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VIA E-MAIL

April 7, 2018

Ontario Energy Board
Attn: Kirsten Walli, Board Secretary
P.O. Box 2319
27th Floor, 2300 Yonge Street
Toronto ON M4P 1E4

RE: EB-2017-0224/0255 Enbridge-Union Carbon Compliance – Technical Conference
FRPO Reference Documents

In respect of the limited time available for discovery at the Technical Conference, we are advancing some reference documents which should be familiar to Utilities.

Respectfully Submitted on Behalf of FRPO,

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c. A. Mandyam, EGDRegulatoryProceedings – EGD
A. Stiers, UnionGasRegulatoryProceedings - Union
V. Bennett, J. Wasylyk – OEB Staff
Interested Parties EB-2017-0224/0255

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Answer to Interrogatory from
Federation of Rental-housing Providers of Ontario ("FRPO")

Reference: Exhibit 3, Tab 4, Page 17, footnote 7

Preamble: We would like to understand better the government's stated support of RNG as an abatement strategy for the utilities. Footnote 7 references page 74 of the LTEP report which, in part, reads: "RNG is a low-carbon fuel produced by the decomposition of organic materials found in landfills, forestry and agricultural residue, green bin and food and beverage waste, as well as the waste from sewage and wastewater treatment plants. Because it comes from organic sources, the use *of RNG does not release any additional carbon into the atmosphere."*

Question:

1) The last sentence in the reference states RNG does release any additional carbon into the atmosphere. As Union understands this statement:
   a) Does RNG methane produce carbon emissions comparable to fossil fuel methane? If not, please clarify the difference.
   b) Understood in context, what does the "additional" refer to in the last sentence?

Response:

a) Assuming that the energy content of the RNG and conventional natural gas is comparable, RNG methane produces carbon emissions comparable to fossil fuel methane. However, CO_2 emissions from RNG are considered CO_2 neutral, for the purposes of determining Cap-and-Trade compliance obligations.

   As per Ontario Ministry of the Environment and Climate Change's ("MOECC") "Guideline for Quantification, Reporting and Verification of Greenhouse Gas Emissions - Effective November 2017," standard quantification method (SQM) ON.400 Natural Gas Distribution, CO_2 emissions are calculated based on the volumes of natural gas distributed, adjusted for deliveries to other distributors or exports, net deliveries to storage and deliveries to capped participants.

   Additionally, any natural gas derived from biomass is excluded from the volumes previously outlined above. As a result, under SQM ON.400, Union Gas has no compliance obligations due to CO_2 emissions from RNG. This methodology is supported by the Intergovernmental Panel on Climate Change (IPCC), which states, in Chapter 8: Anthropogenic and Natural Radiative Forcing of Climate Change 2013: The Physical Science Basis, Contribution of Working Group I to the Fifth Assessment Report of the IPCC, that "emissions of CO_2 from the combustion of biomass for energy in national inventories are currently assumed to have no net RF [radiative forcing], based on the assumption that these emissions are compensated by biomass regrowth" (IPCC WG1 Fifth Assessment Report, Chapter 8, p.714, dated 2013).

b) The reference to “the use of RNG does not release any additional carbon into the atmosphere” refers to the fact that emissions of CO_2 from combustion of biomass are considered CO_2 neutral. In other words, the CO_2 from combustion of biomass is balanced by the CO_2 removed from the atmosphere by biomass growth. This is consistent with part a) above.

Table 8.7 | GWP and GTP with and without inclusion of climate–carbon feedbacks (cc fb) in response to emissions of the indicated non-CO_2 gases (climate-carbon feedbacks in response to the reference gas CO_2 are always included).

	Lifetime (years)		GWP_{20}	GWP_{100}	GTP_{20}	GTP_{100}
CH_4[b]	12.4[a]	No cc fb	84	28	67	4
		With cc fb	86	34	70	11
HFC-134a	13.4	No cc fb	3710	1300	3050	201
		With cc fb	3790	1550	3170	530
CFC-11	45.0	No cc fb	6900	4660	6890	2340
		With cc fb	7020	5350	7080	3490
N_2O	121.0[a]	No cc fb	264	265	277	234
		With cc fb	268	298	284	297
CF_4	50,000.0	No cc fb	4880	6630	5270	8040
		With cc fb	4950	7350	5400	9560

Notes:
Uncertainties related to the climate–carbon feedback are large, comparable in magnitude to the strength of the feedback for a single gas.
[a] Perturbation lifetime is used in the calculation of metrics.
[b] These values do not include CO_2 from methane oxidation. Values for fossil methane are higher by 1 and 2 for the 20 and 100 year metrics, respectively (Table 8.A.1).

and GTP. For the more long-lived gases the GWP_{100} values increase by 10 to 12%, while for GTP_{100} the increase is 20 to 30%. Table 8.A.1 gives metric values including the climate–carbon feedback for CO_2 only, while Supplementary Material Table 8.SM.16 gives values for all halocarbons that include the climate–carbon feedback. Though uncertainties in the carbon cycle are substantial, it is *likely* that including the climate–carbon feedback for non-CO_2 gases as well as for CO_2 provides a better estimate of the metric value than including it only for CO_2.

Emission metrics can be estimated based on a constant or variable background climate and this influences both the adjustment times and the concentration–forcing–temperature relationships. Thus, all metric values will need updating due to changing atmospheric conditions as well as improved input data. In AR5 we define the metric values with respect to a constant present-day condition of concentrations and climate. However, under non-constant background, Joos et al. (2013) found decreasing CO_2 $AGWP_{100}$ for increasing background levels (up to 23% for RCP8.5). This means that GWP for all non-CO_2 gases (except CH_4 and N_2O) would increase by roughly the same magnitude. Reisinger et al. (2011) found a reduction in AGWP for CO_2 of 36% for RCP8.5 from 2000 to 2100 and that the CH_4 radiative efficiency and AGWP also decrease with increasing CH_4 concentration. Accounting for both effects, the GWP_{100} for CH_4 would increase by 10 to 20% under low and mid-range RCPs by 2100, but would decrease by up to 10% by mid-century under the highest RCP. While these studies have focused on the background levels of GHGs, the same issues apply for temperature. Olivié et al. (2012) find different temperature IRFs depending on the background climate (and experimental set up).

User related choices (see Box 8.4) such as the time horizon can greatly affect the numerical values obtained for CO_2 equivalents. For a change in time horizon from 20 to 100 years, the GWP for CH_4 decreases by a factor of approximately 3 and its GTP by more than a factor of 10. Short-lived species are most sensitive to this choice. Some approaches have removed the time horizon from the metrics (e.g., Boucher, 2012), but discounting is usually introduced which means that a discount rate *r* (for the weighting function e^{-rt}) must be chosen instead. The choice of discount rate is also value based (see WGIII, Chapter 3).

For NTCFs the metric values also depend on the location and timing of emission and whether regional or global metrics are used for these gases is also a choice for the users. Metrics are usually calculated for pulses, but some studies also give metric values that assume constant emissions over the full time horizon (e.g., Shine et al., 2005a; Jacobson, 2010). It is important to be aware of the idealized assumption about constant future emissions (or change in emissions) of the compound being considered if metrics for sustained emissions are used.

8.7.1.5 New Metric Concepts

New metric concepts have been developed both to modify physical metrics to address shortcomings as well as to replace them with metrics that account for economic dimensions of problems to which metrics are applied. Modifications to physical metrics have been proposed to better represent CO_2 emissions from bioenergy, regional patterns of response, and for peak temperature limits.

Emissions of CO_2 from the combustion of biomass for energy in national emission inventories are currently assumed to have no net RF, based on the assumption that these emissions are compensated by biomass regrowth (IPCC, 1996). However, there is a time lag between combustion and regrowth, and while the CO_2 is resident in the atmosphere it leads to an additional RF. Modifications of the GWP and GTP for bioenergy (GWP_{bio}, GTP_{bio}) have been developed (Cherubini et al., 2011; Cherubini et al., 2012). The GWP_{bio} give values generally between zero (current default for bioenergy) and one (current for fossil fuel emissions) (Cherubini et al., 2011), and negative values are possible for GTP_{bio} due to the fast time scale of atmospheric–ocean CO_2 exchange relative to the growth cycle of biomass (Cherubini et al., 2012). GWP_{bio} and GTP_{bio} have been used in only a few applications, and more research is needed to assess their robustness and applicability. Metrics for biogeophysical effects, such as albedo changes, have been proposed (Betts, 2000; Rotenberg and Yakir, 2010) , but as for NTCFs regional variations

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Answer to Interrogatory from
Board Staff

Reference: Exhibit 3 / Tab 4 / p. 21, Figure 3

Preamble: Union Gas states that for its procurement model, the forecasted cost of carbon will be determined by the OEB's LTCPF applicable at the time of contracting.

The OEB has committed to updating its LTCPF every year.

In its illustration of the Renewable Natural Gas Procurement Funding Model, Union Gas shows the cost of RNG in $/GJ:

Figure 3

Renewable Natural Gas Procurement Funding Model

		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 9	Year 9	Year 10
		2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**
a)	Forecast gas cost ($ / GJ)	$ 3.91	$ 3.95	$ 3.91	$ 4.22	$ 4.22	$ 4.29	$ 4.28	$ 4.68	$ 5.03	$ 5.43
b)	Forecast Cost of Carbon ($ / GJ)	$ 0.85	$ 0.90	$ 0.90	$ 0.95	$ 1.00	$ 1.05	$ 1.56	$ 1.81	$ 2.16	$ 2.51
(c) = (d)-(a)-(b)	Required Provincial Funding ($ / GJ)	$ 11.24	$ 11.15	$ 11.19	$ 10.83	$ 10.78	$ 10.66	$ 10.16	$ 9.51	$ 8.81	$ 8.06
d)	Assumed Cost of RNG ($ / GJ)	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00	$ 16.00

Question:

a) Please provide the costs in the table in $ per tonne of CO_2e.

b) Please explain why Union Gas used $16/GJ as an illustrative cost of RNG and provide supporting documentation and analysis that shows how Union Gas developed the $16/GJ as a likely price for RNG.

c) Did Union Gas consider any other pricing options, such as variable pricing, over the term of the contract? Please explain.

d) Please explain if, and if so how, the annual updates to the LTCPF could impact ratepayers, provincial funding, and potential RNG suppliers.

Response:

a) Please see Attachment 1.

b) Union used $16/GJ for illustrative purposes only. The RFP is expected to provide a market price. No documentation or analysis was conducted to calculate the $16/GJ.

c) In order to provide the certainty required to enable producers to move forward with RNG production investments a fixed RNG price over a long term contract is required.

d) The following is intended to provide a complete overview of the proposed RNG pricing mechanism and commentary related to ratepayer risks and impacts in response to various related interrogatories received by intervenors.

Union's proposal involves contracting for RNG supply from producers using fixed price, long term contracts. Union is proposing to recover the cost of RNG purchased using three mechanisms:

- The first recovery mechanism is in gas costs based on a forecast cost of gas for the entire term of the RNG contract. This forecast cost is intended to reflect what ratepayers would have otherwise paid for conventional natural gas. In Union's proposal, this impacts system customers who purchase their supply from Union.
- The second recovery mechanism is in Cap-and-Trade costs and will be based on the OEB's Long Term Carbon Price Forecast for the entire term of the RNG contract. Because RNG is a carbon neutral alternative and has lower emissions, when Union purchases RNG, the carbon allowance requirement is reduced. This benefits all customers that Union purchases carbon allowances for, including Union's purchases for operating its own facilities. Union is proposing to recover a portion of the RNG cost in Cap-and-Trade charges to reflect what customers would have otherwise paid for carbon allowances. This charge applies to all customers that pay facility or customer related Cap-and-Trade rates.
- The third and balance of recovery is through government funding. Natural gas customers contribute to Cap-and-Trade program funds through the cost of carbon included in natural gas rates. Access to the Cap-and-Trade funds to support RNG ensures that ratepayers are not paying a premium for RNG in addition to already contributing to Cap-and-Trade in natural gas rates. Government funding provides access to Cap-and-Trade proceeds specifically allocated for RNG, supporting the economic and environmental benefits that RNG can provide in optimizing the use of existing natural gas assets while reducing the province's carbon footprint.

Union will set the price of carbon and natural gas based on the most recent forecast available at the time each RNG contract is finalized. The total RNG and associated forecast gas and carbon price elements will be fixed for the term of the contract, negating the need for Union to update the forecasts which underpin the contract and the allocation of costs each year. This approach ensures the producer's revenue ($/GJ) is predictable and the government funding provided to Union is adequate to support the entire term of the RNG contract.

On an actual basis, the price of natural gas and carbon may be different from the forecast price at the time the RNG contract is negotiated, however, the cost to ratepayers will be at the contracted rate (i.e the forecast cost of natural gas and carbon at the time the RNG contract is finalized and will be fixed for the term of the RNG contract).

Union's RNG procurement will make up a very small portion of its gas supply and Cap-and-Trade compliance plans. Therefore, the impact associated with actual prices for gas and/or carbon being higher or lower than what is forecast is expected to be immaterial.

Renewable Natural Gas Procurement Funding Model

		Year 1 2018	Year 2 2019	Year 3 2020	Year 4 2021	Year 5 2022	Year 6 2023	Year 7 2024	Year 9 2025	Year 9 2026	Year 10 2027	Average
a)	Forecast Gas Cost ($ / tonne)	$77.83	$78.63	$77.83	$84.01	$84.01	$85.40	$85.20	$93.16	$100.13	$108.09	$87.43
b)	Forecast Cost of Carbon ($ / tonne)	$17.00	$18.00	$18.00	$19.00	$20.00	$21.00	$31.00	$36.00	$43.00	$50.00	$27.30
(c) = (d)-(a)-(b)	Required GreenON Subsidy ($ / tonne)	$ 223.67	$ 221.87	$ 222.67	$ 215.50	$ 214.50	$ 212.11	$ 202.30	$ 189.34	$ 175.37	$ 160.41	$ 203.77
d)	Assumed Cost of RNG ($ / tonne)	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50	$ 318.50

Note:

Assumed Heat Conversion Factor M3 to GJ 0.0373