Matter No. 336

NEW BRUNSWICK ENERGY AND UTILITIES BOARD

INTERROGATORY
(Rule 4.3)

In Relation to an Application by: New Brunswick Power Corporation

In Accordance with: Subsection 103(1) of the *Electricity Act*, S.N.B. 2013, c.7

RESPONDING TO: New Brunswick Power Corporation (NBP)

FROM: New Clear Free Solutions (NCFS)

Response to Interrogatories to Intervener Evidence
January 31, 2017

NCFS (NBP) **IR-01** **January 24, 2017**

Reference: Exhibit NCFS 1.01, Page 2, Lines 2-4

Preamble:

This evidence is submitted by Chris Rouse on behalf of New Clear Free Solutions. The mandate of New Clear Free Solutions is to provide energy oversight to the public and official decision makers using scientifically objective regulatory and financial information. The objective of New Clear Free Solutions is to help ensure safe, affordable, and sustainable energy solutions for the Canadian public and environment.

Questions:

a) Please provide a list of all past and present NCFS board members.
b) Please disclose all funding grants and their sources as well as any other affiliations.

Answers:

a) New Clear Free Solutions is an unregistered community group that has no board members and has had no past board members. The community group is guided by its mandate and objectives.
b) New Clear Free Solutions dose not have any funding or grants nor does it have any official affiliations. The work done by NCFS is currently resourced strictly by volunteer time donated in the publics interest. We would not object to doing consulting work for NB Power to help further develop the IRP.

NCFS (NBP) **IR-02** **January 24, 2017**

References: Exhibit NCFS 1.01, Page 2, Lines 36-40

Preamble:

NB Powers current business plan is denying New Brunswickers much needed jobs and the government of New Brunswick the benefits of this economic development. This could be done without any additional rate increase other than what have already been planned for. Paying down debt instead of creating jobs is not in line with the mandate letter supplied to NB Power and we also argue that the current IRP is not consistent with section 100(2) of the act.

Questions:

a) Has NCFS conducted an analysis of the annual rate impact (2016 – 2060) that would be imposed on New Brunswick ratepayers based on NCFS's plan? If so, please provide.

Answers:

a) The impact to ratepayers from the plan will be the amount imposed by the Carbon Tax which is approximately 4% or $20/ton and is less than half of the proposed $50/Ton that is planning on being imposed by the Federal government. We should reject the Federal government setting the amount and any schedule for Carbon Tax increases, that should be left to the provinces if our environmental objectives are being met.

This increase should not be in addition to the already planned 14% rate increases proposed to be imposed on New Brunswick ratepayer by NB Power in their 10 year plan, but in lieu of it. In previous sensitivity analysis performed by NB Power in matter 307, NB Power has assumed a 30% rate increase up to 2030, and there seems to be no end to rate increases and higher debt levels under the current business model.

Our analysis shows that the Carbon Tax and Investment plan is the lowest cost plan to transition to a low carbon economy as well as the most profitable. The modeling is very robust and can accommodate a large amount of uncertainty with minimal effects on rates as shown in our sensitivity analysis in Attachment A and C. We demonstrate in Attachment C, by using sensitivity analysis, that even a significant change to any of the major variables can be mitigated by increasing the time to reach an objective. We also demonstrate via sensitivity analysis in Attachment A that when we fixed the time and set fix the carbon tax appropriately that net profit and dividends can absorb any uncertainty in the variables without the need for rate increases.

In addition, our modeling assumes that the transition is 100% equity financed from the Carbon tax investment and subsequent returns on that investment. Debt financing could also potentially be used to absorb some uncertainty in the modeling without the need for rate increases. Our modeling does not consider the current cash flow from operations of NB Power. Currently NB Power is profitable, so not taking it into account would be conservative in nature. It is assumed that certain programs such as RASD would still be financed through current operations.

It is worth noting that in Attachment C relatively small variations in time can accommodate relatively large amounts of uncertainty. As well it is also worth noting in Attachment A that the sensitivity analysis shows that any 10% change in any of the major variables can be mitigated with less than a 3% rate increase. Adjusting time and profits before rate increases is our current interpretation of section 68 of the electricity act as indicated in our IR to the public intervener. These features allow for both lower and more stable rates compared to business as usual.

As well as having lower and more stable rates, our plan is significantly more profitable, will provide significantly more jobs, will have significantly more CO2 reductions, provide

significant economic development, and considerably less financial risk than the current business as usual plan. In general, our plan is sustainable and the current one is not.

Reference: Exhibit NCFS 1.01, Page 5, Lines 3-9; Exhibit NCFS 1.02, Attachment A Carbon Tax and Investment Plan 2016 Annual Energy Outlook Update

Preamble:

When it became apparent that NB Power was not going to proceed with our requests we began modeling the CTIP ourselves and have updated the modeling several times to be more sophisticated each time and providing more and more sensitivity cases. We have spent a considerable amount of time refining the modeling to a point where it is impractical to refine any further without the expensive sophisticated software already owned by NB Power. We have gone well beyond proving the general concept of the plan and consider it to be reasonably accurate modeling. Our IRP is significantly better than that the current one performed by NB Power.

Questions:

a) Please provide all analysis, supporting calculations for the CTIP model used to produce the tables and charts in Appendix A in MS-Excel format. Please ensure that all formulas are intact.

b) Please provide the assumptions for the following
- In-province Energy and demand forecast by year (2016 – 2060)
- Export volumes and prices by year (2016 – 2060)
- Import volumes and prices by year (2016 – 2060)
- Fuel prices for natural gas and biomass fuel by year (2016 – 2060)
- Escalation rates for construction costs, O&M costs

Answers:

a) Please see attachment NBEUB (NCFS) IR1 Attachment E Carbon Tax and Investment Plan 2016 Annual Energy Outlook Update. Please note that we corrected in this excel sheet the sensitivity analysis on demand. It had the rate parameter from the rate sensitivity analysis in it. The revised demand sensitivity shows that it has the largest affect on net profits.

b) It is important to understand the purpose of the modeling we have done to be able to rationalize and understand the reasons behind any simplifying assumptions we have made. The general purpose of the modeling is to reasonably demonstrate using todays technology and todays costs and todays rates that we can reasonably transition to a low carbon economy by investing the carbon tax into renewable energy. We then compare the results to todays realities and current business plans.

The modeling takes into consideration all the macro economic factors involved in the transition. The modeling has integrated these factors so that they are all interconnected. This type of modeling is very useful for doing sensitivity analysis where you fix a set of parameters and then make changes to the different variables and see how their effect is on the affected variables. In the case of Attachment A we vary net profit based on the changes made in the sensitivity analysis. In the integrated resource plan changes the Dividends would account for any uncertainty in the plans. The modeling shows very significant net profits and dividends and therefore this plan can accommodate a significant amount of uncertainty without any additional rate increases, and if rate increase are needed they would be well below the business as usual case.

It is expected that the dividends will generally be used for climate change adaptation, and incentives for fuel switching like incentivising electric cars or paying for the capital to install an electrode boiler. The supply plan should take priority over the dividends as shown on pg 3 of Attachment A.

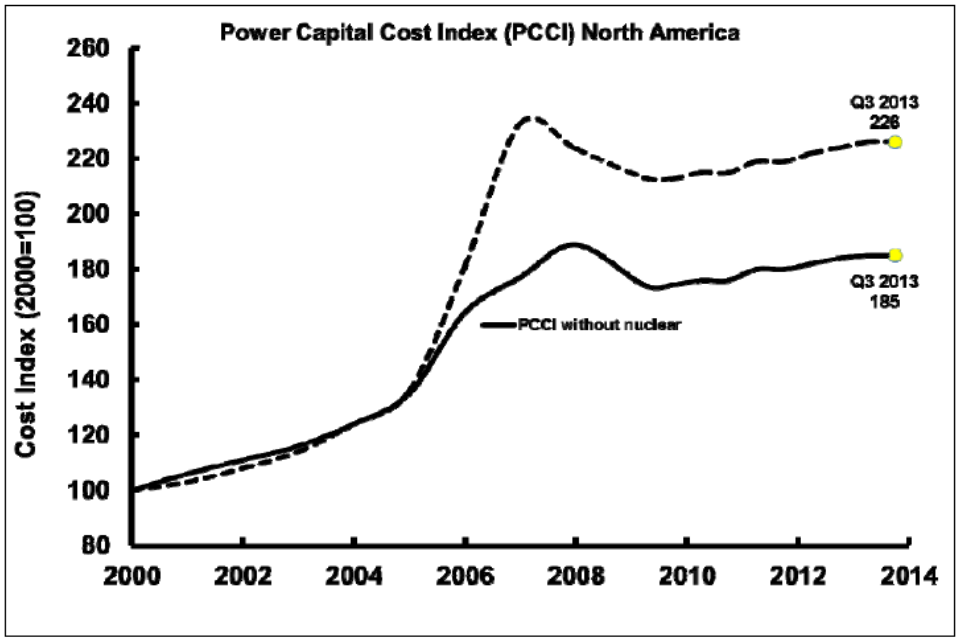
Any assumptions that we have made to simplify the modeling are generally conservative and when taken into full account would generally be positive in nature or at the very least out-perform the business as usual case. It is important to look at all the assumptions collectively as some tend to cancel others out.

Stage 1 RPS represents our current in province electrical energy, demand and load shape and the supply mix that could potentially achieve that RPS without the help any interconnections. This is chosen so that a fair comparison can be made between our modeling and the 2015 annual report or business as usual. Projecting todays energy demands to 2040 is not that unrealistic and is conservative in nature. NB Power is projecting some growth but relatively flat in that timeframe. We provide a sensitivity analysis to show that an increase in load affects net profits in a positive way without affecting rates. It is important to note that the demand parameter has the largest effect in the sensitivity analysis. Attachment A has done the sensitivity cases for stage 2 RPS. We have included in this response sensitivity cases for stage 1 RPS which give a more realistic comparison to the business as usual comparison. These are found in Attachment E Carbon Tax and Investment Plan Stage 1 RPS Sensitivity Analysis.

As the comparison is against the 2015 annual report we did not include any escalation rates for construction or O and M. If O and M escalation was considered it would also have to be considered for the business as usual case comparison, which would also have to have escalation rates. This would essentially cancel the effects out in the comparison, and would complicate the modeling with no real benefit to the objective of the modeling. It is worth noting that largely because of the retirement of Lepreau that O and M costs are lower than they currently are. This would indicate that our plan would be less affected by O and M escalation than a business as usual case.

Our plan would generally be less affected by construction escalation costs than the current IRP. It has gradual increases to replace the current assets, while the current IRP has a large cliff edge around 2040. This large deferral to 2040 would increase the effects of the construction price index on the current plan compared to our model. As noted in the current IRP, and shown below, nuclear has a big effect on construction price index and is one of the reasons nuclear was not selected. Since there is no big mega projects like nuclear power in our plan the risk of cost overruns and delays are also mitigated.

Figure 21: Historical Construction Price Index



The CTIP modeling does not include price escalation in fuel because of the same comparison reasons as O and M and constructions cost. The assumed fuel costs are shown in the modeling. They were selected from Attachment D the EIA levelized cost data, and all of the overnight capital costs are also from the EIA in Attachment B, and we have used the cost with contingency already included. If fuel cost escalation was to be included our sensitivity analysis shows that changes in fuel cost have the least affect on the model because of the high penetration of renewables and very low amounts of fossil energy. It would be expected our plan would be less affected than the business as usual case.

It is not unreasonable to expect small rate increase to account for inflation if needed, however 2% rate increases are not warranted for 2% inflation. Renewable energy acts like a long-term hedge has significant benefits to hedging against inflation.

The CTIP modeling does not assume any improvement in the cost and performance of the technology mix over time. Renewables are still trending downwards which could counteract any escalation increases. Technology usually always gets better over time. There is an exception to that rule for nuclear power which has had a negative learning curve. The cost of the Tesla Powerwall storage used in our modeling is already out of date as the Powerwall II has just been released several months ago. It is now approximately 30% less expensive per MW.

The 2040 date for RPS 1 is used because that is when most of NB Powers current assets retire or are due to retire. As well most existing PPA's, and contracts like the gypsum contract have expired, along with the costs associated with them. This date would represent an assumed fresh start for NB Power, and allow for a fair comparison of the new system to the old system.

The CTIP does not include any modeling for imports or exports and only considers in Province load supplied by in province resources. This is done to simplify the modeling, and is a similar approach to NB Powers IRP in that imports and exports are factored in after. Introducing import and export prices and volumes adds a significant amount of modeling complexity and uncertainty. If it was included in the modeling the result should always be positive. Not including them should be considered conservative in nature.

The other energy and demand forecast we examine is for RPS 2 in 2060. This is based on supplying our current total energy needs of approximately 203 PJ with mostly renewable energy. This is essentially the transition of industrial heat and steam, transportation and additional heating loads to renewable electricity. The 45,000,000 is likely high due to the efficiencies of the technologies that enable the transition but there are other factors like growth that could counteract these efficiencies. The amount of uncertainty is high looking out that many years and this is just an examination of what that transition might it might look like if we continued to use the same amount of total energy as we do now.

The technology to make this transition already exists and as with most technology it will surely get better and less expensive over time. The technology to make the transportation transition is electric cars, busses and trains which all currently exist and have declining costs with better performance. The other technology needed is the electrode boiler which is a mature technology and has a very low per MW capital cost.

The CTIP modeling assumes that this additional combined load will be at the current total system rate of $100.00/MWh like in RPS 1. In staying with the principles of low and stable rates we assume that this transition will cost no more to consumers and industry than the fossil fuel alternative. We do this by utilizing rate design and taking advantage of the efficiencies of the technologies needed to make the transition.

The internal combustion engine is very inefficient and gasoline and diesel are both very expensive fuels. From a cost perspective, this makes the transition at the same or lower cost very easy, especially now that electric car cost are now comparable to fossil fuel powered cars. At a rate of $100.00/MWh it would only cost approximately $5 to $7 to charge a modern electric car with a range of approximately 450 km as compared to the $50 or $60 to fill a modern internal combustion engine at current gas prices. Even at rates as high as $300/MWh the fuel cost are still less than the fossil fuel alternative. It is assumed in our modeling that charging stations will have their own independent meters so that this increased load can be charged accordingly with the ability of time of use pricing at the charging stations. We have meters at the pumps and we should also have meters at the charging stations to allow for time of use pricing. We can have a wind wizard instead of a gas guru.

The transition of industrial heat and steam on the other hand is not as cost effective as transportation. Fossil fuel boilers for industrial heat and steam can be relatively efficient and can have relatively low fuel cost. The equivalent cost to displace these fuels is in the range of $20 to $60 per MWh. It is assumed that the rate for the transportation can be adjusted high enough to balance out the low rate of the industrial heat and steam to maintain the total system rate of $100/MWh assumption. Fossil fuel costs are currently low and have a much larger chance of going up instead of down in the future. Increases in fossil fuel prices will make the transition easier.

There would also be a shift of the remaining fossil fuel home heating to electric heat pumps. This would generally be at the residential and commercial rates, and heat pumps should be less expensive for the rate payer due to the efficiency of the heat pumps.

The load shape we assume for stage 2 RPS is somewhat flattened. This change in load shape is due to several reasons. The first would be the implementation demand side measures like the RASD program. As well the addition of transportation and industrial heat and steam are generally flat base loads at a monthly level. The increase of heat pump usage will also have a flattening effect on the monthly profile, as they use less in the winter but also provide A/C which will increase summer load.

On an hourly basis, the transportation load will more than likely be mostly during the night which will help flatten the day and night peak. Time of use pricing at the charging stations can also help with the integration of renewables. As well the transportation load will generally be charging batteries that can also provide grid services back to the grid if needed as part of the smart grid program.

The installation of electrode boilers will not replace existing fossil fuel boilers for the most part, but instead be installed in addition too them. When there are excess renewables the electrode boilers would generate the steam, and when there is low

renewable generation the original fossil fuel boiler would be used. When implemented this way, the additional electric load comes with no additional capacity or demand cost and enable better integration of renewables. The cost of the electricity would be set to the same price of the fuel it would be displacing to keep the costs the same. We have included Attachment F Business Model Electrode Boiler that looks at the capital cost, and comparison of efficiencies and fuel cost comparisons. We have also include Attachment G 2016-358 New Clear Free Solutions - CEJS400-4MW-300ST which is the quote for the electrode boiler.

The transition to stage 2 RPS does not start when stage 1 is complete, although for model simplification that is how we have modeled it. In reality our grid is already very low carbon and especially in the non winter months. It would be expected that in 2040 the actual in province load could be a lot higher. If this was to be included in the modeling it would have a positive outcome.

It would be expected that some of the dividends and profits could be used to incentivise this transition such as rebates on electric cars, or pay for the capital costs of the electrode boilers.

NCFS (NBP) **IR-04** **January 24, 2017**

Reference: Exhibit NCFS 1.01, Page 7, Lines 2-5

Preamble:

The provinces climate action plan is to tax carbon and invest the proceeds into ghg reduction by investments in conservation, energy efficiency and Renewable energy. We would argue that investing the Carbon Tax into the solutions is the best climate policy of all of the Provinces and should be a model followed by them. Fundamentally this plan is what New Clear Free Solutions has been proposing as the Carbon Tax and Investment Plan.

Questions:

a) In the Carbon Tax and Investment Plan model, in each year from 2016 to 2040, what percentage of the Carbon Tax revenue does NCFS assume is invested in each of:

1. energy efficiency,
2. conservation measures, and
3. renewable energy generation.

Answer:

Fundamentally the solution to climate change is renewable energy unless we want to use zero energy. We don't need to use less energy we just need to use clean energy. New Brunswick has

more than enough renewable energy resources to power the province at our current rates and generate huge dividends for the Province. Conservation is generally used only when there is a lack or finite amount of something like fossil fuels, but we have plenty of renewable energy resources that will last essentially forever. The solution to climate change is the transition from fossil fuels to renewable energy, and along with this shift in energy will also be a shift in who makes the profits on this energy. Efficiency only determine the end size of the overall solution. . Investing $300 plus million dollars from the Carbon tax a year into energy efficiency and conservation measures is a bad idea.

Our sensitivity analysis shows that changes to the demand or the size of the overall solutions negatively affects the plan. Declining growth can choke the very cash flow needed to make the transition to renewable energy, as seen in Ontario. Energy efficiency should focus on displacing ghg emissions. Our grid is already 75% carbon free with an aggressive renewable energy supply plan. Using less electricity has little environmental affect and has negative economic impacts. If efficiency programs are more focused on fuel switching, and renewable integration and demand side management there will be larger ghg emissions reductions and the additional revenue can provide more cash flow to help with the transition and pay larger dividends.

We do assume that the current RASD program is continued and financed through NB Powers current operating cash flow. We have also included $800,000,000 for 400MW of tesla storage, and that could easily double or triple without much effect on the plan.
We do think efficiency programs should be investments and not subsidies. This can be done by issuing low interest long term loans for energy efficiency upgrades.

NCFS (NBP) **IR-05** **January 24, 2017**

Reference: Exhibit NCFS 1.01, Page 8, Lines 15-23

Preamble:

In attachment A we have assumed an economy wide carbon price starting off at $20/Ton which generated approximately $300 million per year to be invested

into renewable energy. It this modeling the $300 million stays constant. It would be expected that as carbon is reduced that this amount would become smaller so that the Carbon Tax would have to increase. We think the portion of the carbon tax that NB Power rate payers pay should simply be a percentage of the revenue requirement so that that portion of the carbon tax stays relatively flat ensuring stable funding. We do not think that a carbon tax of $50/Ton is needed to make the transition. The price on carbon should be no higher than the investments needed for the supply plan to keep rates low and stable.

Questions:

a) Please confirm that the assumed Carbon Tax revenue of $300 million per year is from all sectors (electricity, transportation, industrial, agriculture, etc.)

b) Please confirm that NCFS has assumed that 100 per cent of the Carbon Tax revenue would be invested in the electricity sector.

c) Please confirm that NCFS has assumed that 100 per cent of the Carbon Tax revenue would be provided to NB Power to invest in renewable generation.

d) Has NCFS done any analysis on the economic impact of imposing a carbon tax on the industrial, transportation and agricultural sectors? If so, please provide.

Answers:

a) Yes we assume the carbon tax is economy wide

b) We assume $300 million of revenue from the carbon tax would be invested into the electrical sector, this is approximately $20/Ton. The carbon tax could also be larger to account for any additional programs or the additional programs can be financed with the dividends from the plan.

c) We think this makes the most sense since NB Power is responsible for electricity and energy efficiency within the province. Having all this equity sit on NB Powers books will help with the provinces credit rating. We will however be proposing the investing of the carbon tax have EUB oversight and public hearings, and then government approval. The money should not blindly be given over to NB Power.

There could be a case for some private operations of the NB Power owned renewable energy facilities. Many wind turbine manufacturers also provide O and M support contracts.

d) We discussed our assumption on the economic impacts on the industrial and transportation sectors in the previous IR regarding the assumptions in stage 2 RPS. We conclude that the only additional initial cost to these sectors will be the carbon tax itself,

and that in the end there should be substantial savings from the transportation due to the high cost of gasoline and the efficiency of the internal combustion engine compared to electric transportation.

Reference: Exhibit NCFS 1.02, Attachment A Carbon Tax and Investment Plan 2016 Annual Energy Outlook Update. Slides 4-5

Questions:

a) NCFS includes $800 Million for a 400 MW Storage Tesla Power Wall in the summary table on slide 5, but it is not included in the annual construction table on slide 4. Please reconcile.

Answer:

a) NCFS has modeled storage in different ways in different modeling. Previously we directly included it in the supply plan but because it didn't generate any additional electricity for that year, it left flat spots in the supply plan, when in reality we would expect new generation each years. In this model, we simply subtract the cost of the storage from the dividends total so it doesn't affect our supply plan. This can be seen in cell c41 on the stage 1 IRP tab in Attachment D.

   We also consider lifespan this way for the stage 2 RPS. We subtract the capital cost of any retirements from the dividends.

NCFS (NBP) **IR-07** **January 24, 2017**

Reference: Exhibit NCFS 1.02, Attachment A Carbon Tax and Investment Plan 2016 Annual Energy Outlook Update. Slide 7 (Stage 1 RPS Integrated Resource Plan Technical Details)

Questions:

a) NCFS shows a balance of energy on a monthly basis between current NB Monthly Demand and Stage 1 RPS Monthly Generation stacked. Did NCFS assume that the load and generation will also be in balance on an hourly and intra-hour basis?

Answer:

a) Yes, for the purposes and objectives of the modeling we assumed that the load and generation would also be in balance on an hourly and intra-hour basis. The uncertainty in the question of balancing that much renewables can be mitigated financially and is not a technical problem. We have addressed this in our sensitivity analysis.

   There could be extra costs associated with the integration or renewables but there is also a fair amount of conservativism in our assumptions. We assume no interconnects in our modeling and if this was included would only have significant system benefits. The combination of HQ as a supply and Maine a place to sell excess energy acts like a huge

battery. HQ currently has over 120TWh of energy currently stored in their dams and nuclear power plants are shutting down in the North East US for economic reasons. HQ has enough stored energy to power New Brunswick for almost 10 years.

We take no account for RASD measures in our modeling but assume they continue. We addressed the question of what happens when the wind doesn't blow by keeping lots of fossil fuel capacity operating at very low capacity factors. We also assume the supply is all new builds when facilities like Coleson Cove could provide much of that capacity saving money for more storage or transmission.