NERGICA

SOLAR PHOTOVOLTAIC: A PROMISING RESOURCE FOR OFF-GRID SITES

In a context where governments are seeking to curb their greenhouse gas (GHG) emissions, the time has come to rethink the energy supply of off-grid sites and, in this regard, many of these locations may choose to go solar!

In Canada, roughly 225,000 customers are not connected to the electrical grid while in Quebec, approximately 60,200 customers receive their energy from diesel-powered generating plants [1]. Electricity production in these stand-alone grids generates significant GHG emissions throughout the country. In Quebec alone, 260,041 tonnes of CO_2 equivalent were emitted in 2017 [2]. In this context, the federal and provincial governments have set a target of integrating renewables at mining sites as well as the 292 off-grid systems that power Canadian communities, most of which are located in the Far North.

This being the case, it is clear that achieving the GHG reduction targets approved by Canada and stipulated in Quebec's own energy policy remains contingent on the displacement of diesel in stand-alone microgrids. The objective of the Government of Quebec's 2030 Energy Policy is to achieve a renewable penetration rate of 20% in the stand-alone grids of six selected communities by 2020 [3].

Meanwhile, the master plan for Transition énergétique Québec (TEQ) aims to slash current consumption of petroleum products in stand-alone grids by approximately 15% by 2030. TEQ supports this objective with key measures that consist of stepping up energy efficiency research and activities and integrating renewables into thermal power plants [4].

Solar PV on the radar

These ambitious targets combined with the fact that solar PV projects are increasingly cost-competitive is creating a highly favourable economic climate for innovations and project build-out.

In fact, the cost of solar PV has come down considerably in recent years. In Canada, PV module costs fell from 5.36 CA$/W in 2006 to 0.78 CA$/W in 2016 [6], which corresponds to a relative reduction of 85% in the span of 10 years. Meanwhile, the selling price of commercial PV projects in the country tumbled from 12.60 CA$/W in 2006 to 2.50 CA$/W in 2016 for a relative reduction in the order of 80%. Utility-scale projects have registered similar price drops [5].

On the other hand, although the average efficiency of the most widely used PV modules today is in the order of 18%, promising technologies are currently being developed that might allow for further significant efficiency gains. The constant increase in efficiency and nominal capacity of PV modules will also contribute to cost reductions of PV projects over time.

In this context, the International Energy Agency (IEA) estimates that solar PV will grow substantially between now and 2050. It goes without saying that the sustained growth of solar PV is part of an overall upward trend through 2040 in non-hydro renewable energy sources (Figure 1), both for grid-connected and off-grid sites.

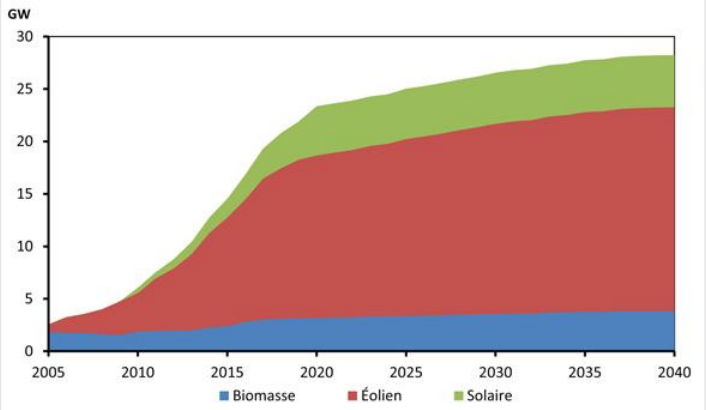

Figure 1: Forecast Installed Capacity of Non-hydro Renewable Sources through 2040 [6]

Integrating solar PV in microgrids: challenges and opportunities

The competitiveness of today's solar PV systems gives reason to believe that they will play a role in helping to displace the petroleum products currently used to power microgrids, most of which are located in northern regions. Although cold climates present a number of advantages for operating solar PV energy systems, numerous challenges remain. Besides logistical challenges, noteworthy issues include the stochastic nature of production which is subject to the vagaries of the climate, short daylight hours in winter, the lack of adaptation between production and electrical load and the need for energy management systems to pair new sources to existing generators.

Certain advances in the field have been made in recent years, however. Whether they relate to the emergence of new materials for solar panel production or developing know-how with regard to sizing, design, or O&M for systems in harsh climate conditions, today's innovations enable PV systems to be installed in cold climates. In fact, a number of demonstration projects have been commissioned in the past few years.

Solar PV demonstration projects

- First PV-diesel microgrid without storage commissioned by CanmetENERGY
  Nemiah Valley, British Columbia
  27.36 kW of rooftop solar PV on six houses
  11% of electrical supply for a village of the Xeni Gwet'in community
  Annual fuel (diesel) savings of 26,000 litres [7]
- Quaqtaq project by Hydro-Québec
  21 kW of solar PV (80 panels)
  Annual fuel savings of 5,000 litres [8]
- Projects completed by Nergica
  Installation of 16 kW of solar panels at its research site in real-world conditions in Rivière-au-Renard in the Gaspé Peninsula

  Feasibility study conducted by Nergica: solar PV project designed to power an arena
  Cree community of Whapmagoostui

  Technology cost assessment for different renewable energy integration scenarios in the Canadian Far North

Financial support programs established by Hydro-Québec and by the different levels of government encourage self-production or subsidize the initial investment, as the case may be. Investment support measures notably help overcome the inherent logistical constraints that come with deploying these technologies at remote sites. The logical consequence of these financial aid programs is a reduction of production costs, which helps make PV even more competitive compared to diesel.

These support programs, together with the prospects for jobs and training of a qualified labour force, represent development opportunities for remote communities that are being called upon to become stakeholders in the energy transition and the security of their energy supply.

According to estimates, Canadian solar PV targets could create jobs for upwards of 10,000 people annually, mainly in the fields of manufacturing and construction, followed closely by operation and maintenance [9].

In conclusion, the integration of solar PV into stand-alone microgrids is a promising avenue toward achieving an energy transition that ensures the sustainable development of communities. In recent years, a number of strategies for integrating solar PV in off-grid and cold climate sites have been developed and continue to be a subject of various studies.

As a leader in renewable energy integration, Nergica invites you to take advantage of the soon-to-be-presented webinar to learn more about the advantages of PV systems for communities across Canada, especially those in remote northern locations.

References

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