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Investment Plan

Clean Energy Fund Investment Plan: Renewable Heating & Cooling Chapter

Portfolio: Market Development

Submitted by:

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19 Renewable Heating and Cooling

Renewable heating and cooling (RH&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. Other benefits, including the value RH&C technologies can offer to the electricity grid, are not yet fully accessible to RH&C customers.

Today, RH&C technologies occupy a niche position in the State's heating and cooling market. Barriers exist, including cost-effectiveness challenges, inadequate access to low-cost investment capital, limited customer awareness of and confidence in RH&C technologies, and a range of supply chain barriers, all of which currently stand in the way of widespread market adoption and growth. As a result, RH&C is often not competitive with conventional heating and cooling technologies in today's marketplace.

In February 2017, NYSERDA published a RH&C Policy Framework that considers a set of policies to support the growth of the RH&C market in New York State. The Policy Framework is structured around consideration of three major pillars: (i) reducing technology costs and lowering supply chain, customer awareness and finance barriers; (ii) mandates that could drive demand for RH&C in new construction and major renovations; and (iii) incentives that improve project cost effectiveness. The Framework noted that cost reductions, plus potentially monetization of value (e.g. value of carbon and grid value) will likely be needed to create conditions for a mass RH&C market. This investment plan presents priority interventions that will unlock RH&C potential and build market momentum and infrastructure, drawing on analysis and input received from stakeholders and market participants in the development of the Policy Framework.

The initial initiatives described in this chapter address several of the barriers described above including RH&C project economics, lack of awareness of the advantages and disadvantages of RH&C technologies, uncertainty regarding savings and technical performance, and lack of technical expertise to evaluate feasibility and execute projects. The first initiative includes activities to reduce soft costs for Ground Source Heat Pumps (GSHP), Air Source Heat Pumps (ASHP), Solar Thermal (ST) and biomass 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 ST; and provide incentives to off-set the cost of GSHP systems. The second initiative continues the Renewable Heat NY activities, including incentives, research and development, policy development, workforce development, and education and outreach) for biomass.

The initiatives in this Chapter are closely related to and coordinated with an initiative in the Products chapter that addresses ASHP. The initiative in this chapter focuses on awareness generation and cost reduction through community campaigns. The Products initiative will focus on upstream tools, resources and incentives to support growth in ASHP product sales through manufacturers and distributors.

Further RH&C initiative under development will consider the impact of relevant policy deliberations under the Clean Energy Standard, and the design and reform of rate structures for beneficial electrification, both of which have the potential to improve the customer economics of RH&C solutions.

19.1 Heat Pumps and Solar Thermal

19.1.1 Overview

Present Situation	• Thermal energy used in the residential and commercial sectors for space heating, hot water, and cooling accounts for 37% of net energy consumption and 32% of all combustion-based GHG emissions in the state. • Today, RH&C technologies occupy a niche position in New York State’s heating and cooling market, penetrating less than 1% of the market. Only a small fraction (around 4%) of statewide heating, ventilation, and air conditioning (HVAC) load can be met by RH&C technology cost effectively today, despite a large technical potential with significant opportunity to realize customer and societal benefits. • Various RH&C technologies suffer from common barriers, including high upfront costs and low fossil fuel prices, inadequate access to low-cost investment capital, and limited customer awareness of and confidence in RH&C technologies. In addition, a range of supply chain barriers to growth exist, including a lack of capacity to manufacture, distribute, design, install, and service reliable, high-quality, and standardized RH&C systems. • In addition to these common barriers, GSHP and ST face additional impediments. GSHP and ST installation typically require specialist contractors. Additionally, due, in part, to installation complexity, lack of a competitive market for installations, and unfamiliarity of customers with system performance history, GSHP systems are high cost and have low market penetration to date. Large GSHP and ST projects are highly complex, face higher technical risk and, as a result, face higher pre-development costs. • Due to the similarity in installation process and shared equipment components between ASHP and conventional air conditioning, many traditional HVAC contractors install and maintain ASHP systems. Also, ASHP are the most-cost effective RH&C technology due to low installation cost and economies of scale derived from their widespread use in Asia and Europe. However, although much progress has been made, ASHP market progress is still impeded by the barriers described in this investment plan, particularly related to customer awareness and supply chain barriers.
Intervention Strategy	This first phase of Renewable Heating and Cooling initiatives under the CEF will advance timely interventions focusing on reducing soft costs. This initiative will: • Target general soft cost reduction strategies for all RH&C technologies: ○ Improve access to reliable information ○ Support the development of a customer targeting tool to identify high potential sites ○ Support local clustering of installations through community campaigns ○ Develop standardized contracts, data protocols and requirements, and quality assurance processes where appropriate based on prioritization • For GSHP and ST, this initiative will provide targeted cost-shared technical assistance for larger projects to address the higher pre-development costs. • GSHPs are the most efficient RH&C technology and present a near-term opportunity for increased focus to help increase the customer awareness and acceptance of RH&C

	technologies more generally. Therefore, this initiative will provide incentives to offset the cost of installation of GSHP systems. • For a visual representation of this strategy, please reference the flow chart entitled “Logic Model: Heat Pumps and Solar Thermal,” which can be found in Appendix A.
Goals	• Achieve project cost reductions of 10% to 20% for enrollees in community campaigns and for college and university campuses benefiting from aggregated procurement. • Increase scale of deployment 10% to 20% in communities that run campaigns. • Increase customer awareness of the benefits of RH&C systems and reduce customer acquisition costs and time.
State Energy Plan/Clean Energy Standard Link	This initiative will contribute to the achievement of New York State’s greenhouse gas (GHG) emissions reduction goals identified in the 2015 New York State Energy Plan — targeting 40% reduction of GHG emissions by 2030, and 80% by 2050.¹ This initiative directly begins to address the 32% of GHG emissions produced by direct thermal use. The Energy Plan calls on NYSEDA to help “make renewable energy solutions more competitive in the energy market” and specific to RH&C technologies, to support development of market infrastructure, which could include project-specific support, training and technical support for service providers, and tools and resources to drive consumer demand.

19.1.2 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 market, NYSEDA is not limiting the offering to any particular market segment, and in doing so intends to allow the strongest value proposition use case(s) to emerge.
Market Participants	Market participants include: • Consultants • Designers • Installers • Drillers • Building Owners and Managers • Equipment suppliers • National labs • Academic institutions • Architectural and mechanical, electrical, and plumbing engineering firms • Financiers • Community groups • Municipalities • Regional associations such as Renewable Thermal Alliance (RTA) and the Northeast Energy Efficiency Partnerships (NEEP) • New York Power Authority (NYPA) • Industry Organizations such as New York-Geothermal Energy Organization (NY-GEO), Solar Energy Industries Association (SEIA) • Utilities

¹ 2015 New York State Energy Plan: *The Energy to Lead*. Albany: New York State Energy Planning Board
<https://energyplan.ny.gov/-/media/nysenergyplan/2015-state-energy-plan.pdf>

Market Readiness	• Communities are ready and interested in leveraging infrastructure from Solarize² and other clean energy campaigns to encourage RH&C. • Customers that are engaged in Solarize campaigns represent a receptive audience motivated to value the benefits RH&C provide. However, awareness and understanding of RH&C systems and the benefits they offer is low. • There are RH&C installers in NYS with varying degrees of certification but not necessarily enough within all geographic areas and not enough to serve a scaled market. A number of installers are seeking and evaluating new business models, and are interested in training and tools support growth of their workforce. • Many customers, in particular colleges and universities and local governments, have adopted aggressive GHG reduction goals toward which RH&C technologies could make a substantial contribution. • Some of New York’s investor owned utilities have expressed interest in further exploring and supporting RH&C market development through incentive programs, in conjunction with energy efficiency programs and possibly through loop field³ ownership.
Customer Value	• End user annual energy bill savings and reduced customer exposure to fossil fuel price volatility. • Improved end user comfort and health, particularly for vulnerable populations, such as the elderly and low-to-moderate income (LMI) residents, via more economical options for building cooling. • Increase site usability through expanded cooling in facilities, such as schools and churches, which will allow for more services to the public. • Improved resiliency with the potential to continue delivering thermal energy generated by distributed electricity resources during disruptions to critical infrastructure. • Increase access to objective and reliable information which will stimulate customer confidence and market growth, while reducing customer acquisition costs for developers. • Broadly, deployment of RH&C technologies will improve fuel diversity across the thermal energy mix, increase the choices available to customers, and reduce dependence on fossil fuel delivery infrastructure and direct consumer exposure to national and global fossil fuel price volatility. Additionally, ground source heat pumps provide higher efficiency cooling than many conventional AC systems, contributing to peak load reductions and associated electricity cost savings passed on to ratepayers. The increased off-peak electricity sales from broader heat pump deployment will also enable fixed utility costs to be spread over a greater volume of sales, contributing to additional electricity cost savings for all ratepayers.

² 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.

³ The “loop field” is the heat exchanger that is buried in the ground or submerged in water that enables the exchange of thermal energy between the building and the ground and/or water.

19.1.3 Stakeholder/Market Engagement

Stakeholder/ Market Engagement	Engagement to date: • 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 RH&C costs and cost reduction strategies. • GSHP stakeholders have been convened to provide input on design of incentive program. • NYSERDA has 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 have 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 RH&C Framework. Input is reflected in the interventions proposed here. Future engagement: • NYSERDA will continue to engage the Cost and Cost Reductions Advisory Committee. • NYSERDA will form a working group of communities with active RH&C campaigns to facilitate peer exchange and ensure best practices are proliferated. • NYSERDA will continue to engage with companies and real estate developers looking to explore innovative business models (e.g., GSHP loop field ownership models, district systems)
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19.1.4 Theory of Change

Market Barriers Addressed	• Systems have high upfront costs and low returns. In the commercial sector, many building owners require a quick payback, and RH&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 will reduce soft costs to address this barrier. • Lack of awareness of the advantages and disadvantages of RH&C technologies. Contractors prefer selling conventional technologies because new technologies like RH&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 will help address this barrier. • Uncertainty regarding energy and operational and maintenance savings and technical performance. Customers and contractors may perceive larger risks associated with RH&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 will help address this barrier.
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	• For technologies other than ccASHP, 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 RH&C systems is a significant barrier to market scale. Conventional HVAC designers and installers often lack experience and training in evaluation and execution of RH&C projects. This difficulty is amplified in sectors where sales staff must both sell their specific product and educate customers about RH&C opportunities more broadly. Customer targeting/engagement tools, installation clustering through community campaigns and de-risking project development in target market segments will help address these barriers.
Testable Hypotheses	• If NYSERDA improves access to reliable information on RH&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.
Activities	NYSERDA will invest to reduce costs through information, standardization and innovation, and will provide direct financial support to community campaigns and installations. • Invest to reduce costs ○ Develop and distribute materials such as performance estimations, building suitability guidelines, and tips for dealing with contractors to potential customers to increase awareness and confidence. ○ Support innovative RH&C business models and successful soft-cost reduction strategies through competitive solicitations and disseminate results to spur replication. ○ 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. ▪ Develop a regional measurement and verification (M&V) protocol for RH&C technology. ○ Investigate the feasibility of implementing a regional contractor and project certification system. Aggregate available data on building energy use and characteristics and share with the market. • Support aggregation of installations through community campaigns ○ Provide direct financial support and access to technical experts to communities to launch 3 to 5 year campaigns that will select qualified installers and negotiate a reduced price for campaign enrollees. Assist communities in dealings with installers. ○ Pilot strategies to increase participation of LMI residents and assess effectiveness⁴. ○ Annually, compile best practices, and share between communities.

⁴ Based on potential for savings, impact on affordability and proposed approach.

	• Support campus installations ○ To lower the cost of development and construction, NYSERDA and NYPA will identify clusters of cost-effective RH&C installations on college campuses and at state and local buildings and seek aggregated development and construction bids. ○ Provide 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 ○ Leverage existing industry standards to develop and refine specifications for how to evaluate, design and measure the performance of RH&C systems. • Provide incentives to offset the cost of installation of GSHP systems ○ Launch short-term open-enrollment incentive program for the deployment of GSHP. The program is expected to be available for 2 years and have a budget of \$15 Million. ○ Qualify GSHP service providers and provide an indication of performance to the market to streamline contractor selection. Support training and mentoring where needed, working with industry associations to develop and grow a base of qualified service providers. ○ Perform or facilitate design and installation reviews to ensure high quality installations and conformance with industry standards.
Key Milestones	<u>Milestone 1 (2017)</u> • Solicit for and contract with technical support contractor for community campaigns. <u>Milestone 2 (2017)</u> • Launch GSHP contractor mentoring program. <u>Milestone 3 (2017)</u> • Release competitive solicitation to select community campaigns (repeat annually). <u>Milestone 4 (2017)</u> • Release open enrollment solicitation for GSHP incentive. <u>Milestone 5 (2017)</u> • Provide list of qualified GSHP designers, installers and drillers to market. <u>Milestone 6 (2017)</u> • Contract with consultants to perform QA and design review for GSHP incentive projects. <u>Milestone 7 (2018)</u> • Provide marketing toolkit and installer selection model solicitations to pilot community campaigns. <u>Milestone 8 (2018)</u> • Launch community campaigns (repeat annually). <u>Milestone 9 (2018)</u> • Contract with consultants to perform screening assessments and schematic designs for college and university campuses and state and local buildings. <u>Milestone 10 (2018)</u> • Provide standardized contracts and best practices manual to market.

	<u>Milestone 11 (2018)</u> - Complete assessment of M&V methodologies for system performance and share with market participants. <u>Milestone 12 (2019)</u> - Disseminate RH&C case studies and design and installation best practices to the market. <u>Milestone 13 (2019)</u> - Develop aggregated procurement for colleges and universities and state and local buildings. <u>Milestone 14 (2024)</u> - Complete commissioning and M&V on large commercial, campuses and state and local building projects.
Goals Prior to Exit	Cost-effective investment opportunities in RH&C would need to increase by an order of magnitude for RH&C to move from its current niche position to a mainstream market. The activities in this initiative are intended to reduce costs by 10%-20% in communities with campaigns in five years, making progress towards the preconditions for a sustainable market. NYSERDA will evaluate market conditions to determine what subsequent activities are needed to continue to move RH&C towards a sustainable market. Additional costs reductions (potentially from indirect benefits of increased market scale) combined with monetization of grid value⁵ and potentially carbon value would likely be needed to create a sustainable mass market industry over the next decade. To exit the initial activities proposed here, the following goals would need to be achieved: - RH&C technology projects are built at 5-10 college and university campuses across New York. - RH&C technology projects are built at 5-10 state buildings across New York. - RH&C campaigns are completed in communities in every region of NY and are incorporated into the Clean Energy Communities program if determined to be high impact actions. - Customer acquisition time and costs in communities with campaigns are decreased by 10 to 20%. - Base of qualified consultants, designers and installers is increased by 10% from 2016 levels by 2022.

19.1.5 Relationship to Utility/REV

Utility Role/Coordination Points	Heat pumps present an opportunity for beneficial electric load that is valuable to utilities, consistent with New York's Reforming the Energy Vision (REV's) goal of improving load factor and also reduces emissions. NYSERDA will coordinate its activities with the utilities in RH&C market development, particularly where the utilities offer rebates for systems, to ensure complementary rather than competing programs.
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⁵ <https://www.nyserdera.ny.gov/-/media/Files/Publications/PPSER/NYSERDA/RHC-Framework.pdf>. NYSERDA estimates that the average grid value from heat pumps replacing fossil fuel is in the range of \$200/installed ton per year of installed capacity. Monetization of some portion of this value could substantially increase the economic potential of these RH&C resources.

	The GSHP program will be a companion incentive to the PSEG-LI GSHP rebate on Long Island and will accordingly be available in other parts of the State. NYSERDA will coordinate with PSEG on program offerings.
Utility Interventions in Target Market	- 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.

19.1.6 Budgets & Expenditures

An annual commitment budget for all activities included in this chapter is shown in Table 1. The annual expenditure projection is included in Table 2. Budgets and expenditures do not include Administration, Evaluation, or Cost Recovery Fee; these elements are addressed in the Budget Accounting and Benefits chapter filing. The budget as presented in the Budget Accounting and Benefits Chapter will serve as the basis for any subsequent reallocation request. The additional level of detail presented within the table below is intended for informational purposes only.

Table 1. Annual Market Development Budget Allocation – Commitment Basis

Commitment Budget	2017	2018	2019	2020	2021	Total
Direct Incentives and Services	\$4,926,675	\$8,560,000	\$7,960,000	\$2,225,000	\$1,625,000	\$25,296,675
Implementation Support	\$750,168	\$1,531,000	\$768,500	\$245,000	\$132,500	\$3,427,168
Tools, Training, and Replication	\$874,300	\$1,938,600	\$1,221,100	\$337,000	\$117,000	\$4,488,000
Total	\$6,551,143	\$12,029,600	\$9,949,600	\$2,807,000	\$1,874,500	\$33,211,843

Table 2. Annual Expenditures Projection

Expenditures	2017	2018	2019	2020	2021	2022	Total
Total	4%	15%	25%	26%	20%	10%	100%

19.1.7 Progress and Performance Metrics

Table 3 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.

Table 3. Initiative Specific Metrics

Indicators⁶		Baseline (Before/Current)	2019 (Cumulative)	2022 (Cumulative)
Activities/Outputs	# of active community campaigns	1	17	29
	# of community campaign enrollees	200	1,700	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	650	2,521
	# of completed projects through the GSHP incentive program	0	430	930
	# of case studies demonstrating successful cost reduction strategies and/or customer value	0	5	20
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

Benefits shown in Table 4 and Table 5 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. Due to the nature of the activities, estimating energy savings impacts at

⁶ A 0 (zero) denotes that the actual value is currently believed to be zero for baseline/market metrics.

this stage is difficult because the specific technologies that will be supported are not known. However, energy savings for projects supported by this initiative will be tracked and reported.

Table 4. Direct Impacts

Primary Metrics ⁷		2017	2018	2019	2020	2021	TOTAL
Energy Efficiency	MWh Annual	-	-	-	-	-	-
	MWh Lifetime	-	-	-	-	-	-
	MMBTU Annual	76,200	190,000	207,000	191,000	178,000	841,600
	MMBTU Lifetime	1,910,000	4,750,000	5,160,000	4,770,000	4,450,000	21,040,000
	MW	-	-	-	-	-	-
Renewable Energy	MWh Annual	-	-	-	-	-	-
	MWh Lifetime	-	-	-	-	-	-
	MW	-	-	-	-	-	-
CO ₂ e Emission Reduction (metric tons) Annual		3,390	8,680	8,850	7,320	6,570	34,810
CO ₂ e Emission Reduction (metric tons) Lifetime		84,800	217,000	221,000	183,000	164,000	870,300
Customer Bill Savings Annual (\$ million)		\$0.57	\$1.48	\$1.46	\$1.13	\$0.99	\$5.63
Customer Bill Savings Lifetime (\$ million)		\$14.30	\$37.0	\$36.5	\$28.3	\$24.8	\$140.8
Private Investment (\$ million)		\$4.56	\$15.7	\$27.8	\$30.2	\$44.7	\$122.9

Table 5. Annual Projected Initiative Participation

	2017	2018	2019	2020	2021	Total
Participants ⁸	155	892	828	804	809	3,487

Benefits shown in Table 6 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

⁷ Impacts are expressed on a commitment-year basis, and are incremental additions in each year. Assumes a 25-year measure life. Benefits are rounded to three significant figures. Totals may not sum due to rounding. Customer Bill Savings are calculated as direct energy bill savings realized by customers participating in NYSERDA's programs. Energy Efficiency values represent MMBTU savings from use of renewable heating and cooling technologies; electricity required to utilize the RH&C technology (28,462 MWh cumulative annual and 711,559 MWh lifetime in total) is netted out of the emission reduction values shown in this table. Emission reductions are net, including both MMBTU savings (1,244,602 tons) which add to the emission benefits and additional electricity required to implement the RH&C technology, which was subtracted from the benefits (374,330 tons).

⁸ Participants are defined as RH&C projects: large commercial/institutional facility and campus installations completed, projects completed by community campaign participants and projects completed through the GSHP incentive program.

market sectors. The values presented below are not discounted, however NYSERDA has applied a discount of 50% to the overall portfolio values in the Budget Accounting and Benefits chapter.

Table 6. Estimated Indirect Market Impact

Indirect Impact ⁹		2020	2025	2030
Energy Efficiency	MWh Cumulative Annual	-	-	-
	MMBTu Cumulative Annual	25,900	133,000	161,000
Renewable Energy	MWh Cumulative Annual	-	-	-
	MW	-	-	-
CO2e Emission Reduction (metric tons) Cumulative Annual		806	4,210	5,140

19.1.8 Fuel Neutrality

Fuel Neutrality	NYSERDA intends to advance this initiative in a fuel neutral manner. This will provide an opportunity to target more cost-effective applications (such as switching from fossil fuel to GSHP/ASHP) and will help develop a market of scale. Offering the initiative on a fuel neutral basis will allow NYSERDA to achieve savings at a cost of \$38 per ton of carbon, compared to a cost of \$121 per ton of carbon in an electric only scenario.
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19.1.9 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. <u>Test-Measure-Adjust Strategy</u> Each year, NYSERDA will undertake a reassessment of effectiveness and funding levels and will adjust the program as appropriate. Specifically: • NYSERDA will assess the level of enrollment in community campaigns and identify tactics to increase overall enrollment and enrollment from key demographics. • NYSERDA will assess the number of enrollees in community campaigns that acted in a campaign year and identify important trends and tactics for increasing conversion. • NYSERDA will partner with communities between campaigns to conduct focus groups of participants and installers to identify lessons learned, best practices and needed adjustments. • NYSERDA will work with the NYPA and the industry to assess the impact of technical assistance for large campuses and adjust approach as necessary to increase impact
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⁹ Energy Efficiency values represent MMBTU savings from use of renewable heating and cooling technologies; electricity required to utilize the RH&C technology (7.626 MWh cumulative in 2030) 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 (9,148 tons) and additional electricity required to implement the RH&C technology (4,012 tons), which was subtracted from the benefits.

	• NYSERDA will work with stakeholder groups such as NY GEO to regularly assess the participation and level of success of the GSHP incentive program and make necessary adjustments <u>Heat Pumps and Solar Thermal Strategy M&V</u> • Performance data will be 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. <u>Market Evaluation</u> 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 Renewable 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 <u>Impact Evaluation/Field Verification</u> Impact evaluation will leverage data collected by community campaigns, through technical assistance studies and the GSHP incentive program. The evaluation will involve field verification of a sample of projects, and focus on: • Renewable heating and cooling energy produced • Fossil fuel displaced
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19.2 Renewable Heat New York

19.2.1 Overview

Present Situation	• Thermal energy used in the residential and commercial sectors for space heating, hot water, and cooling accounts for 37% of net energy consumption and 32% of all combustion-based greenhouse gas (GHG) emissions in the state. • Wood is used as a primary heat source in approximately 140,000 households, as a supplemental heat source in 500,000 households, and is the largest producer of emissions of carbonaceous fine particulate matter (PM) in rural NYS counties.¹⁰ • There is a wide range of performance for wood heating technologies in use throughout the state. Many low to moderate income households rely on older, less efficient, and dirtier biomass heating appliances, and lack the capital necessary to upgrade to cleaner, more efficient technology.
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¹⁰ New York State Wood Heat Report: *An Energy, Environmental, and Market Assessment*. Albany: New York State Energy Research and Development Authority
<https://www.nyserra.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf>

	• In 2014 NYS launched the Renewable Heat NY initiative, a long-term commitment to supporting the high-efficiency and low-emission biomass heating industry. • Since its inception in 2014 Renewable Heat NY has provided support to the high-efficiency and low-emission biomass heating industry, resulting in annual savings of 6,680 gallons of fuel oil, 16 tons of PM emissions, 115 tons of carbon monoxide emissions, and 0.095 tons of sulfur dioxide emissions. • The sharp decline in fossil fuel (home heating oil) prices from \$30 - \$25 per MMBtu at the beginning of 2015 to \$15 per MMBtu in the beginning of 2016 has slowed interest in the high-efficiency and low-emission biomass heating market, but the potential remains to have a meaningful impact on near-term opportunities and long-term goals.
Intervention Strategy	• 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. Support includes: ○ Direct incentives for installations to encourage adoption ○ Research and development to advance high-efficiency and low-emissions technologies ○ Workforce development to train a skilled workforce ○ Education and outreach to inform consumers and market participants ○ Policy development support for state and local governments • As developing this market requires capturing the benefits of scale, particularly in local communities, this initiative will seek to develop activity in focused geographic areas to initiate market traction. For example, clustered development of installations and pellet deliveries will enable cost reductions in the associated service areas. • While the program components will be available statewide, NYSERDA will deploy a co-op marketing campaign in local clusters with the potential for market growth, and will collaborate with local stakeholders to promote positive health and safety impacts. NYSERDA will also focus on replacement of inefficient wood heating appliances with efficient wood heating appliances for health and safety concerns. • For a visual representation of this strategy, please reference the flow chart entitled “Logic Model: Renewable Heat New York,” which can be found in Appendix A.
Goals	• Support a New York State market for high-efficiency and low-emission biomass heating equipment and feedstock supply/infrastructure that is cost-effective and environmentally sound. • Attract private sector capital investment in all segments of the advanced wood heating sector, including pellet production and distribution, sustainable forest management and forest products industry, equipment manufacturing, sales and installation, and workforce training and development. • Replacement of over 1,300 inefficient wood heating appliances with efficient wood heating appliances. • Estimated emissions reductions of 124.7 ton/yr of PM 2.5, 867 ton/yr of carbon monoxide, 0.613 tons/yr of sulfur dioxide, and 1,296 ton/yr of CO₂e.
State Energy Plan/Clean Energy Standard Link	Broadly, the 2015 New York State Energy Plan calls on NYSERDA to help “make renewable energy solutions more competitive in the energy market.” ¹¹ It also specifically puts forth the Renewable Heat NY initiative as an “approach to develop

¹¹ 2015 New York State Energy Plan: *The Energy to Lead*. (Page 75). Albany: New York State Energy Planning Board
<https://energyplan.ny.gov/-/media/nysenergyplan/2015-state-energy-plan.pdf>

	a vibrant and sustainable market for advanced heating technologies” and a commitment to supporting advanced wood heating equipment purchases and installations, improving pellet supply, supporting research and development for continued efficiency and emissions advances, and creating new workforce opportunities.
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19.2.2 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 The target market for policy development activities includes: • Local code enforcement officers • State and Federal regulatory agencies (e.g. NYSDEC, NYSDOH, USEPA)
Market Participants	Market participants include: • Building owners interested in utilizing advanced biomass heating technologies • HVAC contractors • Pellet stove suppliers and installers • Biomass boiler and system component manufacturers • Biomass fuel producers/suppliers • Design engineers • Energy auditors • Academic institutions • National laboratories • Equipment test facilities • Industry organizations

Market Readiness	• The volatility of fossil fuel prices and lack of natural gas availability has forced consumers to look at alternative heating technologies, such as wood. While a sizable portion of the market heats with wood, there is a wide range of performance of wood heating technologies available in the market today. • Due to the variability in technologies, the timing is key for NYSERDA help educate and steer consumers toward more efficient and environmentally healthy technologies. The activities conducted under Renewable Heat NY are intended to prepare and steer the biomass heating market in New York State toward cleaner, more efficient biomass heating technologies. • Consumers have indicated that they value cleaner, more efficient technologies as these technologies lead to reduced fuel consumption and greater cost savings.
Customer Value	• Incentive programs will provide a reduction in up-front capital cost to the customer, which will result in a more economically feasible project and further encourage the adoption of advanced technologies over older, less efficient technologies. • The development of realistic test methods for advanced biomass heating devices will provide consumer protection by ensuring that all devices are evaluated using consistent standards. • Developing standards for advanced biomass heating appliances that can be adopted into state and local building codes will enable state and local officials to incorporate the more advanced technologies, helping to ensure the health and safety of New York State residents. • Through proper training, designers and installers will be better able to size and install these systems properly, resulting in fewer service call-backs and increased customer satisfaction. • Partnering with local stakeholder groups for education and outreach on the negative health and safety impacts of wood smoke will promote a healthier environment for all members of the community, not just those who choose to heat their buildings with biomass.

19.2.3 Stakeholder/Market Engagement

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. These interactions have helped to inform and shape the initiative as described herein. • NYSERDA has also 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 intends to convene this Advisory Group no less frequent than semi-annually. • 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. • NYSERDA also anticipates additional future engagements with Regional Economic Development Councils, community improvement organizations, counties and municipalities, and colleges and Universities.
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19.2.4 Theory of Change

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. Low home heating oil prices disincent the switch from traditional fossil fuels to alternative fuels. Incentive programs are in place to offset up-front costs and make project economics more favorable. • 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. Renewable Heat NY has invested in the training of HVAC contractors and system designers as part of an ongoing effort to educate the industry on proper design and installation practices for biomass boiler systems. NYSERDA's list of qualified installers contains 19 companies. A subset of those (approximately 9) are currently active. 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. Several bulk pellet delivery trucks have only very recently been deployed throughout the state as part of the first phase of Renewable Heat NY. 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 manufactures 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. • Customers are unaware of their options for cleaner technologies. NYSERDA interactions with consumers at public events indicate that people are becoming increasingly aware of their options for cleaner, more efficient biomass heating systems. Through continued outreach and educational efforts, consumer awareness will continue to grow while the industry aligns itself with new federal clean air regulations.
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 suggested standards and language on high-efficiency biomass technology for building and related codes exists then it will be adopted into building codes at the county-level, making it easier to install advanced biomass technologies. • 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 education and outreach on high efficiency, low emission biomass heating appliances is increased, then consumer awareness of and confidence in the technology 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 Solarize¹² model for solar PV). Research and Development: • 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. This work is included in this investment plan due to its highly localized and industry specific nature. • Issue a competitive solicitation to seek proposals from advanced biomass heating equipment manufacturers to improve design, package components, and reduce costs, and evaluate performance. Policy development: • Provide suggested standards and language on high-efficiency biomass technology for building and related codes for adoption at the county-level. Workforce Development: • Evaluate current Renewable Heat NY training program for content and demand. Conduct a follow-up survey to participants to inform adjustments that might be necessary and to gather industry data. 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. Incorporating one-on-one training into large commercial projects will help to ensure that these systems are properly designed, installed, and commissioned. • 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. Trainings will be provided in strategic regions of the state with guidance from NYSERDA staff based on market needs. • Hold "Lunch and learn" webinars/sessions targeted toward system designers and installers on large advanced biomass system sizing, measurement and verification and other advanced biomass technology efficiency topics. 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. • Leverage the existence of local stakeholder groups and low-income assistance programs, such as the Low-Income Heating Assistance Program (LIHEAP) and USEPA's Burn-Wise campaign, promote positive health, and safety impacts per the New York State Wood Heat Report¹³.
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	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.
Key Milestones	<u>Milestone 1 (2017)</u> - Modify incentives to reflect current market conditions and re-issue open enrollment solicitation. <u>Milestone 2 (2017)</u> - Contract with Alliance for Green Heat to provide funding to Wood Stove Design Challenge on an annual basis through 2019. <u>Milestone 3 (2017)</u> - Launch marketing campaign. <u>Milestone 4 (2018)</u> - Contract with research partners to provide studies on wood smoke and public health. <u>Milestone 5 (2018)</u> - Launch community sponsored purchasing campaigns. <u>Milestone 6 (2018)</u> - Contract with manufacturers selected under competitive solicitation. <u>Milestone 7 (2019)</u> - Issue competitive solicitation to seek proposals from advanced biomass heating equipment manufacturers on technology improvements. <u>Milestone 8 (2019)</u> - Reissue workforce development program based on market feedback.
Goals Prior to Exit	<u>Direct Incentives</u> 20% increase in equipment providers and quality installers. - Private investment in new depots for fuel storage and new trucks for bulk fuel delivery. <u>Research and Development</u> - Advances in biomass heating system components and emissions control technology adopted in the market - Availability of low-moisture premium wood pellet feedstocks that will further drive down PM2.5, CO, and SO₂ emissions by as much as 90%. - Certification of new test methods and products in the market - Manufacturing automation to reduce equipment costs implemented in the market

¹² 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.

¹³ Jarnefeld, Judy. New York State Wood Heat Report: *An Energy, Environmental, and Market Assessment*. Albany: New York State Energy Research and Development Authority
<https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf>

	<u>Workforce</u> 75% of biomass heating system design and installation workforce are trained in best practices. - In New York State counties where high-efficiency biomass technology for building and related codes have been adopted, code enforcement officers are educated on the technologies and applicable codes. <u>Policy Drivers</u> - Advanced biomass standards and language incorporated in NYS building codes.
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19.2.5 Relationship to Utility/REV

Utility Role/Coordination Points	Utilities are not currently involved in biomass heating appliances.
Utility Interventions in Target Market	Utilities are not currently involved in biomass heating appliances.

19.2.6 Budgets & Expenditures

An annual commitment budget for all activities included in this chapter is shown in Table 7. The annual expenditure projection is included in Table 8. Budgets and expenditures do not include Administration, Evaluation, or Cost Recovery Fee; these elements are addressed in the Budget Accounting and Benefits chapter filing. The budget as presented in the Budget Accounting and Benefits Chapter will serve as the basis for any subsequent reallocation request. The additional level of detail presented within the table below is intended for informational purposes only.

Table 7. Annual Budget Allocation – Commitment Basis

Commitment Budget	2017	2018	2019	2020	2021	Total
Direct Incentives and Services	\$1,569,000	\$2,066,000	\$2,234,000	\$2,152,000	\$1,606,000	\$9,627,000
Research and Technology Studies/Development/Demos	\$300,000	\$300,000	\$300,000	\$-	\$-	\$900,000
Business Support	\$250,000	\$300,000	\$300,000	\$300,000	\$100,000	\$1,250,000
Tools, Training, and Replication	\$-	\$-	\$100,000	\$100,000	\$100,000	\$300,000
Implementation Support	\$207,000	\$222,000	\$299,000	\$326,000	\$356,000	\$1,410,000
Total	\$2,326,000	\$2,888,000	\$3,233,000	\$2,878,000	\$2,162,000	\$13,487,000

Table 8. Annual Expenditures Projection

Expenditures	2017	2018	2019	2020	2021	2022	2023	Total
Total	13%	16%	18%	20%	16%	13%	4%	100%

19.2.7 Progress and Performance Metrics

Table 9 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.

Table 9. Initiative Specific Metrics

Indicators ¹⁴		Baseline (Before/Current)	2021 (Cumulative)
Activities/Outputs	Large commercial Projects (>88 kW)	4	9
	Residential / Small Commercial Projects (<88 kW)	23	170
	Residential Pellet Stove Projects	89	1,450
	Workforce Development – Training (Individuals Trained)	279	400
	Supply Chain Support – R&D (Projects Completed)	0	20
Outcomes ¹⁵	Reduction in PM _{2.5} 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 SO ₂ from funded systems	0.087 tons/yr	0.7 tons/yr

In addition to the above outcomes, 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 Tables 10 and 11 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.

¹⁴ A 0 (zero) denotes that the actual value is currently believed to be zero for baseline/market metrics.

¹⁵ Baseline value for reductions in PM_{2.5}, CO, and SO₂ reflect reductions achieved through Renewable Heat New York to date. 2021 cumulative value reflects reductions based on targeted program activity.

Table 10. Direct Impacts

Primary Metrics ¹⁶		2017	2018	2019	2020	2021	TOTAL
Energy Efficiency	MWh Annual	-	-	-	-	-	-
	MWh Lifetime	-	-	-	-	-	-
	MMBtu Annual	3,460	4,130	4,400	3,870	1,780	17,640
	MMBtu Lifetime	69,300	82,600	87,900	77,400	35,700	352,900
	MW	-	-	-	-	-	-
Renewable Energy	MWh Annual	-	-	-	-	-	-
	MWh Lifetime	-	-	-	-	-	-
	MW	-	-	-	-	-	-
CO2e Emission Reduction (metric tons) Annual		255	303	323	284	131	1,296
CO2e Emission Reduction (metric tons) Lifetime		5,090	6,070	6,460	5,690	2,620	25,920
Customer Bill Savings Annual (\$ million)		\$0.09	\$0.11	\$0.11	\$0.10	\$0.05	\$0.45
Customer Bill Savings Lifetime (\$ million)		\$1.77	\$2.11	\$2.25	\$1.98	\$0.91	\$9.03
Private Investment (\$ million)		\$ 2.55	\$3.26	\$3.57	\$3.37	\$2.61	\$15.36

Table 11. Annual Projected Initiative Participation

	2017	2018	2019	2020	2021	Total
Participants ¹⁷	370	426	435	344	54	1,629

Benefits shown in Table 12 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 below are not discounted, however NYSERDA has applied a discount of 50% to the overall portfolio values in the Budget Accounting and Benefits chapter.

Table 12. Estimated Indirect Market Impact

Indirect Impact		2020	2025	2030
Energy Efficiency	MWh Cumulative Annual	-	-	-
	MMBTu Cumulative Annual	-	6,510	23,500
Renewable Energy	MWh Cumulative Annual	-	-	-
	MW	-	-	-
CO2e Emission Reduction (metric tons) Cumulative Annual		-	478	1,730

¹⁶ Impacts are expressed on a commitment-year basis, and are incremental additions in each year. Assumes a 20-year measure life. Benefits are rounded to three significant figures. Totals may not sum due to rounding. Customer Bill Savings are calculated as direct energy bill savings realized by customers participating in NYSERDA's programs.

¹⁷ Participants are those individuals or businesses who received an incentive to install high-efficiency, low-emissions biomass heating equipment.

19.2.8 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 carbon¹⁸ component and methane. For example, traditional wood boilers emit ~125 times the particulate matter than high-efficiency, low-emission units. The biogenic nature of the wood used in these heating units results in lower GHG emission on a life-cycle basis when compared to other available means of heating.¹⁹
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19.2.9 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. The performance of the program will be continually assessed to determine how well the goals of the effort are being met, and whether progress against the identified barriers (or new ones) is being adequately achieved. 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 • Private investment • Continuous reassessment of barriers The results of this assessment will be used to determine if components of the program need adjustment, expansion, or replacement, or if funds should be redistributed between Renewable Heat NY activities. Incentives may be adjusted or removed if other federal or local incentive mechanisms become available. <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
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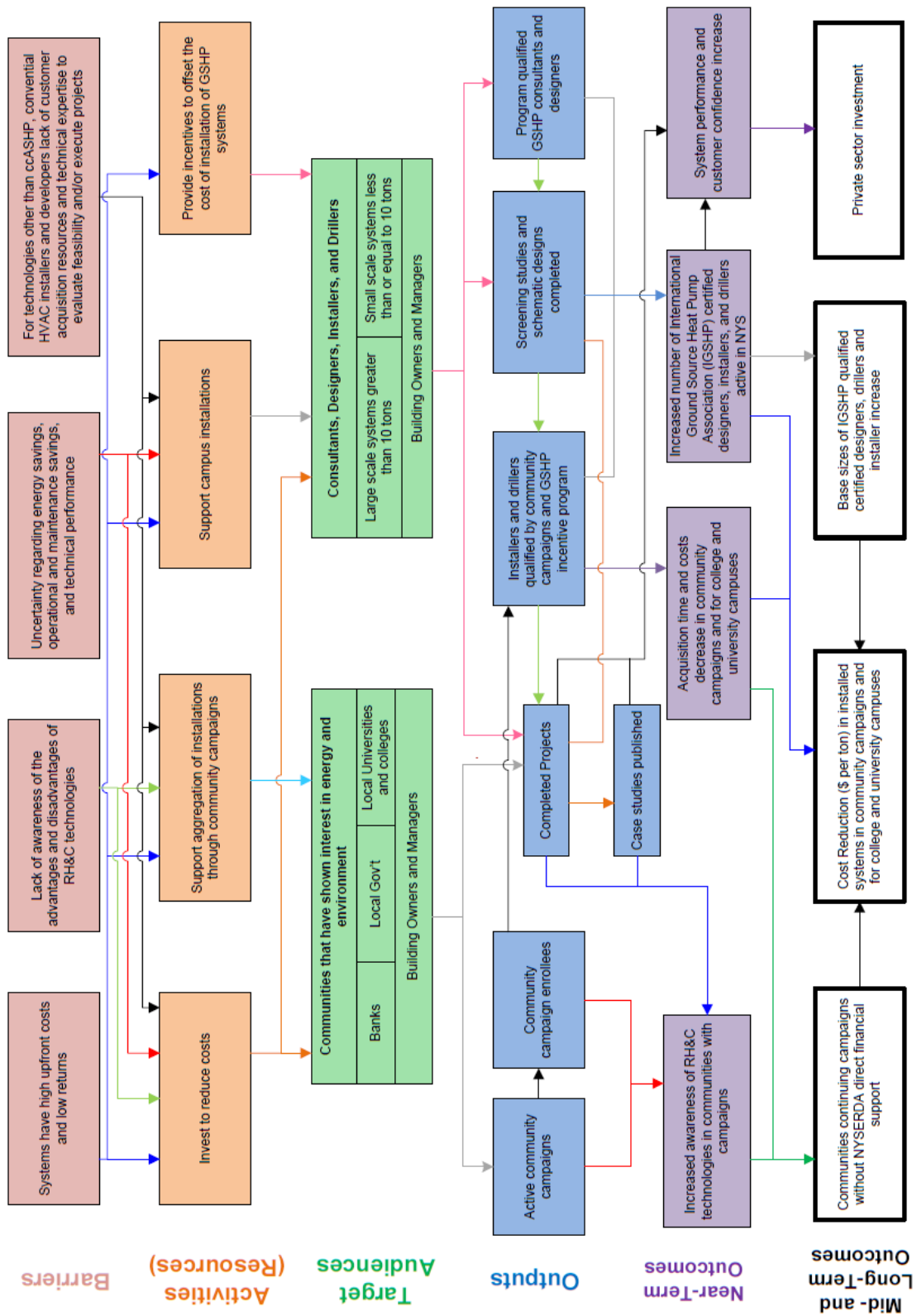
¹⁸ Black carbon is a type of particle resulting from incomplete combustion. By absorbing sunlight, it contributes to global warming.

¹⁹ NYSERDA follows EPA protocols with assumes carbon neutrality of biogenic materials such as wood: <http://www3.epa.gov/climatechange/emissions/usinventoryreport.html>.

	success. Baseline measurements of key market indicators will occur soon following initiative approval and leverage programmatic data to provide additional insights to adjust the strategy. Regular (e.g., annual or biennial) updates to key performance indicators and measurement of market change will occur once the initiative is underway. 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 • Customer satisfaction with installers and equipment after first heating season and with equipment two years after installation, and installer satisfaction with program <u>Impact Evaluation/Field Verification</u> Impact evaluation will be conducted to assess system operation and performance after at least one heating season for a sample of projects. 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.
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Appendix A – Logic Models

LOGIC MODEL: Heat Pumps and Solar Thermal



LOGIC MODEL: Renewable Heat New York

