Matter Number 16-00681, In the Matter of the Clean Energy Fund Investment Plan

Clean Energy Fund Investment Plan: Energy-Related Environmental Research Chapter

Portfolio: Innovation & Research

Submitted by:

The New York State Energy Research and Development Authority

Revised May 7, 2021

Clean Energy Fund Investment Plan: Energy Related Environmental Research Chapter		
Revision Date	**Description of Changes**	**Revision on Page(s)**
January 26, 2017	Original Issue	Original Issue
April 19, 2019	As part of the Annual Investment Plan & Performance Report (IPPR) process, NYSERDA has updated budget and benefit values to align with actuals for past years and adjusted budget and benefit forecasts for future years, as appropriate, based on experience to date. Budget and benefit tables have been moved to Appendix B of this chapter and output/outcome tables have been moved to Appendix C of this chapter. Updated rounding convention has been applied to budget and benefit tables.	Multiple
August 8, 2019	Added activities associated with offshore wind predevelopment activities and corresponding budget.	Multiple
June 1, 2020	As part of the Annual Investment Plan & Performance Report (IPPR) process, NYSERDA has updated budget and benefit values to align with actuals for past years and adjusted budget and benefit forecasts for future years, as appropriate, based on experience to date.	Multiple within the plan. Appendix A, B, & C
May 7, 2021	As part of the Annual Investment Plan & Performance Report (IPPR) process, NYSERDA has updated budget and benefit values to align with actuals for past years and adjusted budget and benefit forecasts for future years, as appropriate, based on experience to date. The chapter has been updated to provide a bridge between committed and acquired planning. Committed budget and benefits summaries have been added to plan text, while Appendix B has been updated to reflect expenditure & acquired benefits plans.	Appendix B 8-9, Appendix B

Energy-Related Environmental Research

The Energy-Related Environmental Research program is designed to increase the understanding and awareness of the environmental impacts of energy choices and emerging energy options by providing a strong scientific, technical foundation for formulating effective, equitable energy-related policies and practices. It will:

- Inform state and federal energy and environmental policies;
- Guide cost-effective greenhouse gas mitigation and climate adaptation strategies;
- Ensure that the chemical, biological and public health impacts of air pollution from power generators are documented in a scientifically-rigorous and legally-defensible manner;
- Defend state energy initiatives against legal challenges;
- Examine the health and ecological co-benefits of alternative energy solutions, and identify and mitigate environmental barriers;
- Guide emerging energy technologies and systems; and
- Assess progress over time toward policy goals and provide environmental accountability.

The investment approach includes ongoing support for long-term monitoring efforts, recurring competitive solicitations targeting research priorities identified in the Program's Research Plans, and opportunistic research projects and partnerships, such as with organizations with similar goals who can leverage program funds and enhance scientific and/or policy value. Based on a robust stakeholder-driven framework, the program's research agenda will continue to develop over time and integrate an evolving energy–environmental landscape that identifies information gaps and research needs.

New York State will need to continuously assess progress toward policy goals related to environmental, energy and economic benefits. As progress is made and challenges are addressed it will be critical that policies and initiatives have the scientific foundation to measure success and guide new strategies.

17.1 Energy-Related Environmental Research

17.1.1 Overview

Present Situation	• Energy production and use can cause adverse environmental, public health and economic impacts including: degradation of lakes, streams, forests, and buildings from acid deposition; elevated levels of mercury in fish and other wildlife; human morbidity and mortality from poor air quality related to ozone, particulate matter and air toxins; habitat alterations and societal impacts from alternative energy development; and costly impacts from the changing climate. • While emission reduction efforts have resulted in measured improvements, energy-related impacts continue to affect New York's sensitive ecosystems and vulnerable populations. • Historically, NYSERDA's energy-related environmental research activities have helped provide the knowledge necessary to reduce the adverse energy-related impacts that damage New York's ecosystems and the health of its citizens, support

	environmental accountability for the State's existing energy and environmental policies, and guide cleaner, more environmentally thoughtful alternatives in ways that advance New York's energy policies. Well established relationships have been developed to facilitate the dissemination of program information to key end users. NYSERDA's energy-related environmental research program has been cited by regulations and actions ranging from the federal Clean Air Interstate Rule to the Update of the National Emissions Inventory to the NYS Climate Risk and Resiliency Act, to name a few. • Scientific information will continue to be needed to provide guidance for sound decision-making related to the State's energy-related environmental goals. • While State regulators and local resource managers and planners desire such scientific information, they often do not have the capacity to conduct the necessary research to help inform their policies and decision-making.
Intervention Strategy	• This program is a continuation of NYSERDA's successful energy-related environmental research efforts (previously known as Environmental Monitoring, Evaluation and Protection Program) that will continue to be based on scientific objectivity and use a stakeholder-driven framework to develop an agenda that addresses information gaps and research needs. It will also consider the broader, evolving energy and environmental policy context. For instance, traditional emission reduction strategies that focused on central generating power plants may no longer be adequate to improve air quality and reduce deposition and its associated effects. Therefore, this program is intentionally designed to address issues related to new distributed generation (DG) initiatives and fuel mixes envisioned under Reforming the Energy Vision (REV). • This program will focus on monitoring and associated research and analysis to provide critical components of information used to guide regulations addressing transport of ozone, fine particles, air toxics and other pollutants and rules affecting mobile and DG/Combined-Heat-and-Power (CHP) sources. The information also guides the development of state implementation plans (SIPs) to achieve ozone reduction and the US National Ambient Air Quality Standards (NAAQS) for ozone, PM2.5, and GHG reduction options, and strategies to accelerate the recovery of impacted ecosystems, improving resiliency, water quality and public benefits. • NYSERDA's strategy will include: o Development and regular updates of a Research Plan to guide program activities, based on input from a diverse set of stakeholders from the scientific and policy communities. o Contracting with institutions and consultants to conduct the prioritized monitoring and research activities identified in the Research Plan. Most of these activities will employ competitive solicitations to select contractors to conduct the activities; ongoing monitoring needs will continually be assessed and may leverage existing networks of organizations conducting complementary activities. • Diverse and targeted technology transfer and outreach activities to guide those responsible for energy-related policies and actions designed to better protect environmental and public health in New York State.
Goals	• Provide the knowledge necessary to better understand and reduce the adverse energy-related impacts that damage New York's ecosystems and the health of its citizens. • Support environmental accountability for existing and future energy and environmental policies. • Guide cleaner, more environmentally thoughtful alternatives in ways that advance New York's energy policies.
State Energy Plan/Clean Energy	• The 2015 New York State Energy Plan states that "*Clean air and clean water are essential to New Yorkers' health and quality of life as well as the State's growing tourism business and other economic development opportunities...While New York has made*

Standard Link	*substantial progress in improving its environment over recent years, the State's environmental imperatives dictate that much more must be done. The Plan sets forth aggressive greenhouse gas (GHG) reduction, renewable energy, and energy efficiency targets. Done properly, this transition will result in the needed emissions reductions, clean air, clean water, and better land-use policy that will foster a cleaner environment while improving the health, economy, and quality of life for all New Yorkers.*" • Through these aggressive goals New York is leading by example, and demonstrating to upwind states with emissions impacting New York, and others, how they can advance an environmentally responsible clean energy economy in their states. • Environmental monitoring and associated research and analysis are critical for assessing and quantifying the environmental soundness and effectiveness of energy programs and provide the foundation for researchers and policymakers to design and implement the most effective policies and programs.

17.1.2 Target Audience Characterization

Target Audience	The target audience includes research institutions and energy and environmental consultants.
Market Participants	Market participants include: • High-level policymakers and elected officials at the federal, state and local levels • Technically-oriented academic, not-for-profit, government and private sector researchers • Environmental and renewable energy advocacy groups • State and federal departments/agencies, including: o NYS Department of Environmental Conservation (DEC) o NYS Department of Health (DOH) o NYS Department of Public Service (DPS) o NYS Department of Transportation (DOT) o NYS Office of the Attorney General (OAG) o U.S. Environmental Protection Agency (EPA) o U.S. Geological Survey (USGS) o Bureau of Ocean Energy Management (BOEM) o U.S. Fish and Wildlife Service (USFWS) o National Oceanic and Atmospheric Administration (NOAA) • Utilities • Renewable energy developers
Market Readiness	• NYSERDA has established very close and productive working relationships with New York, other state, and federal regulatory agencies. In addition to the roles these partners play in developing the Research Plan, they also participate in solicitation planning efforts, Technical Evaluation Panels to select research projects, and Project Advisory Committees to guide contractors throughout the research projects. Through these interactions and audience engagement, the outcomes of NYSERDA projects and products are improved and the key entities are directly involved in and informed by the work. • NYSERDA also conducts topical workshops, conferences, and briefings to expand the dissemination of new findings and information. • Key partners in the Clean Energy Fund program will continue to include DPS staff, DEC, DOH, OAG, USEPA, USGS, BOEM, USFWS, NOAA, private and public sector researchers, and environmental and clean energy advocates.

Customer Value	• The program provides policy-makers and decision-makers with defendable, science-based information to guide and evaluate their efforts related to improving public health and environmental quality.[1] • Examples of regulations and actions that have cited work from NYSERDA's energy-related environmental research program include: o Federal Clean Air Interstate Rule o New York's Acid Deposition Reduction Program, and Mercury Reduction Program o Update of the National Emissions Inventory o Transportation Conformity Rule Amendments for the PM2.5 National Ambient Air Quality Standard: PM2.5 Precursors o 2015 federal New Source Performance Standard for Wood Heat o NYS Climate Risk and Resiliency Act o EPA's Mercury and Air Toxics Standards • Additionally, earlier work by the energy-related environmental research program has helped lay the groundwork for a broader spatial mapping approach to evaluate renewable energy siting in New York, and collaboration with other State and federal partners has resulted in an improved and more cost-effective program to monitor atmospheric deposition.

17.1.3 Stakeholder/Market Engagement

Stakeholder Engagement and Customer Discovery	• The Energy-Related Environmental Research program relies upon a network of professional contacts and working groups of science and policy experts to identify critical gaps and research needs in New York State. Multiple groups, which include the Energy-Related Environmental Research Program's Program Advisory Group and Science Advisory Committee, provide guidance on the areas representing the major issues and cutting edge scientific understanding related to energy-related environmental impacts. • The results of this guidance are compiled into a comprehensive Research Plan designed to guide the focus of energy-related environmental research in New York State. (see: www.nyserda.ny.gov/All-Programs/Programs/Environmental-Research/Research-Planning) • Components of the plan will be updated on a regular basis. The most recent update focused on Marine Wind and Wildlife issues; the next update will focus on energy-related air quality and public health issues, especially those related to REV. • The plan's potential users, in addition to those who were engaged in the plan's development, include NYSERDA programs, other New York State, regional, and national research funding organizations, the scientific and environmental communities, and policymakers. • Implementation of the plan's research recommendations help prioritize, coordinate and maximize the efficient use of limited resources to serve the needs of New York State and others. This stakeholder discovery process will be relied upon to ensure that investments are focused on providing sound scientific research in support of high priority environmental policy issues.

17.1.4 Theory of Change

Barriers/	• Although NYSERDA's energy-related environmental research program has in the past provided sound, current, scientific research to inform decision-making relevant to

[1] A 2013 citation analysis indicated that 245 articles published from NYSERDA-supported studies of this nature were cited 5,833 times between 1999 and 2013.

Challenges Addressed	energy-related environmental policies and goals, research will continue to be needed to meet current and emerging energy and environmental goals. • Lack of coordinated activities between and within State agencies and organizations, each with distinct responsibilities but with intersecting missions of public interest. For example, ozone research is important from public health, environmental, and agricultural perspectives, but the agencies responsible for these areas do not have the capacity or mission to address ozone issues in a comprehensive manner.
Testable Hypotheses	• If the Energy-Related Environmental Research Program supports sound, scientific research, the results will inform and improve decision-making relevant to energy-related environmental policies and goals and continue to assist New York State in reducing environmental impacts and improving environmental quality. • If the long-term monitoring components of the program focus on needs identified in the Research Plan, accountability will be provided for the State's policies and regulations to help assess their effectiveness in attaining goals.
Activities	The investment approach will include ongoing support for long-term monitoring efforts, recurring competitive solicitations targeting research priorities identified in the Program's Research Plans, and opportunistic research projects and partnerships, such as with organizations with similar goals who can leverage program funds and enhance scientific and/or policy value. More information on anticipated near-term projects is provided in Appendix A and will be updated as Research Plans are revised. <u>Program Planning and Stakeholder Discovery:</u> • Develop and provide regular updates to a Research Plan to guide program activities, based on input from a diverse set of stakeholders from the scientific and policy communities. <u>Monitoring:</u> • Promote environmental accountability through support and analysis of long term-monitoring records and modeling of energy-related environmental pollutants. • Encourage the adaptation of traditional monitoring programs and approaches to reflect the changing information needs and policy questions. • Where strategic opportunities exist, support efforts to augment compliance monitoring to provide scientifically robust information to advance understanding of the fate and transport[2] of energy-related pollution in New York and the region. <u>Focused Research:</u> • Support efforts that will help evaluate the effectiveness of energy-related air quality management strategies for acid deposition, mercury, ozone and co-pollutants, particulate matter, climate-forcing agents and their interactions with each other. • Provide the necessary research to assess changes in the environment, specifically in relation to changes in emissions and adoption of renewable and emerging energy technologies. • Support research that will enhance understanding of the source types, source regions, and specific pollution components contributing to environmental issues in New York State. • Provide insight on the relative contribution of the combustion of fossil fuel in the various sectors (e.g., electricity production, heating, transportation) to major environmental problems in New York State. • Help identify, understand and prioritize opportunities for mitigation, and pave the way for cross-sector, and potentially market-based, pollution control strategies.

[2] "Fate and transport" analysis is defined as the study of how chemicals degrade and where chemicals travel in the environment when they are released intentionally or unintentionally.

	• Evaluate and to the extent possible quantify greenhouse gas impacts as well as health and ecological issues related to pollution sources in New York State. • Provide a scientific foundation for formulating effective and equitable policies and practices to guide strategies to prepare for a changing climate. • Support efforts to examine the health and ecological co-benefits of alternative energy and technology solutions. • Enhance the understanding of the environmental impacts of emerging technologies, energy systems, and related energy-related pollution control technologies. Seek options to reduce or mitigate the environmental impacts of these technologies. <u>Technology Transfer/Outreach/Policy Guidance:</u> • Provide insight on how energy-related environmental-protection policies may better protect environmental and public health in New York State. • Collect data and facilitate discussions to reduce costs associated with environmental regulations and permitting, thereby accelerating environmentally responsible development of renewable energy. • Help foster collaborative, inter-disciplinary research to make better use of limited resources available for research and enhance the dissemination of research findings. • Provide seed funding to help attract other resources that will further develop research capability in New York State so it can be sustained and grow beyond resources available to NYSERDA. <u>Offshore Wind Predevelopment Activities</u> • Collect and analyze field data and conduct other site assessment work that will reduce siting and environmental risks and/or lower procurement costs for offshore wind energy, specifically costs to New York State ratepayers. • Make offshore environmental data publicly available to improve transparency, engage stakeholders, and inform offshore wind energy developers and regulators.
Key Milestones	During the term of environmental monitoring and research supported through the Clean Energy Fund, strategically-timed research planning events will be conducted, and program solicitations will be issued. The initial round of research planning events and products for all program areas are expected to be completed by the first quarter of 2018. The exact timing of program offerings and activities will be based on input from Program and Science Advisors, and other stakeholders, as well as current and future needs of the energy-related environmental regulatory and policy communities. Building upon the previous research plans will aid in a smooth transition to Clean Energy Fund supported efforts. <u>Milestone 1 – Complete (2017)</u> • Solicitations issued for research projects consistent with the Research Plan. • Projects contracted from solicitations. • Outreach, technology transfer, and briefings to share research findings. <u>Milestone 2 – Complete (2018)</u> • Solicitations issued for research projects consistent with the Research Plan. • Projects contracted from solicitations. • Outreach, technology transfer, and briefings to share research findings. <u>Milestone 3 – Complete (2019)</u> • Solicitations issued for research projects consistent with the Research Plan. • Projects contracted from solicitations. • Outreach, technology transfer, and briefings to share research findings.

	Milestone 4 (2020) - Complete • Issue awards from solicitations released in 2020. Milestone 5 (2021) • Issue awards from solicitations released in 2021.
Goals Prior to Exit	The overarching goal is to provide the scientific foundation for decisions that will support State goals related to a cleaner environment. • Due to the nature of this work, research priorities will shift as energy and environmental needs, strategies, and policies evolve. These will be articulated and updated in the Research Plan. • Program area activities and completion milestones for near-term activities are included as an appendix.

17.1.5 Relationship to REV

Utility Role/ Coordination Points	While the New York State utilities do not have any similar energy-related environmental research capacity, they do support the Environmental Energy Alliance of New York, a representative of which is an Energy-Related Environmental Research Program Advisor. The Energy-Related Environmental Research Program will use this contact and other mechanisms to continue to look for opportunities to engage with utilities by working collaboratively on projects such as those focused on climate resiliency in the electricity sector, and habitat and renewable energy siting issues relating to right-of-ways.
Utility Interventions in Target Market	New York State utilities don't have interventions in this market.

17.1.6 Budgets

The commitment budget for all activities included in this investment plan is as follows:

Funding Commitments

Budget	Plan Total	Previously Committed	2020	2021	2022	2023	2024	2025
		---------- Commitments Plan ----------						
Incentives and Services	-	-	-	-	-	-	-	-
Implementation	885,381	735,381	150,000	-	-	-	-	-
Research and Technology Studies	36,914,619	12,459,847	11,324,222	8,000,000	5,130,550	-	-	-
Tools, Training and Replication	-	-	-	-	-	-	-	-
Business Support	-	-	-	-	-	-	-	-
Total	**37,800,000**	**13,195,228**	**11,474,222**	**8,000,000**	**5,130,550**	**-**	**-**	**-**

An annual expenditure budget for all activities included in this investment plan is shown in Appendix B alongside expected acquired benefits. Budgets do not include Administration, Evaluation, or Cost Recovery Fee; these elements are addressed in the Budget Accounting and Benefits chapter filing. The budget as presented in the Budget Accounting and Benefits Chapter will serve as the basis for any subsequent reallocation request. The additional level of detail presented within Appendix B is intended for informational purposes only.

17.1.7 Progress and Performance Metrics

The anticipated commitment benefits totals for the initiative with respect to CEF Order target metrics is as follows:

Benefit Commitments

Direct Benefit (2016-2025)	**Plan Total**
Energy Efficiency MWh Annual	-
Energy Efficiency MMBtu Annual	-
Renewable Energy MWh Annual	-
CO2e Emission Reduction (metric tons) Lifetime	-
Participant Bill Savings Lifetime	-
Leveraged Funds	5,849,907

Indirect Benefit (2016-2030)	**Plan Total**
Energy Efficiency MWh Annual	-
Energy Efficiency MMBtu Annual	-
Renewable Energy MWh Annual	-
CO2e Emission Reduction (metric tons) Lifetime	-

Benefits summarized in Appendix B represent the plan for acquiring impacts through completed projects or activities.

Appendix C provides program Activity/Output indicators representing measurable, quantifiable direct results of activities undertaken in the program.

In addition, NYSERDA will also internally track and assess the following activities and outcomes:

- Signed contracts
- Completed research studies
- Briefings with policy makers and other stakeholders
- Formal outreach to both Program and Science Advisors
- Published peer-reviewed scientific journal articles
- Citations of research by others
- Presentations by researchers
- Documented support for energy-related environmental policy and management decisions at the local, state and federal levels

17.1.8 Performance Monitoring and Evaluation Plans

Performance Monitoring & Evaluation Plan	NYSERDA's approach to monitoring and assessing the effectiveness of the program and overall market development is described below. Where appropriate, evaluation efforts for this initiative may be combined with other NYSERDA evaluation studies to optimize resources where technologies, market actors, strategy or geographical regions overlap. While serving to reduce and mitigate potentially duplicative evaluation efforts, this approach will also reduce uncertainty in evaluation findings where discrete, initiative-level assessments are otherwise difficult to discern due to such overlaps. **Test-Measure-Adjust Strategy** • The program will rely upon regular, ongoing input from the Science and Program Advisors, as well as from external stakeholders, to monitor and prioritize energy-related environmental issues, and to effectively target program resources. The regular updating of the research plans, as well as output from funded research projects, will help staff measure success of efforts and identify opportunities for program adjustments. **Stakeholder Discovery Evaluation** • In addition to the metrics detailed above, regular citation analyses will be conducted on articles published through the program. This analysis will provide the number of citations of NYSERDA program research outputs by other researchers and studies. Obtaining citation information helps document if and how the research findings supported by this program are being used by other researchers. • The initial citation analysis was completed in 2017, with updates planned for 2020, 2022, and 2024. • Program staff will regularly track policies, regulations and decisions at the State and federal levels that cite research sponsored through this program. **Impact Evaluation/Field Verification** • Not applicable.

Appendix A – Anticipated Near Term Projects

<u>Climate Change:</u> (Approximately $4M)

- *Inland Flooding Projections* – Inland riverine areas of the State currently have little to no scientific information on their vulnerability. Consistent with the Community Risk and Resiliency Act, this project would develop inland flooding projections to assist communities, owners of critical infrastructure, and agencies in making policy decisions that could reduce their vulnerability to flooding under future climate change. Estimated completion in 2020.
- *CO2 Air Capture Technology Assessment* – Capture of CO2 from the air is seen as a necessary strategy for keeping atmospheric CO2 below catastrophic levels. This project would assess CO2 air capture technology and activity in NYS, with the aim of building business and technological capability. Technology demonstrations would follow. Estimated completion in 2019 for the assessment and 2022 for the demonstrations.
- A competitive solicitation will be issued targeting priority research topics identified in the updated research plan. Resulting projects are anticipated to be of varying length, with all completed by 2021. Based on current priorities it is likely that projects from this solicitation will include:
  - *Climate Vulnerability and Resiliency Guidance* – Develop climate vulnerability and resilience guidance for distributed generation and combined heat and power (DG/CHP) and microgrid systems, which are anticipated to be installed in support of REV. Guidance will identify vulnerabilities of microgrid and DG/CHP systems to future climate changes and identify potential ways of reducing those vulnerabilities and increasing resiliency.
  - *Assessing the climate vulnerability of the liquid-fuel infrastructure in NYS* – An assessment of the State's climate vulnerability of natural gas and liquid-fuel infrastructure in NYS, specifically regarding NYS's existing and potential future infrastructure, and including potential ways to increase the resiliency to climate change.

<u>Air Quality/Public Health:</u> (Approximately $5.5M)

- *Whitepapers* – A series of scoping sessions and workshops and white papers will be conducted and produced in 2017 and 2018 to:
  - better define REV-related environmental research needs, such as pollution issues close to emission sources (e.g. DG/CHP), especially in densely populated areas;
  - define research needs and potential state strategies for meeting air standards related to regional ozone; and
  - identify remote sensing tools to better inform REV-related energy and air planning in New York State.
- *Air Quality and Health Monitoring* – Long-term monitoring projects for air quality and health effects related to energy sources to improve the scientific and technological foundation necessary to address key policy-relevant questions related to air quality and health effects. Estimated completion in 2022.

- A competitive solicitation will be issued based on the priorities identified in the updated research plan. Resulting projects are anticipated to be of varying length, with all completed by 2021. It is likely that projects from this solicitation will include:
    - *Third-party Scientific Validations* – Third-party scientific validation of improved emissions, air quality, and health impacts in locations where new generation in a micro grid displaces older, less efficient, and more polluting generation.
    - *Scientific Validations* – Scientific validation of reduced emissions, air quality, and health impacts for facilities installing CHP or renewables.
    - *Scientific Evaluations* – Scientific evaluation of improved air quality and health impacts in locations with higher vehicle electrification.

Renewable/Alternative Energy: (Approximately $2.5M)

- *Offshore Wind Wildlife Monitoring* – A competitive solicitation will be issued focusing on projects addressing specific near term needs related to offshore wind wildlife monitoring technologies/methods and wildlife distribution/abundance modeling. Estimated completion in 2018.
- A competitive solicitation will be issued based on the priorities identified in the updated research plan. Resulting projects are anticipated to be of varying length, with all completed by 2021. Based on current priorities it is likely that projects from this solicitation will include:
    - *Benthic Habitat Surveys* – Benthic (i.e., plants and animals living at the bottom of a body of water) habitat surveys to map marine ecosystems and manage development of offshore wind resources.
    - *Relationship Examination* – Examination of the relationships between environmental processes, primary productivity, and distributions of species at upper trophic (i.e., feeding position in a food chain) levels to help identify important habitat areas and guide siting and permitting of future wind energy areas.
    - *Avian Vulnerability Assessment* – Development of an avian vulnerability assessment for New York, to identify priority species for targeted research that will lead to more informed decision making and improved outcomes for avian wildlife in wind energy areas.

Ecosystem Response to Energy-related Deposition: (Approximately $5.5M)

- *Long-term Acidic/Mercury Deposition Monitoring* – Long-term monitoring projects related to acidic/mercury deposition to measure the effectiveness of emission reduction policies and guide future actions. Estimated completion in 2022.
- A competitive solicitation will be issued relating to ecosystem response to energy-related deposition, including climate indicators. Resulting projects are anticipated to be of varying length, with all completed by 2021. Projects will be based on the outcome of the revised 2017 Research Plan, but based on current priorities it is likely that projects from this solicitation will include:
    - *Climate Change Impacts* – Projects to better understand how climate change will affect acidification, recovery, and mercury effects by determining how native tree/plant species

will respond to changing environmental conditions, and the resultant effects on ecosystem structure and function.

- *Biogeochemistry Research* – Research on how the biogeochemistry of mercury, acidification, and soil recovery may be affected by changing hydrological factors, such as projected increases in precipitation coupled with periods with more severe droughts and decreased snowpack duration and depth.

Offshore Wind Pre-Development Activities: (Approximately $7.8M)

- Offshore Wind Pre-Development activities include collecting and analyzing field data and other site assessment work that will reduce environmental and developer risks and lower procurement costs for offshore wind, specifically costs to New York State ratepayers. In the absence of these activities, developers acquiring new leases will be required to develop and file a Site Assessment Plan (SAP) with the Bureau of Ocean Energy Management (BOEM) before work can begin. This effectively results in no data collection for a year or more after site acquisition, in addition to another year or more to contract, permit and acquire the data. NYSERDA initiating planning level pre-development work earlier in the process accelerates data acquisition by more than 2-years, bringing value to, potentially, multiple rounds of OREC procurement. Examples of pre-development activities potentially include, but are not limited to:
  - *Geophysical and Geotechnical Surveys* – A competitive solicitation will be issued to select a Geophysical and Geotechnical (G&G) survey contractor and an "owners engineer" to conduct and provide oversight of high quality planning level G&G surveys. G&G conditions and uncertainty present a high uncertainty for foundation types and ultimately development costs. Fugro Marine recently completed a Geophysical and Geotechnical (G&G) desktop study for NYSERDA covering BOEM's draft Wind Energy Areas in the New York Bight and it is clear that more data is needed. A contract is in place with Ecology and Environment to advance the permitting of the G&G work which is critical given the relatively long lead times for permitting G&G surveys. Information developed through a planning level G&G survey will be disseminated to the market and are expected to increase interest and competition around lease areas in the New York Bight, and result in the lower OREC prices.
  - *Digital Aerial Surveys* – A 3-year, NYSERDA-supported, planning level Digital Aerial Survey was initiated in the summer of 2016 and is being completed in 2019. Flights have been conducted quarterly over the entire New York Bight using a transect approach at a density of 7% coverage. Supporting the continuation of Digital Aerial Surveys, but redirecting those surveys over BOEM's defined WEA, using a plot approach and monthly flights will provide greater temporal resolution in migratory periods for wildlife, informing both permitting and construction windows. The data will be disseminated to stakeholders and support a variety of uses including improved understanding of wildlife movements through the Bight, reducing permitting risk and clarifying construction windows for developers in the region, ultimately lowering OREC prices.
  - *Metocean Buoys* - A strong knowledge of meteorological and oceanographical—Metocean—conditions are essential for the safe and efficient design and operation of offshore

installations. In July 2019 two NYSERDA sponsored Metocean Buoys will be deployed in BOEM's designated Draft Wind Energy Area for a period of two years. At this time, it is uncertain where formal lease areas will be defined, but a re-deployment of one or more of these buoys for alternative locations, or for longer term may be warranted. Metocean data, and environmental data collected by Metocean buoys, will be disseminated to the market and marine scientists on a monthly basis. These data are expected to inform permitting, site design and generation potential, reducing permitting and generation risk, result in lower OREC prices.

Verified Gross Savings Specification – not applicable.

Appendix B | Initiative Budget and Benefits Summary

Energy-Related Environmental Research

Benefits Acquisition Plan

Direct Benefit	Plan Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy Efficiency MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MMBtu Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MMBtu Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Participant Bill Savings Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Participant Bill Savings Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leveraged Funds	5,849,907	-	-	-	82,615	509,693	1,010,000	1,000,000	1,300,000	800,000	600,000	300,000	200,000	47,599	-	-

Indirect Benefit	Plan Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Energy Efficiency MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MMBtu Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Energy Usage	Plan Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Direct Energy Usage MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Energy Usage MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Energy Usage MMBtu Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Energy Usage MMBtu Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Energy Usage MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Energy Usage MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Energy Usage MMBtu Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Energy Usage MMBtu Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Participants	Plan Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Participants	168	-	2	10	18	7	25	25	33	20	15	8	5	1	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**168**	**-**	**2**	**10**	**18**	**7**	**25**	**25**	**33**	**20**	**15**	**8**	**5**	**1**	**-**	**-**

Budget Expenditures Plan

Budget	Plan Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Incentives and Services	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Implementation	885,381	-	70,591	353,448	282,080	129,262	50,000	-	-	-	-	-	-	-	-	-
Research and Technology Studies	36,914,619	-	27,010	835,885	1,616,990	8,196,740	5,000,000	5,000,000	6,500,000	4,000,000	3,000,000	1,500,000	1,000,000	237,994	-	-
Tools, Training and Replication	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Business Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**37,800,000**	**-**	**97,601**	**1,189,333**	**1,899,070**	**8,326,002**	**5,050,000**	**5,000,000**	**6,500,000**	**4,000,000**	**3,000,000**	**1,500,000**	**1,000,000**	**237,994**	**-**	**-**

Table Notes:

* With the May 2021 IPPR filing of all investment plans, each Appendix B table that accompanies an investment plan was transitioned from yearly commitment-based budget and benefit plans to plans that forecast expenditures and acquired benefits.

a. Participants are awardees of NYSERDA contracts.

Appendix C | Initiative Outputs and Outcomes Summary

Energy-Related Environmental Research

	Indicators	**Baseline** (Before/Current)	**2019** Target (cumulative)	**2021** Target (cumulative)
Outputs	Update multi-year Research Plan components with input from policymakers, scientists, and other stakeholders	0	3	6
	Sponsored workshops, conferences, seminars or facilitated meetings to inform decision making	0	15	25
Outcomes	$9.5M in leveraged funds (co-funding and outside investment) to support projects and sponsored research	0	$6,255,107	$9,567,644