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May 3, 2023

City of Richmond
6911 No. 3 Road
Richmond, BC
V6Y 2C1

Attention: Anthony Capuccinello Iraci

Dear Anthony Capuccinello Iraci:

Re: FortisBC Energy Inc. (FEI)

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

Response to the City of Richmond and Lulu Island Energy Company Ltd. (collectively City of Richmond or CoR) Information Request (IR) No. 2

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-99-23 for the review of the LTGRP, FEI respectfully submits the attached response to CoR IR No. 2.

In its responses, FEI has identified responses which were provided by, contributed to, or developed with its consultants, the Posterity Group and Guidehouse.

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:

Sarah Walsh

Attachments

cc (email only): Commission Secretary
Registered Parties

1. *Robustness of the Assumptions Informing the Diversified and Deep Electrification Scenarios*

Reference: Exhibit B-1 (FEI 2022 Long Term Gas Resource Plan)

Appendix A-1 (Clean Growth Pathway to 2050)

p.12

On page 12 [page 376 of 2059] of Appendix A-1, FEI states:

> If BC used electricity as the primary source for heat, the seasonal variability of heating load would create a huge need for energy storage. Hydropower could meet the storage requirement were it not for the magnitude of heat load in BC. The approximate peak-hour heating load in 2017 in FortisBC's gas system was over 12 GW of electrical capacity equivalent (at a one-to-one unit energy conversion basis). In other words, electrifying heating could require almost a doubling of the existing hydroelectric capacity in BC even before considering the electrification of some part of the transportation fleet or other energy end uses and the additional transmission and distribution requirements. Recognizing this, decarbonizing the gas flowing through the system while maintaining the use of that system is a prudent and low-cost strategy to ensure that BC achieves its climate targets.

Reference: Exhibit B-1 (FEI 2022 Long Term Gas Resource Plan)

Appendix A-2 (Pathways Report)

p.5, 24

On page 5 [page 389 of 2059] of Appendix A-2, Guidehouse states:

> Peak demand in the Electrification Pathway would require thousands of megawatts of firm renewable electricity generation and energy storage to be built, which is made more difficult by the challenges of developing new large-scale hydroelectric power stations.

On Table 2 on page 17 [page 401 of 2059] of Appendix A-2, Guidehouse states:

> Input: Cost of New Electricity Generation
>
> Assumption/Description: $126/MWh was assumed in both pathways. This value represents an estimate of the expected cost of Site C[14] and is considered a conservative estimate of new renewable power costs. It is conservative because solar, wind, and energy storage costs are significantly higher and do not provide the same level of interseasonal storage. These higher priced renewable assets may need to be deployed due to the difficulty of developing large hydro in Canada.

> It is assumed that hydro resources will be available at the levels modelled in the pathways, which further assumes the deployment of multiple large hydro facilities (similar in size to Site C) in both pathways.

> [14] Guidehouse calculated a levelized cost of energy (LCOE) for Site C based off capital cost estimates from the BCUC Site C inquiry, historical financials from BC Hydro, and internal estimates. The results were benchmarked against Lazard's published LCOEs.

On page 24 [page 408 of 2059] of Appendix A-2, Guidehouse states:

> By 2050, the societal value of the Diversified Pathway is expected to be at least $100 billion higher than the Electrification Pathway.

Reference: Exhibit B-8 (FEI response to BC Hydro IR #1)

p.27

On page 27, FEI states:

> For the modelling, Site C was used as a proxy for the cost of future development of large-scale hydro projects as Site C costs were the most current cost estimates at the time to develop large scale hydro in BC; therefore, Guidehouse used publicly available 2019 estimated Site C costs. A key part of the Pathways report assumption was that BC Hydro would maintain its current hydroelectric generation assets and add additional assets to comprise approximately 65 percent of the future mix with the remaining 35 percent as a blend of fossil fuel generation, which would eventually be phased out to include utility-scale solar and wind generation, as well as battery energy storage.

> Lazard analysis on energy plus storage costs indicates that at the scale required at the time of the analysis in 2019, $126 per MWh was low-cost. Lazard estimates that the levelized cost of storage for large-scale capacity of 100 MW and energy of 400 MWh to be between $131 and $232 per MWh. However, this type of storage still only provides four hours of storage to the grid and likely is unsuitable for the type of seasonal storage needed to displace the service provided by the gas system. Lazard estimates costs for long-duration storage that could provide 10 hours of storage to the grid to be between $136 and $286. Even at 10 hours of storage, other storage technologies may still be required.

Reference: Exhibit B-6 (FEI response to BCUC IR #1)

p.54

On page 54, FEI states:

> The cost of hydro generation was assumed to not decline from $126 per MWh in real terms over the study period.

Reference: Exhibit A2-1 [FEI and BCH Energy Scenarios - BCH Submission]

BC Hydro's Submission – Stage 1, Cover letter;

BC Hydro's Submission – Stage 2, Appendix A (Load Resource Balances for Energy Scenarios), System Load Resource Balances for the FEI Deep 1 Electrification Scenario, p. 1-4, 17-20

In the cover letter to the BCUC [page 2 of 100] in Exhibit A-5, BCUC states:

> In its letter dated January 21, 2022, the BCUC requested BC Hydro and FortisBC Energy Inc to share the data required to file load forecast results based on each other's scenarios contained in their respective resource plans.
>
> The attached submission provides BC Hydro's load forecast results for the following five energy scenarios: three FEI load scenarios used in FEI's 2022 Long-Term Gas Resource Plan and two BC Hydro load scenarios used in BC Hydro's 2021 Integrated Resource Plan.

In BC Hydro's Submission – Stage 2, Appendix A, p. 1-4 [p. 37-40 of 100], BC Hydro provides the following information about its modelling of FEI's Deep Electrification Scenario:

Figure A-1 System energy Load Resource Balance for the FEI Deep Electrification Scenario

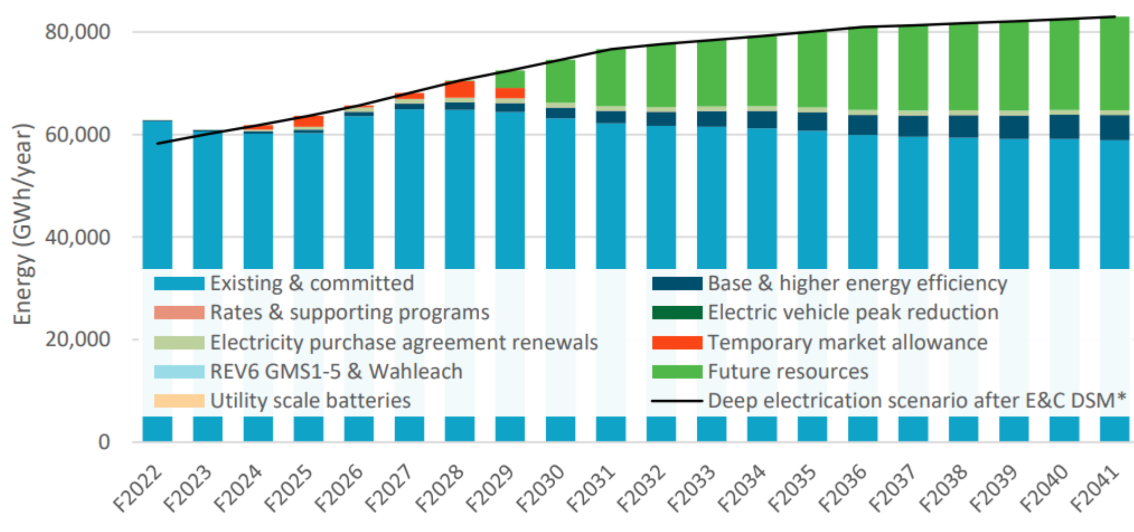


Table A-1 System energy Load Resource Balance for the FEI Deep Electrification Scenario

	(GWh/year)		F2022	F2023	F2024	F2039	F2040	F2041
	LRB with Existing and Committed Supply							
1	***Existing and Committed Heritage Resources***	(a)	46,898	46,898	46,898	52,184	52,184	52,184
2	***Existing and Committed Electricity Purchase Agreements***	(b)	15,719	13,717	13,278	6,952	6,922	6,736
3	**System Capability (before planned resources)**	(c) = a+b	62,617	60,615	60,176	59,136	59,106	58,920
	Demand - Integrated System Total Gross Requirements							
4	Deep Electrification Scenario	(d)	(59,120)	(61,340)	(63,351)	(86,679)	(87,349)	(87,984)
	Existing and Committed Demand-side Measures							
5	F21 Energy Conservations Programs Savings		105	117	117	12	11	10
6	Codes & Standards plus Voltage and VAR Optimization		589	854	1,111	3,771	3,927	3,995
7	Energy Conservation Rate Structures		138	177	210	-	-	-
8	Sub-total	(e)	833	1,148	1,438	3,782	3,938	4,005
9	***Net Metering***	(f)	40	50	62	832	915	998
10	**Surplus / (Deficit) before planned resources**	(g) = c+d+e+f	**4,370**	**473**	**(1,674)**	**(22,929)**	**(23,390)**	**(24,060)**
	Contingency Resource Plan							
	Future Demand-side Measures							
11	Base Energy Efficiency		161	296	472	1,794	1,795	1,795
12	Higher Energy Efficiency[1]		-	-	-	2,804	2,987	3,092
13	Time-Varying Rates & Demand Response		-	-	-	32	32	32
14	Industrial Load Curtailment		-	-	-	-	-	-
15	Electric Vehicle Peak Reduction		-	-	-	-	-	-
16	Sub-total	(h)	161	296	472	4,630	4,814	4,919
17	***Electricity Purchase Agreement Renewals***	(i)	0	59	312	895	895	895
18	***Market Allowance***	(j)	-	-	889	-	-	-
19	***REV6 GMS1-5 & Wahleach***	(k)	-	-	-	26	26	26
20	***Future Resources***	(l)	-	-	-	17,378	17,654	18,220
21	***Utility Scale Batteries***	(m)	-	-	-	-	-	-
22	**Surplus / (Deficit) after planned resources**	(n) = g+h+i+j+k+l+m	**4,532**	**829**	**0**	**0**	**0**	**0**

[1] Includes Higher Plus Energy Efficiency

[Note: some table columns have been omitted for clarity]

Figure A-2 System capacity Load Resource Balance for the FEI Deep Electrification Scenario

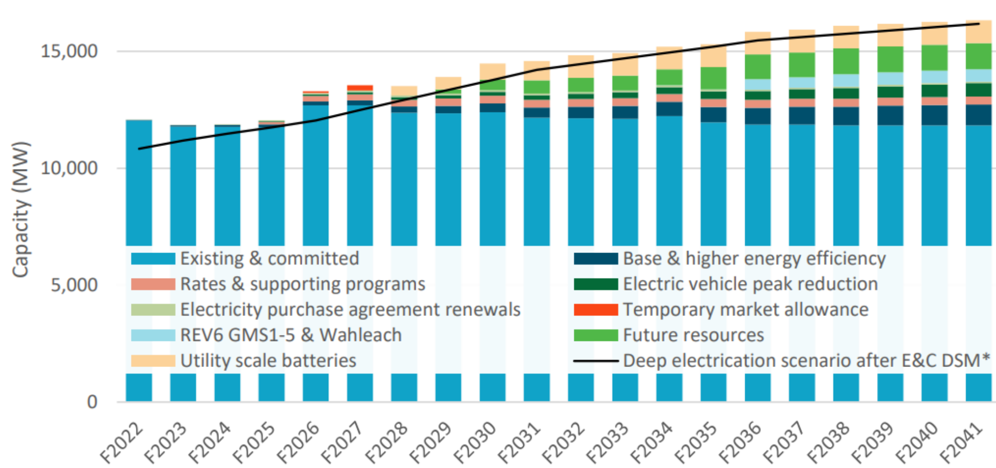


Table A-2 System capacity Load Resource Balance for the FEI Deep Electrification Scenario

	(MW)		F2022	F2023	F2024	F2039	F2040	F2041
	LRB with Existing and Committed Supply							
1	***Existing and Committed Heritage Resources*** [1]	(a)	11,818	11,818	11,818	12,965	12,965	12,965
2	***Existing and Committed Electricity Purchase Agreements***	(b)	1,795	1,512	1,495	445	437	437
3	***12% Reserves*** [2]	(c)	(1,574)	(1,540)	(1,540)	(1,576)	(1,576)	(1,576)
4	**System Peak Load Carrying Capability (before Planned Resources)**	(d) = a+b+c	12,039	11,789	11,773	11,834	11,826	11,826
	Demand - Integrated System Total Gross Requirements							
5	Deep Electrification Scenario	(e)	(10,983)	(11,383)	(11,729)	(16,559)	(16,725)	(16,880)
	Existing and Committed Demand-side Measures							
6	F21 Energy Conservations Programs Savings		21	21	21	3	3	3
7	Codes & Standards plus Voltage and VAR Optimization		118	166	212	659	687	700
8	Energy Conservation Rate Structures		11	16	19	-	-	-
9	Sub-total	(f)	150	203	252	663	690	703
10	***Net Metering***	(g)	-	-	-	-	-	-
11	**Surplus / (Deficit) before planned resources**	(h) = d+e+f+g	**1,206**	**609**	**296**	**(4,063)**	**(4,209)**	**(4,351)**
	Contingency Resource Plan							
	Future Demand-side Measures							
12	Base Energy Efficiency		30	56	85	304	302	302
13	Higher Energy Efficiency [3]		-	-	-	538	574	599
14	Time-Varying Rates & Demand Response		-	-	-	244	246	246
15	Industrial Load Curtailment		-	-	-	98	98	98
16	Electric Vehicle Peak Reduction		-	-	-	491	528	568
17	Sub-total	(i)	30	56	85	1,674	1,747	1,813
18	***Electricity Purchase Agreement Renewals*** [4]	(j)	0	8	24	66	66	66
19	***Market Allowance***	(k)	-	-	-	-	-	-
20	***REV6 GMS1-5 & Wahleach*** [4]	(l)	-	-	-	530	530	530
21	***Future Resources*** [4]	(m)	-	-	-	1,103	1,114	1,118
22	***Utility Scale Batteries***	(n)	-	-	-	970	970	970
23	**Surplus / (Deficit) after planned resources**	(o) = h+i+j+k+l+m+n	**1,236**	**673**	**405**	**280**	**219**	**146**

[1] Includes outages at Mica and Seven Mile
[2] The 12% reserve margin is applied to dependable capacity resources only
[3] Includes Higher Plus Energy Efficiency
[4] The numbers shown include the 12% reserve margin

[Note: some table columns have been omitted for clarity]

In BC Hydro's Submission – Stage 2, Appendix A, p. 17-20 [p. 53–56 of 100], BC Hydro provides the following information about its modelling of FEI's Deep Electrification Scenario:

Figure A-9 System energy Load Resource Balance for the FEI Diversified Energy (Planning) Scenario

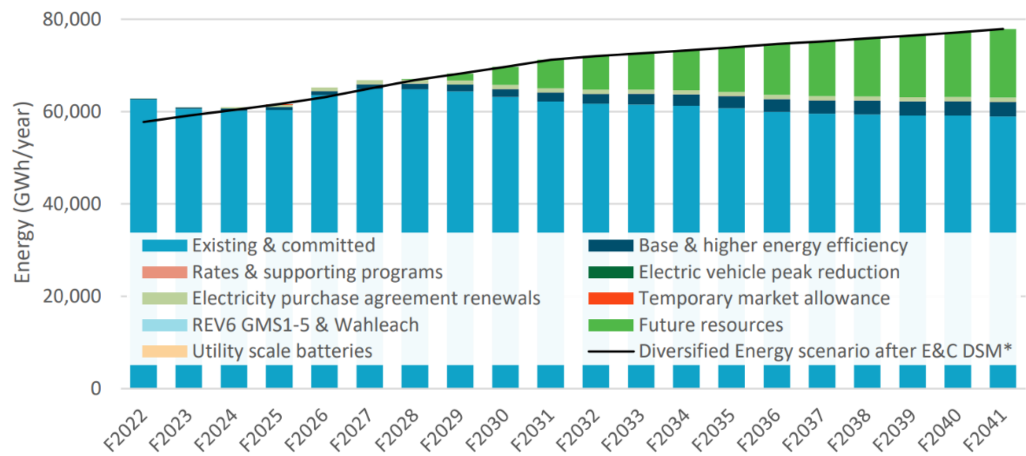


Table A-9 System energy Load Resource Balance for the FEI Diversified Energy (Planning) Scenario

	(GWh/year)		F2022	F2023	F2024	F2039	F2040	F2041
	LRB with Existing and Committed Supply							
1	***Existing and Committed Heritage Resources***	(a)	46,898	46,898	46,898	52,184	52,184	52,184
2	***Existing and Committed Electricity Purchase Agreements***	(b)	15,719	13,717	13,278	6,952	6,922	6,736
3	**System Capability (before planned resources)**	(c) = a+b	62,617	60,615	60,176	59,136	59,106	58,920
	Demand - Integrated System Total Gross Requirements							
4	Diversified Energy Scenario	(d)	(58,613)	(60,327)	(61,831)	(81,081)	(82,004)	(82,892)
	Existing and Committed Demand-side Measures							
5	F21 Energy Conservations Programs Savings		105	117	117	12	11	10
6	Codes & Standards plus Voltage and VAR Optimization		589	854	1,111	3,771	3,927	3,995
7	Energy Conservation Rate Structures		138	177	210	-	-	-
8	Sub-total	(e)	833	1,148	1,438	3,782	3,938	4,005
9	***Net Metering***	(f)	40	50	62	832	915	998
10	**Surplus / (Deficit) before planned resources**	(g) = c+d+e+f	**4,877**	**1,487**	**(154)**	**(17,332)**	**(18,045)**	**(18,969)**
	Contingency Resource Plan							
	Future Demand-side Measures							
11	Base Energy Efficiency		161	296	472	1,794	1,795	1,795
12	Higher Energy Efficiency		-	-	-	1,255	1,320	1,387
13	Time-Varying Rates & Demand Response		-	-	-	27	27	27
14	Industrial Load Curtailment		-	-	-	-	-	-
15	Electric Vehicle Peak Reduction		-	-	-	-	-	-
16	Sub-total	(h)	161	296	472	3,076	3,142	3,209
17	***Electricity Purchase Agreement Renewals***	(i)	0	59	312	895	895	895
18	***Market Allowance***	(j)	-	-	-	-	-	-
19	***REV6 GMS1-5 & Wahleach***	(k)	-	-	-	-	-	-
20	***Future Resources***	(l)	-	-	-	13,360	14,008	14,864
21	***Utility Scale Batteries***	(m)	-	-	-	-	-	-
22	**Surplus / (Deficit) after planned resources**	(n) = g+h+i+j+k+l+m	**5,038**	**1,842**	**631**	**0**	**0**	**0**

[Note: some table columns have been omitted for simplicity]

Figure A-10 System capacity Load Resource Balance for the FEI Diversified Energy (Planning) Scenario

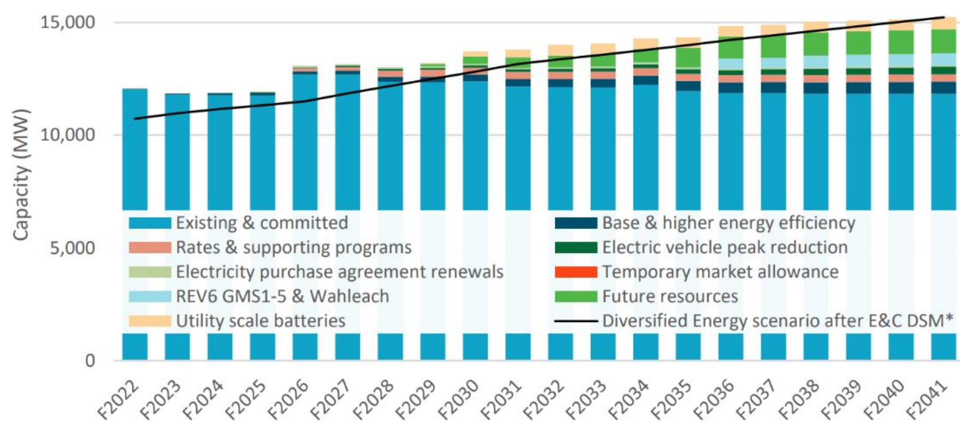


Table A-10 System capacity Load Resource Balance for the FEI Diversified Energy (Planning) Scenario

	(MW)		F2022	F2023	F2024	F2039	F2040	F2041
	LRB with Existing and Committed Supply							
1	***Existing and Committed Heritage Resources***[1]	(a)	11,818	11,818	11,818	12,965	12,965	12,965
2	***Existing and Committed Electricity Purchase Agreements***	(b)	1,795	1,512	1,495	445	437	437
3	***12% Reserves***[2]	(c)	(1,574)	(1,540)	(1,540)	(1,576)	(1,576)	(1,576)
4	**System Peak Load Carrying Capability (before Planned Resources)**	(d) = a+b+c	12,039	11,789	11,773	11,834	11,826	11,826
	Demand - Integrated System Total Gross Requirements							
5	Diversified Energy Scenario	(e)	(10,875)	(11,169)	(11,407)	(15,495)	(15,719)	(15,932)
	Existing and Committed Demand-side Measures							
6	F21 Energy Conservations Programs Savings		21	21	21	3	3	3
7	Codes & Standards plus Voltage and VAR Optimization		118	166	212	659	687	700
8	Energy Conservation Rate Structures		11	16	19	-	-	-
9	Sub-total	(f)	150	203	252	663	690	703
10	***Net Metering***	(g)	-	-	-	-	-	-
11	**Surplus / (Deficit) before planned resources**	(h) = d+e+f+g	**1,313**	**824**	**618**	**(2,998)**	**(3,202)**	**(3,403)**
	Contingency Resource Plan							
	Future Demand-side Measures							
12	Base Energy Efficiency		30	56	85	304	302	302
13	Higher Energy Efficiency		-	-	-	212	226	240
14	Time-Varying Rates & Demand Response		-	-	-	231	232	233
15	Industrial Load Curtailment		-	-	-	98	98	98
16	Electric Vehicle Peak Reduction		-	-	-	293	315	339
17	Sub-total	(i)	30	56	85	1,138	1,174	1,212
18	***Electricity Purchase Agreement Renewals***[3]	(j)	0	8	24	66	66	66
19	***Market Allowance***	(k)	-	-	-	-	-	-
20	***REV6 GMS1-5 & Wahleach***[3]	(l)	-	-	-	530	530	530
21	***Future Resources***[3]	(m)	-	-	-	1,039	1,058	1,072
22	***Utility Scale Batteries***	(n)	-	-	-	481	481	532
23	**Surplus / (Deficit) after planned resources**	(o) = h+i+j+k+l+m+n	**1,343**	**888**	**727**	**255**	**106**	**9**

[1] Includes outages at Mica and Seven Mile
[2] The 12% reserve margin is applied to dependable capacity resources only
[3] The numbers shown include the 12% reserve margin

[Note: some table columns have been omitted for clarity]

Reference: Exhibit A-5 (BCUC IR #1 to FEI)

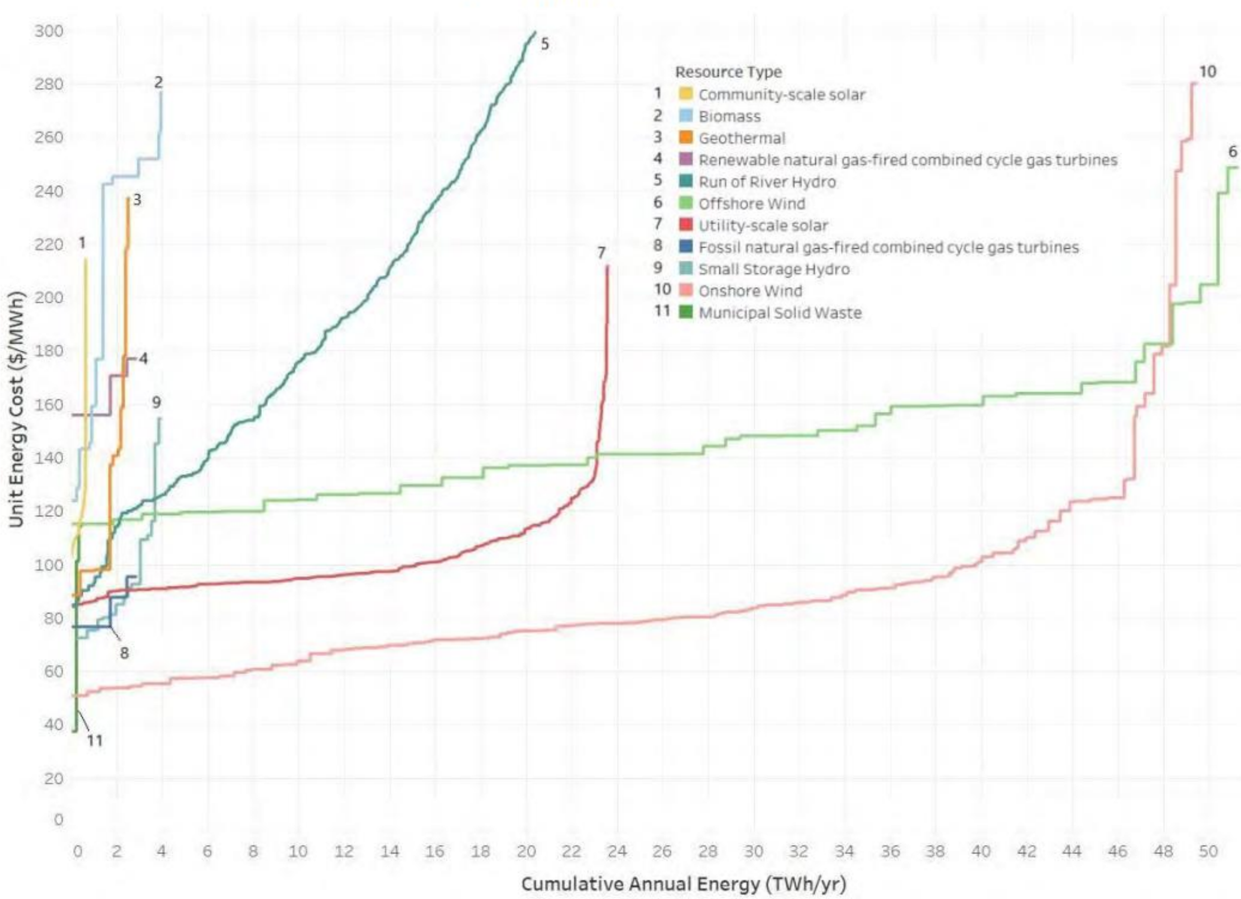
p. 46

On page 46 of Exhibit A-5, BCUC states:

> "In the ongoing BC Hydro 2021 IRP proceeding, BC Hydro provides an updated energy reference price of $65/MWh, and an updated capacity reference price of $109kW-year on page 18 of Appendix L."

We note that in the ongoing BC Hydro 2021 IRP proceeding, BC Hydro also provides the following "supply curve for all supply-side energy resources" on page 10 of Appendix L (Reference Prices and Long-Run Marginal Costs) of the BC Hydro 2021 Integrated Resource Plan.

Figure J-2 Supply Curve for all Supply-Side Energy Resources



There is no reference to large impoundment hydroelectric resources as a potential source of new energy supply on this graph.

1.1 Please confirm whether or not FEI assumes that 100% of the added generation in the Deep Electrification scenario needs be backed up by storage of some type, whether battery or hydropower.

Response:

FEI did not contemplate the impacts to electricity generation requirements as part of the Deep Electrification Scenario or any other LTGRP scenario. For clarity, the Deep Electrification Scenario, as modelled by FEI and Posterity Group, determined what the gas demand would be in such a scenario, and did not determine what the electric demand or supply would be. The model by Posterity Group did not include an assessment of the electricity supply-side requirements. In BC Hydro's modelling of FEI's Deep Electrification Scenario (Exhibit A2-1), BC Hydro and its modelling consultant determined how the FEI scenarios would impact BC Hydro's own electric demand, and therefore its own generation and battery or hydropower storage, if required.

1.2 The BC Hydro load resource plan for FEI's Deep Electrification scenario meets approximately 42% of peak load growth to 2042 using DSM load-shifting measures, by adding additional generation capacity to existing hydroelectric facilities, and by utilizing additional "firm generation capacity" from new generation sources, so that battery storage is only required for 22% of peak load growth. Does FEI consider BC Hydro's draft plan for managing its own utility infrastructure to be worth consideration?

Response:

FEI has no comment on BC Hydro's resource plans for managing its own utility infrastructure. The resource plan of a gas utility has requirements that do not result in an applicable comparison between all components of gas and electric resource plans.

1.3 Please run a sensitivity analysis by modelling both the FEI Deep Electrification and Diversified Energy (Planning) scenario using the costs and assumptions developed for BC Hydro's draft IRP. Specifically:

- For the FEI Deep Electrification Load Scenario, assume the same load resource balance as shown in Exhibit A2-1 Table A-1 and A-2 of Appendix A of Exhibit A2-1
- For the FEI Diversified (Planning) Scenario, assume the same load resource balance as shown in Exhibit A2-1 Table A-1 and A-2 of Appendix A of Exhibit A2-1
- For both the FEI Deep Electrification and Diversified (Planning) Scenarios, assume BC Hydro's energy reference price of $65/MWh and capacity reference price of $109kW-year

1.3.1 Would you expect these assumptions to affect the relative costs of the two scenarios compared to the findings of the Pathways Report? If so, why? If not, why not?

1.3.2 Per the sensitivity analysis above, what is the cost of the two scenarios?

<u>Response:</u>

The City of Richmond (CoR) appears to be misunderstanding what impact there would be on FEI's load scenarios by adjusting the costs and assumptions in BC Hydro's IRP. FEI believes that the CoR is referring to the two FEI load scenarios that BC Hydro modelled, which used the assumptions in FEI's load scenarios to determine how it would affect BC Hydro's electric utility.

During the Energy Scenarios exercise, as referenced above in Exhibit A2-1 (BC Hydro results), FEI and Posterity Group modeled BC Hydro's scenarios based on BC Hydro's published 2021 IRP, not "BC Hydro's draft IRP". For example, FEI and Posterity Group modeled how BC Hydro's costs and assumptions would result in different load scenarios and impact FEI's gas utility – this was shown in FEI's Stage One and Stage Two submissions filed as Exhibit B-4 (FEI results) in the 2022 LTGRP.

For clarity, the BC Hydro load resource balances presented in the preamble were developed based on BC Hydro's interpretation of the impact on the electric grid of these two FEI scenarios. FEI provided BC Hydro and their modelling consultant with detailed information on the assumptions underlying the two scenarios, so the load resource balance tables were already produced based on the FEI scenarios. The BC Hydro load resource balance assumptions do not in turn change how the FEI scenarios would be run, because the supply side of the electric grid is not part of the FEI model.

If Posterity Group and FEI were to model BC Hydro's long-run marginal cost of energy of $65 per MWh instead of the ZEEA cost of $106 per MWh (the equivalent of $29.45 per GJ), this would only change whether specific DSM measures would be included in the potential based on their cost effectiveness. The impact on the overall post-DSM demand from this change would be very small. If, for example, this change caused 20 percent of the DSM measure potential to fail the economic screen (likely an overestimate of the effects of the change), the result would be an increase in 2042 post-DSM demand of 1.5 percent in the DEP Scenario. This is well within the range of the different scenarios included in the LTGRP and thus would not offer meaningful new insights, nor would it justify the expense and time for producing the new scenario.

2. *Planning assumptions regarding the New Construction Code parameter*.

Reference: Exhibit B-6 (Response to BCUC IR #1)

p.8-9

On page 8-9 of Exhibit B-6, FEI states:

> A number of local governments have adopted the BC Energy Step Code (Step Code) along with a GHGi target for new building construction projects. The Step Code is an optional provincial building code that provides the tools for municipalities to adopt a higher level of energy efficiency in new construction that goes above and beyond the requirements of the BC Building Code. Local governments can reference the Step Code in a policy, program or bylaw, requiring that builders comply with the Step Code for new construction projects. Adoption of the Step Code results in improvements in energy efficiency and lower gas consumption. According to the BC Energy Step Code website, 85 local governments have submitted their initial notification, indicating they have started to consult on the Step Code. In addition, UBC has its green building rating system and the City of Vancouver has its own zero emissions building plan.

2.1 Please confirm that the BC Energy Step Code website also indicates that 54 local governments [1] and 7 regional districts in BC have formally adopted the BC Energy Step Code, and are already implementing better-than-Code energy efficiency requirements [2], including:

- 16 of Metro Vancouver's 23 authorities having jurisdiction (not including Vancouver);
- 7 of the Capital Regional District's 13 local governments,
- 10 of BC's 12 municipalities with more than 100,000 people (of the other 2 municipalities, one is currently considering Step Code adoption, and 1 is Vancouver).
- 15 of BC's 20 municipalities with more than 50,000 people (of the other 5 municipalities, 3 are considering Step Code adoption and 1 is Vancouver), and
- 27 of BC's 40 municipalities with more than 20,000 people.
- an additional 25 municipalities are considering adopting the Step Code.

<u>Response:</u>

Confirmed.

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[1] Including the University Endowment Lands.

[2] https://energystepcode.ca/implementation_updates/ Accessed March 19, 2023.

2.2 Please confirm that the BC Energy Step Code website also indicates that 34 local governments were either formally considering adopting the Step Code or had already adopted it prior to the start of 2019 [i.e. when planning for the FEI Long Term Gas Resource Plan began].

Response:

Confirmed.

2.3 Given that the combined population of Vancouver and the 54 local governments that have already adopted the Energy Step Code exceeds 3,794,000 or 71% of the total population of BC [3], and that FEI understands that adoption of the Step Code "results in improvements in energy efficiency and lower gas consumption," please provide FEI's understanding of the implications of the Step Code on load forecasts for residential and commercial customers.

2.3.1 Please discuss what effect implementation of Step Code energy efficiency requirements has on the scenarios presented in the FEI Long Term Gas Resource Plan. If there is little impact, explain why.

2.3.2 Would it be prudent for FEI to incorporate current available information about Step Code adoption by local governments and its implications when developing the FEI Long Term Gas Resource Plan. If yes, why? If not, why?

2.3.3 At a high level, list the risks and consequences to FEI, its ratepayers and its shareholders for not considering current available information about Step Code adoption by local governments and its implications when developing the FEI Long Term Gas Resource Plan?

Response:

Please refer to the responses to the BCUC IR2 81 series in which FEI discusses Step Code adoption by local governments and implications to resource planning. More specifically, please refer to the response to BCUC IR2 81.2.1 for a discussion on the annual demand impact of critical

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[3] 2022 population estimates for municipalities that have adopted the BC Energy Step Code per energystepcode.ca (regional district populations were not counted), plus the City of Vancouver; https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates . Accessed March 19, 2023.

uncertainties, including codes and standards (including New Construction Code) and fuel switching. In addition, please refer to the responses to the BCUC IR2 112.1 series in which FEI discusses FEI's understanding of the potential changes to the BC Building Code over the planning horizon and a range of FEI's potential gas and emission reductions.

Reference: Exhibit B-6 (Response to BCUC IR #1) p.9

On page 9-10 of Exhibit B-6, FEI states:

> Along with adopting the Step Code, a growing number of local governments are implementing changes to their building codes, planning guidelines, or zoning bylaws in order to reduce GHG emissions in new building construction projects and, in some cases, existing building retrofits and improvements. These measures prevent new natural gas connections, as natural gas does not meet their requirements. These measures include:
>
> - Establishing GHGi target limits for new construction necessitating the use of low-carbon or renewable energy discussed below; and
> - Incentivizing developers to use electricity as a low-carbon solution (or in some cases to not connect to a "fossil fuel supply grid" system).
>
> The discussion on establishing GHGi target limits for new construction to be met with low-carbon or renewable energy is provided below, and the "incentive" to use electricity measures are described in the response to BCUC IR1 4.2. In addition to the Step Code, some local governments have developed and implemented their own GHGi targets for new building construction projects. The addition of GHGi targets, in conjunction with Step Code performance targets, means that only an energy source with lower carbon emissions can be used in new construction.
>
> …
>
> The adoption of GHGi targets at the local government level has resulted in a complex patchwork of regulations across BC. The implementation of GHGi targets, and the range of targets that have been set, varies substantially, from 3-6 kg CO2e/m2 to even to 1 kgCO2e/m2. Municipalities may adopt a GHGi regulation for the entire geographic bounds of a city, as seen in the DNV, but limit the application of such regulation to certain building types or sub-building types. Similarly, GHGi requirements may be set at the permit level for a specific home or development or may be required through a rezoning application. In some cases, municipalities may use a combination of one or more of these mechanisms to

effect the desired GHG reduction outcome. Therefore, there is no consistency in approach or adoption across FEI's service territory. To the best of FEI's knowledge, the local governments that have adopted GHGi targets are:

- City of Vancouver;
- City of Surrey;
- City of Burnaby;
- District of North Vancouver;
- City of Richmond; and
- District of West Vancouver.

Please note that there may be additional local governments that are contemplating implementing GHGi targets. Given the complexity of GHGi regulations at the local government level, it is difficult for FEI to know if a local government is considering a GHGi measure or emissions reduction regulation.

2.4 Please confirm that the FEI is aware that on February 8, 2023 the province enacted the Zero Carbon Step Code [4], a province-wide opt-in greenhouse gas emissions standard for new construction that will enter into force on May 1, 2023, with requirements similar to those described in Exhibit B-6, p.9-10.

Response:

Confirmed. Please refer to the response to BCUC IR2 112.1.1.

2.5 Given that the combined population of the municipalities known by FEI to have adopted GHGi targets for new construction even before a provincial standard was available exceeds 1,970,000 or 37% of the total population of BC [5] (and a similar or greater percentage of new development activity), and that FEI understands these targets to "prevent new natural gas connections," please provide FEI's understanding of the implications of local government GHGi measures and the BC Zero Carbon Step Code on demand forecasts for FEI's residential and commercial customers.

2.5.1 Please discuss what effect implementation of local government GHGi measures and the BC Zero Carbon Step Code has on the scenarios

4 https://www.bclaws.gov.bc.ca/civix/document/id/bcgaz1/bcgaz1/886022321.

5 2022 population estimates; https://www2.gov.bc.ca/gov/content/data/statistics/people-population-community/population/population-estimates . Accessed March 19, 2023.

presented in the FEI Long Term Gas Resource Plan. If there is little impact, explain why.

Response:

Please refer to the response to BCUC IR2 81.2.1 for a discussion of the impact of the codes and standards critical uncertainties, including the New Construction Code critical uncertainty, on FEI's annual demand, and BCUC IR2 112.1.2 which provides a range of FEI's potential gas and emission reductions associated with potential policy changes.

2.5.2 Would it be prudent for FEI to incorporate current available information about implementation of local government GHGi measures and the BC Zero Carbon Step Code and its implications when developing the FEI Long Term Gas Resource Plan? If not, why?

Response:

It is prudent for FEI to consider all major policy initiatives that are in place or certain to be put in place at the time the scenarios and demand forecasts are prepared. Neither local government GHGi measures nor the BC Zero Carbon step code were known or certain when the demand forecasts for the 2022 LTGRP were prepared.

2.5.3 At a high level, what are the risks to FEI, its ratepayers and its shareholders of not considering current available information about implementation of local government GHGi measures and the BC Zero Carbon Step Code and its implications when developing the FEI Long Term Gas Resource Plan?

Response:

Please refer to the responses to the BCUC IR2 81 series and 112 series for a discussion on the impact of codes and standards critical uncertainties, including new construction, and fuel switching on FEI's annual demand. While FEI recognizes the risks of not being able to develop a resource plan in real-time, there are technical challenges and time constraints that limit FEI's ability to incorporate rapidly changing policy updates at the later stages of resource plan development. Furthermore, as discussed in the response to BCUC IR2 90.3, while logistical limitations may preclude the incorporation of these ambitious emissions reduction policies, the greatest limitation for FEI continues to be uncertainties associated with the planning environment. The next resource plan will incorporate policy updates at all levels of government that are in effect at that time.

2.6 Is FEI or was FEI, at any one point, a stakeholder in the Step Code Council, or a member of a sub-committee or working group helping to advise the Government or British Colu0mbia on the design and implementation of the BC Energy Step Code and/or the BC Zero Carbon Step Code? If yes, in what capacity was FEI participating?

Response:

FEI is one of many stakeholders who participate in the Step Code Council and some of the sub-committees. In its role, FEI represents both the gas and electric utilities but is one of many voices and viewpoints at the table. There is a Local Government sub-committee which provides input into the design and implementation of the BC Energy Step Code and/or the BC Zero Carbon Step Code for which FEI is not a participant.

2.7 Is FEI aware of the rationale and analysis that supported the Province's decision to set the 1, 3 and 6 kg CO2/m2 greenhouse gas emission limits found in the BC Zero Carbon Step Code? If yes, please explain the significance of the 1, 3 and 6 kg CO2/m2 limits.

Response:

To clarify, the limits set by the Province in the BC Zero Carbon Step Code for Part 9 buildings are 1.5, 2.5 and 6 $kgCO_2/m^2$, which are slightly different from those included in the request. The Province's recommendations for these levels were based on: 6 $kgCO_2/m^2$ to decarbonize heating systems, 1.5 $kgCO_2/m^2$ to decarbonize both space and water heating systems, and 1 $kgCO_2/m^2$ to decarbonize all building energy systems.

2.8 Is FEI aware that the BC Energy Step Code and the BC Zero Carbon Step Code, by design, pertain to Part 3 and Part 9 building types defined in BC Building Code and that both the BC Energy Step Code and the BC Zero Carbon Step Code are only applied to new construction or major renovations, when a local government has opted into the regulations?

Response:

Confirmed. Please refer to the response to BCUC IR2 112.1.1.

3. *A Potential New "hybrid heating system" Planning Scenario*

Reference: Exhibit B-6 (Response to BCUC IR #1)
p.34-35

On page 34-35 of Exhibit B-6, FEI states:

> Residential dual fuel (hybrid) heating technologies have been identified as a promising DSM measure that will support energy savings, reduce GHG emissions, optimize energy use, provide energy system resiliency and reduce long-term energy costs. Hybrid heating systems can be defined as an electric air source heat pump and a natural gas furnace that are sequentially operated by controls to efficiently heat and cool a home. As a DSM measure, gas supply may be primarily used for peak heating purposes in such systems, although further work needs to be conducted to better understand the interactive effects from operating both systems together.
>
> Hybrid heating technologies offer both potential opportunities and challenges to FEI. Hybrid systems could lead to significant reductions in customer natural gas consumption and a corresponding reduction in GHG emissions as the gas heating system would only be used during the coldest season. Hybrid systems can also act as a peaking service, making an important contribution to moderating peak loads on the electric system and offering significant value to the electric system operator. In an electric system with surplus generation, hybrid systems also offer new load opportunities, creating further value. This value could be transferred to the gas system operator for providing peaking services and serve to moderate gas rate increases. The biggest challenge resulting from hybrid systems is quantifying the value of the peaking service and mitigating the potential increase in gas rates resulting from decreased gas load.
>
> FEI's approach to hybrid heating systems is still at an exploratory stage. Hybrid heating systems are one of three emerging energy efficiency technologies, referred to as Advanced DSM Programming in the 2023 DSM Plan Application. They are expected to have a higher potential impact on gas demand than was modelled in the 2021 CPR or in the 2022 LTGRP. If the benefits are proven through FEI's pilots and studies, it is anticipated that hybrid systems will take a larger role in upcoming DSM Plans and the next CPR and LTGRP.

3.1 Given the FEI acknowledges that hybrid heating systems will have a "a higher potential impact on gas demand than [is currently modelled] in the 2021 CPR or in the 2022 LTGRP," what assumptions would FEI make regarding hybrid heating systems if it were directed by BCUC to develop a planning scenario where the natural gas system is used primarily to serve peak heating requirements in existing buildings? More specifically:

3.1.1 For existing buildings, in general terms, what proportion of total gas demand would still be required for peaking loads after a hybrid retrofit for the following existing building types?

- single detached home
- townhouse
- wood-frame Part 3 apartment buildings
- Concrete Part 3 apartment buildings
- Retail buildings
- Office buildings
- Hotels

3.1.2 In such a scenario, would FEI assume any new buildings had hybrid or gas-only systems? If so, why?

3.1.3 In such a scenario, what level of the Step Code and Zero Carbon Step Code would be assumed for new construction?

3.1.4 Would establishing the assumptions noted above be sufficient to run a scenario? If not, please explain or detail what additional assumptions, if any, would be needed to assess a hybrid scenario

3.1.5 Does FEI consider it possible that a hybrid scenario might result in lower GHG emissions at a lower total gas and electricity cost to ratepayers than the diversified scenario?

3.1.6 How much time would it take to run this new scenario?

Response:

Please refer to the responses to BCUC IR2 82.1 and 82.2.1.

Reference: Exhibit B-6 (FEI Response to BCUC IR #1) p.469-470

In response to BCUC IR 72.5, FEI pointed to the analysis in its Pathway Report to compare the costs and investments to third parties such as businesses and customers for the two scenarios equivalent to the Diversified Energy (Planning) and Deep Electrification scenarios in the LTGRP, the Diversified and Electrification scenarios.

3.2 Were projected new renewable electricity costs the same in the Diversified and Electrification scenarios in the Pathway Report?

Response:

FEI understands this question to be asking if the cost assumptions for non-emitting levelized cost of electricity were the same across the Diversified and Electrification scenarios in the Pathways Report. Under this interpretation, yes.

3.3 Were the projected renewable electricity costs the same in the Diversified scenario in the Pathway Report and the Diversified Energy (Planning) scenario in the LTGRP?

Response:

FEI and Posterity Group have collaborated on the following response.

In the LTGRP, the cost of renewable electricity is most closely represented by the assumed cost of the Zero Emission Energy Alternative (ZEEA) fuel used in the MTRC test. The ZEEA cost used in the model was $29.45 per GJ for all years, sectors, and scenarios, including the Deep Electrification Scenario.

3.4 Were the projected renewable electricity costs the same in the Electrification scenario in the Pathway Report and the Deep Electrification scenario in the LTGRP?

Response:

Please refer to the response to CoR IR2 3.3.

3.5 Were the projected renewable electricity costs the same in the Diversified Energy (Planning) scenario and the Deep Electrification scenario in the LTGRP?

Response:

Please refer to the response to CoR IR2 3.3.

3.6 Were projected electricity rates the same in the Diversified and Electrification scenarios in the Pathway Report?

Response:

Electricity rates were not assumed to be the same. Electricity rates were modelled after the fact as an outcome of the scenario analysis. High-level rate modeling was conducted by incorporating cost of service requirements and load differences for the two scenarios based on BC Hydro's rate filings. Similarly, gas rates were also differentiated based on cost of service and load differences.

3.7 Were the projected electricity rates the same in the Diversified scenario in the Pathway Report and the Diversified Energy (Planning) scenario in the LTGRP?

Response:

FEI and Posterity Group have collaborated on the following response.

Customer electricity rates did not influence the modelling of natural gas demand in any of the LTGRP scenarios, including the DEP Scenario.

Electricity rates in the Diversified Pathway from 2019 increase 45 percent by 2050. The breakdown is provided below (rates are in real $2019 CAD):

- Residential: approximately $202/MWh ($56.11/GJ) by 2050 up from $118/MWh ($33.06/GJ) in 2019
- Commercial: approximately $170/MWh ($47.11/GJ) by 2050 up from $$95/MWh ($26.38/GJ) in 2019
- Industrial: approximately $100/MWh ($27.78/GJ) by 2050 up from $54/MWh ($15/GJ) in 2019

Electrified Pathway electricity rates from 2019 increase 69 percent by 2050. The breakdown is provided below (rates are in real $2019 CAD):

- Residential: approximately $241/MWh ($66.94/GJ) by 2050 up from $118/MWh ($33.06/GJ) in 2019
- Commercial: approximately $197/MWh ($54.72/GJ) by 2050 up from $$95/MWh ($26.38/GJ) in 2019

- Industrial: approximately $123/MWh ($34.16/GJ) by 2050 up from $54/MWh ($15/GJ) in 2019

3.8 Were the projected electricity rates the same in the Electrification scenario in the Pathway Report and the Deep Electrification scenario in the LTGRP?

Response:

Please refer to the response to CoR IR2 3.7.

3.9 Were the projected electricity rates the same in the Diversified Energy (Planning) scenario and the Deep Electrification scenario in the LTGRP?

Response:

Please refer to the response to CoR IR2 3.7.

3.10 Were the same costs for renewable electricity used for retail sales and for hydrogen production, including for carbon capture and sequestration (CCS) in each scenario?

Response:

FEI and Posterity Group have collaborated on the following response.

The costs for renewable electricity were not used for retail sales, hydrogen production, or carbon capture and sequestration (CCS) in the LTGRP scenario modelling. As discussed in the response to CoR IR2 3.7, the avoided cost of electricity only determined whether a DSM measure would be included in the potential for energy savings and it did not influence the modelling of demand between scenarios.

For hydrogen production and CCS, the cost of renewable electricity was not used in the development of these in any scenario. The quantities of hydrogen and CCS used in each scenario were based on estimates of how much of each fuel would be available given the policy environment and economic conditions envisioned in that scenario.

4. *Conflict of FEI's Diversified Energy (Planning) Scenario and BC Hydro's Accelerated Electrification Scenario*

Reference: Exhibit B-6 (FEI Response to BCUC IR #1)

p. 165

BCUC IR 30.3 notes that:

> "the Deep Electrification and BC Hydro's Accelerated Electrification scenarios forecast a comparable level of total annual gas demand."

In response to BCUC IR 30.3, FEI states:

> FEI concludes that the Lower Bound and the Deep Electrification Scenarios, modelled as part of its 2022 LTGRP and which involve rapid and extensive declines in annual gas demand, are not plausible by drawing on its examination of alternative pathways to decarbonize as well as the extensive experience of FortisBC's gas and electric utilities in acquiring, transmitting and distributing gas and electricity to customers in BC.

4.1 If FEI implements the Diversified Energy (Planning) scenario plan but BC Hydro's Accelerated Electrification scenario is the one that moves forward for the province, will FEI expect to recover the full cost of its investments and contracts either through rates or through taxes via government subsidies?

Response:

FEI's DEP Scenario will involve various investments in both infrastructure and energy supply. When these investments by FEI are approved by the BCUC and are prudently and reasonably incurred for the purpose of providing the service, then pursuant to the *Utilities Commission Act* (UCA), FEI is eligible to recover its costs and earn a fair return on its investment through customers' rates.

It should be noted that FEI is a privately owned company, as opposed to BC Hydro which is a crown corporation; consequently, FEI does not have the ability to recover the costs to serve its customers through taxes. If these customers are also served by BC Hydro, then they will bear whatever costs BC Hydro has incurred for its Accelerated Electrification Plan.

4.2 In the scenario where both utilities implement their preferred plan, does FEI expect provincial ratepayers to pay for both utility system's investments and contracts, whether those ratepayers are using both systems or not?

Response:

Please refer to the response to CoR IR2 4.1.

5. ***RNG Supply Availability***

Reference: Exhibit B-6 (FEI Response to BCUC IR #1)

p. 499

In response to BCUC IR #1 77.2, FEI states that its *BC Renewable and Low-Carbon Gas Supply Potential Study* demonstrates that "ample supplies" will exist to meet FEI's projected demand for RNG. Table 1 lists the potential Canadian supply of RNG in 2030 at 61-82 PJ/year and the projected delivery to FEI customers of 32 PJ/year in the Diversified Energy (Planning) scenario.

5.1 Is FEI asserting that it will be able or anticipates to acquire by 2030 39% to 52% of Canada's total RNG supply?

Response:

No. Table 1 cited in the preamble illustrates an example where FEI could acquire 32 PJ of RNG (biomethane) by 2030 in the DEP Scenario. Given that FEI acquires RNG from BC, elsewhere in Canada and also from the United States, this RNG supply may be acquired from across these jurisdictions. Table 1 shows Canada's RNG supply potential, not actual supply, and therefore FEI cannot comment on what percentage of Canada's total RNG supply 32 PJ will comprise in 2030.

However, it is important to note that FEI has offered a Renewable Gas Program since 2010, and in being the first to market, FEI at one time contracted 100 percent of the entire available RNG supply in Canada. Although FEI is no longer the sole purchaser of RNG in Canada, FEI remains one of the largest RNG buyers in the Canadian market. Based on the Canada Energy Regulator's estimation that Canada's RNG capacity will reach 17 PJ in 2025[6], FEI estimates that it has acquired approximately 50 percent of Canada's total RNG supply capacity in 2025.

Reference: Exhibit B-6 (FEI Response to BCUC IR #1)

p.398

In response to BCUC IR 62.3.1, FEI states:

> Although FEI has not yet procured off-system hydrogen by displacement, under the existing energy policy and regulatory framework, FEI believes the answer is yes. However, when FEI becomes subject to the GHG emissions cap identified in the CleanBC Roadmap, FEI believes there may be opportunity to claim the GHG emission reductions associated with replacing natural gas and other higher carbon

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6 CER – Market Snapshot: New Renewable Natural Gas Projects Could Double Canada's Current Capacity by 2025 (cer-rec.gc.ca).

emitting fuels like coal or diesel in other jurisdictions, if best practice carbon accounting and protocols are followed.

5.2 In relying on RNG purchases that displace (or offset) use of conventional gas used outside of BC, how did FEI consider the likelihood that other jurisdictions (i.e., provinces and American states) are also planning on using RNG to meet their own GHG emission reduction objectives?

Response:

As noted in Section 2 of the Application, FEI has considered that other jurisdictions are also planning to use RNG as a means of meeting GHG emission reduction objectives by following policy and market developments in other jurisdictions. Since market competition is increasing, FEI is seeking to procure all cost-effective, low-carbon renewable gas supplies that fit within BC's policy and regulatory framework.

Please refer to the response to BCUC IR1 77.2, in which FEI's forecast of renewable and low-carbon gas supply is discussed in relation to the BC Renewable and Low-Carbon Gas Supply Potential Study[7] and additional research. The analysis suggests that there is adequate supply of renewable and low-carbon gas to serve FEI's demand. Therefore, regardless of increasing demand from neighboring jurisdictions, FEI expects there to be sufficient renewable and low-carbon gas available to meet FEI's needs.

[7] Exhibit B-1, Appendix D-2.

6. *Projected Hydrogen Production Cost and Emission Reductions*

Reference: Exhibit B-6 (FEI Response to BCUC IR #1) p.447

In response to BCUC IR 71.4, FEI produced a table with the emission factors for different fuels to be included in its future supply portfolio. Conventional gas shows a factor of 0.0598 tCO_2e, while blue hydrogen shows 0.0200 tCO_2e, creating a GHG emission reduction of 67%. Green hydrogen shows an emission rate of 0 (zero).

Reference: Exhibit B-6 (FEI Response to BCUC IR #1) p.404

In response to BCUC IR 62.10, FEI states:

> *However, in the Application, FEI is not forecasting the amount of each individual type of hydrogen that it will acquire and deliver to customers over the 20-year planning horizon and therefore is unable to provide the requested information.*

6.1 Given this difference in emission rates between blue and green hydrogen, in projecting the emission reductions for mixing hydrogen into its gas supply, what mix of blue and green hydrogen did FEI assume in each of its planning scenarios?

Response:

FEI did not make an assumption on the composition of future hydrogen supply mix, but rather an assumption of the carbon intensity of the future hydrogen portfolio, including supply from a range of suppliers. It was assumed that over time the supply portfolio emission rate would average 10 $kgCO_2e/GJ$ through the introduction of new technologies to reduce carbon intensity, as well as new production pathways such as methane pyrolysis.

6.2 If the assumption is 100% blue hydrogen, does this mean that injecting a 5% mix of hydrogen creates only a 3% reduction in GHG emissions?

Response:

FEI is not assuming that blue hydrogen would comprise 100 percent of the renewable gas supply portfolio. Please refer to the response to CoR IR2 6.1.

7. Feasibility of hydrogen delivery to residential and commercial customers

The California Public Utilities Commission retained the University of California, Riverside and the Gas Technology Institute (UCR/GTI) to conduct an extensive study of the allowable mix of hydrogen into the natural gas system. The Hydrogen Blending Impacts Study states:

> Completion of the project tasks has led the project team to conclusions and recommendations that are influenced by many overlapping variables and conditions. A single injection standard that applies system-wide would have to consider the most susceptible conditions observed throughout all infrastructure components. This type of scenario would also be required to consider all end-uses, appliances, and associated industrial processes**. This system-wide blending injection scenario becomes concerning as hydrogen blending approaches 5% by volume.** As the percentage of hydrogen increases, end-use appliances may require modifications, vintage materials may experience increased susceptibility, and legacy components and procedures may be at increased risk of hydrogen effects. [8] [Emphasis added]

The Hydrogen Blending Impacts Study shows the material composition of California's gas transmission and distribution system to be about 65% polyethylene pipe and 35% metallic which appears to be match that of FEI's as reported in its LTGRP.

7.1 In assessing whether delivering a mix with more than 5% hydrogen fuel was feasible and safe, did FEI identify and consider the same safety, system integrity and customer costs as were identified in the Hydrogen Blending Impacts Study?

<u>Response:</u>

FEI is aware of the UCR/GTI study. FEI is currently undertaking analysis to determine the percentage blend of hydrogen fuel that is feasible and safe to blend in FEI's gas system and the increased hydrogen blend percentage that will be safe to blend in the gas system at higher blend percentage concentrations and that may require system upgrades and modifications.

7.2 Please provide the difference in FEI's projected GHG emission reductions from its Diversified Energy (Planning) scenario if instead the hydrogen mix is constrained

[8] Arun SK Raju, Alfredo Martinez-Morales and Oren Lever, Hydrogen Blending Impacts Study, Prepared by University of California, Riverside and Gas Technology Institute for the California Public Utilities Commission, Final Report, July 2022, p. 4. https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

to 5% per the concerns raised in the Hydrogen Blending Impacts Study, compared to the projected hydrogen mix in FEI's LTGRP?

Response:

Please refer to the response to BCUC IR1 61.3 in which FEI describes its preliminary hydrogen development roadmap and its 10-year supply outlook. FEI is also exploring the feasibility of integrating 100 percent hydrogen for direct use, such as for industrial sites or dedicated distribution networks, which is occurring in other global jurisdictions. In addition to blending at rates found to be safe in the Study, FEI will consider procuring off-system hydrogen when conditions for regulatory approval are understood.

For these reasons, while FEI is anticipating hydrogen to form a large portion of the gas supply portfolio over time, it is not only reliant on on-system blends to displace natural gas for GHG emission reduction and, therefore, the emission reductions achieved in the DEP Scenario are not solely reliant on this distribution option.

8. *Costs to Customers to Upgrade to Use a Hydrogen Mix*

Reference: Exhibit B-14 (FEI Response to MetroVan IR #1) p. 13

In response to MetroVan 4.3, FEI states:

> "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."

8.1 Please provide the studies and documentation supporting this assertion that these customers can use a hydrogen mix above 5% safely with existing equipment.

Response:

FEI's analysis is based on ongoing engagement with research institutions and participation in BC and Canadian-based research and development initiatives as outlined in the response to BCUC IR1 61.3. Much of this research is owned by other entities such as research laboratories and other gas utilities and therefore cannot be provided in response to this question. However, a collection of this research was provided recently to the Canadian Standards Association (CSA) which reviewed the research and advised that their technical committees agree that existing CSA certified gas appliances in the field will also be considered certified for natural gas containing up to and including 5 percent hydrogen. Please refer to Attachment 8.1 for the CSA Group, Formal Interpretations, April 19, 2023.

8.2 If no such studies or documentation exist, please provide the studies showing the cost to these customers for upgrading equipment to accommodate a hydrogen mix above 5%.

Response:

Please refer to the response to CoR IR2 8.1.

Attachment 8.1

Formal Interpretations/ Interprétation formelle

This section lists questions that individuals have submitted about a particular standard. Each question has been reviewed and answered by the appropriate committee. If you would like to submit a question about a particular standard, please see the end notes in the preface of that standard.

Posted April 19, 2023

The following interpretation regarding Clause 11.2.1 Pressure testing for digesters, of CSA Standard CSA/ANSI B149.6:20 has been approved by the Members of the CSA Technical Committee on *Fuels and Appliances Strategic Steering Committee [JB117)*

Question 1: The specification states that the test is to be concluded when the temperature is within ±0.2 oC or ±33 oF. The two temperature ranges provided are not equivalent. Similarly, the tolerance of the temperature measuring equipment is stated to be ±0.1 oC or ±32 oF, these are also not equivalent.

Answer 1: Agree

Note: The degree Celsius is correct, but not Fahrenheit

The following interpretation regarding Clause 8.6.5 Buried Piping, of CSA Standard CSA/ANSI B149.6:20 has been approved by the Members of the CSA Technical Committee on *Fuels and Appliances Strategic Steering Committee [JB117)*

Question 1: Should buried HDPE gas collection piping ranging in sizes from 12” to 24” and encircling 11-acre anaerobic lagoons be subject to section 8.6.5 regarding steel casings?

Answer 1: Yes

The following interpretation regarding Annex D/5.3.2 under "Flare (waste gas burner) controls, of CSA Standard CSA/ANSI B149.6:20 has been approved by the Members of the CSA Technical Committee on *Fuels and Appliances Strategic Steering Committee [JB117)*

Question 1: Are actuated louvers on a flare considered mechanical means of ventilation suitable for a mechanical pre-purge of an enclosed flare stack on their own?

Answer 1: No

The following interpretation regarding Clause 8 Piping and tubing systems and fitting in digester gas systems - 8.1.2, of CSA Standard CSA/ANSI B149.6:20 has been approved by the Members of the CSA Technical Committee on *Fuels and Appliances Strategic Steering Committee [JB117)*

Question 1: Should buried HDPE gas collection piping ranging in sizes from 12” to 24” and encircling 11-acre anaerobic lagoons be subject to section 8.1.2 regarding a minimum pipe slope of 2%?

Answer 1: Yes

Posted April 18, 2023

The following interpretation regarding all standards under the Z21/83 and CSA Gas Technical Committees, as listed below, has been approved by the Members of the CSA Technical Committees on *Gas Appliances and Related Accessories [JB101]* and *Performance & Installation of Gas Burning Appliances & Related Accessories [U101].*

Question: Do you agree that natural gas containing up to and including 5% of Hydrogen is covered by testing with Test Gas A?

Answer: Yes

Standard #	Title
CAN1-1.16	Recreational Vehicle Cooking Gas Appliances
CAN1-11.4	Portable-Type Gas Camp Refrigerators
CAN1-2.20	Gas-Fired Brooders
CAN1-3.1	Industrial and Commercial Gas Fired Package Boilers
CAN1-6.2	Draft Hoods
CGA 2.29	Hand-Held Torches for Fuel Gas
CGA 3.4	Industrial and Commercial Gas-Fired Conversion Burners
CGA 5.2	Gas-Fired Waterless Toilets
CSA 2.15	Gas-Fired Domestic Lighting Appliances
CSA 2.17	Gas-Fired Appliances for Use at High Altitudes
CSA 3.11	Lever Operated Pressure Lubricated Plug Type Gas Shut-Off Valves
CSA 3.16	Lever Operated Non-Lubricated Gas Shut-Off Valves
CSA 3.8	Gas-fired Equipment for Drying Farm Crops
CSA 6.18	Service Regulators for Natural Gas
CSA 6.19	Residential Carbon Monoxide Alarming Devices
CSA 8.1	Elastomeric Composite Hose and Hose Couplings For Conducting Propane and Natural Gas
CSA 8.3	Thermoplastic Hose and Hose Couplings for Conducting Propane and Natural Gas

CSA 9.4	Standard for manually operated metallic gas valves for use on piping systems up to 5 psig
LC 1/CSA 6.26	Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing
LC 2	Direct Gas-Fired Circulating Heaters for Agricultural Animal Confinement Buildings
LC 4/CSA 6.32	Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems
LC 6	Natural Gas Operated Diaphragm Pumps
LC 7	Pipe Joint Sealing Compounds and Materials
Z21.1/CSA 1.1	Household Cooking Gas Appliances
Z21.10.1/CSA 4.1	Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
Z21.10.3/CSA 4.3	Gas Water Heaters, Volume III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
Z21.101/CSA 8.5	Gas Hose Connectors for Portable and Moveable Gas Appliances
Z21.103	Unvented Portable Type Gas Camp Heaters for Indoor and Outdoor Use
Z21.104/CSA 9.2	Manual and automatic gas selector devices for use with gas-fired appliances
Z21.11.2	Gas-Fired Room Heaters, Volume II, Unvented Room Heaters
Z21.11.3	Gas-Fired Room Heaters, Volume III, Propane-Fired Portable Emergency Use Heater Systems
Z21.12	Draft Hoods
Z21.13/CSA 4.9	Gas-Fired Low Pressure Steam and Hot Water Boilers
Z21.15/CSA 9.1	Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves
Z21.17/CSA 2.7	Domestic Gas Conversion Burners
Z21.18/CSA 6.3	Gas Appliance Pressure Regulators
Z21.19/CSA 1.4	Refrigerators Using Gas Fuel
Z23551-4	Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 4: Valve-proving systems for automatic shut-off valves
Z23550	Safety and control devices for gas and/or oil burners and appliances - General requirements
Z21.20/CSA 2.22 No.60730-2-5/UL 60730-2-5 (2120)	Automatic Electrical Controls for Household and Similar Use - Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems
Z21.21/CSA 6.5	Automatic Valves for Gas Appliances
Z21.22/CSA4.4	Relief Valves for Hot Water Supply Systems
Z21.23/CAN1-6.6	Gas Appliance Thermostats
Z21.24/CSA 6.10	Connectors for Gas Appliances
Z21.35/CSA 6.8	Pilot Gas Filters
Z21.40.1/CGA 2.91	Gas-Fired Heat Activated Air Conditioning and Heat Pump Appliances
Z21.40.2/CGA 2.92	Air-conditioning and Heat Pump Appliances (Internal Combustion)

Z21.40.4/CGA 2.94	Performance Testing and Rating of Gas-Fired Air Conditioning and Heat Pump Appliances
Z21.41/CSA 6.9	Quick Disconnect Devices for Use with Gas Fuel Appliances
Z21.42	Gas-Fired Illuminating Appliances
Z21.47/CSA 2.3	Gas-Fired Central Furnaces
Z21.5.1/CSA 7.1	Clothes Dryers, Volume I, Type 1 Clothes Dryers
Z21.5.2/CSA 7.2	Clothes Dryers, Volume II, Type 2 Clothes Dryers
Z21.50/CSA 2.22	Vented Decorative Gas Appliances
Z21.54/CSA 8.4	Gas Hose Connectors for Portable Outdoor Gas-Fired Appliances
Z21.56/CSA 4.7	Gas-Fired Pool Heaters
Z21.57	Recreational Vehicle Cooking Gas Appliances
Z21.58/CSA 1.6	Outdoor Cooking Gas Appliances
Z21.60/CSA 2.26	Decorative Gas Appliances for Installation in Solid-Fuel Burning Fireplaces
Z21.63/CSA 11.3	Portable Type Gas Camp Heaters
Z21.66/CSA 6.14	Automatic Vent Damper Devices for Use with Gas-Fired Appliances
Z21.69/CSA 6.16	Connectors for Movable Gas Appliances
Z21.71	Automatic Intermittent Pilot Ignition Systems for Field Installation
Z21.72/CSA 11.2	Portable Type Gas Camp Stoves
Z21.73/CSA 11.1	Portable Type Gas Camp Lights
Z21.74	Portable Refrigerators
Z21.75/CSA 6.27	Connectors for Outdoor Gas Appliances and Manufactured Homes
Z21.76	Gas-Fired Unvented Catalytic Room Heaters for Use with Propane Gas
Z21.77/CSA 6.23	Manually-Operated Piezo-Electric Spark Gas Ignition Systems and Components
Z21.78/CSA 6.20	Combination Gas Controls for Gas Appliances
Z21.79/CGA 6.21	Gas Appliance Sediment Traps
Z21.8	Installation of Domestic Conversion Burners
Z21.80/ CSA 6.22	Line Pressure Regulators
Z21.81/CSA 6.25	Cylinder Connection Devices
Z21.84	Manually Lighted, Natural Gas Decorative Gas Appliances for Installation in Solid Fuel Burning Fireplaces
Z21.86/CSA 2.32	Vented Gas-Fired Space Heating Appliances
Z21.87/CSA 4.6	Automatic Gas Shutoff Devices for Hot Water Supply Systems
Z21.88/CSA 2.33	Vented Gas Fireplace Heaters
Z21.89/CSA 1.18	Outdoor Cooking Specialty Gas Appliances
Z21.90/CSA 6.24	Gas Convenience Outlets and Optional Enclosures
Z21.91	Ventless Firebox Enclosures for Gas-Fired Unvented Decorative Room Heaters
Z21.92/CSA 6.29	Manually Operated Electric Gas Ignition Systems and Components

Z21.93/CSA 6.30	Excess Flow Valves for Natural Gas and Propane Gas with Pressures up to 5 psig
Z21.94/CSA 6.31	Automatic Flammable Vapor Sensor Systems and Components
Z21.96/CSA 11.6	Portable Water Heaters for Outdoor Use
Z21.97/CSA 2.41	Outdoor Decorative Gas Appliances
Z21.98/CSA 4.10	Non-Metallic Dip Tubes for Use in Hot Water Heaters
Z83.11/CSA 1.8	Gas Food Service Equipment
Z83.18	Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Applications
Z83.19/CSA 2.35	Gas-Fired High Intensity Infrared Heaters
Z83.20/CSA 2.34	Gas-Fired Tubular and Low Intensity Infrared Heaters
Z83.21/CSA C22.2 No. 168	Commercial Dishwasher
Z83.25/CSA 3.19	Direct Gas-Fired Process Air Heaters
Z83.26/CSA 2.37	Gas-Fired Outdoor Infrared Patio Heaters
Z83.4/CSA 3.7	Non-Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application
Z83.7/CSA 2.14	Gas-Fired Construction Heaters
Z83.8/CSA 2.6	Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces
13.1	Combined Heat and Power Appliances

Posted April 6, 2023

The following interpretation regarding Clause 12.4.1.3 and Figure 12 of CSA Standard CSA N285.0-17 with Update No. 1, General requirements for pressure-retaining systems and components in CANDU nuclear power plants, has been approved by the Members of the CSA Standards Technical Committee on *CANDU Nuclear Power Plant Pressure-Retaining Systems and Components (Z953).*

Question 1: For a calandria tube that, in accordance with the Standard N285.0-17, is a "material" or "tubular product welded with filler material" and using Figure 12, does the clause 12.4.1.3 b) requiring a design drawing to be registered apply?

Answer 1: No

Question 2: For a calandria tube that, in accordance with the Standard N285.0-17, is a "material" or "tubular product welded with filler material" and using Figure 12, does the clause 12.4.1.3 i) requiring a check of pressure boundary integrity dimensions imply the critical dimensions of the drawing?

Answer 2: Yes

Question 3: For a calandria tube that, in accordance with the Standard N285.0-17, is as a "material" or "tubular product welded with filler material" and using Figure 12, do the pressure tests required by clause 12.4.1.3 m) include any tests other than those associated with the material specification requirements?

Answer 3: No

Question 4: For a calandria tube that, in accordance with the Standard N285.0-17, is a "material" or "tubular product welded with filler material" and using Figure 12, does the clause 12.4.1.3 n) requiring reconciliation statements apply?

Answer 4: No

Posted April 6, 2023

The following interpretation regarding Clause 6 of CSA N285.6.8 (2005 through 2017), Martensitic stainless steel for fuel-channel end fittings, has been approved by the Members of the CSA Standards Technical Committee on *CANDU Nuclear Power Plant Pressure-Retaining Systems and Components (Z953).*

Question: If the material is reheat treated, are the test results obtained prior to the reheat treatment valid for evaluating against the Clause 6.2.1 and 6.3.1 criteria?

Answer: No

Posted Feb 22, 2023

The following interpretation regarding Section 27.8 of CSA Standard S16:19, Design of steel structures, has been approved by the Members of the CSA Standards Technical Committee on *Steel Structures for Buildings (A263).*

Question: Can it be assumed that the usage of Type D (ductile) buckling restrained braced frame, Rd = 4.0, Ro = 1.2 — appearing in section 27.8 of CSA-S16 including all referenced clauses and recommendations therein indicated— in the analysis and design of an SFRS warrant at least a 10% or less probability of collapse for All-Importance All-Occupancy type of buildings in Canada against the 2% percent probability of exceedance earthquake hazard stated in the National Building Code of Canada? If yes, please kindly indicate technical reference that could sufficiently explain the adoption of the values Rd and Ro proposed.

Answer: Typically, R-factors in S16 have been established in collaboration with the Standing Committee of Earthquake Design. There are technical papers that specifically provide background information for the R-factors specified for some systems but not for others. In any case, Standard S16 does not include a list of reference papers or bibliography.

Posted Feb 22, 2023

The following interpretation regarding Clause 7.2.7 of CSA Standard Z662:19, Oil and gas pipeline systems, has been approved by the Members of the CSA Standards Technical Committee on *Petroleum and Natural Gas Industry Pipeline Systems and Materials (K110).*

Question 1: When using an ASME section IX welding procedure per Clause 7.2.4 or 7.2.5 that has 2 or more PQRs covering multiple thicknesses, is the maximum carbon equivalent value for the welding procedure the highest base metal PQR CE value plus 0.05?

Answer 1: Yes

The following interpretation regarding Figure 7.2, Note 5 a) of CSA Standard Z662:19, Oil and gas pipeline systems, has been approved by the Members of the CSA Standards Technical Committee on *Petroleum and Natural Gas Industry Pipeline Systems and Materials (K110).*

Question 1: The standard specifies in Figure 7.2, Note 5 a) that where butt-welding items of unequal thicknesses and unequal SMYS's, the tensile strength of the deposited weld metal shall be at least equal to that of the item having the higher SMYS.

Answer 1: Agree

Question 2: Figure 7.2, Note 5 a) does not consider whether the item with the higher SMYS is the thinner or the thicker item.

Answer 2: Agree

Question 3: The standard does not specifically address butt-welding items of **equal** thickness and unequal specified minimum yield strengths.

Answer 3: Agree

Question 4: Is it the intent of Figure 7.2, Note 5 a) that when joining items of **equal** thickness, the tensile strength of the deposited weld metal be equal to that of the item having the higher SMYS?

Answer 4: No, Figure 7.2 does not address joining items of equal thickness

The following interpretation regarding Clauses 14.5.2 and I.5 of CSA Standard Z662:19, Oil and gas pipeline systems, has been approved by the Members of the CSA Standards Technical Committee on *Petroleum and Natural Gas Industry Pipeline Systems and Materials (K110)*.

Question 1: According to Clauses 14.5.2 and I.5, the minimum strength test pressure shall be increased in accordance with Equation 24 in para. 345.4.2 of ASME B31.3. Is it the intent of the Z662 Standard, for pipelines designed and built to Annex I, that the allowable stresses for the purposes of Equation 24 from B31.3, come from Table A-1 or A-1M?

Answer 1: Yes, but only for materials that are listed, as defined in Clause I.3.1.2.

Question 2: If the answer to Question 1 is yes, can the minimum strength test pressure for CSA Z245.1 Grade 448 and 550 be calculated using the allowable stresses from B31.3, Table A-1 or A-1M? Note that both grades of materials are unlisted materials in Annex I, but are listed materials in other Clauses.

Answer 2: No

Question 3: Annex I was developed based upon ASME B31.3, Chapter IX (High Pressure Piping). Can the minimum strength test pressure be calculated based upon Equation 38 in para. K345.4.2 of ASME B31.3 with the allowable stresses from Table K-1?

Answer 3: No

Question 4: Shall design allowable stresses be used in accordance with Equation 24 in para. 345.4.2 of ASME B31.3 for unlisted materials in Clause 14 or Annex I, as applicable?

Answer 4: Yes

The following interpretation regarding Clause 15.2 b) of CSA Standard Z245.1:22, Steel pipe, has been approved by the Members of the CSA Standards Technical Committee on *Petroleum and Natural Gas Industry Pipeline Systems and Materials (K110)*.

Question 1: Can a ":" colon or "–" hyphen be used interchangeably at the option of the manufacturer for CSA Standard designation for the required markings and the certifications (e.g., MTRs), e.g., CSA Z245.1:22 or Z245.1-22?

Answer 1: Yes

Question 2: Can a ":" colon or "–" hyphen be used interchangeably at the option of the manufacturer for other CSA Standard designations for additional markings and the certifications (e.g., MTRs), where specified in the purchase order, e.g., CSA Z662:19 or Z662-19?

Answer 2: Yes

The following interpretation regarding Clause 5.3.3 of CSA Standard CSA Z245.30:22, Field-applied external coatings for steel pipeline systems, has been approved by the Members of the CSA Standards Technical Committee on *Petroleum and Natural Gas Industry Pipeline Systems and Materials (K110).*

Question: Does a change in the materials expiration date, require the applicators to be recertified under the new MQAP version?

Answer: No

The following interpretation regarding Clause 7.5.4.2 of CSA Standard CSA Z245.30:22, Field-applied external coatings for steel pipeline systems, has been approved by the Members of the CSA Standards Technical Committee on *Petroleum and Natural Gas Industry Pipeline Systems and Materials (K110).*

Question: May a read-out from a calibrated voltmeter, integrated into the holiday detector to be verified, be used to meet the requirements of "verified and tested against a voltmeter..." as required by Clause 7.5.4.2?

Answer: No