NAVECO POWER

ENERGY FOR TODAY

Town of Riverview Solar Farm Pre-Feasibility Study

Submitted by:

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Fredericton, New Brunswick

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Executive Summary

The Town of Riverview engaged Naveco Power Inc. (Fredericton, New Brunswick) in January 2017 to provide a pre-feasibility study with respect to installing a photovoltaic (PV) solar farm on the municipality's old landfill site located on Niagara Road, south of the town.

This study was requested due to the Town expressing interest in learning more about, and possibly pursuing submitting a proposal to NB Power for their Locally-Owned Renewable Energy Small Scale (LORESS) program. LORESS encourages local entities, such as munipalities, to submit proposals to generate renewable energy up to 20 MW. Local entity proponents are required to own no less than 51% of a project.

This study provides information about the LORESS program as well as another NB Power program called net metering, where proponents can apply to supply up to 100 kW of renewable energy to their own buildings. The study also provides a scan of the solar industry in Canada.

Based on the available cleared land at the old landfill site, it is estimated that a PV solar farm installation of between 2 MW and 4 MW is viable, without having to clear many trees, which would add to the overall project cost. Using an average of 3 MW, overall construction cost would be approximately $8.1 Million and would generate about $375,000 per year, or $9.375 Million over a 25-year period for the owner if the project were to be able to sell electricity to NB Power for $0.10 per kilowatt hour, which could be a challenge. Although these appear to be slim margins, FCM grants for the project, as it is brownfield site, could help make it a viable project.

The Town of Riverview can apply for funding from the Federation of Canadian Municipalities whether they opt for the landfill project (under brownfield sector funding), or the rooftop solar project in conjunction with an energy retrofit for the arena (under energy sector funding). Other possibilities for funding include community bonds if partnered with a non-profit organization, or through the CEDC model.

If this cost and submission deadline to NB Power of April 28, 2017 for LORESS may be a challenge, the consultant is also proposing a net metered project, possibly on the rooftop of the Byron Dobson Arena. If more than 20 kW, this installation would be the largest in New Brunswick and help further position Riverview as a sustainability leader in the province.

Section 1: NB Power LORESS Program Summary

The Locally-Owned Renewable Energy Small Scale (LORESS) program encourages the creation of new renewable generation to serve in-province demand. Under this program, New Brunswick Power is seeking expressions of interest (EOI) from local entities for a total of up to 40 MW of renewable generation, to be in service by December 31, 2020[1].

Regulation 2015-60 (Electricity Act) states that: "On December 31, 2020, and for each subsequent fiscal year, the Corporation shall ensure that 40% of the total in-province electricity sales in kilowatt-hours is electricity from renewable resources"[2].

Through a competitive bid process, NB Power is required to endeavor to obtain 40 MW of electricity from renewable resources owned by local entities. Each local entity can submit a proposal with a maximum capacity of 20 MW. This can include renewable resources such as wind solar, hydroelectric, ocean-powered, biogas, biomass, and sanitary landfill gas.

The LORESS program aims to help the province reach its renewable targets for 2020, and to promote a more sustainable future for New Brunswick.

[1] https://www.nbpower.com/en/about-us/news-media-centre/news/2016/nb-power-invites-first-nations-to-participate-in-renewable-energy-project/
[2] http://www.gnb.ca/0062/acts/BBR-2015/2015-60.pdf

Section 2: NB Power Net Metering Plan

The LORESS program mentioned in Section 1 applies to submissions to NB Power that close on April 28, 2017 and should propose no less than a 20-year Power Purchase Agreement (PPA) with a focus on cost competitiveness. Another option for the Town of Riverview to consider is developing a small project via the NB Power Net Metering program. The following summary is from NB Power[2]:

> *As New Brunswickers, we know the power of nature. We also know that, for you, saving money and being environmentally responsible is important. That's why we created the Net Metering program.*
>
> *The NB Power Net Metering program provides customers with the option to connect their own environmentally sustainable generation unit to NB Power's distribution system. The program allows customers to generate their own electricity to offset their consumption, while remaining connected to NB Power's distribution system – so they can meet their electricity demands when their generation unit cannot.*
>
> ***In order to qualify for the program, the generation units must:***
>
> - *meet NB Power technical requirements*
> - *not exceed 100 kW*
> - *come from renewable energy sources compatible with Environment Canada's Environmental Choice Program (EcoLogo TM) standards such as alternative use, biogas, biomass, solar, small hydro or wind*
> - *use approved equipment – certified by an organization recognized in the Province of New Brunswick*
> - *have an Electrical Wiring Permit from a licensed electrician, and inspection and approval by the New Brunswick Department of Public Safety, Technical Inspection Services prior to connection*
>
> *Note: For off-grid or stand-alone projects, contact New Brunswick Department of Public Safety, Technical Inspection Services.*
>
> *A special type of meter or "net meter" will be installed replacing your existing meter. This new meter provides readings for the electricity you use from NB Power, and the electricity you produce and send back to our distribution system. We then bill you for the difference or 'net' amount of electricity used. Credits cannot be carried forward beyond March of each year. At that time, any remaining credit not used will be reduced to zero.A net metering agreement must be signed prior to the installation of the net meter.*

[2] https://www.nbpower.com/en/products-services/net-metering/

Section 3: Solar Energy Business Scan in Canada

Across the world, the use of solar panels to generate renewable energy has proliferated. This can be attributed to the rising cost of traditional energy methods and the decreasing cost in solar panels. The size of solar projects range from mega-projects, such as the Desert Sunlight project in California of 550 MW (about 83% of Point Lepreau capacity) to the Belfast airport in Ireland of 4.83 MW (see figure 1) to local schools in Japan of 0.11 MW. Although not equally distributed, many nations, states, cities, towns, and citizens have clearly recognized the need to adopt solar energy as a viable renewable energy source. Across Canada, nearly 99% of existing solar panels have been adopted in the province of Ontario[3]. This adoption can be partially attributed to the Feed-in Tariff (FIT) programs developed by the government of Ontario[4]. This program allows for property owners to purchase solar panels or lease their land to solar developers and sell it back to the grid. According to industry stakeholders, these projects can provide profit to the land owner and the solar developer at nearly $0.18 per kWh.

Figure 1: The Belfast airport in Northern Ireland products enough electricity to meet 27% of the airport's electricity demand.

[3]http://www.cansia.ca/uploads/7/2/5/1/72513707/national_survey_report_of_pv_power_applications_in_canada_2014.pdf
[4] http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/pdf/2016-019_RP-ANU_411-PVNORD_Dignard_Poissant_e%20WEB.pdf

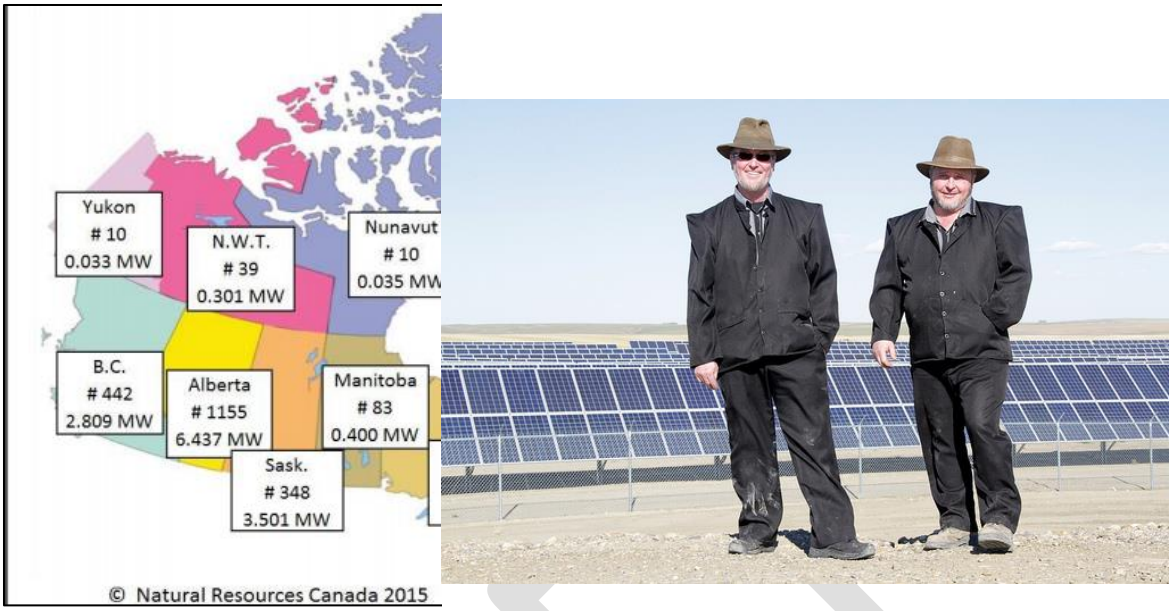


Figure 2: Canadian Solar installed capacity as of 2015

Not only do residents of Ontario deem solar as a wise investment. In Alberta, for example, the Green Acres Hutterite colony of 80 people installed the largest at the time (2014) solar farm. This 2MW, $4.8 million farm was developed without government assistance (see figure 3). "Thanks to a keen business sense and a DIY attitude, Green Acres pushed the envelope on the cost of the solar. They secured an original quote to build their two-megawatt solar farm for $2.80 a watt, but reduced that to $2.40 a watt through their own labour... The result is a payback of 15 years if electricity prices remain low, or as few as 10 years if they start to escalate, says Dan Hofer"[5].

Figure 3: This 2MW, $4.8 million farm was developed without government assistance.

The belief that small scale solar projects, such as roof-top solar installations, carport installations, and side-of-buildings projects, are a viable option for energy users alike has also been clearly demonstrated. For example, at the OrcaLab Whale Research Centre on a remote island near Alert Bay, British Columbia (see figure 4). At the research centre, solar panels have been erected and "translates to fuel cost savings of up to $2,000 per year"[6].

Figure 4: OrcaLab solar project, which has reduced annual fuel costs by $2,000.

[5] http://www.greenenergyfutures.ca/episode/hutterite-solar-western-canada-biggest

[6] http://www.canadiansolar.com/solar-projects/orcalab-whale-research-centre-canada.html

Section 4: Benefits to the Town of Riverview

While solar projects, large and small, have been developed to reduce the financial burden of rising electricity costs in locations across the world, there are additional benefits to those stakeholders who adopt this renewable energy source. Economically, developing a solar farm can produce many jobs during the construction phase. For example, the 10MW Greenough River solar farm in Australia produced nearly 100 jobs at construction peak (see figure 4)[7]. Moreover, the 23.4MW Arnprior Solar project "employed approximately 150 local community trades during design/engineering/construction, resulting in over $20 million in local procurement for materials, equipment, and services[8]". In addition to these jobs during the construction phase, indirect benefits to the community can be realised. This includes the dollars spent by constructor workers, management teams, and other stakeholders on hotels, fuel, meals, and entertainment.

Figure 5: The project is funded with 100% equity, with the WA Government providing A$20 million, including A$10 million from the WA Royalties for Regions program...The project created jobs for about 100 people at construction peak

While solar farms create clear economic benefits to communities, society as a whole also derives many benefits when these projects are commissioned. In particular, solar farms have been used to drastically reduce carbon emissions, repurpose land, and educate local citizens. For example, because of the Desert Sunlight project in California, there has been support and creation of several educational programs, such as renewable energy training at the local college, an on-site solar energy learning centre, and programs designed for local elementary and high school. Moreover, solar farms, as small as the Orcalab projects, can reduce carbon emissions. This small-scale, 270 W solar project was able to reduce carbon emissions from the traditional fuel source by 1.5 to 2.0 tonnes per year.

The largest solar installation in New Brunswick is currently 15 kW, located on the rooftop of the APEGNB office in Fredericton. A NB Power case study on the installation is included in Appendix 1.

[7] http://www.firstsolar.com/About-Us/Projects/Greenough-River-Solar-Farm
[8] http://www.edf-re.com/project/arnprior-solar/

Section 5: Ownership Models

There are several ownership models for PV solar installations depending on the size of the project. A net metering project is simple – NB Power requires the owner of the project to generate their own sustainable electricity for their own buildings, the electricity cannot be sold to anyone else. Also, note that applications for net metered projects can go to NB Power at any point in time – there are no deadlines.

The deadline for submitting a proposal to NB Power for the LORESS Program is April 28, 2017, basically two months from the date of this report. The primary requirement for proposals is that no less than 51% of the project be owned by a 'local entity', defined as[9]:

"local entity" means

(a) a municipal distribution utility,

(b) a municipality, rural community or local service district,

(c) a band as defined in the Indian Act (Canada) that is located in the Province or a partnership or limited partnership between two or more bands that are located in the Province,

(d) a not-for-profit company incorporated under the Companies Act and in which a majority of the voting shares is beneficially owned or controlled, directly or indirectly, by one or more residents of the Province,

(e) an association as defined in the Co-operative Associations Act and in which the majority of members who are entitled to vote are residents of the Province,

(f) an educational institution that is designated by the Lieutenant-Governor in Council as a degree granting institution under the Degree Granting Act or is authorized by an Act of the Legislature to grant degrees,

(g) a regional service commission as defined in the Regional Service Delivery Act, or

(h) a partnership or limited partnership between any of the entities listed in paragraphs (a) to (g) and a person who is a resident of the Province, the majority interest in which is owned by the entity and in which the majority of benefits, under the partnership agreement, accrues to the entity.

Based on estimates on the potential land use of the old landfill site (see Section 6), the capital cost of a 3 MW PV solar farm is about $8 Million. At first glance, this may be a large

[9] http://www.gnb.ca/0062/acts/BBR-2015/2015-60.pdf

number to absorb, that said, there are several financing methods that may make this project financially viable. Examples include:

- 51% ownership by the Town of Riverview and 49% ownership by a partner, such as Community Economic Development Corporation (CEDC[10]), which could include Great Moncton area citizens;
- 51% joint venture with another local entity, such as a First Nation or non-profit organization, and 49% owned by a third party, essentially share the risk three ways;
- 51% owned by another local entity and 49% owned by a third party and the town leases the land to the ownership group;
- 100% owned by the Town of Riverview, and;
- Engage in a vendor takeback loan to reduce initial capital outlay.

A vendor take-back mortgage is a type of mortgage in which the seller offers to lend funds to the buyer to help facilitate the purchase of the property. The take-back mortgage often represents a secondary lien on the property, as most buyers will have a primary source of funding other than the seller[11].

The following information regarding CEDCs is sourced from http://fcnb.ca/cedc.html:

What is a CEDC?

A CEDC is an opportunity for New Brunswickers to channel their investment dollars into their local economy. CEDC stands for "Community Economic Development Corporations". A CEDC is a pool of money raised by selling shares (or other eligible securities) to individuals in a defined community. These funds are controlled by a local group of officers and directors, who may be chosen by the founders and promoters of the CEDC or by the CEDC's investors at an annual general meeting.

How are the funds used?

In order to qualify, the project must have a measureable financial return. A CEDC is not meant to fund projects that do not generate revenue. For example, developing a new children's playground would not be an eligible use of CEDC funds since it does not produce a revenue stream. On the other hand developing a farmer's market or a skating rink with rental income may be eligible projects.

The minimum amount to be raised by a CEDC within a 12 month period is $10,000 and the maximum amount of capital that may be raised is $3,000,000. If the CEDC doesn't raise the minimum amount it requires, all monies are returned to the investor.

[10] http://fcnb.ca/cedc.html
[11] http://www.investopedia.com/terms/v/vendor_take_back.asp

How do I invest in a CEDC?

If you are considering investing in a CEDC, you will fill out an Expression of Interest Form. This does not mean you are committing to investing, but tells the company that you are interested in knowing more about the opportunity. The company will send you an Offering Document to help you make your decision. This document outlines what you would be purchasing with your investment dollars, who is making the shares (or units) available, what the total value of the offering should be and how the funds are to be used. It is important to remember that because these are exempt market investments, they are risky investments. ***Neither FCNB nor the Government of New Brunswick assesses, reviews, or approves the merits of the shares, or reviews the offering document.***

Take the time to fully read the offering document and be sure that you understand the business plan and the risks associated with the investment opportunity. You may also want to discuss any investments you are considering with your financial adviser. They can help you determine if the investment fits your risk tolerance level, and if it is appropriate for you.

The minimum investment per individual is $1000. The maximum amount an individual can invest is $250,000. If the investor is a trust or a corporation, the minimum amount is $50,000.

Naveco Power is in the process of raising capital specifically for financing energy efficiency and renewable energy projects in New Brunswick.

Section 6: Project Cost and Revenue Estimation

This report provides cost and revenue generation estimates for two scenarios; installing a 3 MW solar farm at the old landfill site and a 100 kW net metered rooftop solar farm on the Byron Dobson Arena. Appendices 3 and 4 provides a simulation summary for a 2 MW and a 4 MW solar farm at the old landfill. If an installation were to happen in this location under the LORESS program, a minimum 20 year PPA would be sought, more likely a 25 year PPA.

Per the United States National Renewable Energy Laboratory (NREL[12]), the mean capital cost for photovoltaic (PV) is US$2,025 or approximately CA$2,700 per kilowatt. We believe these numbers to be quite accurate based on conversations with professionals in the field. Multiply $2,700 by 3,000 kW ~ $8.1 Million to construct.

The simulation reports estimate an output of 1,250 kWh/kWp (installed capacity): 1,250 kWh x 3,000 kW x $0.10/kWh ~ $375,000 revenue per year or $9.375 Million revenue over 25 years. On the surface, this doesn't appear to be a solid investment; that said, two major variables could help improve the viability – determining if NB Power would accept a higher price point for solar (could be a challenge) and just as importantly, determining how much capital cost may be offset by grants from organizations such as the Federation of Canadian Municipalities (FCM).

If the Town of Riverview opted to install PV on the rooftop of the Byron Dobson arena, the electricity would have to feed directly into a municipal owned building, such as the arena or adjacent buildings to meet the net metering policy.

Rooftop solar in New Brunswick currently costs about $4,000/kW, so a 100 kW rooftop installation would cost approximately $400,000. Generating 1,250 kWh/year x 100 kW x $0.15/kWh (approximate price you are currently paying NB Power) = $18,750 in electricity bills not paid to NB Power. If the price of electricity were not to increase (which it is not), that would represent $468,750 in savings over 25 years. That said, electricity rates are projected to increase by 2% per year over the next decade, not including the carbon levy of $10 per tonne in 2018 that will rise to $50 per tonne by 2022. NB Power estimates these increases to equate to about 38% by 2027[13], or $0.21/kWh in 2027, an average of $0.175/kWh over the next decade using $0.175/kWh as an avoided cost for just the first decade, actual savings over a 25-year period would be closer to $545,000. Basically, you do not have to worry about the price of electricity increase year over year when you are generating your own!

[12] http://www.nrel.gov/analysis/tech_lcoe_re_cost_est.html
[13] http://www.cbc.ca/news/canada/new-brunswick/nb-power-carbon-tax-planning-1.3924685

Section 7: Potential Funding Sources and Breakdown

The following are potential funding sources for either the landfill site or the arena site for solar:

1. FCM: Green Municipal Fund for Brownfield Sector
2. FCM: Green Municipal Fund for Energy Sector
3. Community bonds

1. FCM: GMF for landfill solar scope

The Federation of Canadian Municipalities (FCM) offers the Green Municipal Fund (GMF) program to municipalities and private sector partners intending to pursue projects in the following five sectors: brownfields, energy, transportation, waste, and water[14].

Accordingly, the Town of Riverview, for example, in partnership with Naveco Power, can apply for the GMF to help remediate the landfill site for the solar farm project. This would fall under the renewable energy production category of the Brownfields sector. The GMF has the following funding and incentive programs:

- *Plan:* grants available for community brownfield action plans (up to 50% of eligible costs, maximum $175,000)
- *Study:* grants available for feasibility studies (up to 50% of eligible costs, maximum $175,000) and pilot projects (up to 50% of eligible costs, maximum $350,000)
- *Remediate:* loans available for brownfield capital projects (up to 80% of eligible costs)
- *Redevelop:* loans and grants available for capital projects in the 5 sectors mentioned above (up to 80% of eligible costs)

[14] http://www.fcm.ca/home/programs/green-municipal-fund/what-we-fund/projects/brownfields-funding.htm

The GMF provides provincial roadmaps for redeveloping brownfields which highlights the different programs, as well as the provincial legislation to be aware of when pursuing these types of projects[15]. In the case of the landfill in Riverview, closed municipal landfills that meet provincial requirements are eligible for redevelopment funding. Therefore, the Town of Riverview can apply for any of the grants in the GMF program[16]. In order to be considered for funding through GMF, the Town of Riverview has to meet prerequisites. If the Town of Riverview chooses to do a feasibility study or a pilot project, they must provide a letter confirming the amount of cash contributions to the initiative. The contribution must be at least 10% of the eligible costs needed for the initiative.

2. FCM: GMF for rooftop solar / retrofit scope

The Federation of Canadian Municipalities also provides funding for the energy sector[17]; however, they do not fund stand along renewable energy projects, i.e. rooftop solar. The funding is for building retrofits or new construction that focuses on energy efficiency of the space[18]. Therefore, a suggestion for the Town of Riverview would be to undergo a building energy retrofit for the arena (or other municipal building) which would further emphasize the impact of the solar panels and create an example of energy efficiency for the community.

The same funding and incentive programs apply for this funding sector:

- *Plans:* grants available for eligible planning initiatives (up to 50% of eligible costs, maximum $175,000)
- *Studies:* grants available for feasibility studies (up to 50% of eligible costs, maximum $175,000) and pilot projects (up to 50% of eligible costs, maximum $350,000)
- *Projects:* loans and grants available for capital projects[19] (up to 80% of eligible costs)

A feasibility study can be conducted for the placement of solar panels on the roof of the town arena[20]. Also, a net metering pilot project can be put in place to gather further data on the feasibility of the project. For the energy sector, the Town of Riverview must meet the same prerequisites[21], and submit a letter confirming the cash contributions (at least 10% of eligible costs). However, the Town of Riverview must also submit an initial review form before anything else, to ensure the project is eligible for funding[22].

[15] http://www.fcm.ca/Documents/tools/GMF/Brownfields_2016Roadmap_NB_EN.pdf
[16]http://www.fcm.ca/Documents/tools/GMF/GMF_Prerequisites_and_Supporting_Documents_for_a_Feasibility_Study_or_Pilot_Project_EN.pdf
[17] http://www.fcm.ca/home/programs/green-municipal-fund/what-we-fund/projects/energy-funding.htm
[18] http://www.fcm.ca/home/programs/green-municipal-fund/what-we-fund/plans.htm
[19] http://www.fcm.ca/home/programs/green-municipal-fund/what-we-fund/projects.htm
[20] http://www.fcm.ca/home/programs/green-municipal-fund/what-we-fund/studies.htm
[21]http://www.fcm.ca/Documents/tools/GMF/GMF_Prerequisites_and_Supporting_Documents_for_a_Feasibility_Study_or_Pilot_Project_EN.pdf
[22] http://www.fcm.ca/home/programs/green-municipal-fund/apply-for-funding/application-and-approval-processes-and-deadlines.htm

3. Community bonds, for both scopes

Community bonds could be a source of funding for either scope of work[23]. They are bonds or shares of the project that community members would buy at an interest rate, and they would be paid back after a specified number of years. This is an excellent avenue to promote community engagement for a project. Community bonds are intended for small-scale, non-accredited investors looking to support a non-profit organization in their community[24]. Interest rates for projects can range from 2.5-6% and can be paid back in a reasonable amount of time depending on the scope and success of the project.

Imagine: Town of Riverview citizens buying solar panels and being able to share that they are part of a project benefitting the community they live in. In recommendation, the Town of Riverview could consider partnering with a local non-profit to be eligible to sell community bonds for the community solar project.

[23] http://socialinnovation.ca/communitybond/faq
[24] http://www.moneysense.ca/columns/community-bonds-explained/

Section 8: Estimated Timeline

LORESS Submission Deadline: April 28, 2017

LORESS Generating Day 1: December 31, 2020

Net Metering: whenever ready

Section 9: Solar Farm Metrics

The following information is presented to assist the Town of Riverview staff and council recognize various metrics in the PV solar industry.

Table 1: Cost for Electric Generating Technologies, US$
Source: http://www.nrel.gov/analysis/tech_lcoe_re_cost_est.html (updated February 2016)

Technology Type	Mean installed cost ($/kW)	Installed cost Std. Dev. (+/- $/kW)	Fixed O&M ($/kW-yr)	Fixed O&M Std. Dev. (+/- $/kW-yr)	Variable O&M ($/kWh)	Variable O&M (+/- $/kWh)	Lifetime (yr)	Lifetime Std. Dev. (yr)	Fuel and/or water cost ($/kWh)	Fuel and/or water Std. Dev. ($/kWh)
PV <10 kW	$3,897	$889	$21	$20	n/a	n/a	33	11	n/a	n/a
PV 10–100 kW	$3,463	$947	$19	$18	n/a	n/a	33	11	n/a	n/a
PV 100–1,000 kW	$2,493	$774	$19	$15	n/a	n/a	33	11	n/a	n/a
PV 1–10 MW	$2,025	$694	$16	$9	n/a	n/a	33	9	n/a	n/a
Wind <10 kW	$7,645	$2,431	$40	$34	n/a	n/a	14	9	n/a	n/a
Wind 10–100 kW	$6,118	$2,101	$35	$12	n/a	n/a	19	5	n/a	n/a
Wind 100–1000 kW	$3,751	$1,376	$31	$10	n/a	n/a	16	0	n/a	n/a
Wind 1–10 MW	$2,346	$770	$33	$16	n/a	n/a	20	7	n/a	n/a
Biomass Combustion Combined Heat & Power*	$5,792	$2,762	$98	$29	$0.04	$0.02	28	8	$0.04	$0.02
*Unit cost is per kilowatt of the electrical generator, not the boiler heat capacity										

For example, mean installed cost ($/kW), PV 10-100 kW indicates the mean cost is $3,463 per kW installed, or a 100 kW PV project would cost about US$3,463 x 100 kW = US$346,300.

Figure 6: Installed Costs for Electric Generating Technologies
Source: http://www.nrel.gov/analysis/tech_lcoe_re_cost_est.html

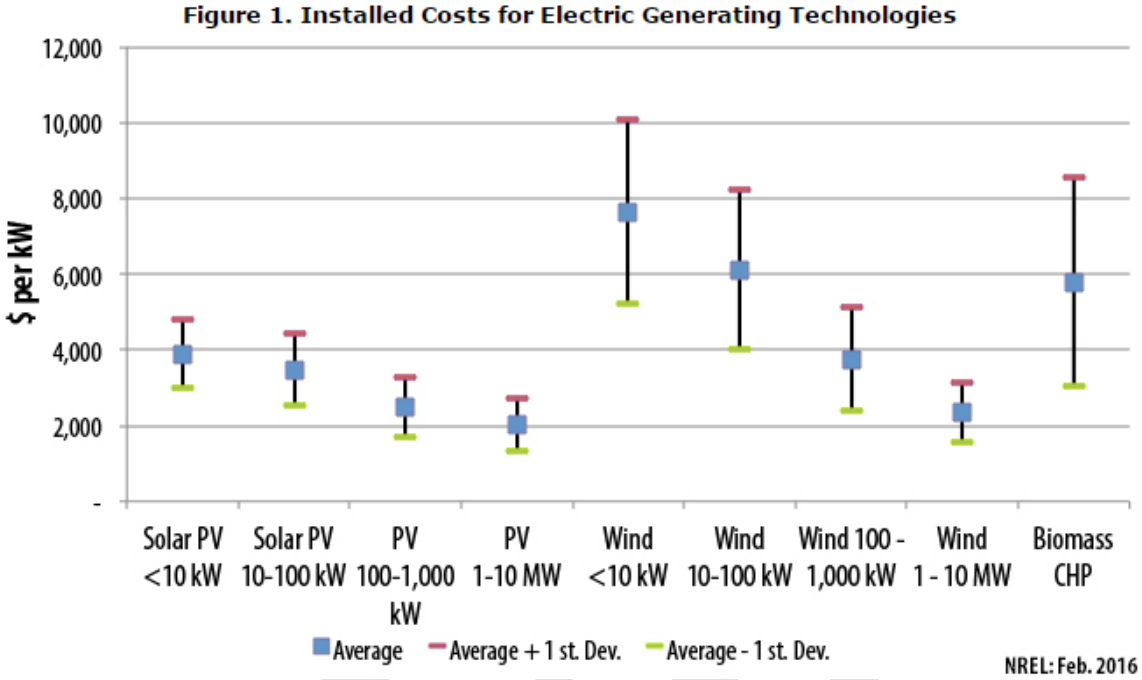


Table 2: Land-Use Requirements for PV Projects in the United States
Source: http://www.nrel.gov/docs/fy13osti/56290.pdf

Technology	Direct Area		Total Area	
	Capacity-weighted average land use (acres/MWac)	Generation-weighted average land use (acres/GWh/yr)	Capacity-weighted average land use (acres/MWac)	Generation-weighted average land use (acres/GWh/yr)
Small PV (>1 MW, <20 MW)	5.9	3.1	8.3	4.1
Fixed	5.5	3.2	7.6	4.4
1-axis	6.3	2.9	8.7	3.8
2-axis flat panel	9.4	4.1	13	5.5
2-axis CPV	6.9	2.3	9.1	3.1
Large PV (>20 MW)	7.2	3.1	7.9	3.4
Fixed	5.8	2.8	7.5	3.7
1-axis	9.0	3.5	8.3	3.3
2-axis CPV	6.1	2.0	8.1	2.8
CSP	7.7	2.7	10	3.5
Parabolic trough	6.2	2.5	9.5	3.9
Tower	8.9	2.8	10	3.2
Dish Stirling	2.8	1.5	10	5.3
Linear Fresnel	2.0	1.7	4.7	4.0

For fixed PV solar panels, roughly 5.5 acres are needed for 1 MW of installed capacity. Fixed solar panels do not move.

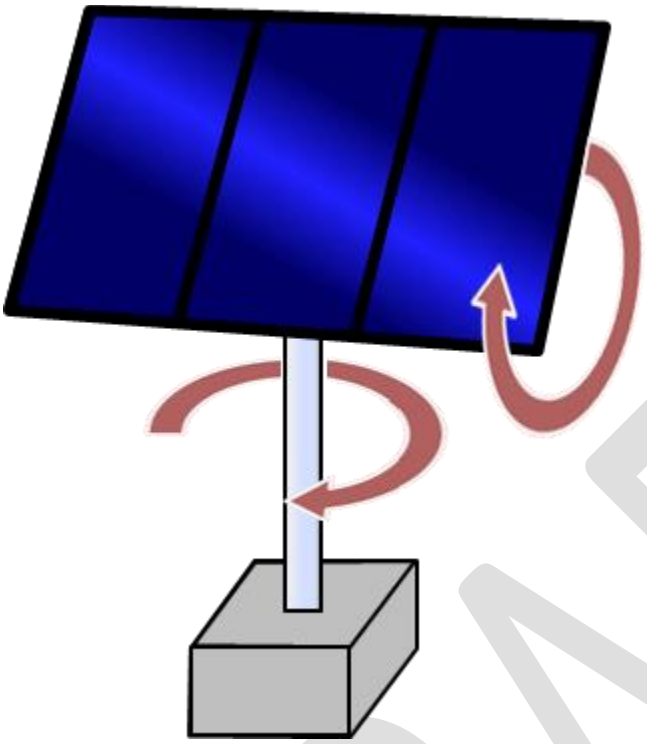
Single axis panels travel one on axis to follow the sun, this does increase capital cost, but also increases sunlight to power generated efficiency. Also, these panels require more physical area is they need to be further apart to not lose efficiency due to panels casting shade on nearby panels. For example, note that fixed panels require 5.5 acres per MW, but 1-axis panels require 6.3 acres.

Figure 7: 1-axis PV solar panels
Source: http://aemstatic-ww1.azureedge.net/content/dam/rew/migrated/assets/images/story/2011/9/12/1-10672-pv-trackers-seek-their-place-in-the-sun.jpg

Dual axis, or 2-axis PV panels track the sun both vertically and horizontally, increasing overall efficiency, but also project cost. Like the 1-axis panels, more physical space is needed so that panels do not become shaded by the motion of nearby panels, hence the increase to 9.4 acres per MW. Figure 8 and 9 illustrate two dual axis systems and the need for the panels to be distanced from each other.

Figure 8: 2-axis PV panels
Source: http://morgansolar.com/wp-content/uploads/2015/03/Kortright_Summer2015.jpg

Figure 9: 2-axis PV panels
Source: http://sedonasolartechnology.com/wp-content/uploads/2012/02/Upright2.png



A recent article in the Globe and Mail entitled "Community ice skating rinks upgrade to fight energy bills"[25] focused on the need for municipalities to reduce energy costs in arenas. Although anecdotal, the energy costs for a single-sheet arena in Woodstock, Vermont were about US$140,000 per year, about one third of the overall arena budget.

For example, (please note these numbers are generic estimates) estimate an arena has a $100,000 electricity bill per year. That represents about 667,000 kWh/year at $0.15/kWh, and will increase year over year.

Plan 1 for the arena should be to complete energy efficiency retrofits, such as LED lighting and more efficient chillers and compressors. Now assume the energy efficiency has improved by 30%, that leaves about 470,000 kWh/yr. Once the retrofits are complete, imagine rooftop solar, or panels within proximity to the arena. A 100 kW PV solar installation (the maximum allowable under the NB Power net metering policy) would generate about 125,000kWh/year, or about 25% of the load. Add this reduction to the energy savings and the arena's energy cost just decreased by 50%.

[25] http://www.theglobeandmail.com/report-on-business/international-business/us-business/community-ice-skating-rinks-upgrade-to-fight-high-energy-bills/article33432686/

Please note the numbers used in the arena example are rough estimates and should not be used for quoting purposes. We recommend that a thorough energy audit be completed by an NB Power certified energy performance contractor to provide actual estimates for this kind of scenario.

Section 10: Regulatory Consideration

When considering a solar project in any capacity, regulations need to be addressed. In the case of the landfill solar site, the Town of Riverview will need to conduct an Environmental Impact Assessment (EIA) before re-use of the old landfill **if a project exceeded 3 MW**. The following describes the process of an EIA.

LANDFILL SOLAR

In regards to EIA regulation – if over 3 MW

To determine whether an Environmental Impact Assessment (EIA) is required, Schedule 'A' of NB Regulation 87-83 was referenced. If the activity is not listed in Schedule 'A', an EIA is not necessary. By the NB Regulation 87-83 under the Clean Environment Act, any project with electric power generating facilities with a production rating of 3 MW or more requires an EIA to be complete on the site[26]. Therefore, the Town of Riverview will undergo an Environmental Impact Assessment (EIA) as required. In addition, the Town of Riverview will apply for any permits and comply with local regulations as required to complete construction.

Since the activity is listed in Schedule 'A', the Town of Riverview must register the project with the Department of Environment and Local Government, and be approved by the Minister before commencing the project. The following must be considered and included in the registration proposal[27]:

- *Project location & proposed activities* (include ecological and cultural considerations)
- *Existing environment* (include field studies if applicable, and description of previous land uses)
- *Potential impacts for each project phase* (include emissions, flooding, wind, etc. Impacts that project has on environment, and environment has on the project)
- *Proposed mitigation* (order of attention: impact avoidance opportunities, impact reduction measures, compensation if impacts are avoidable)
- *Preliminary site plan* (showing location of project components relative to each other and to environmental features on site)

The review process of these proposals includes a determination review (to evaluate environmental issues) and public involvement (to give the affected public the opportunity to be involved in the project, and for the Town of Riverview to address their concerns about the project). If the proposal is not approved after that, the Town of Riverview must undergo a comprehensive review to conduct an inclusive EIA study and to hold more public meetings.

[26] http://laws.gnb.ca/en/showfulldoc/cr/87-83//20170207
[27] http://www2.gnb.ca/content/dam/gnb/Departments/env/pdf/EIA-EIE/GuideEnvironmentalImpactAssessment.pdf

Once approved, the Minister will provide a certificate of determination and the Town of Riverview may proceed with the project.

Additionally, considerations must be made when planning to re-use an old landfill site. The following are some of those considerations.

Regulations for installing a rooftop solar project differ slightly. The following is a description of provincial regulations.

ROOFTOP SOLAR

Please note we are awaiting information on this section.

Section 11: Recommended Development Partners

LORESS:

- UGE
- Allteck
- Terragen

Net Metering:

- MJM Solar
- Fundy Solar
- Solar Global Solutions

Please note the final copy may vary slightly regarding this list.

Section 12: Recommendations

Function of finances:

- Landfill = investment opportunity if grant money and NB Power accepts reasonable price point
- Net Metering = demonstrate leadership in the province

Please note this section will include further elaboration in final copy.

Appendices

1. APEGNB Case Study (PDF) - https://www.nbpower.com/media/212680/apegnb-case-study-en.pdf
2. Appendix re TREC - https://www.pembina.org/reports/trec-ppp-presentation-albertace-ws-16feb16.pdf
3. UGE Helioscope simulation report – 2MW
4. Helioscope simulation report – 4MW
5. NB Power LORESS REOI

Please note the final copy of this report will include Appendices all within one document.