Date: August 3, 2022

To: Travis Warner
Cc: Chair Dan Scripps
Commissioner Tremaine Phillips
Commissioner Katherine Peretick
Mike Byrne
Re: Comments to the Michigan Public Service Commission on the Renewable Natural Gas Study Draft and June 29 Presentation

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Thank you for the opportunity to provide written comments on the draft Renewable Natural Gas (RNG) Study in response to Public Act 87 of 2021. On June 7, 2022, ICF Resources L.L.C (ICF) submitted to the Michigan Public Service Commission the Draft of the Michigan Renewable Natural Gas Study (Draft Study). As you know, stakeholder feedback on the report is critical for ensuring that the Michigan Public Service Commission (MPSC or Commission) and its consultant, ICF, are putting forth the most accurate and informed data of RNG's potential in Michigan. This is an important study as we continue to identify pathways for decarbonizing our state and our economy and we look forward to continuing the conversation.

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1. RNG Will Play a Limited Role in Meeting the State's Decarbonization Goals

As we will discuss in our comments, we have serious concerns that the RNG potential in this study is overstated, its greenhouse gas (GHG) impacts not fully explored, and that the analysis of the GHG reduction potential of RNG as compared to alternatives for the gas utility sector is limited and flawed. While these concerns warrant significant revisions to the report (as discussed in more detail in the below comments), it is nonetheless important to highlight the Draft Study's current findings on RNG potential.

As currently written, the report demonstrates only limited potential for RNG to meet the state's decarbonization goals. ICF has calculated achievable and feasible potentials of 57.2 tBtu/yr and 148 tBtu/yr, respectively. These potentials represent approximately *6 percent* and *15 percent* of Michigan's annual natural gas use.[1] Even these modest estimates likely overstate the RNG that will be available specifically to Michigan – of note, the Draft Study does not account for competing demands for RNG across different sectors and states, such as demand for Michigan's RNG to satisfy the Federal Renewable Fuel Standard and the California and Oregon Low Carbon Fuel Standards transportation programs. As evidence of these competing demands, California's Low Carbon Fuel Standard credits are currently driving the development of RNG

[1] From 2016-2020, the EIA reports that the State of Michigan used approximately 930,000 MMcf of natural gas annually. 57.2 tBtu/yr and 148 tBtu/yr equals 54,996 MMcf/yr and 142,719 MMcf/yr, respectively. For Michigan natural gas use, please see https://www.eia.gov/dnav/ng/NG_CONS_SUM_DCU_SMI_A.htm.

projects in Michigan[2] and across the Midwest.[3] We also note that, if the environmental attributes from RNG are used for compliance with federal and state climate programs outside of Michigan, then those environmental are not available to be claimed by Michigan entities for meeting the state's 2050 goal. The likelihood for Michigan's RNG to be used outside the state or for other competing economic sectors is not sufficiently addressed in the Draft Study.

RNG from certain feedstocks (like capturing landfill gas) may play a role in helping the state meet its decarbonization goals. However, as the Draft Study shows, even under the most optimistic scenarios RNG will be incapable of displacing fossil gas on anything close to a 1:1 basis. As such, it will be important for state policymakers and the Commission to identify how to allocate its limited resources to decarbonize Michigan's economy in a least-cost, least risk manner. We understand that the purpose of the Study is limited and focused on identifying Michigan's RNG potential and to provide a comparison to other available GHG abatement technologies. However, we believe that it is important to clearly state up front that the current and future potential of RNG is limited and it is relatively costly to scale. Combined with our concerns about its actual limited potential for GHG abatement, from both a practical and policy perspective, we would recommend focusing any available RNG on decarbonizing the state's hardest to decarbonize sectors.

In the MI Healthy Climate Plan, the state recommends that Michigan undertake a comprehensive pathways analysis to assess options and timelines for meeting Governor Whitmer's climate goals. When that study is undertaken, state policymakers will consider market forces and the most efficient use of RNG and a range of resources across the economy. There could very well be high-value uses for alternative fuels (such as RNG) in certain sectors of the economy, like heavy industry (which accounts for nearly a quarter of energy demand in Michigan),[4] and in which electrification, for example, may not be as cost-effective or viable. While it is abundantly clear from the Draft Study's findings that RNG is a limited resource and will be a niche decarbonization resource, it is not stated explicitly anywhere in the report.

We also fully expect that when the aforementioned state-decarbonization study is undertaken, electrification will dominate as the most cost-effective and readily-available pathway to cut emissions from buildings and the transportation sector—consistent with all leading U.S. decarbonization studies to date. That is one of the reasons that these comments focus so heavily on the Draft Study's treatment of "alternative" abatement technologies. As discussed below, we find the Draft Study's analysis in this area disappointing and in need of substantial revisions—or, at minimum, clear written guidance from MPSC on the scope and limitations of this element of ICF's study.

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[2] In Consumers Energy 2021/2022 rate case in Docket U-21148, Consumers Energy proposed to build and operate a renewable natural gas facility and sell its environmental attributes for use in the Federal Renewable Fuel Program and California LCFS. *See* Testimony of Neal P. Dreisig.

[3] See https://energynews.us/2021/05/13/california-clean-fuel-standard-sparks-renewable-gas-boom-in-midwest/.

[4] See https://www.eia.gov/state/?sid=MI#tabs-2.

2. Summary of Recommendations

The following summarizes our recommendations for the Draft Study, each of which we discuss in more detail in these comments:

MPSC Findings from the Final Study

1. We ask that the Commission include a cover letter to the Final Study that addresses its scope, identifies its limitations (i.e., what the study does, and does not, comprehensively address), and provides guidance to policymakers on how the study should, and should not, be used for creating policy in Michigan.

Estimates of RNG Potential

2. The Final Study should provide policymakers narrative and visual context for interpreting the Technical, Feasible, and Achievable potentials of RNG relative to Michigan's annual conventional, fossil gas demand.
3. The Final Study should reduce by 50 percent the Draft Study's assumption of the number of existing landfill gas-to-electricity projects that convert to producing pipeline quality RNG, in both the achievable and feasible scenarios, as the assumed number of conversions are highly skeptical.
4. The Final Study should revise the Draft Study's assumption of the likelihood of thermal gasification to reach commercialization during the study's horizon, as the technology is not yet commercially viable. The Final Study should assume no potential in the achievable scenario, and the feasible potential should be reduced by 50 percent.
5. The Final Study should provide more context of the availability of each thermal gasification feedstock at various price points.

Estimates of Greenhouse Gas Potential

6. The Final Study should use an improved GHG lifecycle emissions analysis as the primary approach. The lifecycle analysis should:
    a. Include the emissions associated with transporting RNG through the transmission and distribution pipelines using Michigan-specific leakage rates, and
    b. Include the emissions associated with combusting RNG at the end-use/consumption level, which is a significant source of GHG emissions.

Alternative GHG Abatement Options

7. The Final Study should remove Section 7 in its entirety which compares RNG to alternatives, such as electrification, as the Draft Study's analysis on this question is non-comprehensive, is based on flawed data, and the results can easily be taken out of context and lead to poor decision-making on Michigan's decarbonization policy pathways.

8. If the Commission and ICF decide to keep Section 7 in the Final Study, it should make the following changes:[5]
    a. Explicitly state the limitations of this element of the analysis and caution against decisionmakers and other stakeholders relying on it to make policy decisions. We recommend this be done both in the aforementioned cover letter from the MPSC that would accompany the Final Study's delivery to the legislature, as well as in the text of the study itself.
    b. Substitute the California and national studies with studies from jurisdictions with climates more similar to Michigan. We provide an example from Massachusetts.
    c. For building electrification measures, assume a decarbonizing electric grid consistent with Michigan's current trajectory and 2050 decarbonization goals.
    d. Revise the heat pump assumptions derived from the Pennsylvania and national studies to reflect the current, and future, heat pump market.
    e. Improve the presentation of the relative cost of alternatives abatement technologies.

3. Estimates of RNG Potential

3.1.1 The Draft Study has not sufficiently justified how it determined the achievable and feasible utilizations

The Draft Study identifies three RNG supply scenarios: technical, feasible, and achievable. The total RNG inventory represents the technical potential, i.e., theoretical limit of RNG if every resource was realized regardless of the cost. The Draft Study then identifies a "feasible" and an "achievable" scenario, which assume varying feedstock utilization rates. The Draft Study notes the utilization rates of each feedstock in its report[6] but ICF fails to disclose any specific reasoning for utilizing these particular values, nor does it provide any citations for support. Although the technical potential may seem significant, in practice this scenario would require *perfect* utilization of the potential RNG supply in Michigan *at any cost*. The Draft Study is clear that the technical limit should not be relied upon for estimating an achievable potential. Thus, the key scenarios that are relevant for decisionmakers are the achievable scenario, and to a lesser extent, the feasible scenario. The Draft Study assumes that in the feasible scenario, 60 percent of the technical potential is realized, and assumes that 30 percent of the technical potential is realized for the achievable scenario. We recommend that ICF add explanations as to why those are the appropriate percentages for the achievable and feasible potentials.

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[5] Unfortunately, we do not believe that ICF has sufficient time to modify the Draft Study to adequately address these concerns, and thus strongly recommend removing Section 7 in its entirety.
[6] For achievable potential, 20-50 percent for anaerobic digestion, 30 percent for thermal gasification; and for feasible potential, 60-85% for anaerobic digestion, 40-50% for thermal gasification.

3.1.2 The Final Study should provide narrative and visual context to help policymakers interpret RNG's capacity to meet the state's energy demands

ICF could improve the Final Study by providing context of the relative magnitude of the RNG potential to displace conventional, fossil fuels. RNG can displace various fuels used across the economy. To the extent possible, the Final Study can provide helpful context to policymakers by showing the degree to which fossil gas can be displaced by RNG. The Final Study can do this by comparing the RNG potential by feedstock to Michigan's demand of substitute energy sources. As this is a study sponsored by the MPSC, it is important that the conclusions clearly relate to the two key industries that the Commission regulates—electricity and fossil gas—to potentially inform future decision making and resource planning.

For example, the state of Michigan used approximately 930,000 MMcf of natural fossil gas annually from 2016-2020.[7] Based on our analysis, 57.2 tBtu/yr and 148 tBtu/yr translate to 54,996 MMcf and 142,719 MMcf per year, respectively, or approximately 6 percent and 15 percent of Michigan's annual fossil gas use. We recommend that the Final Study provide similar context in its Executive Summary and Findings.

3.1.3 The Draft Study likely overstates the RNG potential from landfill gas and thermal gasification

Landfill gas (LFG) and thermal gasification account for 87 percent and 91 percent of the achievable and feasible scenarios, respectively. Thus, the assumptions that underly the availability of each of these RNG sources have an outsized impact on the overall estimates of achievable and feasible potential and warrant close scrutiny. Based on our review of the Draft Study and supporting workpapers, we are concerned that the feasible and achievable potentials for LFG and thermal gasification are significantly overstated, unreasonably inflating the (already-low) estimates of RNG potential and sending the wrong message to policymakers as they consider decarbonization pathways for Michigan.

3.1.4 The assumed number of LFG-to-electricity conversions to producing pipeline quality RNG is highly speculative

The Draft Study assumes that a significant number of landfills with existing, dedicated biogas-to-electricity systems will upgrade to technologies that instead produce pipeline quality RNG from biogas.[8] However, this assumption is unreasonable. LFG accounts for 55 percent of the achievable and 36 percent of feasible scenarios. The Draft Study considers 47 landfills as candidates for producing pipeline quality RNG. However, of these 47 sites, 31 have LFG-to-

[7] See https://www.eia.gov/dnav/ng/NG_CONS_SUM_DCU_SMI_A.htm.

[8] Draft Study at 26.

electricity projects already in place for a total generation capacity of 138.2 MW, and 5 others have direct use applications which use biogas in boilers or other direct thermal uses.[9]

The Draft Study assumes that more than *half* the existing LFG-to-electricity projects will install new technology to convert to producing pipeline quality RNG. During the June 29th workshop, Strategen challenged this assumption. In response, ICF noted that the economics of conversion from electricity projects to pipeline RNG are favorable because of the present value of RNG credits for compliance with the Federal Renewable Fuel Standard and the California Low Carbon Fuel Standard. ICF noted at the workshop, and in its Draft Study, that there is one LFG-to-electricity project in Michigan currently being converted to an RNG production site. We appreciate ICF's clarification of its assumptions and recognize that, at this time, the economics may be favorable to conversion. However, the assumption that over half of the LFG sites that are already producing electricity will install new technologies and shift production to RNG is highly speculative. While it may not be unreasonable to expect that some facilities will transition to produce RNG, it is *far* from certain that more than half of the existing LFG-to-electricity projects will make the same calculated risk as the one example in the study. The value of RNG credits, just like renewable energy credits on the electric side, move with the market, and the value proposition of converting to pipeline quality RNG may change. We do not find the Draft Study's ambitious assumption to be justified particularly for a scenario that is being framed as "achievable."

Finally, the Draft Study appears to assume that RNG from landfills that converted from producing electricity would earn the same GHG abatement potential as a new project on a landfill that has not produced energy. However, this assumption is faulty. When an LFG-to-electricity project stops producing electricity, the grid will have to replace that lost energy with another resource. There is also a cost to Michiganders to replace that lost electric generation, which appears to have not been incorporated into the Draft Study. Consequently, the Final Study should assume an emissions increase equivalent to the emissions profile of the Michigan grid for landfill facilities that convert from producing electricity to pipeline quality RNG, and account for the increased cost to society for replacing the lost generation.[10]

3.1.5 Thermal gasification, which is not yet commercially viable, should not be included in the achievable scenario

We are also concerned with the study's reliance on thermal gasification for a significant portion of the potential, as the technology is not yet commercially viable.

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[9] *Id* at 13.

[10] Project developers will likely focus on incremental revenue/profit from converting to pipeline quality RNG when determining whether investment makes sense. In other words, they would consider the foregone revenue/profit from electricity generation an opportunity cost. We do not believe this was factored into ICF's analysis either.

Beginning in 2030, the study assumes that the commercial deployment of thermal gasification production technology will significantly increase RNG production potential, accounting for 32 percent and 55 percent of the achievable and feasible scenarios, respectively. The Draft Study does recognize that thermal gasification is not yet commercial, stating that "[b]iomass gasification technology is at an early stage of commercialization, with the gasification and purification steps presenting challenges."[11] Specifically, "[t]he gasification process typically yields a residual tar, which can foul downstream equipment…The high cost of conditioning the syngas in the presence of these tars has limited the potential for thermal gasification of biomass."[12]

Although the study notes that there are a handful of thermal gasification projects in the late stages of planning and development in North America, the technology is not widespread. The annual production capacity in the entirety of the US from thermal gasification comes from the Sierra Energy Fulcrum Nevada plant.[13] The entire United States production capacity from thermal gasification (from the Sierra Energy Fulcrum Nevada plant) is currently equivalent to 0.8 tBtu/yr. For reference, the study assumes Michigan's RNG from thermal gasification potential to be 18.5 and 81.3 tBtu/yr for the achievable and feasible scenarios, respectively. This scale up of thermal gasification capacity is not a realistic assumption considering the still present technology challenges. Also notably, both the operational Sierra Energy Fulcrum Nevada plant and the planned Red Rock Bio projects are both producing alternative transportation fuels such as ethanol and renewable jet fuel-rather than RNG-because of the end-use incentives and demand.

As such, we recommend that the Final Study assume that thermal gasification is not available for the achievable scenario and should reduce the feasible scenario's assumptions by 50 percent.

Finally, the study should provide additional explanation and context on the availability of each thermal gasification feedstock. ICF includes assumptions on the percentage of each feedstock that is available in each scenario but provides no justification or explanation as to why that is the appropriate percentage.[14] On Table 3-16, ICF lists the Energy Crop RNG Production Potential by region at biomass price points of $40, $60, $80, and $100 per dry ton. However, the reader has no context as to the unit of biomass or its potential competing uses. The study should provide context for current biomass market prices and then translate those costs into RNG $/MMbtu. The Draft Study identifies only 6 percent of energy crop potential and 9 percent of agricultural residue potential as available at the lowest biomass price of $40. The study does not explain if a biomass price of $40 would be cost competitive over the Draft Study's horizon.

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[11] Draft Study at 17.
[12] *Ibid.*
[13] IEA Bioenergy, 2021, Status report on thermal gasification of biomass and waste. See https://www.ieabioenergy.com/wp-content/uploads/2022/03/Status-Report2021_final.pdf.
[14] Draft Study at 54. ICE assumes that 30% of energy crops available at $40/dry ton would be diverted to thermal gasification systems in the achievable scenario.

Table 1: Energy Crop Potential by Biomass Price[15]

Energy Crops – Thermal Gasification		
Biomass Price	**Production**	**Share of Total**
$40	2,904,047	9%
$60	9,860,364	30%
$80	9,617,804	29%
$100	10,790,636	32%
	33,172,851	**100%**

Table 2: Agricultural Residue Potential by Biomass Price[16]

Agricultural Residue – Thermal Gasification		
Biomass Price	**Production**	**Share of total**
$40	1,287,144	6%
$60	6,144,890	29%
$80	6,902,242	32%
$100	7,096,845	33%
	21,431,121	**100%**

4. Estimates of GHG Reduction Potential

4.1.1 The Draft Study should not rely solely on a combustion GHG accounting approach

The authorizing statute requires the study to estimate the GHG abatement potential of RNG and other abatement technologies. It is evident that the Final Study may be used by the Commission, utilities, and policymakers for assessing pathways to decarbonize Michigan's economy, as well as specific policies and programs to get there. Thus, it is imperative that the Final Study include as *comprehensive* an assessment of GHG impacts as possible; anything less could result in the development of policies that delay and/or undermine Michigan's climate goals.

There are two methodologies for estimating GHG abatement potential—a combustion approach and a lifecycle analysis. The main difference between these approaches is the set of boundary conditions that define which activities are included when calculating GHG emissions. In the combustion approach, only the emissions from the fuel end use are accounted for—the emissions that occur on the customer side of the meter. In a lifecycle approach, the emissions associated with all the stages across the life cycle of a commercial product, process, or service are accounted. In the case of RNG, the lifecycle includes collection and processing, pipeline transmission, and end-use combustion.

The ICF study primarily uses a combustion approach with a brief lifecycle analysis included in the Appendix. In stating its reason for relying primarily on the combustion approach, ICF notes that "the emission reduction estimates for RNG consumption can be more easily compared to existing GHG emission inventories, such as Michigan's energy-related GHG[s]."[17]

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[15] *Id*. at 35, Table 3-15.
[16] *Id*. at 34, Table 3-12.
[17] *Id.* at 71.

While there may be some value to this comparison, it is also critical to understand the shortcomings of the combustion approach for GHG accounting as *it does not fully account for the emissions associated with the fuel production.* It is also critical to ensure that, if relying on a combustion approach, the assumptions are as complete and reliable as possible.

The combustion approach has several shortcomings. First, it does not include GHG emissions from RNG collection and processing and pipeline/transmission, which have the potential to significantly impact the GHG abatement potential of RNG. For example, the emissions associated with RNG collection and processing can range from to -96,969 g CO2e/MJ in the case of dairy cow animal waste to fossil gas, to 82,154 g CO2e/MJ wastewater treatment to fossil gas.[18] Additionally, the emissions associated with pipeline/transmission are equivalent to 3,120 g CO2e/MJ, according to the scenarios ICF analyzed in the GREET model.[19] The lifecycle emissions associated with fossil gas as a feedstock to transportation fuel, stationary fuel, and electricity generation are 17,287 g CO2e/MJ, 13,083 g CO2e/MJ, and 11,129 g CO2e/MJ, respectively.[20] The emissions associated with RNG pipeline transportation make up 18-28 percent of the total emissions, while the emissions associated with RNG collection and processing, as in the case of wastewater treatment to fossil gas, could be *more than quadruple* total lifecycle emissions associated with conventional fossil gas.

The combustion approach only accounts for end-use emissions. The Draft Study, however, limits those emissions to CH_4 and N_2O, asserting that CO2 emissions from combusted RNG are "biogenic"—a flawed premise.[21] But that flaw notwithstanding, it is clear that the emissions from the other stages of the RNG lifecycle—collection and processing and pipeline transmission—are indeed significant. Neither the emissions associated with RNG collection and processing, nor the emissions associated with the pipeline transmission of RNG are accounted for in a combustion approach. Further, the significant differences in GHG abatement potential

[18] See the tab titled RNG_CI on the Excel spreadsheet titled "MI RNG Study Greet 2021" provided by ICF and the MPSC.

[19] Ibid.

[20] Ibid.

[21] The term "biogenic" is misleading as the origins of the referenced CO2 are from sources such as municipal solid waste, livestock and agricultural operations, biomass, and energy crops, all of which are the products of human activity—and are not actually naturally occurring. While RNG production may rely on the capture of carbon or methane emissions from these feedstocks, it is not necessarily reasonable to assume those emissions are unavoidable. Policies to reduce food waste, for example, may be more cost-effective and aligned with other state policy goals than RNG facilities that rely on and perpetuate these emissions. In addition, there is a notable risk that commercializing RNG could *increase* emissions by encouraging the proliferation of purpose-grown feedstocks or continuing to encourage unsustainable livestock practices. According to a report by California Climate and Agriculture Network, a profitable market for manure-based RNG likely increases localized pollution by reinforcing industrial livestock farming practices that result in liquid-based manure storage and crowded feedlots. See *Diversified Strategies for Reducing Methane Emissions from Dairy Operations*, California Climate and Agriculture Network, October 2015, at https://calclimateag.org/wp-content/uploads/2015/11/Diversified-Strategies-for-Methane-in-Dairies-Oct.-2015.pdf.

between different RNG feedstocks is completely ignored by the combustion approach. These differences are critical to recognize when considering RNG as a GHG abatement resource.

Solely considering the end use emissions, as the combustion approach does, provides an incomplete picture of the emissions produced or abated by RNG. Some alternatives, such as electrification, reduce or eliminate both lifecycle and end-use methane emissions and other harmful pollutants. An analysis that compares RNG to alternatives using only the combustion approach *will not* recognize the value of a resource to reduce or eliminate methane throughout the entire lifecycle, as well as the ability to reduce or eliminate other pollutants that are harmful to human health.

4.1.2 The Final Study should use a comprehensive GHG lifecycle emissions analysis as the primary methodology

Although it is useful to examine a combustion GHG analysis, the study should *primarily* rely on the lifecycle analysis for measuring the GHG abatement potential of a resource to provide a complete picture of all associated emissions. Unfortunately, the Draft Study does not do that, and therefore provides an incomplete—and seriously misleading—picture of the GHG abatement potential of RNG. For example, when considering the lifecycle emissions specifically for landfill gas to RNG for fueling station use, the RNG collection and processing, pipeline/transmission, and end use emissions are significant—44 percent, 47 percent, and 9 percent of total emissions, respectively.[22]

Further, key existing incentive programs for RNG, including California's Low Carbon Fuel Standard and the Renewable Fuel Standard, are underpinned by a lifecycle perspective in regard to emissions. As these incentives are the key drivers of the RNG industry to date, it is important to consider the potential of RNG to abate GHG emissions in reference to these market drivers. Thus, as NRDC has repeatedly advocated in our first round of comments and during both the January 10th and June 29th stakeholder workshops, a lifecycle analysis *must* be included as part of this study. If the Commission and ICF do not accept our recommendation to shift reporting primarily to the lifecycle approach, the Final Study and the Commission's cover letter should at least present a summary of the emissions impact and cost per ton using a comprehensive lifecycle approach.

4.1.3 The Draft Study's limited GHG lifecycle analysis has several shortcomings

Following the June 29th stakeholder workshop, ICF indicated that it would be modifying figure B-3 (Lifecycle GHG emissions factor ranges for RNG feedstocks) as part of changes to the Final Study. There were a few aspects of that figure which were mistakenly pulled from

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[22] U.S. Environmental Protection Agency, 2020, An Overview of Renewable Natural Gas From Biogas. See https://www.epa.gov/sites/default/files/2020-07/documents/lmop_rng_document.pdf.

previous GREET runs and inter-mingled with some CA-GREET analysis."[23] ICF did not clarify which data it would be updating. We appreciate that the Final Study will remedy this issue; however, we are still concerned by flaws in the Study's limited analysis of the lifecycle carbon intensity for different RNG feedstocks.

We have identified two issues with the lifecycle analysis:

1. The Study's GHG lifecycle analysis stops at the point of pipeline injection, which means it does not include the potentially significant GHG impact of upstream leakage from transporting the RNG to the end-use. Nor does it include Michigan-specific pipeline leakage data in the GREET model, resulting in overestimates of GHG abatement potential.
2. While the study states that it focuses on a combustion approach (which, as noted, we strongly disagree with), it does not remedy the GREET model's failure to account for *all* the GHG emissions at the end use/consumption level, such as combustion occurring for household gas heating and cooking end uses, nor un-combusted methane and other harmful pollutants.

4.1.3.1 The Draft Study does not account for the emissions associated with transporting RNG through distribution pipelines

The Study includes in its appendix a section that it deems a "GHG lifecycle analysis", though that is in name only. We disagree that ICF has, in fact, conducted a true lifecycle analysis in this study. For example, its GHG assessment stops at the point of RNG injection into the pipeline and therefore does not account for emissions that occur from pipeline transport and the end-use consumption. As a consequence of this flaw, RNG and other fuels that have to be transported through a pipeline will compare more favorably—and misleadingly from GHG abatement potential perspective--to alternatives than if the Draft Study had included all upstream emissions. While we understand that it may not be possible to make significant analytical changes at this point, it is important that that the Final Study and the recommended cover letter from the Commission accompanying the Final Study recognizes this issue and contextualizes its findings appropriately.

Perhaps because the analysis stops at the point of pipeline injection, the Draft Study does not try to overcome the limitations of using GREET for estimating the lifecycle GHG emissions that are inherent to the model. It is important to recognize that the GREET model was designed for ***transportation end uses*** and the consumption component of the lifecycle assessment is associated with different driving modes. The GREET model was *not* designed for analyzing different end uses, such as residential appliances. Unless modified by the modeler, GREET uses generalized estimates of methane leakage from fossil gas infrastructure systems that is not specific to pipeline materials or state-level data. According to data collected by the U.S.

[23] See ICF's response to questions raised by NRDC after the June 29, 2022, Stakeholder Workshop in a document titled "220720 MI RNG Study Meeting #3 Response to Questions."

Department of Transportation's Pipeline and Hazardous Materials Safety Administration, Michigan ranks *fifth* in the nation for the amount of iron gas mains, and *tenth* for the amount of bare steel pipelines in operation.[24] Cast and wrought iron pipelines are among the oldest and leakiest energy pipelines constructed in the United States. Many of these pipelines were installed over 60 years ago, and the degrading nature of iron alloys, the age of the pipelines, and pipe joints design have greatly increased the risk involved with continued use of such pipeline.[25] Pipeline age and material has been demonstrated to directly correlate with pipeline leakage rates.[26]

Thus, Michigan has some of the highest expected pipeline leakage rates due to the age and materials of its pipelines. Because replacing these pipelines is extraordinarily expensive, resources such as electrification become even more cost-effective alternatives that are better suited for helping the state meet its decarbonization goals. As already noted, GREET uses a general leakage rate that does not take into account specific state-level pipeline infrastructure differences and leakage rates. Due to the characteristics of Michigan's pipelines, this value should have been adjusted. If that adjustment had taken place, the results of the GHG assessment would certainly have been different—lowering the abatement potential of RNG due to increased leakage expectancy.

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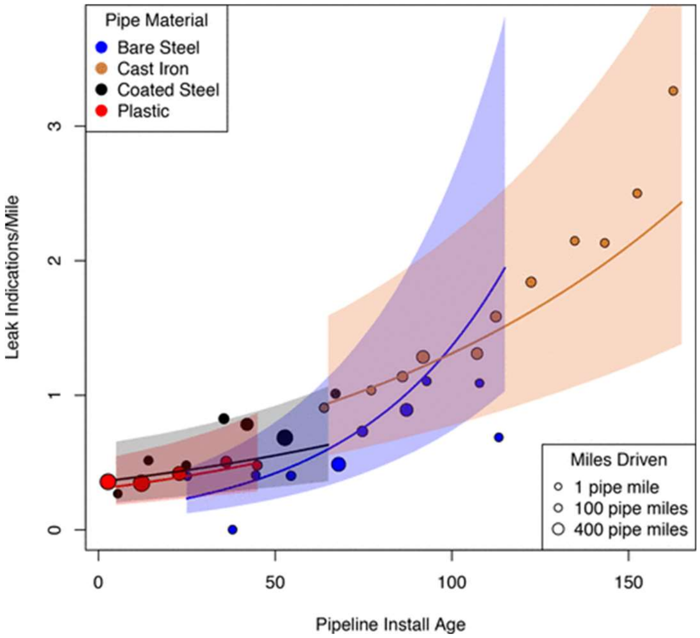
[24] U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, Pipeline Replacement Background. See https://www.phmsa.dot.gov/data-and-statistics/pipeline-replacement/pipeline-replacement-background.
[25] *Ibid.*
[26] Zachary D. Weller, Steven P. Hamburg, and Joseph C. von Fischer, "A National Estimate of Methane Leakage from Pipeline Mains in Natural Gas Local Distribution Systems, *Environmental Science 7 Technology* 54, 14 (2020), 8958-8967.

Figure 1: Correlation of Pipeline Age, Material, and Leakage (Source: Weller et. al., 2020)



4.1.3.2 The Draft Study does not account for all of the GHG emissions, and other harmful pollutants, that can occur at the end use/consumption level

The GREET model also does not account for GHG emissions at the end use/consumption level, such as combustion occurring for household gas heating and cooking end uses. We do not see any effort in the Study to consider end-use emissions of criteria pollutants or from methane leakage from customer gas appliances (e.g., stoves, water heaters), which recent research from Stanford has shown may be significant.[27]

The omission of consideration of criteria pollutants is troubling (while we do acknowledge it is not an explicit statutory requirement of the study). Burning gas indoors deteriorates air quality inside homes; infants and children are more susceptible to illnesses associated with indoor air pollution with children living in homes with a gas stove having a 42 percent higher risk of experiencing asthma symptoms than those without.[28] Black, Hispanic, and Asian households are also disproportionately exposed to harmful particulate matter emitted by

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[27] Eric D. Lebel, Colin J. Finnegan, Zutao Ouyang, and Robert B. Jackson, "Methane and NO_x Emissions from Natural Gas Stoves, Cooktops, and Ovens in Residential Homes, *Environmental Science & Technology,* 56, 4 (2020) 2529-2539, https://doi.org/10.1021/acs.est.1c04707.

[28] Rocky Mountain Institute, Fact Sheet: "Gas Appliance Pollution Inequitably Impacts Health: Who Would Gain the Most from Electrification," *See* https://rmi.org/wp-content/uploads/2022/02/gas_appliance_equity_factsheet.pdf (last visited Mar 11, 2022).

fossil fuel combustion in homes.[29] This pollution adds to the heavy pollution burden that communities of color face throughout the country, while also amounting to substantial health costs for community members and for the state. Michigan placed fifth in the top ten states with the most premature deaths resulting from methane gas burned in buildings – leading to an early 841 deaths and $9.419 billion.[30] None of this is acknowledged in the Draft Study, despite the fact that these indoor air quality concerns are as present with the combustion of RNG in homes as they are with traditional fossil gas.

5. Alternative GHG Abatement Options

The Study's authorizing statute includes a comparison of the cost and emissions reduction potential of RNG to that of comparable carbon abatement technologies, including, but not limited to, hydrogen blending, building electrification and similar technologies.[31] While Section 7 of the Draft Study addresses this topic, we do not believe it meets the objective of the statute.

At a high level, we have two major concerns with the analysis and comparison of RNG to alternatives:

1. The cost estimates for building electrification – the most important alternative for comparisons –are based on studies and assumptions that have little to no relevance to the costs of emission reductions in Michigan in a decarbonized future.
2. The presentation of the results is confusing, is not informative, and could lead to unintended consequences if relied upon for policymaking.

We recommend that the Final Study ***remove this section entirely*** as it is based on flawed data and could easily be taken out of context. We do not believe that ICF has sufficient time to modify this component of the Study.

If the Commission and ICF decide not to remove this section from the Final Study, we recommend that the study be explicit in its limitations, clearly state that a comprehensive study of all GHG alternatives to fossil gas use in Michigan is needed, and caution against relying on Section 7 to make policy decisions. In this latter case, we recommend both that the ICF report include this explicit language in the report text, and that MPSC include a cover letter outlining these limitations and the context for the report when it delivers the Final Report to the legislature this Fall.

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[29] Christopher W. Tessum et. al, "PM2.5 polluters disproportionately and systemically affect people of color in the United States," Science Advances 7, April 28, 2021, *See* https://www.science.org/doi/10.1126/sciadv.abf4491. (last visited Mar,11 2022)

[30] Rocky Mountain Institute, "What is the Health Impact of Buildings in Your State: Michigan," *See* https://rmi.org/health-air-quality-impacts-of-buildings-emissions/#MI (last visited Mar 11, 2022).

[31] Section 1002(c)

5.1.1 The Draft Study's cost estimates for building electrification are of limited relevance to Michigan

The Draft Study identifies a range of building electrification costs between $0 to $1000 per ton of CO2e.[32] That range is based on three studies – the Pennsylvania Climate Plan, a California Deep Decarbonization study, and a national study conducted by individuals from the University of Texas, Carnegie Mellon and the University of Michigan. As we articulate below, there are several problems with relying on these studies to derive costs per ton of GHG emissions for comparison to Michigan RNG costs.

Notwithstanding the fact that such a range of costs is so wide as to be entirely uninformative, in the event MPSC and ICF decide to leave Section 7 in the Final Report we recommend that references to the national and California-based studies be removed and replaced with those from climates more comparable to Michigan's. If the Final Study continues to rely on these studies, their shortcomings as comparators need to be clearly articulated—including the fact that the cost of emission reductions from electrification will be lower for heat pump installations occurring in later years as the market builds and manufacturers achieve economies of scale, particularly if new public policy creates incentives and standards that accelerate heat pump adoption and the decarbonization of the electric grid.[33]

5.1.1.1 The Final Study should only use references with climates that are comparable to Michigan's

The Draft Study's reliance on a national study and a California study is problematic because the climates are very different than Michigan's. Climate is important because the cost per ton of GHG emissions reduction from building electrification will be significantly affected by climate. If a gas furnace must run twice as much in a colder climate than in a warmer climate, then all else equal the cost per ton of GHG emissions reduction in the colder climate will be 50 percent lower than the cost in the warmer climate because the GHG emissions reductions will be twice as large.[34] Needless to say, Michigan's climate is much, much colder than California's. In fact, over the past year, Grand Rapids had nearly four times as many heating degree days as San

[32] Draft Study at 89, Figure 7-2.

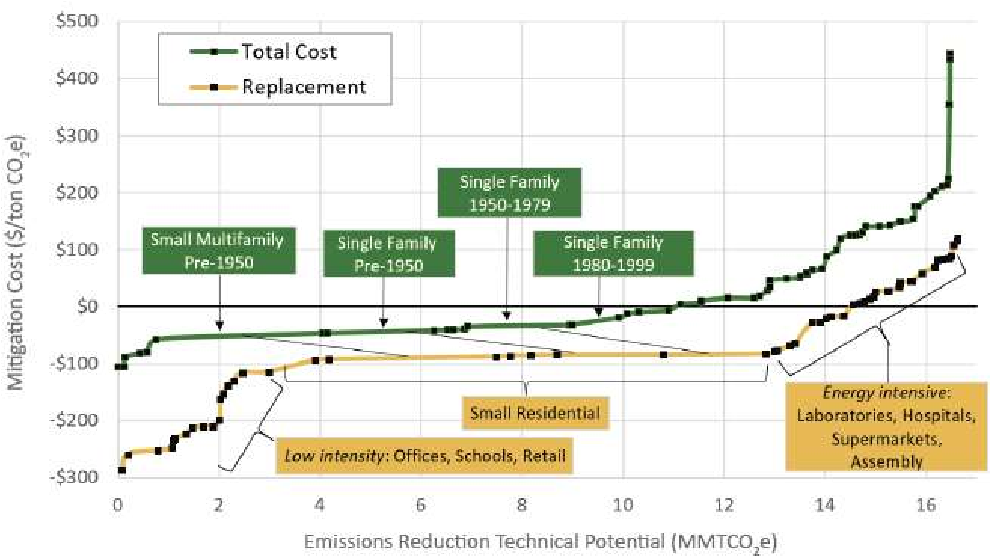
[33] For example, if enacted, the Inflation Reduction Act of 2022 will include significant tax credits for electric heat pumps.

[34] We appreciate that all else will not always be equal. It may be that the size of a heat pump required to electrify a building will be smaller and therefore potentially less costly. On the other hand, the avoided gas furnace cost would also be smaller in the warmer climate. These and other factors mean that there will not be a perfectly linear relationship between climate (e.g., heating degree days) and costs of emissions reductions from heating electrification. Nevertheless, we would expect the costs per ton of reduction to be very strongly correlated to climate.

Francisco, nearly three times as many as Sacramento and about ten times as many as Los Angeles.[35] Michigan is also, on average, much colder than much of the rest of the country.

In the event MPSC and ICF opt to leave Section 7 in the Final Report we recommend that the California and national studies be replaced with references from climates much more comparable to Michigan's. Massachusetts, for example, would be a useful comparison. As can be seen in the figure below, a recent decarbonization study conducted by the Commonwealth of Massachusetts estimated that electrification has a negative cost per ton of emission reduction for most buildings.[36]

Figure 2: Emissions abatement cost curves based upon total or replacement capital costs of building electrification with only moderate efficiency to existing and new buildings.



5.1.1.2 The Draft Study does not account for a rapidly decarbonizing electric grid

Second, the national study assessed emission reductions over the assumed 15-year life of a heat pump installed in 2017. We would suggest that the purpose of assessing the resource potential and cost of RNG in reducing emissions is to understand the role it might play in achieving *future* decarbonization goals. In that context, we suggest that it is misleading to compare the costs of emission reductions associated with heat pumps installed more than 5 years ago in 2017, when the grid was more GHG-intensive than it is today. Indeed, Michigan's electric

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[35] Actual heating degree days relative to a balance point of 60 F (from https://www.degreedays.net/#), which is a typical indicator of heating energy use in residential buildings, for July 2021 through June 2022.

[36] "Massachusetts 2050 Decarbonization Roadmap," Massachusetts Executive Office of Energy and Environmental Affairs, December 2020. *See* https://www.mass.gov/doc/ma-2050-decarbonization-roadmap/download

grid is cleaning up rapidly and dramatically compared to 5 years ago, even without an increase in the state RPS. The state's decarbonization pace is accelerating as utilities like Consumers Energy plan to move off coal-fired power and invest significantly in renewables.[37] The Final Study should account for both the utilities and the state's 2050 decarbonization goals in its assumed GHG-intensity of the Michigan grid. All other things equal, the cleaner the grid, the lower the cost per ton of emissions reduction from electrification; as a result, relying on a retrospective time period well before the grid started its current rapid level of decarbonization seriously skews and undervalues electrification as a GHG abatement technology. This is particularly true given that most of the potential from the comparative alternative, RNG, is not available until the late 2030s and 2040s.[38] This apples-to-oranges comparison, and the many flaws in the study's treatment of electrification, reinforces our recommendations.

We strongly urge ICF to remove Section 7 from the report in its entirety. In the alternative, we recommend that the national study be removed as a reference and replaced with other references that use comparable climates and more appropriate time periods for comparison to future RNG usage. In addition, significant caveats must be included in this report, as outlined above.

5.1.1.3 The heat pump assumptions in the Pennsylvania and national studies are not comparable

Both the national study and the Pennsylvania study used lower heat pump efficiencies than the minimums required by law starting in 2023, do not analyze cold climate models much more appropriate for Michigan's climate and therefore do not account for substantial cost savings from reduced summer peak demands, and do not account for any improvements in efficiency over the multiple decades over which electrification will occur.

If the Final Study retains these two references, it should be explicit that they analyzed the cost of emission reductions from *much less efficient* heat pumps than would be appropriate for current or future electrification efforts in Michigan. For example, the national study was based on a heat pump with a Heating Season Performance Factor (HSPF) of 8.5. The Pennsylvania study assumed an HSPF of only 8.2, which is the lowest heating efficiency currently allowed by federal law for new heat pumps. Beginning in 2023, the federal minimum efficiency standard will be an HSPF of 8.8. That minimum requirement will almost certainly increase over the next couple of decades (just as it has in the past).

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[37] Consumers Energy Integrated Resource Plan, Docket U-21090. *See* https://mi-psc.force.com/s/case/500t000000md6sCAAQ/in-the-matter-of-the-application-of-consumers-energy-company-for-approval-of-an-integrated-resource-plan-under-mcl-4606t-certain-accounting-approvals-and-for-other-relief.

[38] Based on the figure on p. 4 of ICF's report, under the "achievable scenario" only about half of the potential available in 2050 is available as early as 2030; under the "feasible scenario" only about one-third of the potential available in 2050 is available as early as 2030.

The average new heat pump sold—even in the absence of policies promoting higher efficiency models—will be higher than the federal minimums. More importantly, any policy-driven focus on electrification will undoubtedly promote more efficient models. Particularly in a climate like Michigan's, the emphasis should be on cold climate air source heat pumps (ccASHPs) that not only have higher efficiency ratings (roughly three-quarters have HSPF ratings of 10 or higher, some have ratings of 12),[39] but will provide even greater efficiency gains than their relative difference in HSPF ratings suggest because of their ability to provide their nameplate heating capacity—without supplemental electric resistance heat—at temperatures of 5° F or lower. While ccASHPs are more expensive than non-cold climate models, both their seasonal energy efficiency advantages and their ability to minimize winter peak demands on the electric grid are substantial in a state like Michigan's. Moreover, their efficiencies and ability to function in very cold temperatures are expected to improve substantially while their costs are expected to decline over time.[40] It is also worth noting that ccASHPs tend to be much more efficient in cooling mode than the central air conditioners they would likely displace under electrification efforts.[41] That will be particularly valuable as a means of reducing summer peak demands and related costs on the Michigan electric grid.[42]

The Massachusetts study we reference above did focus on cold climate heat pumps. If ICF's Final Study continues to reference the Pennsylvania and national studies, the report should very clearly note that those studies used conservative assumptions for heat pump efficiencies and the probability that alternative analyses of more efficient models—particularly cold climate models more appropriate for the Michigan climate—would produce lower costs per ton of GHG emission reductions than presented in ICF's Draft Study.

Finally, the Pennsylvania study is a flawed comparison because it estimated the cost per ton of GHG emissions reductions from building electrification assuming that optimal amounts of RNG are deployed first. The effect of that assumption is to reduce the amount of emission reduction that electrification is estimated to produce—at least relative to a scenario in which electrification occurs in the absence of RNG. To provide an apples-to-apples comparison of the cost of emissions reductions, one should look at each measure—RNG and electrification—in

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[39] Based on the ratings of 650 centrally ducted cold climate models with heating capacities between 33 and 39 kBtuh at 5 F (Northeast Energy Efficiency Partnerships ccASHP Product List found at https://neep.org/heating-electrification/ccashp-specification-product-list).
[40] Jadun, Paige, Colin McMillan, Daniel Steinberg, Matteo Muratori, Laura Vimmerstedt, and Trieu Mai. 2017. *Electrification Futures Study: End-Use Electric Technology Cost and Performance Projections through 2050*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-70485. See https://www.nrel.gov/docs/fy18osti/70485.pdf at 42.
[41] The median cooling efficiency rating of the 650 centrally ducted cold climate models with heating capacities between 33 and 39 kBtuh at 5 F is SEER 20 (Northeast Energy Efficiency Partnerships ccASHP Product List found at https://neep.org/heating-electrification/ccashp-specification-product-list). Starting in 2023, the minimum federal efficiency standard for new central A/Cs sold in northern states will be SEER 14. That represents a 30% cooling energy savings.
[42] Even if the state were to begin aggressively promoting heating electrification, it will likely be quite some time before the Michigan grid switches from summer peaking to winter peaking.

isolation, particularly if the point of cost comparisons is to inform decision-making regarding which resource merits policy support and/or economic investment over the other. The fact that the Pennsylvania study did not do that—and that the result is a higher cost per ton of emission reduction from electrification—should be noted in the report.

5.1.2 The Final Study should improve its presentation of the relative costs of alternatives

In addition to the issues identified above, in the event Section 7 remains (which, in its current form is highly concerning), we recommend that the Final Study be restructured in how it displays the summary tables and figures. In particular, we are concerned that the current presentation could easily be misinterpreted.

Our specific concerns and suggestions are as follows:

1. **Lack of information on scale of potential**

Cost comparisons, while helpful, are of limited value if the relative magnitude of potential is not also made clear. According to the Draft Study, RNG can only displace 8 percent to 22 percent of current fossil gas consumption in buildings and industry (6 – 15 percent of total current fossil gas use, including gas used for electricity generation). Hydrogen blending cannot displace more than 7 percent by energy content, and perhaps not even half that without significant (and likely, unrealistic) levels of capital investment in new pipes and new appliances that can withstand hydrogen's corrosive impact. On the other hand, electrification has the potential to displace virtually all fossil gas use in residential and commercial buildings, and a large portion of gas use in industrial facilities. We urge ICF to explore ways to convey these emission reduction potentials together in the same tables and figures showing costs.

2. **Clarify that the marginal cost of RNG sets the price of the RNG market**.

Related to the point above, the low end of the range of RNG cost per ton is associated with the lowest cost sources of RNG. However, the price for all RNG will be set by the cost of the marginal unit being purchased. We appreciate and agree with ICF's point made at the June 29 meeting that the market price will not be based just on Michigan RNG sales but on sales from a much broader region. However, if all states are pursuing decarbonization and relying on RNG in any significant way to achieve decarbonization goals, the regional market clearing price will be much, much higher than the low end of the price range shown in the Draft Study. Thus, we urge the Final Study to clarify in its tables and figures that the low end of the RNG cost likely reflects cost only if there are very modest levels of demand for RNG—requiring much more electrification and/or other measures—and that the high end likely reflects costs if Michigan and other states endeavor to maximize use of RNG.

6. Public Participation Process

As a final comment, we appreciate the time that MPSC Commissioners and Staff put into the workgroup sessions and comment solicitation, and recognize the tight timeline that this report was under. At the same time, we feel compelled to note that the structure of the workgroup process made it difficult to have a meaningful impact on the trajectory of the study. The Commission initially scheduled just two public workshops and added an additional meeting at the request of stakeholders. Despite holding a public meeting in January 2022—six months prior to the release of the Draft Study—the Commission did not provide an opportunity for stakeholders to review ICF's proposed assumptions and inputs and provide feedback until the draft was filed. While ICF's underlying data and workpapers were eventually provided (six weeks after the release of the Draft Study), stakeholders were then only afforded two weeks to review the data and incorporate it into their comments. We also felt that the opportunities were limited to have meaningful dialogue with the report analysts. Providing essential underlying data in a timelier manner and creating more facilitated opportunities to engage directly with ICF would have gone a long way and provided more transparency to this process.

Given these limitations, it is now likely that the many concerns raised in these comments, and by other stakeholders, will not be able to be addressed prior to finalization of the report. We recognize that it is likely infeasible from a budgetary and timeline perspective to course correct on key study components that would have benefitted from stakeholders' feedback. At the same time, it is our hope that, with regard to report sections in which assumptions and inputs cannot be altered at this stage, the Final Study include the recommended caveats to frame what is, and is not, accomplished by this study and therefore ensure that its results are used in the most beneficial and appropriate manner for future policymaking in Michigan.