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December 22, 2022

Metro Vancouver Regional District
Metrotower III, 4515 Central Boulevard,
Burnaby, B.C.
V5H 0C6

Attention: Mr. Roger Quan

Dear Mr. Quan:

Re: FortisBC Energy Inc. (FEI)

2022 Long Term Gas Resource Plan (LTGRP) – Project No. 1599324

Response to the Metro Vancouver Regional District (Metro Vancouver) Information Request (IR) No. 1

On May 9, 2022, FEI filed the LTGRP referenced above. In accordance with the amended regulatory timetable established in British Columbia Utilities Commission Order G-287-22 for the review of the LTGRP, FEI respectfully submits the attached response to Metro Vancouver IR No. 1.

For convenience and efficiency, if FEI has provided an internet address for referenced reports instead of attaching the documents to its IR responses, FEI intends for the referenced documents to form part of its IR responses and the evidentiary record in this proceeding.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachments

cc (email only): Commission Secretary
Registered Parties

1.0 Reference: EXECUTIVE SUMMARY

Exhibit B-1, Section 1, p. ES-2

Life Cycle Emission Factor

APPENDIX D-2

Exhibit B-1, Section 5.5, p. 104

Carbon Intensity of Blue Hydrogen

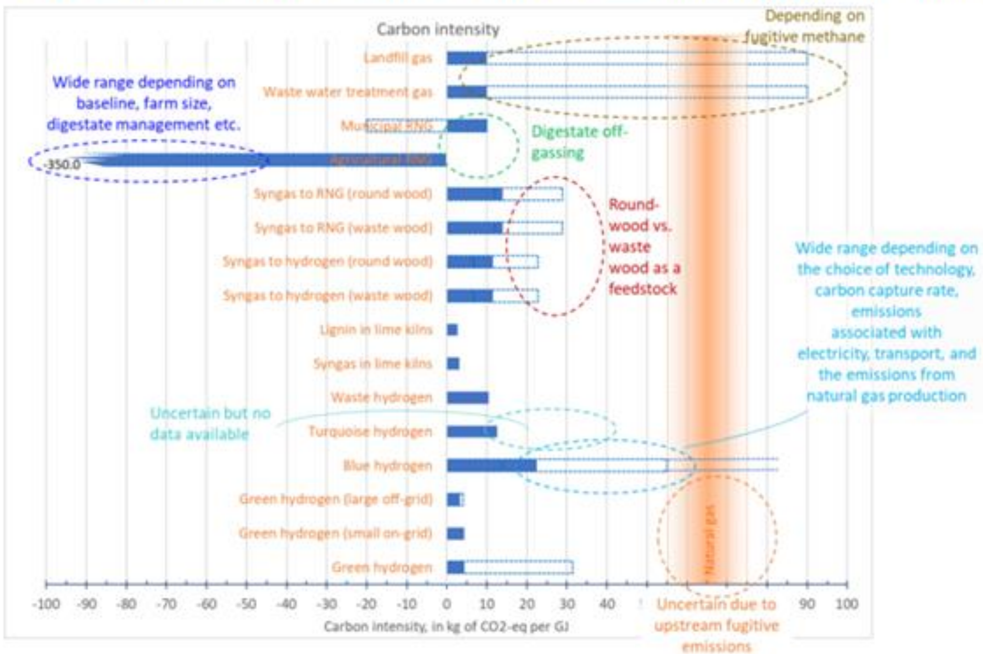
On page ES-2 of Exhibit B-1, FEI provides Figure ES-2 as shown below:

Table ES-2 Fuel Types and Decarbonization Technologies Used in the 2022 LTGRP

Fuel Type	Description[3]	Life cycle Emission Factor (tCO_2e/GJ)	End use cycle Emission Factor (tCO_2e/GJ)
Natural gas	Natural gas is a naturally occurring hydrocarbon. Hydrocarbons are a class of organic compounds consisting of carbon and hydrogen. Raw natural gas (before processing) is composed primarily of methane.[4]	0.0598	0.04987[5]
Renewable natural gas (RNG)	Upgraded biogas produced from farm or municipal organic biomass. Upgraded synthesis gas (syngas) produced from wood biomass at pulp mills and some municipal organic biomass.	0.0100	0.0003
Syngas	Produced from wood to displace natural gas used in lime kilns at pulp mills. Can also be upgraded to green hydrogen.	0.0100	0.0000
Lignin	Produced from black liquor to displace natural gas used in lime kilns at pulp mills.	0.0100	0.0000
Green Hydrogen	Produced via water electrolysis using renewable electricity feedstock.	0.0000	0.0000
Blue Hydrogen	Reformed from hydrocarbon feedstock with up to 90 percent carbon sequestered.	0.0200	0.0000[6]
Natural Gas with Associated Carbon Capture, Utilization and Storage (CCUS)	Applying the carbon reduction benefits of CCUS to the delivery of natural gas on FEI's gas network.[7]	0.0148	0.0148

On page 104 of Appendix D-2 in Exhibit B-1, FEI provides Figure 34 as shown below:

Figure 34 Carbon Intensities of Renewable and Low-Carbon Gas Pathways as reported in literature



British Columbia's *B.C. Hydrogen Strategy*, states as follows:

> The federal *Hydrogen Strategy for Canada* and the European Commission recommend a carbon intensity threshold of 36.4 g CO_2e/MJ. BC will consider this target a starting point and will ensure that its regulatory frameworks relating to hydrogen production and use are aligned to achieve continued reductions in carbon intensity over time.

1.1 Given the high degree of uncertainty associated with the lifecycle emissions of blue hydrogen, as indicated in Figure 34 of Appendix D-2, please discuss how 0.02 tonnes CO_2e/GJ was chosen to represent the lifecycle emissions of blue hydrogen in Table ES-2.

<u>Response:</u>

The lifecycle emissions factor for blue hydrogen of 0.02 tonnes CO_2e per GJ, or 20 kg CO_2e per GJ, was chosen as an indicative value based on the research of carbon intensities for blue hydrogen from the BC Renewable and Low-carbon Gas Supply Potential Study[1] and the Pembina Institute technical paper, "Carbon intensity of blue hydrogen production".[2] Further, the value falls below the federal government's proposed carbon intensity threshold of 36 kg CO_2e per GJ.

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1 Exhibit B-1, Appendix D-2.

2 Jan Gorski, Tahra Jutt & Karen Tam Wu, "Carbon intensity of blue hydrogen production: Accounting for technology and upstream emissions", Pembina Institute Technical Paper (August 2021) online at: https://www.pembina.org/reports/carbon-intensity-of-blue-hydrogen-revised.pdf.

Three of the most important factors affecting the carbon intensity of blue hydrogen are the capture rate, the carbon intensity of electricity for the site, and the overall methane leakage rate. FEI is only evaluating projects and technologies that have very high carbon capture rates for blue hydrogen. Further, BC's grid electricity intensity is among the lowest in North America and BC has implemented stringent methane reduction regulations for BC's upstream gas sector. Given all three of these factors, 20 kg CO_2e per GJ is a conservative value when evaluating the carbon intensity of blue hydrogen.

1.2 Please revise the life cycle emissions factors in Table ES-2 to reflect the range of uncertainty in the carbon intensity for the different fuel types, as per Figure 34.

Response:

The lifecycle emission factors provided in Table ES-2 represent values adopted as part of the forecasting conducted for the Application. FEI acknowledges that there is considerable uncertainty associated with analysis of fuels that are not yet produced within BC and, as such, educated assumptions about the emission factors for hydrogen, syngas and lignin have been made. As technology associated with renewable and low-carbon fuel production pathways matures, estimates on lifecycle emission factors will be updated in future LTGRP submissions to the BCUC. Further, FEI understands that the federal and provincial governments are evaluating carbon intensity thresholds for low-carbon hydrogen production which would apply to any supply produced or acquired by FEI.

The table below summarizes the GHG emission factors from the BC Renewable and Low-Carbon Fuel Potential Study[3] for the fuels listed in Table ES-2.

Fuel type	Lifecycle Emission Factor Low (gCO2e/MJ)	Lifecycle Emission Factor High (gCO2e/MJ)
Natural gas	56	74
RNG	-520	90
Syngas	12	16.8
Lignin	2.7	2.7
Green Hydrogen	4.0	27.4
Blue Hydrogen	10.6	135

[3] Exhibit B1-1, 2022 LTGRP Application, Appendix D-2.

1.3 Please discuss FEI's energy contracting strategy to ensure that the lifecycle emissions of acquired blue hydrogen will not exceed the carbon intensity threshold of 36.4 g CO_2e/MJ, as recommended by the Provincial Government.

Response:

All renewable gas produced or acquired by FEI must undergo a lifecycle carbon intensity assessment using the B.C. government-approved GHGenius model. FEI contractually holds its suppliers to a carbon intensity using this standard so if a supplier exceeds their contracted carbon intensity, they would be in breach of their contract.

FEI is not currently enabled to acquire low-carbon ("blue") hydrogen under the existing regulatory framework. However, if changes were made in future such that FEI could produce or acquire blue hydrogen, FEI would ensure that all blue hydrogen meets the specified carbon intensity threshold through lifecycle carbon intensity assessment, supplier attestation, and contractual obligations.

2.0 Reference: PLANNING ENVIRONMENT

Exhibit B-1, Section 2.4.1, p.91

Outlook of Renewable and Low-Carbon Gas Cost

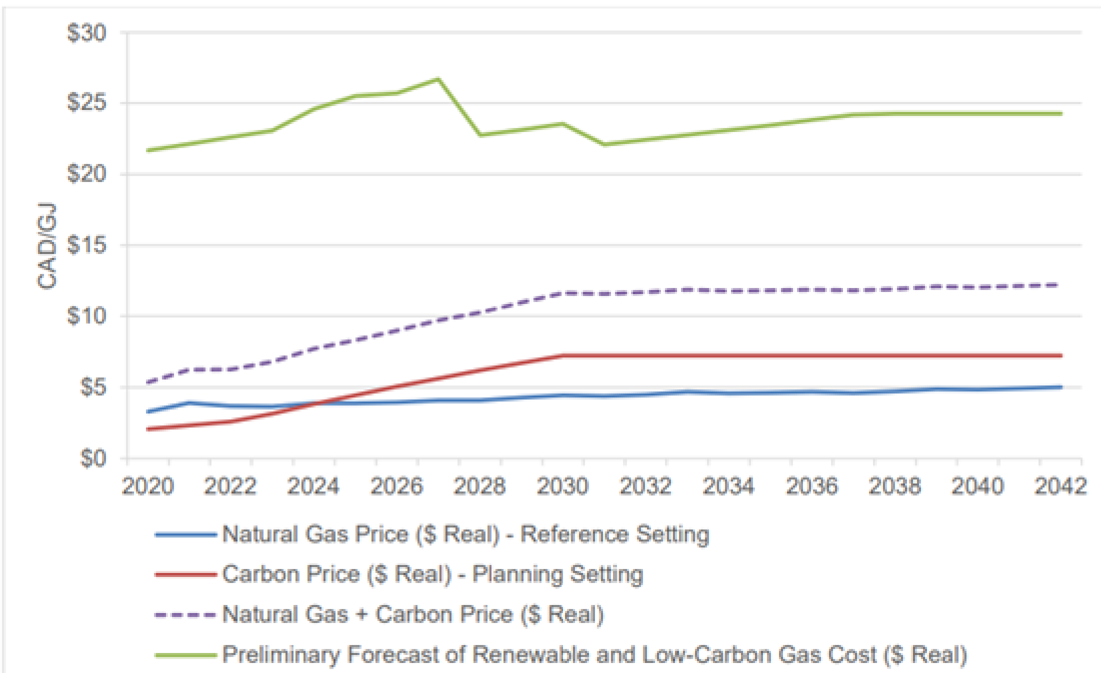
ENERGY SCENARIOS – STAGE 2

Exhibit B-4, Section 2.3, p.22

Rate Impact Analysis

On page 2-25 of Exhibit B-1, FEI provides Figure 2-3 as shown below:

Figure 2-3: Outlook of Energy Costs for Fuel Types Used in the Development of the LTGRP[85,86]



On page 22 of Exhibit B-4, FEI provides Table 7 as shown below:

Table 7: Summary and Comparison of Average Projected Delivery Rate Changes – FEI Scenarios

	Rate Change (2022 – 2042)						
	Average UPC (2022 – 2042)	FEI Diversified Energy (Planning)		FEI Deep Electrification		FEI Economic Stagnation	
		Cumulative	Annual	Cumulative	Annual	Cumulative	Annual
Residential (RS 1)	60	118%	4.0%	235%	6.2%	20%	0.7%
Small Commercial (RS 2)	293	102%	3.6%	207%	5.8%	1%	-0.1%
Large commercial (RS 3)	3,253	107%	3.7%	206%	5.7%	-3%	-0.3%
General Firm Service (RS 5)	18,542	114%	3.9%	150%	4.7%	10%	0.3%

2.1 Please confirm that the forecast for renewable and carbon gas price ($/GJ) out to 2042, shown in Figure 2-3, was used within the calculations for the rate change calculations (2022-2042), as shown in Table 7.

2.1.1 If not, please provide the forecast for the renewable and low carbon gas price ($/GJ) that was used for the calculations in Table 7, for 2022-2042.

Response:

Confirmed. The forecast for renewable and low-carbon gas price ($ per GJ) as shown in Figure 2-3 of the Application and referenced in the preamble above corresponds to the cost of renewable and carbon gas prices that were used in the rate impact analyses shown in Section 9.4 of the Application as well as Table 7 of Exhibit B-4 of the Application (as referenced in the preamble above). However, FEI clarifies Figure 2-3 of the Application was only an illustration of a long-term view for the renewable and low-carbon gas prices out to 2042. Each scenario included in the rate impact analyses in Section 9.4 of the Application as well as Table 7 of Exhibit B-4 of the Application will have different mixes of renewable and low-carbon gas. Therefore, the cost of energy ($ per GJ), which is a weighted-average based on the different types of renewable and low-carbon gas, as was used in the rate impact analysis, is different between each scenario.

For further information, please refer to the response to BCUC IR1 71.8.1 that provides the renewable and low-carbon gas supply portfolio and costs for the DEP Scenario, the Reference Case and alternate scenarios. The rate impact analysis shown in Section 9.4 of the Application and also in Table 7 of Exhibit B-4 of the Application as shown in the preamble reflects the costs and fuel mixes described in these responses.

2.2 Please break down the forecast by the different forms of renewable and low-carbon gas (i.e. renewable natural gas, syngas, lignin, blue hydrogen, green hydrogen, turquoise hydrogen, other).

Response:

Please refer to the response to BCUC IR1 52.6 for a breakdown of the types of renewable and low-carbon gas modelled in the supply portfolio. FEI has not broken out this forecast further into separate hydrogen types within the supply portfolio since hydrogen supply development is still in early stages and insufficient information exists with which to forecast the volume of individual hydrogen supply types. Please also refer to the response to BCSEA IR1 6.5.

2.2.1 Please explain why there is a drop in the forecasted cost from 2026 to 2028.

Response:

FEI analyzed a portfolio of renewable gas supply options including RNG (biomethane), renewable and low-carbon hydrogen, and syngas and lignin as the basis for the Preliminary Forecast of Renewable and Low-Carbon Gas Cost. The analysis evaluated various volume and pricing outlook scenarios for the renewable gas supply pathways considered that indicates a drop in the forecast cost towards 2030 based on the following assumptions regarding renewable gas supply:

1. RNG (biomethane) supply will see an uptick in price due to escalation and demand competition;
2. Syngas and lignin represented a small percentage of forecast future supply volume and therefore were assumed to have little impact on the forward price curve;
3. Proposed world-scale low-carbon hydrogen projects using best-in-class technology and high carbon capture rates would significantly increase renewable and low-carbon gas supply within the next five to ten years;
4. The price outlook for low-carbon hydrogen supply would evolve during that time to be in the range of $15 to $20 per GJ (please also refer to the responses to the BCSEA IR1 18 series); and
5. FEI will have access to on-system and off-system supply of new forms of renewable and low-carbon gas supply including increasing volumes of lower cost hydrogen.

2.2.2 Please provide the supporting materials from which FEI derived the forecast for renewable-low carbon gas cost (i.e. market analysis, studies, etc.) in Figure 2-3, including outlining the methodology and key assumptions that FEI used in the forecast.

Response:

Please refer to the response to BCUC IR 1 71.8.2.

3.0 Reference: OUTCOMES OF FEI'S CLEAN GROWTH PATHWAY

Exhibit B-1, Section 9.2.1.3, p.9-2

Renewable and Low-Carbon Gas Supply

GROWTH IN RENEWABLE GAS SUPPLY

FEI's Application relating to BERC Rate Methodology – BCUC Decision and Order G-133-16 Compliance Filing

Exhibit B-17, Section 3.0, BCUC IRs 3.1

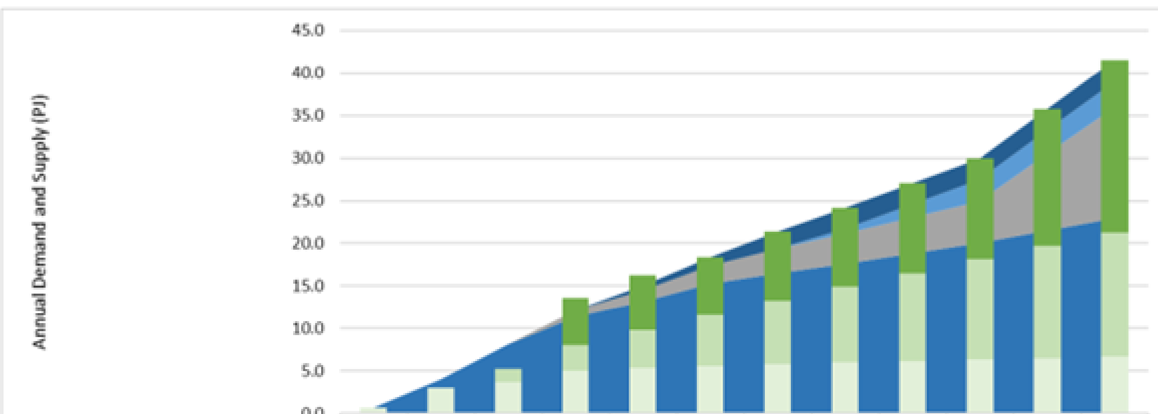
Forecast Volumes of Renewable Gas Supply

On page 9-2 of the Application, FEI states:

> Acquiring and allocating 60.2 PJ of renewable and low-carbon gas supply by 2030 to these customer groups results in emission reductions of 3.0 Mt CO2e. In 2040, the allocation of 99 PJ of renewable and low-carbon gas to these customer groups results in 4.9 Mt CO2e of GHG emission reductions.

In response to BCUC IR 3.1 of the BERC Rate Methodology Proceeding, FEI provided a re-stated Figure 8-3 as shown below:

Restated Figure 8-3: Breaking out Renewables by Type



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Supply - Lignin	0.0	0.0	0.0	0.0	0.5	1.0	2.0	2.5	2.5	2.5	2.5	2.5
Supply - Syngas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	2.5	2.8	3.0
Supply - H2	0.0	0.0	0.0	0.7	1.4	2.1	2.9	3.6	4.3	5.0	9.0	13.0
Supply - RNG	0.7	4.0	8.1	11.4	13.1	15.3	16.5	17.6	18.8	20.0	21.5	23.0
Demand - Renewable Gas Blend	0.0	0.0	0.0	5.5	6.4	6.9	8.2	9.3	10.6	11.8	16.1	20.2
Demand - Renewable Gas Connections	0.0	0.0	1.6	3.1	4.6	6.0	7.5	8.9	10.4	11.8	13.2	14.6
Demand - Voluntary Renewabe Gas	0.7	3.0	3.7	5.0	5.3	5.5	5.7	6.0	6.2	6.4	6.5	6.6

3.1 Using the same format as the re-stated Figure 8-3, please re-state Figure 8-3, extended out to 2042, with the volumes of each type of renewable and low-carbon gas that FEI is anticipating supplying in order to achieve its greenhouse gas targets under the Greenhouse Gas Reduction Standard (i.e. 60.2 PJ by 2030 and 99 PJ by 2040 per FEI's Application). Additionally, please separate the hydrogen row into the different production methods (i.e. green, blue, turquoise, etc.).

Response:

The Application does not assume an allocation of supplies of renewable and low-carbon gas to customers in the way that it was done for the BERC Rate Methodology Proceeding and there are no new updates to the demand information contained in Restated Figure 8-3. Please refer to the response to BCUC IR1 52.7 in this proceeding for a discussion of the difference between what is contained in Restated Figure 8-3 above from the BERC Rate Methodology Proceeding and what was modelled in the Application. To remain consistent with the modelling in the Application, FEI provides one example of how the components of the renewable and low-carbon gas supply portfolio could evolve over the 20-year planning horizon in the response to BCUC IR1 52.6. Please also refer to the response to BCUC IR1 71.8.1.

4.0 Reference: CLEAN GROWTH PATHWAY

Exhibit B-1, Section 3.3.3, p. 3-14

Hydrogen Backbone

ENERGY SCENARIOS – STAGE 2

Exhibit B-4, Section 2.3, p.22

Rate Impact Analysis

On page 3-14 of the Application, FEI states:

> Hydrogen is a clean-burning molecule that can be used to displace natural gas and liquid fossil fuels to decarbonize a range of end use applications […] A low-carbon "backbone" system" would provide the necessary capacity to link hydrogen hubs, producers, and consumers over longer distances and enable a regional market.

British Columbia's *B.C. Hydrogen Strategy*, states as follows:

> While the volume of hydrogen that can be directly injected in B.C.'s extensive pipeline distribution network depends on the point of injection and pipeline capacity, studies have shown that hydrogen by volume up to 5%-15% can be tolerated in the pipeline network with minimal disruption to appliances in homes and businesses.

On page 22 of Exhibit B-4, FEI provides Table 7 as shown below:

Table 7: Summary and Comparison of Average Projected Delivery Rate Changes – FEI Scenarios

	Rate Change (2022 – 2042)						
	Average UPC (2022 – 2042)	FEI Diversified Energy (Planning)		FEI Deep Electrification		FEI Economic Stagnation	
		Cumulative	Annual	Cumulative	Annual	Cumulative	Annual
Residential (RS 1)	60	118%	4.0%	235%	6.2%	20%	0.7%
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Large commercial (RS 3)	3,253	107%	3.7%	206%	5.7%	-3%	-0.3%
General Firm Service (RS 5)	18,542	114%	3.9%	150%	4.7%	10%	0.3%

4.1 Please confirm that blending hydrogen into the existing pipeline network, in quantities above what can be tolerated by appliances and businesses (5%-15%), would require substantial upgrades to distribution lines and to appliances in homes and businesses.

4.1.1 If not, please explain why not.

Response:

Not confirmed. Blending hydrogen in quantities above what can be tolerated by appliances and businesses would not require substantial upgrades to distribution lines. As described below, buried distribution lines represent most of the installed gas distribution system infrastructure in BC and could supply renewable and low-carbon hydrogen to all gas customers in BC at blend concentrations beyond quantities tolerated by existing appliances without needing substantial upgrades. Blending hydrogen in quantities above what can be tolerated by domestic and commercial appliances would require appliances to be upgraded or replaced, customer service lines to be checked, and specific upgrades to the gas distribution system facilities and operational procedures to ensure ongoing safe and reliable energy delivery service.

FEI operates approximately 50 thousand kilometres of pipeline infrastructure in BC, serving over 1 million customers. Approximately 6 percent of the total length operates as high-pressure transmission lines located in dedicated right-of-way corridors. Approximately 94 percent, or 47 thousand kilometers, is comprised of the low-pressure distribution mains and service lines referred to in the information request. The distribution lines operate at low pressure and include conservative design safety factors to ensure safe operation in urban settings. Approximately 65 percent of the distribution lines are made of polyethylene (PE) materials. On Vancouver Island, for example, approximately 98 percent of the distribution lines are PE. The integrity of PE gas distribution lines is considered not to be affected by the presence of hydrogen in the gas stream. Approximately 35 percent of the distribution lines are made from a type of steel that is less susceptible to hydrogen-induced brittle cracking (hydrogen embrittlement). Based on the combination of materials and low operating stress levels, distribution lines are generally considered compatible with hydrogen blend concentrations well beyond that of appliances and are potentially compatible with up to 100 percent hydrogen. Distribution lines make up most of the gas distribution system infrastructure; however, some components of the widespread distribution network include facility equipment such as regulator valves, relief valves and metering and measurement apparatus that may need to be upgraded or replaced beyond a certain hydrogen blend concentration. This equipment is localized at specific points on the distribution network and easily accessible and therefore relatively easily upgraded or replaced, if required.

While material compatibility would be one of the main drivers to avoid distribution line replacement upgrades, there are other factors that FEI will consider, including capacity to meet peak demand scenarios, overall safety, potential hydrogen leakage, leak detection and monitoring and other considerations regarding the safe and reliable operation of a gas system distributing natural gas and hydrogen blends. From the perspective of capacity, many of FEI’s systems will accommodate the small capacity reduction 5 to 15 percent blends would cause without needing substantial upgrades. Beyond this range, capacity upgrades may be required. For example, in Section 1.1.2 of Appendix D-3, FEI provides an example that demonstrates how the Whistler distribution system could accept up to a 45 percent hydrogen blend before requiring additional pipeline upgrades within the system.

FEI is currently planning to execute system-wide technical analysis and community level demonstration projects that will involve extensive investigation of the capability of existing infrastructure and user equipment to use higher concentrations of hydrogen, followed by implementation and testing. This work will inform the planning of the evolution of FEI's gas infrastructure to utilize higher concentrations of hydrogen.

4.2 Please confirm that without a dedicated hydrogen "backbone", FEI would be unable to integrate sufficient hydrogen into its system in order to achieve its GHG targets under the upcoming Greenhouse Gas Reduction Standard, as per FEI's Diversified Energy scenario.

4.2.1 If not, please explain why not.

Response:

Not confirmed. As discussed in the responses to BCUC IR1 61.3 and 61.5, FEI has undertaken preliminary analysis but is continuing to develop its overall hydrogen deployment strategy and has yet to determine the optimum strategy to integrate hydrogen. While the hydrogen backbone can play an important role, it is not a necessary component; GHG targets could be met through blending and local dedicated systems (hubs).

As described in FEI's response to MetroVan IR1 4.1, the provincial gas system is made up of mainly dense networks of low-pressure distribution lines concentrated in urban demand centres throughout FEI's gas service territories in BC. The gas distribution systems are supplied by high-capacity bulk gas transport pipelines (transmission pressure pipelines) that serve as "backbone" infrastructure to bring gas from remote production to demand centres. The BC power system operates in much the same way. In the context of the Application and IR preamble, hydrogen "backbone" refers to a potential future scenario towards the latter part of the planning period when hydrogen may need to be delivered in bulk supply from remote production to FEI's distribution networks in much the same way that natural gas is delivered today. The infrastructure to operate a hydrogen "backbone" could comprise repurposing and upgrading of existing transmission pressure pipelines or developing new dedicated hydrogen infrastructure to integrate sufficient hydrogen as part of a deeply decarbonized provincial gas system.

4.3 Please confirm that the costs to upgrade FEI distribution lines, appliances in homes and businesses, and the cost of developing a dedicated hydrogen "backbone" were included in the calculation of the rate impacts in Table 7.

4.3.1 If not, please explain why not.

Response:

To the degree that these costs are identifiable to FEI they have been included; however, it is early days on the path to a decarbonized future and much of the information about the costs of alternative decarbonization initiatives and pathways is evolving. As discussed in the response to BCUC IR1 61.3, FEI's research indicates that hydrogen-natural gas blends will be safe to distribute in FEI's system, minimizing costs for distribution upgrades. Thus, no additional costs were added to the analysis. FEI's research also shows that appliances can run safely on a range of blends of hydrogen-natural gas and FEI anticipates that as hydrogen forms a greater part of the fuel mix, appliances will evolve to be compatible so that incremental costs would not be significant. As discussed in the response to BCUC IR1 61.11, FEI needs to complete further system planning analysis considering existing transmission system infrastructure, ongoing transmission projects, and planned transmission infrastructure projects to determine which transmission lines FEI will need to consider to support hydrogen development and to what extent this would involve existing or new pipelines. Please also refer to the response to BCUC IR1 77.4.1.1 in which FEI discusses how FEI factored in the potential for future capital expenditures and commodity costs which could be for blending hydrogen into FEI's gas system into the effective rate impact analysis shown in Section 9.4 of the Application. In this regard, FEI will update its understanding of any costs that would be incurred, beyond those that would already occur if hydrogen were not being incorporated into the gas supply, as information emerges.