Advancing the Clean Energy Future

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April 30, 2022

Secretary Kathleen Theoharides
Massachusetts Executive Office of Energy and Environmental Affairs
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RE: Draft Clean Energy and Climate Plan for 2025 and 2030

Dear Secretary Theoharides, Undersecretary Chang, and the 2025 and 2030 Clean Energy and Climate Plan Team:

Acadia Center appreciates the opportunity to offer comments on the Updated Interim Clean Energy and Climate Plan (CECP) for 2025 and 2030. These plans represent an opportunity to set the Commonwealth on a prosperous decarbonization path that promotes health, safety, and the environment and centers Environmental Justice. However, there is a real danger in a plan that falls short. Short-sighted investments or pursuits that lock-in the Commonwealth into maladaptive options could threaten our Commonwealth's ability to meet its ambitious net zero greenhouse gas emissions reduction targets. Therefore, it is absolutely essential to get this right now.

In December of 2020, the Executive Office of Energy and Environmental Affairs (EEA) released a full interim CECP for 2030. This document called for bold reductions in emissions from each major sector of the economy through ambitious strategies, like the deployment of heat pumps in one million homes by 2030 and the deployment of seven gigawatts of new clean energy projects. While progressive, Acadia Center and other stakeholders believed there were areas in which the plan could be improved. These stakeholders were grateful to be afforded an opportunity to see this full document and submit comments on it. Acadia Center, both individually and as part of coalitions, submitted several sets of comments outlining ways in which it believed the plans could be improved. These recommendations included adding additional policies to commit to equity and justice, the development of a comprehensive strategy to meet the one million heat pump target, and expanding public transit operations throughout the Commonwealth.

Stakeholder input and engagement is a critical part of public process, and the CECP is no exception. Acadia Center is aware and appreciative of the difficult work that EEA has performed to incorporate stakeholder comments and revise the plans. Along the way, EEA has continued to convene the GWSA Implementation Advisory Committee, held several public meetings on the CECP for 2025 and 2030, and done outreach to stakeholders. This difficult work has led to an updated plan.

However, EEA has not released the updated plan itself. As the deadline to comment approaches, the only document upon which stakeholders can rely for updated information is a 22-slide deck posted for public hearings on April 14th and 15th. Only five of these slides document changes from the interim 2030 CECP. This lack of detail stands in stark contrast to the previous comment period. In that period, stakeholders were provided with a full draft on which we could base our comments and critiques. With the level of information provided with this update, it is unfortunately

difficult to provide cohesive and comprehensive comments. For example, the slide deck lists the anticipated number of passenger EVs on the road in 2030 as 900,000. However, without a breakdown by type (e.g. plug-in hybrid versus fully electric) this target is difficult to evaluate. Acadia Center fully understands the difficult task that EEA has in getting the plan out by the statutory mandate of July 1st. However, more information is necessary to enable a healthy and full response to the Updated CECP that incorporates all voices meaningfully.

Updated CECP vs Interim CECP Comments

What was included

As stated earlier, Acadia Center submitted several sets of comments with recommendations for improvements to the Interim CECP. The organization appreciates that some of these recommendations appear to have been incorporated, including:

- Buildings
  - Developing building performance reporting methodology for the Commonwealth
  - Continuing to support weatherization and electrification, though Acadia Center would like to see this expanded to include pre-weatherization barriers and has concerns with hybrid heating proposals, which will be outlined below.
- Transportation
  - Accelerating the coordinated deployment of EV charging stations
  - Electrifying transit buses
  - Modifying EV rebate programs to accelerate deployment and expand access to electric mobility options
- Power Generation (the modifications to this section were required by the Climate Act)
  - Setting Municipal Light Plant GHG emissions standards
  - Continuing aggressive promotion of timelines for solar and offshore wind
  - Raising the Renewable Portfolio Standard
- Gas
  - Changing the approach to Gas System Enhancement Plans
  - Long-term utility infrastructure planning aligning with decarbonization

Acadia Center also commends EEA for creating a declining cap on building for heating emissions, developing municipal opt-in building scorecards at point of sale and lease, implementing the MBTA Communities and Housing Choice program, and launching a program to electrify vehicles for hire. The inclusion of these policies show the foresight necessary to achieve our decarbonization requirements.

What Wasn't Included

Unfortunately, based upon the available information, a number of critical recommendations from stakeholders appear not to have been incorporated, such as explicit protections for farmlands and forests in solar development, a regulatory or legislative target to ensure rapid progress and jump-start the marketplace for zero-emissions-ready technologies in buildings, or developing and implementing strategies to reduce vehicle miles traveled. Most

concerning, despite requests for Environmental Justice themes to be weaved into every program along with specific asks in that sector, the available information indicates a lack of explicit Environmental Justice provisions. In fact, it appears that the only explicit Environmental Justice provisions are to reform the MOR-EV program to target low- and moderate-income drivers and require equity and Environmental Justice to be included in siting board decisions. While both of these are welcome inclusions, it is not enough. There is no mention at all of other recommendations, such as requiring a diverse hiring and workforce development process, prioritizing investments in overburdened and underserved communities, and allocating funds and jobs for climate adaptation projects that benefit Environmental Justice populations. Additionally, most of the focus of the transportation sector is on electric vehicles, while public transit expansion tends to benefit Environmental Justice populations more. While all of these may end up in the final CECP, that information is not clear given the current information.

Unclear Whether Incorporated

A number of recommendations provided by Acadia Center and other stakeholders could be viewed as included in this Updated CECP. For example, Acadia Center requested the development of a specific framework for electrifying one million homes and 300-400 million square feet of commercial real estate by 2030. Acadia Center also recommended addressing Mass Save program design and cost-effectiveness accounting methods that limit electrification. The Updated CECP calls for the development of a "comprehensive Energy Transition approach to enhance Mass Save®," with a recommendation to the legislature by December 2023. This program has the potential to address those two recommendations, but without more information about the specific details of this program, it is impossible to judge. This evaluation is emblematic of the difficulties of evaluating the plan updates overall. Other stakeholder recommendations, like greatly expanding public service, are also possibly touched upon in the slide deck. The Updated CECP slides reference fully funding the MBTA Bus Modernization Program, but without more specific details it is difficult to judge on the merits.

In-Depth Modeling Concerns

As stated earlier, it is difficult to comprehensively judge the updated CECP with the level on information provided. However, Acadia Center does have major concerns about some of the provisions outlined in the slide deck. Acadia Center will cover those issues more in-depth here.

Concerns Related to Hybrid Heating

As it relates to the building sector, slide 14 of the April 14th presentation mentions: *"Expanding the definition of electric space heating to explicitly include hybrid heating solutions (for example a heat pump serving greater than 50% of heating demand, with a back-up fossil fuel system)."* This is a significant change from the metric included in the Interim CECP, which called for the full electrification of approximately a million housing units and full electrification of 300-400 million square feet of commercial building space by 2030.

All-electric buildings have a clear path to carbon neutrality as the electric grid becomes carbon-free over the ensuing decades – however, homes and businesses that have a long-term dependence on hybrid electric/gas heating systems do not, particularly if these buildings are relying on gas to supply nearly half of their total heating demand. This less aggressive hybrid heating metric results in a proposed GHG emission sublimit for the buildings sector by 2030 that is *37% higher* than the sublimit initially proposed in the Interim CECP. In addition,

promoting hybrid heating systems has potential ramifications beyond 2030 if not executed properly, as many of the fossil fuel boilers and furnaces installed over the next decade will still be operational well into the 2040s and even 2050s, and perpetuate the investment in gas distribution infrastructure that consumers may be paying for into those later decades as well.

Acadia Center encourages EEA to instead adopt policies that promote full electrification at every decision point, relying on hybrid heating solutions only when full electrification is not possible, for economic or technical reasons. Even then, any plan or policy promoting hybrid electrification as an intermediate step to full electrification of buildings needs a clearly articulated plan that details 1) Why hybrid heating is the best short-term approach; 2) How this near-term hybrid heating approach cost-effectively sets up buildings up for an eventual transition to all-electric heating, and; 3) How does the proposal to promote hybrid heating take into consideration the fact that we need to strategically decommission the gas distribution system over the coming decades? The details provided to stakeholders so far in the CECP process do not offer enough answers to any of the above questions. For this reason, it is impossible to fully articulate a response to the proposal.

Acadia Center hopes that the CECP proposal to rely heavily on hybrid heating systems is not the result of the findings of the recently released D.P.U. 20-80 Future of Gas report. The study pushes the narrative that a heavy reliance on hybrid gas heating systems offers one of the most cost-effective pathways to decarbonization of the buildings sector, but the analysis underlying this narrative is significantly flawed. The Future of Gas modeling, led by consulting firm Energy and Environmental Economics (E3), relies heavily on biomethane (often referred to as "RNG") in the Hybrid Electrification Scenario. For example, RNG accounts for over 80% of the total energy flowing through the pipes to homes and businesses in 2050 under the Hybrid Electrification Scenario.

Several of the key flaws in the analysis that undermine the validity of the Hybrid Electrification scenario as a viable path to economy-wide decarbonization by 2050 are listed below. For more information on these concerns, please see Acadia Center's December 2021 comments related to the Future of Gas draft scenario analysis found here. All of these concerns still hold true in the final analysis developed by E3.

- **Concern #1: Making a blanket assumption that all forms of RNG are carbon neutral.** This is simply not the case, particularly when considering significant methane leaks along the entire RNG supply chain.[1] RNG is methane and the same problems natural gas presents from a methane leak perspective hold true with RNG. The GHG accounting in the Massachusetts Greenhouse Gas Inventory ("MA GHG Inventory") has serious problems – these problems are amplified when decarbonization modeling, like that conducted by E3 in the Future of Gas, are repeated and used as the basis for making policy recommendations. **In Appendix 1 at the end of this document, Acadia Center has included our December 2021 letter to EEA on considerations for Massachusetts GHG accounting methodologies.**

[1] Emily Grubert 2020 Environ. Res. Lett. 15 084041 https://iopscience.iop.org/article/10.1088/1748-9326/ab9335

Just like the MA GHG Inventory, E3's analysis significantly underestimates the level of methane leaks in the current gas distribution system, ignores the GHG impacts of methane leaks occurring outside of the Commonwealth, uses an outdated global warming potential value for methane, and does not consider the global warming impacts of methane on a 20-year timescale. New York Switching from one form of methane to another (natural gas to RNG) does nothing to solve this problem. Switching from one form of methane to another (natural gas to RNG) does nothing to solve this problem. Switching from one form of methane to another (natural gas to RNG) does nothing to solve this problem.[2] Switching from one form of methane to another (natural gas to RNG) does nothing to solve this problem.

- **#2: Overestimating the supply of RNG that will realistically be available to the Commonwealth in the future and downplaying the intense level of future competition for biomass feedstocks from other states and other sectors of the economy.** Truly sustainable biomass that can be utilized to produce biofuels is extremely limited. The same biomass feedstocks that could be used to produce RNG for use in buildings, a sector that is relatively easy-to-electrify, will be needed to help decarbonize the sectors of the national economy that are hardest-to-electrify; including high-heat industrial applications, marine shipping, and aviation.

  There is near-universal consensus among experts that limited supplies of biofuels and green hydrogen should be prioritized for the hardest-to-electrify sectors - this is one of the reasons that none of the five decarbonization pathways modeled in the Princeton Net-Zero America (NZA) Project found it cost effective to use biomass to produce biofuels for use in buildings, instead prioritizing these fuels for hard-to-electrify sectors.[3]

- **#3: Underestimating the future price of RNG, assuming that it will be available at a significantly lower price than more reasonable projections suggest.** In E3's Hybrid Electrification Scenario, once the supplies of RNG are exhausted and the blending limitations of hydrogen in the gas system are reached, the only remaining fuel available to *theoretically* decarbonize the gas system is synthetic natural gas (SNG). Production of SNG relies on three separate incredibly expensive processes: 1) Green hydrogen production via electrolysis, 2) Direct air capture of CO_2, and 3) Methanation which converts hydrogen and CO_2 to SNG.

  Despite the two fuels being chemically identical - they're both just methane - E3's analysis assumes that there is no connection between the market clearing price of the SNG and the market price of RNG. This defies basic supply and demand economics. In reality, the higher cost of SNG will set the market clearing price and drive up the cost of chemically identical RNG. The end result is a significantly higher price for

[2] New York State Department of Environmental Conservation 2021 Statewide GHG Emissions Report, Page 17, Table A1 https://www.dec.ny.gov/docs/administration_pdf/ghgsumrpt21.pdf

[3] Princeton University Net Zero America Project Final Report, pages 30-33. https://netzeroamerica.princeton.edu/the-report

RNG than the Hybrid Electrification Scenario assumes, significantly driving up the overall cost of the scenario.

Simply put – there is no viable path to full decarbonization of the building sector using hybrid gas heating systems as a long-term approach. Proposals that suggest there is a viable path gloss over the lifecycle GHG emissions of biofuels, the extremely limited supplies of biofuels and green hydrogen, the massive opportunity cost of using these fuels in buildings rather than hard-to-electrify sectors, and the extremely high cost of these fuels. **The above points articulate why the CECP's proposal to pursue 20% biodiesel blending in heating oil and 5% "decarbonized fuel" blending (presumably RNG of hydrogen) in the gas distribution system by 2030 is badly misguided.**

If EEA and the Clean Heat Commission see hybrid electrification over the next 10 years as a viable intermediary step to whole-building electrification in the 2030s and 2040s, they need to provide more detailed information to stakeholders including:

- What analysis is informing the decision to purse hybrid heating rather than whole-building electrification? What are the results of the updated EnergyPATHWAYS analysis that led to this decision?
- Why was the definition of electrification adjusted to a heat pump serving greater than 50% of annual heating demand for a building? Why not greater than 70%? 80%? 90%? What are the cost-benefit tradeoffs with these different levels of hybrid electrification?
- What policies and programs are needed to eventually transition customers from a partially electrified home to a fully electrified home?
- How will these policies address system design challenges associated with multiple customer intervention points (e.g. one intervention to design and electric system capable of serving a fraction of total heating demand, a second intervention X years later to design and install an electric heating system capable of serving the full heating demand)? Are the downsides of this multiple intervention approach worth the benefits?
- Is EEA envisioning policies promoting hybrid electrification to only incentivize cold climate heat pumps that are capable of providing space heating well below 0 degrees Fahrenheit? Why or why not? It's Acadia Centers view that there is no downside to exclusively incentivizing the use of cold climate heat pumps. The upside is two-fold: 1) In the short-term, hybrid heated buildings would be able to electrify and decarbonize a greater share of their space heating demand through the use of cold climate heat pumps and 2) Cold climate heat pumps better position these hybrid heated buildings for an eventual conversion to all-electric.
- Perhaps most importantly, what does the EnergyPATHWAYS model envision as the long-term role of the gas distribution system and how does this interact with the promotion of hybrid heating solutions? What is the scale and timing of gas system decommissioning that the EnergyPATHWAYS analysis finds most cost-effective?

The above represents just a small portion of the questions that need to be answered for stakeholders to make truly informed, substantial comments on the CECP proposal to pursue hybrid electrification.

Concerns Related to EV Charging Infrastructure

As it relates to the transportation sector, intelligently and efficiently deploying electric vehicle charging infrastructure at scale will be essential to achieving the 2030 GHG transportation sector sublimits. However, Acadia Center has several concerns related to proposed EV charging targets in the CECP.

Slide 13 of the April 14th presentation references a transportation sector target of achieving "*75,000 public, level 2 and DC fast chargers installed*" by 2030. This target should be broken out into two metrics – one for the number of public level 2 chargers installed and one for number of public DC fast chargers installed (DCFC). Bundling these targets together muddles the fact that these two types of chargers – with very different speeds of charging - serve dramatically different roles in accelerating EV adoption. Most public level 2 chargers are a "nice to have," while having a sufficient number of DC fast chargers located along key corridors is absolutely essential for quelling range anxiety and accelerating EV adoption at the scale the Commonwealth desperately needs. No one is going to buy an EV because their local grocery store offers a level 2 charger they can use for 30 minutes while they go shopping. They're going to buy an EV when they have access to overnight charging at or near their home and DCFC along key transportation corridors.

None of the EV metrics shared with stakeholders reference targets for the deployment of EV charging in either new or existing multi-family construction. This is one of the areas where policies driving investments in level 2 chargers, and even the even slower level 1 chargers, are desperately needed to drive EV adoption. The Stretch Code and Net Zero Stretch Code proposed by DOER only call for 10% and 20%, respectively, of parking spaces in multi-family residential buildings to be "EV Ready". Simply put, this is not nearly enough charging for residents living in multi-family buildings given the anticipated speed of EV adoption called for in the CECP. Not all residents of multi-family buildings need parking, but each housing unit that *does* come with dedicated parking needs access to at least one EV charger. This principle also doesn't just apply to new construction – the Commonwealth must also prioritize rapidly expanding EV charging infrastructure to existing multi-family buildings that already have on-site parking.

Please see Acadia Center's March 18th comments on DOER's Stretch Code Straw Proposal for more details on our concerns related to the proposed levels of EV charging in the Stretch Code and Net Zero Stretch Code. Access to EV charging in multi-family residential buildings isn't just a climate issue, it's an environmental justice issue. EV adoption has been disproportionately concentrated among wealthy, white, single-family homeowners. Prioritizing expanded EV charging access to multi-family residents is a critical part of making EVs more accessible to less advantaged residents of the Commonwealth.

Massachusetts desperately needs an overarching EV charging infrastructure plan that strategically identifies policies and programs that will most effectively deploy EV charging infrastructure in a manner that supports the scale of EV adoption needed to achieve overarching climate targets, including the 2030 transportation subsector target in the CECP. Some example of plans from neighboring or nearby states with a focus on EV charging infrastructure deployment include those developed in Pennsylvania, Rhode Island, and Connecticut.

Acadia Center urges EEA to consider establishing aggressive, measurable metrics related to deployment of DC fast charging along key corridors and the deployment of EV chargers in multi-family residential buildings. A comprehensive plan guiding these efforts will also be critical to this effort.

Implications for Aggressive Sector-specific GHG Reductions Projected for 2025-2030

Slide 10 of the April 14th presentation provides information on historic GHG emissions by sector for 1990 and 2020 and the proposed GHG sublimits by sector for 2025 and 2030. The slide focuses on the percent change in emissions by sector from a 1990 baseline to the future year, either 2025 or 2030. However, what the slide doesn't directly focus on is the proposed percent change in sector emissions over the 2020-2025 and 2025-2030 five-year time periods. Below, the data from slide 10 is presented in a different format.

Table 1: CECP Proposed Emissions Sublimits by Sector for 2025 and 2030 and Proposed Percent Change in Emissions from 2020-2025 and 2025-2030

Sectror	2020 GHG Emissions	2025 GHG Emisisons Proposed Sublimit	2030 GHG Emisisons Proposed Sublimit	% Change GHG Emissions 2020-2025	% Change GHG Emissions 2025-2030
Power	12.9	13.2	8.5	2%	-36%
Comm. & Indus. Heating	11.7	11.4	7.5	-3%	-34%
Industrial Processes	4.1	3.6	2.5	-12%	-31%
Residential Heating	12.9	11.1	8.6	-14%	-23%
Transportation	23.9	23.1	18.7	-3%	-19%
All Other Sources	1.2	1.0	0.9	-17%	-10%
Natural Gas Dist. Services	0.5	0.4	0.4	-20%	0%
TOTAL	**67.2**	**63.8**	**47.2**	**-5%**	**-26%**

What jumps off the page is that the proposed 5-year percent changes in total GHG emissions is *significantly* higher in the 2025-2030 time period (26% decrease) than in the 2020-2025 time period (5% decrease). This difference is even more pronounced in particular sectors. For example, the Power Sector shows a projected 2% *increase* in emissions from 2020-2025 compared to a 36% decrease from 2025-2030. The Commercial and Industrial Heating Sector shows a projected 3% decrease from 2020-2025 compared to a 34% decrease form 2025-2030.

While it will be a terrific accomplishment if these aggressive sector-specific emissions reduction sublimits are achieved, it's extremely difficult to comment on these targets without more detailed information on the proposed policies and programs that will be needed to drive these sharp declines in emissions, particularly over the 2025-2030 period. For example, a 34% decrease in Commercial and Industrial Heating emissions between 2025 and 2030 would be nothing short of a heroic accomplishment, but the details provided to date on the actual approach for accomplishing this monumental undertaking have been few and far between. Stakeholders need more information if we're expected to provide informed comments on whether the specific sub-sector targets make sense in the context of the Commonwealth's overarching 2030 emissions reduction target. For example:

- What is the logic behind targeting a 23% reduction in residential heating from 2025-2030, but a much higher target of a 34% reduction in commercial and industrial heating over the same time period?

- Did the EnergyPATHWAYS model determine that a more aggressive 5-year reduction in commercial and industrial heating emissions was more cost-effective than an equivalent reduction in residential heating emissions?
- What are the key policies and programs that will be needed to drive the 34% reduction in commercial and industrial heating emissions over five years? What is the relevant GHG reduction contribution from each policy and program?
- What is the average level of electrification anticipated in the 300-400 million square feet of commercial building space that is being targeted by 2030? Is electric heat assumed to account for 55% of space heating demand in those buildings? 70%? 80%?
- Is the 19% reduction in residential space heating from 2025-2030 aggressive enough given the potential risk of not achieving the significantly more aggressive targets in commercial and industrial heating (34% reduction) or power generation (36% reduction)?

These questions represent just a small subset of the questions that stakeholders need answers to in order to be able to intelligently comment on the proposed subsector targets and the policies and programs that are needed to actually achieve these targets.

Thank you for the opportunity to provide additional comments in this incredibly important process. If you have questions or concerns, please do not hesitate to reach out.

Sincerely,

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Appendix 1: Acadia Center December 21, 2021 Letter to EEA on Considerations for Massachusetts GHG Accounting Methodologies

Via Email

December 21, 2021

Undersecretary Chang
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Considerations for Massachusetts GHG Accounting Methodologies

Dear Undersecretary Chang,

Thank you for taking the time to meet with Acadia Center on November 16, 2021. One of the topics that came up during our discussion was current greenhouse gas (GHG) accounting practices in the MassDEP Emissions Inventories ("MA Inventory") and how limitations related to these accounting practices could potentially hinder the ability of policymakers to make fully informed decisions on the most optimal decarbonization pathways for the Commonwealth. Acadia Center has four key areas of concern related to GHG accounting in the MA Inventory and thinks there is an opportunity to bring the MA Inventory in line with more accurate accounting practices by:

1) Capturing out-of-state emissions from extraction and transmission of fossil fuels that are ultimately consumed in the Commonwealth.

2) Relying on 20-year global warming potential (GWP) values that are on a timescale well aligned with the Commonwealth's GHG emissions reduction targets.

3) Accounting for the net GHG impacts of producing biofuels and measuring biomethane emissions against the counterfactual (e.g., not intentionally producing biogas in the first place or diverting biogas from flaring).

4) Quantifying emissions associated with "green" and "grey" hydrogen imported from out-of-state based on the emissions resulting from the production of the fuel.

Acadia Center outlines these concerns in greater detail below and suggests potential paths forwards for improved GHG accounting practices in the Commonwealth.

Fossil Fuel Extraction and Transmission Accounting

Acadia Center recommends that Massachusetts account for emissions resulting from the extraction and transmission of fossil fuels (ultimately consumed in Massachusetts) occurring outside the borders of the Commonwealth. This GHG accounting change will put electricity and fossil fuels consumed in Massachusetts on a more equal playing field from a GHG accounting perspective and more accurately capture the true GHG implications of continued fossil fuel consumption in the Commonwealth.

In the case of natural gas, the MA Inventory only accounts for GHG emissions resulting from natural gas transmission and distribution losses occurring within state borders. In contrast, the MA Inventory accounts for GHG emissions resulting from electricity transmission and distribution losses that occur outside of the state as required by M.G.L. c. 21N, section 1:[4]

" 'Statewide greenhouse gas emissions', the total annual emissions of greenhouse gases in the commonwealth, including all emissions of greenhouse gases from the generation of electricity delivered to and consumed in the commonwealth, ***accounting for transmission and distribution line losses, whether the electricity is generated in the commonwealth or imported****; provided, however, that statewide greenhouse gas emissions shall be expressed in tons of carbon dioxide equivalents."*

This inconsistency between electricity and fossil fuel accounting is one of the reasons the New York Climate Leadership and Community Protection Act (CLCPA 2019) required adjustments to New York's GHG accounting practices to account for the GHG emissions resulting from both the extraction and transmission of fossil fuels imported into New York:[5]

"The statewide greenhouse gas emissions report shall also include an estimate of greenhouse gas emissions associated with the generation of imported electricity and with the ***extraction and transmission of fossil fuels imported into the state which shall be counted as part of the statewide total.****"*

The New York State Department of Environmental Conservation (NYSDEC) is taking what is referred to as an "upstream fuel cycle emission factor" approach to comply with the CLPCA.[6] This approach quantifies GHG emissions resulting from the extraction, processing, and transmission of fossil fuels (natural gas, coal, petroleum products) outside the state borders of New York. For example, with natural gas, this approach would account for GHG emissions associated with extraction, gathering and boosting, processing, and transmitting the fuel by using National Energy Technology Laboratory (NETL) natural gas model data and U.S. Greenhouse Gas Inventory (GHGI) emissions data.

One question that came up during our call on November 16th was around the topic of potential issues from considering upstream emissions from fossil fuels while simultaneously not considering the upstream emissions from renewable electricity generation (e.g., embodied wind turbine emissions from streel production). While NYSDEC has

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[4] M.G.L. c. 21N, section 1 https://malegislature.gov/Laws/GeneralLaws/PartI/TitleII/Chapter21n/Section1

[5] New York Senate Bill S6599 ("CLCPA") https://www.nysenate.gov/legislation/bills/2019/s6599

[6] NYSDEC Technical Conference: Oil and Gas Emissions Accounting webinar: https://meetny.webex.com/recordingservice/sites/meetny/recording/c70b87ddede64ec891f87fde6803080c/playback

not directly addressed this topic to date, Acadia Center thinks New York's approach is reasonable and warranted given the following two points:

1) There are embodied emissions associated with both fossil fuel extraction and the construction of renewable electricity generation technologies. Just as the New York approach is not capturing embodied natural gas drilling rig emissions from steel production, it is also not capturing embodied wind turbine emissions from steel production.

2) The equivalent of accounting for embodied wind turbine emissions (e.g., from steel production) would be accounting for the embodied natural gas power plant emissions (e.g., from cement production). The New York approach is not capturing embodied emission of either.

100-year vs. 20-year GWPs GHG Accounting

Acadia Center recommends that Massachusetts quantify GHG emissions using GWP-20 values. This approach more accurately reflects the GHG impacts of methane on timescales relevant to the Commonwealth's and global GHG reduction targets.

The MA Inventory currently relies on 100-year GWPs. In New York, the CLCPA required that the state's GHG accounting switch from utilization of 100-year GWPs to 20-year GWPs given that a 20-year time horizon is more relevant to the goal of net zero emissions by 2050:[7]

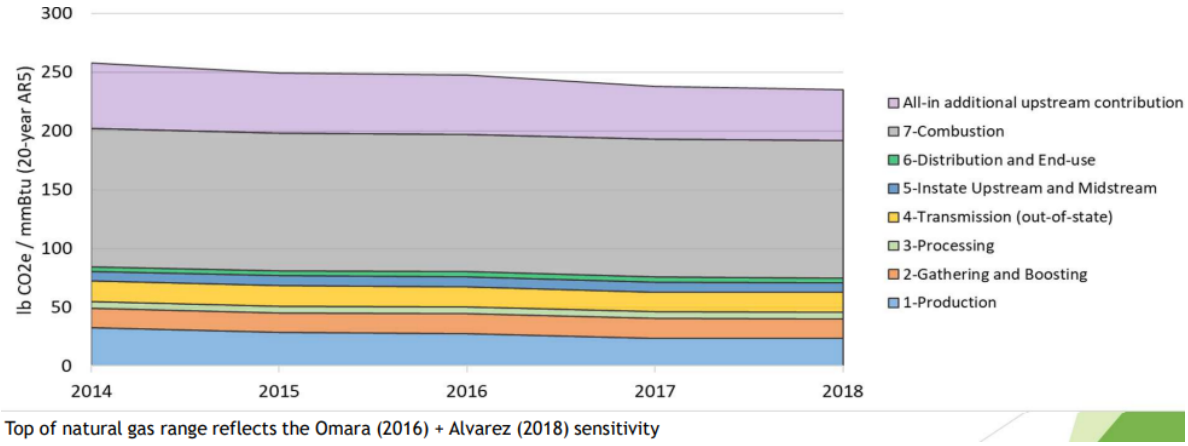
" 'Carbon dioxide equivalent' means the amount of carbon dioxide by mass that would produce the same global warming impacts as a given mass of another greenhouse gas over an integrated ***twenty-year time frame*** *after emission."*

Figure 1 below is a screenshot from the NYSDEC *Technical Conference: Oil and Gas Emissions Accounting* webinar held on March 26, 2021. This figure demonstrates the overall impact on the natural gas emission factor resulting from the two accounting changes (out-of-state extraction and transmission, 20-year GWPs) currently being implemented in New York. The 235.4 lbs CO_2e/MMBtu 2018 natural gas emission factor from the figure below is over two times higher than the combustion-only emission factor of natural gas of 116.98 lbs CO_2e/MMBtu, highlighting the magnitude of this change in accounting principles.[8]

[7] New York Senate Bill S6599 ("CLCPA") https://www.nysenate.gov/legislation/bills/2019/s6599

[8] NYSDEC "Upstream Fuel Cycle Emission Approaches and Sensitivities: Methodologies and Results", slide 33. https://www.dec.ny.gov/docs/administration_pdf/upstreamerg.pdf

Figure 1: NYSDEC Preliminary Natural Gas "Well-to-Combustion" Emissions Factor



Biomethane GHG Accounting

One of the key limitations of the MA Inventory is that it treats biogenic emissions as an informational item and does not consider the impact of biogenic emissions on overall statewide emissions totals. The use of biofuels that are purported to be low carbon or carbon-neutral is likely to increase in coming years, and certainty regarding that accounting will become even more necessary. Acadia Center recommends that the Commonwealth establish GHG accounting principles that clearly assert that 1) Biogenic emissions should impact total reported emissions in the MA Inventory and 2) Biogenic emissions from biofuels need to be measured against the counterfactual (e.g., not intentionally producing biogas in the first place or diverting biogas from flaring to produce biomethane). These accounting practices are critical to establish now given they significantly impact modeling assumptions of studies like D.P.U. 20-80 (which relies heavily on biomethane across multiple scenarios).

As an example of current biofuel GHG accounting the MA Inventory, only the CH_4 and N_2O GHG emissions resulting from combustion of biogas are captured in the "non-biogenic" portion of the MA Inventory. These CH_4 and N_2O emissions represent a small fraction of total biogas combustion emissions and even a smaller fraction of the total net GHG emissions resulting from the biofuel supply chain (including production, processing, and transmission). This accounting of biofuels is gross simplification of a complex issue, particularly in instances where biogenic emissions result from the production, processing, and transportation of biomethane.

Energy crops, sometimes referred to as "intentionally produced biogas", are the most problematic biomethane feedstock for a number of reasons, including the net GHG implications of indirect land use changes. Even excluding energy crops, many of the pathways for producing biomethane via biogas are problematic from a GHG emissions perspective. Typically, biogas produced at facilities, including wastewater treatment plants and landfills, is either vented or flared. While both processes release GHG emissions, flaring is much preferable from a GHG emissions perspective since it converts CH_4 to CO_2 prior to being released into the atmosphere.[9] This is one of the reasons

[9] Greenhouse Gas Protocol "Global Warming Potential Values" https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential-Values%20%28Feb%2016%202016%29_1.pdf

California requires all municipal waste landfills to install gas collection and control systems that have a "methane destruction efficiency" of at least 99%.[10] Alternative to venting or flaring, biogas can be captured and processed to produce biomethane.

Research suggests that total supply chain methane leakage from RNG intended for pipeline injection typically ranges from 2.8-4.8% but can range as high as 15.8%.[11] The same study assumed a reasonable natural gas supply chain leak rate of 2.8%. Assuming an average 3.8% RNG supply chain leak rate, a 2.8% natural gas supply chain leak rate, and using 20-year global warming potential (GWP) values, the methane leakage GHG footprint of RNG derived from intentionally produced sources of biogas (e.g., energy crops) is 50% of the combustion plus methane leakage GHG footprint of natural gas. Using the same assumptions, the methane leakage GHG footprint of RNG derived from waste biogas diverted from flaring is 33% of the GHG footprint of natural gas.[12] Under any scenario where the RNG supply chain leak rate exceeds 5.8% for RNG produced using intentionally created biogas or 6.8% for RNG produced using biogas diverted from flaring, the RNG GHG footprint exceeds that of natural gas.

Considering the GHG implications of CH_4 leaks, RNG produced through biogas upgrading can only potentially be considered a carbon-neutral replacement for natural gas if the RNG supply chain leak rate is 0% (for intentionally produced biogas) or held under 1% (for waste biogas diverted from 99% efficient flaring). Given this information, and the extreme technical challenges with achieving these leak rates, sensible climate policy aimed at minimizing net GHG emissions would 1) Require biogas that is currently being vented to instead be captured and 2) Dictate that the biogas be flared or used in a CHP plant on-site, rather than upgraded to RNG. Understanding this concept is critical to understanding why the MA Inventory's current approach of treating all biogenic emissions as having no impact on the Commonwealth's total reported emissions is problematic – the net GHG implications of biomethane are highly variable depending on the original source of the biogas and the methane supply chain leak rate.

While there is currently no certification process or mechanism in place for tracking types of biogas production (e.g., intentionally produced biogas from energy crops, biogas diverted from flaring, etc.), it is likely that such a system will be needed at a state, regional, or national level if reliance on biomethane grows. In the meantime, it's reasonable that the baseline assumption should be that the biogas used to produce biomethane has either been intentionally produced or diverted from flaring – if it can be captured to produce biomethane it can be flared.

Hydrogen GHG Accounting

Acadia Center recommends that, given the energy carrier nature of both hydrogen and electricity, the Commonwealth establish GHG accounting principles that clearly assert that imported gray hydrogen and imported green hydrogen will not both be treated as carbon neutral fuels and that the emissions resulting from the production

[10] California Air Resources Board, Subchapter 4, Article 4, Subarticle 6. https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2009/landfills09/landfillfinalfro.pdf
[11] Emily Grubert 2020 Environ. Res. Lett. 15 084041 https://iopscience.iop.org/article/10.1088/1748-9326/ab9335
[12] Ibid.

of hydrogen, regardless of whether that production occurs in or out of state, will directly impact the reported emissions total in the MA Inventory.

Hydrogen, like electricity, is an "energy carrier" that allows the transport of energy in a usable form from one location to another. Like electricity, hydrogen must also be produced from another substance. For example, hydrogen can be produced in a carbon neutral process using electrolyzers powered by 100% renewable electricity. At the other extreme, hydrogen can be produced through the emissions-intensive process of steam methane reforming. The emissions associated with creating 1 MMBtu of hydrogen via steam methane reforming are approximately 45% greater than the emissions resulting from the combustion of 1 MMBtu of natural gas (76.92 kg CO_2 per MMBtu for hydrogen vs. 53.06 kg CO_2 per MMBtu of fossil gas).[13] And like electricity, the GHG intensity of the production should be included in the inventory for products produced in state and imported.

The MA Inventory is currently set up in such a way that the emphasis is on the eventual "end use," rather than the GHG intensity of the fuel production, where more significant concerns arise. For example, imported hydrogen from New Hampshire produced via steam methane reforming has zero impact on GHG emissions in Massachusetts if the hydrogen is consumed in a fuel cell. Using this logic, there is no emissions reduction benefit to Massachusetts of importing carbon-neutral green hydrogen versus importing carbon-intensive gray hydrogen. It's the equivalent of treating imported electricity generated via coal and imported electricity generated via wind as carbon neutral forms of electricity from a Massachusetts GHG perspective, and quite problematic.

New York has not begun to address GHG accounting of hydrogen because the CLCPA GHG accounting language was limited to fossil fuels. This is concerning given the recent focus, both in New York and Massachusetts (see D.P.U. 20-80), on exploring the potential of blending hydrogen into the gas distribution similar. While there is currently no certification process or mechanism in place to track the GHG intensity of hydrogen production, it is likely that such a system will be needed at a state, regional, or national level if reliance on hydrogen grows as many projections expect it to. In the meantime, it's reasonable to assume that hydrogen is "grey" unless proven otherwise given that 95% of global hydrogen production is produced through steam-methane reforming.[14]

[13] EPA Emission Factors for Greenhouse Gas Inventories, 2018. https://www.epa.gov/sites/default/files/2018-03/documents/emission-factors_mar_2018_0.pdf

[14] U.S. Department of Energy "Hydrogen Production: Natural Gas Reforming." https://www.energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming

Conclusion

The recommendations outlined in this letter have the potential to significantly improve the overall accuracy of GHG accounting in the Commonwealth and, as a result, the effectiveness of state policies aimed at reducing GHG emissions that are ultimately attributable to Massachusetts. Thank you for taking the time to review Acadia Center's concerns and recommendations related to these GHG accounting issues.

Sincerely,

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