Specialized Pricing Strategy for Renewable Energy Suppliers to QEC

Final Report

InterGroup CONSULTANTS

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ATTACHMENTS

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1.0 INTRODUCTION

InterGroup Consultants Ltd (InterGroup) was retained by Qulliq Energy Corporation (QEC) to develop a specialized pricing strategy for renewable energy suppliers to sell renewable electricity to QEC as non-utility generators. The pricing strategy takes into consideration the findings and recommendations of the Utility Rates Review Council (URRC) in its October 6, 2020 report. This report provides InterGroup's findings and proposed next steps.

The impact of the proposed specialized pricing strategy on renewable energy penetration levels in Nunavut is not part of the assignment and is not addressed in this report.

Background to URRC Report

QEC is the sole supplier and distributor of electric power in Nunavut whose mandate is to provide safe, reliable and affordable electricity. QEC operates diesel power plants in 25 communities and supplies electricity to approximately 15,000 customers across Nunavut. The total installed capacity of QEC's power plants is approximately 76,900 kW.

QEC uses 55 million litres of diesel fuel annually to meet electricity demand for the territory. In 2018, QEC introduced a net metering program aimed at increasing renewable electricity generation. The program allows residential customers and one municipal customer account in each community to install a renewable energy generation system of up to 10 kW and deliver energy that is surplus to the customer's needs to QEC's system. Customers receive a credit for energy they deliver to the grid that can be used to offset future electricity purchases from QEC.

As a next step in the strategy to increase renewable energy generation in Nunavut, QEC launched/implemented the Commercial and Institutional Power Producers (CIPP) program in March 2021. The program will allow commercial and institutional customers to generate renewable electricity to sell to QEC.

QEC applied to its Minister on May 11, 2020, for approval of a pricing structure for the CIPP program where customers would be paid for the energy they deliver to QEC based on the avoided cost of diesel fuel. The Minister referred the request to the URRC. The URRC noted many of the public submissions it received in response to QEC's application suggested the CIPP prices should not be based solely on the avoided cost of diesel fuel and that other costs and benefits should be included in the CIPP pricing structure.

In their October 6, 2020 report to the Minister, the URRC recommended rejecting QEC's proposal based on their view that other costs and benefits of renewable generation should be included in the pricing structure. In particular, the URRC recommended the following:

- QEC should directly engage with stakeholders in its supply chain to identify any other potential avoided costs related to the introduction of renewable energy generation.
- QEC should directly engage with other government departments and private organizations that are currently developing or are currently actively planning for the development and installation of commercial-scale renewable energy generation systems in Nunavut in order to better understand the financial requirements of those projects.

- QEC should address the many concerns expressed in this Report about its pricing structure in any new CIPP Application.
- QEC should reapply for approval of the CIPP program in its entirety when all aspects of the program are ready for approval, perhaps when the IPP is also ready to be submitted.
- If any new grants, benefits, incentives, or cost savings related to renewable energy are identified by the Government of Nunavut (GN) or elsewhere, they should be made available to QEC so they may be flowed through to CIPP proponents in the CIPP price.

The Minister's letter to QEC dated November 4, 2020, directed QEC to develop a new pricing proposal factoring in the considerations brought forward by the URRC.

2.0 APPROACH

2.1 CIPP PROGRAM OBJECTIVES

QEC's objectives for the CIPP program are:

- To promote the development of renewable electricity generation in Nunavut, including establishing a price that provides a reasonable incentive to customers to develop renewable generation.
- To ensure purchasing renewable electricity through the CIPP program does not increase costs to QEC's customers, who already pay some of the highest electricity rates across Canada.

QEC's original CIPP pricing structure application proposed that compensation for CIPP renewable generation should be based on the avoided cost of fuel to QEC to ensure purchases from CIPP customers would not increase costs. However, the URRC found a CIPP power purchase agreement (PPA) price based solely on the avoided cost of fuel to be insufficient to encourage the development of renewable generation in Nunavut.

The public submissions to the URRC agreed with QEC that the CIPP program should be cost-neutral to customers but noted that it should also be attractive enough to encourage investment in renewables – and reflect the full avoided costs of diesel to QEC, the Government of Nunavut (GN) and society in the short and long term that can result from use of renewables to reduce materially the current reliance on diesel generation. By way of example, the CIPP PPA price proposed by QEC based on the avoided cost of fuel was $0.252/kWh, while the minimum CIPP PPA price proposed in the Pembina Institute submission was $0.400/kWh.

The challenge to QEC is to develop a pricing structure solution that facilitates the desired increase in renewable generation, but does not lead to cost increases to customers. In order for the CIPP program to be cost-neutral to customers, QEC can only offer compensation prices equivalent to the costs it saves directly, which include the avoided cost of diesel fuel, non-fuel Operations & Maintenance (O&M) savings and any net capital cost savings. These cost savings may vary in the short-term and the longer-term, e.g., by 2030. However, QEC's savings alone are unlikely to provide sufficient incentive to potential CIPP customers without territorial and/or federal government support.

2.2 APPROACH

This review focuses on assessing the full range of factors affecting the cost of fossil fuel use for electricity generation in Nunavut, including:

- Variable fuel costs;
- Non-fuel operating costs;
- Capital related costs;
- Government subsidies; and
- Social and external costs.

The analysis is based on review of publicly available documents, including public submissions and the URRC report on QEC's 2020 CIPP pricing structure application, practices of other jurisdictions, Government of Canada policies and programs and other relevant literature.

The proposed pricing strategy facilitates the desired transition to renewable generation and contributes to achieving the Government of Canada's renewable energy development targets by 2030. The strategy clearly outlines the role of QEC and the support required from the territorial and federal governments for the successful implementation of the pricing framework. Section 4 sets out the details of the proposed pricing structure. Supporting detail is provided in three attachments:

- **Attachment 1 – Current Utility Avoided Diesel Generation Costs:** This attachment analyses the direct utility costs that would be avoided through increased renewable energy generation including variable fuel costs, non-fuel operating costs, and capital related costs. The attachment also summarizes findings from public submissions and publicly available studies used in deriving the estimates for these costs.
- **Attachment 2 – Avoided Cost of Diesel Generation Outside of QEC's Cost Structure:** This attachment focuses on identifying and estimating government fuel cost subsidies. In particular, the public submissions note the current cost of fuel to QEC is subsidized by the GN. Accordingly, if QEC reduces diesel consumption, the GN saves the portion of the fuel cost that it subsidizes.
- **Attachment 3 – External / Social Cost of Diesel Generation:** This attachment reviews social and external costs related to diesel generation. Social costs may include direct and indirect impacts to health and well-being of people, impacts to animals and plants, climate change effects and other impacts. Social costs are not limited to the communities where the diesel generation occurs (e.g., GHG emissions related to such diesel generation can impact climate globally). Recent international studies are reviewed to provide preliminary indications of possible social and external costs.

3.0 SUMMARY REVIEW OF THE URRC REPORT AND PUBLIC SUBMISSIONS

3.1 SUMMARY OF URRC COMMENTS

The URRC report notes QEC's statement that its mandate is to provide safe, reliable and affordable electricity. The URRC also notes QEC's statement that it recognizes the need for a long-term approach that prioritizes and maximizes the benefits of moving to renewable energy and affordable electricity and that the CIPP program is aligned with that objective. As well, during the review process, QEC and the Climate Change Secretariat of the GN submitted that the GN is committed to reducing GHG emissions in Nunavut.

The key findings in the URRC report include:

- The URRC stated it was clear from QEC's application and the public submissions that there is no consensus on how to introduce and provide incentives for the development of renewable generation reflecting the fact that there are significant differences in service territory, systems, legislation, policies and programs across Canada. The URRC in particular noted that while Nunavut's programs may be informed by the approach taken in other jurisdictions, Nunavut and QEC should develop its own program.
- The URRC stated that in general terms it agreed with the premise that QEC should enable the addition of renewable generation to its system without increasing the costs and rates for its other customers. The URRC however noted that it was not clear if a CIPP price based solely on the avoided cost of fuel will be sufficient on its own to provide the necessary incentives to encourage the development of renewable generation in Nunavut.
- With respect to the relationship between renewable generation added to QEC's grid and the corresponding diesel savings, the URRC noted QEC's position that a linear one-to-one relationship may not be realized in the short-term due to generation requirements and operational conditions. The URRC commented that while it understands there may not be a perfect one-to-one relationship between avoided cost of diesel and renewable generation it should be close in the long term as suggested by QEC.
- Based on the premise of not increasing costs and rates to other QEC customers, the URRC noted that most of the additional considerations that could be included in the pricing structure should only be adopted if QEC is either flowing through actual direct cost savings, or government grants or other contributions. The URRC shared QEC's position that it is not acceptable to include additions in the CIPP PPA price that are funded by other QEC customers, especially if it will take some time for the cost savings to be confirmed. The URRC considered that avoided variable costs and deferred fixed costs, as well as costs incurred by QEC in the future that may be avoided through renewable generation, should be considered for inclusion in the CIPP PPA price at the appropriate time.
- The URRC also found that many of the suggestions for improvement provided in the public submissions could be addressed and included in the PPA – the URRC noted matters like the term, renewal options, determination of the initial rate, guaranteed minimum rate,

adjustment mechanism (including the escalation, de-escalation, overall cap on purchase rate increases), and regulatory review could all be clarified in the PPA. The URRC considered that if the pricing adjustment mechanism is well documented, and clear enough, it may be made routinely and without significant regulatory effort (or perhaps none).

3.2 SUMMARY OF PUBLIC SUBMISSIONS

The Nunavut Nukkiksautiit Corporation (NNC) and Pembina Institute submissions to the URRC calculated the total avoided cost of fossil fuel generation at a significantly higher amount than the diesel fuel cost in QEC's application due to inclusion of additional cost categories. Categories of avoided costs reviewed in these submissions included:

- NNC's submission calculated the total Nunavut avoided diesel electricity cost at $0.640/kWh, including QEC costs for fuel ($0.255/kWh), diesel generation O&M ($0.160/kWh) and diesel capital ($0.173/kWh), plus $0.052/kWh of Petroleum Product Division (PPD) O&M, capital and environmental costs related to selling diesel fuel to QEC. NNC proposed a minimum renewable electricity price at $0.520/kWh based on 100% of QEC fuel and PPD environmental costs, 60% of the other QEC and PPD non-fuel avoided diesel costs, and $0.033/kWh for estimated GN subsidy savings with 20% renewables penetration. The QEC portion of the proposed price is $0.455/kWh and GN portion $0.065/kWh. NNC submitted that its proposed approach would enable cost savings for QEC customers. NNC proposed higher prices for projects with Inuit ownership and locations other than Iqaluit.
- The Pembina Institute stated the PPA rate for CIPP rate should be a minimum of $0.400/kWh to include O&M as well as fuel cost savings, based on QEC's reported 2018-19 diesel generation costs and experience in other jurisdictions. This submission also suggested renewable pricing should take into account savings on diesel subsides while recognizing the additional social, health, and environmental benefits renewable energy systems can offer.

The NNC and Pembina Institute submissions supported QEC's position that the CIPP pricing structure should not result in rate increases to QEC's customers but argued that the proposed higher prices for renewables would reflect savings to QEC from avoided diesel generation costs. Further, as noted by URRC, sustainable renewable development in Nunavut was seen in these submissions to require materially higher prices than QEC had proposed.

The comments from the public interveners mainly focused on the cost issues and categories discussed below:

- **Avoided Cost of Diesel Fuel, Territory-Wide CIPP Pricing over Multiple Years:** A common comment in the public submissions with respect to the avoided cost of diesel was that QEC's application with its focus on diesel fuel costs proposed a single territory-wide purchase price for CIPP power, which does not reflect the differences in construction and operational costs across Nunavut that affect renewable option development. Comments were also provided on changes to CIPP purchase power prices related to fuel cost changes over multiple time periods, and the need for a minimum CIPP purchase power price to support renewable development.

  The Nihtat Energy Ltd. (NEL) submission stated that QEC's energy rates charged to non-government commercial customers vary materially between different communities, reflecting variances in QEC costs as well as community cost of living. NEL stated that in order to support CIPP renewable generation development outside of Iqaluit, it is appropriate to assess options to vary CIPP prices to reflect these basic cost variances. NEL also strongly supported the QEC proposal for a minimum purchase price that cannot change over the term of a PPA, regardless as to potential reductions in QEC's actual cost of diesel generation. NEL noted that capital intensive renewable generation project financing requires this degree of minimum price certainty, as well as a minimum price that is adequate and effective to develop CIPP renewable generation for sale to QEC.

NNC proposed that a Locational Value be included in a power pricing structure to ensure power producers are being reasonably compensated for the additional costs associated with projects in more remote communities, thus equalizing project economics across communities.

Pembina Institute referenced the REINDEER program in Ontario, which offers PPA rates specific to each remote community in northern Ontario because transportation costs vary so widely (with PPA rates ranging from $0.258 per kWh to $0.691 per kWh).

The Pembina Institute submission noted that at a minimum, PPA rates should be specific to communities, as diesel energy costs vary between Nunavut's 25 communities. Pembina Institute states that this should be done to foster equity between communities and renewable energy proponents developing projects.

Pembina Institute also recommended that that 100% of cost increases in diesel fuel prices should be passed on to the PPA rate (as opposed to 50% as outlined in the policy proposal), potential decreases in PPA rates in relation to diesel price decreases should be removed from the policy, and the 20% cap on PPA rate increase should be removed.

- **Avoided Cost of Diesel Non-Fuel O&M:** NNC's submission presented its calculation of the avoided cost of diesel generation non-fuel O&M based on NNC's analysis of QEC's electricity cost components, which include plant operations and technical support operations. Review of NNC's submissions suggests that NNC calculated avoided diesel generation non-fuel O&M per kWh in two steps:

    1. Estimate plant operations and technical support operations costs related to energy generation. For this estimate NNC stated that it used QEC's 2018/19 GRA expenses, where NNC states 70% of plant operations costs were allocated to electricity generation.

    2. Divide estimated energy generation related O&M costs by total annual generation to calculate avoided cost of O&M per unit of generation.

Using this approach NNC derived an avoided diesel generation O&M cost of about $0.160/kWh.

Pembina Institute and NEL also noted renewable generation results in lower generator operational time and therefore lower non-fuel O&M costs to QEC. These parties submitted these cost savings should be passed on to CIPP customers and reflected through an increase in the PPA rate for CIPP. NEL referenced a Northwest Territories Power Corporation (NTPC) estimate in 2009 that a cost of 2.5 cents/kWh would be a conservative estimate for the minimum expected diesel non-fuel O&M incremental costs saved by purchase of renewable generation and that these incremental cost savings could exceed 6 cents/kWh. NEL also noted that the 2.5 cent/kWh saving reflected short-term cost savings from use of renewable generation, and that increased non-fuel O&M savings should result from a long-term shift to renewable generation.

- **Avoided Diesel Capital Costs:** NNC submission stated that based on QEC's 2018/19 GRA about 88% of QEC's capital costs are allocated to electricity generation and computed estimated capital cost savings from renewable generation at $0.170/kWh.

  The Pembina Institute and NEL submissions similarly noted that savings from deferred capital costs should be included in the CIPP PPA rate, however they did not provide any estimate of this avoided cost.

- **Government Subsidies:** The NNC submission referenced PPD operational savings for diesel fuel use and other GN subsidies to QEC related to non-fuel O&M and capital costs. With respect to the PPD operational savings to be included in the fair renewable purchase power rate, NNC proposed $0.032/kWh comprising 60% of PPD operational and capex savings and 100% of PPD environmental savings as estimated by NNC. The NNC submission also proposed to include avoided GN subsidies to customers in the avoided cost of fuel calculation for CIPP pricing structure, which it estimated at $0.033/kWh (based on NNC's estimated QEC production cost savings with renewable generation translating to proportional savings to the GN in subsidies).

- **External / Social Costs of Diesel Generation:** The NEL submission noted that the social cost of CO_2 emissions as at 2020 has been estimated at $50/tonne, and that at a minimum the social cost of QEC diesel generation could be estimated at this current cost of $50/tonne (4 to 5 cents/ kWh of diesel generation), with increases as estimated for future years. NEL suggested that this social cost could reasonably be added to the price for renewables used to displace diesel generation, recommending that federal funding support be sought to enable (without added costs to customers) PPA prices for CIPP to reflect social costs saved.

  The Pembina Institute submission noted there are a few leading examples where utilities and governments have negotiated "social adders" of 5% to 10% on top of the PPA price to recognize the benefits of renewables and the long-term reduction of diesel dependence. An example is provided of an economic development rider of $0.184/kWh added by directive of the Ontario government to the base PPA price for the Whites and First Nation in northern Ontario.

4.0 RENEWABLE ENERGY PRICING STRATEGY

The development of a pricing strategy considered the economic aspects of diesel generation displacement highlighted in the public submissions summarized in the URRC's report:

1. **Avoided Cost of Diesel Fuel:** Direct savings in fuel costs to the utility and customers can be readily established. QEC's original pricing application reflected this avoided cost component as the basis for CIPP generation compensation, subject to adopting a territory wide average fuel price versus the fuel price applicable to each community.
2. **Avoided Cost of non-fuel O&M:** These are other types of diesel generation expenses (plant operator salaries, generator set maintenance and overhauls, maintenance of the power plant, and other non-fuel O&M). Some of these cost savings occur in the short-term while other savings arise only in the longer-term.
3. **Capital Costs:** Renewable generation may allow the utility to defer new investment in diesel generation assets. However, the intermittent nature of renewable generation may require additional investment in new assets such as battery storage to ensure power stability.
4. **Government Subsidies:** This cost category includes government subsidies related to the diesel energy generation.
5. **External / Social Costs of Diesel Generation:** This cost category includes social/health costs of diesel which are not reflected in the price of fuel charged.

Not all of these cost components are included in QEC's current cost of electricity. Further, some types of avoided diesel generation costs do not materialize in the short-term. For example, as discussed in Section 3.2, NNC derived an avoided diesel generation non-fuel O&M cost of about $0.160/kWh. However, this is an average cost of O&M, which does not indicate the extent to which QEC can avoid O&M costs for diesel generation in either the short or long term through reductions in diesel generation. In the short-term there may not be any material cost non-fuel O&M savings to QEC or customers.

Accordingly, in order to ensure the CIPP program implemented today is revenue neutral to other customers, QEC can only offer compensation prices based on its direct short-term cost savings. Basing the CIPP power purchase price on both direct and indirect costs of diesel generation without external support to QEC will raise the cost of electricity to other QEC customers. This would be contrary to the position of all parties (QEC, the URRC and public interveners) that the CIPP program should not result in higher rates to other QEC customers.

QEC as the utility, the public, represented by the URRC and interveners, and CIPP program proponents – are aligned in the promotion of renewable energy generation in Nunavut. However, the challenge to QEC is to develop a pricing structure solution that facilitates the desired transition to the development of renewable generation in Nunavut but does not lead to cost increases to customers in the Territory.

The federal government announced its target to have 90 percent of Canada's electricity coming from non-emitting sources by 2030. This will likely require significant renewable uptake in the Territories. As such, QEC has an opportunity to partner with the GN and Federal government to bridge the cost difference between the avoided cost of diesel that QEC can track and record as customer savings and the rate reflecting more economic aspects than pure avoided cost of diesel fuel and other QEC diesel costs that are necessary to make the CIPP program attractive to customers.

4.1 SHORT-TERM PRICING STRATEGY

The initial proposed pricing strategy is based on short-term avoided cost parameters and estimated current costs of diesel generation in Nunavut. This pricing strategy separately estimates price components which arise from avoided costs to QEC and components which are external to QEC's cost structure. This clearly illustrates the need for government support to promote renewable generation in Nunavut.

- **Avoided cost of diesel generation in QEC's costs:** This category includes the following avoided costs:
  - **Variable fuel costs:** short-term variable fuel costs are based on the average fuel price of $0.940/l and the average approved fuel efficiency of 3.76 kWh/l as detailed in Attachment 1.
  - **Non-fuel O&M:** In the short-term there may not be any material non-fuel O&M cost savings to QEC or customers. InterGroup's review of the applied literature as detailed in Attachment 1 indicates a short-term avoided non-fuel O&M cost of diesel specific for a number of Nunavut communities, including Iqaluit, Baker Lake and Rankin Inlet ranging from $0.017/kWh to $0.025 /kWh. Therefore, in the short-term, the proposed pricing structure reflects a short-term cost saving of $0.020/kWh for non-fuel O&M savings.
  - **Capital related costs:** QEC capital costs of $0.170/kWh referenced by NNC are an average per kWh of all existing annual capital costs allocated to diesel generation activities. This average does not indicate the extent to which QEC can avoid future capital costs for diesel generation in either the short or long term through reductions in diesel generation. Accordingly, the short-term parameter for this avoided cost category is set at zero in the proposed pricing framework. Potential considerations for future review are noted below.

    Among other considerations, diesel capital costs are likely to increase going forward as older facilities are replaced with required new facilities. In addition, diesel generation facilities with sufficient capacity to serve the winter peak power demand in each community are likely to continue to be required for system reliability. Intermittent renewable energy generation will likely reduce diesel engine operation hours but will not impact diesel engine required capacity due to its intermittent nature. Intermittent generation requirements can result in engine operation being less fuel efficient and require higher maintenance cost.

- **Avoided external costs of diesel generation:** This category includes the following avoided costs:
    - **PPD avoided costs:** The cost of fuel delivered typically includes basic commodity prices (e.g., market prices for oil), processing cost to provide the specific fuel (e.g., refinery cost for diesel fuel reflected in retail prices), transportation from processing centers to the northern community, storage costs at the community (repairs and maintenance only, reflected in retail prices), and any taxes applicable to the fuel. QEC's communication with PPD confirmed that PPD does not charge a price markup to bulk fuel deliveries to QEC, however nominated fuel deliveries do include a small markup for PPD overhead, administration, facilities maintenance and similar expenses. Further, in all likelihood, PPD in the near term will not be shutting down any facilities or reducing maintenance or capital expenditure because QEC is purchasing some intermittent renewable energy. Given the current intermittent nature of the renewable energy in Nunavut, QEC will have to plan and order enough fuel every year in at least the short to medium term as though the renewable generation were unavailable to meet energy requirements. Accordingly, QEC does not expect to see PPD cost savings related to the renewable energy generation in the short to medium term. However, considering that this is an external cost component to the avoided cost of diesel generation, for purposes of the current assignment, the proposed pricing strategy uses a PPD avoided cost estimate of $0.032/kWh as calculated by NNC and detailed in Attachment 2. This strategy recognizes that reduced diesel generation due to increased renewables will reduce the new PPD annual diesel supply requirements needed for QEC to ensure that available stored diesel volumes for each year are adequate to supply requirements as though the renewable generation were unavailable to meet energy requirements.
    - **Social and external cost:** InterGroup undertook a review of international studies on social and external costs, which is detailed in Attachment 3. A 2017 study from Germany provides medium level estimates for social costs of fossil fuel electricity generation at $0.120/ kWh for GHG emissions, $0.006/kWh for non-GHG pollution and $0.001/kWh for impacts on ecosystem and diversity.[1] These estimates are generally in line with InterGroup's own 2016-17 review of social cost of diesel generation.

      The main challenge with respect to the social cost of avoided diesel generation is that while these costs are acknowledged and the estimates are provided in the literature, there is typically a lack of any practical mechanism to include these costs in the renewable generation pricing mechanism.

      One potential mechanism to address these social costs in the Canadian context is the federal government carbon pricing program. Carbon tax implementation by the federal government is designed in part to capture social costs of carbon emissions. The federal government explains that the federal carbon pollution pricing system is about recognizing the cost of fossil fuel pollution, empowering Canadians, and

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[1] Values have been converted to Canadian dollars based on the exchange rate of CAD1:€0.677.

encouraging cleaner growth and a more sustainable future.[2] The federal government has announced that it will increase the carbon price from $50 per ton in 2023 (approximating $0.040 cents per kWh of diesel generation) by $15 per year, rising to $170 per tonne in 2030 (approximating $0.120 cents per kWh of diesel generation).[3] At these target carbon price levels, the related carbon price component will be approaching levels similar to the international study estimates for social and external costs of diesel generation.

In summary, the CIPP pricing strategy could include the federal government's carbon pricing system as a mechanism for capturing social costs of diesel generation. Absent carbon taxes being applied to QEC diesel generation and increasing ratepayer costs, this carbon pricing system would need to be applied to a government funded price support for CIPP renewable generation that displaces QEC diesel generation.

At a carbon price support of approximately $0.100/kWh, the federal government annual subsidy to the social cost component of the PPA price structure would approximate $2.0 million at a renewable penetration level sufficient to displace 10% of QEC's generation across all communities.

- **Single PPA Price across Nunavut:** Public submissions noted that one CIPP purchase rate for all communities was not attractive and does not reflect the differences in construction and operational costs across Nunavut.

  Fuel prices charged to QEC by PPD are fairly harmonized across Nunavut. Looking only at fuel costs, the small cost differences which exist do not appear to justify a community-based structure, given that such a structure will add administrative cost to the program.

  QEC purchases fuel under two different arrangements – in some communities QEC has sufficient fuel-storage to make bulk fuel purchases via sealift, while in other communities and in the off-season period QEC makes trucked fuel purchases from PPD (nominated fuel purchases). QEC confirmed the nominated price for diesel fuel is the same for all communities, except Iqaluit. In the most recent Fuel Stabilization Rate Rider application (March 2021), the average fuel prices by community were about $0.900/litre in 19 of 25 communities with prices in the remaining communities being about $0.800/litre, the differences driven by bulk fuel purchases.

  Construction and operational cost differences for renewable generation facilities related to CIPP projects cannot be reflected in QEC's compensation price because they are not part of QEC's cost structure.

  Based on these considerations, the proposed framework uses a single PPA price across the territory.

[2] How carbon pricing works. Available at: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html.
[3] Pricing Carbon Pollution. Available at: https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/annex_pricing_carbon_pollution.pdf.

Table 1 presents the proposed initial CIPP pricing strategy for the short-term. In the longer-term, the calculation of each component can be reviewed and updated as required to reflect long-term changes, including capital cost changes.

Table 1: Proposed Initial CIPP Pricing Strategy

Pricing Component		Price Short-Term	
Avoided Cost of Diesel Generation in QEC's Costs			
Variable Fuel Cost	$	0.250	$/kWh
Average QEC Fuel Price ($/l)	*$*	*0.940*	$/l
Average QEC Fuel Efficiency (kWh/l)		3.760	kwh/l
Non-Fuel O&M ($/kWh)	$	0.020	$/kWh
Capital related costs			
Asset life extension			
Grid stability investment			
Sub-total PPA price reflected in QEC's costs	**$**	**0.270**	$/kWh
Avoided Cost of Diesel Generation not in QEC's Costs			
Government subsidies			
PPD cost savings	$	0.032	$/kWh
Social and External Cost	$	0.100	$/kWh
Sub-total PPA price from external funding (non-QEC costs)	**$**	**0.132**	$/kWh
Total Power Purchase Price with Government Support	**$**	**0.402**	$/kWh

The approach outlined in Table 1 could potentially yield an avoided cost price of $0.402/kWh with the following components that exclude any added support for Inuit ownership:

- Avoided QEC diesel costs of $0.270/kWh (e.g., potentially at $0.250/kWh for fuel costs and $0.020/kWh for short-term non-fuel O&M costs) based on the actual fuel cost provided in QEC's CIPP Pricing Structure application from May 2020;
- Avoided PPD costs of $0.032/kWh; and
- Federal carbon price funding support of $0.100/kWh (equal to carbon price of approximately $140/tonne of diesel CO_2 equivalent emissions).

4.2 LONGER-TERM CONSIDERATIONS

Fuel prices, non-fuel O&M and capital costs are likely to vary in the longer-term, along with the level of displacement of non-fuel O&M and capital costs by new renewables. The federal government has also set renewable energy targets by 2030. Therefore, it is important to develop a longer term pricing assessment that will allow QEC to plan for material renewable energy development, likely cost changes and funding requirements.

Future study is recommended to evaluate the overall savings to QEC capital generation costs linked to a range of avoided diesel generation scenarios. In general, long-term capital costs savings are likely to be related to new facilities required for each system and the reduced annual hours of generation required from these facilities due to significant renewable uptake.

In this regard, it is noted that the community of Old Crow in Yukon has recently completed a community-scale 940 kW solar microgrid project with battery storage (where ATCO Electric Yukon will be responsible for operating the battery storage system and overall microgrid).[4] The project is expected to displace around 25% of diesel use in the community and may become a good source for assessing the practical extent of likely diesel non-fuel avoided costs (both capital and O&M).

As well, with respect to NNC's estimates for the GN avoided cost of subsidies to customers, InterGroup's analysis of avoided QEC non-fuel and capital costs does not show any basis for assuming any near-term reduction in GN subsidies due to renewables displacing diesel generation. Assessment of potential long-term impacts on GN subsidies would require future studies of overall long term QEC cost changes.

4.3 SOCIAL DEVELOPMENT SUPPORT

Both NNC and Pembina Institute commented on a need to include Inuit Ownership Incentive in the pricing structure to promote and prioritize Inuit-owned renewable energy proponents for CIPP applications.

While such an incentive is not directly related to avoided cost of diesel generation, the GN has a policy targeted at supporting Inuit business development – Nunavummi Nangminiqaqtunik Ikajuuti (NNI Policy). The objective of the NNI Policy includes increasing participation of Inuit firms in business opportunities in Nunavut; improving capacity of Inuit firm to compete for contracts; promoting employment of Inuit in Nunavut; increasing access by Inuit to on-the-job training, apprenticeship, skill development; and providing greater opportunities for Inuit in successfully creating, operating, and managing Northern business. Supporting Inuit ownership of renewable energy investments under the CIPP program and upcoming Independent Power Producers program is consistent with the GN's NNI Policy objectives. As such, inclusion of a price premium for Inuit-owned projects appears justified. However, in order to avoid higher customer costs, this component can only be included if funded via government contribution (i.e. a flow-through subsidy from the government to Inuit-owned CIPP renewable generation). The proposed pricing strategy includes this parameter as social development support.

The NNI Policy is tailored to procurement contracts and its methodology is not directly applicable to setting up an Inuit-owned business in Nunavut. However, the NNI methodology allows bid price adjustments in the range of 5%-25% depending on the Inuit and Nunavut labour involvement and location of the business. It appears reasonable to apply a parameter within this range to the CIPP purchase price, which could be linked to the proportion of Inuit ownership of the CIPP facility. The illustrative parameter in the proposed pricing structure assumes a limit of

[4] Power Shift in Remote Indigenous Communities, Dylan Heerema, Dave Lovekin, July 2019. Available at: https://www.pembina.org/reports/power-shift-indigenous-communities.pdf.

20% price premium prorated at assumed Inuit ownership of 50% (i.e. 10% price premium) and is illustrated in Table 2.

Table 2: Social Development Support Pricing Component

Total Power Purchase Price with Government Support	$	0.402	$/kWh
Inuit ownership support		10%	
Maximum price adjustment		20%	
Inuit ownership in the project		50%	
Social Development Support (Inuit Ownership)	**$**	**0.040**	$/kWh

The QEC Act allows for the establishment of Affordable Energy Fund for the purpose of subsidizing the cost of energy or otherwise making energy more affordable.[5] Feasibility of a partnership arrangement with the government for the renewable energy development via Affordable Energy Fund may be an item for consideration by QEC.

4.4 GUARANTEED MINIMUM PRICE AND PRICE ADJUSTMENT MECHANISM

QEC's CIPP pricing application provided a minimum price based on the $0.252/kWh recorded at the time of the proposal. InterGroup notes IPP renewable energy prices paid by utilities in Yukon and British Columbia include a minimum price. The URRC questioned why price increases/ decreases should not be symmetrical, with no limits up or down.

QEC's CIPP proposal understands a minimum price is an important element for capital intensive renewable energy projects - absent a minimum price, renewable energy investors are required to bear unacceptable risks related to world market fuel price changes. As such, consideration will need to be given to setting a floor for the diesel fuel price component to clarify and manage risks related to development of the desired capital-intensive renewable generation while also addressing potential adverse impacts on QEC customer costs.

There are certain options to design a minimum price such that it provides some price certainty to investors while avoiding undue risk of overpayment by the utility/customers for the avoided cost of diesel generation. The following options are proposed for consideration by QEC in the pricing strategy:

1. **Option 1:** Setting a minimum price at the initial rate, similar to QEC's CIPP pricing application, where however any negative difference between actual cost of avoided diesel generation and the minimum price (i.e., the minimum price being higher than the actual cost of diesel generation) is funded via government contribution. This requires establishing a partnership funding agreement between QEC and the government.
2. **Option 2:** Setting a minimum price at the initial rate, similar to QEC's CIPP pricing application, but subject to deferral treatment of the difference between actual costs of avoided diesel generation and the minimum price. Under this approach any variance between

[5] Consolidation of Qulliq Energy Corporation Act, R.S.N.W.T. 1988, c. N-2; paragraph 39(1).

minimum diesel and actual cost of avoided diesel generation is tracked in a deferral account, where:

a. When the minimum price is higher than the actual cost of diesel generation the deferral account will be charged with a balance for future recovery from the power purchase payments to the CIPPs.

b. When actual cost of diesel generation becomes higher than the minimum price, this difference is first used to true-up the deferral account balance to bring up to zero, and only after that true-up would the current power purchase price from CIPPs be adjusted for the price increase.

Option 2 can be directly designed and administered by QEC and does not require any additional funding mechanism and arrangements with external parties.

The details with respect to setting of the initial minimum price, its adjustment frequency and application to current and newly joining CIPP customers can be developed depending on the option selected for consideration.

With respect to the price adjustment frequency and price adjustment caps, the URRC and public submissions commented that price adjustments should be more frequent (e.g., annual) rather than timed with a general rate application (GRA). The proposed pricing framework provides for semi-annual adjustments timed to the Fuel Stabilization Fund update filings. The CIPP pricing framework also proposes any price increases resulting from the adjustment first used to true-up Minimum Price Deferral Account balance (if Option 2 is selected), following which there is no cap to CIPP price adjustments.

The proposed minimum price setting and price adjustment mechanism for the CIPP pricing strategy is illustrated in Table 3.

Table 3: Minimum Price Setting and Price Adjustment Mechanism Illustration

Guaranteed minimum price illustration - Option 1:			
(a) Minimum price at initial rate	$	0.402	$/kWh
(b) Current PPA price (illustrative of a $0.05/kWh drop in fuel cost)	$	0.352	$/kWh
(c) If (a) is higher than (b) insert the price variance, otherwise 0	$	0.050	$/kWh
(d) Amount of energy IPP purchase in the current period (illustrative)		20,000	kWh
(e) = (c)x(d) Government funding in the current period	$	1,000	

Guaranteed minimum price illustration - Option 2:			
(a) Minimum price at initial rate	$	0.402	$/kWh
(b) Current PPA price (illustrative of a $0.05/kWh drop in fuel cost)	$	0.352	$/kWh
(c) If (a) is higher than (b) insert the price variance, otherwise 0	$	0.050	$/kWh
(d) Amount of energy IPP purchase in the current period (illustrative)		20,000	kWh
(e) = (c)x(d) Charged to Deferral Account in the current period	$	1,000	
(f) Deferral Account Opening Balance (illustrative)	$	6,400	
(g) = (e)+(f) Deferral Account Closing Balance (for future recovery/true-up)	$	7,400	

Purchase price adjustment mechanism:
1. Updated every 6 months (April and October) based on the last 6-month average price from FRS filing.
2. No cap on price increases (subject to Deferral Account balance being zero)

5.0 CONCLUSION AND NEXT STEPS

The proposed renewable energy pricing strategy aims to find a principled way to provide a price that provides sufficient incentive for customers to invest in renewable generation while avoiding placing upward pressure on rates for other customers. The approach employed in designing the proposed Strategy explains and addresses the issues in the public submissions during the URRC's review of the QEC proposal and takes into consideration the information provided in these submissions as key first step in developing the proposed strategy.

The main basis for the renewable energy pricing which is accepted by all stakeholders is the "avoided costs" of diesel. The analysis completed in this report reviews the approach and estimates provided in the public submissions, government policies and programs and relevant applied literature. The pricing strategy reflects the short and long-term aspects as well as the internal QEC and external social/ government avoided cost elements of the avoided costs of diesel.

The renewable energy pricing strategy concludes that to achieve the stated objectives of promoting renewable energy generation in Nunavut while avoiding placing upward pressure on QEC customer rates, it is necessary that the pricing include short as well as long-term considerations, where the initial pricing reflects short-term (i.e., current) avoided QEC costs in combination with longer-term avoided social and government costs. Absent a material government funded element, there is no apparent way to secure adequate renewable energy prices without requiring increases to QEC rates once material new renewable generation is connected to QEC's electricity grid.

Canada recently announced more aggressive emission reduction targets, which aims to reduce emissions by 40-45% below 2005 levels, by 2030 and targeting net-zero emissions by 2050.[6]

The initial purchase price of $0.402/kWh for renewable energy generated by CIPPs in Nunavut under the proposed strategy is a short-term estimate. Given Canada's greenhouse gas emission reduction and renewable energy generation increase goals consideration of longer term avoided QEC costs and assessing when and how to include these in the renewable pricing, remains an important matter to address in the future.

As such, it is important to undertake timely review of the renewable energy pricing structure. Assuming the proposed pricing structure is approved by the Government of Nunavut in 2021, a review of the proposed pricing structure in 2024 is recommended as it provides a reasonable window to understand the impact of the new structure on renewable generation in the Territory and more detail will also likely become available on the Government of Canada's longer term renewable energy development initiatives.

[6] Prime Minister Trudeau announces increased climate ambition, April 22, 2021. Available at: https://pm.gc.ca/en/news/news-releases/2021/04/22/prime-minister-trudeau-announces-increased-climate-ambition.

ATTACHMENT 1:

Current Utility Avoided Diesel Generation Costs

This review focuses on the direct utility costs that would be avoided through increased renewable energy generation including variable fuel costs, non-fuel operating costs, and capital related costs.

1.0 VARIABLE FUEL COST

When QEC purchases renewable energy, it reduces QEC's fuel expense. QEC's average variable fuel cost can be calculated by dividing QEC's diesel fuel cost per litre by the average QEC generation plant fuel efficiency as illustrated in the following formula:

$$Variable\ Fuel\ Cost\ (\$/kWh) = \frac{Average\ QEC\ Fuel\ Price\ (\$/l)}{Average\ QEC\ Fuel\ Efficiency\ (kWh/l)}$$

QEC's proposed CIPP pricing structure in its 2020 application calculated a territory-wide average avoided cost of fuel over a 3-year period. Using a weighted 3-year average actual fuel price of approximately $0.946/l and weighted average fuel efficiency of 3.760 kWh/l, QEC derived an avoided cost of fuel of $0.252/kWh.[1]

Public submissions made during the URRC's review of QEC's 2020 CIPP application generally agreed the avoided cost of fuel should be included in developing the CIPP pricing structure. However, some of the submissions indicated the avoided fuel cost calculation should be specific to communities reflecting differences in diesel fuel prices.

However, fuel prices charged to QEC by PPD are fairly harmonized across Nunavut. Looking only at fuel costs, the small cost differences which exist do not appear to justify a community-based structure, given that such a structure will add administrative costs to the program. Further, basing a single territory-wide CIPP price framework offers additional advantages in simplifying communications and understanding of the pricing structure by QEC's customers. Table A1-1 shows actual weighted average fuel prices by community as of December 2020.

As illustrated in Table A1-1, average fuel price was about $0.900/l by community in 19 of 25 communities served by QEC. Fuel prices were also fairly harmonized at about $0.800/l in Cambridge Bay, Kugluktuk, Rankin Inlet, Arviat, Iqaluit and Clyde River – the communities with bulk fuel storage facilities.

[1] QEC application for CIPP Pricing Structure, May 11, 2020; p. 5, Table B. Based on monthly weighted average fuel prices and GRA fuel efficiencies for 2016/17 to 2018/19 fiscal periods.

Table A1-1: Actual QEC Fuel Prices by Community – December 2020[2]

Plant	Actual Fuel Price $/L
Cambridge Bay	0.8085
Gjoa Haven	0.9024
Taloyoak	0.9024
Kugaaruk	0.9024
Kugluktuk	0.8094
Rankin Inlet	0.7981
Baker Lake	0.9024
Arviat	0.7945
Coral Harbour	0.9024
Chesterfield Inlet	0.9045
Whale Cove	0.9026
Naujaat	0.8992
Iqaluit	0.8139
Pangnirtung	0.9024
Kinngait	0.9025
Resolute Bay	0.9024
Pond Inlet	0.9024
Igloolik	0.9024
Sanirajak	0.9024
Qikiqtarjuaq	0.9025
Kimmirut	0.9025
Arctic Bay	0.9024
Clyde River	0.8080
Grise Fiord	0.9042
Saniqiluaq	0.9024

Accordingly, the variable fuel cost used for the initial pricing in the proposed pricing strategy is calculated at $0.250/kWh reflecting the average actual fuel price of $0.940/l and weighted average fuel efficiency of 3.760 kWh/l.

[2] QEC March 2021 Fuel Stabilization Rider application, Schedule 3.3.

2.0 NON-FUEL OPERATING COSTS

Non-fuel operating costs are utility costs that are incurred and expensed on an annual basis, including costs that may vary with generation and costs that do not vary materially with actual generation. Such expenses include plant operator salaries, mechanical and electrical maintenance of diesel units, maintenance of the powerhouse, engine overhaul costs and other similar expenses.

The submission by Nunavut Nukkiksautiit Corporation (NNC) presented its calculation of the avoided cost of non-fuel operating and maintenance (O&M) costs. NNC states that QEC will see cost savings related to O&M requirements on existing generation equipment, leading to a reduction in equipment O&M costs, as well as travel and accommodations connected to such O&M.

Table A1-2 shows the avoided non-fuel operating cost of generation calculated by NNC in its submission. For this estimate NNC assumed that 70% of non-fuel operating costs were related to energy generation based on its review of QEC's 2018/19 general rate application (GRA).

Table A1-2: QEC's avoided operating cost per kWh with Renewable Energy Integration

	2018/19 (QEC Annual Report)	% of Cost related to Generation	2018/19 Total Generation	Cost per kWh
	A	B	C	D=(AxB)/C
Plant Operations (non-fuel)	16,377,000	70%	196,529,481	0.0583
Technical Support Operations	28,615,000	70%	196,529,481	0.1019
Total Variable O&M				**0.1603**

Notes:
1. 2018/19 actual costs as derived by NNC from QEC's 2018/19 Annual Report
2. 2018/19 generation is estimated by NNC based on average annual electricity demand increase in 2014/15 to 2017/18

Using this approach NNC derived an avoided diesel generation O&M cost of about $0.16/kWh.

The Pembina Institute and Nihtat Energy Ltd. (NEL) also noted renewable generation results in lower generator operational time and therefore lower non-fuel O&M costs to QEC. NEL referenced a Northwest Territories Power Corporation (NTPC) estimate in 2009 that a cost of 2.5 cents/kWh would be a conservative estimate for the minimum expected diesel non-fuel O&M incremental costs saved by purchase of renewable generation and that these incremental cost savings could exceed 6 cents/kWh. NEL also noted that the 2.5 cent/kWh estimate reflected short-term cost savings from the use of renewable generation, and that increased non-fuel O&M savings should result from a long-term shift to renewable generation.

It is important to note that the QEC O&M costs of $0.160/kWh referenced by NNC are an average per kWh of all existing annual O&M costs allocated to diesel generation activities. This average does not indicate, however, the extent to which QEC can avoid future O&M costs for diesel generation in either the short or long term through reductions in diesel generation. In the short-term there may not be any material cost O&M savings to QEC. For example, QEC will continue to require a plant operator even if some diesel generation is replaced with renewable energy. As well, the power plant and auxiliary equipment will still require maintenance independent of renewable energy generation volume.

In order to determine a reasonable estimate of incremental O&M savings, InterGroup reviewed relevant literature in this topic. In particular, a recent study by I. Das and C. Canizares of the University of Waterloo provides non-fuel O&M costs of diesel specific for Canadian Arctic communities, including five Nunavut communities – Arviat, Baker Lake, Iqaluit, Rankin Inlet and Sanikiluaq.[3]

The Das and Canizares study completed HOMER simulations and mathematical optimization models of renewable integration in the Canadian Arctic. Table VI of the study reproduced below presents the O&M cost ranges in the selected Canadian Arctic communities.

TABLE VI
RANGE OF THE O&M COSTS OF DIESEL AND RE EQUIPMENT IN $/KWH [70]

Community	Wind		Solar		Battery	Diesel Generator		
						Existing FSG		New VSG
	low	high	low	high		low	high	
Arviat	0.0398	0.0414	0.0155	0.0157	0.0073	0.0225	0.0256	0.0168
Baker Lake	0.0531	0.0626	0.0186	0.0191	0.0093	0.0257	0.0291	0.0196
Iqaluit	0.0231	0.0292	0.0088	0.0090	0.0036	0.0171	0.0194	0.01275
Rankin Inlet	0.0295	0.0324	0.0120	0.0123	0.0054	0.0197	0.0223	0.0147
Sanikiluaq	0.0363	0.0393	0.0145	0.0149	0.0069	0.0218	0.0248	0.0163
Sachs Harbour	0.0581	0.0659	0.0190	0.0193	0.0088	0.0260	0.0295	0.0194

The study presents low and high levels for the fixed speed diesel generator O&M for Nunavut communities of Arviat, Baker Lake, Iqaluit, Rankin Inlet and Sanikiluaq. The low level of O&M cost ranges from $0.017/kWh (Iqaluit) to $0.026/kWh (Baker Lake), whereas the high level of O&M costs range from $0.019/kWh (Iqaluit) to $0.029/kWh (Baker Lake).

Based on the review of public submissions and available literature discussing avoided non-fuel operating costs with renewable energy integration, the proposed pricing strategy assumes rate of $0.020/kWh as a reasonable short-term estimate for this parameter.

[3] I. Das and C. Canizares, Renewable Energy Integration in Diesel-based Microgrids at the Canadian Arctic, 2019.

3.0 CAPITAL RELATED COSTS

Increased renewable generation may allow utilities to extend the life of existing diesel units by reducing the number of operating hours required. However, utility capital cost requirements may also increase to address issues related to the intermittent nature of renewable generation, for example, battery storage costs to ensure power stability.

NNC's submission stated that based on QEC's 2018/19 GRA about 88% of QEC's capital costs are allocated to electricity generation and computed estimated capital cost savings from renewable generation at $0.173/kWh.[4]

The Pembina Institute and NEL submissions similarly noted that savings from deferred capital costs should be included in the CIPP PPA rate, however they did not provide any estimate of this avoided cost.

It is important to note that QEC capital costs of $0.173/kWh referenced by NNC are an average per kWh of all existing annual capital costs allocated to diesel generation activities. This average does not indicate the extent to which QEC can avoid future capital costs for diesel generation in either the short or long term through reductions in diesel generation. Among other considerations, diesel capital costs are likely to increase going forward as older facilities are replaced with required new facilities. In addition, diesel generation facilities are likely to continue to be required for system reliability. Intermittent renewable energy generation will likely reduce diesel engine operation hours but will not impact diesel engine required capacity due to its intermittent non-dispatchable nature. QEC must continue to have sufficient diesel generation capacity to serve the winter peak in each community. These requirements can result in engine operation being less fuel efficient and require higher maintenance cost. As such, current average capital costs per kWh provide no useful guidance for potential short or long term costs savings from avoided diesel generation.

Therefore, in the short-term, the proposed pricing structure reflects no incremental capital costs or capital cost savings. These parameters can be revisited in the future.

[4] NNC's assumption of 88% of QEC's capital costs being related to electricity generation appears to be in line with QEC's net plant in-service composition from the 2018/19 GRA which indicate that diesel generation plants make up about 85% of net plant in-service figures.

ATTACHMENT 2:
Avoided Cost of Diesel Generation Outside of QEC's Cost Structure

1.0 FUEL PRICE AND GOVERNMENT COSTS

1.1. SUBSIDIES TO CUSTOMER BILLS

In Nunavut the territorial government subsidizes energy costs to residential and small commercial customers through the Nunavut Electricity Subsidy Program. The Program pays the cost differential between Iqaluit rates and rates in other communities up to a maximum consumption level each month.

In its submission to the URRC, Nunavut Nukkiksautiit Corporation (NNC) also refers to the following subsidy programs of the Government of Nunavut (GN):

- Public Housing Power Support Program
- Staff Housing Policy – Power and Fuel
- Income Assistance Program

These subsidies pay for a portion of QEC's costs to generate and distribute electricity. As a result, they reduce the bills paid by customers, but do not decrease QEC's total costs to provide electricity service.

NNC states the GN spends close to $42 million each year to subsidize electricity. NNC estimates that assuming 20% renewable integration, QEC would save approximately 3.09% of its operating costs. NNC estimates these cost savings would directly translate to proportional savings to electricity subsidies and the GN would realize savings of approximately $0.033/kWh of renewable energy generation.[1] NNC's derivation of the GN subsidy savings is illustrated in Table 2A-1.

Table A2-1: GN Subsidy Savings Calculation by NNC

	Amount	Reference
GN Subsidy Cost ($000)	$41,925	NNC Submission, Table 4.5
QEC production costs reduction at 20% renewable	3.09%	NNC assumption
GN electricity subsidy proportional savings ($000)	$1,295	
2018/19 Total Generation (MWh)	196,529	NNC estimate
Renewable generation at 20% renewables integration (MWh)	39,306	NNC assumption
GN subsidy savings per renewable kWh	**$0.033**	NNC Submission, Table 4.6

The Pembina Institute submission similarly notes that electricity pricing in Nunavut is subsidized at a scale of $60.5 million per year. It states that if electricity is generated from renewable infrastructure that QEC does not need to maintain, the energy subsidies to QEC customers are not needed and represent a cost savings to the Government of Nunavut.

[1] NNC's submission to URRC on QEC's proposed CIPP program (July, 2020), p. 13-14.

To the extent such cost savings from renewable generation arise, the proposed pricing strategy would include those savings in the calculation of the CIPP rate. As such, it is not anticipated there would be any additional savings to existing bill subsidy programs.

1.2. FUEL PROCUREMENT COSTS

The cost of fuel delivered to QEC typically includes basic commodity prices (e.g., market prices for oil), processing costs to provide the specific fuel (e.g., refinery costs for diesel fuel), transportation from processing centers, storage costs in the community, and any taxes applicable to the fuel.

The Petroleum Products Division (PPD) of the Government of Nunavut is responsible for the purchase, transportation, storage and distribution of all petroleum products in Nunavut, including the fuel required for QEC's operations.

The price of the fuel price for QEC varies significantly between the sealift season, where a bulk purchase price is available, and the rest of the year, when only nominated purchase is available. Some communities have enough fuel storage capacity for the annual volume of fuel required (e.g., Cambridge Bay), and their fuel prices are typically lower reflecting largely bulk fuel purchases. However, larger communities like Iqaluit do not have such fuel storage capacity, and from time to time would need to purchase fuel at nominated fuel prices which are typically higher than bulk fuel prices. This pushes their average fuel price higher than bulk purchase only communities.

QEC confirmed that nominated prices for diesel fuel are the same for all communities except Iqaluit. In the most recent Fuel Stabilization Rate Rider application (March 2021), the actual average fuel prices by community in December 2020 were about $0.900/litre in 19 of 25 communities with prices in the remaining communities being about $0.800/litre, the differences driven by bulk fuel purchases as discussed in Attachment 1.

NNC's submission states that PPD sells diesel fuel to QEC at cost with no markup for either profit or overhead costs. Note however that PPD operates under the Revolving Funds Acts (the Act), where Petroleum Products Revolving Fund (PPRF) provides the financial resources to purchase and distribute the fuel consumed annually in communities across Nunavut and PPD states that the Act requires PPRF to operate on a "break-even" basis.[2]

Based on QEC's communication with PPD, nominated fuel prices do include a markup for overhead, administration, facilities maintenance and similar expenses, which is effectively the difference between bulk and nominated fuel prices. Note that PPD confirmed that there is no price markup to bulk fuel PPD supplies to QEC.

NNC notes that in 2018/19, QEC purchased about 50.2 million litres of diesel fuel from PPD representing 23.59% of all fuel imported by PPD. Based on PPD's 2016/17 annual report, NNC grouped PPD's costs related to electricity generation into three categories – operations, capital

[2] PPD 2017/18 Annual Report, p.14. Available at: https://assembly.nu.ca/sites/default/files/TD-355-EN-PPD-2017-2018-Annual-Report.pdf (accessed July 7, 2021).

expenditures and environmental costs – and converted these costs to a cost per kWh by taking total QEC generation in 2016/17 of 191.7 GWh.

NNC then states that with increased renewable energy integration QEC's fuel purchases from PPD will decrease resulting in reduction of PPD costs to support QEC's electricity generation, estimated at $0.032/kWh.

NNC's computation of PPD's avoided costs per kWh related to selling fuel to QEC is reproduced in Table 2A-2.

Table A2-2: Annual Incurred Operational Costs per kWh related to Selling Fuel to QEC for Electricity (as computed by NNC)

Line No		2016/17 Amount	Reference
1	PPD operational costs	$32,903	NNC Submission, Table 2.1
2	QEC's share in total fuel volume imported by PPD	23.59%	NNC Submission, p. 6
3=1x2	PPD operational costs related to fuel for electricity	$7,761	NNC Submission, Table 2.1
4	QEC 2016/17 Total Generation (MWh)	191,736	NNC Submission, p. 6
5=3/4	**PPD operational costs related to QEC fuel supply per kWh**	**$0.040**	NNC Submission, Table 2.1
6=5x60%	PPD savings assumed at 60% of avoided operational costs	**$0.024**	NNC Submission, Table 5.1
7	PPD capital costs	$7,613	NNC Submission, Table 2.1
8	QEC's share in total fuel volume imported by PPD	23.59%	NNC Submission, p. 6
9=7x8	PPD capital costs related to fuel for electricity	$1,796	NNC Submission, Table 2.1
10	QEC 2016/17 Total Generation (MWh)	191,736	NNC Submission, p. 6
11=9/10	**PPD capital costs related to QEC fuel supply per kWh**	**$0.009**	NNC Submission, Table 2.1
12=11x60%	PPD savings assumed at 60% of avoided capital costs	**$0.006**	NNC Submission, Table 5.1
13	PPD environmental costs	$1,336	NNC Submission, Table 2.1
14	QEC's share in total fuel volume imported by PPD	23.59%	NNC Submission, p. 6
15=13x14	PPD environmental costs related to fuel for electricity	$315	NNC Submission, Table 2.1
16	QEC 2016/17 Total Generation (MWh)	191,736	NNC Submission, p. 6
17=15/16	**PPD capital costs related to QEC fuel supply per kWh**	**$0.002**	NNC Submission, Table 2.1
18=17x100%	PPD savings assumed at 100% of avoided environmental costs	**$0.002**	NNC Submission, Table 5.1
19	**PPD savings estimate related to renewable energy generation**	**$0.032**	L6+L12+L18

QEC obtained some detail with respect to PPD's operational and capital costs and how those costs are related to the cost of fuel supplied by PPD to QEC. Based on the review of this information, it appears that PPD capital costs indicated by NNC as related to QEC fuel supply may be overstated. Construction and upgrade of fuel storage facilities in the communities are on GN books and are not under PPD's responsibility. PPD only provides repair and maintenance of fuel storage facilities and it is QEC's understanding that estimating power generation related portion of this capital expenditure simply in proportion to QEC's share in total fuel volume imported by PPD may overstate true PPD capital costs related to power generation.

It is noted however that even if delivered fuel cost are being subsidized by PPD, these subsidies are not included in QEC's cost structure and accordingly in the electricity rates. As such, in the short term any subsidy savings can only be included in the renewable pricing structure if it is funded by the government. In the longer term if reduced fuel purchase requirements from PPD result in direct fuel price reductions to QEC, these lower fuel prices may get reflected in direct savings to QEC.

For purposes of the current assignment, the proposed pricing strategy uses a GN subsidy estimate of $0.032/kWh as calculated by NNC.

ATTACHMENT 3:
External/Social Cost of Diesel Generation

1.0 APPROACH AND DEFINITIONS

Fossil fuel electricity generation results in indirect social costs in addition to the direct utility costs and government subsidies reviewed in Attachments 1 and 2. Social costs may include direct and indirect impact to the health and well-being of people, impacts to animals and plants and climate change. Social costs are not limited to the communities where thermal generation occurs, for example, GHG emissions related to fossil fuel generation can impact climate globally.

In 2017 InterGroup conducted a review of social costs of fossil fuel generation as part of the Diverging from Diesel technical report prepared for the Gwich'in Council International[1] The analysis reviewed four studies and reports to provide guidance on potential social costs for air emission impacts from the use of different fossil fuels.

For the purposes of the current assignment, InterGroup reviewed additional international studies, including from Europe where renewable generation development is at higher levels than in North America – with Germany reaching more than 50% of its energy generation from renewables sources in 2020, including wind farms and solar power plants.[2]

Overall, the estimates in the additional studies were in line with InterGroup's 2017 study as set out in this attachment.

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[1] Diverging from Diesel (2017), Gwich'in Council International and InterGroup Consultants Technical Report. Available at: https://www.rncan.gc.ca/sites/www.nrcan.gc.ca/files/energy/energy-resources/Diverging_from_Diesel_-_Technical_Report_FINAL.pdf.

[2] Public Net Electricity Generation in Germany 2020: Share from Renewables Exceeds 50 percent. Available at: https://www.ise.fraunhofer.de/en/press-media/news/2020/public-net-electricity-generation-in-germany-2020-share-from-renewables-exceeds-50-percent.html#:~:text=In%202020%20the%20total%20electricity,generation%20for%20the%20first%20time (accessed June 29, 2021).

2.0 SUMMARY OF 2017 REVIEW

The 2017 review of social costs of fossil fuel generation focused on the following studies:

- The Social Cost of Atmospheric Release by a US researcher D. T. Shindell (2015). The Shindell analysis is a detailed and technical paper, which builds upon the Social Cost of Carbon framework and extends it to a broader range of pollutants and impacts.[3] The Social Cost of Carbon is the marginal global damage costs of carbon emissions and is usually estimated as the net present value of climate change impacts over the long term (100 years or longer) of one additional carbon emitted to the atmosphere today.

  The paper estimates the costs to the society arising from the impacts of emissions (from fossil fuel generation and transportation) on health and climate related to 11 factors, including baseline mortality projections, fertilization on agriculture/malnutrition, climate sensitivity, carbon-cycle response to non-CO_2 forcing, and others. Social costs include both health and cost of environmental impacts from air emissions, and specifically from GHG emissions.

- Environmental accounting for pollution in the United States by Muller, Mendelsohn and Nordhaus (2011) published in the American Economic Review 101:5. This study measures only the externalities from air pollution and omits other external effects that take place through water, soils, noise, and other media. The pollutants tracked in this study include sulfur dioxide, nitrogen oxides, two measures of particulate matter ($PM_{2.5}$ and PM_{10}), ammonia, volatile organic compounds, and carbon dioxide emissions from the electric power generation sector.

- Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use by National Research Council (2010). This study evaluated effects from thermal power generation in the US related to air emissions of particulate matter (PM), sulfur dioxide (SO_2), and oxides of nitrogen (NO_x), which form criteria air pollutants.

- Economic Value of U.S. Fossil Fuel Electricity Health Impacts by Machol and Rizk (2013) published by Environment International, v. 52. This study provides an estimate of the economic value of air quality-caused health impacts resulting from the use of fossil fuels for power generation in the U.S. by source type and by state, but does not include climate cost impacts. The study analyzes the same common pollutants analyzed in the National Research Council and Muller et al. studies, i.e., particulate matter (PM), sulfur dioxide (SO_2), and oxides of nitrogen (NO_x).

Table 3A-1 provides a comparison of air emission cost impacts from these four studies. The studies showed a wide range of estimated social costs from air emissions from US thermal power

[3] The Social Cost of Carbon is the marginal global damage costs of carbon emissions and is usually estimated as the net present value of climate change impacts over the long term (100 years or longer) of one additional carbon emitted to the atmosphere today. See P. Watkiss, *The Social Cost of Carbon*, OECD publication (https://www.oecd.org/env/cc/37321411.pdf).

generation from $0.032/kW.h to $0.192/kW.h for oil generation (diesel was not specifically examined) and from $0.003/kW.h to $0.132 /kW.h for natural gas generation.[4]

Table A3-1: Comparison of Estimated Social Costs from Fossil Fuel Air Emissions (2016 $CAD)

All in CAD $, 2016 dollars	D. T. Shindell (2015) - Climate & Health Impacts from wide range of air emission pollutants		Muller et al. (2011) - Climate & Health Impacts from specific air emission pollutants			NRC (2007) - Health and non-climate impacts from specific air emission pollutants		Machol and Rizk (2013) - Health Impacts (US national average) from specific air emission pollutants		
	Natural Gas for Thermal Generation	Coal for Thermal Generation	Oil for Thermal Generation	Natural Gas for Thermal Generation	Coal for Thermal Generation	Natural Gas for Thermal Generation	Coal for Thermal Generation	Oil for Thermal Generation	Natural Gas for Thermal Generation	Coal for Thermal Generation
Total Social Cost, cents/kW.h	13.2	37.6	3.2	0.8	4.6	0.3	5.0	19.2	3.0	47.2

Notes:

1. The estimates from D. T. Shindell (part 4) at 3% discount rate are converted from 2007$ to 2016$ using 2% inflation rate and converted from US dollars to Canadian dollars using exchange rate of $1.31CAD/$1US. Health impacts tend to dominate compared with climate damages. Cost impacts reflect average activities (e.g., major variances for different aged coal technologies and/or activity regions).

2. The estimates from Muller et al. (Table 2) for impacts in the US are inflated from 2000$ to 2016$ using 2% inflation rate and converted from US dollars to Canadian dollars using exchange rate of $1.31CAD/$1US. CO_2 emission cost impacts assume $7.4/ton of CO_2 (US$2000).

3. The average estimates from NRC (Tables 2-9 and 2-15) for the US are inflated from 2007$ to 2016$ using 2% inflation rate and converted from US dollars to Canadian dollars using exchange rate of $1.31CAD/$1US. Wide variances are noted around the mean value estimates for coal and natural gas plant emissions. The NRC document did not provide estimate for CO_2 air emission impacts.

4. The average estimates from Machol and Risk (Figure 1) are inflated from 2010$ to 2016$ using 2% inflation rate and converted from US dollars to Canadian dollars using exchange rate of $1.31CAD/$1US. This study provided a range for national average health impacts of +/-40% for coal generation and +/-46% for oil generation (no material range provided for natural gas generation). The study also showed wide variances in health impact values for thermal generation in different US states, reflecting variances in technologies (e.g., age of plants) and fossil fuel mix.

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[4] All cost estimates in 2016 $CAN.

3.0 FURTHER STUDY REVIEW

In addition to the sources included in the 2017 study completed for the GCI, a study by Sascha Samadi of the Wuppertal Institute for Climate, Environment and Energy, Germany (2017) was also reviewed.[5] This study seeks to provide a comprehensive overview of the current knowledge on the social costs of electricity generation based on an extensive literature review. The study emphasizes the fact that not only plant-level costs, but also system and external costs, are relevant when assessing the costs of different electricity generation technologies from a societal perspective. This is similar to InterGroup's findings from the 2017 review.

The study identifies sub-categories of costs relevant for comparing external costs of electricity generation, which include:

- Social costs of GHG emission
- Impact of non-GHG pollution
- Impacts on ecosystem and biodiversity

The Samadi analysis provides low, medium and high estimates of social cost of GHG emission based on research and review of other similar studies.

- Social cost of carbon estimates had a lower value of €11 per ton of CO_2 (in 2015 values) based on a value from the Interagency Working Group on Social Cost of Carbon (SCC) using Integrated Assessment Models (IAMs) with a discount rate of 5%.[6] The Samadi analysis notes however that the choice of discount rate has a considerable influence on the SCC estimate under IAMs (using a discount rate of 3% the SCC value goes up to €37 per ton) and that in recent years many authors have criticized the SCC values typically derived from IAMs and have provided a number of arguments supporting their belief that these values are systematically too low.
- The medium value was selected at €114 per ton of CO_2 (in 2015 values) corresponding to the estimate by van den Bergh and Botzen 2014 study *A Lower Bound to the Social Cost of CO_2 Emissions*.
- The high value was selected at €626 per ton of CO_2 (in 2015 values) based on the value derived Kopp et al study (2012) *The Influence of the Specification of Climate Change Damages on the Social Cost of Carbon*.

[5] S. Samadi, The Social Cost of Electricity Generation – Categorizing Different Types of Costs and Evaluating Their Respective Relevance (2017), Energies 2017, 10, 356.
[6] Interagency Working Group on Social Cost of Carbon. Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis (2015). https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf.

The medium estimate of €114 per ton of CO_2 indicates a cost of $0.120/kWh of diesel generation.[7] This cost estimates is within the range of $0.032/kWh to $0.192/kWh noted in InterGroup's 2017 review.

The Samadi analysis notes that particulate matter (PM), especially fine particulate matter consisting of particles with a diameter of 2.5 micrometres (PM2.5) or less, has been identified by numerous studies to be the most significant pollutant from power plants to cause negative health effects. The studies analyzed by Samadi do not provide non-GHG pollution costs specifically for diesel plants, however the costs from natural gas power plants were estimated at $0.006/kWh in Canadian dollars.[8] Again this cost estimate is in line with InterGroup's 2017 review, which indicated a range of $0.002/kWh to $0.030/kWh of other social costs for natural gas thermal generation.

Finally, the Samadi analysis shows estimates for the biodiversity costs of impacts caused by various forms of electricity generation as provided by the European research project "New Energy Externalities Development for Sustainability" (NEEDS). Again, the analysis does not provide a cost estimate specifically for diesel plants, however the costs from natural gas power plants were estimated $0.001/kWh in Canadian dollars.[9]

Table 3A-2 summarizes social cost of diesel generation based on the findings of the studies reviewed in the Samadi analysis.

Table 3A-2: Social Costs GHG emissions and non-GHG pollution (2021 $CAD)

	S. Samadi (2017) - Social Costs of Electricity Generation		
All in CAD$, 2021 dollars	**Low**	**Medium**	**High**
Social cost of GHG emission (cents/kWh)	1.2	12.0	65.9
Social cost of non-GHG pollution (natural gas plant)	0.6	0.6	0.6
Social cost of pollution on ecosystems and biodiversity	0.1	0.1	0.1
Total social cost from fossil fuel generation, cents/kWh	**1.8**	**12.7**	**66.6**

Notes:

1. Low range of GHG emission social cost is based on Interagency Working Group on Social Cost of Carbon findings (2015)
2. Medium range of GHG emission social cost is based van den Bergh and Botzen 2014 study 'A Lower Bound to the Social Cost of CO2 Emissions' (2014)
3. High range of GHG emission social cost is based on Kopp et al study 'The Influence of the Specification of Climate Change Damages on the Social Cost of Carbon' (2012)

Further review of the available literature on social costs of fossil fuel generation supports $0.100/kWh short-term estimate used in the proposed CIPP pricing framework.

[7] Based on CAD1:€0.677 exchange rate, the emission factor of 2,681 grams of CO_2 per litre of diesel fuel, and QEC average approved fuel efficiency of 3.76 kWh/l.

[8] Based on an estimate of $0.41 euro-cents/kWh and the exchange rate of CAD1:€0.677.

[9] Based on an estimate of $0.05 euro-cents/kWh and the exchange rate of CAD1:€0.677.

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