REF: Exhibit B / Tab 1 / Schedule 1 / p. 4 #11 and 12

Preamble: In addition to Board Staff IR.1, we are interested in how EGD envisions this potential service as compared to Union Gas M13 and M16 services.

1) Please provide a comparison and/or contrast between EGD's proposed service and Union's M13 and M16 Rates. Please describe fully the similarities and differences.

REF: Exhibit B / Tab 1 / Schedule 1 / p. 15, #44, p. 16, #48, p. 17 # 49, #50 and p.19 #56 and 57

And

EB-2017-0224 Transcript Volume 3, Oral Hearing, 2018 Compliance Plans, 20180426, page 16

Preamble: In the Transcript Reference from EB-2017-0224, Mr. McGill from Enbridge states:

> *MR. McGILL: Yes. Yesterday we received a letter from the Minister of Energy indicating to us that the proposed funding in support of our RNG procurement plan will not be available until after the provincial election in June. And as such, we are putting the procurement RFP on hold for the time being and we're in the process of communicating this information to the parties that have responded to the RFP, so for the time being that process is going to be on hold.*

In addition to Board Staff IR-6, we would like to understand better Enbridge's plans in the short term.

2) In light of the uncertainty of funding and in the period before a decision is made:
   a) What activities will Enbridge undertake in exploring the respective RNG and Geotherm initiatives?
   b) Where will the costs of these activities accrue?
   c) What is Enbridge's proposed disposition of these costs in the event that funding is not provided and the company chooses not to proceed?

REF: Exhibit B / Tab 1 / Schedule 1 / pp. 21-22 and p. 25, #74

Preamble: In addition to Board Staff IR-10, we would like to understand Enbridge's investment in this area of the market.

3) Does Enbridge expect to garner offset credits from its investment in these ventures?
   a) If so, please describe how Enbridge proposes that would be accomplished.

REF: Exhibit B / Tab 1 / Schedule 1/ p. 8, #24, p. 10, #30 and p.20, #59

Preamble: We are interested in understanding Enbridge's belief and commitment to these initiatives. On page 20, paragraph 59, Enbridge states:

> "*As detailed in the "Regulatory Treatment of RNG Enabling Service and Geothermal Energy Service Program" section of this evidence, Enbridge is also requesting approval of its proposal to record the annual revenue deficiency or sufficiency associated with the RNG enabling service program in the GHG-Customer VA to be periodically cleared to ratepayers."*

4) Would Enbridge be willing to accept approval of the proposed construct with no deferral account to accept the risks associated with the uncertainty of the development of the market?
   a) If not, why not?
   b) If not, please explain why the Board should ask ratepayers to take on that risk?
      i) Please answer the above question recognizing, as stated in evidence, ratepayers contribute to the government funds that may be available to subsidize these projects.

REF: EB-2017-0255, Exhibit B.FRPO.1 and EB-2017-0255, Exhibit JT1.24 (attached for ref.)

Preamble: We would like to understand better the company's technical views on the inclusion of human and animal waste as biomass given the scientific view of biomass as emission-neutral as pre-scribed by the new regulations.

5) Please provide Enbridge's technical view of the inclusion of human and agricultural waste combustion as biomass being emission neutral due to the absorption of CO_2 as the biomass regrows.
   a) Please provide company's technical views how this carbon cycle is sustainable as carbon-neutral with the introduction of human waste-derived RNG being combusted in customers' homes and businesses.

DR QUINN & ASSOCIATES LTD.

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,

Dwayne R. Quinn
Principal
DR QUINN & ASSOCIATES LTD.

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

• 130 Muscovey, Drive • Elmira, ON • N3B 3P7 • drquinn@rogers.com • (519)-500-1022 •

UNION GAS LIMITED

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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Undertaking of Ms. Flaman
To Mr. Quinn

Reference: Tr.1, p.116

WITH RESPECT TO THE IPCC WG1 FIFTH ASSESSMENT REPORT, CH. 8, P. 714 DATED 2013 REFERRED TO AT FRPO.1, COMMENT ON WHETHER UNION'S UNDERSTANDING OF THIS SECTION OF THE REPORT IS THAT THE EMISSIONS ARE NETTED OUT OVER TIME DUE TO REGROWTH OF THE BIOMASS THAT ABSORBS CARBON DIOXIDE FROM THE ATMOSPHERE.

TO THE EXTENT THE INFORMATION EXISTS,

TO ADVISE WHETHER IT IS CORRECT THAT WHEN THE EMISSIONS ARE NETTED OUT OVER TIME DUE TO REGROWTH OF THE BIOMASS, THAT ABSORBS CARBON DIOXIDE FROM THE ATMOSPHERE; ALSO, TO EXPLAIN HOW THIS PHENOMENON OCCURS FOR HUMAN OR ANIMAL WASTE BEING CONVERTED TO METHANE FOR THE PURPOSES OF RNG.

Response:

Union's understanding of this issue has been informed by the following publically available information.

The Ontario Ministry of the Environment and Climate Change (MOECC) has considered carbon dioxide emissions from RNG as carbon neutral for the purposes of Ontario greenhouse gas reporting, and therefore, for the purposes of determining Cap-and-Trade compliance obligations. As per the MOECC's standard quantification method (SQM) ON.400 Natural Gas Distribution, any volumes of natural gas derived from biomass are netted out of the carbon dioxide emission calculations. This is based on the assumption that the carbon dioxide from the combustion of biomass is balanced by the carbon dioxide removed from the atmosphere by biomass growth.

In other words, *"renewable natural gas is a low-carbon fuel that does not add new carbon to the atmosphere"*.[1] This is consistent with the British Columbia Ministry of Energy, Mines and Petroleum Resources, which states, in their BC Bioenergy Strategy that *"Bioenergy is energy derived from organic biomass sources – such as trees, agricultural crops, food processing and agricultural wastes and manure. Biomass can be generated from logging, agriculture and aquaculture, vegetation clearing and forest fire hazard areas. When used for energy, biomass such as organic waste, wood residues and agricultural fibre, is considered clean or carbon neutral because it releases no more carbon into the atmosphere than it absorbed during its*

[1] Ontario's Five Year Climate Change Action Plan 2016-2020, Section 6.1, p.28.

lifetime. When used to replace non-renewable sources of energy, bioenergy reduces the amount of greenhouse gases released into the atmosphere."[2]

[2] BC Bioenergy Strategy – Growing Our Natural Energy Advantage