RAMSEY/WASHINGTON RECYCLING & ENERGY
CONNECTING VALUE TO WASTE

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION
121 7th Place East, Suite 350
St. Paul, MN 55101-2147

In the Matter of a Commission Investigation into a Fuel Life-Cycle Analysis Framework for Utility Compliance with Minnesota's Carbon-Free Standard	PUC Docket No. E-002/CI-24-352 **INITIAL COMMENT**

I. INTRODUCTION AND BACKGROUND

The Ramsey/Washington Recycling & Energy Board ("R&E") submits this initial comment in response to the Minnesota Public Utilities Commission Notice of Comment Period seeking comments on actions that the Commission should take to establish the criteria and standards necessary for utilities to calculate partial compliance with the Carbon Free Standard ("CFS").[i] There are a number of topics open for comment, but these initial comments will focus on the following:

- Whether biomass, renewable natural gas, and solid waste should be eligible as fully or partially carbon-free generation resources based on a fuel life-cycle analysis; and
- Calculating partial compliance by generators burning waste materials based on a fuel cumulative life-cycle basis considering greenhouse gas benefits relative to alternative waste management methods.
- The Partnership on Waste and Energy's recommendations regarding the scope of the instant docket;

R&E is a joint powers board between Ramsey and Washington counties ("Counties") that is tasked with overseeing management of solid waste generated in the Counties, including maximizing waste reduction and material reuse, and ensuring the highest rate of quality recycling.[ii] R&E owns and operates the Recycling & Energy Center ("R&E Center") in Newport, Minnesota. Of the approximately 440,000 tons of mixed municipal solid waste ("MSW") generated in the Counties after recyclable materials have been source separated, about 400,000 tons of the MSW are delivered to the R&E Center where R&E processes the waste to remove additional recyclable materials left in the waste, and creates Refuse-Derived Fuel ("RDF") that is used as fuel at two

(Red Wing and Mankato) of Xcel's three RDF Plants.[iii] In 2023, the 331,000 tons of RDF produced at the R&E Center and delivered to the two RDF Plants ("RDF Plants") produced enough electricity to power more 13,450 homes for a year. In addition, 13,185 tons of recyclable materials were recovered from the trash, and 99,500 fewer metric tons of carbon dioxide were produced than if the trash had been landfilled.[iv] Only about 12 percent of the MSW delivered to the R&E Center is sent to local landfills.[v]

Not only does this waste-to-energy ("WTE") system have significant emissions benefits over landfilling, but the Plants play a critical role in Minnesota's waste management infrastructure. In addition to the RDF produced by R&E, the RDF Plants also utilize RDF produced by other suppliers from MSW generated in Blue Earth, Faribault, Goodhue, LeSueur, Martin, Nicollet and Sibley counties.[vi]

The MSW received at the R&E Center consists of waste discarded after County residents, businesses, and institutions have separated recyclable materials (including yard and food waste and other organic materials) from the trash. Combusting RDF typically reduces waste volume by 90% and weight by 75%.[vii] The combination of R&E's waste reduction and recycling efforts, along with its production of RDF and Xcel's subsequent use of the RDF to generate renewable electricity, results in only about 12% of the MSW received at the R&E Center being landfilled. If the RDF Plants were to close, this percentage would rise to about 95%, creating a significant landfill capacity crisis in and around the Twin Cities metropolitan area.

In addition to proper waste management, the RDF Plants contribute to energy security and reliability.[viii] A Commission decision that does not grant this form of WTE full or partial credit under the CFS would severely hamper the ability of these RDF Plants to operate. Utilities would be less incentivized to invest in or use energy technologies that do not help to achieve compliance under the CFS. In addition to contributing to significant landfill capacity issues, closure of the RDF Plants would result in significantly higher greenhouse gas ("GHG") emissions, a loss of reliable baseload power, and loss of more than one hundred well-paying green jobs in the communities served by R&E and the RDF Plants.[ix]

II. ARGUMENT

A. Biomass and Refuse Derived Fuel is Carbon Free Under Minn. Stat. § 216B.1691.

The plain language of Minn. Stat. § 216B.1691 is clear that the electricity and the renewable energy credits ("RECs") generated by eligible energy technologies ("EETs") satisfy the CFS. EETs include solar, wind, hydroelectric, hydrogen, and biomass.[x] Specifically, the RDF produced by R&E qualifies as biomass pursuant to Minn. Stat. § 216B.1691, subd. 1(c)(5), which provides that an "energy recovery facility used to capture the heat value of mixed municipal solid waste or refuse-derived fuel from mixed municipal solid waste as a primary fuel" qualifies as an EET.[xi]

Subdivision 4 of Minn. Stat. § 216B.1691 addresses RECs and states in relevant part:[xii]

> (a) To facilitate compliance with this section, the commission… shall establish … a program for tradable renewable energy credits for electricity generated by eligible energy technology. The credits must represent energy produced by an eligible energy technology, as defined in subdivision 1… **The program must permit a credit to be used only once, except that a credit may be used to satisfy both the carbon-free energy standard obligation under subdivision 2g and either the renewable energy standard obligation under subdivision 2a or the solar energy standard obligation under subdivision 2f, if the credit meets the requirements of each subdivision**….
>
> (b) In lieu of generating or procuring energy directly to satisfy a standard obligation under subdivision 2a, 2f, or 2g, an electric utility may utilize renewable energy credits allowed under the program to satisfy the standard.

Subdivision 4(a) provides that all renewable energy credits are generated by EETs. Subdivision 4(b) states that a utility can procure RECs to meet the CFS in 2g. Therefore, EETs, which include RDF and biomass, must be classified as carbon-free and eligible to satisfy the CFS.

Statutes must be read in their entirety, and effect must be given to all their provisions.[xiii] When reading subdivision 7 in concert with subdivision 4, it is clear that generation from EETs and the associated RECs is intended to satisfy the CFS.

Under Minn. Stat. § 216B.1691, subd. 7, the Commission must determine whether a utility is in compliance with the standards in § 216B.1691, subds. 2a, 2f, and 2g.[xiv] If the Commission finds noncompliance, it may order the electric utility to do one of the following:

(i) Construct facilities,

(ii) Purchase energy generated by EETs,

(iii) Purchase renewable energy credits, or

(iv) Engage in other activities to achieve compliance

The compliance option of "purchase renewable energy credits" must be read in conjunction with § 216B.1691, subd. 4. Since the Commission can order an electric utility to purchase renewable energy credits to comply with the CFS, and because § 216B.1691, subd. 4(a) provides that all RECs are generated by EETs, and because subd. 4(b) states that a utility can procure RECs to meet the CFS in 2g, therefore, EETs and the RECs they generate must be classified as carbon-free and eligible to satisfy the CFS.

Similarly, if the Commission determines that a utility is out of compliance with the CFS, one of the Commission's powers, under (ii), is to order the utility to "purchase energy generated by EETs." If the Commission can order a utility to purchase energy generated by EETs to comply with the CFS, it follows that EETs are carbon-free.

Further, the EET standard laid out in subdivision 2a has much lower generation threshold requirements than the CFS in subdivision 2g. For example, the statute requires electric utilities to generate or procure 55 percent of electricity from EETs by 2035. Under the CFS, public utilities must generate or procure 80 percent of electricity from carbon-free energy sources.[xv] This large discrepancy in the standards signals that the Legislature intended the CFS to encompass all EETs in addition to other carbon-free generation sources that are not classified as EETs, like nuclear technologies, for example. It is thus consistent with this statutory framework to allow RECs and energy generated by EETs to count towards the CFS.

B. Alternatively, RDF should be Eligible as a Fully Carbon-Free Generation Resource Based on a Fuel Life-cycle Analysis That Shows Eliminated Greenhouse Gas Emissions Compared to Landfilling MSW.

The Partnership on Waste & Energy ("PWE") recommends a definition of carbon free that takes a big picture view of GHG emissions and considers additional factors outside of just direct stack emissions from a power plant. R&E agrees with the PWE and supports the Commission

taking a big picture view of GHG emissions. A thorough "carbon free" definition should consider all greenhouse gas ("GHG") emissions using a carbon equivalency calculation which normalizes the global warming potential ("GWP") of different GHGs using carbon dioxide as the base unit. This is important when trying to determine the carbon free status of WTE technologies under a life cycle analysis ("LCA").

Landfilling of MSW results in substantial amounts of methane being emitted into the atmosphere. Methane is responsible for 1/3 of the global warming impacts felt currently,[xvi] and it has more than 80 times the global warming power of CO2 over the first 20 years of it reaching the atmosphere.[xvii] Defining the term "carbon free" in a way that only accounts for emissions at the point of combustion, and ignores GHG emissions other than CO2, would obfuscate the net environmental impact of different management waste solutions.

In its Reply Comments, PWE agreed with the Minnesota Pollution Control Agency ("MPCA") recommendation that the Commission consider net emissions from CO2-emitting energy production technologies in a way that accounts for emissions from alternative methods that would be used to handle materials. R&E agrees with the MPCA as well. This framework is essential to accurately consider the total environmental impact of waste management alternatives. The landfilling of waste results in a large amount of methane emissions. Methane is a stronger contributor to the climate crisis than CO2 and must be acknowledged when comparing emissions from WTE to the landfill alternative.

PWE also agreed with MPCA that the Commission should consider cumulative emissions over time and not just direct emissions at the point of generation. R&E agrees as well. Considering cumulative emissions over time is a key principle of the LCA view of emissions.

The Commission should focus on the GWP of all harmful greenhouse gases, including methane, when determining if a generation resource should be eligible as a fully carbon-free generation resource. Methane is responsible for 1/3 of global warming impacts felt currently and is a more destructive GHG than CO2.[xviii] Methane has 80 times the warming potential of CO2, and[xix] the US Environmental Protection Agency ("EPA") attributes 17% of all methane emissions in the US to the landfilling of waste.[xx] International environmental agencies have recognized THE dangers associated with methane emissions and the UN Global Methane Pledge has a goal to

reduce overall global methane emissions 30% below 2020 levels by 2030.[xxi] Decisions about electricity generation that focus only on reducing or eliminating CO2 emissions will result in waste that could be used for energy production being landfilled instead, which is contrary to the waste management hierarchy in Minn. Stat. § 115A.02(b).

Studies have shown substantially reduced GHG emissions when comparing WTE to landfilling. Researchers from the University of Buffalo completed an LCA in 2023 to quantify GHG emissions associated with the Xcel Energy WTE facilities in Red Wing, Wilmarth, and French Island ("WTE Plants").[xxii] The study compared emissions associated with the WTE Plants and landfill alternatives that would be most likely to accept the waste if these WTE facilities did not exist. Emissions for both the currently in-use and alternative scenarios were modeled from 2019 to 2050.

Five of the six modeled scenarios found between 10% and 58% reduced cumulative GHG emissions for WTE compared to landfilling.[xxiii] Further, the study found that modeled scenarios with a higher biogenic fraction of waste being burned had more favorable outcomes from a climate perspective.[xxiv] Biogenic materials emit more methane and GHG when landfilled. Increased emphasis on pre-combustion sorting, which is a focus of R&E, will continue to decrease GHG emissions in the future when compared to landfilling alternatives. Even with conservative assumptions, WTE GHG emissions and the corresponding CO2 equivalent emissions were found to be lower than landfilling.[xxv]

Total Emissions Savings by 2050

Facility	Methane GWP	Emissions Savings (ton CO_2 eq)	Global Warming Savings vs Landfill
Wilmarth	28	512,946	+10%
Wilmarth	35	2,211,770	+42%
Red Wing	28	-102,067	-2%
Red Wing	35	1,896,148	+29%
French Island	28	788,017	+32%
French Island	35	1,492,820	+58%

- WTE emissions savings largely attributed to high impact of methane, which is expected to grow with time
- Even with conservative and defensible assumptions, WTE emissions generally lower that landfill

Other studies have conducted broader LCA analyses comparing WTE and landfilling GHG emissions. A Reworld study compared the emissions of more than 90 WTE facilities across the US to the landfilling alternative.[xxvi] The study found that over 350 million tons of municipal waste are generated each year in the US,[xxvii] and that 64% of that waste is landfilled, 27% is recycled, and only 9% is recovered in WTE facilities.[xxviii,xxix]

Landfilling is the status quo waste management solution in the US, and the emissions and climate benefits of WTE cannot be seen without comparison to landfilling. Some landfills have systems to capture the methane emitted from the landfilled waste. However, these systems capture only 30-55% of the GHG generated over the life of waste in a landfill. The remaining gas escapes and is emitted into the atmosphere.[xxx- xxxv]

The Reworld study found consistent GHG benefits from diverting waste from landfills to WTE facilities. WTE facilities that deliver high amounts of energy and metal recovery show an increase in net GHG reductions. Waste with higher biogenic carbon content will result in higher avoided landfill emissions. A carbon intensive electric grid that is heavily based on fossil fuels will result in an even higher GHG reduction factor, due to the fact that energy generated by WTE will offset the energy generation from fossil fuels.

Reworld found that diverting MSW from landfills to WTE facilities resulted in 2.4 tons of CO2 equivalent avoided per ton of MSW diverted when landfill methane avoidance was considered for the 20-year global warming period, or a saving of 3.9 metric tons of CO2 equivalent per MWh of electricity generated.[xxxvi] This number included emissions from the combustion of the biogenic and fossil portion of MSW, avoided emissions associated with electricity generation and steam export from WTE, avoided emissions from metal recycling from WTE that replaces metal production from new raw material, and avoided landfill methane emissions.

A 2015 study prepared by Great Plains Institute at the request of R&E analyzed the GHG emissions specific to the RDF produced by the R&E Center and compared the emissions of different options for various waste management scenarios.[xxxvii] The study analyzed 400,000 tons of MSW managed in 7 different systems or potential scenarios. The Base Case modeled the current system at that time: processing 400,000 tons of MSW into RDF and all RDF going to Xcel for

combustion for energy generation. This scenario resulted in emissions of 73,659 metric tons of CO2 equivalent ("MtCO2e").

The Phase 1 scenario assumed increased Source Separated Recycling ("SSR") and source separated organics ("SSO"), which are now being implemented by R&E, with all remaining MSW processed into RDF and combusted by Xcel. The Phase 1 model resulted in emissions of 35,592 $MtCO_2e$.

The Phase 2 scenario modeled Phase 1 plus the use of Mixed Waste Processing ("MWP") to increase recycling and organics quantities and sending the organics offsite to an Anaerobic Digestion ("AD") facility. In 2024, R&E contracted to deliver a minimum of 30,000 tons per year of SSO and 20,000 tons per year of organics separated from MSW at the R&E Center to an AD facility slated to begin construction later this year in Shakopee, MN. The Phase 2 model resulted in emissions of 7,816 $MtCO_2e$. The study also modeled scenarios involving gasification of the RDF instead of combustion by Xcel, which would result in negative GHG emissions. These other scenarios are shown in the overall summary Table ES-1 below. Although R&E has thoroughly explored various gasification options for the RDF it produces, none have to date proven both technologically and economically feasible.

Table ES-1
GHG Emissions Summary ($MtCO_2e$)

	Processing Only (Base Case)	Phase 1 - SSO/SSR	Alternative 1 - Processing, AD, and MWP	Phase 2 - SSO/SSR/ MWP/AD	Alternative 2 - Processing and Gasification Only	Phase 3 - Gasification/SSO /SSR/MWP/AD	Existing System - Extended
Collection	**13,502**	**14,684**	**13,502**	**14,684**	**13,502**	**14,684**	**13,502**
Transportation	**9,384**	**8,770**	**8,771**	**8,419**	**5,414**	**5,114**	**11,342**
RDF Processing	**5,393**	**4,969**	**9,048**	**8,957**	**5,393**	**8,957**	**4,341**
Material Management							
♦ Recycling	(32,190)	(58,813)	(71,550)	(76,937)	(32,190)	(76,937)	(25,910)
♦ Anaerobic Digestion (AD)	0	(4,934)	(10,060)	(11,044)	0	(11,044)	0
♦ RDF Combustion	72,198	65,860	60,714	58,909	0	0	58,119
♦ Gasification	0	0	0	0	61,075	48,343	0
♦ Landfill	5,372	5,057	4,871	4,828	5,372	4,828	15,244
Material Management Subtotal	**45,380**	**7,170**	**(16,024)**	**(24,244)**	**34,257**	**(34,810)**	**47,454**
RDF Combustion Plant Shut-down	0	0	0	0	(170,538)	(141,967)	0
Ethanol Offset	0	0	0	0	(80,523)	(69,987)	0
Electrical Offset	0	0	0	0	100,641	83,780	0
Total GHG	**73,659**	**35,592**	**15,296**	**7,816**	**(91,855)**	**(134,229)**	**76,636**

The study found that implementing Source-Separated Organics (SSO) and Source-Separated Recyclables (SSR) to the Processing Only (Base Case) system results in a GHG

reduction of 52%. If only Mixed Waste Processing (MWP) and Anaerobic Digestion (AD) are added to the Base Case, the GHG reduction is estimated to be 79%. Combining both SSO/SSR and MWP/AD with the Base Case results in an estimated GHG reduction of 89% compared to the Base Case. [xxxviii] This is the path the R&E is currently pursuing.

Even though this analysis was completed in 2015, it remains useful to highlight the significant potential for GHG emission reductions through enhanced waste processing strategies at R&E. The analysis indicates that conversion of waste to recyclables has the greatest impact on GHG emissions. In the 10 years since this study, R&E has implemented many programs to increase recycling and sorting efforts to lower the overall GHG emissions.

BizRecycling, an R&E initiative to help businesses, apartment building and schools improve their recycling and food waste collection, has kept over 700,000 pounds of material out of the trash and helped to avoid 772 $MtCO_2e$ as a result.[xxxix] R&E has increased sorting efforts and implemented new recycling programs that helped recover 4,300 tons of edible food to feed families instead of ending up in the trash and recycled 13,000 mattresses that would have ended up the trash.[xl] R&E also made progress towards establishing an AD facility in the region to help manage organic waste and further reduce the GHG impacts of waste management.[xli]

Globally, the vast majority of LCAs that measure the environmental benefits of landfilling and WTE find that WTE is more favorable from a GHG emissions standpoint.[xlii] Generally, the few LCA studies that have found landfilling favorable from a GHG standpoint did not account for emissions offsets for the energy produced by WTE.[xliii] WTE generates electricity that offsets the need for more generation.

Any LCA framework adopted by the Commission to determine the carbon-free status of WTE must incorporate these offsets to produce an accurate picture of the emissions and environmental benefits of WTE. Additionally, the few LCA studies that found landfilling to be favorable from an emissions standpoint assumed a high level of landfill gas collection (>75%) and a very high level of landfill gas-to-energy recovery efficiency (>90%).[xliv] Currently, state-of-art MSW landfills capture only about 65% of the methane they generate.[xlv] The average US landfill captures only about 48% of the methane it generates.[xlvi] Landfills that collect methane gas can either flare it to convert CH4 into CO2, use it as an energy source, or sell it as "green" natural gas.

However, many landfills lack methane collection systems and release CH4 directly into the atmosphere. Flaring requires additional fuel and can produce air pollutants like nitrogen oxides.[xlvii]

WTE facilities, including the RDF Plants supported by R&E, offer significant GHG emission reductions compared to landfilling. The comprehensive LCAs cited above highlight the environmental benefits of WTE, particularly in terms of methane avoidance and overall GHG reductions. The Commission should grant full carbon-free credit to the RDF Plants under the CFS to ensure their continued operation and contribution to energy security and waste management in Minnesota.

C. Alternatively, RDF Should Be Granted Partial Credit Under the CFS Due to Reduced GHG Emissions Relative to the Landfilling Alternative.

If the Commission chooses not to grant full carbon-free credit to the RDF Plants under the CFS, they should still receive partial credit under the CFS. The Commission should consider the GHG benefits of WTE relative to the alternative of landfilling when calculating partial compliance.

Evaluating the emissions of landfill alternatives to WTE is necessary when conducting an LCA for MSW that is used at a WTE.[xlviii] MPCA data indicates that about one third of the Twin Cities metropolitan waste is sent to landfills,[xlix] and if not for R&E's comprehensive programs and efforts to recover resources from waste the 400,000 tons of MSW generated in Ramsey and Washington counties would be landfilled as well. As discussed above, different landfills have differing waste compositions, landfill gas collection systems, and different levels of landfill gas utilization, meaning that different landfill alternatives will lead to different levels of GHG emissions reductions when compared to WTE.[l]

The University of Buffalo study analyzed the 2019 actual emissions from the RDF Plants that R&E supplies along with the alternative emissions from the likely landfills that the waste would otherwise be sent to. The study found approximately 31% lower CO2 equivalent emissions for the RDF Plants as opposed to landfilling using a GWP of 28 for methane for the RDF Plants, and approximately 45% lower emissions for the RDF Plants when using a GWP of 35 for methane.[li]

Table 2. 2019 total GHG emissions for the three Xcel facilities and two methane GWPs, with comparison to landfill alternative scenarios.

Facility	Methane GWP	2019 Actual Emissions (ton $CO_{2,eq}$)	2019 Alternative Emissions (ton $CO_{2,eq}$)
Wilmarth	28	143,122	202,753
	35	145,520	263,033
Red Wing	28	171,240	235,447
	35	175,376	310,198
French Island	28	40,700	22,594
	35	41,810	25,028

If the Commission does not grant full CFS credit to WTE, the Commission should grant partial compliance credit under the CFS in proportion to the reduction in emissions versus the likely landfilling alternative.

III. CONCLUSION

R&E believes that Minn. Stat. § 216B.1691 provides the statutory basis for the Commission to determine that RDF meets the CFS requirements as a carbon-free fuel because RDF is considered biomass, which qualifies as an EET. Electricity generated from EETs qualifies for RECs, which in turn enables the RECs generated to meet the CFS.

R&E also supports and advocates for a comprehensive definition of "carbon free" that encompasses all GHG emissions, not just direct emissions from power plants. This approach should use carbon equivalency calculations to normalize the GWP of different GHGs, with carbon dioxide as the base unit. This is crucial for accurately assessing the carbon-free status of WTE technologies. Methane emissions from landfills, which have a significantly higher GWP than CO2, must be considered to avoid misrepresenting the environmental impact of waste management solutions.

WTE facilities, including the RDF Plants supported by R&E, are favorable from a GHG emissions standpoint and should be granted full credit under the CFS since they emit less CO2e than landfilling, the status-quo waste management solution. At the very least, WTE facilities should be granted partial CFS credit in the proportion that they reduce emissions compared to the landfilling alternative.

The Plants supported by R&E contribute to energy security, waste management, create green jobs, and support statewide recycling efforts. A Commission decision that does not grant the RDF Plants credit under the CFS would make it very difficult for these RDF Plants and R&E to continue operating and serving important functions in our state.

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Respectfully submitted,

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[i] In the Matter of a Commission Investigation into a Fuel Life-Cycle Analysis Framework for Utility Compliance with Minnesota's Carbon-Free Standard. Docket No. E-999/CI-24-352 ("LCA Docket") (Jan. 22, 2024).
[ii] *Who We Are and What We Do*, RAMSEY/WASHINGTON RECYCLING & ENERGY, https://recyclingandenergy.org/who-we-are-and-what-we-do/ (last visited Dec. 12, 2024).
[iii] *Id*.
[iv] *Id*.
[v] *Id.*
[vi] In the Matter of Xcel Energy's 2024-2040 Upper Midwest Integrated Resource Plan, MPUC Docket No. E002/RP24-67 ("IRP Docket"), Appendix W: RDF Plants, 12 (February 1, 2024) (eDocket No. 20242-203-027-01) ("Appendix W")
[vii] RAMSEY/WASHINGTON RECYCLING & ENERGY, *supra* note 1.
[viii] Appendix W: RDF Plants, *supra* note 6, at 1.
[ix] William Lazarus, Economic Impact of the Ramsey/Washington Recycling and Energy Center (April 2020).
[x] 216B.1691. Renewable energy objectives, MN ST § 216B.1691 subd. 1.
[xi] *Id*.
[xii] 216B.1691. Renewable energy objectives, MN ST § 216B.1691 subd. 4.
[xiii] *State v. Watkins*, 840 N.W.2d 21 (Minn. 2013).
[xiv] 216B.1691. Renewable energy objectives, MN ST § 216B.1691 subd. 7.
[xv] 216B.1691. Renewable energy objectives, MN ST § 216B.1691 subd. 2g.
[xvi] International Energy Agency, *Methane and Climate Change*, https://www.iea.org/reports/global-methane-tracker-2022/methane-and-climate-change.
[xvii] *Methane*, Climate & Clean Air Coalition, https://www.ccacoalition.org/short-lived-climate-pollutants/methane.

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[xix]*Methane*, Climate & Clean Air Coalition, https://www.ccacoalition.org/short-lived-climate-pollutants/methane.
[xx] *Frequent Questions about Landfill Gas*, Environmental Protection Agency, https://www.epa.gov/lmop/frequent-questions-about-landfill-gas#:~:text=Per%20the%20most%20recent%20Inventory,methane%20emissions%20across%20all%20sectors.
[xxi] *Global Methane Pledge*, Climate & Clean Air Coalition, https://www.ccacoalition.org/content/global-methane-pledge#:~:text=The%20Global%20Methane%20Pledge%20(GMP,C%20of%20warming%20by%202050.
[xxii] Dr. John D. Atkinson and Dr. Michael Shelly, *Current and Future Life Cycle Greenhouse Gas Emissions Modeling for Xcel Energy Waste-to-Energy Facilities*, University of Buffalo, The State University of New York (2023).
[xxiii] *Id*. at 2.
[xxiv] *Id*. at 16.
[xxv] *Id.* at 31.
[xxvi] Reworld, *Lifecycle Assessment (LCA) of the Climate Impacts of Municipal Solid Waste (MSW) Diverted from Landfill to Reworld Thermomechanical Treatment Facility (TTF)* (Sept. 2024).
[xxvii] *Id*. at 8.
[xxviii] Michaels, T. and Krishnan, K. (2018). Directory of waste-to-energy facilities. Energy Recovery Council. https://wtert.org/wp-content/uploads/2023/02/WtE-facilities-2018-directory.pdf
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[xxxvi] Reworld, *supra* note 26, at 10.
[xxxvii] Great Plains Institute, Greenhouse Gas Systems Analysis, Ramsey/Washington County Resource Recovery Project (April 2015).
[xxxviii] *Id.* at vi-vii.
[xxxix] Ramsey/Washington Recycling & Energy, 2024 Annual Report, https://recyclingandenergy.org/2024-annual-report/.
[xl] *Id.*
[xli] *Id*.
[xlii] Malak Anhassi et al., *A review of LCA assumptions impacting whether landfilling or incineration results in less greenhouse gas emissions*, 174 RESOURCES, CONSERVATION AND RECYCLING 105810 (2021).
[xliii] *Id*.
[xliv] *Id*.
[xlv] Atkinson, *supra* note 22, at 5.
[xlvi] *Id*.

[xlvii] *Id*.
[xlviii] Uisung Lee et al., *Evaluation of landfill gas emissions from municipal solid waste landfills for the life-cycle analysis of waste-to-energy pathways*, 166 J. OF CLEANER PROD. 335-342 (2017).
[xlix] Minnesota Pollution Control Agency, *Metropolitan Solid Waste Management Policy Plan 2022-2042,* 16 (Jan. 2024).
[l] Lee, *supra* note 48.
[li] Atkinson, *supra* note 22, at 18.