:

- Entrepreneurial drivers and barriers,
- Outcomes achieved by recipients of incubator, POCC, and EIR services;
- Connections between stakeholders that make up the entrepreneurial ecosystem; and
- Perceived gaps in services offered by the ICBD program.

Respondents had the option to complete the survey online or by phone; most opted for online. Appendix B1 contains more details about the administration process and questionnaire.

The survey was administered in two stages:

- *Stage One* focused on past or present recipients or providers of business development services from NYSERDA-funded incubators, POCCs, and EIRs. IEC coordinated with NYSERDA to request contact information from directors of the NYSERDA-funded incubators, POCCs, and EIR program. IEC then sent the survey to the 475 contacts for whom IEC had direct contact information, and in

addition, one incubator director sent the survey link directly to their 75 contacts. The Stage One survey was completed by 248 respondents, yielding an overall response rate of 45%.⁹¹

- The *Stage Two* survey was sent to 114 contacts identified by the initial respondents in Stage One to round out our characterization of the market with a broader set of stakeholders. A total of 63 contacts completed the Stage Two survey, a response rate of 55%.⁹²

Open-ended responses to the survey were coded, and analyzed, comparing responses by region, type of organization, and type of technology focus.

Survey gaps and limitations: Stage One and Two survey samples may not be perfectly representative of the general population. First, in Stage One, IEC attempted to conduct a full census of all past and present participants and service providers affiliated with ICBD-funded incubators, POCCs, and the EIR program, but contact information was not received from one of the six incubators. Second, in Stage Two, IEC used an opportunistic sample based on contact information furnished by respondents in Phase One. However, a comparison between Phase One and Phase Two responses did not reveal any systematic differences between the two groups. Additionally, the information collected through interviews was generally consistent with the survey data on most topics, which lends confidence to our overall conclusions.

4D. Data Sources for Quantitative Metrics

IEC identified a wide range of data sources in the Metrics Map review and sought quantitative and credible data to describe certain indicators of the NYS cleantech entrepreneurial ecosystem. For several indicators, data sources were combined including interviews and survey results and significant desktop research to fill in data gaps was also conducted, as no single source was comprehensive.

Data Gaps and Limitations:

Although IEC verified and crosschecked data where possible, limitations of the data sources carry through to our research. Additionally, gaps remained in data for company closings, and the activities of large companies in cleantech, as discussed in Section 2A.

⁹¹ The target response rate for Stage One in our work plan was 50%. This was very nearly achieved (49%) for the contacts where the IEC team received direct contact information, due to targeted follow-up by email and phone. IEC was not able to conduct similar follow-up with the 75 contacts in the incubator that distributed the survey link directly to their contacts as contact information was not gathered, and the response rate for that group was considerably lower (17%).

⁹² This comfortably exceeds our target response rate of 25% for Stage Two. The target response rate was lower for Stage Two because it included individuals who have not been directly involved in the ICBD program.

5. Conclusions and Recommendations

This MCA presents an overview of the current cleantech entrepreneurial ecosystem in NYS, the drivers and barriers that affect it, and the current position of the ICBD program as it seeks to further the success of the early-stage companies within it, helping them to accelerate the pace and scale of their innovations.

The study identified 649 early-stage cleantech companies in NYS, of which 325 (50%) are in clean energy, and 200 (31%) began operations within the last five years. Added to this is the harder-to-measure population of entrepreneurs (individuals and teams) that are currently exploring new cleantech innovations and markets, but have not yet formalized their work into an incorporated company.

Beyond ICBD's target market, the NYS cleantech ecosystem also features established companies with cleantech business lines and service offerings (such as GE and IBM), and a variety of professional service companies and individuals, including lawyers, accountants, marketing firms, certification and testing services, consultants and others providing strategic and tactical advice to companies as they grow.

5A. Summary of Key Findings

5A.1 Resources

The NYS entrepreneurial ecosystem for cleantech companies is healthy; NYS is rich in resources, though they appear in some cases to be unevenly distributed. The success of entrepreneurs and technological innovations relies in part on the surrounding conditions, and the ability to harness needed resources. This MCA characterized the financial resources, intellectual property resources, human resources and business development resources within the NYS entrepreneurial ecosystem.

- NYS cleantech companies are finding ways to access **financial resources**. In 2015, NYS cleantech companies accessed at least \$265M, including \$210 in VC investments, \$34M in DOE and SBIR related funding, and \$42M in NYSERDA funding.
 - The increasing number and value of “seed” investments reported to the Cleantech i3 Database in recent years is a positive indicator that investors are focusing on the potential of early-stage cleantech companies in the state.
 - While financial resources exist, they are less plentiful for pre-seed and expansion stages of development. Resources also appear less available to companies distant from the financial resources of New York City, and for those companies with “hardware” technologies that have more capital-intensive needs.
- NYS has a wealth of **IP resources** being generated by individual entrepreneurial teams, universities, and large companies. Existing technological capabilities in NYS, such as in manufacturing, mechanical assembly and electrical assembly technical competencies, underpin the types of cleantech innovations being developed and commercialized by early-stage companies. However, IP resources are not always readily available to early-stage companies. Additional financial resources, training, incentive structures, and improvements to licensing processes at universities could unlock more of the IP resources at these institutions.
- In terms of **human capital**, NYS is already a national leader in “clean jobs,” and a broader “culture of entrepreneurship” is emerging in NYS, fueled in part by rising demand for energy efficiency, by universities and also media, which helps shape career choices and encourages individuals to found and join cleantech companies. However, some gaps in specific skills emerged from our primary research. In particular, interviewees and survey respondents mentioned the challenge of attracting and retaining people to commercialize technologies and build sustainable businesses. ICBD programs are already targeting these gaps, but continued focus will be important.

- A rich landscape of **business development services for early-stage companies** exists in NYS, including at least 119 incubators, accelerators, EIR programs and POCCs, with 19 (16%) of these focused on cleantech (of which nine were ICBD), and the rest either open to any technology, or open to technology fields that overlap with cleantech. Within that landscape of existing business development resources, the nine ICBD programs fill a gap by serving geographic regions (in the northern and western parts of the state). These programs also coincide with some noted emerging clusters of cleantech innovation.

In addition, NYS boasts other important resources, including a robust financial services sector and the media and communications hub of NYC. However, these resources are of limited use to most early-stage companies who typically lack the collateral necessary to access the capital, or funds available to access communications and media resources until they grow larger.

5A.2 Market Structure – Drivers and Barriers

While the NYS entrepreneurial ecosystem is large and resource-rich, cleantech companies still face barriers, including risk-averse customers (e.g., utilities and large industrial facilities) that can be reluctant to adopt new technologies. A central challenge for early-stage companies – cleantech included – is identifying “product-market fit”, and then determining the most effective path to market. ICBD programs can and often do help early-stage companies by providing market intelligence, strategic advice, technology validation, and contacts in industry to do this. One such initiative sponsored by the ICBD program was the “StartupGPS” tool, which helps companies to identify the business development areas they should focus on, given their stage of development.⁹³

Other identified barriers facing cleantech companies include state regulatory framework and policies, lack of tax incentives and subsidies, and high state tax rates, all of which can delay time to market for innovative technologies. While these are beyond the scope of ICBD, and may not be specific to NYS, they suggest that a holistic approach to policy supporting entrepreneurship and cleantech in the state.

Finally IEC’s spatial analysis of ecosystem resources (Appendix E) has identified some emerging concentrations of resources to support entrepreneurs in various areas in NYS, particularly in and around major urban areas (NYC, Albany, Syracuse, Rochester, Buffalo, and Ithaca). These are areas where ICBD programs already have a presence aside from Ithaca (Southern Tier region), as noted in the January 2017 ICBD CEF Investment Plan.

5A.3 Role of NYSERDA and ICBD

NYSERDA appears to play a central role in the entrepreneurial ecosystem, and has a considerable but not universal reach among cleantech companies. Our research suggests that around 53% of the 649 cleantech companies have accessed NYSERDA R&D programs; and 31% are currently enrolled in or recently graduated from ICBD incubators and POCCs. Some companies access more than one NYSERDA program at different stages in their development (e.g., PON grants for R&D, and ICBD incubator support for commercialization). NYSERDA’s resources are especially important and highly valued in regions that are less rich in resources, such as those in the northern and western parts of the state. Stakeholders view NYSERDA as a reliable and valuable resource for early-stage companies and entrepreneurs, especially as the availability of other resources fluctuates.

A limiting factor for the NYS ecosystem is the ability to locate and then *access* resources, and the time and effort it is taking companies to do so. ICBD can (and already does) help connect entrepreneurs and companies to relevant resources, and could help to further extend these connections, connecting them to the right resources at the right time in their development.

⁹³ The NYSERDA sponsored “StartupGPS” tool features an interactive survey enabling entrepreneurs to supply information that will be used to assess their team skills, product development, marketing and internal operations. Upon completion of the survey, users receive a report showing core business development areas that are the most complete and which ones need attention. See: www.StartupGPS.org.

5B. Implications and Suggestions for ICBD

Our analysis of the current entrepreneurial ecosystem in NYS provides some informal “actionable intelligence” for ICBD and NYSERDA that could help position programs to build on existing strengths of NYS’s marketplace, and also address some of the key weak points in the entrepreneurial ecosystem.

ICBD program should continue to focus on growing the NYS cleantech market and ecosystem.

Suggestions include:

- Supporting incubators, POCCs, and EIR programs, with a focus on regions with emerging cleantech clusters, such as in and around major urban and university centers (Albany, Buffalo, New York City, Ithaca, Rochester, Stony Brook/Long Island, and Syracuse), and the regions where there are fewer resources but strong signs of entrepreneurial activity. Given that NYS is geographically very large and travel times are long, a focus on localized services is valuable, as is building up the local networks in each of these regions so that they can be self-sufficient in the longer term.
- Building the network of VC and angel investors for ICBD clients.
- Promoting the success of ICBD client companies to key stakeholder groups.

ICBD program could expand and/or complement its work by helping NYS cleantech companies connect to and access the resources they need to grow and succeed. Suggestions include:

- Providing seed grants to nascent companies, such as is planned with the pre-seed, non-dilutive “Ignition Grants”. These grants, if provided in a way that minimizes administrative burden, will enable entrepreneurs to dedicate more time to develop and commercialize their innovation.
- Helping NYS early-stage cleantech companies to build and capture the value of IP resources, for example by providing more funds for certifying and testing of new technologies; by adding capacity to the two Technology Testing Centers; and/or by creating including a “fast-track” program for early testing of technologies to counter delays.
- Building connections to potential suppliers, manufacturers, customers and clients in specific cleantech segments, helping cleantech companies to find the best “product/market fit” for their innovation, and connecting clients to large corporations, banks, and large purchasers/buyers that are supportive of cleantech innovations. Examples of specific program activities could include:
 - Providing grants that support expert market and commercialization studies.
 - Training and ‘lean start-up’ accelerator-type training for entrepreneurs.
 - Providing feedback on the business development tasks companies most needed to work on.
 - Linking companies to contacts in target markets, for example by building technology roundtables, and holding other knowledge-sharing and business-development events on specific segments of technologies.
- Expanding the EIR program by providing financial support to proven, serial entrepreneurs to come to NYS to commercialize technologies and build companies.
- Coordinating resources with other programs (both NYSERDA and other providers of business development services in the state), for example by:
 - Creating a visual process map of business development programs, focusing on the point of view of an entrepreneur trying to access them. Clarify where possible funding amounts, deadlines, processes concur and where there are gaps.
 - With this knowledge, optimize administrative processes to speed up processes, and get resources to those that can make the best use of them, and connect ICBD programs, for example by shepherding POCC teams into incubators.