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

Clean Energy Fund:
Clean Heating and Cooling Chapter

Portfolio: Market Development

Submitted by:

The New York State Energy Research and Development Authority

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Clean Energy Fund: Clean Heating and Cooling Chapter		
Revision Date	**Description of Changes**	**Revision on Page(s)**
May 8, 2017	Original Issue	Original Issue
March 29, 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
	Various changes to the Heat Pumps and Solar Thermal initiative including: Change the GSHP Rebate program end date from June 30, 2019 to December 31, 2019, adding $5.5M to support the extension. Add $1.5M to support additional Community Campaigns. Changes to support natural gas load constrained areas: Add $6.5M to GSHP Rebate (incentives), Add $0.5M to Communities (pilots). Revised all budget and benefits tables impacted by the additional funds.	
April 19, 2019	No revisions made	NA
May 15, 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.	Heat Pump Phase 1 and Renewable Heat NY
	Changed the name of this Chapter from 'Renewable Heating & Cooling' to 'Clean Heating and Cooling'	Title page
	Replace 'Renewable Heating & Cooling' and 'RH&C' with 'Clean Heating and Cooling' and 'CH&C' throughout the chapter.	Multiple
	19.1 Change the Initiative name from 'Heat Pumps and Solar Thermal' to 'Heat Pumps Phase 1 (2017)'	3
	19.2 Add Initiative: 'Heat Pump Phase 2 (2020)' The sub-initiatives included in this section of the investment plan support NYS Clean Heat, a partnership between NYSERDA and the utilities focused on growing the heat pump market in NYS.	10-23 and Appendices: A, B, C
	19.3 Change the Initiative name from 'Renewable Heat New York' to 'Renewable Heat NY - Clean and Efficient Biomass Heating'	24

19. Clean Heating and Cooling

Introduction

Clean heating and cooling (CH&C) technologies, have the potential to contribute significantly to decarbonization of the heating and cooling sector. They also offer other benefits to those directly using the technologies, including energy bill savings, increased comfort levels, and health benefits, compared to conventional heating and cooling technologies.

Today, CH&C technologies occupy a niche position in the State's heating and cooling market. Barriers exist, including cost-effectiveness challenges, limited customer awareness of and confidence in CH&C technologies, and a range of supply chain barriers, all of which currently stand in the way of widespread market adoption and growth.

This Chapter includes three initiatives:

- **Heat Pumps Phase 1 (2017)**
    - Phase 1 – which was launched in 2017 following the Renewable Heating and Cooling Framework and provided the foundation for New York's initial work to stimulate building electrification and shift away from fossil fuel combustion for heating

- **Heat Pumps Phase 2 (2020)**
    - Phase 2 – will launch in 2020 and supports the NYS Clean Heat Program goals established in the Public Service Commission January 2020 Order. These initiatives will seek to rapidly accelerate market capacity and adoption of heat pumps across New York

- **Renewable Heat NY - Clean and Efficient Biomass Heating** – which was launched in 2014 and advances clean and efficient biomass combustion systems primarily for rural New Yorkers.

Starting in Q2 2020, the utilities will administer the NYS Clean Heat Statewide Heat Pump incentive program. To achieve the heat pump goals and build the market infrastructure for a low-carbon future, the utility incentive program will be paired with market development initiatives implemented by NYSERDA. NYSERDA will invest approximately $230 million in market enabling initiatives funded through Clean Energy Fund (CEF).

The Heat Pump Phase 2 initiative is a core component of NYSERDA's work to build the market infrastructure for heat pumps and building electrification in New York.

Together with building electrification initiatives outlined in the Residential, Multifamily, Multisector Solutions, Workforce Development, and Advanced Buildings/Innovation Investment Plans, these initiatives will seek to transform the way New Yorkers heat their homes and businesses. For a summary of all market enabling building electrification initiatives, see the

Appendix to the NYS Clean Heat: Statewide Heat Pump Program Implementation Plan, Case 18-M-0084 filed on March 16, 2020.

Across its component initiatives, the NYS Clean Heat Market Development Plan aims to build market capacity to deliver building electrification solutions – including cold climate air-source heat pumps (ASHP), water- and ground-source heat pumps (GSHP), and heat pump water heaters (HPWH) – in order to meet the following central goals by 2025:

- Help achieve the state's energy savings targets from the installation of heat pumps.
- Increase the pool of skilled labor needed to grow a quality-oriented industry, training 14,000 workers across the heat pump supply chain, including 4,200 workers to sell, design, and install systems.
- Reduce the cost of heat pump installations by at least 25%.
- Increase stocking of heat pumps by 50% above 2019 industry shipments and increase penetration of high-performance cold climate heat pumps to 90% of all heat pumps shipped for space conditioning in New York.

19.1 Heat Pumps Phase 1 (2017)

Theory of Change

This first phase of Clean Heating and Cooling initiatives under the CEF advances timely interventions focusing on reducing soft costs. This initiative supports soft cost reduction strategies for all CH&C technologies, as well as provide targeted cost shared technical assistance for Ground Source Heat Pumps (GSHP) and Solar Thermal technologies and incentives for GSHP and Air Source Heat Pumps (ASHP). Results from a Market Insights study to guide the development of new support mechanisms for Solar Heating and Cooling technologies concluded that there is little cost-effective potential in the near term based on current capital and fuels costs.

Market Barriers Addressed	• **Systems have high upfront costs and low returns.** In the commercial sector, many building owners require a quick payback, and CH&C technologies must compete for scarce internal investment dollars with other priorities, including priorities that are more central to the business or mission. This first phase of initiatives reduces soft costs to address this barrier. • **Lack of awareness of the advantages and disadvantages of CH&C technologies.** Contractors prefer selling conventional technologies because new technologies like CH&C require new training and/or installation practices, and a different sales approach, both of which require investments in time and money for their staff. Customer targeting/engagement tools and installation clustering through community campaigns help address this barrier. • **Uncertainty regarding energy and operational and maintenance savings and technical performance.** Customers and contractors may perceive larger risks associated with CH&C than traditional systems, including concerns over quality and durability, warranties from the manufacturer, overall performance, and availability of maintenance services. Contractors also face higher risks of installing a poorly performing project when using new technologies, which can further increase their costs. Improving access to reliable information and de-

	risking project development costs for target market segments help address this barrier. • **For technologies other than ASHP, conventional HVAC installers and project developers, lack customer acquisition resources and technical expertise to evaluate feasibility and/or execute projects.** A lack of capacity to manufacture, distribute, design, install, and service CH&C systems is a significant barrier to market scale. Conventional HVAC designers and installers often lack experience and training in evaluation and execution of CH&C projects. This difficulty is amplified in sectors where sales staff must both sell their specific product and educate customers about CH&C opportunities more broadly. Customer targeting/engagement tools, installation clustering through community campaigns and de-risking project development in target market segments help address these barriers.
Testable Hypotheses	• If NYSERDA improves access to reliable information on CH&C solutions, then awareness and confidence will increase, system costs will decrease, and installations will increase. • If NYSERDA supports the development of a customer targeting tool, customer acquisition time and cost will decrease. • If NYSERDA supports local clustering of installations, customer acquisition, contractor mobilization and installation costs will decrease. • If NYSERDA provides cost-shared technical assistance to large systems, pre-development costs will decrease, and system performance and customer confidence will increase. • If NYSERDA develops standardized contracts, data protocols and requirements, and quality assurance processes, soft costs will decrease, confidence in performance will increase and market conditions enabling more private sector investment will be created. • If NYSERDA provides incentives to distributors and/or contractors to increase the stocking, promotion, and sales of underutilized products, they will become more widely available and sales will increase.
Activities	NYSERDA's investment to reduce costs through information, standardization and innovation, and provided direct financial support to community campaigns and installations. **Invest to reduce costs** • Developed and distributed marketing and outreach materials such as case studies, performance estimations, building suitability guidelines, and tips for dealing with contractors to potential customers to increase awareness and confidence. • Developed tools for contractors: collaborated to develop and disseminate energy and cost savings assessment tools, as well as customer mapping tools, that can be used by contractors to demonstrate trustworthy savings estimates to customers and identify customer leads. • Supported innovative CH&C business models and successful soft-cost reduction strategies through competitive solicitations and disseminate results to spur replication. This includes a competitive solicitation for technology pilots to identify and deploy solutions for the integration of traditional and advanced systems in the residential and small commercial markets, based on current technologies and strategies being deployed in other sectors. • Facilitate the development of standardized contracts, data protocols and requirements, and quality assurance (QA) processes (in collaboration with neighboring states or regional associations where feasible). ○ Develop standardized contracts, including for third-party ownership models.

	○ Developed a regional measurement and verification (M&V) protocol for CH&C technology for large campus geothermal systems. • Investigated the feasibility of implementing a regional contractor and project certification system; to aggregate available data on building energy use and characteristics and share with the market. **Supported aggregation of installations through community campaigns** • Provided direct financial support and access to technical experts to communities to launch 3 to 5-year campaigns that selected qualified installers and negotiated a reduced price for campaign enrollees. Assisted communities in dealings with installers. • Piloting strategies to increase participation of LMI residents and assess effectiveness[1]. • Annually, compile best practices, and share between communities. **Support campus installations** • To lower the cost of development and construction, NYSERDA and NYPA identified clusters of cost-effective CH&C installations on college campuses and at state and local buildings and to seek aggregated development and construction bids. • Provided technical support to conduct screening/feasibility studies, develop system designs, and M&V protocols for large commercial, institutional and government facilities and campuses to build confidence in outcomes and accelerate growth in key market segments • Leveraged existing industry standards to develop and refine specifications for how to evaluate, design and measure the performance of CH&C systems. **Provided incentives to offset the cost of installation of GSHP and ASHP systems** • Launched open-enrollment incentive program for the deployment of GSHP and ASHP. • Qualified service providers and provided an indication of performance to the market to streamline contractor selection. Supported training and mentoring where needed, worked with industry associations to develop and grow a base of qualified service providers. • Performed and facilitated design and installation reviews to ensure high quality installations and conformance with industry standards. • Issued standard offer, first come, first served solicitation to provide incentives to ASHP distributors and/or contractors to decrease the wholesale cost of the products and encourage sales, stocking, service expansions, and/or promotion of early retirement or displacement. • Provided incentives to address areas of natural gas constraints (e.g., areas affected by a utility natural gas moratorium)

Target Market Characterization

Target Market Segment(s)	• The target market includes residential, multi-family, commercial, and institutional buildings owners/managers/developers that have a stronger value proposition, such as sites that currently use oil and propane, or have limited access to natural gas, as these represent high value use cases across market segments based on project economics. Due to the newness of the

[1] Based on potential for savings, impact on affordability and proposed approach.

	market, NYSERDA did not limit the offering to any particular market segment, allowing the strongest value proposition use case(s) to emerge.
Stakeholder/Market Engagement	• NYSERDA convened a Cost and Cost Reductions Advisory Committee of over 30 industry stakeholders and experts (including manufacturers, designers/engineers, installers, and drillers) to provide input on CH&C costs and cost reduction strategies. • GSHP stakeholders have been convened to provide input on design of incentive program. • NYSERDA held discussions with ten communities, from regions including Westchester, Western NY, Central NY, Southern Tier and the Capital District to assess the level of interest and opportunity for community campaigns, seek feedback on the planned approach and ask for input on program design. • HeatSmart Tompkins and NYSERDA conducted focus groups with customer and contractor participants in HeatSmart Tompkins to better understand decision making, explore lessons learned and establish best practices in community campaigns. • NYSERDA and NYPA engaged with the State University of New York (SUNY), and several other college campuses, to assess interest and co-investment in a GSHP campus initiative. NYSERDA held a stakeholder meeting on March 2, 2017 to get input on the strategies identified in the CH&C Framework.
Relationship to Utility Programs and REV Initiatives	During Heat Pumps Phase 1 (2017-2019): • PSEG-LI offers rebates for ASHPs (up to $600 per system) and GSHPs (up to $2,000 per ton). • Several of New York's investor owned utilities offer rebates for the purchase and installation of ASHPs including Con Edison (up to $500 per ton), NYSEG (commercial only up to $100 per ton) and Central Hudson (commercial only up to $125 per ton). • National Grid, in the KEDLI (Long Island) service territory, has been approved to implement a pilot program to demonstrate geothermal heating and cooling as an alternative to either new or existing firm or interruptible gas customers. KEDLI is to work with local water utilities and LIPA/PSEG-LI in the program development. Funding for the program consists of $350,000 in rate year one and $50,000 in each of rate years two and three. The goal is to use geothermal technologies to potentially displace peak gas consumption versus adding pipeline capacity. • Con Edison is proposing 'Smart Solutions' to invest in renewable natural gas and offer new incentives for customers who upgrade their heating equipment or install heat pumps to reduce natural gas usage. • The Public Service Commission's December 13, 2018 'Order Adopting Accelerated Energy Efficiency Targets' adopts accelerated energy efficiency goals, targets, and budgets for investor-owned utilities and provides direction on numerous implementation issues including a target of at least 5 TBtu in reduction through heat pump deployment.

Key Implementation Milestones

Key Milestones	**<u>Milestone 1 (2017)</u> - Complete** • Solicit for and contract with technical support contractor for community campaigns. **<u>Milestone 2 (2017)</u> - Complete** • Release competitive solicitation to select community campaigns (repeat annually).

	Milestone 3 (2017) - Complete • Release open enrollment solicitation for GSHP incentive. **Milestone 4 (2017) - Complete** • Provide list of qualified GSHP designers, installers and drillers to market. **Milestone 5 (2017) - Complete** • Contract with consultants to perform QA and design review for GSHP incentive projects. **Milestone 6 (2017) - Complete** • Launch open enrollment incentive program for ASHPs. **Milestone 7 (2018) - Complete** • Mapping tool for ASHP potential released in the market. **Milestone 8 (2018) - Complete** • Provide marketing toolkit and installer selection model solicitations to pilot community campaigns. **Milestone 9 (2018) - Complete** • Launch Phase 1 Community Campaigns (two rounds). **Milestone 10 (2018) - Complete** • Contract with consultants to perform screening assessments and schematic designs for college and university campuses and state and local buildings. **Milestone 11 (2018) - Complete** • Provide standardized contracts and best practices manual to market. **Milestone 12 (2018) - Complete** • Complete assessment of M&V methodologies for system performance and share with market participants. **Milestone 13 (2018) - Complete** • Issue competitive solicitation for pilots to identify and deploy solutions for the integration of traditional and advanced systems, such as ASHPs. **Milestone 14 (2019) - Complete** • Launch co-branded marketing awareness campaigns with the NYS investor-owned utilities. **Milestone 15 (2020)** • ASHP Case studies developed and deployed in the market, along with current resources from regional and national organizations. **Milestone 16 (2020)** • Close the ASHP and GSHP Rebate program in timing with the launch of the NYS Clean Heat Statewide Heat Pump Program **Milestone 17 (2024)** • Complete commissioning and M&V on large commercial, campuses and state and local building projects.

Fuel Neutrality

Fuel Neutrality	• NYSERDA advanced this initiative in a fuel neutral manner. This provided an opportunity to target more cost-effective applications (such as switching from fossil fuel to GSHP/ASHP) and helped develop a market of scale.

Performance Monitoring and Evaluation Plans

Performance Monitoring & Evaluation Plan	NYSERDA's approach to monitoring and assessing the effectiveness of the initiative and overall market development is described below. **Test-Measure-Adjust Strategy**

	Each year, NYSERDA undertook a reassessment of effectiveness and funding levels and adjusted the programs as appropriate. Specifically: • NYSERDA assessed the level of enrollment in community campaigns and identified tactics to increase overall enrollment and enrollment from key demographics. • NYSERDA assessed the number of enrollees in community campaigns that acted in a campaign year and identified important trends and tactics for increasing conversion. • NYSERDA partnered with communities between campaigns to conducted focus groups of participants and installers to identify lessons learned, best practices and needed adjustments. • NYSERDA worked with the NYPA and the industry to assess the impact of technical assistance for large campuses and adjusted approach as necessary to increase impact • NYSERDA worked with stakeholder groups such as NY GEO to regularly assess the participation and level of success of the GSHP incentive program and made necessary adjustments **Heat Pumps Phase 1 Strategy M&V** • Heat Pumps Performance data was collected through the incentive program, by community campaigns and through M&V, where possible, using a common/standardized web platform and on-board/technology integrated tools. **Market Evaluation** This intervention will include surveys/interviews with market participants at various stages and levels of involvement to assess: • Improvements in awareness and customer confidence in Clean Heating and Cooling • Effectiveness of tools such as the customer targeting tool, RFP template, marketing materials and standard protocols for assessments, feasibilities, design and M&V • Installed cost by category • Size of the qualified installer base **Impact Evaluation/Field Verification** Impact evaluation will leverage data collected by community campaigns, through technical assistance studies and the GSHP and ASHP incentive programs. The evaluation will involve field verification of a sample of projects, and focus on: • Clean heating and cooling energy produced • Fossil fuel displaced • Effective use of ASHP for heating as well as for cooling

Budgets

An annual commitment budget for all activities included in this chapter is shown in Appendix B. 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 in Appendix B is intended for informational purposes only.

Progress and Performance Metrics

Appendix C provides program Activity/Output indicators representing measurable, quantifiable direct results of activities undertaken in the initiative. Outputs are a key way of regularly tracking progress, especially in the early stages of an initiative, before broader market changes are measurable. Outcome indicators can encompass near-term through longer-term changes in market conditions expected to result from the activities/outputs of an intervention. Outcome indicators will have a baseline value and progress will be measured periodically through Market Evaluation.

Benefits shown in Appendix B, listed as direct, are direct, near term benefits associated with this initiative's projects. These benefits will be quantified and reported on a quarterly basis and will be validated through later evaluation.

Benefits shown in Appendix B, listed as indirect, represent the estimated indirect market effects expected to accrue over the longer term as a result of this investment and follow on market activity. The indirect benefits that accrue from this investment will be quantified and reported based on periodic Market Evaluation studies to validate these forecasted values. Market Evaluation may occur within one year (-/+) of the years noted in the table and projected future indirect benefits and/or budgets necessary to achieve them may be updated based on the results of market evaluation. Indirect impact across NYSERDA initiatives may not be additive due to multiple initiatives operating within market sectors. The values presented in Appendix B are not discounted, however NYSERDA has applied a discount of 50% to the overall portfolio values in the Budget Accounting and Benefits chapter.

19.2 Heat Pumps Phase 2 (2020)

Theory of Change

The NYS Clean Heat Market Development Plan is designed to address critical barriers and market needs through the initiatives listed in the table below. These sub-initiatives have been or will be approved through various CEF Investment Plans. Eight (8) of the sub-initiatives (highlighted below) are presented in this Heat Pumps Phase 2 (2020) initiative.

NY Clean Heat Market Development Plan - $230M Building Electrification Investment

Initiatives funded through the Heat Pumps "Phase 2" Investment Plan [1]			
Critical Market Need	**Total Funding**	**Initiative**	**Budget**
TRAIN AND DEVELOP THE NEEDED CLEAN HEATING AND BUILDING ELECTRIFICATION WORKFORCE	$38.2	WORKFORCE DEVELOPMENT	$38.2
BUILD CONSUMER DEMAND AND MARKET CONFIDENCE AND REDUCE CUSTOMER ACQUISITION COSTS	$60.9	**MARKETING**	**$19.2**
		COMMUNITY CAMPAIGNS	**$10.0 [1a]**
		CRITICAL TOOLS	**$4.0**
		TECHNICAL ASSISTANCE	$27.7
DRIVE PERFORMANCE IMPROVEMENTS, REDUCE COST, AND DELIVER NEW ECONOMIC SOLUTIONS THROUGH TECHNOLOGY INNOVATION AND DEMONSTRATIONS	$60.0	**CLEAN THERMAL DISTRICT SYSTEMS**	**$15.0**
		HVAC TECHNOLOGY CHALLENGES	$15.0
		EMPIRE BUILDING CHALLENGE	$15.0
		MULTIFAMILY BUILDING DEMONSTRATIONS	$5.0
		COST REDUCTION STRATEGIES	**$10.0**
MAKE ELECTRIFICATION SOLUTIONS AVAILABLE FOR LMI CONSUMERS	$31.0	**LMI**	**$31.0 [1b]**
MAKE PRODUCTS AVAILABLE WHEN AND WHERE CONSUMERS NEED THEM BY BUILDING THE CLEAN HEAT SUPPLY CHAIN	$12.0	**SUPPLY CHAIN**	**$12.0**
MINIMIZE WINTER ELECTRICAL PEAK BY INVESTING IN DEMAND REDUCING "HEAT-PUMP READY" SOLUTIONS	$26.5	COMFORT HOME	$26.5
DEVELOP A LONG-TERM BUILDING ELECTRIFICATION ROADMAP TO GUIDE THE TRANSFORMATION OF HOW NEW YORKER'S HEAT AND COOL THEIR BUILDINGS	$1.0	**BUILDING ELECTRIFICATION ROADMAP**	**$1.0**
Sub-Total (representing the Heat Pump Phase 2 sub-initiatives in this Investment Plan			**$98.2**
TOTAL (representing totality of NYSERDA's Investments in the NYS Clean Heat Market Development Plan			**$229.6**

Funding Clarifications

1. The Heat Pump Phase 2 (2020) investment plan budget total is $98.2, however funding to support these investment plan objectives has been leveraged from multiple sources

   a. The Community Campaigns component ($10M) includes $3M of funding approved under the *Clean Energy Communities* investment plan

   b. The LMI component ($31M) includes $1M of funding approved under the *Market Characterization & Design* investment plan

Testable Hypotheses	The sub-initiatives presented below are designed to address these critical market needs: **1. Build consumer demand and market confidence and reduce customer acquisition costs** • If NYSERDA provides consumer education, community engagement, and timely decision-quality information to the marketplace, then market confidence in and consumer demand for heat pumps and related technologies[2] will increase. • If NYSERDA drives sufficient market confidence in and consumer demand for heat pumps, then customer acquisition costs for installations will reduce. • If NYSERDA aggregates customers into larger purchasing blocks and/or drives uptake with owners of large portfolios of buildings, the unit costs of heat pumps installations for this population can be reduced. **2. Drive performance improvements, reduce cost, and deliver new economic solutions through technology innovation and demonstrations** • If NYSERDA invests in technology innovation and demonstrations to develop, demonstrate, and validate building electrification solutions, then lower-risk replicable project designs and business models will emerge. • If NYSERDA focuses on driving the emergence of lower-risk replicable project designs and business models that can deliver better performance, cost reduction, and new economic solutions for a wider range of building types, then the market will accelerate its growth to scale. **3. Electrification solutions are available for LMI consumers** • If NYSERDA addresses institutional barriers, technical challenges associated with the building stock, and critical consumer protections/affordability issues affecting LMI consumers, then deployment of clean and efficient solutions will grow in the LMI sector as the costs of heat pumps come down in the market. **4. Products are available when and where consumers need them by building the clean heating and cooling supply chains** • If NYSERDA supports development activities to draw a larger pool of companies across the supply chain into business activities serving New York State, then a more-robust clean heating and cooling supply chain will persist. • If NYSERDA builds a robust clean heating and cooling supply chain, products will be available when and where consumers need them which will enable the wide-scale deployment of heat pumps. **5. Develop a long-term building electrification roadmap** to transform how New Yorkers heat and cool their buildings

[2] Related technologies are those technologies which are included in and eligible to receive incentives under the NYS Clean Heat Statewide Heat Pump Program.

	• If NYSERDA develops a policy and program framework that can be advanced in New York State to enable energy efficient and cost-effective building electrification for consumers, then more buildings will migrate their heating and cooling operations to be consistent with the state's low-carbon future.
Market Barriers Addressed	NYS Clean Heat Market Development Plan Market Barriers: • Shortage of qualified labor to rapidly scale the market. • High costs of energy-efficient electrified space and water heating technologies compared to fossil fuel alternatives • Lack of solutions for many building types. • Lack of consumer awareness about clean heating and cooling options. • Reluctance in the HVAC and general contractor communities to transition their business and service models to emphasize clean heating technologies.
Goals Prior to Exit	Across the totality of its component sub-initiatives, the NYS Clean Heat Market Development Plan aims to build market capacity to deliver building electrification solutions – including air-source heat pumps (ASHP), water- and ground-source heat pumps (GSHP), and heat pump water heaters (HPWH) to advance the adoption of heat pump systems that are designed and used for heating – in order to meet the following central goals[3] by 2025: • Help achieve and possibly exceed the state's **energy efficiency goals** reflected in the New Efficiency: New York 2025 site TBtu savings target. • Help achieve and exceed the state's current heat pump energy savings targets with the installation of approximately 130,000 **heat pump installations**.[4] • Increase the pool of **skilled labor** needed to grow a quality-oriented industry, training 14,000 workers across the heat pump supply chain, including 4,200 workers to sell, design, and install systems. • Help increase the capacity of the NYS **supply chain** to meet the demand for heat pumps. Specifically: o Increase stocking of heat pumps by 50% above 2019 industry shipments; o Increase penetration of high-performance electrified space and water heating technologies to 90% of all heat pumps shipped for space conditioning in New York.

[3] This investment plan includes broader market progress metrics, for example overall heat pump market size, installations, workforce development, and market penetration of heat pumps to advance the adoption of heat pump systems that are designed and used for heating. These market progress metrics will be supported collectively by all of NYSERDA's market development activities that extend beyond this singular investment plan. NYSERDA will measure market progress broadly, rather than for each specific investment plan. Progress will be reported collectively within the Statewide Heat Pump Program Annual Report, filed in April each year.

[4] The state's current energy savings targets from the installation of heat pumps by 2025 total 4.6 TBtu, including 3.6 TBtu from the state's investor-owned electric utilities and 1.0 TBtu from the Long Island Power Authority. The 130,000 installations noted above refers to target installations in the regions served by the CEF (largely aligned with the IOU territories.)

	• Reduce the **cost** of heat pump installations by at least 25%.
Stakeholder/Market Engagement	• NYSERDA commenced stakeholder engagement in 2016 with the development of the Renewable Heating and Cooling Policy Framework, which was guided by an Industry Advisory Group. Since program launch in 2017, 11,800 systems have been installed and a contractor network of over 440 installers has been built. • NYSERDA has regularly engaged with market participants throughout Phase I of the Clean Heating and Cooling work. NYSERDA has convened targeted workshops and industry roundtable on heat pumps to inform policy and program development. • NYSERDA will convene a market advisory group and topical stakeholder engagement sessions to guide the development of the Building Electrification Roadmap.
Relationship to Utility Programs and REV Initiatives	NYS Clean Heat is being advanced as a portfolio of market enablement initiatives designed to work in concert with the utility administered incentives. Coordination with the utilities in all facets of the program will be critical. Specific coordination points include: • Transfer the ASHP and GSHP incentive programs from NYSERDA to the utility administered NYS Clean Heat Statewide Heat Pump Program with minimal market disruption • Participate on the Joint Management Committee of the NYS Clean Heat Statewide Heat Pump Program • Continued collaboration with the utilities on the NYS Clean Heat Statewide Heat Pump Program, as well as residential, LMI, and energy efficiency programs • Seek continued input from utilities on design of market development initiatives to support NYS Clean Heat. • Develop the trainings to support ASHP and GSHP contractor requirements and certification • Establish collaboration on broad market progress evaluations including data sharing • Draw upon knowledge and experience of neighboring state utilities.

Fuel Neutrality

Fuel Neutrality	• These initiatives will be driving the electrification of buildings, converting from oil/propane and gas to electric heating and cooling.

19.2.1 Marketing – Consumer Awareness

Market Barriers Addressed	Market barriers: • Lack of consumer awareness about heat pump options for homes and businesses across New York State. Will address critical market need to: • Build consumer demand and market confidence and reduce customer acquisition costs.

Activities	• NYSERDA and Utility Co-branded Marketing, Awareness and Education
	  ○ Co-brand heat pump outreach and awareness campaigns with the utilities, to leverage the name recognition of both the utilities and NYSERDA and drive market uptake.
	  ○ Develop a central online landing environment for NYS Clean Heat that will serve as a resource for the customer, segment the customer's offers based on their utility company and geography, and drive to qualified contractor listings.
	  ○ Coordinate with trade allies (including manufacturers, distributors, contractors) and community groups to maximize reach and frequency in advertising and deliver a consistent message regarding the benefits of energy-efficient electrified space and water heating technologies.
	  ○ Deliver in concert with Community Campaigns (described below) to maximize impact.
	  ○ Test and refine marketing approach, messages and effectiveness throughout.
	
	• NYSERDA and Contractor Cooperative (Co-op) Advertising
	  ○ Continue co-op advertising, which offers clean heating and cooling industry partners marketing funds and materials; planned enhancements include templated ads, opt-in opportunities for contractors to access additional marketing support from NYSERDA, and re-targeting to consumers who are more likely to be aware of heat pumps and their benefits based on their earlier exposure to an education and awareness communication.

Target Market Segment(s)	• Target customers who have a higher propensity to adopt clean heating and cooling technologies, including broad-based marketing to targeted geographies, hyper-targeting customers based on characteristics of their home and heating fuel, or reaching customers who are actively searching to replace their HVAC equipment. • Co-op advertising activities with clean heating and cooling industry partners to enable contractors participating in NYS Clean Heat Program to market and grow their business and build market demand.
Relationship to Utility Programs and REV Initiatives	• Co-brand heat pump outreach and awareness campaigns with the utilities, to leverage the name recognition of both the utilities and NYSERDA and drive market uptake. • All activities and campaign results will be fully coordinated and shared with the electric utilities.
Target Market Impacts	• NYSERDA's campaigns to increase consumer awareness of clean energy options for heating and cooling homes and business will build demand resulting in 1 million leads generated, supporting the 130,000 installations of energy-efficient electrified space and water heating technologies through NYS Clean Heat. • $9.5M of NYSERDA's marketing dollars will be leveraged through industry coop advertising.
Key Milestones	<u>CONSUMER AWARENESS</u> Milestone 1: (2020) Launch NYS Clean Heat Contractor Resource Landing Page Milestone 2: (2020) Launch focused marketing campaign to support the residential Comfort Home initiative Milestone 3: (2020) Launch revised Co-op Advertising offering to clean heat industry partners

	Milestone 4: (2020) Launch Co-branded utility marketing campaign within one or more electric utility territories Milestone 5: (2022) support 18,900 installations of energy-efficient electrified space and water heating technologies through NYS Clean Heat

19.2.2 Community Campaigns

Market Barriers Addressed	Market barriers: • Lack of consumer awareness about heat pump options for homes and businesses. Will address critical market need to: • Build consumer demand and market confidence and reduce customer acquisition costs
Activities	• Continue the work from Phase 1 to extend and expand (Phase 2) existing Clean Heating and Cooling Community Campaign activity. • Expand NYSERDA's comprehensive toolkit of materials and leverage complementary resources and technical assistance that NYSERDA's Clean Energy Communities program offers to local governments. • Explore additional aggregation strategies such as via buying groups, community organizing groups, affinity groups, homeowners' associations, and developers to accelerate participation, facilitate access to capital and financing, and enable community-scale buying groups. • Target marketing in communities with campaigns and leverage data on enrollees to increase effectiveness.
Target Market Segment(s)	• NYSERDA supports communities in implementing multi-year campaigns that help homes and businesses, in the same area, install heat pump technologies through locally organized community outreach.
Relationship to Utility Programs and REV Initiatives	• Leverage utility-administered incentive component of NYS Clean Heat Program • Coordinate with the respective utilities in areas with active Community Campaigns
Target Market Impacts	• Targeted marketing activities in communities with active campaigns, leveraging clean energy community relationships and resources, will result in $3 million of market/contractor customer acquisition cost directly offset by NYSERDA investment.
Key Milestones	<u>COMMUNITY CAMPAIGNS</u> Milestone 6: (2020) Launch final round of Phase 1 Community Campaigns Milestone 7: (2022) Release new Phase 2 solicitation for future Community Campaigns

19.2.3 Critical Tools

Market Barriers Addressed	Market barriers: • Lack of market analysis and user resources to make it easier for consumers to adopt clean heat solutions

	Will address critical market need to: • Build consumer demand and market confidence and reduce customer acquisition costs
Activities	• Develop user-friendly resources such as a Heat Pump Pattern Book, to aid consumers in their decision-making and contractors in adopting good industry practices, including the presentation of standardized heat pump packages for common buildings types in New York State, tools to support good practice heat pump design and selection, and a prioritization tool for energy efficiency investments. • Provide assistance to the market and utilities in developing appropriate quality assurance and quality control protocols for heat pump deployment programs to improve customer satisfaction and build customer confidence in this nascent market. • Conduct market research and analysis to address critical market challenges (e.g., refrigerant management); to assess potential impacts as markets shift and new challenges emerge; and to support the evolution of NYS Clean Heat framework.
Target Market Segment(s)	• NYSERDA will develop and publish Critical Studies, Tools, and User Guides for contractors who install heat pumps and related technologies and their residential, multifamily and commercial consumers, to advance uptake in energy-efficient electrified space and water heating technologies.
Relationship to Utility Programs and REV Initiatives	• Provide assistance to the market and utilities in developing appropriate quality assurance and quality control protocols for heat pump deployment programs to improve customer satisfaction and build customer confidence in this nascent market. • Engage with the utilities to identify areas in which market research and analysis are needed or emerge to support the evolution of the NYS Clean Heat Pump Program. • Provide guides to eligible Contractors in the NYS Clean Heat utility network.
Target Market Impact	• Develop resources that range from market analysis to user guides to make it easier for consumers to adopt clean heat solutions
Key Milestones	<u>CRITICAL TOOLS</u> Milestone 8: (2021) Finalize and release the Heat Pump Pattern Book through a public web-based interface Milestone 9: (2021) Development of revised QA/QC protocols to support the NYS Clean Heat Pump

19.2.4 Clean Thermal District Systems

Market Barriers Addressed	Market barriers: • Lack of next generation building electrification solutions that can deliver better performance, cost reduction, and new economic solutions for a wider range of building types. • Lack of novel business models for scalable clean thermal district systems. Will address critical market need to: • Drive performance improvements, reduce costs and deliver new economic solutions through technology innovation and demonstrations
Activities	• Provide technical assistance funding for initial scoping, pre-development and environmental impact studies. Scoping studies are expected to identify anchor

	customers, appropriate heat sources/sinks, and opportunities to dovetail with other major construction projects on the horizon. Studies may characterize issues regarding rights-of-way or create a request for proposals to recruit additional experts for the next steps of detailed design. • Provide technical assistance (for design) to cost-share detailed design work that will develop cost estimates and a financial plan for the proposed system; develop draft agreements with customers, including the customer billing structure; and produce schematic drawings of major equipment and systems. • Provide installation incentives (for construction) to competitively selected clean thermal district demonstration projects, providing "gap" funding to enable construction. • Use multibuilding aggregation to load smooth across different building demands to deliver a more cost-effective solution than a single building solution. • Advance related outreach, tools, and training.
Target Market Segment(s)	• Focus on new and redevelopment sites such as campuses, downtown corridors, with an anchor tenant. • Target large-scale solution providers who can deliver a range of services, including financing and turnkey services. • Explore a variety of business models, including but not limited to customer-ownership, third-party ownership, utility-ownership, public-private-partnerships, etc., with preference to support a diverse portfolio to maximize learning.
Relationship to Utility Programs and REV Initiatives	• Collaborate with the utilities who have targeted district thermal demonstrations (e.g., Con Edison, National Grid). • Work with other utilities to identify potential sites. • Coordinate on opportunities to provide financial incentives through the utility-administered incentive component of NYS Clean Heat, where appropriate. • Investigate business and ownership models including district systems.
Target Market Impacts	• NYSERDA will support 20 scoping studies (2021), 8 detailed design studies (2022), and the launch of 2 demonstration projects (2023). This investment will demonstrate viable business models (e.g., thermal Energy as a Service unlocks accessibility/affordability for more customers) and identify and target systemic frictions in the development of clean thermal district systems resulting in the replication of two Clean Thermal District System projects beyond NYSERDA supported projects (2025).
Key Milestones	<u>CLEAN THERMAL DISTRICT SYSTEMS</u> Milestone 10: (2021) Award contracts to experts to support scoping, design and construction of district systems

19.2.5 Additional Cost Reduction Strategies

Market Barriers Addressed	Market barriers: • High costs of heat pump systems compared to fossil fuel alternatives. Will address critical market need to: • Drive performance improvements, reduce costs and deliver new economic solutions through technology innovation and demonstrations
Activities	• Efforts to be scoped in the future, informed by learnings from the Building Electrification Roadmap and other investigative work. • Develop an action plan for the next phase of cost reduction work.

Target Market Segment(s)	• The target market includes residential, multi-family, commercial, and institutional buildings owners/owners of large portfolios of buildings building managers/developers, contractors and supply chain actors that have a stronger value proposition, such as sites that currently use oil and propane, or have limited access to natural gas, as these represent high value use cases across market segments based on project economics. Specific targets will be defined in year 1 and informed by the Building Electrification roadmap.
Relationship to Utility Programs and REV Initiatives	• Continually engage with utilities for insights regarding potential cost reduction strategies and the execution of these strategies.
Target Market Impacts	• The combined efforts of the NYS Clean Heat market development plan will drive cost reductions of at least 25% by 2025. Specific market impacts associated with additional cost reduction initiatives will be developed by Q1 2021. • Additional tracking metrics may be identified during the development of the action plan.
Key Milestones	<u>COST REDUCTION STRATEGIES</u> • Milestone 11: (2021) –Develop action plan for the next phase of cost reduction work, following the publication of the Building Electrification Roadmap to be issued Q4 2020.

19.2.6 Low To Moderate Income (LMI)

Market Barriers Addressed	Market barriers: • Lack of viable and scalable solutions for electrifying LMI homes while addressing energy affordability, intuitional barriers unique to affordable housing, and consumer protections, Will address critical market need to: • Make electrification solutions available for LMI consumers
Activities	• Develop best practices for utilizing heat pumps for space conditioning and water heating for common LMI building types. Related research and analysis will assess challenges associated with older housing stock such as structural deficiencies and insufficient electric service; examine market, policy, and institutional barriers in the areas of energy and affordable housing to mitigate cost shifts associated with electrification; and identify necessary consumer protections. • Through demonstrations and pilots, identify replicable models for heat pump deployment in affordable multifamily and single-family buildings. Possible examples include developing a model for delivering heat pumps while improving energy affordability, developing a retrofit prototype for manufactured housing, and pilot aggregation strategies. Replication will be supported through the development of playbooks that provide guidance on implementing successful models for electrification and targeting large portfolio owners and property managers with heat pump solutions. • Identify aggregation strategy replication models used in other regions to drive cost reduction (e.g. through weatherization programs). • Engage market participants such as building owners, property managers, installers, and manufactures to identify early-stage opportunities for such demonstrations and pilots.

	• Provide short-term, targeted incentives to offset the cost of heat pump solutions for LMI consumers and building owners where there is a clear energy affordability benefit, such as in the displacement of deliverable fuels. The development and implementation of LMI incentives will be done in collaboration with the utilities. Additional financial support for heat pump installations in the LMI market segment will be conditioned on minimum building performance thresholds. • Educate LMI consumers who install heat pumps on how to operate and maintain the system and coordinate consumer education across direct outreach and the communication channels of utilities, state agencies, local government, and community-based organizations.
Target Market Segment(s)	• The LMI market segment consists of nearly half of the occupied housing units in NYS • Entities to support NYSERDA's investment in research and analysis, demonstrations, targeted incentives, and consumer education to inform the long-term LMI electrification strategy in NYS. • Program and policy administrators, nonprofit housing energy retrofit service providers, and consumer protection entities who will integrate these findings into their platforms to address the needs of LMI consumers and building owners.
Relationship to Utility Programs and REV Initiatives	• Joint decision making and development with utilities on: o Research priorities o Topics of challenges/demonstrations o A single application for supplemental LMI incentives o Consumer education content on maximizing the benefits from heat pumps
Target Market Impacts	• Through this investment, NYSERDA will develop a foundation for heat pump deployment in the LMI market segment and inform longer-term utility investment. Targeted incentives and demonstrations will directly support heat pump installations in over 7,500 LMI housing units. To catalyze replication of successful demonstrations, NYSERDA will make specifications and playbooks available for heat pump installation that maximizes energy affordability for LMI consumers and in affordable housing; and NYSERDA will publish data on cost, performance, and energy affordability impacts to improve market confidence. NYSERDA also will help advance policy change in the energy and affordable housing realms to enable the adoption of heat pumps while addressing energy affordability.
Key Milestones	<u>LMI</u> • Milestone 12: (2020) Receive and review submittals from RFI seeking input on LMI electrification demonstration/competition categories • Milestone 13: (2020) Initial LMI incentives (supplemental to utility incentives) are made available • Milestone 14: (2021) Award RFP seeking LMI electrification demonstration/competition proposals

19.2.7 Supply Chain Development

Market Barriers Addressed	Market barriers: • Lack of businesses across the HVAC supply chain providing clean heating and cooling products and solutions to consumers.

	• Lack of business best practices to ensure product and service availability to support wide-scale deployment of heat pumps and related technologies across NYS. Will address critical market need to: • Make products available when and where consumers need them by building the clean heat supply chain
Activities	• Conduct regional roundtables seeking input from distributors, vendors, and original equipment manufacturers (OEMs) to define and describe the value proposition of clean heat to the market through Market Maps which identify all activities within the supply chain and Value Stream Maps which focus on areas within the supply chain that add value to a service or product . • Use market intelligence and above mappings to identify opportunities for high impact upstream aggregation and other intervention strategies. • Support improvements to stocking practices and explore mid-stream interventions in coordination with utilities. • Build and support the activities of a network of trade allies to support the technical transfer and dissemination of training, tools, and resources to a wide range of contractor markets. • Provide business development support and technical resources to help companies transition to building electrification solutions, focusing first on larger HVAC companies (25+ employees), leveraging Workforce Development initiatives where appropriate.
Target Market Segment(s)	• Engage companies across the supply chain in providing clean heating solutions • NYSERDA, in close coordination with the utilities, will engage with those companies who are currently supplying clean heating and cooling solutions as well as those providing conventional solutions to new and existing buildings in the residential, commercial and multifamily sectors • Companies can include manufacturers and their suppliers, large and small distributors, contractors, installers, and other technical support and business development solutions providers.
Relationship to Utility Programs and REV Initiatives	• Explore and develop mid-stream interventions in coordination with utilities, The market mapping, value stream mapping, roundtables, and trade ally engagement listed in the above activities as well as utility experience and input will all inform the most effective way of engaging with mid-stream actors. Engage with utilities to participate in regional stakeholder roundtables within their territories. • Closely coordinate with utilities in reaching out to supply chain entities to minimize duplicative efforts and maximize effectiveness in the advancement of NYS Clean Heat
Target Market Impacts	• NYSERDA's investments will support 200 businesses across the supply chain by providing training, tools, technical support, and business development assistance; secure partnerships with midstream and upstream market actors whose businesses represent at least 80% of heating equipment sales statewide; and increase mid-stream and upstream stocking of clean heating technologies by 50% above 2019 HARDI shipment data for New York State.
Key Milestones	<u>SUPPLY CHAIN DEVELOPMENT</u> Milestone 15: (2021) Establish a network of trade allies Milestone 16: (2021) Launch Business Support offer to marketplace to provide business development support and technical resources

19.2.8 Building Electrification Roadmap

Market Barriers Addressed	Market barriers: • Lack of a long-term policy and market framework to advance the technical and business model solutions needed to transform the way in which NY consumers heat and cool buildings, consistent with the ambitious Climate Leadership and Community Protection Act goals. Will address critical market need to: • Guide the transformation of how New Yorker's heat and cool their buildings
Activities	• Support a comprehensive analysis of technology and market readiness for efficient electric heat pump solutions by building type. • Develop a roadmap for advancement of the technical and business model solutions and the policy supports necessary to transform how New York consumers heat and cool buildings. • Engage industry experts and stakeholders to ensure relevant, informed, and market- and customer-oriented work. • Model scenarios for achievable market uptake, energy savings, and greenhouse gas emissions reductions from efficient electric heat pumps through 2030. • Use analysis to guide policy and program interventions, including the refinement of NYS Clean Heat initiatives. Opportunities to refine the market development work include identifying and expanding high-potential building typologies to target for support; identifying building use cases that displace gas heating to target for support; informing investments in technology innovation and demonstrations; and developing additional cost-reduction strategies.

Target Market Segment(s)	• The Roadmap analysis will characterize both the current state and a 10-year vision for building electrification solutions across the small residential, multifamily, and commercial and institutional market segments. Target audiences include policy decision makers and program administrators, market participants in the heat pump supply chain, and building decision makers
Relationship to Utility Programs and REV Initiatives	• The Roadmap analysis will be used to guide NYS policy and program interventions, including the refinement of the NYS Clean Heat initiatives led by both NYSERDA and the electric utilities. • NYSERDA will engage with utility counterparts to shape and solicit input for the Roadmap analysis, directly and in conjunction with stakeholder engagement sessions, including to develop strategies that are responsive to market needs
Target Market Impacts	• Through the roadmap analysis and stakeholder engagement, NYSERDA will characterize for each major building typology in New York State a path to develop and scale building electrification solutions that are cost-effective and attractive to building decision makers. NYSERDA will identify public policies and investments that are needed to support the development of a robust 2030 market for these solutions with greater speed, efficiency, and certainty.
Key Milestones	<u>BUILDING ELECTRIFICATION ROADMAP</u> • Milestone 17: (2020) Publish the Building Electrification Roadmap

Performance Monitoring and Evaluation Plans

Performance Monitoring & Evaluation Plan	Per the Commission's January 16, 2020 *Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025*, NYSERDA will work with the Electric Utilities to jointly file a Statewide Heat Pump Program Annual Report by April 1, 2021 and annually thereafter. NYSERDA will be conducting periodic assessments of the overall development of the market, in collaboration with utilities, and will coordinate with DPS staff and utilities on the statewide evaluation, measurement and verification (EM&V) study of heat pumps to be completed by June 1, 2022. **Test-Measure-Adjust Strategy** Each year, NYSERDA will undertake a reassessment of effectiveness and funding levels and will adjust the program as appropriate. The reassessment may result in adjustments to funding levels, deployment timing and tactics and/or resource allocation. Specifically, within the following initiatives: • NYSERDA will review the analysis from the Building Electrification Roadmap to guide policy and program interventions, including the refinement and development of initiatives including Cost Reduction Strategy and Critical Tools development. • NYSERDA will conduct initial voice of customer round tables within the Supply Chain Development initiative to inform the details of the Business Development Support activity as well as the framework to establish the ally network. • NYSERDA will launch a new Phase 2 Community Campaign solicitation in 2022, allowing time to analyze the performance and best practices from the previous rounds and incorporate those learnings into the new solicitation. • NYSERDA will launch joint market efforts with select utilities which will allow for test marketing of co-branded campaigns. A period of recalibration will follow, allowing time to determine the most effective modes and integrate them into the statewide marketing effort. **Market Evaluation** NYSERDA plans to regularly track data on market size (i.e., number of heat pumps shipped/sold in NYS), along with other important leading indicators of market progress and the effectiveness of NYSERDA interventions including, but not limited to awareness of clean heat technologies, market penetration of clean heat technologies, cost/soft cost, availability of a trained and skilled workforce, etc. NYSERDA has estimated indirect benefits related to the joint implementation of this heat pump electrification effort with the Utilities. These broader market effects are expected and will be assessed through evaluation, based on the regular tracking of market progress. Following measurement, NYSERDA will report out on the identified indirect energy and other benefits. 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. **Impact Evaluation/Field Verification** NYSERDA will collaborate with DPS staff and utilities on the statewide evaluation, measurement and verification (EM&V) study of heat pumps to be completed by June 1, 2022.

	For Clean Thermal District Systems, while direct impacts are not estimated, an independent evaluation contractor will be procured by NYSERDA to perform the M&V and analyses. The M&V will be conducted according to the International Performance Measurement & Verification Protocol (IPMVP) method(s) most appropriate. These M&V activities will commence as the sites are determined and may include monitoring sites to assess performance. For the LMI sector, NYSERDA will employ M&V activities which may include, but are not limited to, billing analysis and site data collection, metering and monitoring of installations to validate efficacy of the installed measures. LMI evaluation efforts will be coordinated and included within the corresponding market rate efforts, including coordination with the statewide study of NYS Clean Heat.

Budgets

An annual commitment budget for all activities included in this chapter is shown in Appendix B. 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.

Progress and Performance Metrics

In the case of this program, and in particular, the electrification market development plan components described in the March 16, 2020 filing, NYSERDA and the Utilities are collaborating toward a shared goal for direct benefits resulting from heat pump installations statewide. Both have made financial & programmatic commitments to support delivery of these savings which, excluding LIPA, are defined as a target of 3.6TBtu. NYSERDA will closely evaluate progress of these direct benefits on an annual basis but will make no claim of these savings in quarterly reporting.

Indirect market effects are expected to accrue over the longer term as a result of NYSERDA's investment and follow on market activity. Appendix B includes an estimate of these anticipated indirect effects. As these impacts are evaluated over time, NYSERDA intends to report these indirect benefits as well.

Appendix C provides program Activity/Output indicators representing measurable, quantifiable direct results of activities undertaken in the initiative. Outputs are a keyway of regularly tracking progress, especially in the early stages of an initiative, before broader market changes are measurable. Outcome indicators can encompass near-term through longer-term changes in market conditions expected to result from the activities/outputs of an intervention. Outcome indicators will have a baseline value and progress will be measured periodically through Market Evaluation.

19.3 Renewable Heat NY – Clean and Efficient Biomass Heating

Theory of Change

Since its inception in 2014 Renewable Heat NY has provided support to the high-efficiency and low-emission biomass heating industry. Through Renewable Heat NY, New York is pursuing a multi-pronged market support strategy to promote development in a manner that will enable individuals who choose to heat their building with biomass and support best available, high efficiency, low emissions biomass installations.

Technology Opportunities and Market Barriers Addressed	• **Up-front costs for advanced wood heating equipment can be prohibitive when compared to incumbent technologies.** Historically low home heating oil prices have slowed the advance of the high-efficiency and low-emission biomass market and impeded the development of innovative business models. • **Errors in system design, installation, commissioning, and controls integration lead to underperformance and operational issues.** The design and installation of high-efficiency and low-emission biomass boiler systems requires a high level of skill and understanding. Training and education will need to continue and evolve as the industry matures. • **Lack of a reliable fuel supply network contributes to customer apprehension.** The bulk pellet delivery network in NY is still in its infancy. Continued support is needed to build this network to a point where bulk pellets can be delivered to customers economically. • **Advanced technologies are often viewed as untested and unreliable.** There is currently an emergent network of manufacturers and distributors of high-efficiency and low-emission biomass heating technologies in NYS. NYSERDA is working with them to improve equipment performance as well as manufacturing capabilities.
Testable Hypotheses	• If NYSERDA provides incentives to improve the economics of installing a high-efficiency, low emissions biomass heating appliances, then more consumers will choose to do so. • If high-efficiency, low-emissions biomass heating appliances are made cleaner and more efficient, then the customer value proposition will improve, and installations will increase. • If reliable supply chain and service networks are fully developed, then the likelihood of high-efficiency, low-emissions biomass heating appliances to be viewed as favorable to the next-best alternative will increase. • If less efficient biomass heating appliances are replaced with high-efficiency, low-emissions biomass heating appliances then there will be a positive impact on ambient air quality.
Activities	**Direct Incentives:** • Continue standard offer, first-come first-served incentive programs statewide. Monitor market interest and adjust incentives as appropriate. • Seek further soft cost reductions by providing financial support through community sponsored purchasing campaigns (similar to the Solarize[5] model for solar PV). **Research and Development:**

[5] Solarize campaigns are locally organized community outreach efforts aimed at getting a group of homes and businesses in one area to go solar. When groups of neighbors—including residents and businesses—learn about solar and the installation together, they can often get better pricing and share the tasks. Group members can contribute their strengths and learn new skills. NYSERDA provides technical assistance, marketing materials, and other support for these efforts.

	• Develop test methods for wood stoves and wood boilers under realistic operational conditions in collaboration with USEPA, Northeast States for Coordinated Air Use Management (NESCAUM), and Brookhaven National Laboratory (BNL). • Provide financial support to the Alliance for Green Heat's competitive woodstove design challenges, where multi-functional teams compete to submit the most innovative and high performing pellet stoves and prototype stove models, with the goal of advancing high-efficiency, low-emissions technologies. • In collaboration with the Energy-related Environmental Research Initiative, commission studies of wood smoke and public health utilizing established partnerships to assist NYSDEC, NYSDOH, and local communities in addressing older more polluting units. • Issue a competitive solicitation to seek proposals from advanced biomass heating equipment manufacturers to improve design, package components, and reduce costs, and evaluate performance. **Workforce Development:** • Evaluate current Renewable Heat NY training program for content and demand. Revise training program in response to feedback and re-issue in the market. • Educate engineering/design firms and mechanical contractors throughout the state regarding proper sizing, piping design, controls, and system integration. • Offer targeted training for HVAC contractors, facility owners, and professional engineers to disseminate new information and keep designers and installers up to date on high-efficiency, low-emissions biomass industry best practices. **Education and Outreach:** • Issue a targeted co-op marketing campaign which will focus resources in geographic areas where fuel suppliers and qualified installers have been active and stimulate qualified installers that have not been active. • Convene the Renewable Heat NY Advisory Group on a semiannual basis to discuss ways that NYSERDA can best support generating awareness of the benefits of advanced biomass.

Target Market Characterization

Target Market Segment(s)	The target market for direct incentive programs includes: • Residential, small commercial, and large commercial customers currently using inefficient wood technologies for heat or customers that decide to switch from oil or propane to high efficiency, low emissions wood heating • State facilities as potential large customers The target market for research and development activities includes: • High-efficiency and low-emission biomass heating technology manufacturers • Bulk pellet producers and suppliers • State and Federal regulatory agencies (e.g. New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), United States Environmental Protection Agency (USEPA)) The target market for workforce development activities includes: • Local code enforcement officers • Heating, ventilation and Air Conditioning (HVAC) contractors • Design engineers • Energy auditors

	The target market for education and outreach activities includes: • Residential, small commercial, and large commercial customers currently using oil, propane, or inefficient wood technologies for heat • Local code enforcement officers • HVAC contractors • Design engineers • Energy auditors
Stakeholder/Market Engagement	• As NYSERDA has worked to foster this nascent industry, it has a strong understanding of and is in frequent communication with market participants and stakeholders across the state. • NYSERDA established a formal Renewable Heat NY Advisory Group comprised of manufacturers, installers, fuel providers, design engineers, and independent engineering consultants to gauge the state of the market and seek input on potential program adjustments in a more structured manner. • NYSERDA engages in communication with other states such as Maine, Vermont, Massachusetts, New Hampshire, Washington, Michigan, Oregon, and Arkansas on the topic of advanced biomass heating technologies and market development strategies.
Relationship to Utility Programs and REV Initiatives	• Utilities are not currently involved in biomass heating appliances.

Key Implementation Milestones

Key Milestones	Milestone 1 (2017) - complete • Modify incentives to reflect current market conditions and re-issue open enrollment solicitation. Milestone 2 (2017) - complete • Contract with Alliance for Green Heat to provide funding to Wood Stove Design Challenge on an annual basis through 2019. Milestone 3 (2017) - complete • Launch marketing campaign. Milestone 4 (2018) - complete • Contract with research partners to provide studies on wood smoke and public health. Milestone 5 (2018) - complete • Launch community sponsored purchasing campaigns. Milestone 6 (2018) • Contract with manufacturers selected under competitive solicitation. Milestone 7 (2019) - complete • Issue competitive solicitation to seek proposals from advanced biomass heating equipment manufacturers on technology improvements. Milestone 8 (2019) - complete • Reissue workforce development program based on market feedback.

Fuel Neutrality

Fuel Neutrality	• NYSERDA intends to advance this initiative in a fuel neutral manner. The high-efficiency, low-emissions biomass heating units emit less greenhouse gases per

	unit of heat delivered than conventional biomass heating units, including a significant reduction in PM, its black carbon[6] component and methane.

Performance Monitoring and Evaluation Plans

Performance Monitoring & Evaluation Plan	As an initiative in support of an emerging industry, the Initiative will implement the most promising strategy approaches in a mode of learning from the market and from experience. Strategies will be monitored and evaluated for each program component, including wood supply, fuel manufacturing, fuel delivery, wood heat appliance manufacturing, and service. These parameters will be tracked through program-level data collection as well as by direct communication with market actors to assess the prevailing state of the market. Key metrics to monitor by segment for this test/measure/adjustment purpose include: • Installed costs • Customer economics • Actual market penetration vs planned market penetration • Growth of supplier businesses • Leveraged investment • Continuous reassessment of barriers **<u>Program M&V</u>** Programmatic measurement and verification activities will include: • Post installation inspection on each biomass boiler project and a percentage of pellet stove projects. • Measurement and verification of all large commercial boiler projects. • Verification of compliance with Renewable Heat New York program rules. **<u>Market Evaluation</u>** • Market Evaluation will draw on the logic model and will include baseline and longitudinal measurements of key indicators of programmatic and broader market success. Sources of data include intervention data, data from pilots and demonstrations, commercially available data (e.g., HARDI data), and primary data collection through surveys of key market actors. Possible indicators for market evaluation include: Size of existing base of biomass HVAC installers, designers, and engineers relative to size of those qualified under Renewable Heat New York • Sales of NYSERDA qualified biomass boilers compared to sales of all biomass boilers statewide • Percentage of installations in the market that were completed by Renewable Heat NY installers • Incorporation of Program's suggested standards and language on high-efficiency, low-emissions biomass technology for buildings and related codes at the county level

[6] Black carbon is a type of particle resulting from incomplete combustion. By absorbing sunlight, it contributes to global warming.

	• Customer satisfaction with installers and equipment after first heating season and with equipment two years after installation, and installer satisfaction with program

Budgets

An annual commitment budget for all activities included in this chapter is shown in Appendix B. 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.

Progress and Performance Metrics

Appendix C provides program Activity/Output indicators representing measurable, quantifiable direct results of activities undertaken in the initiative. Outputs are a keyway of regularly tracking progress, especially in the early stages of an initiative, before broader market changes are measurable. Outcome indicators can encompass near-term through longer-term changes in market conditions expected to result from the activities/outputs of an intervention. Outcome indicators will have a baseline value and progress will be measured periodically through Market Evaluation.

In addition, NYSERDA will also assess the following broad outcomes:

- Percentage of installations in the market following Renewable Heat NY standards
- Monetize the health benefits of Renewable Heat NY

Benefits shown in Appendix B, listed as direct, are direct, near term benefits associated with this initiative's projects. These benefits will be quantified and reported on a quarterly basis and will be validated through later evaluation.

Benefits shown in Appendix B, listed as indirect, represent the estimated indirect market effects expected to accrue over the longer term as a result of this investment and follow on market activity. The indirect benefits that accrue from this investment will be quantified and reported based on periodic Market Evaluation studies to validate these forecasted values. Market Evaluation may occur within one year (-/+) of the years noted in the table and projected future indirect benefits and/or budgets necessary to achieve them may be updated based on the results of market evaluation. Indirect impact across NYSERDA initiatives may not be additive due to multiple initiatives operating within market sectors. The values presented in Appendix B are not discounted, however NYSERDA has applied a discount of 50% to the overall portfolio values in the Budget Accounting and Benefits chapter.

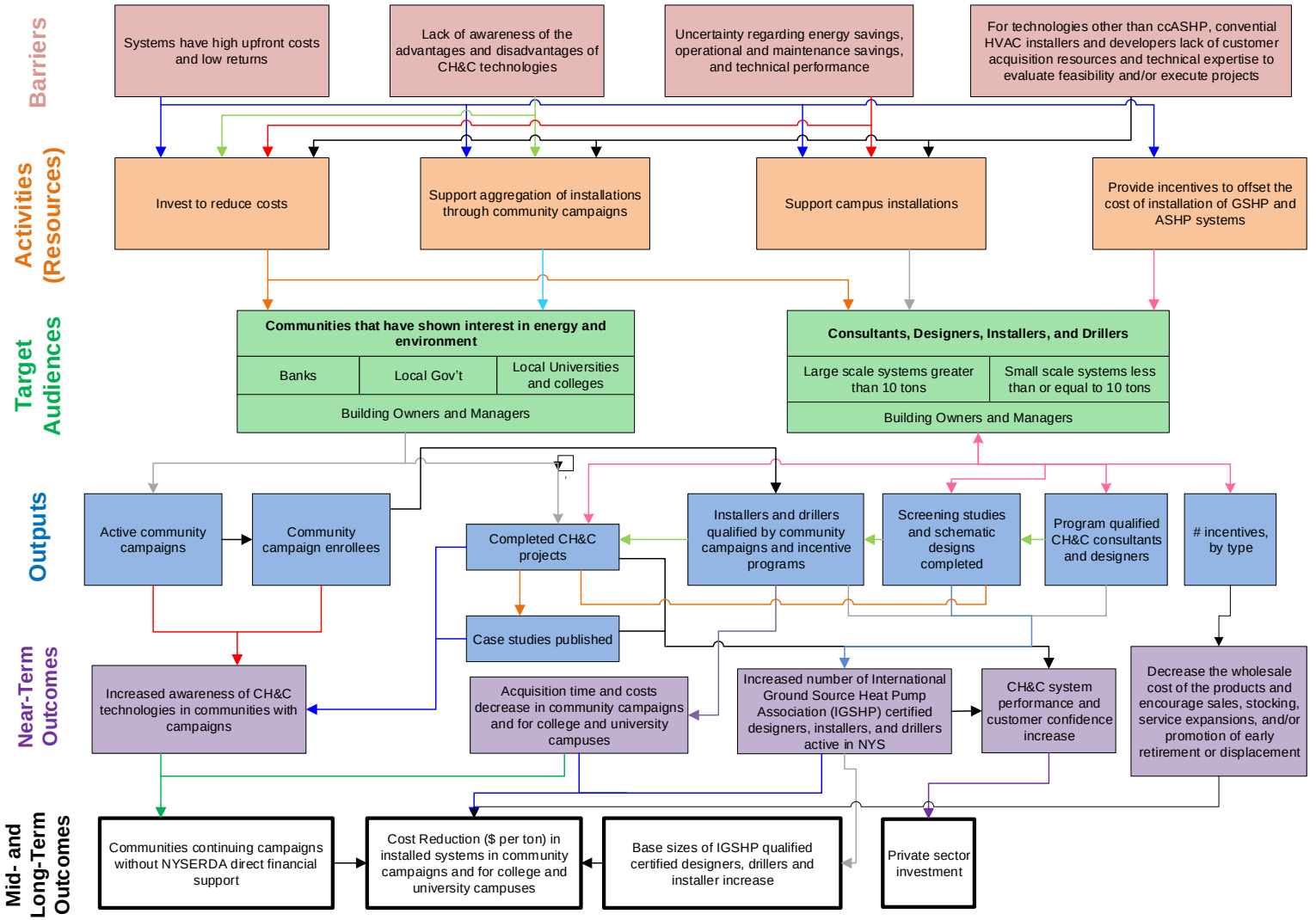
Verified Gross Savings Specification	
Date of CEF filing *see cover page*	
CEF Chapter Name	Clean Heating &Cooling (formerly Renewable Heating and Cooling)
Initiative Name	Heat Pumps Phase 1 (2017)
Initiative Description	Heat Pumps Phase 1 of the Clean Heating and Cooling (CH&C) chapter addresses CH&C project economics, lack of awareness of CH&C technologies, uncertainty regarding savings and technical performance, and lack of technical expertise to evaluate feasibility and execute projects. The Heat Pumps Phase 1 initiative includes activities to reduce soft costs for Ground Source Heat Pumps (GSHP) and Air Source Heat Pumps (ASHP) by improving access to reliable information, supporting the development of a customer targeting tool, and supporting clustering/aggregation of installations developing standardized contracts, data protocols and requirements and quality assurance processes; provide targeted cost-shared technical assistance for GSHP and ASHP; and provide incentives to off-set the cost of GSHP and ASHP systems.
Gross Savings Methodology	Performance data will be collected through the incentive program, by community campaigns and through M&V activities, where possible, using a common/standardized web platform and on-board/technology integrated tools. The results of the M&V activities will inform the NYS Clean Heat Statewide Heat Pump Program and the NYS TRM.
Realization Rate (RR)	No realization rates have been determined for this initiative within the preceding five-year time frame.
Planned Verified Gross Savings Approach	Impact evaluation activities will leverage data collected by community campaigns, through technical assistance studies and the GSHP and ASHP incentive program. The evaluation will involve customer surveys as well as billing analysis and metering and monitoring for a sample of projects and focus on customer behavior, renewable heating and cooling energy produced and fossil fuel displaced and will seek to verify gross savings reported. This evaluation includes initial testing of heat pump incremental impact analysis that may serve as a template for embedding incremental feedback across initiatives. An Independent evaluation contractor (ERS with DNV-GL) has been procured by NYSERDA to perform the M&V and analyses. The M&V will be conducted according to the International Performance Measurement & Verification Protocol (IPMVP) method(s) most appropriate and details related to the Gross Savings Analysis were submitted in an EM&V Plan in Q4 2019 . Results from this activity are anticipated in Q1 2021. Where appropriate, evaluation 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.
Exemption from EAM Status	N/A

Verified Gross Savings Specification	
Date of CEF filing: *see cover letter*	
CEF Chapter Name	Clean Heating & Cooling (formerly Renewable Heating and Cooling)
Initiative Name	Heat Pumps Phase 2 (2020)
Initiative Description	Heat Pumps Phase 2 of the Clean Heating and Cooling chapter supports NYS Clean Heat. NYS Clean Heat will pair consumer incentives with market enabling initiatives to deliver building electrification solutions to New Yorkers. New York State will be investing over $450 million in heat pump incentives through electric utilities' NYS Clean Heat incentive program and approximately $230 million in market enabling support through the NYS Clean Heat Market Development Plan initiatives, funded by NYSERDA's Clean Energy Fund (CEF).
Gross Savings Methodology	Per the Commission's January 16, 2020 Order Authorizing Utility Energy Efficiency and Building Electrification Portfolios Through 2025, NYSERDA will work with the Electric Utilities to jointly file a Statewide Heat Pump Program Annual Report by April 1, 2021 and annually thereafter.
Realization Rate (RR)	No RR has been determined for this initiative within the preceding five-year time frame
Planned VGS Approach	NYSERDA will collaborate with DPS staff and utilities on the statewide evaluation, measurement and verification (EM&V) study of heat pumps. This EM&V study is to be conducted by June 1, 2022 to ensure energy savings are appropriately captured. NYSERDA will collaborate with the utilities to evaluate the energy savings resulting from heat pumps across all sectors and subsectors. For the LMI sector, NYSERDA will also employ M&V that activities which may include, but are not limited to, billing analysis and site data collection, metering and monitoring of installations to validate efficacy of the installed measures. LMI evaluation efforts will be coordinated and included within the corresponding market rate efforts and statewide measurement activities. For Clean Thermal District Systems, while direct impacts are not estimated, an independent evaluation contractor will be procured by NYSERDA to perform the M&V and analyses. The M&V will be conducted according to the International Performance Measurement & Verification Protocol (IPMVP) method(s) most appropriate. These M&V activities will commence as the sites are determined and may include monitoring sites to assess performance.
Exemption from EAM Status	N/A

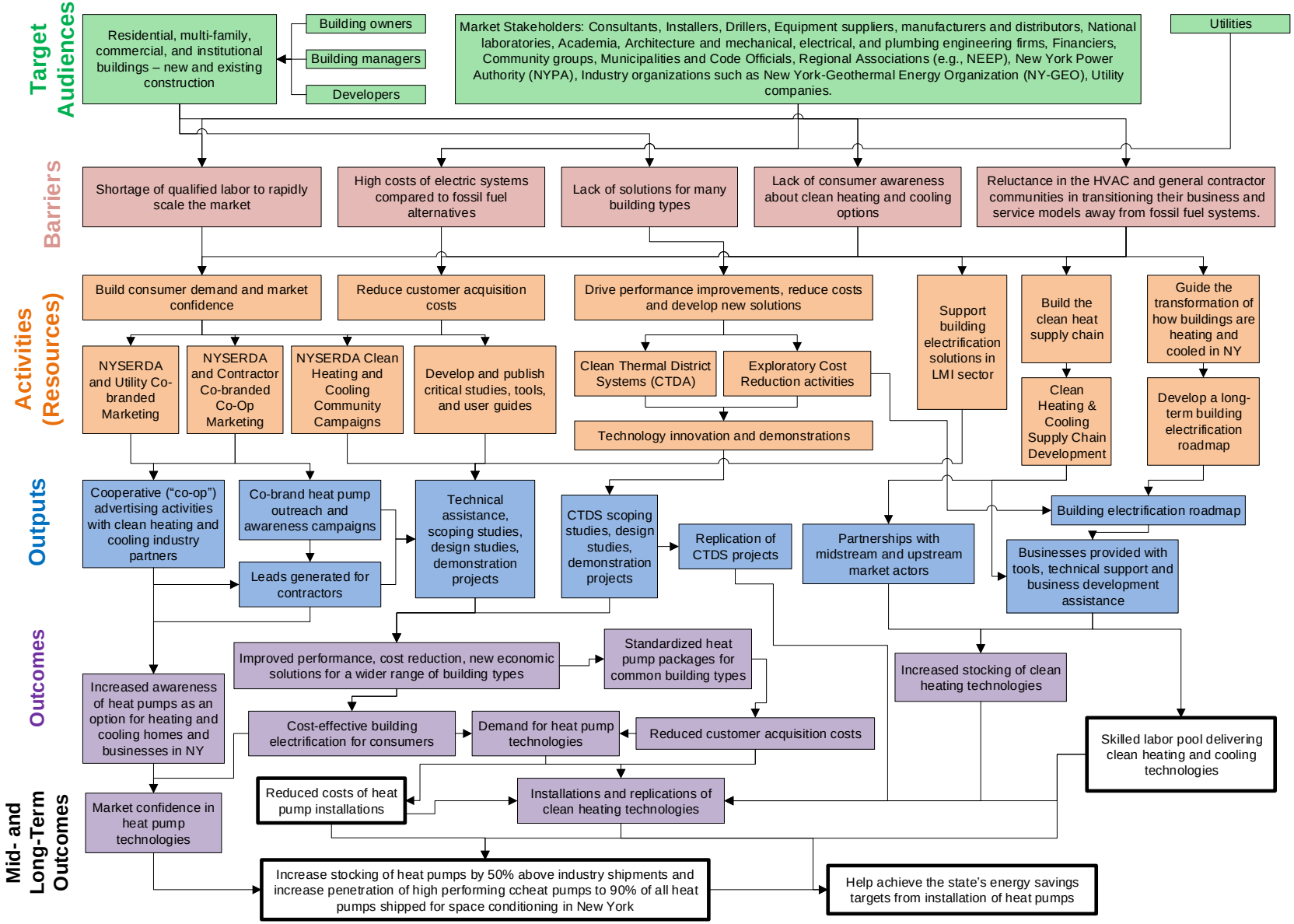
Verified Gross Savings Specification	
Date of CEF filing: *see cover page*	
CEF Chapter Name	Clean Heating and Cooling (formerly Renewable Heating and Cooling)
Initiative Name	Renewable Heat NY – Clean and Efficient Biomass Heating (2014)
Initiative Description	Through Renewable Heat NY – Clean and Efficient Biomass Heating, New York is pursuing a multi-pronged market support strategy to promote development in a manner that will enable individuals who choose to heat their building with biomass and support best available, high efficiency, low emissions biomass installations.
Gross Savings Methodology	Performance data will be collected, and programmatic measurement and verification activities will include post installation inspection on each biomass boiler project and a percentage of pellet stove projects and verification of compliance with Renewable Heat New York program rules.
Realization Rate (RR)	No realization rates have been determined for this initiative within the preceding five-year time frame.
Planned Verified Gross Savings Approach	Planned impact evaluation will include an assessment of system operation and performance. This assessment will be conducted after at least one heating season for a sample of projects and will leverage data collected through the initiative. Impact evaluation will apply the IPMVP methods most appropriate for the type of projects and expected level of energy impact and may involve engineering analysis, billing analysis, site visits and metering. An Independent evaluation contractor will be procured by NYSERDA to perform the M&V and analyses. The M&V will be conducted according to the International Performance Measurement & Verification Protocol (IPMVP) method(s) most appropriate. This evaluation is planned for Q4 2020.
Exemption from EAM Status	N/A

Appendix A – Logic Models

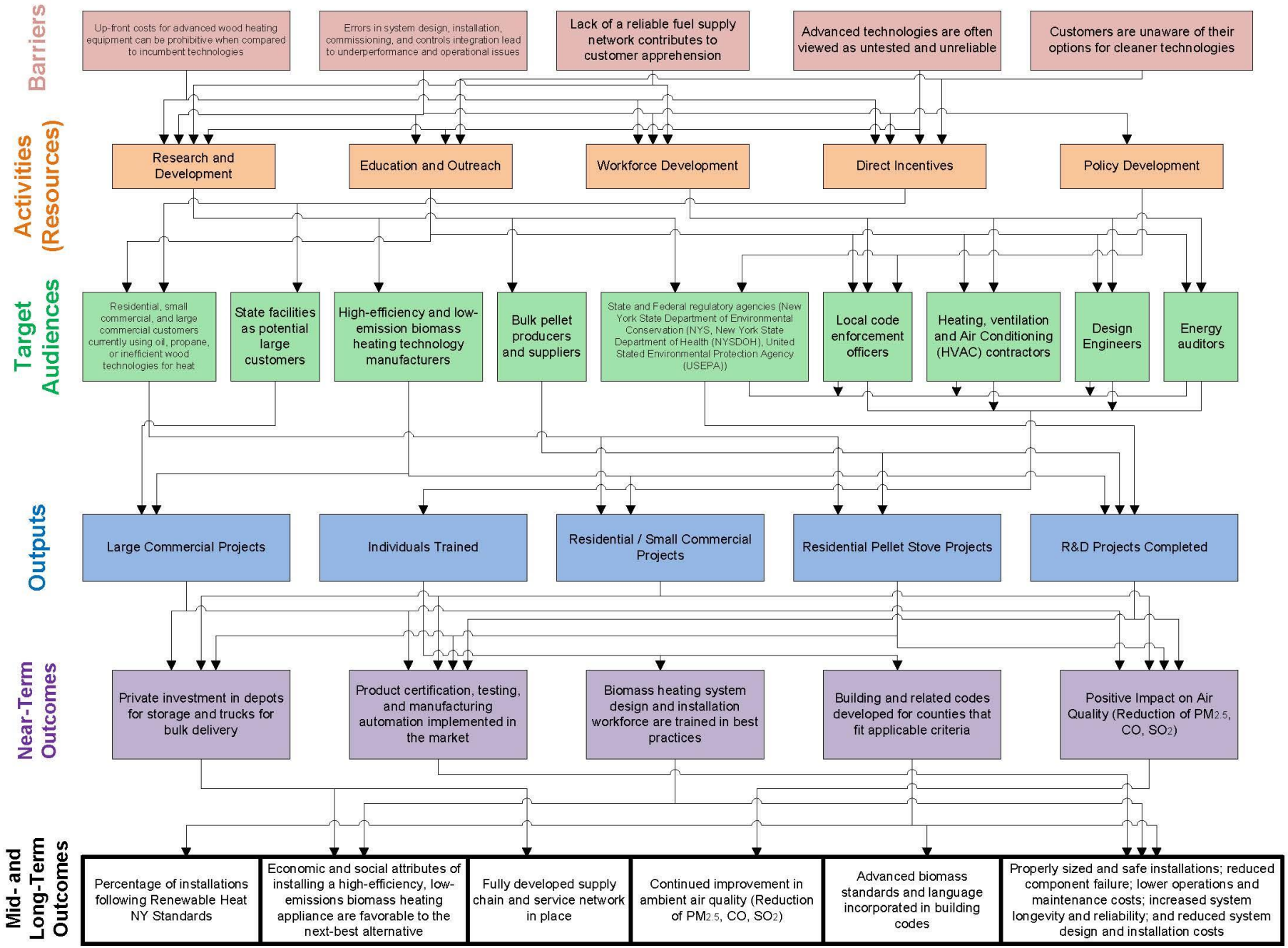
LOGIC MODEL: Heat Pumps Phase 1 (2017)



LOGIC MODEL: Heat Pumps Phase 2 (2020)



LOGIC MODEL: Renewable Heat New York



Appendix B | Initiative Budget and Benefits Summary

Heat Pumps Phase 1 (2017)

	Actuals	Actuals	Actuals	Actuals	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	
Direct Benefit	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Energy Efficiency MWh Annual	-	404	1,283	1,081	553	-	-	-	-	-	-	-	-	-	-	3,321
Energy Efficiency MWh Lifetime	-	10,107	32,073	26,967	13,825	-	-	-	-	-	-	-	-	-	-	82,972
Energy Efficiency MMBtu Annual	-	365,069	338,739	527,858	468,094	114,000	-	-	-	-	-	-	-	-	-	1,813,760
Energy Efficiency MMBtu Lifetime	-	8,287,024	6,035,150	8,985,834	11,472,710	2,850,000	-	-	-	-	-	-	-	-	-	37,630,718
Energy Efficiency MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	14,172	13,742	21,521	15,321	4,415	-	-	-	-	-	-	-	-	-	69,171
CO2e Emission Reduction (metric tons) Lifetime	-	320,155	244,398	366,657	373,698	110,371	-	-	-	-	-	-	-	-	-	1,415,279
Participant Bill Savings Annual	-	2,575,517	4,098,283	6,746,398	2,137,908	652,840	-	-	-	-	-	-	-	-	-	16,210,947
Participant Bill Savings Lifetime	-	53,997,548	70,898,743	113,496,251	49,982,297	16,321,000	-	-	-	-	-	-	-	-	-	304,695,839
Leveraged Funds	-	69,556,731	48,141,969	80,158,850	68,779,767	50,000,000	-	-	-	-	-	-	-	-	-	316,637,317

Indirect Benefit	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Energy Efficiency MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MMBtu Annual	-	-	-	-	51,900	-	-	-	-	307,100	-	-	-	-	28,000	387,000
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	-	-	-	2,561	-	-	-	-	9,810	-	-	-	-	382	12,754
CO2e Emission Reduction (metric tons) Lifetime	-	-	-	-	64,037	-	-	-	-	245,257	-	-	-	-	9,546	318,840

Energy Usage	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Direct Energy Usage MWh Annual	-	(17,591)	(21,419)	(33,636)	(26,152)	(4,706)	-	-	-	-	-	-	-	-	-	(103,504)
Direct Energy Usage MWh Lifetime	-	(383,977)	(374,294)	(561,445)	(638,530)	(117,650)	-	-	-	-	-	-	-	-	-	(2,075,897)
Direct Energy Usage MMBtu Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Direct Energy Usage MMBtu Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Energy Usage MWh Annual	-	-	-	-	(1,040)	-	-	-	-	(16,840)	-	-	-	-	(2,560)	(20,440)
Indirect Energy Usage MWh Lifetime	-	-	-	-	(26,000)	-	-	-	-	(421,000)	-	-	-	-	(64,000)	(511,000)
Indirect Energy Usage MMBtu Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indirect Energy Usage MMBtu Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Participants	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Participants	-	1,298	3,345	6,324	796	19	-	-	-	-	-	-	-	-	-	11,782
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**-**	**1,298**	**3,345**	**6,324**	**796**	**19**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**11,782**

Budget	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Direct Incentives and Services	-	5,369,391	11,152,631	15,940,418	9,578,162	2,123,250	-	-	-	-	-	-	-	-	-	44,163,852
Implementation Support	-	1,864,982	2,711,652	3,491,464	3,324,508	2,082,500	-	-	-	-	-	-	-	-	-	13,475,107
Research and Technology Studies	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tools, Training and Replication	-	131,149	2,436,927	4,008,271	725,000	407,950	-	-	-	-	-	-	-	-	-	7,709,298
Business Support	-	70,300	(1,820)	309,948	50,000	-	-	-	-	-	-	-	-	-	-	428,428
Total	**-**	**7,435,822**	**16,299,391**	**23,750,101**	**13,677,670**	**4,613,701**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**65,776,685**

Table Notes:

a. Impacts are expressed on a commitment-year basis, and are incremental additions in each year. Assumes a 25-year measure life. Participant Bill Savings are calculated as direct energy bill savings realized by customers participating in NYSERDA's programs.

b. Energy Efficiency values represent MMBTU savings from use of clean heating and cooling technologies; electricity required to utilize the technology is netted out of the emission reduction values shown in this table. Emission reductions are net, including both MMBTU savings which add to the emission benefits and additional electricity required to implement the technology, which was subtracted from the benefits.

c. Participants are defined as projects: large commercial/institutional facility and campus installations completed, projects completed by community campaign participants and projects completed through the GSHP incentive program. For ASHPs participants include the number of customers receiving the benefit of midstream incentives (units rebated divided by the average

d. In 2020 the Air Source Heat Pump sub-initiative of the Underutilized Product Support initiative was relocated (combined) with this Phase 1 set of sub-initiatives to that all heat pump related activity would be grouped and reported together despite their original filings being separate.

Appendix B | Initiative Budget and Benefits Summary

Heat Pumps Phase 2 (2020)

	Actuals	Actuals	Actuals	Actuals	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	
Direct Benefit	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Indirect Benefit	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Energy Efficiency MWh Annual	-	-	-	-	-	1,180	2,360	4,130	5,310	7,670	-	-	-	-	-	20,650
Energy Efficiency MMBtu Annual	-	-	-	-	-	72,000	144,000	252,000	324,000	468,000	-	-	-	-	-	1,260,000
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	-	-	-	-	5,910	11,821	20,687	26,597	38,418	-	-	-	-	-	103,433
CO2e Emission Reduction (metric tons) Lifetime	-	-	-	-	-	147,762	295,523	517,166	664,928	960,451	-	-	-	-	-	2,585,831

Energy Usage	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
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	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Budget	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Direct Incentives and Services	-	-	-	-	8,100,000	15,410,000	10,190,000	3,500,000	4,200,000	2,700,000	-	-	-	-	-	44,100,000
Implementation Support	-	-	37,545	129,925	4,421,000	5,143,530	4,920,000	6,326,667	6,071,667	5,481,666	-	-	-	-	-	32,532,000
Research and Technology Studies	-	-	-	-	600,000	550,000	450,000	450,000	100,000	50,000	-	-	-	-	-	2,200,000
Tools, Training and Replication	-	-	-	-	2,655,000	4,275,000	3,626,000	3,718,500	2,518,500	1,575,000	-	-	-	-	-	18,368,000
Business Support	-	-	-	-	125,000	250,000	250,000	250,000	125,000	-	-	-	-	-	-	1,000,000
Total	**-**	**-**	**37,545**	**129,925**	**15,901,000**	**25,628,530**	**19,436,000**	**14,245,167**	**13,015,167**	**9,806,666**	**-**	**-**	**-**	**-**	**-**	**98,200,000**

Table Notes:

a. The electrification market development plan components described in the March 16, 2020 filing show NYSERDA and the Utilities are collaborating toward a shared goal for direct benefits resulting from heat pump installations statewide. Both have made financial & programmatic commitments to support delivery of these savings which, excluding LIPA, are defined as a target of 3.6TBtu. NYSERDA is not claiming any of these direct benefits in their plans or their reporting, although will closely monitor.

b. Indirect market effects are expected to accrue over the longer term as a result of NYSERDA's electrification market development investment and follow-on market activity. This table includes an estimate of these anticipated indirect effects.

Appendix B | Initiative Budget and Benefits Summary

Renewable Heat NY - Clean and Efficient Biomass Heating

	Actuals	Actuals	Actuals	Actuals	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	Plan	
Direct Benefit	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Energy Efficiency MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MMBtu Annual	-	5,332	13,979	20,437	24,876	5,553	-	-	-	-	-	-	-	-	-	70,176
Energy Efficiency MMBtu Lifetime	-	106,633	279,571	408,733	497,520	111,060	-	-	-	-	-	-	-	-	-	1,403,517
Energy Efficiency MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MWh Lifetime	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	415	629	603	1,838	410	-	-	-	-	-	-	-	-	-	3,896
CO2e Emission Reduction (metric tons) Lifetime	-	8,299	12,583	12,056	36,762	8,206	-	-	-	-	-	-	-	-	-	77,906
Participant Bill Savings Annual	-	142,875	249,553	276,527	636,577	142,101	-	-	-	-	-	-	-	-	-	1,447,633
Participant Bill Savings Lifetime	-	2,857,508	4,991,061	5,530,539	12,731,537	2,842,025	-	-	-	-	-	-	-	-	-	28,952,671
Leveraged Funds	-	754,503	2,547,360	3,920,126	4,428,400	1,032,100	-	-	-	-	-	-	-	-	-	12,682,490

Indirect Benefit	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Energy Efficiency MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy Efficiency MMBtu Annual	-	-	-	-	-	-	-	-	-	6,510	-	-	-	-	16,990	23,500
Renewable Energy MWh Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Renewable Energy MW Annual	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual	-	-	-	-	-	-	-	-	-	481	-	-	-	-	1,255	1,736
CO2e Emission Reduction (metric tons) Lifetime	-	-	-	-	-	-	-	-	-	9,621	-	-	-	-	25,108	34,728

Energy Usage	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
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	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Participants	-	174	782	1,366	1,423	355	-	-	-	-	-	-	-	-	-	4,100
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**-**	**174**	**782**	**1,366**	**1,423**	**355**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**4,100**

Budget	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**Total**
Direct Incentives and Services	-	862,076	2,372,404	3,028,421	3,626,000	961,200	-	-	-	-	-	-	-	-	-	10,850,101
Implementation Support	-	40,807	233,032	428,240	541,111	287,557	-	-	-	-	-	-	-	-	-	1,530,747
Research and Technology Studies	-	192,894	556,250	296,850	-	-	-	-	-	-	-	-	-	-	-	1,045,994
Tools, Training and Replication	-	-	-	60,158	-	-	-	-	-	-	-	-	-	-	-	60,158
Business Support	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	**-**	**1,095,777**	**3,161,686**	**3,813,669**	**4,167,111**	**1,248,757**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**13,487,000**

Table Notes:

a. Impacts are expressed on a commitment-year basis, and are incremental additions in each year. Assumes a 25-year measure life.

b. Participant Bill Savings are calculated as direct energy bill savings realized by customers participating in NYSERDA's programs.

c. Energy Efficiency values represent MMBTU savings from use of clean heating and cooling technologies; electricity required to utilize this technology is netted out of the emission reduction values shown in this table. Emission reductions are net, including both MMBTU savings which add to the emission benefits and additional electricity required to implement the technology, which was subtracted from the benefits.

Appendix C | Initiative Outputs and Outcomes Summary

Heat Pumps Phase 1 (2017)

	Indicators	Baseline (Before/Current)	**2019** (cumulative) Target	**2020** (cumulative) Target	**2022** (cumulative) Target
Outputs	# of community campaigns	1	8		72
	# of community campaign enrollees	200	800		2,900
	# of program-qualified GSHP consultants and designers	0	10		15
	# of installers and drillers qualified by community campaigns and GSHP incentive program	0	40		50
	# of large commercial/institutional facility and campus screening studies completed	0	30		75
	# of large commercial/institutional facility and campus schematic designs completed	0	30		72
	# of large commercial/institutional facility and campus installations completed	0	7		36
	# of projects completed by community campaign participants	90	240		3660
	# of completed projects through the GSHP incentive program	0	1000		1100
	# of case studies demonstrating successful cost reduction strategies and/or customer value	0	5		20
	Vendors trained (ASHP)	0		400	
	Upstream ASHP Incentives offered on individual units	0		11,433	
	Count of completed ASHP control pilot projects related to managing dual systems	0		2	
	Number of technical requirements and protocols finalized	0		20	
	Number of cost/benefit studies completed	0		30	
	Number of compliance and enforcement processes established	0		1	
Outcomes	Increased awareness of RH&C technologies in communities with campaigns	0%	10%		20%
	Cost ($ per ton) in installed systems in community campaigns and for college and university campuses is reduced	0%	10% decrease		20% decrease
	# of communities continuing campaigns without NYSERDA direct financial support	0	0		8
	# of International Ground Source Heat Pump Association (IGSHP) - certified designers, installers and drillers active in NYS	82	100		110
	ASHPs sold annually	32,000		53,000	
	ASHPs as percentage of installed residential HVAC base	7%		15%	
	Average decrease in first cost	0%		15%	
	Vendor use of NYSERDA co-op assistance in promoting ASHPs	0		25	

Table notes

a. A 0 (zero) denotes that the actual value is currently believed to be zero for baseline/market metrics.

b. In 2020 the Air Source Heat Pump sub-initiative of the Underutilized Product Support initiative was relocated (combined) with this Phase 1 set of sub-initiatives to that all heat pump related activity would be grouped and reported together despite their original filings being separate.

Heat Pumps Phase 2 (2020)

	Indicators	Baseline (Before/Current)	2020 (cumulative) Target	2021 (cumulative) Target	2022 (cumulative) Target	2023 (cumulative) Target	2024 (cumulative) Target	2025 (cumulative) Target
Outputs	Number of leads generated for contractors	1	30,000	140,000	250,000	430,000	680,000	1,000,000
	Customer acquisition costs offset, in dollars	0	185,000	600,000	1,000,000	1,600,000	2,250,000	3,000,000
	Coop advertising campaign costs offset, in dollars	0	600,000	3,150,000	5,850,000	8,250,000	9,500,000	
	Number of Clean Thermal District System projects supported by NYSERDA	0				2		
	Businesses provided with tools, technical support and business development assistance	TBD		50	75	125	150	200
	Number of LMI households with heat pump installations (demonstrations and direct installations)	TBD	2,300	5,650	7,500			
	Number of energy-efficient electrified space and water heating technologies installed through NYS Clean Heat	0	3,900	18,200	32,500	55,900	88,400	130,000
Outcomes	Increase in awareness of CH&C technologies*	TBD			15%			50%
	Replication of Clean Thermal District System projects beyond NYSERDA supported projects	0					1	2
	Reduce the cost of heat pump installations in New York*	0%			10%			25%
	Increase stocking of heat pumps above HARDI 2019 shipments*	0%			20%			50%
	Increase penetration of high-performance cold climate heat pumps as a percent of all heat pumps shipped for space conditioning in New York (baseline 2018 HARDI ASHP data)*	61%			70%			90%

Table notes

* This investment plan includes broader market progress metrics, for example overall heat pump market size and market penetration of cold climate heat pumps. These market progress metrics will be supported collectively by all of NYSERDA's market development activities that extend beyond this singular investment plan. NYSERDA will measure market progress broadly, rather than for each specific investment plan. Progress will be reported collectively within the Statewide Heat Pump Program Annual Report, filed in April each year.

Renewable Heat NY - Clean and Efficient Biomass Heating

	Indicators	**Baseline** (Before/Current)	**2021** Target (cumulative)
Outputs	Large commercial Projects (>88 kW)	4	9
	Residential / Small Commercial Projects (<88 kW)	23	170
	Residential Pellet Stove Projects	89	1450
	Workforce Development – Training (Individuals Trained)	279	400
	Supply Chain Support – R&D (Projects Completed)	0	20
Outcomes	Reduction in PM2.5 from funded systems	15.8 tons/yr	140.5 tons/yr
	Reduction in CO from funded systems	114.8 tons/yr	981.8 tons/yr
	Reduction in SO2 from funded systems	0.087 tons/yr	0.7 tons/yr

Table notes

a. A 0 (zero) denotes that the actual value is currently believed to be zero for baseline/market metrics.

b. Baseline value for reductions in PM2.5, CO, and SO2 reflect reductions achieved through Renewable Heat NY at the time of initial filing. 2021 cumulative value reflects reductions based on targeted program activity.