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Fuel Mix and Greenhouse Gas Emissions of Municipal Electric Light Plants in Massachusetts

Paul J. Hibbard
Pavel G. Darling

Analysis Group, Inc.

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About the Authors

Paul Hibbard is a Principal at Analysis Group. Paul is a former Chairman of the Massachusetts Department of Public Utilities, and has held positions in both energy and environmental regulatory agencies in Massachusetts. Paul has also served on the Massachusetts Energy Facilities Siting Board, the New England States' Committee on Electricity, and the Executive Committee of the Eastern Interconnect States' Planning Council. In private practice, Paul provides technical, economic and policy analysis, and strategic advice to public and private sector participants in the natural gas and electric industries.

Pavel Darling is a Vice President at Analysis Group. He has worked on a wide variety of energy-related matters while consulting on behalf of utilities, state and regional organizations, and global companies, and has testified and supported testimony before state energy siting boards, state public utility commissions, and other regulatory agencies.

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I. Executive Summary

The Context: Decarbonization

The Commonwealth of Massachusetts has set an aggressive pathway to achieving decarbonization of *all* of our energy sectors, reducing greenhouse gas (GHG) emissions by at least 80 percent by 2050. This will not be easy, and will require proactive planning, investment, and operational changes across power, building and transportation sectors. In particular, efforts to decrease emissions in building and transportation sectors increasingly focus on electrification of those end uses, while energy and environmental policies affecting the electric sector are increasingly focused on reducing the carbon intensity of electricity generation. In Massachusetts, such programs include caps on carbon dioxide emissions from power plants, support for investments in energy efficiency, and encouraging growth in renewable and other low-carbon generation (through, e.g., renewable and clean energy portfolio standards (RPS), net metering, and long-term contracts).

Given the outsized role the electric sector is expected to play in decarbonization, meeting the Commonwealth's GHG goals will require the continuous evolution of our electricity resources towards growth in energy efficiency investments, major increases in low- and zero-carbon generation, and the advancement of new technologies and power management practices by electric companies and their customers, and continued improvement in the efficiency of the fossil-fired generation that will continue to be needed through the transition. These are considerations and actions that will need contributions across all companies and sectors.

In this transitional context, the role and contribution of Municipal Light Plants (MLP) are often overlooked. This is because MLP investment, policy, and operating decisions are tied to the interests and objectives of their host communities, and are not regulated by the DPU. Consequently, the focus of most state actions to meet climate goals and requirements is directed at the investor-owned utilities (IOU), and the contributions of the IOUs are continuously evaluated against those goals. MLP contributions to the state's goals have tended to "fly under the radar," and there may be a presumption among some that on the whole the MLP's are not attentive to state policies and interests.

The Role of Municipal Light Plants

The data on the resource portfolio and GHG emissions of the MLPs tell a very different story. MLP resource procurement decisions (and associated portfolio mix and emissions), and their investments in advanced technologies and practices, are undervalued. This is due in large part to the presumption that the MLP sector has not participated in the development of lower-emission technologies compared to the larger

investments of developers and/or IOUs. However, our analysis shows that the MLPs are well ahead of the New England region and the MA IOUs when it comes to the transition to a lower-emitting resource mix, with a lower carbon emission portfolio, and proactive investment in the advanced energy technologies that will play a crucial role in longer-term progress on climate.

The reasons for the more advanced position of the MLPs in the transition of the power sector are more nuanced than the drivers of IOU actions. This is due in part to the MLP's unique structure, non-profit status, and ability to take decisive action without adjudication of resource planning and investment decisions. MLP contributions are more nimble, driven by individual municipal decisions responsive to local community interests in a vertically-integrated planning context.

MLP support for real renewable development rests on the ability of MLPs to enter into long-term commitments to purchase at least the energy and capacity of eligible renewable projects, their ability to quickly pull the trigger on project development, investment, and/or contracting, and their ability to think and act proactively considering their integrated (generation, transmission and distribution) planning context. New renewable development has required or benefitted substantially from the stability and revenue guarantee of longer-term contracts for energy and capacity with credit-worthy counterparties (such as the MLPs).

Terminology: "Clean," "Green," and RECs

It is important to be clear about how renewable energy credits (RECs) associated with MLP resources have been treated historically, what this implies for how to interpret the attributes of MLP resources in the past, and what to assume or not assume going forward. The MLPs do not need to obtain, purchase, take ownership of, or retire RPS-compliant RECs. Yet as discussed in this report, this has not in any way diminished MLP direct actions in support of the development of "steel in the ground" renewable projects - projects that may not have achieved development and operation based *only* on the partial financial incentive of RECs.

This is an important but frequently-confused discussion. Massachusetts RECs are one specific attribute of certain resources, defined through state-specific law and regulation, and in the end are only one of several marketable financial instruments of eligible generation. Whether and to what extent MLPs take ownership of, retain or retire the RECs associated with the renewable resources they back is often less important to the development of renewables than the commitments of participating MLPs to invest in or purchase the actual energy and capacity from operating renewable resources on a long-term basis. Nevertheless, to the extent the RECs associated with MLP-backed resources are sold (by the resource owner/operator or the MLP, if REC ownership is transferred by contract), it is important to be careful in how one discusses credit for this specific "renewable attribute" of the resource.

RECs are sometimes viewed as the only attribute of a resource that spurs development; but they are not the only, and in some case may not even be the most important, element of project revenue structure from the standpoint of project investment and development. For example, an MLP might contract for a zero-carbon resource, and retain for the benefit of MLP customers the energy, capacity, reliability and emission attributes of the resource. The bulk of revenue to be earned by the developer may be associated with these value streams, and the viability of the project may rest mostly on locking in these attribute values over a long-term period with the MLP (rather than leave that to the chance of regional wholesale markets). But RECs represent an *additional* potential value stream, and may be sold separately. If the associated RECs are sold (e.g., to a state IOU subject to the RPS), the picture of who should take "credit" for the development of the resource becomes mixed, and it is important to clearly delineate who owns the RECs, and thus who can claim credit for the specific renewable attribute.

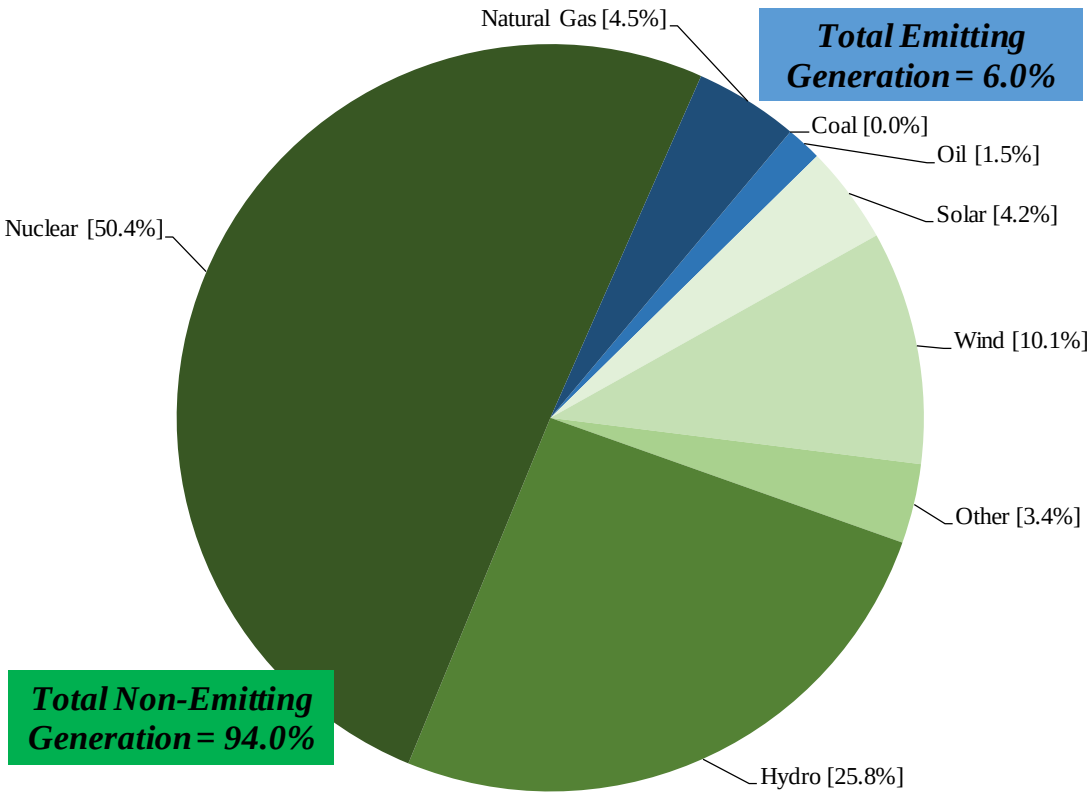
We recognize that what the MLPs may do with RECs associated with the numerous renewable projects in which they have invested or signed contracts will change over time. Given the many layers of complication in considering the role of RECs in the MLP portfolio, we strive in the report to avoid explicit attribution of the "renewable" attribute, and try to avoid broad, generic or undefined statements of resource characteristics such as "green" or "clean," instead focusing specifically and explicitly on only the emission attributes of the MLP portfolio.

Based on our analysis, described in more detail in the body of this report, we come to several observations:

MLP specific resource choices - namely those that involve longer-term investment in specific resources or technologies - are nearly emission free.

The most important indicator of the role MLPs play in helping transition to a lower-emission resource mix is reflected in the resources that the MLPs own or have under contract. These resources reflect the explicit decisions of MLPs on how to meet customer needs over the long term. In these selections the MLPs have assembled an owned/contracted portfolio resource mix that is 94 percent non-emitting, including primarily wind, solar, hydro, and nuclear generating assets. See Figure ES-1.

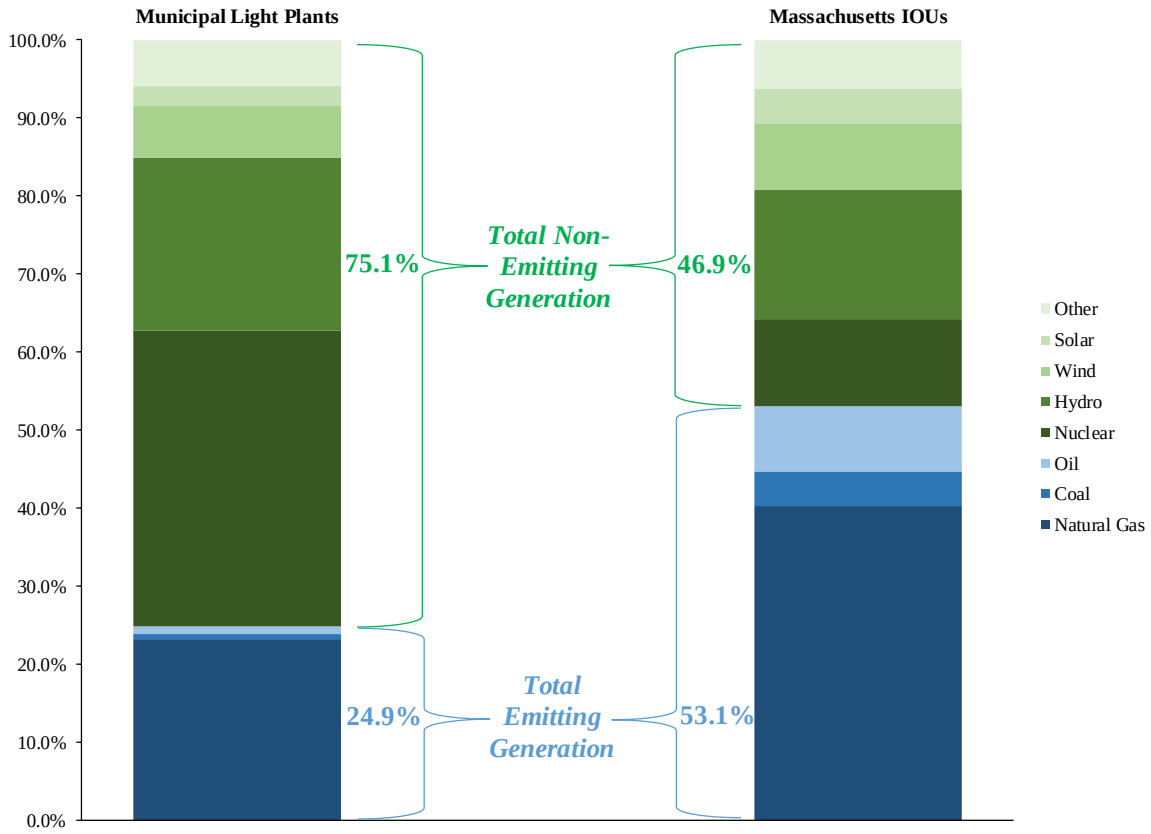
Figure ES-1: MLP Owned and Contracted Generation Mix (2017)



Even when absorbing the emission characteristics of the MLP's short-term wholesale market purchases, the resulting "effective" MLP resource mix is far lower-emission than that of the MA IOUs, and the broader New England region.

The MLPs round out their resource needs through shorter-term transactions in wholesale markets. In these purchases, the MLPs' resource mix is affected by factors and decisions made by other wholesale market entities (that is, outside MLP control). Yet even when incorporating these shorter-term market purchases, the MLP resource mix includes 75 percent non-emitting resources, compared to 47 percent for the Massachusetts investor-owned utilities. See Figure ES-2.

Figure ES-2: Comparison of MLP Generation Portfolio to Massachusetts IOUs (2017)



The end result of the MLP's resource and investment decisions means that the MLP's GHG emission rate (in pounds per MWh generated) is well ahead of (i.e., lower than) Massachusetts' aggregate rate, or that of the region.

The resource mix of the MLPs points to an effective carbon dioxide emission rate - in pounds of CO_2 per MWh used to meet customer needs - far lower than that of the MA IOUs and the region as a whole. We estimate that the MLP's GHG emission profile is on the order of 60 percent lower than that of the MA IOUs, and 40 percent lower than the New England region.

The MLP's resource mix reflects the fundamental differences in company structure, decision-making processes, cost of capital, and interests of host communities.

The MLPs are not-for-profit vertically-integrated utilities that operate as a division of local government, are governed by local city councils or elected or appointed boards subject to voters' views and expectations, and are fully embedded in the communities they serve. Community ownership provides an opportunity for open citizen input into investment, operational and policy decisions governing local utility service, and for a

direct and transparent line of accountability and oversight between the city's or town's citizens and the utility's management and decisions that affect cost and reliability outcomes.

These features drive the ability of the MLPs to pursue resource investment and operational decisions with an eye towards both local customer expectations and state policies and emission targets. And the MLPs can do this efficiently and proactively, given their direct access to local permitting and zoning processes and positive relationships with local government, access to low-cost capital, not-for profit viewpoint, and ability to approach resource planning for the long-term including an integrated view of utility operations (i.e., generation, transmission, and distribution).

The past trading of a portion of eligible renewable energy credits associated with MLP-funded renewable resources does not negate the positive impact of MLP investments on renewable development in the region, nor does it imply that MLPs will necessarily sell owned RECs on a going-forward basis.

The MLPs hold ownership in or are in contracts with a number of major regional generating assets that are eligible renewable resources under Massachusetts law, and that qualify for the issuance of renewable energy credits (RECs). As discussed above, the ability of MLPs to quickly act on development and contract opportunities, and to access low-cost capital for renewable investment, make the MLPs a valued investment partners for such projects. As a result, the MLPs have been a highly constructive driver of the development and construction of qualified renewable resources in New England, and have contributed to the development of actual steel in the ground, reducing retail suppliers' reliance on the state's Alternative Compliance Payments (ACPs) and potentially suppressing the overall cost of meeting the state's RPS.

In balancing MLP's aggressive participation in renewables development with ratepayer interests, the MLPs have in the past sold RECs to other retail suppliers that must meet MA RPS standards. Thus, in those years the MLPs cannot claim primary operational or financial support for that specific quantity of a resource's MA eligible renewables attributes. Nevertheless, it is important to recognize that (a) historically this represents only a portion of MLP-supported renewables, (b) it is only true in the years that MLPs have sold RECs, and (c) it is an annual decision that can be reversed in future years. This is an important consideration for MLPs going forward, but REC sales by MLPs should not be viewed as diminishing the positive role MLPs have played and will going forward continue to play in the development of eligible renewable resources and helping the Commonwealth meet its goals.

MLPs have been a productive contributor to state energy and environmental policy, and will continue to support the Commonwealth on its path to decarbonization on a going-forward basis

The Commonwealth is clearly on a transitional path; one that will result in a continuous decline in the CO_2 emissions associated with energy production and use in the coming decades. The data we review for this Report demonstrate that the MLPs have been a consistent, productive, and highly effective partner in Massachusetts' efforts to reduce GHG and foster the development of advanced energy technologies, and are well positioned to continue to support these requirements and targets on a going-forward basis. MLP's past actions also demonstrate that letting the current structure continue to be the basis for MLP actions is the best way to support the MLP's ongoing partnership with the state in its GHG reduction efforts. Any increase in state regulation or oversight of MLP actions may thus be counterproductive, and should be weighed carefully against the practical and historical benefits of "home rule."

II. Context and Purpose

A. Background: Public Power in Massachusetts

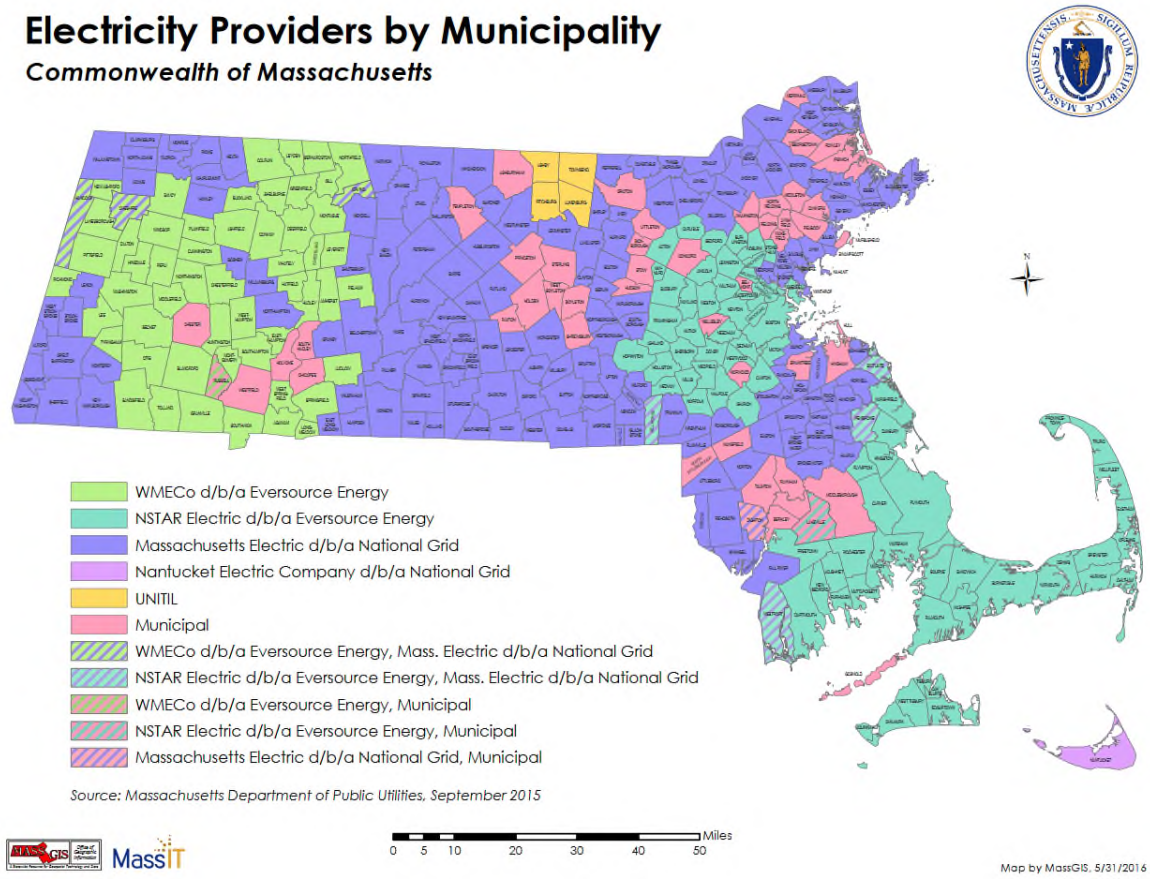
Over a hundred years ago, communities began to create utilities to provide electricity to residents and businesses to meet lighting and other power needs. In the ensuing decades, as communities, populations, and demand for electricity grew, so did the electric industry and the degree of interconnection among neighboring communities and electric companies. Many communities sold their municipal electric light plants (MLPs or munis) to growing private investor-owned utilities (IOU) who integrated generation, transmission and distribution services over larger service territories; and over time the IOUs themselves have consolidated. In Massachusetts today, regulated electric utility service is provided by just three IOUs - National Grid, Eversource, and Unitil.

Not all communities in Massachusetts were sold to IOUs. In Massachusetts, forty communities decided to retain community ownership and local control over electric utility service, and today remain in operation as MLPs. Table 1 below identifies the 40 communities that have retained their MLPs; Figure 1 shows the distribution of the Commonwealth's MLP service territories, as well as those of the three IOUs (and their subsidiary electric companies).

Table 1: Massachusetts MLPs

Ashburnham	Groveland	Merrimac	Russell
Belmont	Hingham	Middleborough	Shrewsbury
Boylston	Holden	Middleton	South Hadley
Braintree	Holyoke	North Attleborough	Sterling
Chester	Hudson	Norwood	Taunton
Chicopee	Hull	Paxton	Templeton
Concord	Ipswich	Peabody	Wakefield
Danvers	Littleton	Princeton	Wellesley
Georgetown	Mansfield	Reading	West Boylston
Groton	Marblehead	Rowley	Westfield

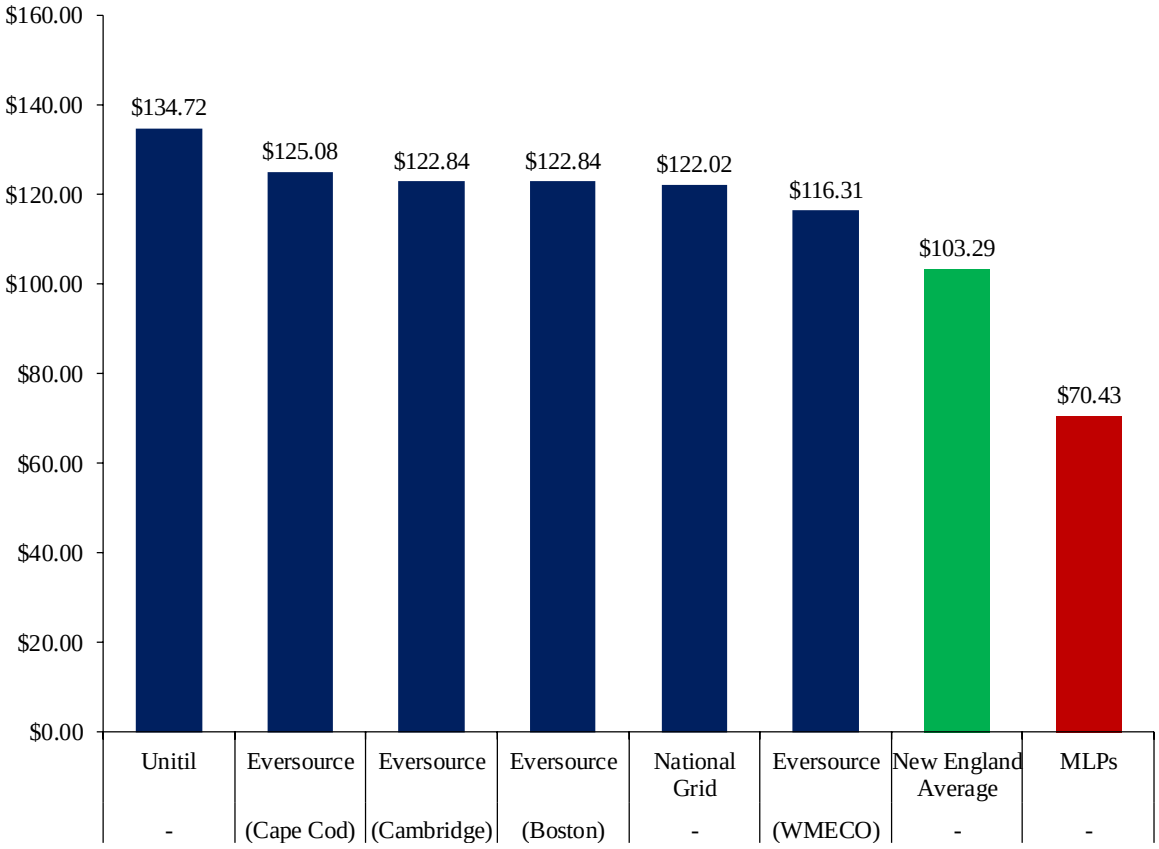
Figure 1: Electricity Providers in Massachusetts[1]



Massachusetts is not alone in the retention of MLPs, which are also referred to as public power utilities. Nationally, public power provides electric service to over two thousand cities and towns, covering roughly fifty million people in forty-nine states. Munis generate roughly ten percent of all electricity in the U.S., and are responsible for approximately fifteen percent of retail load. They employ nearly 100,000 people and serve one in seven electricity customers.[2] For a variety of financial, operational, and policy reasons, the rates of public power entities tend to be lower than neighboring IOUs.[3]

In Massachusetts, the MLPs play an important role in the electric sector. They serve over 400,000 customers covering approximately 14% percent of electric load in the state, and generate annual revenues of almost $1 billion.[4] The MLPs in Massachusetts provide service to customers at rates that are on average 42% percent lower than the IOUs in the state, and 32% percent lower than the New England region's average cost of electricity. See Figure 2.

Figure 2: Comparison of MLP, IOU and regional residential electric costs (April 2018 - March 2019, 12 month average monthly bill per 500 kWh)[5]



B. MLP Structure and Oversight

MLPs in Massachusetts are fundamentally different from the IOUs in numerous and important ways. First and foremost, MLPs exist based on the explicit decision by host communities to retain local ownership and control over the reliability, rates, operations, and policies of electric service within the cities and towns. Community ownership provides an opportunity for open citizen input into investment, operational and policy decisions governing local utility service, and for a direct and transparent line of accountability and oversight between the city's or town's citizens and the utility's management and decisions that affect cost and reliability outcomes. Munis are not-for-profit entities that operate as a division of local government, and are governed by local city councils or elected or appointed boards subject to voters' views and expectations.

For these reasons, the MLPs in Massachusetts are not and need not be regulated for ratemaking or general supervisory purposes by the state's Department of Public Utilities (DPU). General supervision, operational reliability, investment and expenses, the allocation of costs, and the design of rates are all subject to direct local community oversight. The administration of programs to meet energy or environmental policy objectives are made pursuant to the directives that flow from the local governing

processes established by the citizens of the city or town. If the MLP's board or management fail to maintain reliable service at reasonable costs, and/or successfully meet the collective energy and environmental policy interests of the city/town residents, they will be replaced by those that can and will be responsive to the town's intent.

MLP's were therefore not obligated to join the Commonwealth's functional unbundling of the IOUs and restructuring of the electric industry in the late 1990s. While MLP communities were offered the opportunity to take these steps in the 1997 Electric Industry Restructuring Act,[6] the decision of whether or not to open their service territories to retail choice, or require divestiture of power contracts and generating assets was left with the communities that oversaw the MLPs. Similarly, MLP communities have the authority to adopt (or not) energy policy requirements placed on the IOUs through the Restructuring Act and subsequent energy legislation, such as renewable portfolio standards (RPS), energy efficiency (EE) investments, net metering, renewable investment funding, energy storage investment, long-term contracts with eligible renewable resources, and the development of grid modernization plans.

It is important to recognize that these differences between MLPs and IOUs are not by chance, or some kind of oversight. It is a long-standing structural and organizational difference in utility operations and governance, rooted in a century-long history of citizens' desire for home rule and local control over utility operations. And it has a number of implications for the actions that have been and can be taken by the Commonwealth's MLPs. Specific examples include the following:

- MLPs have access to lower-cost financing for capital investment projects. MLP's can float tax-exempt municipal bonds to raise money for generation, transmission and/or distribution infrastructure projects, saving significant amounts of money relative to the typical cost of capital for an IOU.
- MLPs are not for profit, and are beholden only to the citizens of the cities or towns in which they reside. There are no shareholders, and thus munis do not face the conflicting objectives and incentives sometimes faced by IOUs with respect to the balance between returns on investment and minimizing consumer risks and costs.
- MLPs are embedded in their local communities, draw from and contribute to the local population and civic activities, and can be more responsive to the interests and goals of the city or town. This relationship is often viewed as promoting a higher level of accountability of the utility to the interests and needs of its customers.
- MLPs are part of the communities they serve, and can act quickly. With direction through local government to make a particular investment on the MLP's system, a muni can more rapidly move from concept to development to construction and operation of generation, transmission or distribution infrastructure, with a more direct path in many cases to siting, zoning, permitting, and cost recovery.

- MLPs in Massachusetts remain vertically integrated. This means MLPs can view power system opportunities and investments on an integrated planning basis, and can more easily capture the benefits of certain infrastructure and efficiency investments across the full range of value streams - generation, transmission, and distribution. For example, the business case for electricity storage is far easier to make than it is for an IOU that can only realize value for transmission and/or distribution reliability outcomes.

As discussed in the next section, these features of MLP structure and operations have important implications for the role the munis have played to-date in the decarbonization of the power system in Massachusetts, and the role they can play on a going-forward basis.

C. Purpose and Scope of this Report

This Report evaluates a particular element of difference among IOU and MLP investment and operations that flows in part from their different structures and management processes - namely, the evolution of the utilities' generation resource mix, and the associated emissions of greenhouse gases (GHG) that flow from meeting retail customer needs.

There is little doubt that the power sector in Massachusetts is on a transitional path, one that will move continuously towards an overall decarbonization of the Commonwealth's economy if the state is to meet the requirements of the Global Warming Solutions Act (GWSA). From the power sector perspective, and depending on how the economics of grid-based and distributed resources evolve, this may involve some combination of:

(a) increasing generation from low- and zero-carbon resources;

(b) decreasing carbon intensity of the emitting resources that support grid reliability throughout the transition, through retirement of higher-emitting resources and improved generation efficiency among those still in operation;

(c) increasing demand for electricity as the heating and transportation sectors are electrified to achieve economy-wide carbon reductions; and

(d) increasing uptake of distributed renewable generation, energy storage, and consumer demand management at the distribution level.

This transition is in the early stages, and it is difficult to anticipate what role each of these elements will play going forward, and what new options may emerge. As the technologies and their economics evolve, and the carbon reductions needed increase, it will be important that all sectors of the economy - and the electric sector in particular - contribute to achieving the state's goals and proactively plan to do so in a way that is efficient and minimizes consumer impacts.

It is often assumed in this context that *because the MLPs are not subject to DPU oversight and regulation*, they have not historically contributed their "fair share" to the

Commonwealth's climate policy goals and requirements (and by implication will not do so in the future). In this Report we review historical data to explore how MLP investments and operations compare with respect to Massachusetts and New England from fuel mix and carbon emission perspectives. We consider the generation owned and operated by the MLPs on an individual and joint basis, and the long-term contracts they have entered into. We also review the range of innovative projects and investments that MLPs have initiated which affect the carbon intensity of the power system and the advancement of key decarbonization technologies.

We view this history with an eye not only to the role MLPs have played historically, but also in the context of what role the MLPs will play in the coming decades on the path to near-decarbonization by 2050. Our goal is to clearly present MLP performance to date relative to the state and the region, and to provide context for consideration of whether and to what extent specific state legislative or MLP city/town ordinance are needed to ensure full and constructive participation by the MLPs in meeting the state's decarbonization targets.

III. Analysis of MLPs' Electric Portfolio

A. Introduction and Data

As noted above, the primary purpose of this study is to gather and analyze electric supply data from the individual MLPs, and make comparisons of the fuel mix and emissions profile of the MLP's generation mix to the broader New England region and Massachusetts utilities. This section describes the data used and the results of the data analysis and comparison.

The data relied on in this study was collected primarily with the assistance of the Massachusetts Municipal Wholesale Electric Company (MMWEC), Energy New England (ENE), and the MLP members themselves. Additional data were reviewed or obtained from publicly available data sources including ISO New England, MA Department of Energy Resources (DOER), MA Department of Environmental Protection (DEP), MA DPU, and the US Energy Information Administration (EIA).

Our starting point for this study was data on each MLP's power supply sources, including generating resources owned/operated or under contract to the munis, and purchases made through the New England wholesale electricity market. These data were provided primarily by MMWEC, ENE, and the individual MLPs. The data for individual MLPs were aggregated across all MLP entities, and processed to ensure consistency across data sources. Additionally, data were validated, where possible, against information from EIA's Form 861 retail electric sales database. In order to compare MLP resource mix and emission profiles against IOUs, the state as a whole, and the New England region, we obtained additional electric industry data from various publicly available industry and government sources. All data were collected for the most recent years possible.

B. Results

We present results on the MLP's electricity supply portfolio in three parts:

1. First we review MLP direct investments - that is, the resources specifically backed through long-term investments and commitments made by the Massachusetts MLPs. These resources are either owned and operated by MLPs, or whose development and/or continued operation were made possible through the investments and commitments of MLPs and their customers. In effect, this is the resource mix over which the MLPs have made specific resource decisions and for which the MLPs invested capital needed to add resources to the regional mix.

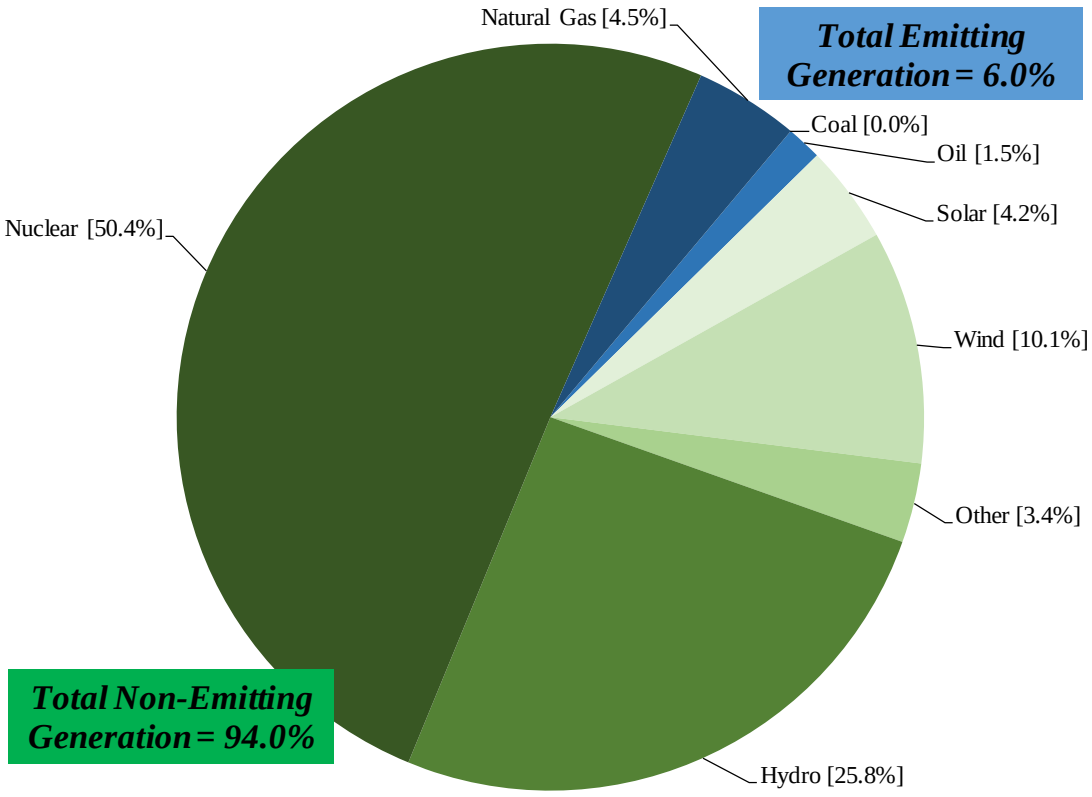
2. Second, we review what portion of the MLP resource mix derives from short-term wholesale market purchases made on top of their direct investments, to

ensure adequate supply for customers and/or to hedge fuel and electricity prices in regional markets. While these resources do not reflect the specific long-term resource interests of the MLPs, they do reflect resources bought and sold through the region's wholesale markets, and imply a "regional" fuel mix supported in the short term in part through MLP market activity.

3. Third, we combine direct investment and market purchases to show an "effective" combined resource portfolio fuel mix and emission profile associated with the mix of MLPs' resource decisions and market purchases.

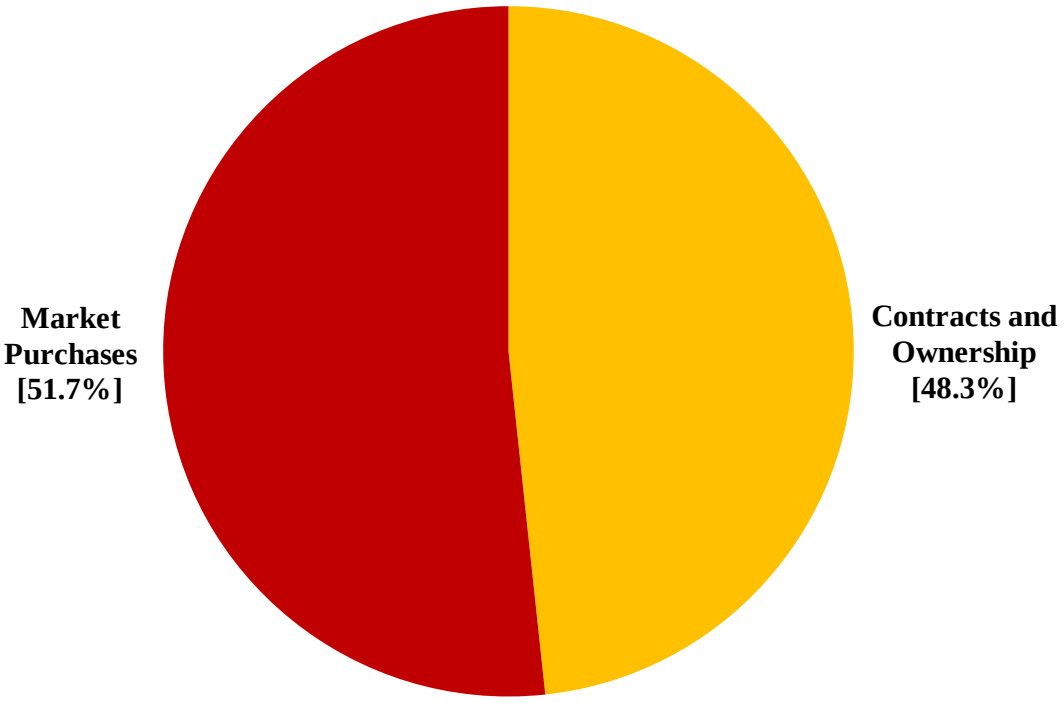
The MLP's owned and contracted portfolio provides an important view into the mix of resources supported through MLPs' direct investment and contracting activities. Specifically, for the generation associated with MLP ownership or individual contracts, the vast majority (94%) is associated with non-emitting resources. Approximately half of these resources are from nuclear assets (Millstone and Seabrook), with hydroelectric, wind, and solar assets comprising much of the remainder. Figure 3 provides the breakouts of MLP owned and contracted generation by fuel type. These ownership and contracted generation resources represent specific resource allocation decisions entered into by the MLPs, and are differentiated from their market purchases (described below), which instead reflect the broader region's collective resource mix outcomes.

Figure 3: MLP Owned and Contracted Generation Mix (2017)



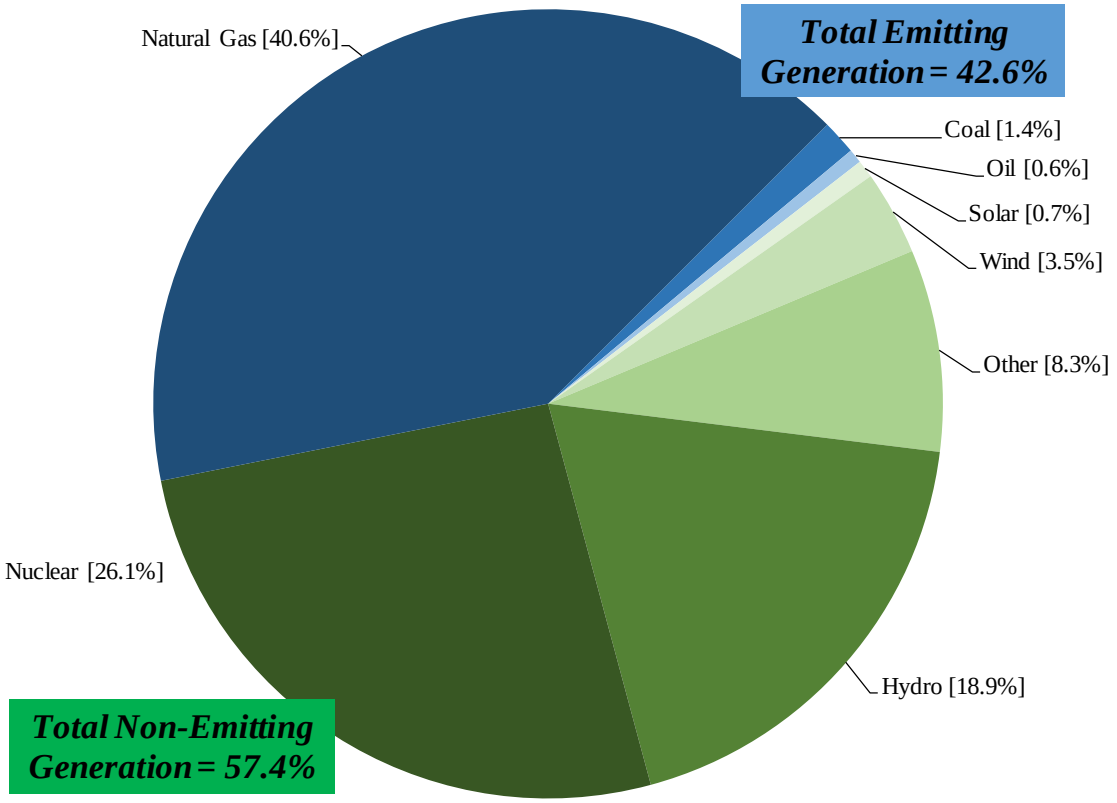
While the MLP's owned/contracted portfolio is almost fully non-emitting, it does not include that portion of MLP purchases made on a short-term basis (i.e., daily to annually) through the region's wholesale markets. In fact, while the MLP's owned/contracted portfolio comprises a significant foundation for MLP operations (roughly half), the remainder comes from these wholesale market activities.[7] Figure 4 shows the breakdown for 2017 between MLP owned/contracted resources and these short-term market purchases.

Figure 4: MLP Generation Sourcing (2017)



This roughly half of the MLP portfolio for 2017 associated with short-term market purchases occurs within the ISO New England-administered wholesale electricity markets. In order to account for the generation mix of these purchases, we obtained information from ISO New England to determine the composition of generation types within the New England region. Figure 5 presents this breakdown of resources associated with New England's wholesale market activity. As can be seen in Figure 5, the region's resource mix comprises a significantly greater share of emitting resources than the MLP's direct own/contract portfolio - specifically, regional resources are 43 percent emitting (compared to the MLP portfolio at 6 percent), and 57 percent non-emitting (compared to the MLP portfolio at 94 percent).[8]

Figure 5: New England Generation Mix (2017) [9]



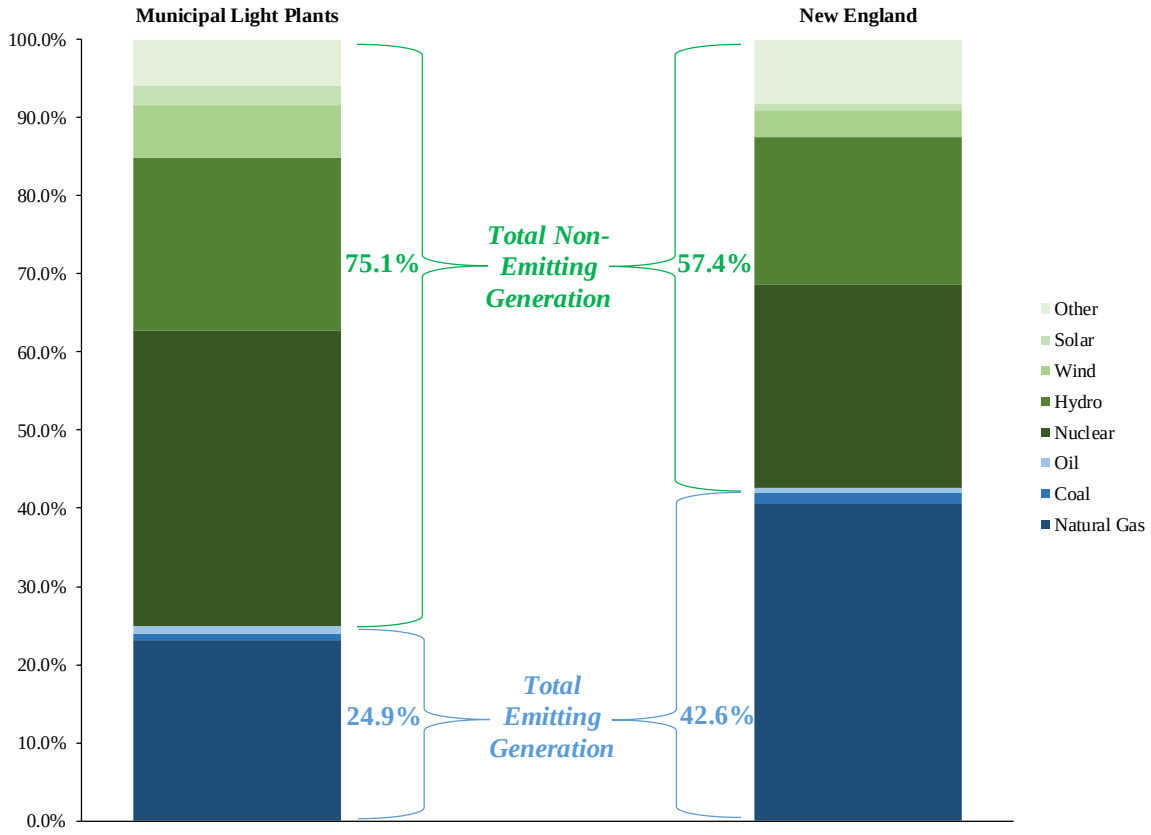
C. Comparison of MLPs' Portfolio to Massachusetts IOUs and Regional Market

In order to estimate an "effective" resource mix for the MLPs, to compare with others, we combine the short-term wholesale market resource mix for 2017 with the MLP's direct own/contract resource mix (both presented above), on a weighted average basis. Figure 6 presents this combined outcome for the MLPs, and compares it to the average New England regional resource mix. Comparing the generation portfolio of the MLPs to the broader New England region highlights two important takeaways:

- MLPs have a higher percentage of non-emitting generation than the overall region, regardless of whether looking solely at their ownership/contracted generation (94 percent non-emitting) or including their short-term market purchases on a weighted average basis (leading to an "effective" MLP portfolio in 2017 that is 75 percent non-emitting). Both methods result in a substantially greater share of non-emitting resources in the MLP portfolio than New England's overall resource mix (57 percent non-emitting).

- The MLPs have a higher reliance on nuclear generation (38%) and a slightly lower reliance on natural gas generation (23%) than the broader region (26% and 41%, respectively).

Figure 6: Comparison of MLP Generation Portfolio to New England Regional Supply (2017) [10]

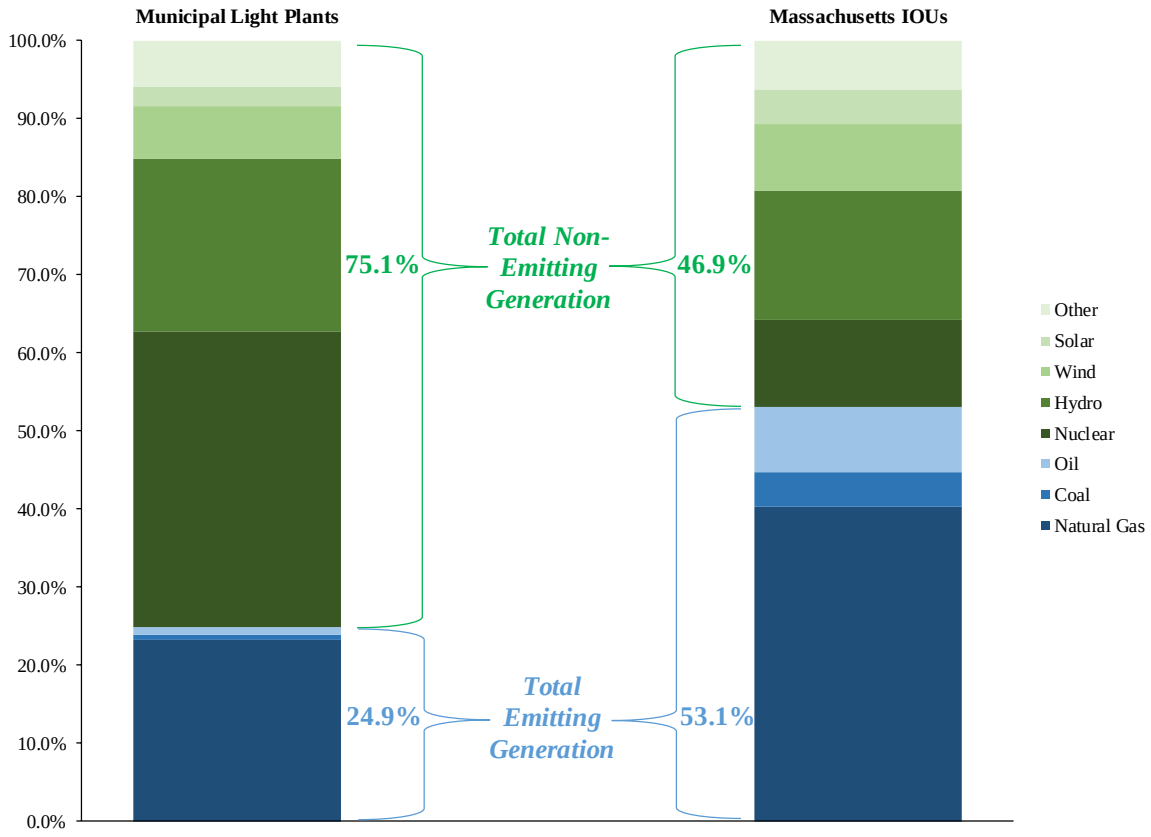


It is also useful to compare the MLPs to the Massachusetts investor-owned utilities (IOUs), given their similar purpose and focus on in-state service. To make this comparison, generation mix data for the IOUs was gathered from the IOU disclosure labels required by the state.[11] The comparison of MLPs to IOUs is similar to the broader region in that the MLPs have a higher share of non-emitting generation resources than the Massachusetts IOUs. In fact, somewhat surprisingly, the IOUs have an even lower share of non-emitting resources than the rest of New England. Figure 7 provides details on this comparison, and highlights the following points:

- The MLPs have a higher percentage of non-emitting generation than the Massachusetts IOUs, at 75 percent compared to 47 percent.

- The MLPs have a higher reliance on nuclear generation (38%) and a slightly lower reliance on natural gas generation (23%) than the Massachusetts IOUs (11 percent and 40 percent, respectively).

Figure 7: Comparison of MLP Generation Portfolio to Massachusetts IOUs (2017) [12]



D. Implications for GHG Emissions Associated with MLP Investment and Operations

Given the above results, it should come as no surprise that MLPs, with their lower emitting portfolio, would also have a lower emissions profile than the broader region and Massachusetts IOUs. For example, emitting generation for MLPs represents over 40% less than the regional total (25% vs 43%) and over 50% less than the IOUs (24% vs 53%). Similarly, when comparing emissions profiles, the results are similar: the MLPs have a 40% lower emissions profile than the broader region, and a 60% lower emissions profile than the IOUs.

IV. Additional Features of the MLPs' Electric Programs

The impact of the MLPs on state fuel mix, emission targets, and energy policy extends well beyond the composition of resources procured through ownership, contract and market purchases. In fact, the MLPs have been active in their support for forward-looking investments in emerging practices and technologies, due in large part to their vertically-integrated structure, ease of access to low-cost capital, ability to move quickly (without extended regulatory review) from concept to practice, and responsiveness to local resident and business interests.

To review this we collected information on the various energy programs that the MLPs administer related to energy efficiency, advanced energy technology investments, and other vehicles to promote resources and practices supporting decarbonization of our energy systems. Since much of the data on these programs varies significantly across the various MLPs, we did not attempt to aggregate the data to present collective energy or fuel savings. Instead, we present a more qualitative summary of these programs in order to at least capture the additional resources and efforts expended by the MLPs in ways supportive of state energy policy.

A. Energy Efficiency Programs

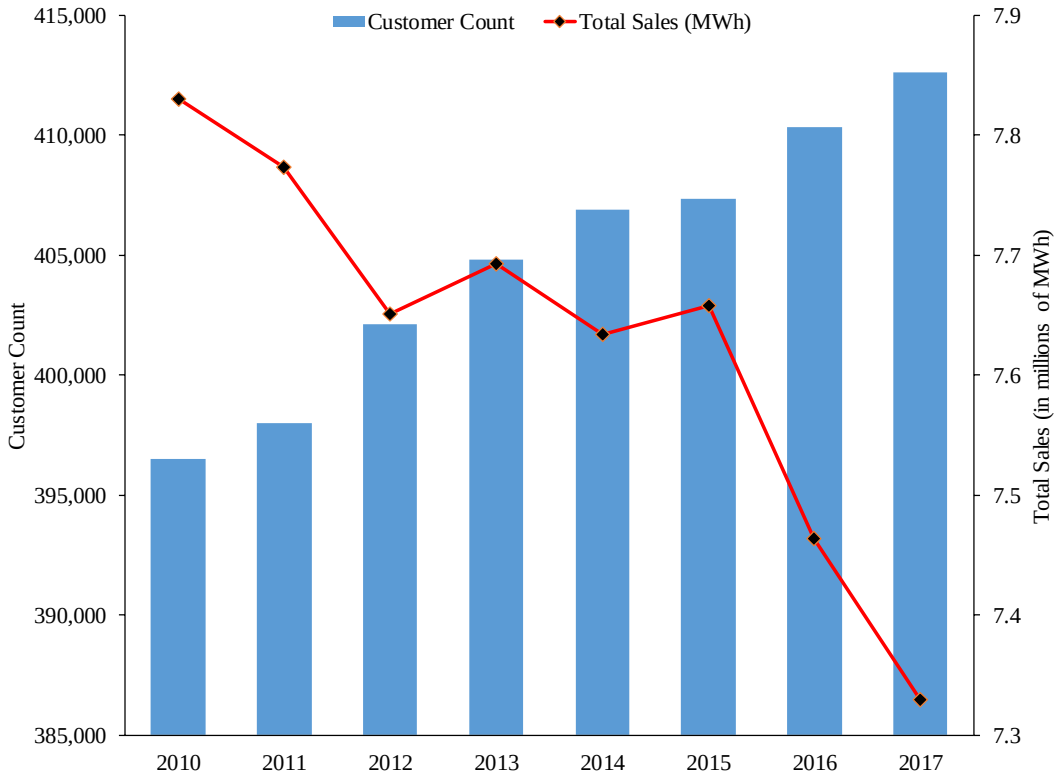
For decades, the Massachusetts IOUs have been required by the DPU to implement energy efficiency programs, subject to DPU oversight of their purpose, design, implementation and measurement. The MLPs have not faced these directives, yet over the years have learned from the efficiency programs of utilities in MA and across the country, and have invested significant resources into the development and deployment of energy efficiency programs in the municipalities in which they operate. These programs span a wide breadth of program types, and include investments in various measures and programs across all customer classes (residential, commercial, industrial). Many of these energy efficiency programs are administered through MMWEC and ENE directly, though individual MLPs also support their own programs, or supplement those run by MMWEC and ENE. Examples of energy efficiency programs include:

- Residential and commercial energy assessments (audits), combined with financial incentives for installations of identified energy efficiency measures (such as low- or zero-interest loans)
- Administration of ENERGY STAR appliance programs
- Implementation of various programs focused on increased lighting efficiency, such as commercial retrofits, residential LED replacements, discounted purchase offers, and comprehensive community streetlight LED replacement programs

- Participation in weatherization programs, offsetting costs for insulation and air sealing that can reduced both electricity consumption and heating costs
- Administration of programs providing rebates for the installation of heat pumps
- Implementation of demand management programs to reduce MLP demand during tight system condition, including lower rates for demonstrated peak usage reductions

In part through these energy efficiency programs, the MLPs have experienced reduced overall per-customer electricity demand over the past decade, helping manage an increase in the number of customers that rely on the MLPs for electric service. Figure 8 presents in total for the MA MLPs data on the number of customers receiving service and total MLP electricity sales over the same time period. Despite an increase in number of customers over the past decade by over 15,000 - roughly 4.1% percent - MLPs have realized a total *decrease* in energy consumption in this time period of approximately half a million MWh, or 6.4% percent of total annual sales.

Figure 8: MLP Historical Load and Customers, 2010 - 2017 [13]



B. Other Innovative Energy Programs

The Commonwealth's efforts to reduce the carbon intensity of the state's energy systems extends well beyond energy efficiency programs and CO2 emission reduction programs. It also includes a vast array of programs to achieve ancillary GHG reductions, support the development and commercialization of renewable energy sources and other advanced energy technologies and practices (e.g., energy storage, combined heat and power), and help reduce emissions in other carbon intensive energy sectors through electrification (e.g., of the heating and transportation sectors). The full range of programs administered or required by the state reflects an overall effort to continuously reduce carbon emissions towards eighty percent reductions by 2050, and advance those pre-commercial and advanced technologies that can help the state efficiently meet these targets.

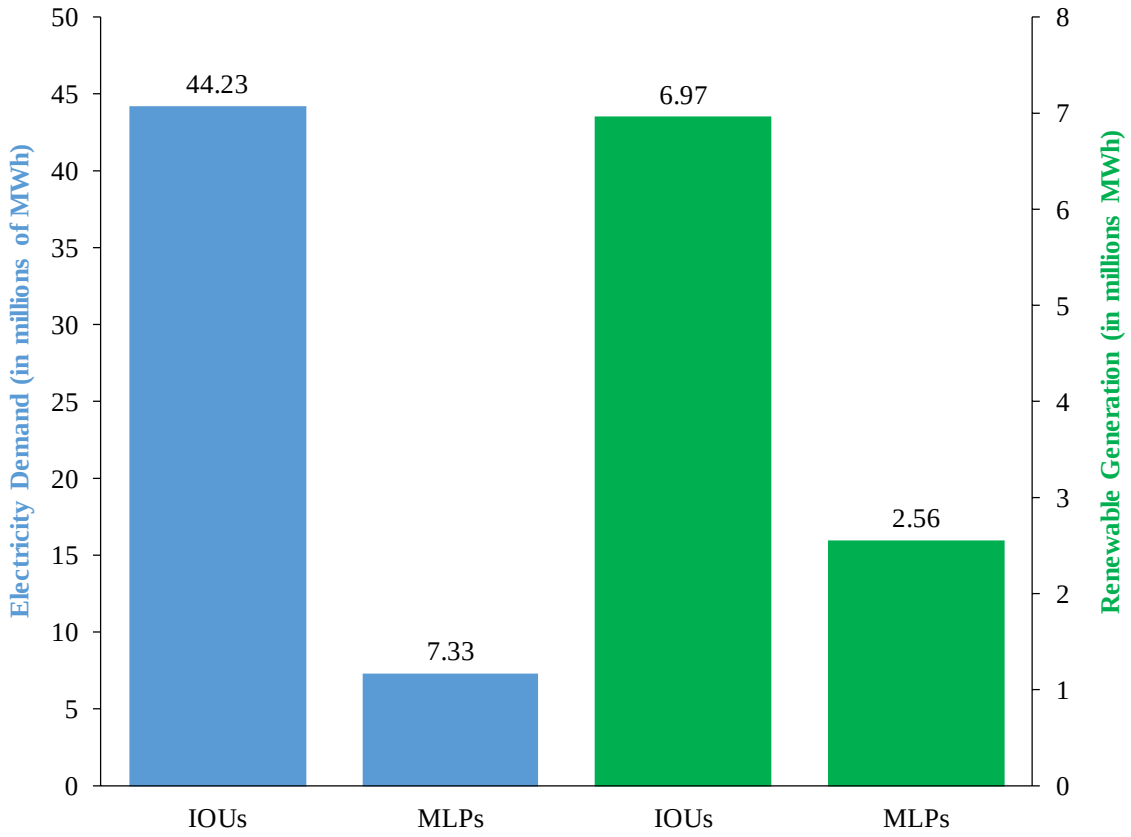
The MLP have gone further than the state's IOUs to-date with respect to the advancement of many of these resources, programs and technologies. In addition to proactive investments in energy efficiency programs (discussed above), the MLPs have successfully funded through grants and/or municipal funding, a number of innovative energy programs that represent investments in cutting-edge technologies and pilot programs for new and advanced energy initiatives. These forms of investment in advanced technologies have been relatively slow to develop at the level of the state's IOUs, in part due to the challenges of evaluating program costs and designing program goals and substance. The MLPs, however, have been able to take advantage of their lower-cost and easier path to investment in advanced energy technologies, and thus have been at the forefront of the Commonwealth's entry into these areas. Examples of these programs include:

- Electric vehicle programs, including off-peak charging credits, charger and/or vehicle rebates, and awareness and education funding
- Advance metering infrastructure deployment (AMI), including funding for installations and real-time load analysis
- Distributed solar, including community-based solar programs, incentives for solar installations, and net metering
- Energy storage, including existing batteries and upcoming installations
- Renewable energy rate schedules for voluntary customer commitments

MLP experience with these programs and investments is diverse and widespread. Some may be administered to date by a subset of MLPs, while others are widespread in their implementation. For example:

- 100% of MLPs have either already converted or are implementing LED replacements for street lighting
- MLPs currently have over 35 MWs of energy storage either in operation or currently planned
- Renewable investment and use by the MLPs represents a larger share of the Commonwealth's overall renewable portfolio than their share of load (see Figure 9)

Figure 9: Comparison of MLP Share of Massachusetts Load and Renewable Generation (2017) [14]



MLP investment in advanced technologies and practices is often overlooked, mostly because the MLP has a smaller footprint compared to larger renewable and energy efficiency investments of developers and/or IOUs. However, many of these technologies may be vital in the Commonwealth's pace and realization of energy system decarbonization, and the MLPs have served as leaders in their implementation of programs pushing advanced technologies towards commercialization, and gaining operational experience. Going forward, MLP's will likely continue to make oversized

contributions (relative to their proportion of state demand) given the MLP's ability to view project benefits through a broader lens (i.e., one that includes generation, transmission and distribution), continue to move relatively quickly with design and development, and access lower cost capital for investment.

V. Observations

The Commonwealth has set an aggressive pathway to achieving decarbonization of our energy sectors, resulting in a reduction in GHG emissions of 80 percent by 2050. This will not be easy, and will require proactive planning, investment, and operational changes across power, building and transportation sectors. Some of these - such as electrification of heating and transportation - may put additional pressure on the electric industry through increasing demand and changing load shapes. Others will depend on changes within the electric sector, requiring substantial and continuous evolution of our electricity resources towards declining and more efficient fossil-fired generation, energy efficiency investments, major increases in low- and zero-carbon generation, and the advancement of new technologies and power management practices by electric companies and their customers.

The changing economics of electricity markets - including lower and less volatile natural gas prices, increased generation efficiency, and significant cost declines for solar PV and wind generation (on shore and off shore) - have contributed to a major transition in the electric sector that has been underway for over a decade. This transition has contributed to a drop in the carbon intensity of the electric sector, and continues to open avenues to further reductions in energy sector GHG emissions. In this context, the actions of the state's IOUs and MLPs will continue to play an important role in helping the state achieve further reductions.

MLP investment, policy, and operating decisions are tied to the interests and objectives of their host communities, and are not regulated by the DPU. Consequently, the focus of most state actions to meet climate goals and requirements is directed at the IOUs, and the contributions of the IOUs are continuously evaluated against those goals. MLP contributions to the state's goals have tended to "fly under the radar," and there may be a presumption among many that on the whole the MLP's are not attentive to the state's interests.

The data on fuel mix and GHG emissions of the MLPs tell a very different story. MLP resource procurement decisions (and associated fuel mix and emissions), and their investment in advanced technologies and practices, are often overlooked, mostly because the MLP sector has a smaller footprint compared to the larger renewable and energy efficiency investments of developers and/or IOUs. However, the MLPs are far ahead of the New England region and the MA IOUs when it comes to the transition to a cleaner resource mix, a lower carbon emission portfolio, and proactive investment in the advanced energy technologies that will play a crucial role in longer-term progress.

In this report we evaluate and summarize the data on the Massachusetts MLP's resource mix, GHG emissions, and advanced energy investments. Based on that analysis, we come to several observations:

MLP specific resource choices - namely those that involve longer-term investment in specific resources or technologies - are nearly emission free.

The most important indicator of the role MLPs play in helping transition to a cleaner resource mix is reflected in the resources that the MLPs own or have under contract. These resources reflect the explicit decisions of MLPs on how to meet customer needs. As seen in Figure 3, in these selections the MLPs have assembled an owned/contracted portfolio resource mix that is 94 percent non-emitting, including primarily wind, solar, hydro, and nuclear generating assets.

Even when absorbing the fuel mix and emission characteristics of the MLP's short-term wholesale market purchases, the resulting "effective" MLP resource mix is far cleaner than that of the MA IOUs, and the broader New England region.

The MLPs round out their resource needs through shorter-term transactions in wholesale markets. In these purchases, the MLPs' resource mix is affected by factors and decisions made by other wholesale market entities (that is, outside MLP control), which determine the changing resource mix of non-MLP resources in New England. Even when incorporating these shorter-term market purchases, the MLP resource mix includes 75 percent non-emitting resources, compared to 57 percent for the region as a whole, and 47 percent for the Massachusetts investor-owned utilities.

The end result of the MLP's resource and investment decisions means that the MLP's GHG emission rate (in pounds per MWh generated) is well ahead (i.e., lower) than Massachusetts' aggregate rate, or that of the region.

The cleaner resource mix of the MLPs means that their effective carbon dioxide emission rate - in pounds of CO_2 per MWh used to meet customer needs - is far lower than that of the MA IOUs and the region as a whole. We estimate that the MLP's GHG emission rate is 60 percent lower than that of the MA IOUs, and 40 percent lower than the New England region.

The MLP's resource mix reflects the fundamental differences in company structure, decision-making processes, cost of capital, and interests of host communities.

The MLPs are not-for-profit vertically-integrated utilities that operate as a division of local government, are governed by local city councils or elected or appointed boards subject to voters' views and expectations, and are fully embedded in the communities they serve. Community ownership provides an opportunity for open citizen input into investment, operational and policy decisions governing local utility service, and for a direct and transparent line of accountability and oversight between the city's or town's citizens and the utility's management and decisions that affect cost and reliability outcomes.

These features drive the ability of the MLPs to pursue resource investment and operational decisions with an eye towards both local customer expectations and state policies and emission targets. And the MLPs can do this efficiently and proactively, given their direct access to local permitting and zoning processes and positive relationships with local government, access to low-cost capital, not-for profit viewpoint, and ability to approach resource planning for the long-term including an integrated view of utility operations (i.e., generation, transmission, and distribution).

The past trading of a portion of eligible renewable energy credits associated with MLP-funded renewable resources does not negate the positive impact of MLP investments on renewable development in the region, nor does it imply that MLPs will necessarily sell owned RECs on a going-forward basis.

MLPs do not need to obtain, purchase, take ownership of, or retire RPS-compliant renewable energy credits. Yet this has not in any way diminished MLP direct actions in support of the development of "steel in the ground" renewable projects - projects that may not have achieved development and operation based *only* on the partial financial incentive of REC value.

MLP support for real renewable development rests on the ability of MLPs to enter into long-term commitments to purchase at least the energy and capacity of eligible renewable projects, their ability to quickly pull the trigger on project development, investment, and/or contracting, and their ability to think and act proactively considering their integrated (generation, transmission and distribution) planning context. New renewable development has required or benefitted substantially from the stability and revenue guarantee of longer-term contracts for energy and capacity with credit-worthy counterparties (such as the MLPs). This arguably is at least as important as the relatively shorter-term potential revenues from the REC market.

Nevertheless, it is important to be clear about how RECs associated with MLP resources have been treated historically, what this implies for how to interpret the attributes of MLP resources in the past, and what to assume or not assume going forward.

This is an important but frequently-confused discussion, in part because MA RECs are one specific attribute of certain resources, defined through state-specific law and regulation, and in the end are only one of several marketable financial instruments of eligible generation.[15] Whether and to what extent MLPs take ownership of, retain or retire the RECs associated with the renewable resources they back is often less important to the development of renewables than the commitments of participating MLPs to invest in or purchase the actual energy and capacity from operating renewable resources on a long-term basis. Nevertheless, to the extent the RECs associated with MLP-backed resources are sold (by the resource owner/operator or the MLP, if REC

ownership is transferred by contract), it is important to be careful in how one discusses credit for this specific "renewable attribute" of the resource.

RECs are sometimes viewed as the only attribute of a resource that spurs development; but they are not the only, and in some case may not even be the most important, element of project revenue structure from the standpoint of project investment and development. For example, an MLP might contract for a zero-carbon resource, and retain for the benefit of MLP customers the energy, capacity, reliability and emission attributes of the resource. The bulk of revenue to be earned by the developer may be associated with these value streams, and the viability of the project may rest mostly on locking in these attribute values over a long-term period with the MLP (rather than leave that to the chance of regional wholesale markets). But RECs represent an additional potential value stream, and may be sold separately. If the associated RECs are sold (e.g., to a state IOU subject to the RPS), the picture of who should take "credit" for the development of the resource becomes mixed.[16]

Complicating things further is the fact that different state energy policies seek to meet different objectives. Some seek to directly reduce emissions of GHG, such as the Department of Environmental Protection's power plant emission rule (MA 310 CMR 7.74) and Regional Greenhouse Gas Initiative (RGGI). In this, the MLP ownership/contract with a low- or zero-carbon resource (whether or not the MLP holds the renewable attributes) helps the MLP achieve, and reduce the cost of, compliance with those emission reduction policies. Other policies that promote development of the same type of resource may have multiple objectives and a less direct impact on resource environmental impacts. The RPS is a good example - it seeks to increase renewable contributions to the resource mix for multiple reasons, including reducing the depletion of finite resources and increasing resource diversity, in addition to reducing the environmental impacts of electricity production over time.

Given the many layers of complication in considering the role of IOU RECs in the MLP portfolio, in this report we avoid broad, generic or undefined statements of resource characteristics such as "green" or "clean," and instead present specifically and explicitly on the emission characteristics of the MLP portfolio.

In short, it is important to not let the existence of RECs confuse the more complete picture of MLP advancement of the Commonwealth's renewable energy goals. The MLPs hold ownership in or are in contracts with a number of major regional generating assets that are eligible renewable resources under Massachusetts law, and that qualify for the issuance of RECs. The ability of MLPs to quickly act on development and contract opportunities, and to access low-cost capital for renewable investment, make the MLPs a valued investment partners for such projects. As a result, the MLPs have been a highly constructive driver of the development and construction of qualified renewable resources in New England, and have contributed to the development of actual steel in the ground, reducing retail suppliers' reliance on the state's Alternative

Compliance Payments and potentially suppressing the overall cost of meeting the state's RPS.

In balancing MLP's aggressive participation in renewables development with ratepayer interests, the MLPs have at times in the past sold RECs to other retail suppliers subject to MA RPS laws, and in those years cannot suggest operational or financial support for that quantity of resource attributes. Nevertheless, it is important to recognize that (a) historically this represents only a portion of MLP-supported renewables, (b) is only true in the years that MLPs have sold RECs, and (c) is an annual decision that can be reversed in future years. This is an important consideration for MLPs going forward, but REC sales by MLPs should not be viewed as meaningfully diminishing the role MLPs have played and will going forward continue to play in the development of eligible renewable resources.

MLPs have been a productive contributor to state energy and environmental policy, and will likely continue to help move the Commonwealth forward on its path to decarbonization on a going-forward basis

The Commonwealth is clearly on a transitional path; one that will result in a continuous decline in the CO_2 emissions associated with energy production and use in the coming decades. The data we review for this Report demonstrate that the MLPs have been a consistent, productive, and highly effective partner in Massachusetts' efforts to reduce GHG and foster the development of advanced energy technologies, and are well position to continue to support these requirements and targets on a going-forward basis. MLP's past actions also demonstrate that letting the current structure continue to be the basis for MLP actions is likely the best way to support the MLP's ongoing partnership with the state in its GHG reduction efforts. Any increase in state regulation or oversight of MLP actions may thus be counterproductive, and should be weighed carefully against the practical and historical benefits of "home rule."

Endnotes

[1] Massachusetts Department of Energy Resources, https://www.mass.gov/files/documents/2017/11/09/Electricity2015.pdf.

[2] American Public Power Association, https://www.publicpower.org.

[3] APPA, *Public Power 2018 Statistical Report*, p. 19.

[4] US Energy Information Administration, Form 861 data.

[5] **Notes**: [1] The overall rate for MLPs is calculated as the weighted average of the 40 individual municipalities average rate weighted by generation in 2017.

Sources: [1] MMWEC Residential Rate Comparison Data. [2] MMWEC/ENE 2017 Generation Data. [3] EIA 861 Data.

[6] Mass. Gen. Laws ch. 164 (1997).

[7] Wholesale market activities refers to both direct purchases from the spot market as well as market-based hedging.

[8] We note that these totals reflect the generation associated with the Pilgrim nuclear power plant as of 2017. Pilgrim's retirement in 2019 will result in the region's overall generation mix having less nuclear power generation going forward.

[9] **Notes**: [1] "Other" fuel types include Landfill Gas, Methane, Refuse, Steam, and Wood. [2] Imported power to New England is distributed to different fuel types based on NEPOOL's estimated import mix in September 2018.

Sources: [1] "2017 Net Energy and Peak Load by Source," ISO-NE. [2] NEPOOL GIS Import System Mix.

[10] **Notes**: [1] Imported power to New England and the MLPs is distributed to different fuel types based on NEPOOL's estimated import mix in September 2018. [2] Generation from market purchases is distributed to each fuel type by percentage allocated in the 2017 ISO-NE generation mix. [3] Other non-emitting sources include landfill gas, wood, methane, refuse, and steam.

Sources: [1] "2017 Net Energy and Peak Load by Source," ISO-NE. [2] EIA Form 923 Data. [3] NEPOOL GIS Import System Mix.

[11] For more information on disclosure labels, see https://www.mass.gov/info-details/information-disclosure-label.

[12] **Notes**: [1] Imported power to IOUs and the MLPs is distributed to different fuel types based on NEPOOL's estimated import mix for New England in September 2018. [2] Generation from market purchases is distributed to each fuel type by percentage allocated in the 2017 ISO-NE generation mix. [3] Other non-emitting sources include landfill gas, wood, methane, refuse, and steam. [4] The IOU overall generation mix is estimated using a weighted average of the generation mixes for Eversource and National Grid in Massachusetts.

Sources: [1] "2017 Net Energy and Peak Load by Source," ISO-NE. [2] EIA Form 923 Data. [3] NEPOOL GIS Import System Mix. [4] Western Massachusetts Electric Co. and NSTAR Electric Co. (Eversource), and Massachusetts Electric Co. (National Grid) Disclosure Labels.

[13] **Notes**: [1] Customer counts and total sales include all residential, commercial, industrial, and transportation sales for all 40 municipal utilities in Massachusetts. [2] 2015 data for Belmont was missing.

Sales and customers were estimated for Belmont in 2015 by interpolating between 2014 and 2016. [3] Customers were estimated for Taunton in 2016 by interpolating between 2015 and 2017.

Source: [1] EIA Form 861.

[14] **Notes**: [1] Investor-owned utilities include Western Massachusetts Electric Co and NSTAR Electric Co (Eversource), Massachusetts Electric Co (National Grid), and Fitcbhurg Gas and Electric Light Co (Unitil). [2] Renewable generation for investor-owned utilities is calculated by applying disclosure label generation mixes for known resources to total electricity sales.

Sources: [1] EIA Form 861. [2] MMWEC/ENE 2017 Generation Data. [3] National Grid, Eversource, and Unitil Disclosure Labels.

[15] There are a number of attributes of various resources that are separate from the "Massachusetts-eligible renewable" attribute needed to qualify for the issuance of a renewable energy credit that can count towards RPS compliance. Since the REC attribute is created and sold as a financial product separate from the capacity, energy and other attributes or benefits of a resource, it is important to try to be transparent and clear about how to interpret or credit various resource characteristics. While RECs are designed to capture the underlying fuel characteristics of a resources (that is, the "fuel" is a non-depletable resource such as sun and wind rather than a depletable/finite resource such as oil or natural gas), they do not represent other characteristics, such a dispatchability, reliability, or emissions.

[16] In this scenario it is possible that, but for the willingness and ability of the MLP to invest or enter into a long-term contract for energy and capacity, a potential renewable resource would not be developed - that is, the project would not go forward on the basis of potential REC value alone given the uncertainty of spot market sales of energy and capacity. In this instance, an IOU that would have purchased the RECs would instead have to meet compliance requirements in part through an Alternative Compliance Payment (ACP) - this technically ensures compliance with the RPS, but with less actual renewable steel in the ground.