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

Portfolio: Innovation & Research

Submitted by:

The New York State Energy Research and Development Authority

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17 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:
	  ○ NYS Department of Environmental Conservation (DEC)
	  ○ NYS Department of Health (DOH)
	  ○ NYS Department of Public Service (DPS)
	  ○ NYS Department of Transportation (DOT)
	  ○ NYS Office of the Attorney General (OAG)
	  ○ U.S. Environmental Protection Agency (EPA)
	  ○ U.S. Geological Survey (USGS)
	  ○ Bureau of Ocean Energy Management (BOEM)
	  ○ U.S. Fish and Wildlife Service (USFWS)
	  ○ 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:
	  ○ Federal Clean Air Interstate Rule
	  ○ New York's Acid Deposition Reduction Program, and Mercury Reduction Program
	  ○ Update of the National Emissions Inventory
	  ○ Transportation Conformity Rule Amendments for the PM2.5 National Ambient Air Quality Standard: PM2.5 Precursors
	  ○ 2015 federal New Source Performance Standard for Wood Heat
	  ○ NYS Climate Risk and Resiliency Act
	  ○ 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.
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. For each of the program years (2017 through 2021), key milestones will include: <u>Milestone 1 (each calendar year)</u> • Solicitations issued for research projects consistent with the Research Plan. <u>Milestone 2 (each calendar year)</u> • Projects contracted from solicitations. <u>Milestone 3 (each calendar year)</u> • Outreach, technology transfer, and briefings to share research findings.
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 & Expenditures

An annual commitment budget for all activities included in this chapter is shown in Table 1. The annual expenditure projection is included in Table 2. Budgets and expenditures 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 the table below is intended for informational purposes only.

Table 1: Annual Innovation & Research Budget Allocation – Commitment Basis

Commitment Budget	2017	2018	2019	2020	2021	Total
Research and Technology Studies/Development/Demos	$10,100,000	$8,400,000	$4,850,000	$4,150,000	$1,500,000	$29,000,000
Implementation Support	$500,000	$0	$0	$0	$500,000	$1,000,000
Total	$10,600,000	$8,400,000	$4,850,000	$4,150,000	$2,000,000	$30,000,000

Table 2: Annual Expenditures Projection

Expenditures	2017	2018	2019	2020	2021	2022	2023	2024	Total
Total	6%	12%	14%	16%	16%	14%	12%	10%	100%

17.1.7 Progress and Performance Metrics

Table 3 provides program Activity/Output indicators representing measurable, quantifiable direct results of activities undertaken in the program.

Table 3. Program Specific Metrics

Indicators		2019 (Cumulative)	2021 (Cumulative)
Activity/ Outputs	Update multi-year Research Plan components with input from policymakers, scientists, and other stakeholders	3	6
	Sponsored workshops, conferences, seminars or facilitated meetings to inform decision making	15	25
Outcomes	$7.5M in leveraged funds (co-funding and outside investment) to support projects and sponsored research	$5,962,500	$7,500,000

In addition to the above, 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

Table 4. Direct Impacts

Primary Metrics[3]		**2017**	**2018**	**2019**	**2020**	**2021**	**TOTAL**
Energy Efficiency	MWh Annual						
	MWh Lifetime						
	MMBtu Annual						
	MMBtu Lifetime						
	MW						
Renewable Energy	MWh Annual						
	MWh Lifetime						
	MW						
CO2e Emission Reduction (metric tons) Annual							
CO2e Emission Reduction (metric tons) Lifetime							
Customer Bill Savings Annual ($ million)							
Customer Bill Savings Lifetime ($ million)							
Private Investment ($ million)		$2.65	$2.10	$1.21	$1.04	$0.50	$7.50

Table 5. Annual Projected Program Participation

	2017	**2018**	**2019**	**2020**	**2021**	**Total**
Participants[4]	35	28	16	14	7	100

[3] Impacts are expressed on a commitment-year basis, and are incremental additions in each year. Benefits are rounded to three significant figures. Totals may not sum due to rounding.

[4] Participants are awardees of NYSERDA contracts.

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. **<u>Test-Measure-Adjust Strategy</u>** • 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. **<u>Stakeholder Discovery Evaluation</u>** • 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. • Program staff will regularly track policies, regulations and decisions at the State and federal levels that cite research sponsored through this program. **<u>Impact Evaluation/Field Verification</u>** • 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.

<u>Renewable/Alternative Energy:</u> (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.

<u>Ecosystem Response to Energy-related Deposition:</u> (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.