



NJ Clean Tech Seed Grant Program analysis

**A report developed for NJ Commission on Science,
Innovation, and Technology**

Roshani Bharati

NJIT Martin Tuchman School of Management (PhD candidate)

Michael Ehrlich

NJIT Martin Tuchman School of Management (Associate Professor)

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Executive Summary

Climate change has created pressing challenges to mankind, prompting governments around the world to adopt new strategies for reducing greenhouse gas emissions. While the development and deployment of clean technologies can help tackle climate change issues, the development of a vibrant clean tech industry has the potential to uplift a local economy. However, there is a significant crisis in clean tech innovation deployment as most clean tech solution ideas die in the early stage. Clean tech solutions, often characterized by high uncertainty, regulatory dependency, and capital intensity, are deemed unattractive to private investors, and often face a lack of financing.

In view of this critical need to support clean tech startups, the New Jersey Commission on Science, Innovation, and Technology (CSIT) in coordination with the New Jersey Board of Public Utilities (NJBP) and the New Jersey Economic Development Authority (NJEDA) implemented a Clean Tech Seed Grant Pilot Program in 2021. The first round of the program conducted in 2021 provided \$75,000 grants to each of nine qualifying companies. The companies were selected based on a competitive grant solicitation evaluating innovation, market opportunity, implementation plan, go-to-market strategy, economic and environmental impact, and team quality. Subsequently, in 2022, CSIT administered a multi-part survey to the grant recipients gathering information on their project status and the economic impact of the grants they obtained.

The survey was conducted one year after the grant distribution and most of the companies were either working in product development or preparing for commercialization. While the companies had limited commercialization outcomes (revenue) to report they did indicate that the grant has had significant contribution in helping those companies further their product development and commercialization activities including raising additional funds and hiring personnel. Eight of the nine companies obtained follow on funding and reported dollar amount of their new investment totaling about \$32,405,000 in new capital (grants and equity) after receiving the CSIT grant, which is 48X the original CSIT grant. One company did exceptionally well by obtaining 66% of the total new capital. However, even after removing the outlier company, the total capital received by the remaining 8 companies was 18X the CSIT original grant, which is higher than the investment received (14X) by SBIR companies that received matching grants from CSIT. The companies also created an average of 6.2 jobs each, totaling 56 jobs, after receiving the grant. Additional economic impact of the grant can be evaluated when the awarded companies are surveyed up to three years post grant activity completion.

Background

Climate change refers to a long-term shift in temperatures and weather patterns.¹ According to NASA, sea levels have increased by 4 inches since 1993 and the global temperature has increased by 1.1 °C since the pre-industrial era². Climate change has been exacerbated by human activities such as burning fossil fuels and poses an existential threat to the health and economic well-being of mankind. Due to this, it is receiving increasing attention as one of the pressing challenges for our time. To tackle this climate emergency, governments around the world have adopted strategies to reduce greenhouse gas emissions. Accordingly, both federal and state level governments in the U.S. have also taken a variety of actions, including enacting legislation covering economic incentives, emission controls on power plants and vehicles, and building codes to reduce greenhouse gas emissions.³

As the energy sector is the source of around three-quarters of global greenhouse gas emissions, meeting the climate challenge also heavily depends on the acceleration of clean energy innovation.⁴ The development and deployment of new clean tech solutions are important to curb the negative effects of climate change efficiently and cost-effectively. Clean technology encompasses a broad range of technologies that aim to either reduce or optimize the use of natural resources, while simultaneously reducing the negative impact on the environment by using energy-efficient, sustainable, and environment-friendly materials, processes, or practices. The technologies currently in the market are insufficient to substantially reduce greenhouse gas emissions. Therefore, it is crucial to foster innovations in clean tech solutions to tackle climate challenges.⁵ The development of a vibrant clean tech industry also has substantial advantages to the local economy, including the creation of new businesses and jobs.

Even though clean tech projects can help create a better environment and economy, there is a significant crisis in clean tech innovation.⁶ One of the main deterrents to clean tech project development is the lack of financing. Clean tech projects often lack investments from the traditional finance sector. These projects are often characterized by high uncertainty, regulatory dependency, and capital intensity which makes them unattractive to private investors.⁷ As a result, most clean tech solution ideas die in the early development stage. An early-stage government investment is often critical to help a nascent solution move from the

¹ <https://www.un.org/en/climatechange/what-is-climate-change>

² <https://climate.nasa.gov/>

³ <https://crsreports.congress.gov/product/pdf/R/R46947>

⁴ <https://www.iea.org/reports/world-energy-outlook-2021/executive-summary>

⁵ <https://www.iea.org/reports/how-governments-support-clean-energy-start-ups/six-reasons-governments-support-clean-energy-start-ups>

⁶ Saha, D., & Muro, M. (2017). Cleantech venture capital: Continued declines and narrow geography limit prospects. Brookings Institution Report, 1-14.

⁷ Polzin, F. (2017). Mobilizing private finance for low-carbon innovation—A systematic review of barriers and solutions. *Renewable and Sustainable Energy Reviews*, 77, 525-535.

research stage to the commercial stage in which its benefit can be significantly realized.⁸ A study among U.S. based clean tech startups found that in comparison to clean energy startups that did not win prestigious research grants, the startups that received government grants were 12% more likely to receive subsequent venture capital funding. The government investment in clean tech solutions can help startups overcome the ‘valley of death’ in two critical stages: first between basic concept development and viable prototype development, and second between prototype verification and product commercialization.⁹

In view of this pressing need to support clean tech innovation, the New Jersey Commission on Science, Innovation, and Technology (CSIT) launched the Clean Tech Seed Grant Pilot Program in 2021 with funding from the New Jersey Board of Public Utilities (NJBP) and administrative support from the New Jersey Economic Development Authority (NJEDA).¹⁰ The Clean Tech Seed Grant Pilot Program was the first grant program launched by CSIT to support upcoming small businesses in New Jersey following its highly successful SBIR/STTR Direct Financial Assistance matching grant program. The main objective of the Clean Tech Seed Grant Pilot Program is to help accelerate the development and innovation of clean technologies by providing grants for R&D activities to very early-stage, New Jersey-based, clean technology companies. To qualify for the grant award, the applicants were required to be between a minimum technology development level of Technology Readiness Level (TRL) 2 (applied research) to TRL 7 (Full-scale, similar (prototypical) system demonstrated in relevant environment), based on the Department of Energy definitions. With support from the program, the early-stage clean technology-focused businesses can continue working on their new discoveries and move from the research stages to the proof of concept and prototyping stages, at which point they can more readily attract the interest of outside investors.

Specifically, the program is designed to fund projects developing technologies that can recapture or avoid emissions of greenhouse gases and/or other pollutants or to enable such avoidance or recapture in the following areas:

1. Chemicals/Advance Materials,
2. Energy Distribution/Storage,
3. Energy Efficiency,
4. Energy Generation,
5. Green Buildings,
6. Transportation,

⁸ Burger, S. P., Murray, F. I. O. N. A., Kearney, S., & Ma, L. (2018). The investment gap that threatens the planet. *Stanford Social Innovation Review*, 16(1), 28-35.

⁹ Lessons from the first cleantech bubble and the role of venture capital and governments in clean energy

¹⁰ <https://www.njeda.com/clean-tech-grant/>

7. Waste Processing, and
8. Water and Agriculture.

Comparison with Other States Providing Support to Clean Tech Startups

To tackle the climate crisis and foster clean tech innovations, the states around the U.S. are ramping up their support for clean tech businesses. The State of California started California Sustainable Energy Entrepreneur Development Initiative (CalSEED) program in 2016 to support California-based early-stage entrepreneurs and researchers in bringing their clean tech solution concepts/prototypes to market. The program provides \$150,000 for Concept Award and \$450,000 for Prototype Award along with professional development support to the entrepreneurs. Specifically, the program supports solutions that fall between Technology Readiness Levels (TRL) 2 and 4 on the TRL scale defined by the Department of Energy. It has already supported more than 116 entrepreneurs in six cohorts¹¹.

The Massachusetts Clean Energy Center (MassCEC) in the state of Massachusetts started the Catalyst program in 2010. The program provides grants of up to \$75,000 and professional development support to researchers and early-stage startups seeking to demonstrate initial prototypes of their clean technology solutions. The aim of the program is to help businesses attract the interest of investors by demonstrating the feasibility of their new ideas transforming into the commercialization stage. MassCEC also supports slightly mature up-and-coming clean energy companies via its InnovateMass program. The program provides up to \$250,000 in grant funding as well as technical support to startups deploying new clean energy technologies or innovative combinations of existing technologies with a strong potential for commercialization. Specifically, the program aims to support companies during the funding gap they often face between early-stage funding provided by angel investors and later-stage funding provided by venture capital investors also known as the ‘commercialization valley of death’.

Similarly, in New York state, the New York State Energy Research and Development Authority (NYSERDA) has been promoting clean tech innovation and the use of renewable energy since 1975 by providing various funding opportunities and professional development support to businesses. It designed a wide range of programs to provide support infrastructure, mentorship, and funding to businesses moving from the ideation stage through commercialization¹².

¹¹ <https://calseed.fund/about/>

¹² <https://www.nyserda.ny.gov/>

The clean tech solution support programs in these states have significantly contributed to reducing carbon emissions as well as accelerating economic growth in the states. For example, the 2022 Massachusetts Clean Energy Industry Report showed that the industry, powered by small businesses with 58% of them having less than 10 employees, contributed over \$14.2 billion to Massachusetts' Gross State Product in 2021 and has created over 44,000 jobs since 2010¹³. Therefore, support programs for small businesses with innovative clean tech solutions such as Clean Tech Seed Grant Pilot Program have the potential to help New Jersey achieve sustainable development, diversify the local economy, and create new jobs and businesses.

Economic Impact of the Program

In round 1 of the Clean Tech Seed Grant Pilot Program conducted in April 2021, \$75,000 grants were provided to each of the nine eligible companies in New Jersey. The grants were provided to businesses with diverse backgrounds. Among the awardees, there were three businesses located in Opportunity Zone-eligible census tracts, three businesses with technology from New Jersey universities (Rutgers University and Princeton University), two minority-owned businesses, and one female-owned business. The awarded companies were also working on clean tech solutions related to a wide variety of areas, including advance materials, agriculture, chemical, energy generation, energy storage and waste management.

In 2022, CSIT administered a multi-part economic impact survey to the nine companies receiving the first round of Clean Tech Seed Grants. The questionnaire template used for the survey is provided in the appendix section of the report. The purpose of the survey was to learn from each supported company:

- 1) the current status of their projects,
- 2) the challenges the companies were facing in carrying out their projects,
- 3) the impact of the grants on the firms' ability to receive additional funding, and
- 4) the project's economic outcomes.

The survey result showed that most of the companies were either working in product development and testing or were preparing to commercialize their products. While they reported that they were on track to meet project goals, they outlined the following challenges during project implementation.

1. Limited funding
2. Finding talent
3. Scientific issues for product development

¹³ https://www.masscec.com/sites/default/files/documents/2022%20Massachusetts%20Clean%20Energy%20Industry%20Report_Final.pdf

4. Supply chain issues

Among the nine awarded companies, three companies reported funding limitations as a major challenge in implementing their projects. However, two of them were able to attract \$380,000 and \$250,000, respectively, in new investment after receiving the CSIT grant. All of them were also able to continue making progress in product development and were focusing on building partnerships with other companies to begin commercialization. One of the three companies specifically reported that the CSIT grant was helping it overcome funding challenges.

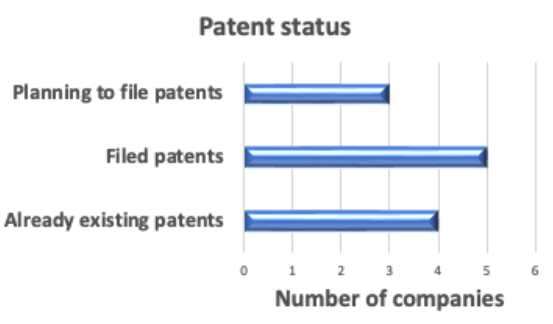
The next challenge reported by companies was facing technical challenges in product development, which was further exacerbated by the difficulty in finding talent. One company mentioned labor shortages and their fundraising initiative to collect sufficient capital to add new hires. Supply chain issues, which prevented timely availability of materials, created difficulty for a company in product development. As the grant was distributed during the Covid-19 pandemic, the pandemic could have exacerbated the supply chain issues and labor shortages. The challenges reported by the companies receiving Clean Tech Seed Pilot Grant in 2020 and 2021 were similar to the challenges reported by the companies receiving SBIR matching grants from CSIT, which suggests that startups in general have difficulty finding funding and attracting talent in addition to the product development issues that most technological companies face. Based upon the report by the awardees, the CSIT Clean Tech Seed grant has assisted companies in overcoming the startup specific challenges and furthering their product development and commercialization activities.

A. Commercialization Status

We describe the companies' commercialization status in three phases: product development, prototype testing, and commercialization. Among the awarded nine companies, three were towards the end of product development phase and reported that they planned to start commercialization by 2023/2024. Five companies reported successful prototype testing, building strategic relationships with other companies, and preparing to start the commercialization phase. One company had already started the commercialization process and earned \$1,500,000 in revenue.

B. Intellectual Property (IP) Status

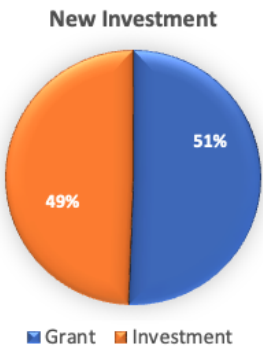
Technology development and knowledge important for economic growth and and the number of patents obtained by indicates innovation and new technological Four of the nine surveyed companies having patents when they applied for the one of them reported filing a new patent application after receiving the grant, and others are planning to file new patents soon in the near future.



creation are development, companies development. reported program, and

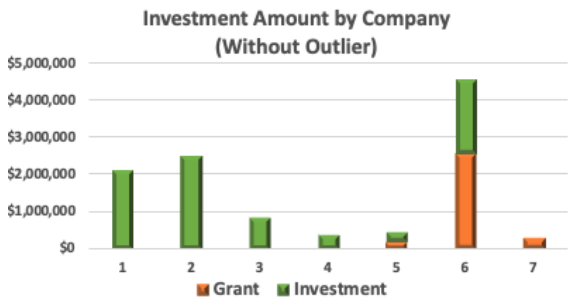
C. New Investment

Eight of the nine surveyed companies reported receiving funding after obtaining the Clean Tech Seed Grant from one company that was not able to secure additional reported that the grant obtained from CSIT helped attract from investors. In total, the eight companies received in new capital after receiving the award, with in the form of grants and \$16,010,000 from outside because of partnership agreements with other companies, angel investors, and venture capitalists.

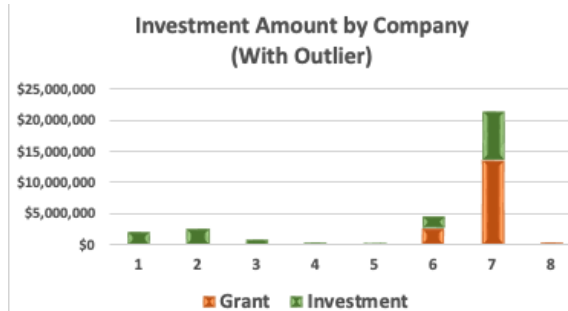


additional CSIT. The funding attention \$32,405,000 \$16,395,000 investors

The total investment received by the was more than 48 times the grant provided by Among the eight companies that reported the amount of new investment they received, one received a disproportionally higher amount of representing 66% of the total investment the companies. However, even after the investment obtained by the outlier the total investment obtained by the companies was more that 18 times the grant



companies CSIT. dollar company investment, reported by removing company, remaining provided by



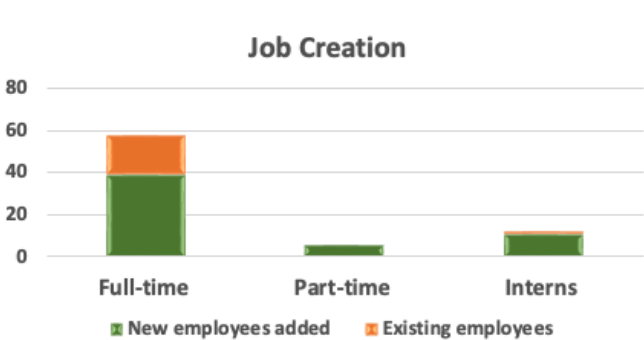
CSIT. This is significantly higher than the additional investment obtained by companies receiving CSIT SBIR matching grants which was 14X. These findings suggests that clean tech businesses have a high potential to attract new investment if they receive support from the government in early stages of product development, helping them to avoid the ‘valley of death’.

D. Physical Expansion

The physical space expansion of the companies denotes the expansion in economic activity. Among the nine surveyed companies, three companies reported expanding their physical space after the receipt of the award while six companies did not.

E. Employment Creation

The funded companies were creating new jobs. They went from employment for 19 full-time and 1 intern to providing for 58 full-time employees, 6 employees, and 12 interns in total receiving the grant from CSIT. On project employed 8.4 employees at the time of the survey and had created 6.2 new jobs per project after receiving the CSIT Clean Tech Seed grant. This is higher than the jobs created (1.36 jobs on average) by companies receiving SBIR matching grants.



successful in providing employees employment part-time after average, each

Conclusion

The finding shows that the companies that won Clean Tech Seed Grants have been able to obtain a substantial amount of new investment and have created new employment opportunities for the workers in New Jersey. Most companies were either preparing to start the commercialization process or had started the commercialization process by establishing strategic relationships with outside companies and might start earning revenue in near future. At this stage, the data are limited and preliminary. Additional follow up survey data collected over the years and including cohort 2 data will provide a more robust analysis of the program and the economic impact. Following the awarded companies over more years will likely generate more significant results.

Appendix A: Survey Questionnaire Template



New Jersey Commission on Science, Innovation and Technology
Clean Tech Seed Grant Program Annual Reporting Questionnaire (Economic Impact Report)
Please submit within thirty (30) days of annual grant signing anniversary

Company Name:

Effective Date of Seed Grant award:

1. In one or two sentences, describe the status of development activity for your R&D project for which the grant was awarded?
2. Describe the current commercialization status of your technology or research; include details on number of license agreements signed, strategic relationships formed, any Sales of your technology (revenue level) and current number of customers.
3. In one or two sentences, outline any challenges your company or R&D project is currently facing?
4. If applicable, please provide an update on the current status of your IP (invention disclosures, provisional patents filed, full patents filed, patents issued, both in the US and internationally).
5. Since receipt of the CSIT grant, has your company been able to secure any additional investment or funding including grants, angel investments, venture capital or loans? Please provide details on the dollar amount, type of funding and the funding terms.
6. Since receipt of the CSIT grant, has your company expanded physical presence in NJ? If so, include details of physical spaces in NJ (include address of physical space in NJ, when did you acquire physical presence in NJ? Purpose of physical space - lab space, headquarters)
7. Since receipt of the CSIT grant, how many new employees paid and unpaid (full-time, part time, interns, and contractors) have you added? How many existing employees (paid and unpaid) have been retained? In NJ and outside of NJ? Please provide demographic data for employees including gender and ethnicity.
8. Since receipt of CSIT grant, have you participated in any cohort programs? - I-Corps, accelerators, incubators etc. If so, please indicate which program and the dates of the program.
9. If applicable, please provide any relevant press releases, articles, or video links as it pertains to the project for which the grant funding was received.

Appendix B: Awarded Applicants and Brief Descriptions

Clean Tech Seed Grant Program			
Applicant Name	Average score	Bonus Points	Total score
Princeton NuEnergy	88	10	98
Andluca Technologies Inc	87	5	92
Sunray Scientific	82	10	92
Farm to Flame Energy	80	10	90
Renew CO2	82	5	87
GreenBlu	82	5	87
WeSolar CSP Inc.	80	5	85
Arbela Laboratories	81		81
Eion NJ Corp	81		81

Arbela Laboratories (Randolph, Morris County), \$73,000: Arbela Labs is an early-stage company focused on increasing the scale and reducing the costs of biomanufacturing using its methanol-fed *Pichia* platform and end-to-end systems engineering. Their goal is to economically produce proteins and other biomolecules for customers at unprecedented volume while enabling a revolution in protein production for human and animal nutrition without the environmental downside of current practices.

Andluca Technologies Inc. (Princeton, Mercer County), \$74,969: Andluca Technologies is a spin-out of Princeton University that aims to significantly reduce the energy use of existing buildings via solar-powered smart glass systems. The Andluca team has shepherded an R&D breakthrough - transparent ultraviolet solar films for smart windows - from university discovery to granted US patent to pilot integration with electrochromic glazing.

Eion NJ Corp (Princeton, Mercer County), \$75,000: Eion Corp is developing a specialty fine-grained mineral material that rapidly captures and stores CO₂ when applied to agricultural soils. They've identified a unique strategy that has low startup and marginal costs, is permanent, verifiable, and certified organic. Their innovation is use of chemical tracers to verify the CO₂ drawdown for trading securitized carbon credits.

Farm to Flame Energy (Kearny, Hudson County), \$74,995: Farm to Flame Energy provides scalable, end-to-end electricity generation systems for communities in underdeveloped countries. They are developing portable generators that utilize agricultural and residential wastes in a smokeless and carbon neutral process to provide power.

Green Blu (Hamilton, Mercer County), \$75,000: GreenBlu solves the toughest challenges facing desalination and wastewater, which are high electricity use and liquid waste discharge. GreenBlu's go-anywhere, modular, containerized distillers and ZLD crystallizers are highly efficient, cost-competitive, and completely changes the economics of waste brine by monetizing dissolved solids. Their vapor adsorption distillation cycle powered by waste or solar heat achieves low operating cost by not using membranes and minimizing electricity use.

Princeton NuEnergy (Bordentown, Burlington County), \$75,000: Princeton NuEnergy's mission is to create new solutions in renewable energy, alternative fuels, and environmental protection by generating novel processes and materials. Their current focus is on second-life battery solutions and closed-loop lithium-ion battery recycling to solve the issues of high cost and chemical pollution which traditional battery recycling methods suffer from.

RenewCO2, LLC (Cranford, Union County), \$75,000: RenewCO2 is designing and developing technologies and equipment for the direct reduction of carbon dioxide into chemicals such as plastics precursors. Their technology uses only CO2, electricity from sources such as wind and solar, and water as the feedstock yielding plastics with an overall negative CO2 footprint.

SunRay Scientific, LLC (Eatontown, Monmouth County), \$75,000: SunRay Scientific Inc. has pioneered and is bringing to market an environmentally clean electrical connection technology. The simplicity of SunRay's technology lowers production costs while speeding up production time, enabling bringing electronics manufacturing back to the USA. New generation customized conductive inks and epoxies address challenges of silver migration to allow for finer printing of printed electronics.

WeSolar CSP Inc (Princeton, Mercer County), \$75,000: WeSolar CSP designs and builds scalable and modular Concentrated Solar Power (CSP) plants for energy and heating solutions for: Government, Utilities, Corporations, Industry, and Community/Micro-grids. Their system can generate 24 hours of electricity by employing long duration storage technology and enables high-temperature applications like green hydrogen production and process heat