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July 5, 2013

Via Email
Original via Mail

Commercial Energy Consumers Association of British Columbia
c/o Owen Bird Law Corporation
P.O. Box 49130
Three Bentall Centre
2900 – 595 Burrard Street
Vancouver, BC
V7X 1J5

Attention: Mr. Christopher P. Weafer

Dear Mr. Weafer:

Re: FortisBC Energy Inc. (FEI)

Biomethane Service Offering: Post Implementation Report and Application for Approval for the Continuation and Modification of the Biomethane Program on a Permanent Basis (2012 Biomethane Application) (the Application)

Response to the Commercial Energy Consumers Association of British Columbia (CEC) Information Request (IR) No. 2

On May 28, 2013, FEI filed its response to IR No. 1. In accordance with Commission Order G-53-13 setting out the Revised Regulatory Timetable for review of the Application, FEI respectfully submits the attached response to CEC IR No. 2.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed by: Shawn Hill

For: Diane Roy

Attachments

cc (e-mail only): Commission Secretary
Registered Parties

1 Reference: Exhibit B-15, CEC 1.2.2; Exhibit B-15, CEC 1.2.3; Exhibit B-15, CEC 1.3.1; Exhibit B-4, Slide 12

> The residential customers are segmented at a broad level by demographics and region but additional research has been done to further segment them based on their attitudes and lifestyle on adoption of green products. The segmentation categories are described in slide 12 of Exhibit B-4 of the FEI workshop presentation materials. The primary target markets for FEI are "dark greens" to "extreme practical."

> FEI has only qualitatively identified the market segments as described in response to CEC IR 1.2.2 but does not have the total number of customers identified in each segment and the penetration rates. The penetration rates and market potential are described in Appendix E of the 2012 Biomethane application (Exhibit B-1) in slides 17 & 18 across the entire residential segment. It is not unreasonable to assume that the penetration would be highest in dark greens and then gradually drop towards extreme practical.

> The statement "large secondary target market of residential customers" who are environmentally-minded but are also price sensitive represents a segment of the total residential market of natural gas users and not characteristics of existing subscribers.

1.1 Has FEI segmented its known customer base into the attitudinal/motivational segments of 'dark greens', 'light greens', 'potential switchers', etc.?

Response:

This response addresses CEC IRs 2.1.1, 2.1.1.1 and 2.1.2 and provides a context for all the CEC IR 2.1 series.

The segmentation provided in response to CEC IR 1.2.2 was developed as part of research conducted by TNS in 2010 as a way to qualitatively segment the market potential of RNG by lifestyle and their attitude to the environment. This information is primarily used by FEI's internal marketing and communications team to have a common understanding of the various target

segments while developing channel strategies or while discussing the program with media companies outside the firm. In addition, this segmentation description was provided to stakeholders by way of information requests and workshops for informational and educational purposes as part of the RNG regulatory process.

FEI does not have specific marketing strategies for each segment but has developed an integrated marketing plan to educate customers across all segments. Copies of the plan were submitted in response to BCUC IR 1.10.1. Also refer to the response to BCUC IR 1.15.3 for FEI's plan to increase awareness of the Biomethane program. As part of the plan FEI may target certain consumers in certain neighborhoods that could be in any of the segments from dark greens to extreme practicals to increase response rates.

In response to this question, FEI has provided more context on the process for arriving at the 8 lifestyle segments and its intended purpose.

In the research conducted by TNS in 2010, TNS began with an explanation of eight lifestyle segments to measure the extent to which residents are committed to minimizing their carbon footprint and engaging in green environmental practices. TNS used its Conversion Model solution which uses a psychological framework that measures the strength of the relationships between people and something else – for example: a brand, a service, or a political party. In the theory that underpinned the model, there were three dimensions that contributed to a person's psychological attachment to a lifestyle:

- Needs fit: How positively do people view the lifestyle they are currently in?
- Involvement in the category: How important is the lifestyle to them / does it matter?
- Ambivalence: How much are people torn between the appeal of different lifestyle choices?

The questionnaire contained a set of questions that covered these three dimensions. Three different lifestyles were developed at the design phase of this study to capture the extent to which residents consider the environmental impact of their actions. Some residents are extremely environmentally conscientious, some are not, and many are somewhere in between. Residents were then categorized into one of eight commitment segments depending on which of the three lifestyles they relate to most.

FEI is aware of the distribution and the demographic details of the entire sample as part of the research but not specifically for its existing customer base. FEI is aware of the demographic details as provided in Appendix E of the Application (Exhibit B-1) for the entire customer base, but not by the attitudinal/motivational segment.

The specific charts and results are attached as part of this response.

1.1.1 If so, please provide an approximate proportion of FEI's existing customers that would fall into each segment.

Response:

Pease refer to the response to CEC IR 2.1.1.

1.2 Please provide any additional demographic, lifestyle or other information such as age, residence type, gender, that FEI may reasonably expect to apply to each attitudinal segment.

Response:

Please refer to the response to CEC IR 2.1.1.

1.3 Please confirm or otherwise explain that in establishing the 'dark greens to extreme practicals' as the primary target markets FEI is intending to specifically target all these segments in its market strategy, and is not intending to target the 'Unconcerned' and 'Browns' segments.

Response:

Please refer to the response to CEC IR 2.1.1.

FEI's current communication campaigns, such as bill inserts, print ads and radio ads, are directed to all natural gas customers. FEI expects the dark greens to extreme practicals segment to be more responsive based on their lifestyles and attitude than unconcerned or browns. For focused direct mail pieces, FEI targets consumers that exhibit attitudes described in dark greens to extreme practical's segment based on the market insight of those neighborhoods from third party companies.

1.4 Would FEI agree that the 'Unconcerned' and 'Brown' segments could potentially be moved into different attitudes through consumer education programs?

Response:

FEI agrees that it is possible for any customer to move into a different attitude group. As stated in the response to CEC IR 2.1.3, FEI's communication campaigns are directed to all customers which would include the "Unconcerned" and "Brown" segments. In this way, FEI does have some potential to influence this market.

However, FEI is only anticipating to achieve a participation rate of 2 percent in its moderate case demand scenario by 2015 and believes that there is enough potential within the dark greens to extreme practical segment to achieve that goal. FEI would not specifically target unconcerned and browns in its targeted communication campaigns as they do not think about the environment while making a decision and as such may or may not change their attitude despite FEI's customer education programs.

1.4.1 If so, would FEI consider itself in a position to influence this market?

Response:

Please refer to the response to CEC IR 2.1.4.

1.5 Please confirm or otherwise clarify that the "large secondary target market of residential customers who are environmentally minded but are also price sensitive" is a subset of the 6 segments that FEI has described as the 'primary target markets' ranging from the 'dark greens' to 'extreme practical'.

Response:

Confirmed. This secondary market represents every segment from light greens to extreme practicals.

1.5.1 If so, please identify which segments would be considered primary targets and which segments would be included in the large secondary market of residential customers who are environmentally minded but also price sensitive.

Response:

Please refer to the response to CEC IR 2.1.1. FEI would consider primary target markets to be in the dark greens segment and the large secondary market in any of the segments from light greens to extreme practicals based on the description provided for each segment.

1.6 Has FEI identified priorities among the targeted market segments and if so, on what basis?

Response:

No, FEI has not identified any priorities amongst the targeted market segments and believes that all segments from dark greens to extreme practicals are important to achieve the target signups. In slide 3 of the Attachment 1.1 provided in the response to CEC IR 2.1.1, it is quite clear from the sample size that the segments from light greens to extreme practicals represent about 65 percent of the market potential and as such signal that all segments are equally important.

1.7 Please provide information including any rough estimates FEI may have regarding the proportion of residential customers in each of the targeted and untargeted segments.

Response:

Please refer to the response to CEC IR 2.1.1.

Please refer to slide 3 of Attachment 1.1 provided in the response to CEC IR 2.1.1 for rough estimates on each segment. FEI only has this information based on the sample of customers surveyed as part of the 2010 research, conducted on behalf of FortisBC, but not for the existing subscribers. As explained in CEC IR 2.1.1, this classification was done for qualitative purpose to segment the potential customers by attitude types and not for categorizing existing customers into the lifestyle segments.

1.7.1 If this information is not available, please identify any plans FEI has to acquire this information and when it can be expected to be available.

Response:

Please refer to the response to CEC IR 2.7.1.

1.7.2 Would FEI consider it fair to say that the 'dark green extremes' are likely to be a small segment of the market and relatively low consumers of natural gas in relation to other segments? Please comment.

Response:

From its understanding of the segmentation provided by TNS consulting in 2010, FortisBC believes that the ' dark green segments ' represent 6 percent of the overall market. FEI is unable to comment if they would also be low consumers of natural gas but it could be reasonable to assume that this group may take appropriate steps to conserve gas.

Please refer to BCUC IR 1.35.1.1 for consumption distribution of all residential Biomethane customers.

1.8 Please provide information including any rough estimates FEI may have regarding the natural gas consumption patterns of each segment.

Response:

FEI does not have any estimates on natural gas consumption for each segment as this level of research has not been conducted.

1.8.1 If this information is not available, please identify any plans FEI has to acquire this information and when it can be expected to be available.

Response:

FEI currently has no plans to acquire this information. FEI would need to assess the costs and benefits of conducting the research necessary to acquire the information and how it can potentially use this information to acquire more customers in a cost effective manner. As additional information becomes available from current subscribers, FEI may investigate the option of conducting research to acquire more information about the target segments and asses the usefulness of that information as it pertains to acquire more customers in a cost effective manner

1.9 Please provide information including any rough estimates FEI may have regarding the growth or decline of any of the attitudinal segments identified.

Response:

FEI does not have this information available for each segment. Please refer to the response to CEC IR 2.1.1.

1.10 Has FEI identified different marketing and/or communications strategies for the various market segments being targeted?

Response:

Please refer to the response to CEC IR 2.1.1

1.10.1 If so, please explain how FEI intends to direct its marketing plan to address the relevant segments.

Response:

Please refer to the responses to CEC IRs 2 1.1 and 2.13.

1.11 It is the CEC's view that the total number of customers in each market segment, expected growth and the 'average natural gas usage per customer' in each segment is key information in establishing the most rational segments to target; determining the appropriate marketing mix to reach those segments and identifying the communication messages to be delivered. Please comment on whether or not FEI agrees with the appropriateness of this analysis and whether or not FEI intends to conduct such an analysis with respect to its marketing.

Response:

In theory, FEI agrees with the approach and believes that it would be important to identify the total number of customers in each segment and how /where they consume information and the average usage. However, FEI would need to assess the costs and benefits of conducting the research necessary to acquire the information and how it can potentially use this information to acquire more customers in a cost effective manner. As additional information becomes available from current subscribers, FEI may investigate the option of conducting research to acquire more information about the target segments and asses the usefulness of that information as it pertains to acquire more customers in a cost effective manner.

2 Reference: Exhibit B-15, CEC 1.2.3 and Exhibit B-1, Appendix E, Slides 17 and 18

> FEI has only qualitatively identified the market segments as described in response to CEC IR 1.2.2 but does not have the total number of customers identified in each segment and the penetration rates. The penetration rates and market potential are described in Appendix E of the 2012 Biomethane application (Exhibit B-1) in slides 17 & 18 across the entire residential segment. It is not unreasonable to assume that the penetration would be highest in dark greens and then gradually drop towards extreme practical.

2.1 Please provide the penetration and market potential rates to which FEI refers as the slides are not numbered.

Response:

The market potential is 27 percent assuming perfect market conditions. When taking current levels of awareness into consideration, it drops to 4 percent.

3 Reference: Exhibit B-15, CEC 1.2.2; Exhibit B-1, Application, Page 24; Exhibit B-15, CEC 1.3.1

Growing Market Potential

There is also a large secondary target market of residential customers. The customers in this market consider themselves to be environmentally-minded and have taken steps to conserve energy, reduce their costs and generally participate in well-established programs such as recycling that do not increase their costs. They also aspire to be more environmentally conscious in their actions and choices. These customers are price sensitive and therefore tend to require additional tangible benefits to participate in the program. This secondary market accounts for a large portion of FEI's current participants. Over seventy percent (a ranking of 3.65 out of 5) of those surveyed indicated that FEI thanking customers with AIR MILES reward miles was a motivation for them to sign up for RNG.

The statement "large secondary target market of residential customers" who are environmentally-minded but are also price sensitive represents a segment of the total residential market of natural gas users and not characteristics of existing subscribers.

3.1 Would FEI consider the environmentally-minded but also price sensitive segment who require additional tangible benefits and have air miles as a motivator as being characteristic of the 'extreme practical' group or other segment? Please explain.

Response:

FEI does not have any formal research with its existing subscribers to establish if the segment of customers referenced in the question could be in the extreme practical group or not. It could be reasonable to assume that this group could be in the extreme practical group based on the attitude and lifestyle of this segment and possibly in other segments as well ranging from light greens to practicals.

3.1.1 If so, would FEI describe 70% of its existing RNG customer base as being part of the 'extreme practical' segment?

Response:

Please refer to the response CEC IR 2.3.1. In the absence of any formal research on existing subscribers, the only directional comment FEI is able to make about its existing customer base is that prior to the launch of AIR MILES in May 2012, roughly 1,200 or 25 percent of customers that signed up are the early adopters and could be in the dark greens segment based on the characteristics of the consumers in this segment. The rest of the customers would be anywhere from light greens to extreme practicals.

3.1.2 If not, please identify into which segment(s) FEI would classify those requiring air miles as a motivator to sign up and explain why.

Response:

Please refer to the response to CEC IR 2.3.1.

4 Reference: Exhibit B-15, CEC 1.5.11

> FEI is unable to provide a breakdown of consumption for residential customers by dwelling type but on average Rate 1 residential customers use 90 GJ / year. When enrolled in RNG, the customer designates 10 percent of their usage as renewable, resulting in 9 GJ of RNG.

4.1 Is FEI's information with respect to actual RNG residential customer billing consistent with the average natural gas residential customer use of 90 GJ/year?

Response:

Yes. Please refer to the response to BCUC IR 1.35.1.1.

5 Reference: Exhibit B-15, CEC 1.6.1.; Exhibit B-15, CEC 1.13.1; Exhibit B-15, CEC 1.12.4

> FEI allocated approximately 50 percent of its approved budget on residential and commercial segments. However, it would be difficult to conclusively state the exact proportion of expenses that could be attributed to each of the commercial and residential segments. In 2012, FEI developed an integrated marketing plan as attached in response to BCUC IR 1.10.1 to effectively and efficiently allocate resources to create awareness and increase participation across all segments. To achieve this objective, FEI allocated the expenditure accordingly. It

> FEI agrees that commercial customers are significantly more likely to increase their blend than residential customers. Higher blends will allow commercial customers to meet their corporate environmental goals. In addition, commercial customers can in some cases pass on the incremental costs back to their customers and there may be brand building aspects of the business case that apply for commercial customers that do not apply for residential customers.

> FEI does expect the relationship to change with commercial volumes contributing to more than 85 percent of the volumes by 2022. Please refer to the responses to CEC IR 1.12.2 and BCUC IR 1.38.1 for the volumes.

5.1 Please provide the basis on which FEI 'accordingly' allocated the marketing expenditures, i.e., anticipated demand, overall volume, number of potential customers etc.?

Response:

The 50 percent allocation referred to in the response to CEC IR 1.6.1.2 was FEI's rough estimate of the expenditures spent on marketing activities for residential versus commercial customers. FEI's tracking of 2012 actual expenditures is provided in response to CEC IR 1.16.1. As noted in CEC IR 1.6.1.2, however, it is difficult to allocate costs of marketing activities that target both customer groups. The 50 percent allocation is therefore a rough representation of historical dollars spent and does not necessarily reflect the allocation of costs going forward.

In the beginning of the year FEI establishes a goal and then develops an integrated marketing campaign to achieve that goal. FEI then monitors the success of each campaign and adjusts the campaigns as necessary to achieve the desired objective, rather than establishing budgets for commercial and residential sectors.

5.2 Does FEI intend to review or modify its 50% allocation to achieve the 85% volumes anticipated from commercial customers by 2022?

Response:

Please refer to the response to CEC IR 2.5.1. FEI does not intend to modify its 50 percent estimate as stated in CEC IR 2.5.1 and believes that to achieve the 85 percent volumes anticipated, FEI requires dedicated sales effort to convert commercial customers to RNG customer.

5.2.1 If so, what marketing allocation does FEI foresee over the next 5 years?

Response:

Please refer to the responses to CEC IRs 2 5.1 and 2.5.2.

5.2.2 If not, please clarify FEI's views with respect to the appropriate allocation of marketing resources for each market segment.

Response:

Please refer to the responses to CEC IR 2 5.1 and BCUC IR 2.18.1.

6 Exhibit B-14, BCSEA 1.3.1 and Exhibit B-3, PIR Summary Report

> At a broad level, FEI segments its customers into residential, small and large commercial. At this level, customers segments are broader than the rate schedules. FEI can further segment the customers within those categories using factors such as demographic, region and behavior. As an example, FEI could internally segment its RNG residential customers under Rate Schedule 1B (RNG rate for single-family residences and separately metered multi-family residences) into eight segments as described in Exhibit B-4 slide 12 of the PIR Biomethane workshop presentation. Depending on their characteristics, commercial customers are further segmented by sector, and may either be in Rate Schedule 2b, 3b or 11B depending on if they buy the commodity through FEI or gas marketer.

> "For commercial customers, the key success factor has been targeting businesses that are leaders in sustainability and providing recognition to organizations that sign up for the RNG Offering. Organizations that sign up are featured as Green Leader businesses on FEI"s website, are provided decals (printed and digital) they can use to display at their business, receive tweets about their participation in the RNG Offering and are featured in a Thank You ad once per year. FEI featured early adopters in customer education promotions to encourage other businesses in similar industries to sign up, which has been an effective way to gain businesses" interest." [p.10, underline added]

6.1 On what basis did FEI identify commercial customers as being leaders in sustainability?

Response:

FEI has identified commercial customers as being leaders if they have a clearly defined sustainability goal, care about the environment in every action that they take, and believe in brand building benefits. These businesses have often accomplished many energy efficiency and sustainability driven initiatives such as reuse, reduce, recycle and undertake efficient lighting programs.

6.2 Please provide the results of any segmentation analysis FEI has conducted on commercial customers such as behavior or marketing strategies (i.e. companies that market themselves as eco-friendly) that it has not already provided.

Response:

FEI has not conducted any additional research on segmentation analysis apart from the research conducted by TNS in 2010 on the market potential for commercial uptake and surveying existing subscribers as submitted in Appendix E-2 of the Application (Exhibit B-1).

7 Reference: Exhibit B-15, CEC 1.7.1 and CEC 1.7.4

> FEI's early response from PSOs was that biomethane was too expensive an alternative when compared to the offsets they would have to purchase from PCT. This was especially true for hospitals and school districts. However, as FEI furthered discussions with municipalities and universities, there turned out to be interest in this market from a handful of PSOs, that resulted in large volume potential.
>
> There are over 100 PSOs that are mandated and 180 municipalities that have signed on to the Climate Action Charter to be carbon neutral.

7.1 Does FEI intend to allocate marketing resources specifically to PSOs and municipalities in its future budgets?

Response:

Yes, FEI does allocate resources from its existing customer education budget to create awareness, but believes this sector needs dedicated one-on-one effort to discuss the options, impact on budgets and billing, and to make presentations to management committees before leading to a sign up. It would typically take almost 6 months before a municipality signs up.

All the municipalities and PSO's are natural gas customers and so receive bill inserts and become aware of FEI's RNG product offering as part of FEI's regular campaigns. FEI may also work with certain municipalities such as city of Vancouver to do specific targeted co-branded promotions across certain neighborhoods to drive awareness in the residential and commercial sector.

In summary, FEI has allocated its marketing resources as part of the integrated marketing plan to create awareness either through bill inserts or by participating in events such as Union of BC Municipalities, but believes this sector needs dedicated effort to encourage sign ups.

7.1.1 If so, please provide the expected budget allocation and its proportion relative to the commercial and residential markets.

Response:

The only budgeted allocated at the beginning of the year is for bill inserts. FEI does not allocate any fixed percent to residential or commercial or PSOs, but has an integrated approach to reach all segments and consumers through multiple channels.

7.1.2 If not, please explain why not.

Response:

Please refer to the responses to CEC IRs 2.7.1 and 2.7.1.1.

8 Reference: Exhibit B-15, CEC 1.13.2

> Although FEI's primary research indicates that commercial customers are more likely to increase their blends to as high as 50 percent than residential customers, FEI does not have definitive information to comment on the degree of price sensitivity at this stage. For commercial customers, the degree of price sensitivity will vary depending on a number of factors including:
>
> - The organization's goals with respect to environmental issues
> - The degree to which energy costs are significant within the overall cost of the organizations end product

8.1 What proportion of energy costs within the overall cost of the end product would FEI consider as 'significant'?

Response:

The proportion of energy costs within the overall cost of the end product that could be significant and would depend on the customer, the industry, their budgets and the degree to which they are sensitive when compared to their overall sustainability goals.

By looking at the existing natural gas usage across certain sectors, FEI would think that industries that use natural gas on a continuous basis (e.g. manufacturing, food processing, hospitality, retail, and institutional) may have significant energy costs, but that is relative when compared to other companies within the same sector.

FEI's 2010 research sampled the consumption profile of its respondents and FEI has provided the results below of the percent breakdown of the consumption of the companies surveyed by sectors. FEI does not have the background data on the actual consumption. For example the 18 percent in retail means that this sector in general is a large consumer of gas when compared to other sectors.

	TOTAL	TOTAL CONSUMPTION	
		LARGE COMMERCIAL	SMALL COMMERCIAL
Base Size	(500)	(108)	(392)
ORGANIZATION SECTOR:			
Retail	18%	3%	**22%**
Industrial	10%	8%	10%
Commercial	10%	7%	11%
Construction	9%	4%	**11%**
Hospitality	8%	**12%**	7%
Institutional	8%	**17%**	6%
Office	7%	9%	6%
Food	7%	5%	7%
Government Organization	6%	13%	4%
Agriculture	4%	**8%**	2%
Auto Repair / Gas Station	3%	1%	4%
Recreation	2%	**6%**	2%
Wood & Forest	1%	1%	1%
Don't Know / Decline	9%	7%	9%

8.2 Please identify the key industries FEI considers as having 'significant' energy costs, and particularly those with significant natural gas costs.

Response:

Please refer to the response to CEC IR 2.8.1.

9 Reference: Exhibit B-15, CEC 1.14.1

> FEI is not aware of any negative feedback that it received from commercial customers. In fact most of them supported the concept and the efforts taken by FEI to put together the green leader rewards package to make this an attractive offer. The only complaint that FEI received was the premium associated with this product.

9.1 Does FEI anticipate that commercial customers would continue to be positive in the absence of green leader rewards packages?

Response:

The Green leader rewards package was a way for FEI to recognize the subscribers of the Biomethane program. In the FEI commercial subscribers survey (Appendix E-2), 50 percent of those sampled said that they are using the green leader decals. It would be reasonable to assume that in absence of green leaders package, the customers could feel less positive towards the program.

10 Reference: Exhibit B-17, BCUC 1.15.3

> In the commercial segment, FEI has used a combination of direct sales and targeted communications tactics to reach customer segments. The internal sales staff inform customers of RNG as an option as part of their regular sales conversation with prospective and existing customers. FEI also developed partnerships with external channels such as Climate Smart[5], Greenstep[6], to further promote and educate about RNG within their customer base including speaking engagements at industry events where appropriate. Additionally FEI also used mass media tactics such as bill inserts, targeted print Ads, radio and digital ads, as well as FEI's website and customer testimonial videos to generate awareness and understanding of the program.

10.1 Did FEI address specific commercial customer segments such as hospitality or service industries in their targeted communications?

Response:

Yes.

10.2 If so, please identify which commercial segments FEI targeted and provide a rationale for each.

Response:

FEI targeted the hotel, retail, restaurant and food service industries as all the early adopters were in one of those sectors. FEI used these customers in its communication pieces to attract other similar customers within the same industry and spread the awareness of the program in general. The primary research also indicated that customers in these segments would be more inclined to buy RNG as they are consumer facing and may use RNG to differentiate their offerings to attract and retain customers that care about the environment. FEI then sought recommendations from the media companies on the appropriate channels to deliver the message. Please refer to Attachment 10.2 for examples of the print and digital ads that were featured in Hotelier, Inn Focus Magazine, Western Grocer, BC Business and Canadian restaurant and Food services.

11 Reference: Exhibit B-14, BCSEA 9.1

> We have conducted analysis which demonstrated that 39 percent of customers who are recorded as "dropped customers" actually returned to the RNG tariff after being removed from the RNG tariff due to a move or disconnection. The analysis also showed that 42 percent moved out of their premise and dropped from RNG, and did not return to RNG. This may be because the customer left the FEI service territory or because they consciously chose not to return to RNG at their new premise. Another 20 percent dropped from the RNG rate, Rate Schedule 1B, maintained at their current premise, and returned to the standard natural gas rate, Rate Schedule 1.

11.1 Does the attrition information cited apply only to residential customers?

Response:

Confirmed. The information cited applies only to residential customers.

11.2 Please provide attrition information for commercial customers by customer rate class and segments.

Response:

Please refer to the response to CEC IR 1.31.2.

12 Reference: Exhibit B-14, BCSEA 9.4

> The reason for discontinuing participation in the RNG program matters more when trying to assess the success of the program than it matters for forecasting purposes. When using the attrition rate to determine if customers are satisfied with the program, FEI must take into consideration those customers who are dropped from the system but return to the RNG tariff immediately/shortly thereafter due to a move, transfer, or disconnection.

12.1 Please elaborate on why understanding customer behavior such as the reason for discontinuing participation in the RNG program matters more in assessing the success of the program than it does for forecasting.

Response:

The statement above was not meant to imply that understanding reasons why customers are leaving the program is not important for forecasting. FEI believes that both issues are important. At the current time, however, the attrition rate is not a concern from a forecasting perspective.

Currently the attrition rate is below industry averages and is captured in the forecasting approach. If the attrition rate exceeds industry averages, FEI will conduct research to determine customer motivations for leaving the program. FEI will then use these findings to adjust the forecast at that time. In addition, pending the approval of additional blends in this regulatory proceeding, FEI will adjust the forecast to accommodate demand for increased blends and the price.

With respect customer satisfaction, FEI is currently able to use this information to assess if more people are leaving the program due to low satisfaction levels or if more people are leaving due to something like a move or a disconnection. Low satisfaction levels would require FEI to look at factors such as the design of the program and customer service.

12.2 Would FEI agree that understanding customer behavior and price sensitivity is key to developing a successful biomethane program? If not, please explain.

Response:

Understanding customer behavior and price sensitivity is one of many factors that are key to developing a successful biomethane program. Please refer to the response to CEC IR 2.12.1.

12.3 Would FEI agree that understanding customer behavior and price sensitivity is necessary to accurately predict customer demand at given prices and blend rates, and is therefore crucial to forecasting?

Response:

FEI believes understanding customer behavior and price sensitivity is one of the many factors necessary to predict customer demand at given prices and blend rates and therefore FEI has conducted primary research on this subject, included in Exhibit B-1, Appendix E, and will continue to explore this factor if additional blends are approved in this proceeding. FEI also believes secondary research on market trends is equally important. Please refer to the response to CEC IR 2.12.1.

12.4 If not, please explain why not.

Response:

Please refer to the response to CEC IR 2.12.3.

13 Reference: Exhibit B-17, BCUC 1.8.2

Billed volumes vary slightly from booked volumes due to the accrual for December and the delay in manual billing to the City of Vancouver.

2012	Booked Volumes	Billed Volumes
Commercial (GJ)	2,350	2,034
On System Sales (GJ)	3,905	660

13.1 What proportion of the 3,245 booked volumes which were not billed (3905-660) was a result of a delay in billing to the City of Vancouver?

Response:

100 percent.

13.2 Has the delay in manual billing to the City of Vancouver been resolved and if not, when does FEI expect this to occur?

Response:

Yes, this has been resolved.

14 Reference: Exhibit B-15, CEC 1.18.2 and CEC 1.19.3

> **Response:**
>
> FEI had a total of 76 subscribers enrolled into the Biomethane program end of 2012. All the 76 subscribers were sent the green leader rewards package. FEI only featured those companies that responded back to our request on our website.
>
> 19.3 What proportion of those surveyed were profiled on FortisBC's website?
>
> **Response:**
>
> FEI is unable to answer this response as the survey was conducted anonymously and FEI does not know who the survey respondents were

14.1 Please confirm the following information:

- 26 of the 76 customers were featured on the FEI website and all of those had responded to a request on the FEI website; and
- Of 40 customers enrolled at the time of survey, 19 customers were sent surveys.

Response:

Confirmed.

14.2 Was the survey available to all 40 commercial customers or were certain customers sent surveys while others were not?

Response:

Please refer to the response to BCUC IR 1.12.1.

14.3 If the survey was sent to customers, does FortisBC know which 19 customers were sent surveys regardless of whether the responses were anonymous?

Response:

Yes, FEI does know which 19 customers were sent the survey but FEI does not know who the 9 respondents were as the answers were submitted anonymously.

14.3.1 If so, please identify what proportion of the 19 customers who were sent surveys were also profiled on FortisBC's website.

Response:

100 percent.

15 Reference: Exhibit B-1, Application, Page 48 and Exhibit B-15, CEC 1.21.2

> Under Rate Schedule 16, FEI currently offers dispensing service and sale of Liquefied Natural Gas on a pilot basis. An option of designating a portion of a customer's consumption under Rate Schedule 16 as RNG can further reduce GHG emissions. On September 24, 2012, FEI applied to the Commission, pursuant to sections 59-61 of the Act, for approval to amend Rate Schedule 16 to provide LNG sales and dispensing service on a permanent basis. Following a decision in that proceeding, FEI will evaluate whether to bring forward a proposal to include the RNG Offering under Rate Schedule 16.

FEI's most recent LNG forecast was presented in the Rate 16 Amendment Application, filed on September 24, 2012. FEI provided a revised version of its LNG forecast (in response to BCUC IR 1.8.3) on December 7, 2012, which is summarized in the table below.

Item	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
LNG Trucks	54	219	284	344	454	454	454	454	454	454	454
LNG Truck Demand (GJ)	150,000	843,000	1,116,000	1,368,000	1,830,000	1,830,000	1,830,000	1,830,000	1,830,000	1,830,000	1,830,000
LNG Marine Vessels	0	0	1	2	3	3	3	3	3	3	3
LNG Marine Demand (GJ)	0	0	150,000	250,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000
Total NGT Demand (GJ)	150,000	843,000	1,266,000	1,618,000	2,180,000	2,180,000	2,180,000	2,180,000	2,180,000	2,180,000	2,180,000

15.1 Has FEI made any further determinations with respect to whether or not to bring forward an RNG Offering under Rate Schedule 16?

Response:

FEI is currently contemplating the recent Rate Schedule 16 decision. Since some potential NGT customers have already expressed interest in RNG, FEI will likley apply for an RNG offering under Rate Schedule 16 at a later date.

15.1.1 Please identify and discuss the opportunities and drawbacks FEI perceives as being relevant with respect to offering RNG under Rate Schedule 16 especially with respect to the June 4, 2013 decision.

Response:

The incremental cost of RNG is estimated at ~$8/GJ which is about $0.32/ diesel litre equivalent (DLE). The Commission ruling to increase FEI's proposed RS 16 delivery charge by 57 percent will increase RS 16 customer costs by a further 9 cents per DLE, which will make it a more difficult business case to sell and FEI expects that this will reduce adoption rates for the transportation market.

The total cost for Renewable LNG includes RNG at $12/GJ, Liquefaction under RS 16 at $6.50 and Carbon Tax at $1.49/GJ. This is equivalent to $0.77/Diesel Litre on an energy basis FOB the LNG plant. In comparison the rack price for diesel fuel in Vancouver is $0.86 (Shell posted price as of July 3.2013)

For the end user, the price comparison must include LNG distribution and LNG fueling services. These services are more expensive than diesel distribution and fueling services. For example distribution and fueling service can be expected to add $2 and $5/GJ respectively which adds another $0.27/DLE to the costs. For diesel, distribution and fueling charges would be in the range of $0.08/litre.

On the other hand LNG is presently exempt from various road taxes that increase the end user costs for diesel by approximately $0.12 to $0.16 cents per litre depending on the location.

Netting all the costs out, the customer's cost of Renewable LNG can be expected to be close to the cost of diesel fuel. Ordinarily this pricing would not be attractive enough to provide customers an operating cost savings that would pay back the large expenditures required for NG trucks, training and maintenance facility modifications. Nor would it provide any incentive to take on the risk of switching to a new fuel for core business operations.

FEI believes, however, that some customers who have already made the decision to switch to conventional LNG powered vehicles, may be willing to adopt low level blends (e.g. 10 percent) of R-LNG, foregoing a percentage of the savings offered by adopting conventional LNG. The situation would be similar to customers adopting a 5 percent biodiesel blend, but in the case of biodiesel there is no opportunity cost to the customer.

FEI has not identified LNG for Transportation customers who would be willing to make this change at present, but notes that the City of Surrey has indicated a desire to purchase 100 percent RNG for their fleet of CNG waste haulers. Even though it is CNG, it shows there is still a market demand for RNG as a transportation fuel. (R-CNG can be provided to customers for lower cost than R-LNG, in large part because of the large increase in the RS 16 charge. In addition the costs of switching to NG trucks is much larger for LNG vehicles than it is for CNG vehicles so the business case for R-LNG is more challenging than for R-CNG)

On the basis that some customers may elect to forego savings to achieve environmental benefits, FEI believes that it would still be useful to offer customers the ability to choose to take some portion of their RS 16 supply as renewable product, but adoption rates are expected to be low.

16 Reference: Exhibit B-15, CEC 1.23.1

Particulars	Fraser Valley Biogas	Salmon Arm Landfill	Kelowna Landfill	Dicklands Farm	Seabreeze Farm	Earth Renu	MetroVan
Total Interconnection Cost ($000's)	$ 504	$ 509	$ 1,117	$ 1,014	$ 1,189	$ 786	$ 739
20 Year Expected Supply Volume (GJ)	1,485,555	675,000	1,928,535	867,000	801,000	950,000	800,000
Capital Cost $/GJ	$ 0.34	$ 0.75	$ 0.58	$ 1.17	$ 1.48	$ 0.83	$ 0.92

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16.1 The CEC notes that the Capital Cost per GJ ranges from a low of $0.34/GJ to $1.48/GJ and varies amongst projects of similar size and type. Please explain if there is an optimum size of supply project, type or any other characteristics that result in the lowest capital costs/GJ.

Response:

In this calculation, the capital costs per GJ are a sum of the piping cost and the interconnection station (measurement, metering and odorization). The interconnection station costs are estimated to be approximately equal for all of the projects. The costs of piping (affected by the location, length, size and material of interconnection piping) and the volume of biomethane flowing through the interconnection facility will therefore affect the cost per GJ. Other factors such as the need to construct piping in an urban environment where concrete breaking and replacement may need to be done, can also increase piping costs and impact the price per GJ.

However, it is generally true that a shorter length of interconnecting pipe with a higher volume of biomethane would result in the lowest cost per GJ.

17 Reference: Exhibit B-15, CEC 1.23.2

FEI has estimated gross operating costs per GJ by dividing the estimated 20 Year O&M costs (yearly un-inflated costs x 20 years) by the total estimated volume for 20 years. These gross O&M costs are for the interconnection facilities referred to in Table 5-7 in the question as well as the Table 7-1 referred to in the response to CEC IR 1.25.1.

Particulars	Fraser Valley Biogas	Salmon Arm Landfill	Kelowna Landfill	Dicklands Farm	Seabreeze Farm	Earth Renu	MetroVan
20 Year Expected Supply Volume (GJ)	1,485,555	675,000	1,928,535	867,000	801,000	950,000	800,000
Gross Operating Cost $/GJ[1]	$ 0.13	$ 0.30	$ 0.10	$ 0.23	$ 0.25	$ 0.21	$ 0.25

1 FEI has estimated operating costs at $10k/year for each station

17.1 Please explain FEI's estimate of $10K/year for each station and how it applies in each supply project?

Response:

In the 2012 Biomethane Application (Section 5.4), FEI states that the "ongoing maintenance costs for the interconnection facilities are expected to be $10 thousand per supply point". FEI has estimated that for the range of flows represented by these projects the costs will be approximately equal because it is using the same design for the interconnection points.

The estimated costs are based on costs of the Fraser Valley Biogas stations and represent labour and materials for the stations. The general categories covered are the bypass odorizer, meter set, H2S measurement, Gas Chromatograh and an overhead allocation. It was rounded to $10 from a total estimated cost of $9,760 annually.

18 Reference: Exhibit B-17, BCUC 1.70.2; Exhibit B-17, BCUC 1.72.1.1; Exhibit B-15, CEC 1.27.2

While there is no strict time limit on the inventory in the BVA, FEI would generally consider the volume of unsold Biomethane to be unmanageable when FEI has large volumes of unsold Biomethane for a period of time in its current portfolio with no large volume buyer commitments in the near term. By looking at certain industry timeline standards as explained in the response to BCUC IR 1.64.1, FEI currently believes holding a cumulative inventory in excess of 250,000 GJ for a consecutive 24 month period would be considered unmanageable.

In the event FEI determines it has unmanageable inventory of Biomethane that it is unable to sell through any channels at the BERC rate, FEI would first seek to sell the Biomethane through Rate Schedule 30 at a price lower than the BERC, but higher than the cost of conventional natural gas. This would mitigate the loss on the sale of Biomethane. Any loss on the sale (i.e. the difference between the sale price and the BERC) would be reflected in the BVA.

The forecast BVA volumes and dollar balances assuming a low demand scenario and the negotiated supply" scenario.

BVA forecast @ Dec 31.	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Volume (TJ)	124.2	251.8	387.9	494.5	564.9	636.9	716.2	790.6	861.3	929.4
BVA pre-tax balance ($000)	$ 1,461	$ 3,130	$ 5,210	$ 6,893	$ 8,065	$ 9,203	$ 10,349	$ 11,445	$ 12,489	$ 13,484

Table 1: Annual Bill Impacts for Typical Lower Mainland Customers [1]

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	Rate 6	Rate 7
Average Annual Consumption (GJ)	95	300	2,800	5,400	9,700	2,900	8,100
Average Annual Bill $ / Year	889	2,446	19,594	28,488	62,637	22,206	50,266
Impact on Midstream $/GJ [A]	0.0033	0.0033	0.0026	0.0019	0.0019	0.0010	0.0019
Annual Impact $ / Year [A]	0.29	0.90	8.40	10.80	19.40	2.90	16.20
Annual Impact % / Year	0.03%	0.04%	0.04%	0.04%	0.03%	0.01%	0.03%

Notes:

[1] Table 1 provides the impacts of the loss associated with 100 TJ of unsold Biomethane being absorbed in the MCRA. The value of the loss, in this case approx. $832 thousand, has been calculated based on the difference between the existing January 1, 2013 BERC rate and the 2013 12-month weighted average market price of natural gas based on the 5-day average forward prices of November 1, 2, 5, 6, and 7, 2012, as filed in the FEI 2012 Fourth Quarter Gas Cost Report. The calculated loss also excludes the current value of Carbon Tax offsets of approx. $1.50 per GJ.

18.1 Please calculate the Annual Bill Impacts for Typical lower Mainland Customers accounting for the value of Carbon Tax offsets of approximately $1.50 per GJ.

Response:

The following table revises the response to CEC IR 1.27.2 by including the value of Carbon Tax offsets of approximately $1.49 per GJ.

Table 1: Annual Bill Impacts for Typical Lower Mainland Customers [(1)]

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	Rate 6	Rate 7
Average Annual Consumption (GJ)	95	300	2,800	5,400	9,700	2,900	8,100
Average Annual Bill $ / Year	889	2,446	19,594	28,488	62,637	22,206	50,266
Impact on Midstream $/GJ [(A)]	0.0028	0.0028	0.0022	0.0016	0.0016	0.0009	0.0016
Annual Impact $ / Year [(A)]	0.29	0.90	5.60	10.80	19.40	2.90	16.20
Annual Impact % / Year	0.03%	0.04%	0.03%	0.04%	0.03%	0.01%	0.03%

Notes:

(1) Table 1 provides the impacts of the loss associated with 100 TJ of unsold Biomethane being absorbed in the MCRA and includes the value of Carbon Tax offsets. The value of the loss, in this case approx. $683 thousand, has been calculated based on the difference between the existing (effective January 1, 2012) BERC rate of $11.696/GJ and the 2013 12-month weighted average market price of natural gas of $3.376/GJ plus the current value of Carbon Tax offsets of $1.4898/GJ. The 2013 12-month weighted average market price is based on the 5-day average forward prices of November 1, 2, 5, 6, and 7, 2012, as filed in the FEI 2012 Fourth Quarter Gas Cost Report. For comparability the average annual bill amounts are based on the rates effective January 1, 2013 and Rider 6 has been amortized over three years, consistent with how the bill impacts in the response to CEC IR 1.27.2 were calculated. While noting that effective July 1, 2013 FEI delivery and commodity rates change and, as filed in the FEI Performance Based Ratemaking Revenue Requirement Application (2014-2018) to comply with US GAAP, the Rider 6 amortization period will be changed from three to two years for setting 2014 rates.

(A) Midstream riders have been calculated and shown to 4 decimals for purposes of this table; variable per GJ charges in tariff rate schedules are set at 3 decimals. Annual bill impacts, in dollars, are rounded and shown to 2 decimals.

18.2 Please calculate the Annual Bill Impacts based on there being 250TJ of unsold biomethane, with and without the Carbon Tax offsets.

Response:

The following tables show the impact of transferring 250 TJ of unsold Biomethane to the MCRA with and without the value of Carbon Tax offsets. All other assumptions, remain the same as used in the response to CEC IR 1.27.2.

Annual Bill Impacts for Typical Lower Mainland Customers

Table 1: – With Value of Carbon Tax Offsets [1]

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	Rate 6	Rate 7
Average Annual Consumption (GJ)	95	300	2,800	5,400	9,700	2,900	8,100
Average Annual Bill $ / Year	889	2,446	19,594	28,488	62,637	22,206	50,266
Impact on Midstream $/GJ [A]	0.0070	0.0070	0.0055	0.0041	0.0041	0.0021	0.0041
Annual Impact $ / Year [A]	0.67	2.10	16.80	21.60	38.80	5.80	32.40
Annual Impact % / Year	0.07%	0.09%	0.09%	0.08%	0.06%	0.03%	0.06%

Table 2: – Without Value of Carbon Tax Offsets (2, 3)

	Rate 1	Rate 2	Rate 3	Rate 4	Rate 5	Rate 6	Rate 7
Average Annual Consumption (GJ)	95	300	2,800	5,400	9,700	2,900	8,100
Average Annual Bill $ / Year	889	2,446	19,594	28,488	62,637	22,206	50,266
Impact on Midstream $/GJ [A]	0.0086	0.0085	0.0067	0.0050	0.0050	0.0026	0.0050
Annual Impact $ / Year [A]	0.86	2.70	19.60	27.00	48.50	8.70	40.50
Annual Impact % / Year	0.10%	0.11%	0.10%	0.09%	0.08%	0.04%	0.08%

Notes:

[1] Table 1 provides the impacts of the loss associated with 250 TJ of unsold Biomethane being absorbed in the MCRA and includes the value of Carbon Tax offsets. The value of the loss, in this case approximately $1,708 thousand, has been calculated based on the difference between the existing (effective January 1, 2012) BERC rate of $11.696/GJ and the 2013 12-month weighted average market price of natural gas of $3.376/GJ plus the current value of Carbon Tax offsets of $1.4898/GJ. The market price of natural gas is based on the 5-day average forward prices of November 1, 2, 5, 6, and 7, 2012, as filed in the FEI 2012 Fourth Quarter Gas Cost Report. For comparability the average annual bill amounts are based on the rates effective January 1, 2013 and Rider 6 has been amortized over three years, consistent with how the bill impacts in the response to CEC IR 1.27.2 were calculated. While noting that effective July 1, 2013 FEI delivery and commodity rates change and, as filed in the FEI Performance Based Ratemaking Revenue Requirement Application (2014-2018) to comply with US GAAP, the Rider 6 amortization period will be changed from three to two years for setting 2014 rates.

[2] Table 2 provides the impacts of the loss associated with 250 TJ of unsold Biomethane being absorbed in the MCRA and excludes the value of Carbon Tax offsets. The value of the loss, in this case approximately $2,080 thousand, has been calculated based on the difference between the existing (effective January 1, 2012) BERC rate of $11.696/GJ and the 2013 12-month weighted average market price of natural gas of $3.376/GJ based on the 5-day average forward prices of November 1, 2,

5, 6, and 7, 2012, as filed in the FEI 2012 Fourth Quarter Gas Cost Report. For comparability the average annual bill amounts are based on the rates effective January 1, 2013 and Rider 6 has been amortized over three years, consistent with how the bill impacts in the response to CEC IR 1.27.2 were calculated. While noting that effective July 1, 2013 FEI delivery and commodity rates change and, as filed in the FEI Performance Based Ratemaking Revenue Requirement Application (2014-2018) to comply with US GAAP, the Rider 6 amortization period will be changed from three to two years for setting 2014 rates.

(3) In the response to BCUC IR 2.44.1, the results based on a scenario of 250 TJ, using a proposed BERC rate of $12.001/GJ, an average cost of gas based on the forecast costs used in the FEI 2013 Second Quarter Gas Cost Report, and excluding the value of Carbon Tax offsets, produce a result similar to the Without Carbon Tax Offsets scenario presented in Table 2.

(A) Midstream riders have been calculated and shown to 4 decimals for purposes of this table; variable per GJ charges in tariff rate schedules are set at 3 decimals. Annual bill impacts, in dollars, are rounded and shown to 2 decimals.

18.3 Please confirm or otherwise explain that should the inventory in the Biomethane account reach 250,000 GJ for a consecutive 24 month period, the maximum annual impact on bills for typical lower mainland customers would be reasonably expected to be less than or equal to approximately 1% for each customer group, being calculated at 2.5 times the cost estimates of 100TJ of unsold biomethane presented in Table 1.

Response:

FEI can confirm that, based on the assumptions remaining the same as were used in calculating the response to CEC IR 1.27.2, transferring 250 TJ of unsold Biomethane to the MCRA would cause approximately 2.5 times the cost estimates and bill impacts of 100 TJ of unsold Biomethane as was presented in Table 1. However, even based on the latest Biomethane assumptions as filed in the FEI 2013 Second Quarter Gas Cost Report which indicate that the loss could be slightly higher than determined in the response to CEC IR 1.27.2, after accounting for the BERC rate being expected to increase in the future from the existing BERC rate of $11.696/GJ and this increase being partially offset by the market price of natural gas also increasing, the annual bill impact for typical Lower Mainland customers may be slightly higher than 0.1 percent. Although the scenarios presented may not be the absolute maximum loss, they are reasonable estimates of the maximum loss based on current prices, and the impact on annual bills is less than 1 percent.

18.4 Please confirm, or otherwise explain that under the low demand scenario the maximum annual impact on bills for typical lower mainland customers would be a 4% premium, based on current average bills, which would occur in 2022.

Response:

FEI cannot confirm any quantified premium in 2022, since most of the assumptions (other than demand forecast), such as the price differential between the BERC rate and the market price of natural gas, FEI's MCRA portfolio volume, load factors, etc. do not support such a long term forecast. However, based on the assumptions used in the response to CEC IR 1.27.2 for 2013 and using the increased volume of 929 TJ, as forecasted in the low demand scenario above for 2022, the calculated impact on Lower Mainland customer annual bills is less than 0.4 percent. This is less than the 4 percent premium stated in the question.

18.4.1 Please confirm or otherwise explain that such a scenario would only occur in the event of there being ongoing low demand, full negotiated supply and FEI being unable to reduce the inventory through Rate Schedule 30.

Response:

FEI can confirm that any rate impact proposed to the MCRA would be as a last resort such as in the scenario of ongoing low demand, unused supply and being unable to reduce the inventory at the BERC rate, or a discounted rate, through risk mitigation tools such as Rate Schedule 30 sales.

Please refer to the response to CEC IR 2.18.4.

19 Reference: Exhibit B-15, 1.27.6

> At this point in time, the biomethane volumes are very small and not material enough for FEI to consider shedding other supply resources to meet core customer load requirements. In the future, should the biomethane volumes become material in terms of FEI's total resource portfolio, FEI would consider shedding some regular gas supply resources. However, the biomethane supply volumes would have to be consistent and reliable on a daily basis, particularly during peak winter demand periods, before any portfolio changes would be made.

19.1 What levels would FEI consider sufficiently material to shed other supply resources to meet customer load requirements?

Response:

Please refer to the response to BCUC IR 2.4.2.4.

19.2 Does FEI anticipate that the negotiated supply volumes will be consistent and reliable on a daily basis, including during peak winter demand periods. Please explain why or why not.

Response:

While FEI expects that the actual delivered volume of negotiated supply to be generally consistent on a daily basis throughout the year, this expectation needs to be proven by actual operating experience. FEI does not anticipate any difference in the reliability of supply during periods of low or high demand. FEI also believes that having multiple sources of supply will improve the reliability of the aggregate daily amount of biomethane, thereby minimizing the likelihood of a supply shortfall.

20 Reference: Exhibit B-14, BCSEA 15.3

> One purpose of the sections referenced in the question was to demonstrate that, where biogas-to-biomethane or biogas-to-electricity are competing options, the biogas-to-biomethane option will generally produce more useable energy at the end use level and therefore has the potential to better achieve public interest objectives such as reducing greenhouse gas emissions. Another issue to consider is that electricity can be produced from more sources of bioenergy than can biomethane. For example, pine-beetle killed timber and other sources of wood waste can be burned to produce electricity, but are not a source of biogas that can be upgraded to produce biomethane. For these reasons, FEI believes that where the bioenergy source can be used to produce biomethane, this option should be given due consideration and, further, that policies should not unfairly favour using the bioenergy to produce electricity.

20.1 What types of analysis would FEI consider as providing 'due consideration' for the option of producing biomethane from various bioenergy sources?

Response:

The main issue that FEI has been pointing to in the quoted portion of the response to BCSEA IR 1.15.3 and other responses that deal with the option of biogas-to-electricity vs. biogas-to-biomethane is that a project proponent can pursue the electricity option with fewer regulatory approvals required since the Standing Offer Program is an open supply acquisition program that has been removed from Commission oversight by the Clean Energy Act. Proponents see the extra regulatory requirement of needing BCUC approval for a biogas-to-biomethane project as a significant hurdle to overcome.

Other than the matter of an uneven playing field from a regulatory perspective, "due consideration" would involve considering all the benefits and costs of both the electricity option and the biomethane option. The costs and benefits would include consideration of energy costs to be borne by energy consumers (and which energy consumers) under either option as well as the benefits achieved towards policy objectives such as emission reductions. The costs and benefits of either option will vary from project to project so the conclusion may be different from one to the next. FEI believes that an analysis of this nature will be favourable to the biomethane option in many cases; however the result may favour electricity generation where there is a viable cogeneration or similar opportunity.

20.2 On what criteria should the two options (biogas-to-biomethane or biogas-to-electricity) be compared?

Response:

Ideally, assuming there is an equal regulatory playing field and each option is technically feasible at a proposed site, the two options should be compared based on price to the consumer, environmental benefits and possibly customer demand.

Other things equal, it is evident that either lower price to the consumer or higher environmental benefits would be favourable. In the case of customer demand, FEI believes that due to the current and proposed structure of its biomethane program, there is evidence of direct demand for biomethane, whereas for electricity the demand is not specific to the source of electricity generation. Therefore, for example, as demand for biomethane increases, there should be preference for developing biomethane projects over biogas-to-electricity projects.

20.3 What types of policies would FEI consider as unfairly favouring the use of bioenergy to produce electricity?

Response:

The option of electricity purchase is well-established and is paid for by all electricity customers. Further, BC Hydro has been able to establish and maintain its Standing Offer Program (or other calls for power such as the bioenergy call). These programs were initially a result of BC government policy and in some cases have been removed from BCUC jurisdiction by the *Clean Energy Act*. The regulatory process as a result involves less (or no) BCUC oversight. See also CEC IR 2.20.1.

These policies (and resulting programs) provide certainty for potential electricity suppliers in regard to both price and regulatory approval (provided the suppliers of electricity meet the established program criteria). Conversely, the option to supply biomethane does not have the same certainty with respect to price, program permanence or the costs being covered by a larger group of consumers.

20.3.1 Please identify any such policies that are currently in effect in BC and explain how these policies favour the use of bioenergy to produce electricity.

Response:

Please refer to the response to CEC IR 2.20.3.

20.4 What other sources of bioenergy can be used to economically produce electricity but cannot be upgraded to produce biomethane?

Response:

Other than the wood-based examples cited in the excerpt above, FEI is not aware of any other sources of organic waste that cannot be used to produce biogas and upgraded to biomethane. However, it is important to note that wood waste and other wood-based sources of bioenergy are abundant in BC relative to the bioenergy sources that can be used to produce either electricity or biomethane.

20.4.1 Please provide a discussion of the advantages and disadvantages of each of these sources in producing electricity.

Response:

When compared to other alternate means of generating electricity (such as wind or solar), wood-waste-derived electricity is advantageous due to the widespread availability of wood in BC and the fact that it can be generated when needed. In other words, where there is fuel, electricity can be generated. This is compared to wind and solar which depend on more variable and less predictable natural weather cycles. In addition, the fuel (source of energy) is storable and electricity can be generated to match the load as required (unlike solar or wind). However wood is used for other value-added products such as paper and wood products. The availability of suitable wood-waste from these products may be affected by business cycles.

When compared to biogas-to-biomethane, wood-waste generated electricity does not have any significant advantages. In fact, if waste heat from the electricity generation cannot be captured and put to use, the efficiency will typically be much lower than a biogas-to-biomethane process.

20.5 Does FEI have any estimates as to the magnitude of the sources of bioenergy available in BC that could be used to produce electricity and that could not be used to produce biomethane?

Response:

In its 2010 Biomethane Application FEI referred to a report done by the BC Bioenergy Network (Section 7.3.1) in which the total amount of energy from wood biomass was estimated to be approximately 387 PJ per year (excluding the temporary wood mass of approximately 43 PJ per year available from Mountain Pine Beetle Kill and the potential to plant forests specifically for bioenergy, also 43 PJ per year, which is not being pursued at present). Only a portion of this resource would be feasible to use for generating electricity due to factors such as competing uses for the biomass or proximity to the BC Hydro system. FEI has not attempted to refine this estimate for the purpose of using biomass to generate electricity. FEI does not intend to make any estimates of available energy for electricity generation at this time.

By comparison the BC Bioenergy Network report referenced above assessed the potential in bioenergy sources that could produce either electricity or biomethane at 56 PJ per year. Thus the resource pool for biomethane is only in the range of 10 percent to 15 percent of the total bioenergy resource potential while the potential pool for producing electricity would be the full resource potential. (These are the resource potentials, but do not imply that producing electricity or biomethane is economic at these levels).

20.5.1 If so, please provide these estimates.

Response:

Please refer to the response to CEC IR 2.20.5.

21 Reference: Exhibit B-15, CEC 1.28.1

Response:

The alternative options for the "lost projects" involved the sale of electricity to BC Hydro in both cases. Harvest qualified for a Power Purchase Agreement with BC Hydro under the Community Based Biomass Electricity Call and Wastech has chosen to use the Standing Offer Program to sell to BC Hydro as well. FEI is not aware of other options beyond selling electricity to BC Hydro that may have been considered by these parties.

Harvest revealed that a contributing factor in its decision was to work with a known and established program rather than contending with the uncertainty in the regulatory process for the biomethane program, even though the sale to BC Hydro did not provide a better business case. With respect to Wastech, it was stated that the regulatory approval process involved too much uncertainty (Please see Exhibit B-1, p.78).

21.1 Does FEI know if the sale to BC Hydro resulted in a worse business case or an equivalent business case for Harvest? If so, please provide any evidence that FEI may have to that effect.

Response:

FEI was told by Harvest Power that the business case was equivalent and the pricing for biomethane was competitive with the call for Community Based Biomass for which they qualified. However, FEI does not have any written evidence nor did it have access to the Harvest business case.

21.2 Please provide any information that FortisBC may have regarding whether or not either of the lost projects does or intends to incorporate any co-generation of heat, and if that possibility figured into the decision-making process.

Response:

FEI does not know whether or not the use of co-generation (understood as generating both electricity and heat) factored into the decision-making of either of these projects. However, in general, there must be a nearby need for heat to successfully use co-generation. So, for example, in the case of the Cache Creek Landfill, it is unlikely that the heat can be used due to the remote location of the facility (i.e. it is not located close to a heat sink load).

22 Reference: Exhibit B-15, CEC 1.28.2

Response:

FEI is unsure of what is meant by the question. There are a limited number of possible alternatives that may be considered for raw biogas: simple flaring, producing electricity, upgrading to biomethane and injecting into the natural gas system, or upgrading to biomethane and then used locally for purposes such as CNG vehicle fuel. In some cases the waste heat and CO2 produced from the combustion of biogas can be put to useful purposes in the immediate vicinity of biogas production facility. The options or combinations of options that exist for any particular biogas source are to some degree unique to the particular locale and the nature of the project.

22.1 Given that the options are somewhat limited for each production facility what rough proportion of potential projects would FEI expect to go to simple flaring, producing electricity, upgrading to biomethane for injection into the natural gas system, upgrading to biomethane for local purposes?

Response:

FEI will answer the question based on the fact that a reasonable sized facility (say 50,000 GJ per year or higher) would likely consider either electricity production or biomethane production. FEI believes that facilities of this size could economically produce biomethane in the absence of government funding and with the current biomethane price maximum. The most-recently approved projects are all above this threshold. Facilities below that threshold may have a viable economic case for electricity production or they may opt to simply flare (say a small landfill).

Based on the assumption that the biomethane price is reasonably competitive with the current electricity pricing, the decision to choose can depend on other non-tangible factors. These factors may include preference in working relationship (i.e. FEI over BCHydro or vice-versa), preference in equipment (e.g. preference to work with engine/generator rather than gas processing), preference for a more efficient use of the resource or number of reference sites. As stated in response to CEC IR 2.20.3, there is also a perceived imbalance in regulatory certainty and policy. Based on its experience to date, the existing ratio of electricity projects to biomethane projects in BC and the current regulatory climate, FEI could surmise that the percentage of biomethane projects (out of the total number of future projects) would be in the range of 0 percent (assuming no increase to the biomethane cap) to 50 percent.

22.2 Under what circumstances would projects typically consider flaring as the preferable alternative?

Response:

FEI suspects that this could be likely in smaller landfills where the volume of gas is too low to provide an economic reason to pursue a utilization project.

22.3 Would FEI agree that the two major alternatives for projects not wishing to flare would be to produce electricity or upgrade to biomethane for injection to the gas system unless special circumstances exist which provide additional options such cogeneration?

Response:

Yes. Please also refer to the response to CEC IR 2.22.1.

23 Reference: Exhibit B-15, CEC 1.28.5 and Exhibit B-14, BCSEA 13.11

> FEI has not tracked the projects in terms of the prices being offered under the BC Hydro programs. However the Standing Offer Program currently has a price of $97.02 / MWh (2010$) for projects in the Kelly / Nicola region where the Wastech project is located. This is approximately $27/GJ. This price is subject to inflation at 100 percent of CPI annually before contract signing and 50 percent of CPI annually after contract signing. FEI is unfamiliar with how pricing was finalized in the Community Based Biomass (CBB) Power Call. The BC Hydro website states "…contract terms and prices have not been pre-determined and will be specific to a project…"[1] Although FEI has no direct evidence, it believes that the prices established under the CBB process are likely somewhat higher than those set for the Standing Offer Program based on the fact that another recent bioenergy power call of BC Hydro's, the Bioenergy Phase 2 Call RFP, allowed for pricing of up to $150 per MWh.
>
> Response:
>
> FEI believes that every future biogas project could potentially be developed to generate electricity. In other words, FEI will always compete against electricity generation for bio-energy resources.
>
> Electricity generation will always be a viable option for project developers provided BC Hydro continues to offer long-term power purchase agreements at the current SOP prices.

23.1 At what level would FEI consider the BC Hydro SOP prices to be so high as to make biomethane uncompetitive for suppliers and explain why.

Response:

In section 5.6 of the 2012 Biomethane Application FEI stated that from the perspective of a supplier, the revenues for biomethane would be comparable to revenues for an electricity project. A high level analysis was presented in the form of a table (Table 5-9) which is reproduced and expanded here.

Option	Available Raw Energy	Efficiency Factor	Remaining Energy	Price	Revenue (for 100GJ)
SOP (Low)	100GJ	X 0.358	35.8 GJ	$26.33/GJ	$942.61
SOP (High)	100GJ	X 0.358	35.8 GJ	$28.80/GJ	$1031.00
Biomethane	100GJ	X 0.760	76.0 GJ	$15.28/GJ	$1161.30

Using the same methodology, the electricity price at which biomethane and electricity revenues become equal is $32.40/GJ (equivalent to 0.1166$/kWh).

A project developer is likely to look at the revenues generated by either of the options. Comparable or higher revenues from electricity, coupled with the lighter regulatory burden, would favour a biogas-electricity project. Higher prices for electricity (such as those offered in the BC Hydro call for community biomass at up to $0.15/kWh) may eliminate the possibility of future biomethane projects despite its other advantages.

FEI understands that the initial capital costs for a biogas-electricity project are typically lower, which would be an advantage of an electricity option in cases where start-up capital may be limited. Though the initial capital for biomethane upgrading equipment is typically higher, the electricity option may incur higher overhaul costs and more frequent replacement of the reciprocating engines (estimated at twice as frequent). These observations are general in nature and the comparisons may vary from case to case due to the differing and unique circumstances of each project.

In conclusion, FEI believes that any increase in electricity prices above the current SOP pricing will discourage biomethane projects. Iincreases in electricity purchase prices in the order of 20 percent or more) may effectively eliminate the development of any future biomethane projects, absent any increase in the biomethane supply price cap.

23.2 Please explain under what circumstances FEI projects would remain competitive to potential suppliers including relative prices, regulatory policy and other factors and provide quantitative analysis where possible.

Response:

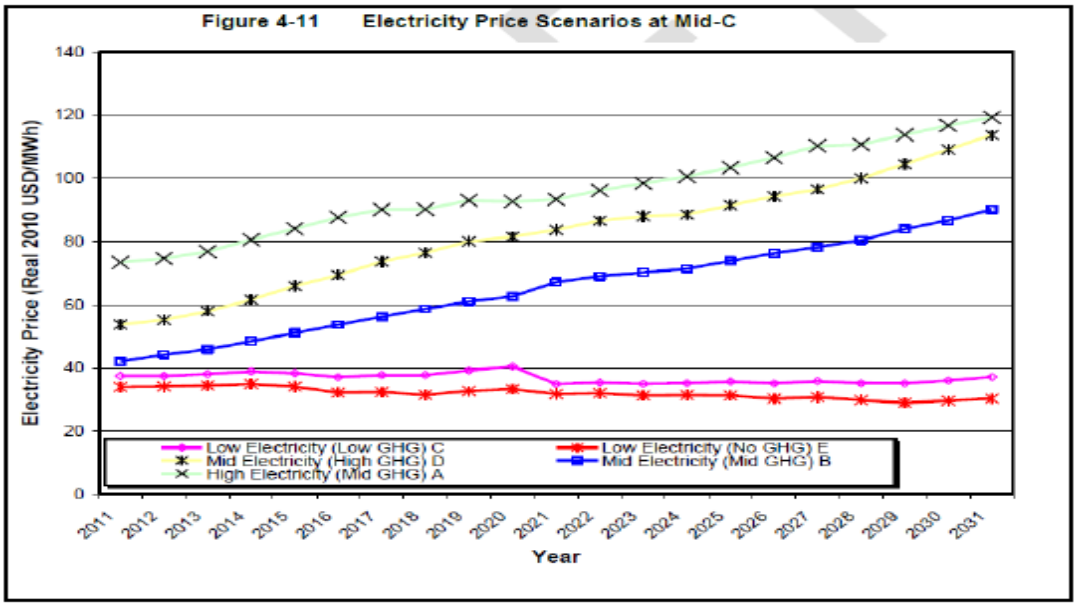
Please refer to the response to CEC IR 2.23.1.

23.3 Does the bioenergy power call pricing of up to $150 per MWh mean that FEI's biomethane proposals are uneconomic by comparison for those projects for which this is an option? Please explain and provide quantification where possible.

Response:

Based on the high level analysis presented in CEC IR 2.23.1, FEI believes that at electricity offer prices in the range of $150/MWh ($0.15/kWh) the electricity option would be more favourable from a supplier perspective than the biomethane option.

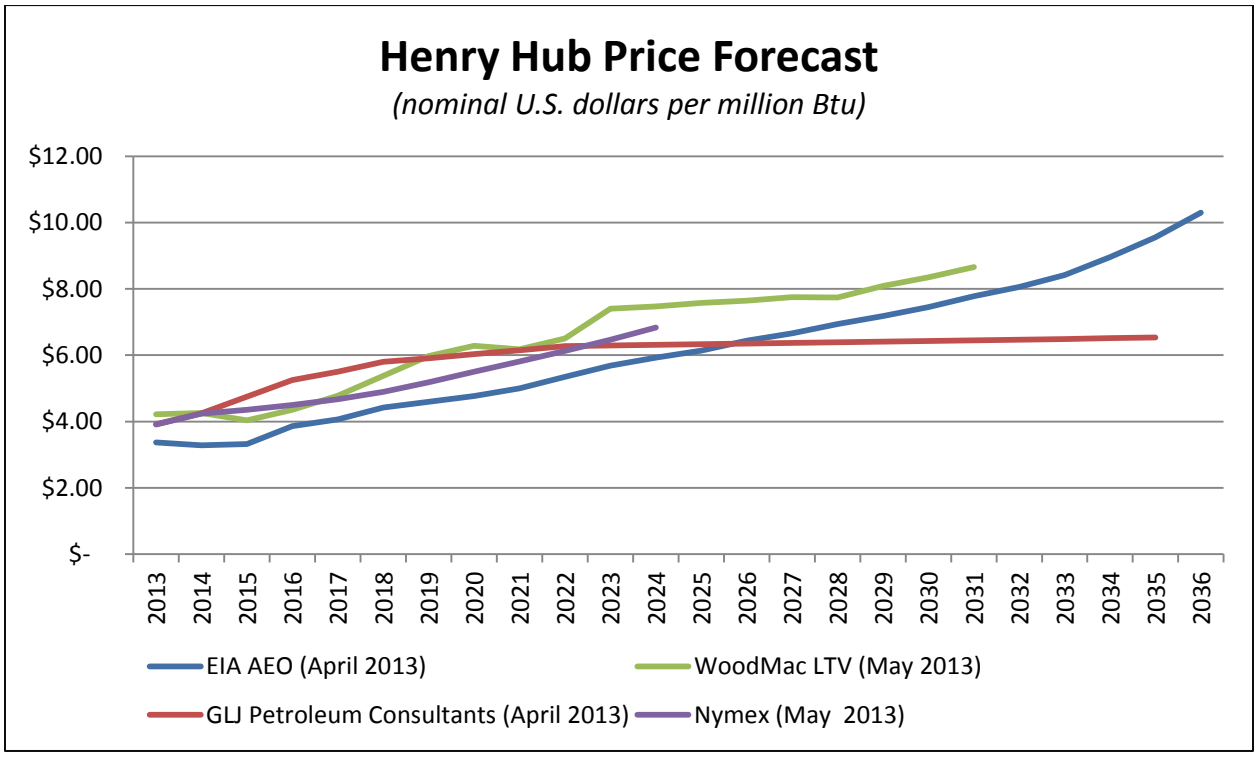
24. Reference: Exhibit B-15, CEC 1.28.6



24.1 Please supply FEI's forecast for the price of natural gas until 2036.

Response:

FEI does not produce its own forecast of the price of natural gas. Rather, FEI relies on a variety of sources to help understand the future potential price of natural gas. Some of these sources are included in the following graph, which shows price forecasts for Henry Hub (the North America natural gas benchmark) in nominal dollars. A number of these sources have not yet developed their own forecast of natural gas prices as far out in the future as 2036. In all cases, actual settled prices of natural gas may vary considerably from what was forecast at any given time.

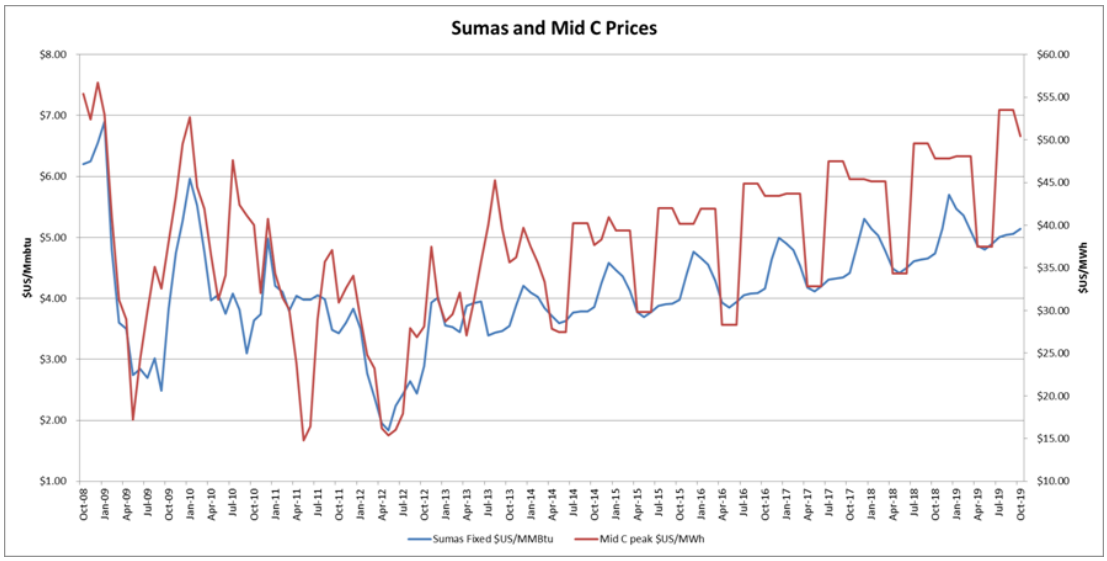


Sources: EIA Annual Energy Outlook 2013; Wood Mackenzie North America Gas Long Term View, Spring 2013; GLJ Petroleum Consultants, April 2013; Nymex prices provided by Prophet X.

24.2 Please explain why the price of natural gas should not be compared to the Mid-C electricity prices.

Response:

The following graph shows actual and forward Sumas natural gas prices and Mid-C power prices over the same time period. Actual settled prices are shown to mid-2013 and then forward prices after this to 2019.



The graph indicates that caution should be exercised before assuming that the Sumas natural gas prices and Mid-C power prices are highly correlated or that one can be used to predict the other.

The actual settled prices show that Sumas natural gas prices and Mid-C power prices have at times moved significantly in opposite directions over the period from 2008 to mid-2013. The reasons for these differences are due to the differences in factors that affect regional gas and power prices. For example, power prices can be affected by factors that do not affect gas prices such as varying levels of snowpack and spring runoff that affect hydro-electric power generation and the growth in, and availability of, wind power generation in the US Pacific Northwest. Natural gas prices also influence power prices given the growing need for gas fired generation to help balance wind and hydro load, although it is a marginal resource given its cost. Also, while gas is traded on a daily basis, power is traded on an hourly basis and so power pricing tends to be more volatile than gas pricing.

The forward prices appear to indicate that Sumas natural gas prices and Mid-C power prices are highly correlated. However, this is due to the inability of the marketplace to predict, for example, higher or lower than normal snowpack or hydro generation or the degree that wind generation will be available at a particular time. Given this uncertainty, the forward pricing of natural gas, as the marginal source for electricity, tends to drive forward power prices. However, as the actual settled prices show, the correlation may not occur in the actual results.

25 Reference: BC Hydro 2012 Annual Report, BC Hydro Website

OPERATING STATISTICS
(CONTINUED)

for the years ended or as at March 31	**2012**	2011	2010	2009	2008
Average Revenue (per kilowatt-hour)					
Residential	**8.3 ¢**	7.7 ¢	7.2 ¢	6.7 ¢	6.7 ¢
Light industrial and commercial	**7.3**	6.9	6.7	5.8	5.7
Large industrial	**5.0**	4.5	4.5	3.4	3.5
Other	**7.8**	14.5	13.0	3.9	9.3
Trade[2]	**4.0**	4.0	4.4	6.6	6.5
Average Annual Kilowatt-Hour					
Use Per Residential Customer	**11,067**	10,818	10,857	11,258	11,290
Lines In Service					
Distribution (kilometres)	**57,914**	57,648	57,278	56,780	56,297
Transmission (circuit kilometres)	**18,864**	18,764	18,603	18,531	18,531
Full Time Equivalent (FTE)[3]	**5,875**	5,805	5,687	5,416	4,677

[1] *Maximum sustained generating capacity.*
[2] *The method used to calculate the trade revenue per kilowatt hour is based on gross electricity and gas revenues.*
[3] *Regular FTEs (the productive hours of work for one employee) for BC Hydro, excluding subsidiaries.*

25.1 Please confirm that the BC Hydro 2012 average revenue from electricity was $0.083 per kilowatt hour from residential customers, or $83 per megawatt hour.

Response:

The quote from the BC Hydro 2012 Annual Report in the preamble to the IR indicates that .the BC Hydro 2012 average revenue from electricity was $0.083 per kilowatt hour from residential customers, or $83 per megawatt hour.

25.2 Would FEI agree that the rate of $83/MWh may be reasonably used as a general proxy to reflect BC Hydro residential electricity rates in 2012?

Response:

Yes, $83/MWh would be reflective of BC Hydro's average residential rates in fiscal 2012.

25.2.1 If not, please comment and provide any other figure(s) that FortisBC deems to be more appropriate.

Response:

FEI does not have any other figures that it considers more appropriate. However, FEI notes that the revenue quantities quoted in the preamble to the IR provide an average for the residential rates for the fiscal year from April 1, 2011 to March 31, 2012 and that residential rates consist of several components (basic charge, Step 1 energy charge, Step 2 energy charge and the rate rider) which are affected differently by rate increases. Therefore this average of $83/MWh only captures 3 months of 2012. By Government Special Direction No. 3 to the BCUC, dated May 22, 2012, an average rate increase of 7.1 percent was applied to rates for the period April 1, 2012 to March 31, 2013. In addition, the Government directed rates to increase by 1.44 percent on April 1, 2013.

25.3 Please confirm that from 2010 to 2012 BC Hydro's average revenue per kilowatt-hour from electricity increased at an approximate rate of 7.6% per year in the residential sector; 4.5% in the light industrial and commercial customer sector; and 5.5% in the large industrial sectors.

Response:

In the period March 31, 2010 to March 31, 2012, BC Hydro's average revenue per kilowatt-hour from electricity increased at an approximate rate of 7.4 percent per year in the residential sector; 4.4 percent in the light industrial and commercial customer sector; and 5.4 percent in the large industrial sector (accounting for compounding).

Each of the rate groups would have been subject to the same general rate increases from revenue requirement applications and rate rider changes; however differences in customer response to other factors such as, for example, the stepped rate designs or external influences such as the economic downturn would need to be understood to explain why the increases in the average revenue per kWh are different amongst the rate groups.

25.4 It is the CEC's perspective that the average revenue per kilowatt-hour for electricity can be expected to continue to increase over the next 10 years for all three rate classes and is expected to do so at a greater rate than 2% per year and closer to 10% per year for next several years and over 80% over 10 years, barring any write-offs of costs. Please comment.

Response:

On May 2, 2012 by Order in Council 314 (Special Direction No. 3), the Government directed BCUC to reduce BC Hydro's proposed rate increases over three years by 50 percent. It was the province's goal to keep rates affordable for B.C. families and it directed that rates increases of 7.1 percent be applied on April 1, 2012 and 1.44 percent in April 1, 2013 respectively.

In view of the Government's history of intervention to mitigate rate increases, it would be speculative to project a high value for rate adjustments over the next 10 years other than to suggest that in all probability they will on average be higher than the inflation rate. FEI is aware of the much publicized discussion of the cost pressures facing BC Hydro and growing deferral account balances. FEI believes that the opportunities for BC Hydro to mitigate rates increases may be more limited in the short term, but, over a longer period such as 10 years, more options for mitigating increases will be available.

25.5 It is the CEC's perspective that the average revenue per kilowatt-hour for electricity could reasonably be expected to increase by 50% within the next 5-7 years and is based on its understanding of the BC Hydro Integrated Resource Plan, which does not directly forecast rates but provides the context from which they may be estimated. Please comment on whether or not this is an unreasonable proposition and whether or not FortisBC would have any information that would discount this expectation or any information that would support an alternative view.

Response:

FEI agrees that electricity rate increases for BC Hydro in the range of 50 percent within the next 5 to 7 years is a possible outcome. Older versions of BC Hydro's rate increase forecast such as

the one provided to their IRP Technical Advisory Committee[1] would support this view. However, despite information available in the draft integrated resource plan, it is difficult from outside of BC Hydro to assess the full implications for the rate increase outlook of various recent developments such as (for example):

- The changes to the provincial self-sufficiency definition to be based on average water conditions and removal of the 3,000 GWh insurance requirement.
- BC Hydro's efforts to address various recommendations in the Government Review report such as implementing workforce reductions and finding cost savings and efficiencies. BC Hydro's 2012 Annual Report devotes two pages (p.26 and 27) to discussing initiatives of this nature.
- Recent and possible future government intervention in revenue requirement hearings and other regulatory matters, such as through special Direction No.3, OIC 314 to mitigate potential rate shock.

FEI recognizes that in various matters the course for BC Hydro has already been set (such as the effects of large recent capital programs, previously awarded EPAs from recent Power Calls that are still coming into full effect, and large deferral account accumulations). This would suggest that rate increases in the short term are likely to be larger in nature.

25.6 Would the CEC's view be as reasonable a view as may be available to the Commission in this proceeding?

Response:

Yes, CEC's view is reasonable; however, FEI believes there is uncertainty in the outlook for electricity rate increases going forward. Please refer to the response to CEC IR 2.25.5.

[1] http://www.bchydro.com/content/dam/hydro/medialib/internet/documents/planning_regulatory/iep_ltap/ror/irp_tac_mtg01_summarybrief1.pdf

26 Reference: Exhibit B-17, BCUC 1.3.3

Cost of emissions reductions due to displacement of fossil fuel natural gas					
		2013 BERC	Current Max BERC	2013 BERC	Current Max BERC
Cost of Biomethane (1)	$/GJ	$12.001	$15.28	$12.001	$15.28
Long-run cost of NG (2a)	$/GJ	$5 [c]		$6.66 [a]	
Carbon Tax Credit (2b)	$/GJ	$1.49 [d]		$1.49 [d]	
Biomethane "premium" (3=1-2a-2b)	$/GJ	$5.51	$8.79	$3.85	$7.13
Avoided emissions from NG /GJ(4)	Tons of CO2e/GJ	0.0502 [b]			
Cost per GJ of avoided emissions (6=3/4)		**$109**	**$175**	**$77**	**$142**

a. *FortisBC and MEM paper, p. 8-210, www.aceee.org/files/proceedings/2012/data/papers/0193-000258.pdf*
b. *Appendix C-6, Table 1*
c. *Indicative number intended to represent sensitivity to LRMC, selected to be between current market prices and the gas utility's LRMC.*
d. *Purchases of Biomethane receive a carbon tax credit*

26.1 Does FEI have a forecast for the $/GJ value of Carbon Tax Credits? If so, please provide.

Response:

No, FEI does not have a forecast value for the $/GJ value of Carbon Tax Credits beyond 2013.

27 Reference: Exhibit B-15, CEC 1.28.12; Exhibit B-14, BCSEA 1.13.12; Exhibit B-1, Application, Page 80

> While the information available on BC Hydro's website for these two projects does not indicate that their review processes are finalized or that they have been awarded EPAs as yet, it is FEI's understanding that these proponents intend to continue pursuing an electricity purchase agreement with BC Hydro. As neither party has expressed interest in re-opening discussions in regard to pursuing a biomethane agreement FEI believes these two projects should be considered permanently lost.

> FEI has deliberately slowed its pursuit of future potential projects over the last few months to allow time for clarity in the program. However, the two most prominent projects were mentioned in the 2012 Biomethane Application. They are the City of Vancouver, Delta Landfill and the City of Surrey Organic waste project.
>
> According to the categories, in Table 7-1, these two projects represent landfill and municipal solid waste.
>
> It is too early to make an accurate estimate of volume, but on a preliminary basis, the volume for these two projects is estimated to be as much as 650,000 GJ annually combined.

Category	Maximum Projected Annual Volume (GJ)	Comment
Agriculture and Agri-Food	90,000	On-farm (Fraser Valley)
Agriculture and Agri-Food	70,000	On-farm (Fraser Valley)
Agriculture and Agri-Food	70,000	On-farm (Fraser Valley)
Landfill	50,000	
Landfill	75,000	
Landfill	75,000	
Landfill	100,000	
Wastewater Plant	125,000	
Total	***655,000***	

> Based on this analysis, the total known prospects have expected maximum contribution of approximately 1,305,000 GJ annually (1.305TJ).

> In the case of supply contracts, FEI has experienced a range of time required for feasibility analysis and negotiation. Longer periods of evaluation and negotiation can shift total supply volumes to later years.

27.1 Does FEI have priorities amongst the known prospects?

Response:

FEI sees the projects with Surrey and City of Vancouver as the top two priorities at this time. These two projects have progressed further than the others with respect to feasibility and the volumes are significant. These are two of the largest potential sources of biomethane (provide the most volume). If they are not developed as biomethane projects (but rather as electricity

projects for example), the potential loss of volume would hamper FEIs ability to secure additional projects in a timely manner to meet future demand.

Beyond these two projects FEI intends to develop new supply in a first come, first served manner. To date, this has not created any difficulty. However, if required, FEI could prioritize the projects further. At this time, Factors such as price, reputation of supplier, location of supply and timing of development could all factor into the prioritization.

27.1.1 If so, which projects would FEI consider as the most important to pursue and why?

Response:

Please refer to the response to CEC IR 2.27.1.

27.2 Does the size or other characteristics mean that projects more reasonably lend themselves more to either electricity generation or upgrading to biomethane? Please explain in what way projects may be better suited to upgrading or electricity generation and highlight any restrictions that apply to each use.

Response:

FEI has indicated in the responses to CEC IRs 2.20.1 to 2.20.5 conceptual criteria and advantages of upgrading versus electricity generation. In those IRs, FEI also discussed the challenges with the existing inequality in the policy and regulatory landscape where developers perceive an additional hurdle related to biomethane production. This response will therefore discuss other aspects.

The first restrictions will be location. FEI has not done a detailed system analysis for all these projects so some may be excluded from upgrading due to system capacity. (FEI has done preliminary analysis with respect to the volumes expected from the Surrey Digester and Delta landfill projects and this analysis indicates that the volumes can be accommodated in the FEI system) Likewise, the costs of attaching to the BC Hydro system may be a limiting factor. In most cases these projects are near existing populations being served by BC Hydro, however interconnection costs and process can be a significant barrier.

Beyond that FEI surmises that the volumes are likely sufficient to provide an economic argument for either electricity generation or biogas upgrading.

From an energy use perspective, some of these projects may be suited to co-generation rather than strictly electricity generation. This may help justify generating electricity.

27.3 If so, which of the known prospects identified would be best suited to upgrading to biomethane and which may be better suited to electricity generation.

Response:

FEI has not directly identified or segregated this prospect list. As indicated in response to BCSEA IR 1.13.12, this is a result of deliberately not evaluating more projects until there is greater certainty in the future of the biomethane program.

27.4 Would FEI expect BC Hydro to be pursuing any or all of these prospects at present?

Response:

It is FEI's understanding that BC Hydro does not specifically pursue projects of this size. However, the existence of the Standing Offer program provides an option for project developers and therefore there is a possibility that these projects can generate electricity.

27.5 Does the negotiation process tend to favour the first candidate to initiate discussions for a supply project (i.e. does being the first to initiate negotiations result in an advantage when competing for a given supply project, or alternatively, not being the first result in a disadvantage)? Please explain.

Response:

Yes, FEI believes that being first in the negotiation process favours the first candidate. Regardless of which option a project developer initiates (biomethane upgrading or electricity generation), there is a measure of sunk cost in initiating discussions with a candidate such as FEI or BC Hydro. This sunk cost can be in the form of time, money or both. Therefore the project developer must be willing in essence to spend that time and money twice if it switches from one option to the other.

The second candidate must also provide at least as much information as the first and it may have the disadvantage of meeting a fixed decision timeframe imposed by the project developer. The second candidate must also provide an offer at least as good as the first, if not greater. For example, in the case of the Kelowna Landfill project, FEI was the second candidate. The price paid for the raw landfill gas needed to provide a return to the City at least as good as the competing option of electricity production (BC Hydro SOP). It is possible, that if FEI were the first candidate in this case, the initial offer price could have been lower.

27.6 If so, at what stage of negotiation would FEI consider a biomethane project as being at a disadvantage or lost on this basis, and over what time frames might this occur.

Response:

FEI would expect that once a supplier has invested in an interconnection study, it is unlikely that it will seriously consider the biomethane option.

27.6.1 If so, does FEI expect that any of its known prospects will be 'lost' due to time delays?

Response:

At this stage, FEI is not aware of any of the potential prospects listed in the preamble above having proceeded with an interconnection study with BC Hydro.

28 Reference: Exhibit B-15, CEC 1.29.3 and Cat 3500, Product Performance Pages from the Caterpillar Website

CEC IR1, 29.3: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View (Continued)

		Reference	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard											
2	Generator Plant											
3	Available Raw Energy (TJ)	Note 3	391	391	391	391	391	391	391	391	391	391
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	140	140	140	140	140	140	140	140	140	140
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	39	39	39	39	39	39	39	39	39	39
8	Home Heating											
9	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1
10	Remaining Energy at Home (GWh)	Line 7 * Line 9	39	39	39	39	39	39	39	39	39	39
11	Cost to Electric Company											
12	SOP Price (2017) $/MWh	Note 5	126.4	127.7	129.0	130.2	131.5	132.9	134.2	135.5	136.9	138.3
13	Total Cost '000$	Line 7 * Line 12	4,910	4,960	5,009	5,059	5,110	5,161	5,212	5,265	5,317	5,370

Notes:

1: Caterpillar G3516 Generator for Landfill Gas found on data sheet (Company Website)

2: 85% recovery, 90% efficiency based on quotation from ARC Technologies

3: Electric generation requires a greater amount of raw biomethane to equate with amounts from biomethane upgrading

4: 1 kWh = 0.0036 GJ

5: BC Hydro Standing Offer Program - Program Rules Version 2.2 March 2013, adjusted for 2017 start, Price escalation based on 50% of 2% CPI / year

6: 2017-22 based on biomethane forecast BERC rate (BCUC IR1, 72.2, moderate demand / negotiated supply), 2023+ inflated at 2%/year

7: 2013 FEI After-Tax WACC, Capital structure and rates based on BCUC Order No G-44-12, Tax Rate = 25%

G3516A		G3516A+		G3520C	
170 / 190	6.7 / 7.5	170 / 190	6.7 / 7.5	170 / 190	6.7 / 7.5
69.0	4210	69.0	4210	86.0	5266
1500		1500		1500	
4906	193	4906	193	6316	249
2155	85	2155	85	1828	72
2051	81	2072	82	2254	89
17,824	39,303	17,778	39,200	17,826	39,306

G3516A		G3516A+		G3520C	
500	1	500	1	500	1
1041		1105		1991	
12.4	180	13.2	191	18.9	274
1,556	88,475	1,245	70,803	2,323	132,098
32.1		36.8		39.3	
47.0		41.5		44.7	
79.1		78.3		84.0	
516GE87 / DM0761-03		DTO / S02-35-03		520GE37 / DM8647-03	

28.1 The CEC was unable to locate the appropriate data sheet on the Caterpillar website. Please provide the Data sheet for the generator specified.

Response:

FEI has attached the original data sheet used in these calculations. FEI notes that the efficiency was quoted at 35.8 percent. FEI used this value based on an assumed 85 percent load factor (between 100 percent and 75 percent load) and derived the efficiency factor by interpolating.

29. Reference: Exhibit B-15, CEC 1.29 and Cat 3500, Product Performance Pages from the Caterpillar Website

CEC IR1, 29.3: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View (Continued)

		Reference	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard											
2	Generator Plant											
3	Available Raw Energy (TJ)	Note 3	391	391	391	391	391	391	391	391	391	391
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	140	140	140	140	140	140	140	140	140	140
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	39	39	39	39	39	39	39	39	39	39
8	Home Heating											
9	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1
10	Remaining Energy at Home (GWh)	Line 7 * Line 9	39	39	39	39	39	39	39	39	39	39
11	Cost to Electric Company											
12	SOP Price (2017) $/MWh	Note 5	126.4	127.7	129.0	130.2	131.5	132.9	134.2	135.5	136.9	138.3
13	Total Cost '000$	Line 7 * Line 12	4,910	4,960	5,009	5,059	5,110	5,161	5,212	5,265	5,317	5,370

Notes:

1: Caterpillar G3516 Generator for Landfill Gas found on data sheet (Company Website)

2: 85% recovery, 90% efficiency based on quotation from ARC Technologies

3: Electric generation requires a greater amount of raw biomethane to equate with amounts from biomethane upgrading

4: 1 kWh = 0.0036 GJ

5: BC Hydro Standing Offer Program - Program Rules Version 2.2 March 2013, adjusted for 2017 start, Price escalation based on 50% of 2% CPI / year

6: 2017-22 based on biomethane forecast BERC rate (BCUC IR1, 72.2, moderate demand / negotiated supply), 2023+ inflated at 2%/year

7: 2013 FEI After-Tax WACC, Capital structure and rates based on BCUC Order No G-44-12, Tax Rate = 25%

Notes
1) Transport dimensions of genset only. Accessory components must be taken into account separately.
2) Series (A, B, C-60Hz, C-50Hz-Biogas) include losses for engine-mounted JW & AC mechanical coolant pumps. Series (C-50Hz-Natural Gas, E, & H) exlcude engine-mounted JW & AC pumps. In accordance with ISO 3046/1 using standard low voltage (medium voltage for > 2000kW) generator at PF=1.0. Assumes methane number of MN80 for natural gas, MN 130 for biogas.
3) In accordance with nominal tolerances. Calculated as exhaust gas heat cooled (to 120°C) plus engine jacket water circuit heat.
* NO_x emissions as NO_2 dry exhaust gas @ 5% O_2 with 54°C (130°F) SCAC inlet temperature [48°C (118°F) for H Series]. <500 mg/m_n^3 (1.0g/bhp-h) NO_x performance available via engine setting for lean burn engines or via 3-way catalyst for rich burn engines. Ultra-low NO_x options available via SCR catalyst.
** Orders available beginning Dec. 2013

Biogas fuels (landfill gas, sewage gas, digester gas) assumed to meet published engine-in contaminant limits with minimum heating value (LHV) = 18.0 MJ/m_n^3 (457 Btu/scf).
Natual gas fuels assumed to be mostly methane with a lower heating value (LHV) = 35.6 MJ/m_n^3 (905 Btu/scf).
Specifications for special gases are available.
Data is representative and non-binding. Contact your Cat dealer for generator set, site and fuel-specific performance.

29.1 Please confirm or otherwise explain if the amount or quality of biogas used to produce 391 TJ of Available Raw Energy (line 3) for conversion to electricity would also produce 391 TJ of Available Raw Energy for upgrading to biomethane.

Response:

Yes, the 391 TJ of Available Raw Energy for conversion to electricity would also produce 391 TJ of Available Raw Energy for upgrading to biomethane. The analysis contained in CEC IR 1.29.1 focuses on equivalent levels of energy available for consumption at a typical home. To provide equivalent levels of energy (140 TJ) for home consumption, the biomethane to electric option requires 391 TJ of raw energy and the biomethane to gas requires 200 TJ.

29.1.1 If not, please provide any additional conversion factors or costs that may be associated with creating the equivalent amounts of Available Raw Energy and provide information as to the amount of biogas that would be required to produce 391 TJ of Available Raw Energy for conversion to electricity and the amount of biogas that would be required to produce 200 TJ of Available Raw Energy for upgrading to biomethane.

Response:

Please refer to the response to CEC IR 2.29.1.

29.2 Please confirm or otherwise explain if the Available Raw Energy (line 3) that would be provided to the Generator resulting in an Efficiency Factor of 0.358 (line 4) from a landfill or other project likely to be undertaken can reasonably be assumed to conform to the published engine-in contaminant limits with minimum heating of 457 Btu/scf (Note 1).

Response:

The efficiency factor quoted is based on an assumed Lower Heating Value of 22.4 MJ/Nm3, which is approximately equivalent to 588 BTU/scf. This would correspond to approximately 60 percent methane which is a reasonable assumption for an anaerobic digester. Landfill gas will typically be closer to the 457 BTU/scf which is equivalent to approximately 48 percent methane. Please refer to the data sheet provided in Attachment 28.1 in response to CEC IR 2.28.1.

29.2.1 If not, please provide any further analysis and recalculate the total amount of biogas required to produce 140 (TJ) at the plant gate.

Response:

Please refer to the the response to CEC IR 2. 29.2.

29.3 Please confirm that based on the above a single plant producing 200 TJ of raw energy would produce 71.6 TJ of energy when converted to electricity, or 152 TJ when converted to methane.

Response:

Confirmed.

29.4 Please identify any transmission losses that could reasonably be expected to occur between the plant gate and the home for both electricity and gas.

Response:

FEI would expect transmission losses for natural gas to be 0.1 percent (Lower Mainland UAF), while electricity would incur 6.28 percent (calculated on the energy received at the Point-of-Receipt).

Transmission losses have been accounted for in this revision to CEC IR 1.29.3. Results show that, when including transmission losses, the electric option is $24.5 million (NPV of cost difference over 20 year, Line 37 of the attached table) more than the biomethane option. This compares to the $20.9 million difference shown in CEC IR 1.29.3 (Line 31), where transmission losses have not been accounted for.

CEC IR2, 29.4: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View (Revision to CEC IR1, 29.3)

		Reference	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard											
2	Generator Plant											
3	Available Raw Energy (TJ)	Note 3	417	417	417	417	417	417	417	417	417	417
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	149	149	149	149	149	149	149	149	149	149
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	41	41	41	41	41	41	41	41	41	41
8	Transmission											
9	Line Losses %	Note 8	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%
10	Remaining Energy at Reciept (GWh)	Line 7 * (1 - Line 9)	39	39	39	39	39	39	39	39	39	39
11	Home Heating											
12	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1
13	Remaining Energy at Home (GWh)	Line 7 * Line 12	39	39	39	39	39	39	39	39	39	39
14	Cost to Electric Company											
15	SOP Price (2017) $/MWh	Note 5	114.4	115.6	116.7	117.9	119.1	120.3	121.5	122.7	123.9	125.2
16	Total Cost '000$	Line 7 * Line 15	4,749	4,796	4,844	4,893	4,941	4,991	5,041	5,091	5,142	5,193
17	Biomethane Upgrading, Sell to FortisBC, Home Heating using Gas Furnace											
18	Upgrading Plant											
19	Available Raw Energy (TJ)	Note 3	200	200	200	200	200	200	200	200	200	200
20	Efficiency Factor - Upgrader	Note 2	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
21	Remaining Energy at Plant Gate TJ	Line 19 * Line 20	152	152	152	152	152	152	152	152	152	152
22	Transmission											
23	Line Losses %	Note 9	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
24	Remaining Energy at Receipt (TJ)	Line 21 * (1 - Line 23)	152	152	152	152	152	152	152	152	152	152
25	Home Heating											
26	Gas Furnace Efficiency factor		0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
27	Remaining Energy at Home (TJ)	Line 24 * Line 26	140	140	140	140	140	140	140	140	140	140
28	Cost to Gas Company											
29	Biomethane Price $/GJ	Note 6	14.54	15.26	16.09	16.86	17.58	18.29	18.47	18.84	19.22	19.60
30	Total Cost '000$	Line 21 * Line 29	2,209	2,320	2,446	2,562	2,672	2,780	2,808	2,864	2,921	2,980
31												
32	Cost Difference Electric - Gas '000$	Line 16 - Line 30	2,539	2,477	2,398	2,331	2,269	2,211	2,233	2,227	2,221	2,214
33												
34	Discount Rate	Note 7	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
35	Discount Period (Years)		1	2	3	4	5	6	7	8	9	10
36	Annual PV '000$	Line 32 (1+Line 34)^(Line 35)	2,377	2,171	1,968	1,790	1,632	1,489	1,407	1,314	1,227	1,145
37	NPV of Cost Difference '000$	Sum Line 36 2017 to year	2,377	4,548	6,516	8,306	9,938	11,426	12,834	14,148	15,375	16,520

1

CEC IR2, 29.4: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View (Continued)

		Reference	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard											
2	Generator Plant											
3	Available Raw Energy (TJ)	Note 3	417	417	417	417	417	417	417	417	417	417
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	149	149	149	149	149	149	149	149	149	149
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	41	41	41	41	41	41	41	41	41	41
8	Transmission											
9	Line Losses %	Note 8	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%	6.28%
10	Remaining Energy at Reciept (GWh)	Line 7 * (1 - Line 9)	39	39	39	39	39	39	39	39	39	39
11	Home Heating											
12	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1
13	Remaining Energy at Home (GWh)	Line 7 * Line 12	39	39	39	39	39	39	39	39	39	39
14	Cost to Electric Company											
15	SOP Price (2017) $/MWh	Note 5	126.4	127.7	129.0	130.2	131.5	132.9	134.2	135.5	136.9	138.3
16	Total Cost '000$	Line 7 * Line 15	5,245	5,298	5,351	5,404	5,458	5,513	5,568	5,624	5,680	5,737
17	Biomethane Upgrading, Sell to FortisBC, Home Heating using Gas Furnace											
18	Upgrading Plant											
19	Available Raw Energy (TJ)	Note 3	200	200	200	200	200	200	200	200	200	200
20	Efficiency Factor - Upgrader	Note 2	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
21	Remaining Energy at Plant Gate TJ	Line 19 * Line 20	152	152	152	152	152	152	152	152	152	152
22	Transmission											
23	Line Losses %	Note 9	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%	0.10%
24	Remaining Energy at Receipt (TJ)	Line 21 * (1 - Line 23)	152	152	152	152	152	152	152	152	152	152
25	Home Heating											
26	Gas Furnace Efficiency factor		0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
27	Remaining Energy at Home (TJ)	Line 24 * Line 26	140	140	140	140	140	140	140	140	140	140
28	Cost to Gas Company											
29	Biomethane Price $/GJ	Note 6	20.00	20.40	20.80	21.22	21.64	22.08	22.52	22.97	23.43	23.90
30	Total Cost '000$	Line 21 * Line 29	3,039	3,100	3,162	3,225	3,290	3,356	3,423	3,491	3,561	3,632
31												
32	Cost Difference Electric - Gas '000$	Line 16 - Line 30	2,206	2,198	2,189	2,179	2,169	2,157	2,145	2,133	2,119	2,105
33												
34	Discount Rate	Note 7	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
35	Discount Period (Years)		11	12	13	14	15	16	17	18	19	20
36	Annual PV '000$	Line 32 (1+Line 34)^(Line 35)	1,068	996	929	866	807	751	699	651	606	563
37	NPV of Cost Difference '000$	Sum Line 36 2017 to year	17,588	18,585	19,514	20,379	21,186	21,937	22,637	23,288	23,893	24,456

Note:

1: Caterpillar G3516 Generator for Landfill Gas found on data sheet (Company Website)

2: 85% recovery, 90% efficiency based on quotation from ARC Technologies

3: Electric generation requires a greater amount of raw biomethane to equate with amounts from biomethane upgrading

4: 1 kWh = 0.0036 GJ

5: BC Hydro Standing Offer Program - Program Rules Version 2.2 March 2013, adjusted for 2017 start, Price escalation based on 50% of 2% CPI / year

6: 2017-22 based on biomethane forecast BERC rate (BCUC IR1, 72.2, moderate demand / negotiated supply), 2023+ inflated at 2% / year

7: 2013 FEI After-Tax WACC, Capital structure and rates based on BCUC Order No G-44-12, Tax Rate = 25%

8: Electric supplier interconnect with BC Hydro transmission system. Incur 6.28% line losses calculated on the energy received at the Point-of-Receipt

9: Biomethane suppliers inject gas into FEI distribution system. Line losses based on UAF for the lower mainland of 0.1%

30 Reference: Exhibit B-15, CEC 1.29.3

CEC IR1, 29.3: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View

		Reference	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard											
2	Generator Plant											
3	Available Raw Energy (TJ)	Note 3	391	391	391	391	391	391	391	391	391	391
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	140	140	140	140	140	140	140	140	140	140
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	39	39	39	39	39	39	39	39	39	39
8	Home Heating											
9	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1
10	Remaining Energy at Home (GWh)	Line 7 * Line 9	39	39	39	39	39	39	39	39	39	39
11	Cost to Electric Company											
12	SOP Price (2017) $/MWh	Note 5	114.4	115.6	116.7	117.9	119.1	120.3	121.5	122.7	123.9	125.2
13	Total Cost '000$	Line 7 * Line 12	4,445	4,490	4,535	4,580	4,626	4,672	4,719	4,766	4,814	4,862
14	Biomethane Upgrading, Sell to FortisBC, Home Heating using Gas Furnace											
15	Upgrading Plant											
16	Available Raw Energy (TJ)	Note 3	200	200	200	200	200	200	200	200	200	200
17	Efficiency Factor - Upgrader	Note 2	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18	Remaining Energy at Plant Gate TJ	Line 16 * Line 17	152	152	152	152	152	152	152	152	152	152
19	Home Heating											
20	Gas Furnace Efficiency factor		0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
21	Remaining Energy at Home (TJ)	Line 18 * Line 20	140	140	140	140	140	140	140	140	140	140
22	Cost to Gas Company											
23	Biomethane Price $/GJ	Note 6	14.54	15.26	16.09	16.86	17.58	18.29	18.47	18.84	19.22	19.60
24	Total Cost '000$	Line 18 * Line 23	2,209	2,320	2,446	2,562	2,672	2,780	2,808	2,864	2,921	2,980
25												
26	Cost Difference Electric - Gas '000$	Line 13 - Line 24	2,236	2,170	2,089	2,018	1,953	1,892	1,911	1,902	1,892	1,882
27												
28	Discount Rate	Note 7	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
29	Discount Period (Years)		1	2	3	4	5	6	7	8	9	10
30	Annual PV '000$	Line 26 (1+Line 28)^(Line 29)	2,093	1,902	1,714	1,550	1,405	1,274	1,205	1,122	1,045	973
31	NPV of Cost Difference '000$	Sum Line 30 2017 to year	2,093	3,995	5,709	7,260	8,665	9,938	11,143	12,265	13,311	14,284

Notes:

1: Caterpillar G3516 Generator for Landfill Gas found on data sheet (Company Website)

2: 85% recovery, 90% efficiency based on quotation from ARC Technologies

3: Electric generation requires a greater amount of raw biomethane to equate with amounts from biomethane upgrading

4: 1 kWh = 0.0036 GJ

5: BC Hydro Standing Offer Program - Program Rules Version 2.2 March 2013, adjusted for 2017 start, Price escalation based on 50% of 2% CPI / year

6: 2017-22 based on biomethane forecast BERC rate (BCUC IR1, 72.2, moderate demand / negotiated supply), 2023+ inflated at 2%/year

7: 2013 FEI After-Tax WACC, Capital structure and rates based on BCUC Order No G-44-12, Tax Rate = 25%

30.1 Please provide the information contained in the Comparison of Biomethane to Electricity form Electric/Gas company Point of View for 2013 to 2016 inclusive.

Response:

The years 2013 to 2016 have been added to the tables included in the response to CEC IR 1.29.3. The NPV of Cost Difference (Line 31) now reflects results starting on 2013 rather than 2017 (as in CEC IR 1.29.3).

1

CEC IR2, 30.1: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View (Addition of 2013-16 to CEC IR1, 29.3)

		Reference	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard													
2	Generator Plant													
3	Available Raw Energy (TJ)	Note 3	391	391	391	391	391	391	391	391	391	391	391	391
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	140	140	140	140	140	140	140	140	140	140	140	140
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	39	39	39	39	39	39	39	39	39	39	39	39
8	Home Heating													
9	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1	1	1
10	Remaining Energy at Home (GWh)	Line 7 * Line 9	39	39	39	39	39	39	39	39	39	39	39	39
11	Cost to Electric Company													
12	SOP Price (2013) $/MWh	Note 5	106.8	108.9	111.1	113.3	114.4	115.6	116.7	117.9	119.1	120.3	121.5	122.7
13	Total Cost '000$	Line 7 * Line 12	4,147	4,230	4,315	4,401	4,445	4,490	4,535	4,580	4,626	4,672	4,719	4,766
14	Biomethane Upgrading, Sell to FortisBC, Home Heating using Gas Furnace													
15	Upgrading Plant													
16	Available Raw Energy (TJ)	Note 3	200	200	200	200	200	200	200	200	200	200	200	200
17	Efficiency Factor - Upgrader	Note 2	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18	Remaining Energy at Plant Gate TJ	Line 16 * Line 17	152	152	152	152	152	152	152	152	152	152	152	152
19	Home Heating													
20	Gas Furnace Efficiency factor		0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
21	Remaining Energy at Home (TJ)	Line 18 * Line 20	140	140	140	140	140	140	140	140	140	140	140	140
22	Cost to Gas Company													
23	Biomethane Price $/GJ	Note 6	11.70	12.06	13.01	13.67	14.54	15.26	16.09	16.86	17.58	18.29	18.47	18.84
24	Total Cost '000$	Line 18 * Line 23	1,778	1,833	1,978	2,078	2,209	2,320	2,446	2,562	2,672	2,780	2,808	2,864
25														
26	Cost Difference Electric - Gas '000$	Line 13 - Line 24	2,370	2,397	2,337	2,323	2,236	2,170	2,089	2,018	1,953	1,892	1,911	1,902
27														
28	Discount Rate	Note 7	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
29	Discount Period (Years)		1	2	3	4	5	6	7	8	9	10	11	12
30	Annual PV '000$	Line 26 (1+Line 28)^(Line 29)	2,218	2,101	1,918	1,785	1,608	1,461	1,317	1,191	1,079	979	925	862
31	NPV of Cost Difference '000$	Sum Line 30 2013 to year	2,218	4,319	6,238	8,022	9,630	11,091	12,408	13,599	14,678	15,657	16,582	17,444

CEC IR2, 30.1: Comparison of Biomethane to Electricity from Electric / Gas Company Point of View (Continued)

		Reference	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
1	Convert Biomethane to Electricity, Sell to BC Hydro, Home Heating using Electric Baseboard													
2	Generator Plant													
3	Available Raw Energy (TJ)	Note 3	391	391	391	391	391	391	391	391	391	391	391	391
4	Efficiency Factor - Power Generation	Note 1	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358	0.358
5	Remaining Energy at Plant Gate (TJ)	Line 3 * Line 4	140	140	140	140	140	140	140	140	140	140	140	140
6	kWh / GJ Conversion	Note 4	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036	0.0036
7	Remaining Energy at Plant Gate (GWh	Line 5 / Line 6 / 1000	39	39	39	39	39	39	39	39	39	39	39	39
8	Home Heating													
9	Electric Baseboard Efficiency Factor		1	1	1	1	1	1	1	1	1	1	1	1
10	Remaining Energy at Home (GWh)	Line 7 * Line 9	39	39	39	39	39	39	39	39	39	39	39	39
11	Cost to Electric Company													
12	SOP Price (2013) $/MWh	Note 5	123.9	125.2	126.4	127.7	129.0	130.2	131.5	132.9	134.2	135.5	136.9	138.3
13	Total Cost '000$	Line 7 * Line 12	4,814	4,862	4,910	4,960	5,009	5,059	5,110	5,161	5,212	5,265	5,317	5,370
14	Biomethane Upgrading, Sell to FortisBC, Home Heating using Gas Furnace													
15	Upgrading Plant													
16	Available Raw Energy (TJ)	Note 3	200	200	200	200	200	200	200	200	200	200	200	200
17	Efficiency Factor - Upgrader	Note 2	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
18	Remaining Energy at Plant Gate TJ	Line 16 * Line 17	152	152	152	152	152	152	152	152	152	152	152	152
19	Home Heating													
20	Gas Furnace Efficiency factor		0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
21	Remaining Energy at Home (TJ)	Line 18 * Line 20	140	140	140	140	140	140	140	140	140	140	140	140
22	Cost to Gas Company													
23	Biomethane Price $/GJ	Note 6	19.22	19.60	20.00	20.40	20.80	21.22	21.64	22.08	22.52	22.97	23.43	23.90
24	Total Cost '000$	Line 18 * Line 23	2,921	2,980	3,039	3,100	3,162	3,225	3,290	3,356	3,423	3,491	3,561	3,632
25														
26	Cost Difference Electric - Gas '000$	Line 13 - Line 24	1,892	1,882	1,871	1,859	1,847	1,834	1,820	1,805	1,790	1,773	1,756	1,738
27														
28	Discount Rate	Note 7	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
29	Discount Period (Years)		13	14	15	16	17	18	19	20	21	22	23	24
30	Annual PV '000$	Line 26 (1+Line 28)^(Line 29)	803	748	696	648	602	560	520	483	448	416	386	357
31	NPV of Cost Difference '000$	Sum Line 30 2013 to year	18,248	18,995	19,691	20,339	20,941	21,501	22,021	22,504	22,952	23,368	23,753	24,111

1

Note:

1: Caterpillar G3516 Generator for Landfill Gas found on data sheet (Company Website)

2: 85% recovery, 90% efficiency based on quotation from ARC Technologies

3: Electric generation requires a greater amount of raw biomethane to equate with amounts from biomethane upgrading

4: 1 kWh = 0.0036 GJ

5: BC Hydro Standing Offer Program - Program Rules Version 2.2 March 2013, adjusted for 2013 start, Price escalation based on 50% of 2% CPI / year

6: 2013-22 based on biomethane forecast BERC rate (BCUC IR1, 72.2, moderate demand / negotiated supply), 2023+ inflated at 2% / year

7: 2013 FEI After-Tax WACC, Capital structure and rates based on BCUC Order No G-44-12, Tax Rate = 25%

30.2 Please confirm that the cost to produce the same amount of home heating energy would be about 2.01 times as expensive for electricity as for biomethane in 2017.

Response:

Confirmed. According to the assumptions made and the analysis done by FEI in the excerpt above, the expected cost to acquire electricity (from biogas) under the SOP for 2017 is approximately $4.445 million, while the expected cost of biomethane is $2.209 million (both cases producing the same 140 TJ of home heating energy). $4.445 million / $2.209 million = 2.01.

30.3 Please confirm that the inflation of 2%/year for the BERC rate in the years 2023 and beyond (Note 6) represents the company's prediction of the Consumer Price Index (Note 5) or otherwise explain.

Response:

Confirmed. 2 percent per year represents the company's long range planning assumption for the Consumer Price Index.

30.4 Please confirm that from a customer's perspective the of the cost of home heating using biomethane at the BERC rate can be converted with the following formula, and rewritten as $52.3457/Megawatt hour using the FEI inputs for 2017 or provide the appropriate calculation and result for 2017. (Price ($) per GJ/(KWh/GJ))*MWh/KWh or $14.54/GJ (1/.0036)*1000 = $52.3457/MWh.

Response:

The calculation in the question represents the simple conversion of the BERC rate from $/GJ to $/MWh. (The BERC rate incorporated into the response to CEC 1.29.3 reflects the commodity cost of Biomethane.) From the customer's perspective, the total charges for natural gas used

for space heating or other purposes include the delivery, midstream, commodity and basic charges. The BERC rate in effect reflects a substitute for the commodity item only. The breakdown of the total energy charges from the residential customer's point of view, including biomethane as the commodity component is shown in the following table:

Total Energy Charge with Biomethane - Customer Point of View in 2017

Delivery Rate $/GJ	$	3.53
Midstream $/GJ		1.24
Biomethane $/GJ		14.54
Basic Charge $0.405/Day, 95GJ / Year		1.56
Total Charges $/GJ	$	20.87
Total Charges $/MWh	$	75.12

Note: The total energy charge is based on 2017 projections for a typical Lower Mainland residential customer using 95 GJ/year.

If the $75.12/MWh is to be used for making comparisons to electricity rates there needs to be a recognition of the lower thermal efficiency of natural gas space heating equipment relative to electric equipment. (The referenced table from CEC IR 1.29.3 shows gas space heating efficiency at 92 percent compared to 100 percent for electricity.) The equipment efficiency difference can be accounted for by either scaling down the electricity cost or scaling up the biomethane cost. Using the latter approach in this case would increase the efficiency adjusted biomethane cost to $75.12 per MWh/92% = $81.65 per MWh.

30.4.1 If not, please revise the calculation and provide the appropriate cost of home heating at the BERC rate in $/MWh.

Response:

Please refer to the response to CEC IR 2.30.4.

30.4.2 Please provide the equivalent figure for 2012.

Response:

Using the current 2012 BERC rate of $11.696/GJ plus $6.23/GJ for delivery, midstream and basic charges, the equivalent figure would be $64.55/MWh. The calculation is as follows:

($11.696/GJ + $6.235/GJ) * 0.0036 GJ/kWh * 1000 kWh/MWh = $64.55.

Adjusting this result for the thermal efficiency difference of gas space heating equipment relative to electric equipment (as per CEC IR 2.30.4) would increase this result to $70.16 per MWh ($64.55 per MWh/92%).

30.5 Would FEI consider the $52.3457/MWh figure after adjustment to 2012, (or otherwise revised by FEI), as a ballpark comparison to the proxy CEC developed, (or revised by FEI) for the cost of residential electricity rates in CEC IR 2.26 above?

Response:

As noted in CEC IR 2.30.4 the pure BERC or biomethane rate must be adjusted for the inclusion of delivery, midstream and basic charges and to account for the lower end use thermal efficiency of gas heating equipment compared to electric equipment to arrive at the appropriate point of comparison for electricity. Adding in the delivery, basic and midstream charges makes a total delivered cost of biomethane in 2012 of $64.55/MWh as the appropriate starting point to compare to CEC's projection of electricity rates and rate increases discussed in the response to CEC IR 2.25.5. (Since CEC IR 2.26 noted in the question deals with Carbon Tax Credits we have assumed the question is referring to the CEC IR 2.25 series.) After applying an efficiency adjustment the cost of biomethane to residential customers would be about $70.16/MWh in 2012. This would compare favorably to the current average revenue of $83/MWh for residential customers. It should be noted that while $83/MWh represents the average cost of electricity for residential customers, the cost of acquiring new clean energy produced from biomethane costs $103.69/MWh in 2010$, based on BC Hydro's standing offer program. Even with expected inflationary increases in the cost of biomethane over the coming years it would continue to compare favorably to the average cost of electricity for residential consumers which may increase in the order of 50 percent in the next 5 to 7 years.

30.5.1 If not, please explain why not and provide an alternate ballpark comparison of prices available to residential customers for home heating either by biomethane or electricity in $/MWh.

Response:

Please refer to the response to CEC IR 2.30.5.

30.5.2 Please provide the ballpark equivalent costs for both services in $/MWh for each year from 2012-2036 using the most reasonable available price for electricity available to the Commission in this proceeding.

Response:

FEI has considered two electric scenarios to reflect different assumptions based on (1) SOP pricing / escalation and (2) average residential electricity rates and estimated general rate increases, and compares these to the Biomethane costs derived from CEC IR 1.29.3.

Electric Scenario 1 - BC Hydro Standing Offer Program (SOP). This forecast is based on the BC Hydro SOP base price of $103.69/MWh (2010$ Lower Mainland) and is escalated at CPI annually. CPI from 2010 to early 2013 is based on actual data, 2013+ on long term projections of 2 percent per year. This forecast is similar to the one incorporated in the response to CEC 1.29.3; however, in that response, it was assumed that an Electric Purchase Agreement (EPA) is signed in 2016 and the electric price is escalated at 50 percent of projected CPI per year (1 percent) from that point onwards.

Electric Scenario 2 – Average residential revenues per kWh escalated by estimated general rate increases: This scenario is based on the average residential revenue of $0.083 per kWh for F2012 (see the CEC IR 2.25 series) and is escalated by legislated Direction No. 3 increases for F2013 and F2014, followed by a rate of 6 percent per year for 7 years (which reflects an increase of 50 percent over 7 years - see the response to CEC IR 2.25.5), and 2 percent per year for F2022 and beyond[2].

[2] BC Hydro electricity revenues per customer are also adjusted from a fiscal year to a calendar year basis using a 3 month / 9 month weighting since the biomethane rates are on a calendar year basis

Biomethane: Total biomethane costs include the delivery charge, basic charge, midstream, (Lower Mainland residential) and the biomethane charge (The biomethane forecast is based on the response to CEC IR 1.29.3, with additional years of 2012 to 2016 added in.).

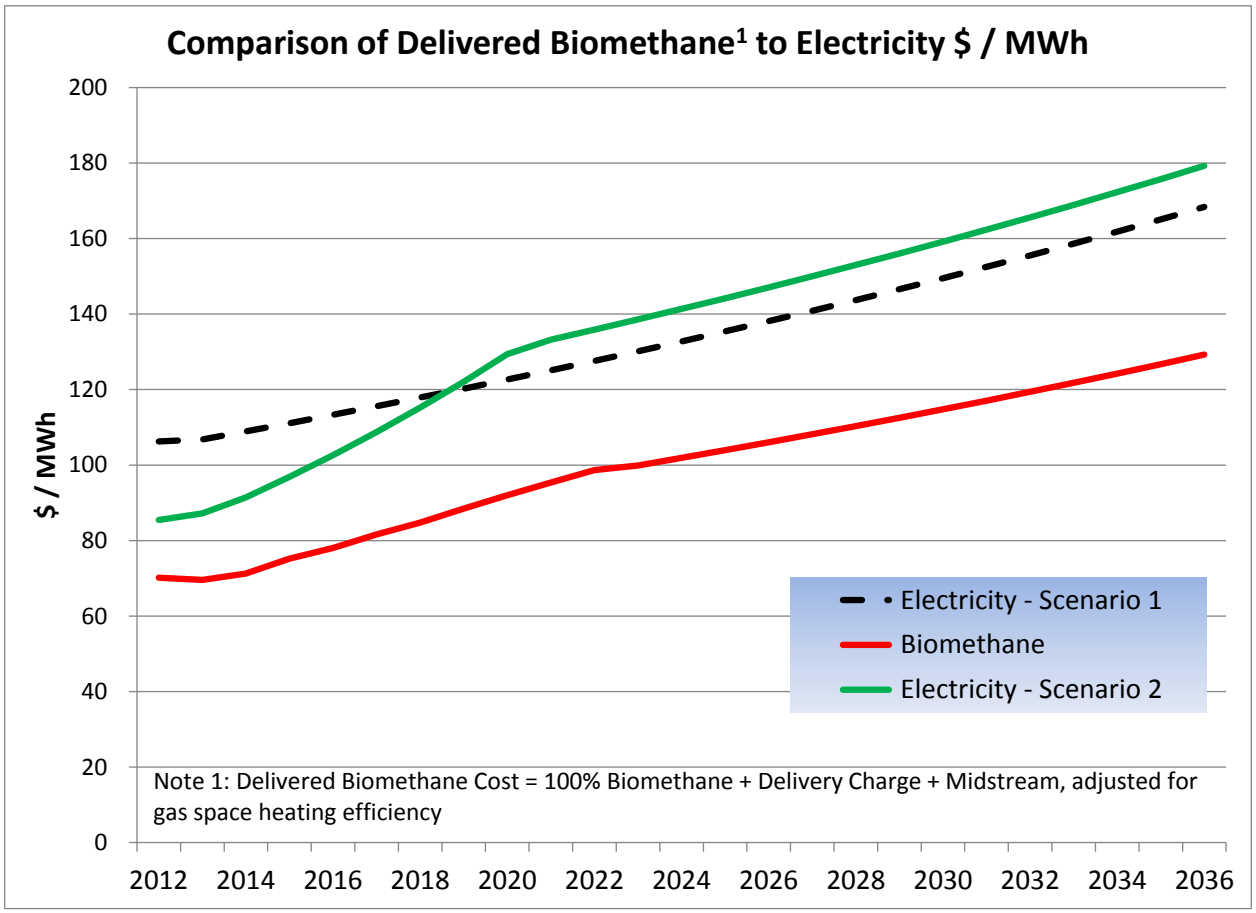
It should be noted that the electricity scenarios provided in response to this question are for illustrative purposes only. The SOP pricing, which is linked to the marginal cost of acquiring clean / renewable energy, has not been tied to BC Hydro's general electricity rate increases. Future electric rate increases can be based on many factors besides the cost of acquiring new energy, such as asset (transmission & distribution) replacement / upgrades, and operating and maintenance costs escalations. The current SOP program sets its price according to a 2010 base price and escalates it by CPI until the EPA is signed, then the price is escalated at 50 percent of CPI, or about 1 percent per year. The SOP base price may be reset at some point in the future but likely would not follow the same trend as general rate increases since it is based on marginal supply costs.

The following table and chart shows projected equivalent costs for Biomethane and Electric services in $/MWh for each year from 2012 to 2036. The Biomethane results have been adjusted for efficiency to allow direct comparison with electricity.

Comparison of Delivered Biomethane with Electricity

	Delievered Biomethane[1]	Electric Scenario 1	Electric Scenario 2
	$/MWh	$/MWh	$/MWh
2012	70.2	106.2	85.4
2013	72.2	106.8	87.2
2014	73.4	108.9	91.4
2015	75.0	111.1	96.9
2016	76.4	113.3	102.6
2017	77.9	115.6	108.7
2018	79.4	117.9	115.2
2019	80.9	120.2	122.1
2020	82.3	122.6	129.4
2021	83.8	125.1	133.2
2022	85.1	127.6	135.9
2023	86.4	130.2	138.6
2024	87.5	132.8	141.4
2025	88.6	135.4	144.2
2026	89.6	138.1	147.1
2027	90.5	140.9	150.0
2028	91.4	143.7	153.0
2029	92.3	146.6	156.1
2030	93.1	149.5	159.2
2031	93.9	152.5	162.4
2032	94.6	155.5	165.6
2033	95.4	158.7	168.9
2034	96.1	161.8	172.3
2035	96.8	165.1	175.8
2036	97.5	168.4	179.3
Level (2012-36)	97.5	133.7	131.7

1 Note 1: Delivered Biomethane costs include delivery, midstream, biomethane and basic charges



30.6 The CEC conclusion is that heating with biomethane directly versus through use to produce electricity will be a very poor economic proposition for customers over and extended time into the future as the cost inflation for electricity is expected to exceed the cost for biomethane used directly over an extended time into the future. Please comment based upon the quantitative data available in this proceeding.

Response:

The CEC has indicated to FEI that this IR question was worded incorrectly and that CEC's conclusion is that heating with electricity will be a very poor economic decision for customers over an extended period of time.

FEI understands that the CEC has concluded that customers heating their homes with biomethane can expect to pay less than if they were to use electricity [produced from biogas] for this purpose.

FEI has also reached the conclusion that RNG is a good alternative form of energy that would be a better economic choice than electricity for home heating.

FEI has calculated the total cost of space heating for a single residential customer in the Lower Mainland using either biomethane or electricity. The results are based on the biomethane and electric rate / price forecasts developed in CEC IR 2.30.5.2 and an average annual space heating load of 50 GJ. The following table compares the results of using either biomethane or electricity for residential space heating.

				NPV
$	2012	2020	2030	2012-36
Electric Scenario 1	1,358	1,567	1,910	20,240
Electric Scenario 2	1,092	1,653	2,034	19,948
Biomethane	897	1,175	1,466	14,758

The results show that using electricity for residential space heating is about 35 percent to 37 percent (or $5,200 to $5,500) greater in total costs (NPV) over 25 years relative to using biomethane.

31 Reference: Exhibit B-15, CEC 1.30.1

> There are a total of 29 regional districts within BC, and only about 15 clearly overlap the FEI service territory and have a significant population. There are 25 municipalities with a population over 15,000. There are probably approximately 20 (and a maximum of approximately 40) municipalities and regional districts that could reasonably considered to be possible partners for FEI.
>
> Of these municipalities FEI does not have an accurate count of wastewater plants that have existing digesters or that would consider building digesters. It is likely that there are only a few based upon the relative population of municipalities in BC. One clear opportunity is on Vancouver Island with the CRD. According to its website, utilization of biogas is a priority for CRD and one clear option is biomethane production either for vehicles or injection.
>
> There are 35 landfills in BC, and 18 of them are as big as or larger than the Salmon Arm landfill which FEI considers to be one of the smallest economically viable landfills for upgrading. If
>
> existing landfills with projects are excluded there are 10 remaining. FEI has not confirmed accessibility to pipelines, but expects that many will be within a reasonable distance of population centers.

31.1 Please identify an approximate figure range (such as "5-8") for 'only a few' municipalities that have or would build digesters.

Response:

Based on a brief review of the BC Ministry of Environment website (Waste Discharge Authorizations), there are between 8 and 20 permitted municipal sewage systems. Based on the names of the communities, FEI would surmise that the number with digesters is closer to the lower number.

31.2 Please provide a total figure for the estimated number of landfill and sewage treatment opportunities that FEI perceives as viable and, if different from the sum of 10 landfills plus the estimated range of wastewater plants specified please explain.

Response:

FEI estimates on a preliminary basis that the total number of opportunities would be between 18 and 30. This is an estimate based upon a cursory survey of the number of plants and landfills as reported on the Ministry of Environment websites and a preliminary estimate of the number that could be the right size (based roughly on population). It is not a thorough review and should not be considered definitive.

31.3 Please provide a rough estimate of the total biomethane supply that could be derived from these opportunities.

Response:

Using an average estimated energy supply of approximately 50,000 GJ annually, a rough estimate of the total potential is approximately 900,000 GJ to 1,500,000 GJ.

32 Reference: Exhibit B-17, BCUC 1.36.2 and 1.36.2.1

> FEI believes the ideal way to structure the program would be to have a user-pay program backstopped by an RPS standard or renewable portfolio allowance whereby FEI would be allowed to develop RNG for the user pay market and any unsold Biomethane could be absorbed by all customers. This would allow FEI to fully pursue supply projects, without having to tie customer user-pay demand to projects. This serves customers that want to select a higher percentage blend of Biomethane and large industrial customers such as UBC, while at the same time maximizing the development of Biomethane and GHG emission reductions in BC.

> It is difficult to quantify any cost savings at this time without knowing what the Renewable Portfolio Allowance would be. There could be some regulatory efficiency, customer education, billing and administration savings if there was not a customer offering to have to promote, bill or seek Commission approval of. But there could also be an increase in supply development, procurement, and O&M resource needs should the Renewable Portfolio Allowance be mandatory and contain aggressive targets in terms of timeline and volumes.

32.1 What renewable portfolio allowance would FEI consider to be optimal? Please explain.

Response:

FEI believes an RPA of 3 to 5 PJ for biomethane supply would be optimal as it would allow the full pursuit of biomethane projects within BC. Assuming the RPA is optional as FEI believes is desirable, the opportunity to develop 3 to 5 PJ is a broad enough allowance to allow FEI to explore the range of available biomethane opportunities in BC without being obliged to secure supply from high cost projects that might occur if the supply requirement was fixed.

Attachment 1.1

Biogas Study

Terasen Gas

March 2010

Measuring Commitment To A Green Lifestyle

Residents are then categorized into one of eight commitment segments depending on which of the three lifestyles they relate to most. These segments will be used throughout this report.

1. Dark Greens: Extreme Environmentalists: Committed to considering the environmental impact in everything they do

2. Light greens: Not as committed to the environment as the Greens, but still caring

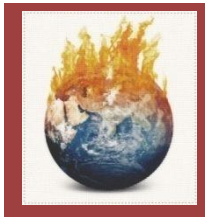
3. Potential Switchers: Consider themselves environmentally friendly, but thinking of switching to a more practical lifestyle

4. Try harders: Practical but striving to be more environmentally caring

5. Practicals: Committed to a practical environmental impact lifestyle, but still takes the environment in account

6. Extreme Practical: Committed to a pragmatic lifestyle; only considers the environmental impact only when it is reasonable or practical to do so

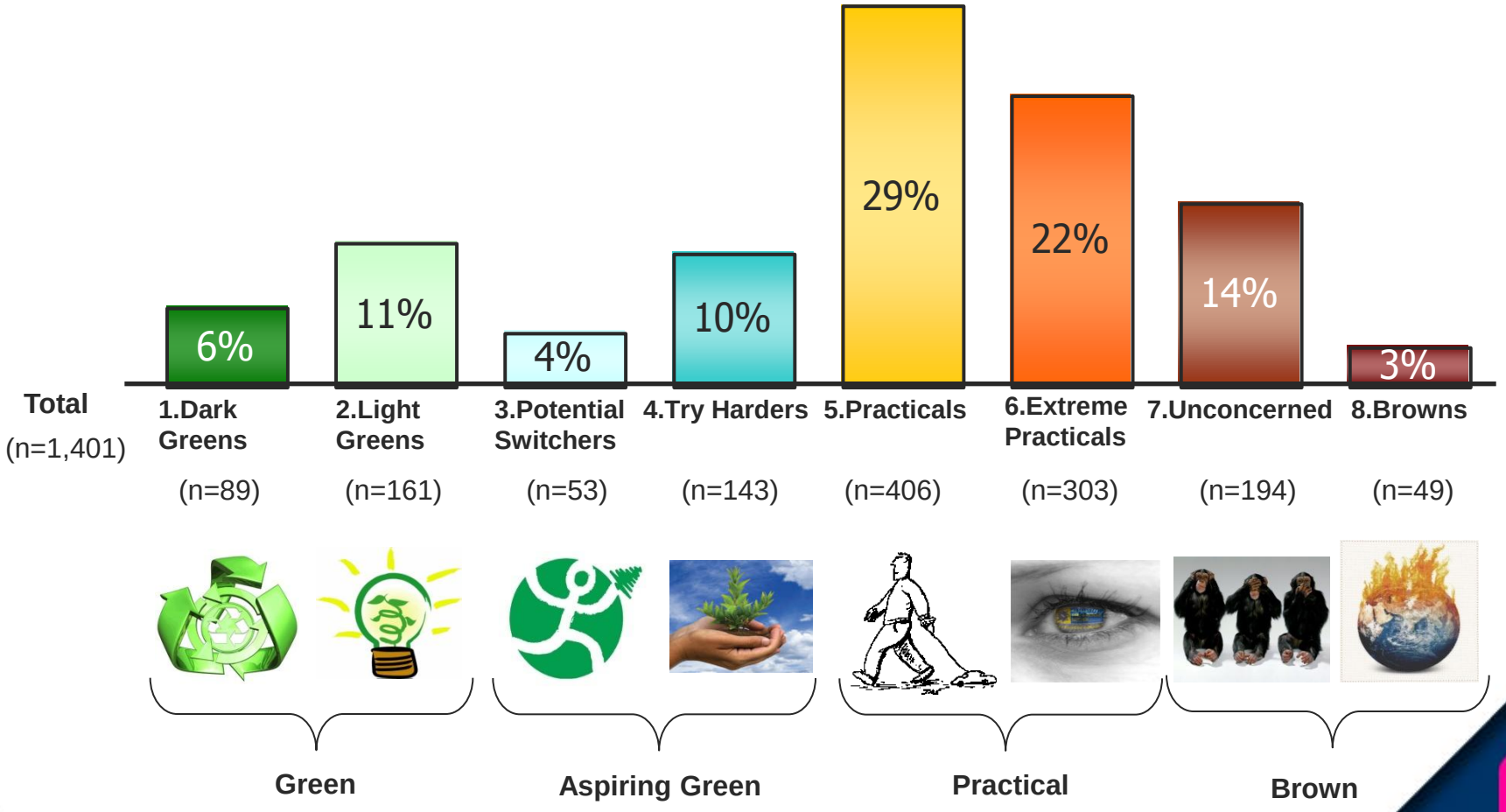
7. Unconcerned: Don't think that much about the impact their decisions have on the environment



8. Browns: Don't think at all about the environmental impact in anything they do

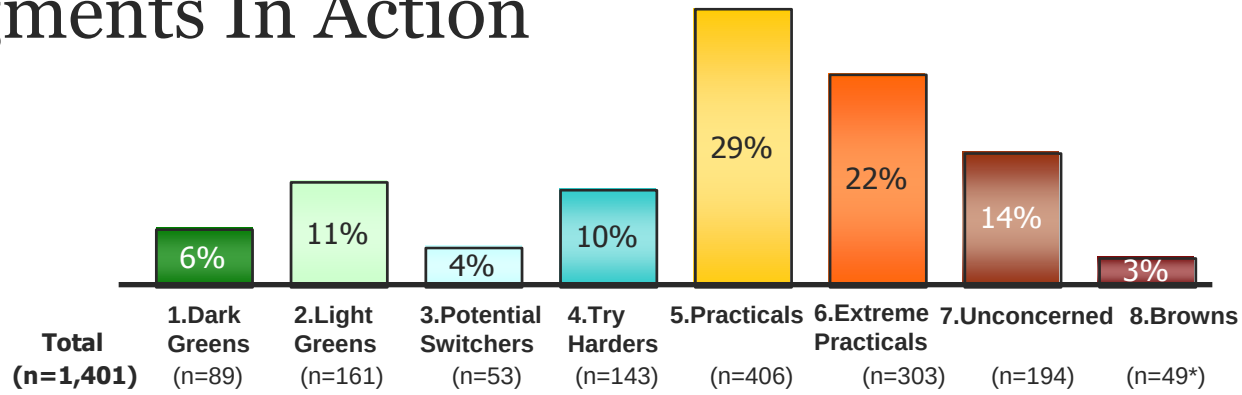
Lifestyle Segment Distribution

Just under one-fifth of BC residents are "Green" (Dark Green and Light Green combined)– they are sensitive about their environmental footprint in everything they do and buy. An equal proportion of residents are the exact opposite (Browns and Unconcerned combined)– they do not care about the environmental consequences of their actions. However, two-thirds of residents would consider more environmentally-friendly alternatives if it is practical for them to do so. In other words, if they see the value and benefits to them for choosing the greener option, they will do so.



The Lifestyle Segments In Action

Each lifestyle segment holds a different attitude towards the environment as shown by their varying levels of concern in the chart below.



How concerned are you about…

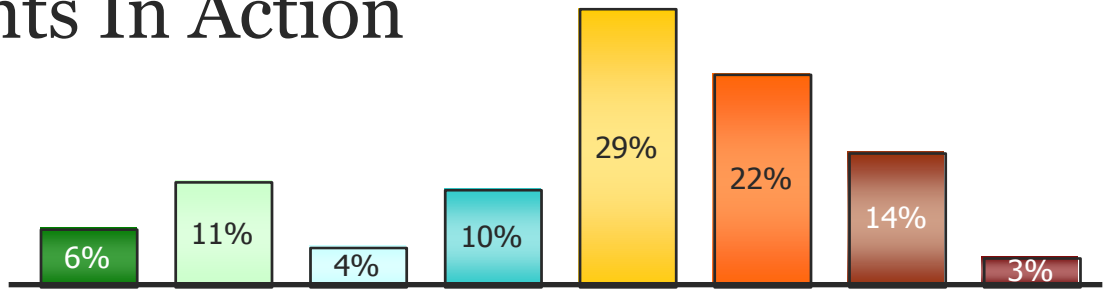
Top-two box scores

The Try Harders are quite concerned about the environment (as they are striving to be more environmental)

	Total (n=1,401)	1.Dark Greens (n=89)	2.Light Greens (n=161)	3.Potential Switchers (n=53)	4.Try Harders (n=143)	5.Practicals (n=406)	6.Extreme Practicals (n=303)	7.Unconcerned (n=194)	8.Browns (n=49*)
The current state of the environment	**40%**	79%	67%	49%	49%	41%	26%	21%	16%
The future state of the environment	**45%**	80%	74%	49%	52%	46%	31%	22%	20%
The effects of climate change	**39%**	81%	65%	47%	47%	40%	22%	19%	18%
Greenhouse gas emissions	**36%**	80%	61%	49%	43%	36%	21%	17%	14%
The loss of oxygen producing forests	**46%**	85%	73%	57%	50%	45%	35%	26%	18%
The level of government or industry leadership on environmental issues	**41%**	76%	66%	49%	46%	42%	31%	21%	16%
Access to alternative energy solutions	**41%**	75%	65%	55%	46%	41%	31%	19%	14%

* Caution: small base size

The Lifestyle Segments In Action



	Total (n=1,401)	1.Dark Greens (n=89)	2.Light Greens (n=161)	3.Potential Switchers (n=53)	4.Try Harders (n=143)	5.Practicals (n=406)	6.Extreme Practicals (n=303)	7.Unconcerned (n=194)	8.Browns (n=49*)
Top-two box scores									
Do you think Terasen Gas should be investing in biogas projects?	**49%**	76%	65%	53%	51%	50%	46%	31%	14%
Do you think Terasen Gas should invest in offering a biogas program to its residential customers?	**47%**	75%	62%	55%	48%	48%	44%	31%	14%
All things being equal, if Terasen Gas offered a biogas program, how likely would you be to sign up?	**31%**	48%	46%	45%	35%	29%	27%	22%	8%
Knowing this information, how likely would you be to purchase a carbon offset for your personal natural gas use in order to reduce your individual environmental footprint?	**16%**	35%	32%	25%	11%	16%	11%	9%	4%

Even though the Try Harders, Practicals and the Extreme Practicals believe that Terasen Gas should be investing in a biogas project, when it comes to actually signing up or paying, they are far less enthusiastic

* Caution: small base size

Reaching Out To The Greens

The Greens are the most likely segments to enroll in a biogas program. So, naturally it begs the questions – who are they and how does one best reach them? This group tends to skew towards female and have taken steps to save energy in the past. If Terasen maintains a database of households that have signed up for previous energy savings projects, this may be one way to access this segments. Additionally, there is a large concentration of Light Greens who receive their gas bill directly from Terasen. The gas bill may be another channel for reaching this group.

	Lifestyles Segments							
	Dark Greens	Light Greens	Potential Switchers	Try Harders	Practicals	Extreme Practicals	Uncon-cern	Browns
Base Size	(89)†	(161)	(53)†	(143)	(406)	(303)	(194)	(49)††
HAVE TAKEN STEPS IN PAST TO SAVE ENERGY								
Yes	100%	97%	91%	96%	95%	91%	80%	59%
No	0%	2%	6%	1%	2%	6%	10%	31%
Don't Know	0%	1%	4%	4%	3%	3%	9%	10%
GENDER								
Male	34%	30%	38%	30%	37%	35%	38%	63%
Female	66%	70%	62%	70%	63%	65%	62%	37%
HOW RECEIVE BILL								
Receive bill directly from Terasen Gas	46%	63%	49%	58%	59%	58%	56%	51%
Pay gas bill indirectly	20%	11%	23%	13%	15%	14%	13%	12%
Does not use gas	29%	24%	26%	25%	24%	25%	24%	31%

† Data based on sample sizes of less than 100 should be interpreted with caution.

†† Data based on sample sizes of less than 50 should be interpreted with extreme caution.

Attachment 10.2

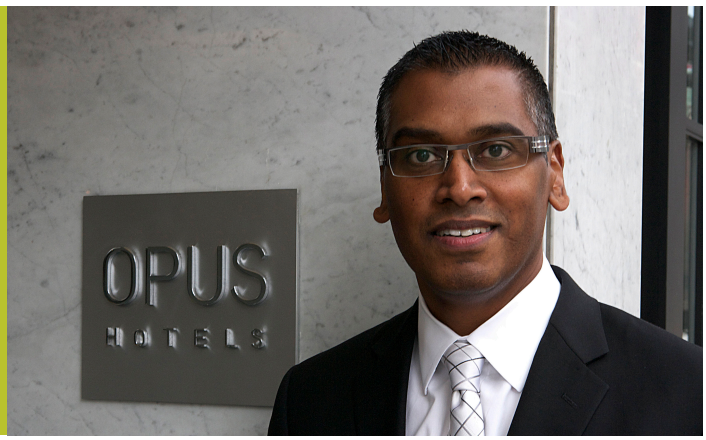
FORTIS BC™

Renewable natural gas
It's naturally better

OPUS Hotel Vancouver is a Green Leader

"We want to be a leader. By taking on this initiative, we hope to make an impact on the environment. My suggestion to other businesses is to seriously consider it."

Selvan Chetty, Financial Controller, OPUS Hotel Vancouver



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OPUS Hotel Vancouver signed up for renewable natural gas from FortisBC. Renewable natural gas is natural gas, but better, because the methane gas is captured from organic waste found at local landfills and farms. Green Leaders like OPUS Hotel Vancouver reduce greenhouse gas emissions and support sustainable energy that's made in B.C.

Your business can be a Green Leader too. To learn more and sign up, visit **fortisbc.com/rng**.

Scan this code with your smartphone app to watch the video instantly or go to **youtube.com/fortisbc.**

with OFFSETTERS carbon neutral product

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Be a Green Leader

Say yes to renewable natural gas

Renewable natural gas is another step in the right direction for our business and the environment.

Harold Burgess, CMA, Financial Controller, Fairmont Pacific Rim Hotel

Fairmont Pacific Rim is an industry leader in innovative sustainable programs. So saying yes to renewable natural gas was an easy decision. Plus, it helps reduce their carbon footprint and shows guests they care about the planet.

Your business can be a Green Leader too. Learn more at **fortisbc.com/rng**.

FORTIS BC™

FortisBC's renewable natural gas has been designated as carbon neutral in B.C. by Offsetters.

FortisBC Energy Inc., FortisBC Energy (Vancouver Island) Inc. and FortisBC Energy (Whistler) Inc. do business as FortisBC. The companies are indirect, wholly owned subsidiaries of Fortis Inc. FortisBC uses the FortisBC name and logo under license from Fortis Inc. (12-011.48 07/2012)

with OFFSETTERS carbon neutral product

FORTIS BC™

Renewable natural gas
It's naturally better

Van Houtte Coffee Services is a Green Leader

"We signed up for renewable natural gas because it's good for the environment and good for business."

Morten Schroder,
VP Operations, British Columbia,
Van Houtte Coffee Services

Companies like B.C.'s Van Houtte Coffee Services want to be a part of green-minded initiatives. That's why they signed up for FortisBC's renewable natural gas, a carbon neutral source of energy—derived from local organic waste. It's naturally better for the environment, so customers will love you for it. And that is ultimately good for business.

Your organization can be a Green Leader too. Visit **fortisbc.com/rng.**

with OFFSETTERS carbon neutral product

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Water heater draining your profits?

Start saving with the Efficient Commercial Water Heater Program

Install a high-efficiency natural gas water heater and qualify for a rebate of up to $15,000 from FortisBC. And now LiveSmart BC may match the incentive, doubling your rebate. That's up to $30,000.*

More information
fortisbc.com/businessoffers
commericalrebates@fortisbc.com
Call toll-free **1-866-884-8833**, option 1

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**Maximum rebate of $30,000 applies to a 3,000 MBH storage water heater or a hot water supply boiler with an efficiency of 90 per cent or higher.*

BRITISH COLUMBIA | LiveSmartBC.ca

FORTIS BC™

Follow a Green Leader

Thrifty Foods said yes to renewable natural gas

Thrifty Foods is committed to communities. So they chose renewable natural gas for their Lower Mainland stores. Made from local organic waste, it's naturally better for the environment.*

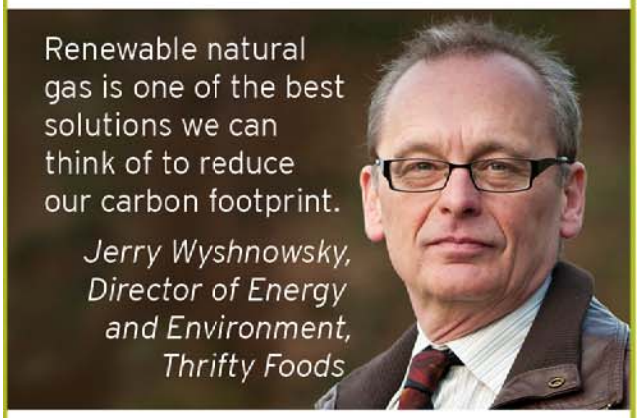
Your business can be a Green Leader too. Learn more at **fortisbc.com/rng**.

with OFFSETTERS carbon neutral product

**FortisBC's renewable natural gas has been designated as carbon neutral in B.C. by Offsetters.*

FORTIS BC™

Follow a Green Leader



Thrifty Foods said YES to renewable natural gas.

It's carbon neutral* and better for the environment... naturally. Your business can be a Green Leader too. Learn more at **fortisbc.com/rng**.

FORTIS BC™

with OFFSETTERS carbon neutral product

*FortisBC's renewable natural gas has been designated as carbon neutral in B.C. by Offsetters.

FORTIS BC™

Follow a Green Leader

Ezra Cipes, CEO, Summerhill Pyramid Winery

Summerhill Pyramid Winery is organic from vineyard to cellar. So they said yes to FortisBC's renewable natural gas made from local agricultural waste.

Watch Summerhill's story and learn how you can be a Green Leader.

Learn more

Attachment 28.1

G3516 LE

GAS ENGINE TECHNICAL DATA

CATERPILLAR®

Partial load data is an estimate

ENGINE SPEED:	1200	FUEL:	LOW ENERGY
COMPRESSION RATIO:	11:1	FUEL SYSTEM:	CAT LOW PRESSURE
AFTERCOOLER - MAX. INLET (°C):	54		WITH CUSTOMER SUPPLIED AIR FUEL RATIO
JACKET WATER - MAX. OUTLET (°C):	110	FUEL PRESS. RANGE (KPAg):	10.0 - 34.5
COOLING SYSTEM:	JW, OC+AC	MIN. METHANE NUMBER:	130
IGNITION SYSTEM:	EIS	RATED ALTITUDE (m):	350
EXHAUST MANIFOLD:	DRY	AT AIR TO TURBO. TEMP. (°C):	25
COMBUSTION:	LOW EMISSION	NOx EMISSION LEVEL:	338.0 mg/Nm3
		FUEL LHV (MJ/Nm3):	22.4
		APPLICATION:	60 Hz GENSET

RATING AND EFFICIENCY		NOTES	LOAD	100%	75%	50%
ENGINE POWER	(WITHOUT FAN)	(1)	KW	974	731	487
GENERATOR POWER	(WITHOUT FAN)	(2)	EKW	925	694	463
ENGINE EFFICIENCY	**(ISO 3046/1)**	**(3)**	**%**	**36.4**	**34.9**	**32.4**
ENGINE EFFICIENCY	(NOMINAL)	(3)	%	35.7	34.2	31.8
THERMAL EFFICIENCY	(NOMINAL)	(4)	%	40.3	42.2	45.7
TOTAL EFFICIENCY	(NOMINAL)	(5)	%	76.0	76.4	77.5

ENGINE DATA						
FUEL CONSUMPTION	**(ISO 3046/1)**	**(6)**	**MJ/bkW-hr**	**9.89**	**10.32**	**11.1**
FUEL CONSUMPTION	(NOMINAL)	(6)	MJ/bkW-hr	10.08	10.52	11.32
AIR FLOW (0 °C, 101.3 kPa)		(7)	Nm3/bkW-hr	4.26	4.14	4.28
AIR FLOW		(7)	kg/bkW-hr	5.5	5.35	5.53
COMPRESSOR OUT PRESSURE			kPa (abs)	281	237	183
COMPRESSOR OUT TEMPERATURE			°C	164	145	101
AFTERCOOLER AIR OUT TEMPERATURE			°C	57	51	46
INLET MAN. PRESSURE		(8)	KPAa	255	184	118
INLET MAN. TEMPERATURE	(MEASURED IN PLENUM)	(9)	°C	61	57	56
TIMING		(10)	°BTDC	24	24	24
EXHAUST STACK TEMPERATURE		(11)	°C	505	534	541
EXHAUST GAS FLOW (0 °C, 101.3 kPa)		(12)	Nm3/bkW-hr	4.54	4.44	4.6
EXHAUST MASS FLOW		(12)	kg/bkW-hr	6.05	5.92	6.15

EMISSIONS DATA					
NOx (as NO2) (corr. 5% O2)	(13)	mg/Nm3 (dry)	338	328	320
CO (corr. 5% O2)	(14)	mg/Nm3 (dry)	1812	1758	2067
THC (corr. 5% O2), molecular weight of 15.84)	(14)	mg/Nm3 (dry)	3038	3263	3173
NMHC (corr. 5% O2, molecular weight of 15.84)	(14)	mg/Nm3 (dry)	456	490	476
EXHAUST O2	(15)	% DRY	6.3	5.6	5.2
LAMBDA	(15)		1.57	1.46	1.41

HEAT BALANCE DATA					
LHV INPUT	(16)	KW	2726	2135	1531
HEAT REJECTION TO JACKET (JW)	(17)	KW	386	333	300
HEAT REJECTION TO ATMOSPHERE	(18)	KW	106	88	70
HEAT REJECTION TO LUBE OIL (OC)	(19) (22)	KW	91	84	75
HEAT REJECTION TO EXHAUST (LHV to 25°C)	(20)	KW	966	761	534
HEAT REJECTION TO EXHAUST (LHV to 120°C)	(20)	KW	713	567	400
HEAT REJECTION TO A/C (AC)	(21) (22)	KW	186	120	48
HEAT REJECTION TO ENGINE PUMPS		KW	17.2	17.2	17.2

CONDITIONS AND DEFINITIONS

ENGINE RATING OBTAINED AND PRESENTED IN ACCORDANCE WITH ISO 3046/1 (STD. REF. CONDITIONS OF 25°C, 100 KPA BAROMETRIC PRESSURE, 152 m ALTITUDE). NO OVERLOAD PERMITTED AT RATING SHOWN. CONSULT ALTITUDE CHARTS FOR APPLICATIONS ABOVE MAXIMUM RATED ALTITUDE AND/OR TEMPERATURE.

EMISSION LEVELS ARE BASED ON THE ENGINE OPERATING AT STEADY STATE CONDITIONS AND ADJUSTED TO THE SPECIFIED NOx LEVEL AT 100% LOAD. EMISSION TOLERANCES SPECIFIED ARE DEPENDANT UPON FUEL QUALITY. METHANE NUMBER CANNOT VARY MORE THAN ± 3. PUBLISHED PART LOAD DATA REQUIRES CUSTOMER SUPPLIED LAMBDA CONTROL.

ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS.

FOR NOTES INFORMATION CONSULT PAGE THREE.

FUEL USAGE GUIDE

CAT METHANE NUMBER	30	35	40	45	50	55	60	65	70	75	80	130
IGNITION TIMING	-	-	-	-	-	-	-	-	-	-	-	24
DERATION FACTOR	0	0	0	0	0	0	0	0	0	0	0	1.00

ALTITUDE DERATION FACTORS

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	0.96	0.93	0.91	0.88	0.85	0.82	0.80	0.77	0.75	0.72	0.70	0.68	0.66
45	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.79	0.76	0.74	0.71	0.69	0.67
40	0.99	0.96	0.93	0.91	0.88	0.85	0.82	0.80	0.77	0.75	0.72	0.70	0.68
35	1.00	0.98	0.95	0.92	0.89	0.86	0.84	0.81	0.78	0.76	0.73	0.71	0.69
30	1.00	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.80	0.77	0.75	0.72	0.70
25	1.00	1.00	0.98	0.95	0.92	0.89	0.87	0.84	0.81	0.78	0.76	0.73	0.71
20	1.00	1.00	1.00	0.97	0.94	0.91	0.88	0.85	0.82	0.80	0.77	0.75	0.72
15	1.00	1.00	1.00	0.98	0.95	0.92	0.90	0.87	0.84	0.81	0.79	0.76	0.74
10	1.00	1.00	1.00	1.00	0.97	0.94	0.91	0.88	0.85	0.83	0.80	0.77	0.75

ALTITUDE (METERS ABOVE SEA LEVEL)

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF)

AIR TO TURBO (°C)	0	250	500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000
50	1.25	1.29	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
45	1.18	1.23	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
40	1.12	1.16	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
35	1.05	1.10	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
30	1.00	1.03	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

ALTITUDE (METERS ABOVE SEA LEVEL)

FREE FIELD MECHANICAL & EXHAUST NOISE

100% Load Data			dB(A)	(dB)							
Free Field Mechanical	DISTANCE FROM THE ENGINE (METERS)	1	96.3	95.5	92.1	86.3	87.3	90.0	91.6	88.4	80.0
		7	86.7	85.9	82.5	76.7	77.7	80.4	82.0	78.8	70.4
		15	81.3	80.6	77.2	71.4	72.4	75.1	76.7	73.5	65.0
Free Field Exhaust	DISTANCE FROM THE ENGINE (METERS)	1.5	111.6	99.8	103.6	105.7	102.2	103.0	105.1	106.9	100.3
		7	98.3	89.5	91.8	93.2	89.6	92.0	91.8	92.2	85.2
		15	91.6	82.9	85.2	86.6	83.0	85.4	85.2	85.6	78.5
			Overal SPL	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 khz

Octave Band Center Frequency (OBCF)

FUEL USAGE GUIDE:
This table shows the derate factor required for a given fuel. Note that deration occurs as the methane number decreases. Methane number is a scale to measure detonation characteristics of various fuels. The methane number of a fuel is determined by using the Caterpillar Methane Number Calculation program.

ALTITUDE DERATION FACTORS:
This table shows the deration required for various air inlet temperatures and altitudes. Use this information along with the fuel usage guide chart to help determine actual engine power for your site.

ACTUAL ENGINE RATING:
It is important to note that the Altitude/Temperature deration and the Fuel Usage Guide deration are not cumulative. They are not to be added together. The same is true for the Low Energy Fuel deration (reference the Caterpillar Methane Number Program) and the Fuel Usage Guide deration. However, the Altitude/Temperature deration and Low Energy Fuel deration are cumulative; and they must be added together in the method shown below. To determine the actual power available, take the lowest rating between 1) and 2).

1) (Altitude/Temperature Deration) + (Low Energy Fuel Deration)
2) Fuel Usage Guide Deration

Note: For NA's always add the Low Energy Fuel deration to the Altitude/Temperature deration. For TA engines only add the Low Energy Fuel deration to the Altitude/Temperature deration whenever the Altitude/Temperature deration is less than 1.0 (100%). This will give the actual rating for the engine at the conditions specified.

AFTERCOOLER HEAT REJECTION FACTORS (ACHRF):
Aftercooler heat rejection is given for standard conditions of 25°C and 152 m altitude. To maintain a constant air inlet manifold temperature, as the air to turbo temperature goes up, so must the heat rejection. As altitude increases, the turbocharger must work harder to overcome the lower atmospheric pressure. This increases the amount of heat that must be removed from the inlet air by the aftercooler. Use the aftercooler heat rejection factor (ACHRF) to adjust for ambient and altitude conditions. Multiply this factor by the standard aftercooler heat rejection. Failure to properly account for these factors could result in detonation and cause the engine to shutdown or fail.

SOUND DATA:
Data determined by methods similar to ISO Standard DIS-8528-10. Accuracy Grade 3. SPL = Sound Pressure Level.

NOTES

1 ENGINE RATING IS WITH 2 ENGINE DRIVEN WATER PUMPS. TOLERANCE IS ± 3% OF FULL LOAD.

2 GENERATOR POWER DETERMINED WITH AN ASSUMED GENERATOR EFFICIENCY OF 95% AND POWER FACTOR OF 0.8 [GENERATOR POWER = ENGINE POWER x GENERATOR EFFICIENCY].

3 ISO 3046/1 ENGINE EFFICIENCY TOLERANCE IS (+)0, (-)5% OF FULL LOAD % EFFICIENCY VALUE. NOMINAL ENGINE EFFICIENCY TOLERANCE IS ± 3% OF FULL LOAD % EFFICIENCY VALUE.

4 THERMAL EFFICIENCY: JACKET HEAT + EXH. HEAT TO 120°C.

5 TOTAL EFFICIENCY = ENGINE EFF. + THERMAL EFF. TOLERANCE IS ± 10% OF FULL LOAD DATA.

6 ISO 3046/1 FUEL CONSUMPTION TOLERANCE IS (+)5, (-)0% OF FULL LOAD DATA. NOMINAL FUEL CONSUMPTION TOLERANCE IS ± 3 % OF FULL LOAD DATA.

7 UNDRIED AIR. FLOW TOLERANCE IS ± 5 %

8 INLET MANIFOLD PRESSURE TOLERANCE IS ± 5 %

9 INLET MANIFOLD TEMPERATURE TOLERANCE IS ± 5°C.

10 TIMING INDICATED IS FOR USE WITH THE MINIMUM FUEL METHANE NUMBER SPECIFIED. CONSULT THE APPROPRIATE FUEL USAGE GUIDE FOR TIMING AT OTHER METHANE NUMBERS.

11 EXHAUST STACK TEMPERATURE TOLERANCE IS (+)35°C, (-)30°C.

12 WET EXHAUST. FLOW TOLERANCE IS ± 6 %

13 NOX VALUES ARE SET POINTS AND WILL VARY WITH OPERATING CONDITIONS.

14 CO, CO2, THC, and NMHC VALUES ARE "NOT TO EXCEED".

15 O2% TOLERANCE IS ± 0.5; LAMBDA TOLERANCE IS ± 0.05. LAMBDA AND O2 LEVEL ARE THE RESULT OF ADJUSTING THE ENGINE TO OPERATE AT THE SPECIFIED NOX LEVEL.

16 LHV INPUT TOLERANCE IS ± 3%.

17 HEAT REJECTION TO JACKET TOLERANCE IS ± 10 % OF FULL LOAD DATA, BASED ON TREATED WATER.

18 HEAT REJECTION TO ATMOSPHERE TOLERANCE IS ± 50% OF FULL LOAD DATA, BASED ON TREATED WATER.

19 HEAT REJECTION OF LUBE OIL TOLERANCE IS ± 20% OF FULL LOAD DATA, BASED ON TREATED WATER.

20 HEAT REJECTION TO EXHAUST TOLERANCE IS ± 10% OF FULL LOAD DATA, BASED ON TREATED WATER.

21 HEAT REJECTION TO A/C TOLERANCE IS ± 5 % OF FULL LOAD DATA, BASED ON TREATED WATER.

SITE SPECIFIC COOLING SYSTEM SIZING EQUATIONS (WITH TOLERANCES)

22 TOTAL AFTERCOOLER CIRCUIT (AC+OC) = (AC x ACHRF x 1.05) + (OC x 1.2).