# *Closing the Gap: Renewable Energy in Orillia's Climate Future*

A Report by Sustainable Orillia to Support Big Move #1 of Orillia's Climate Future

Infrastructure and Energy Sector

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Sustainable Orillia

# I. Introduction

The City of Orillia has committed to being a net zero community by 2050. Energy generation, its use, distribution and conservation will be a key component to achieving this goal. There are many renewable and non-emitting technologies that could play a role; some of them are more complex than others. This report provides an overall synopsis of the energy technologies that we believe will be most pertinent to the City when decisions under Big Move # 1 are being made and provide recommendations for consideration. As shown in table 2, these technologies are not all the same; each has its unique pros and cons and in addition they will evolve. This report shows what the advantages and disadvantages will likely be in selecting the best mix to achieve the target of 62 MW, which may in itself change based on actual Ontario electrical grid emissions. There will not be a magic silver bullet for Orillia, as has been shown in other communities going through the same issues.

The underlying principle of these technologies are that they either generate energy without direct GHG emissions or help the generation component in a supportive capacity. We have not focussed on the distribution issues to any great extent although we do give examples such as the Speedier project where distribution is incorporated into the planning process. As well, energy use behind the meter is not discussed in any detail. To determine the optimal mix for Orillia, careful planning and social licence will be key. Some examples are: public acceptance and public direct involvement, cost - total and per MW including government incentives, local job creation, technology maturity, role of OPGC vs community Energy Corporation(s), land requirements and Land Use Planning considerations, broad regional factors and opportunities e.g. Simcoe County, partnership opportunities and requirements e.g. community/businesses etc, policy Integration e.g. Greening the Building Code, Hydro, OPG, OPGC, OEB and IESO.

As with any technology there are both advantages and disadvantages and the City will need to understand the balance between these in their selection process. For example, solar panels are being installed at a significant rate, but there is little being done on the high cost of end of life/recycling issues and Orillia will not want to be overly burdened with these potential future costs.

The City of Orillia is fortunate in owning Orillia Power Generation which has a good base of renewable generation. To maximize this opportunity, we believe that using OPG as the future driving force in this space will provide Orillia the best future opportunities for its residents. However, a community energy corporation could also become part of the mix and it could become a focus for local investors who care about the energy security of their community and want a good return on investment. Energy, just like food, is an important security issue for our community and in pursuing a path of net zero we will need to ensure community energy security while also providing expanded local job opportunities which will include skills in renewable energy audits, retrofits, renewable technologies etc. While the detail of these opportunities is beyond the scope of this report the lens of ensuring energy security also involves our economy and this needs to be considered in the not too distant future and in the context of Orillia's Climate Future.

The report is divided into three sections: I The Abstract, II an Introduction and Summary of Technical Observations, Conclusions and Recommendations and III Detailed Technical Discussion. The recommendations in II are the same as those associated with the individual technologies in III.
In summary, this report provides a basis for the City to help develop selection criteria in helping decide what the future of energy security in the City of Orillia will look like in a climate change constrained environment.

# II. Overview and Summary of Technical Observations, Conclusions and Recommendations

The City of Orillia has recently completed a Climate Change Action Plan entitled Orillia's Climate Future. This report is a roadmap for the City to help it achieve its target of being a net zero community by 2050. The Report outlines current emissions, so we know what reductions are needed to reach a net zero status. Once all actions (Big Moves 2 & 3) have been accounted for in this report, the remaining reductions in energy would be 62 MW. This is the amount of energy that will be needed to be generated from non-emitting sources from within the City in order to reach the target. It is a large number.

The aim of this Summary is to provide a generalized outline of the energy-related technologies with recommendations to consider in helping Orillia fill this gap. It is by necessity, brief, but it is intended to help generate further discussion on what the next energy steps should be and to focus attention on the fact that there is no one single magic solution; Orillia will need to use a combination of technologies. Additional technical detail is provided in the Part III

## The Need For Renewable Electricity Production

## *Closing The Gap: Renewable Energy in Orillia's Climate Future*

In order to achieve Net Zero by 2050, Orillia needs to produce an additional 62 MW of green electricity to offset residual carbon emissions from its other sources of electrical generation.

The generation of an additional 62 MW of renewable electricity is a significant challenge, not to mention having to increase it further to offset grid emissions that are forecast to rise due to current government policies. To develop a 62 MW capacity, typically a community would look to the development of some type of "community renewable energy corporation" or to contract with an existing electrical energy generation company to develop renewable energy generation capability. Further information can be found in a fact sheet from the Pembina Institute https://www.pembina.org/reports/community-owned-re-fact-sheet.pdf

Orillia owns its own electrical generation utility and that is rare. Orillia Power Generation Corporation (OPGC) has one shareholder - the City of Orillia. It currently produces about 23 MW annually from hydro and solar sites across Ontario. This situation provides Orillia with a headstart advantage in achieving not only the stated 62 MW of additional renewable electricity in Orillia's Climate Future but also provides the foundation for additional renewable electricity to power a significant production of Hydrogen, which the Canadian Renewable Energy Association calls "The Green Light" and notes that green Hydrogen is a massive enabler of renewable energy.

The role of OPGC in developing additional solar and other renewable sources must be confirmed. It seems counterintuitive and simply ineffective and inefficient to create a "community renewable energy corporation" when the City "owns" an existing one and has not yet exhausted OPGC's potential to meet the Target of 62 MW. OPGC will need to be provided with additional resources (both technical and financial) to enable such a large increase in generation capacity but with both City and community support this could be achievable in the view of Sustainable Orillia (SO). However, there is also no reason why a community based energy corporation with residents investing in their own energy security could not also be a major contributor to renewable energy generation and management. Many Ontario communities are engaged in examining their options as part of climate action and energy management

programs. Developing community energy plans that considers all local energy flows that impact activities within the community is key. Examples of this in the Ontario context are Brampton, Guelph and East Gwillimbury (some 10 years ago).[1]

Table 2, below, describes at a high level the various types of renewable energy generation systems that are currently being used in Canada and elsewhere. We also provide commentary with respect to the relative size of installations to meet the 62MW capacity increase proposed in Big Move #1. From this analysis, a broad mix of electrical generation technologies will be required to meet Orillia's future energy needs and technologies such as small nuclear reactors may need to be part of that mix along with what are considered renewable energy solutions.

Another important consideration is the concept of "additionality". To make sure hydrogen production is not diverting renewable energy away from the grid, in the EU the energy used to produce green hydrogen production will have to be matched by additional renewable energy production on an hourly basis. They have enacted legislation that requires proof that renewable hydrogen is only produced when and where sufficient renewable energy is available, and from 2038 onwards, that the renewable energy installations they are getting their electricity from are no older than 36 months. This policy direction is important. Regarding Renewable Energy, Orillia's Climate Future discusses several strategies: Local renewable generation, advocating for a "decarbonized Ontario Electricity Grid", Renewable Energy Credits and Power Purchasing Agreements. It is important when considering the latter two that Orillia is adding to the renewable energy generating capability and not buying renewable energy that had previously been fed into the Grid. The details of the Renewable Energy Credits and Power Purchasing Agreements must provide for "additionality" to the renewable energy system.

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[1] A well recognised consultant in this field is Peter Garforth of Garforth International who worked on these municipal plans - see https://www.garforthint.com/communities. He worked on the Guelph Community Energy Plan and Windsor's Deep Energy Efficiency Retrofit Program (https://ehq-production-canada.s3.ca-central-1.amazonaws.com/01f1295c425fdb1ad93a2732713e7341aec561d7/original/1667240685/8973387f3be6ff80b52761fdaf5cef6b_Windsor_Deep_Energy_Efficiency_Retrofit_Program.pdf?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA4KKNQAKIOR7VAOP4%2F20230726%2Fca-central-1%2Fs3%2Faws4_request&X-Amz-Date=20230726T191720Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=e11dfd8432f6feac6794866ea68e809fbdd1b14a90d72a1c29228a3a178015cf); see Embedding Energy Planning in Brampton's 2040 Vision (https://e3p.jrc.ec.europa.eu/file/2163/download?token=KH07cccw)

Table 2 is an up-to-date list, but this technology area is changing rapidly, especially for niche markets. For example, recently in the UK, a new heating system using the waste heat from computer cloud systems is being used to heat swimming pools, so there may be niche areas within Orillia that are not covered in this document.[2]

Sustainable Orillia believes that the next step is to do an assessment of how much each of these technologies can provide the energy required to meet the 62 MW gap and what the implications would be.
As an introduction to the following overview, table 1 provides a summary of the relative efficiencies of energy options including conventional fossil and nuclear.

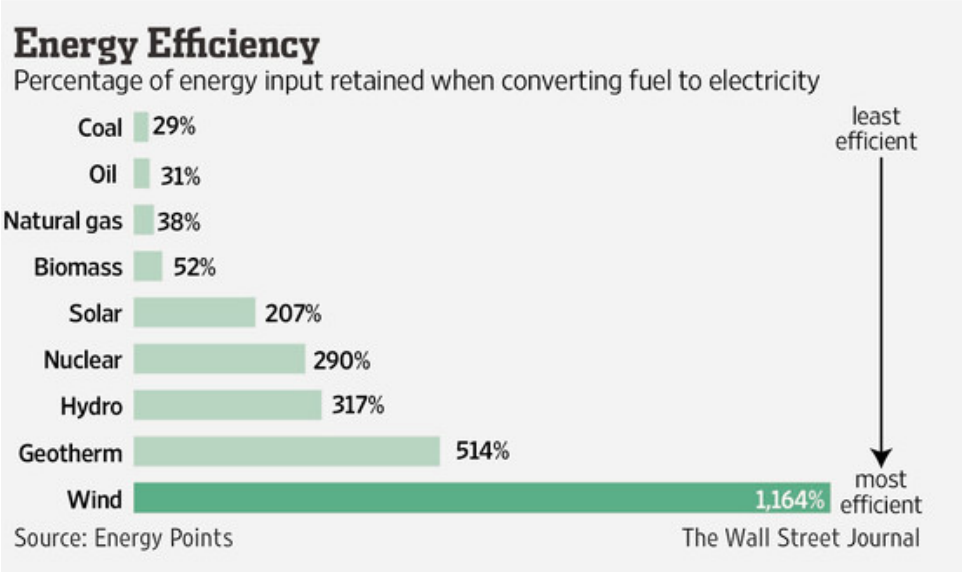


Table 1 Updated Sept. 15, 2014 10:30 am ET By Rani Molla

[2] https://www.bbc.com/news/technology-64939558

Table 2: Types of Renewable Energy Systems

| **Systems (Generating and Management or Conservation)** | **Operating Characteristics** | **Effectiveness in achieving 62 MW generation** | **Implementation Timescale for Orillia** | **Pros** | **Cons** | **Comments/ Recommendations** | **Estimated land area to generate 62 MW** |
|---|---|---|---|---|---|---|---|
| **Renewable Energy Generating Systems** | | | | | | | |
| Hydroelectric** | Proven, Reliable, Limited Supply, high capital cost | Likely limited as not much hydro potential left in local area | N/A | Well known technology and predictable operating characteristics | Large areas required; local environmental impacts. | Potential needs to be confirmed | Not applicable; but we note that with more drought conditions and extreme weather this option will be more difficult to manage in the future. |

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|---|---|---|---|---|---|---|---|
| Hydrogen | Proven for industrial use, but emerging technology for electricity generation. /Transportation, | Potentially very large as unlimited supply of raw hydrogen that could be generated in Orillia from renewable sources of electricity and local water sources | > 5 years | Known characteristics in industrial settings; can be generated almost anywhere; technology being supported by Federal and Provincial Governments; wide acceptance globally | Regulatory framework weak, limited education for public acceptance, | The Ontario government has introduced a policy to help promote this technology.[3] | Approx 1 hectare[4] So this is practical. |
| Rooftop Solar | Proven | Gap is too much | Can install | Panels | Do not work when | issues with local | Land area |

[3] https://environmentjournal.ca/ontario-launches-hydrogen-innovation-fund-to-kickstart-opportunities/
[4] https://www.lenntech.com/applications/hydrogen.htm

| Systems (Generating and Management or Conservation) | Operating Characteristics | Effectiveness in achieving 62 MW generation | Implementation Timescale for Orillia | Pros | Cons | Comments/ Recommendations | Estimated land area to generate 62 MW |
|---|---|---|---|---|---|---|---|
| PV* | technology, time and weather dependent, Local production/distribution, low cost; so rooftop and parking lot locations preferable | for solar alone to provide the solution | immediately; providing roof can take the weight | inexpensive; easy to install, low cost | sun does not shine;<br>Need other backup systems for the grid | grid being able to accept the power may be problematic | required for solar to generate 62 MW is about 372 ha. It does not matter whether it is ground mounted or rooftop.[5] There are micro wind turbine rooftop systems that are applicable to buildings in Orillia such as the Fram development and Matchedash lofts, which can provide 50% more energy than a solar array of the same price |

[5] https://www.epa.gov/sites/default/files/2015-09/documents/houston_solar.pdf

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| | | | | | | | while taking up 10% of the roof space.[6] |
| Ground Mounted Solar PV Systems | Proven solar technology; requires large areas to be commercially viable without a FIT program | Unlikely to be able to completely fill the gap | Could install immediately, but approvals could take significant time; will also depend on local grid "acceptability" | Panels inexpensive; easy to install at ground level, low cost, | ground based solar farms require significant land area<br>Do not work when sun does not shine;<br>Need other back up systems for the grid | Need about 13 acres for a 1 MW system; so, to fill the gap will need about 850 acres; | See above |
| Large Scale Wind* | Proven technology, weather dependent, | With large turbines now reaching 2 MW, only 30 turbines needed to | Immediate once design and approvals received and contracts | Significant local Ontario expertise for design, construction | Can get local opposition from noise and some issues with bird kills. | Orillia should focus on land based wind generation as opposed to | The average size of a wind farm is 50 acres per MW; so for 62 MW we will need about |

[6] https://newatlas.com/energy/aeromine-rooftop-wind

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|---|---|---|---|---|---|---|---|
| | Local/grid production and distribution, mid cost* | provide the gap requirements. Very efficient. Local grid systems likely need upgrading to accept power generated locally, unless put into a microgrid system | signed for delivery of turbines; | and maintenance from the FIT program; Small land area requirements Local jobs from maintenance program | Need to ensure all community benefits from the program and not just landowner; | offshore e.g., on Lake Couchiching. | 3100 acres or 7750 hectares. This would require areas outside of Orillia boundaries |
| Micro Wind Turbines | There are two types: vertical and horizontal axis. These are proven technologies and can last for 20 years. | Micro rooftop wind is cost effective and less obtrusive; Would need to be part of a wider energy generation solution as not large enough on | >2 years, as is needed to do research on which systems are most appropriate for Orillia's conditions. Need for changes in local building | These are significantly less obtrusive than large scale turbines; Visually less impact than traditional wind turbines and are | New technology, More public education needed on them Difficulty finding local contractors | | Assume each micro turbine can produce 10 kw; we will need 6200 rooftop mounted micro turbines for 62 MW |

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|---|---|---|---|---|---|---|---|
| | | its own to generate this gap amount | by-laws | efficient enough to power a home. | | | |
| Distributed Generation | This technology can use a variety of generation technologies that generate electricity close to where it is used. It avoids costly major grid investments and line losses, typically about 7%. It can serve a single building or | Potentially this could provide a significant portion the gaps need; further analysis of this will be needed. If used in the business park, shopping centres or the lakefront development could be | Depending on the technology used e.g., solar, <1 year. | Improves energy security locally, Flexible in terms of technologies used. Can be used to expand systems incrementally. Reduces line losses from | Upfront planning is needed prior to construction. Management systems needed to be effective. Billing to customers Public acceptance | This is the future of electrical generation. | Very small footprint required for generation/storage - generally < 1 hectare but located close to users or power[7] |

7 https://www.sandc.com/en/solutions/microgrids/?gad=1&gclid=Cj0KCQjwxYOiBhC9ARIsANiEIfYSKdIYSwAcqiOAKgVRl-KYem9CjzJb_vYoLsfYGoeNCd-gt2Mw6OQaAthlEALw_wcB#CaseStudies

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|---|---|---|---|---|---|---|---|
| | be part of a wider micro grid system. It is very flexible. | significant | | major grids. efficient | | | |
| Small Modular Reactors (SMR) | Nuclear generation technology developed for small scale and for distributed generation giving zero carbon emissions; Planned for remote communities and can support | SMR's can generate 200-300 MW; therefore 1 SMR would be sufficient to meet Orillia's gap needs | Uncertain, but likely due to regulatory and environmental impact assessment issues > 5 years. | Flexible and can support renewables. Good for distributed generation Small enough can be trucked to the site. | Uncertain technology at present Generated all levels of radioactive water. No permanent waste disposal site in Ontario | First grid scale project currently under construction at Darlington Ontario. | Rolls-Royce's new SMR will produce 470 megawatts of power and require just 10 acres of land, so for 62 MW this will be about 1 acre or 0.5 hectare.[8] |

[8] https://www.forbes.com/sites/robertbryce/2022/05/27/rolls-royces-smr-needs-10000-times-less-land-than-wind-energy-proves-iron-law-of-power-density/#:~:text=Rolls%2DRoyce's%20new%20SMR%20will,of%20land%2C%20giving%20...

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|---|---|---|---|---|---|---|---|
| | renewables. | | | | | | |
| **Management and Conservation Systems** | | | | | | | |
| | | | | | | | |
| Geothermal | Proven, Reliable, Local, requires electricity, low operating costs, moderate? capital costs | Will need to be part of a wider energy solution as will likely not be able to provide all gap needs | Immediate as Ontario has local expertise; | Well known technology working in harsh Canadian conditions. Does not require large land areas. Can be used with current forced air or hot water systems. | Major construction required to install pipes. Better with new construction rather than retrofits | There are about 700 systems in Canada so proven technology and avoided about 1.9 million kg of CO2 being emitted | There are two types of systems - vertical and horizontal pipes; for horizontal ground loops a guide is land required 2.5 times the area of the house or building; for a 2000 sq ft house you will need 5000 sq. ft of land |

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|---|---|---|---|---|---|---|---|
| | | | | | | | (0.04 ha);[9] as a rule of thumb 500-600 feet of pipe is needed per ton of system capacity[10] |
| Biogas/Renewable Natural Gas | Proven technology, but not widely available depending on the organic source such as landfills and farms; sometimes | Likely minimal contribution to reaching gap requirements | Likely > 2 years for approvals and developing business case | Removes methane already being emitted to the atmosphere. Proven technology Will require Enbridge to | Likely relatively small volumes available Need for a local gas pipeline for injection or other local user | Orillia could consider being a local organic waste collection hub | Little additional land required as biogas/RNG will likely come from the landfills and other sites that are already in existence |

[9] https://besthomeheating.com/how-much-land-for-ground-source-heat-pump/

[10] http://www.waterfurnace.ca/geothermal-questions.php#:~:text=As%20a%20rule%20of%20thumb,1%2C500%20%2D%201%2C800%20feet%20of%20pipe.

| Systems (Generating and Management or Conservation) | Operating Characteristics | Effectiveness in achieving 62 MW generation | Implementation Timescale for Orillia | Pros | Cons | Comments/ Recommendations | Estimated land area to generate 62 MW |
|---|---|---|---|---|---|---|---|
| | difficult to insert into pipelines if not close enough. | | | develop the project | | | |
| Energy Storage | Proven technology and the Ontario government is using this as part of their future electrification planning. This technology does not create energy but enables more efficient supply/demand management | Could prove key to helping meet the gap when used with other renewable technologies such as wind | Could be immediate as local Ontario companies have "off the shelf" systems | Well known technology. Many systems worldwide Systems already in Ontario e.g., Oneida | Land area required is large. Status of local grid to accept power. | IESO has asked for bids for 4000 MW of storage. Will need to work with OPGC as local generator on system | Storage itself will not be used for generations but as an additional tool. For a 30 MW storage system which is 50% of total energy required, will occupy about 150 containers taking up about ¾ |

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|---|---|---|---|---|---|---|---|
| | | | | | | | hectare.[11] |
| Heat Exchange Systems | These technologies include waste water heat recovery systems, solar hot water, various types of heat exchanger. All capture useful energy in some form for later use. | Uncertain, but not likely sufficient to meet all gap needs | Immediate, as can purchase these systems off the shelf | Easy to install. No need to change lifestyle habits. Can apply to both natural gas and electric hot water systems | Relatively small savings | Should be installed in all new builds | Not applicable |
| Micro grid technologies | These are localized distribution systems; allows for less outages | Uncertain, further analysis required to make assessment | Needs to be built into new construction, so little or no additional time | | | | |

[11] https://en.wikipedia.org/wiki/Battery_storage_power_station

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|---|---|---|---|---|---|---|---|
| | from the grid and flexibility in technology being used; once established they can be improved as necessary with minimal additional approvals | | is required; if retrofitted, could be > 5 years to get approvals | | | | |
| Building energy conservation | Low tech; simple to implement; good technical support from installers, and suppliers, benefits well documented | The most cost effective way of reducing energy demand | Immediate | Public acceptance, no need to change lifestyle, widely available | Difficult to install in older buildings, | Establish local programs to help in financing e.g. "on bill" accounts for Enbridge. | No new land area required. |
| * Hydro, Solar and Wind currently require costly grid upgrade to enable electrification everywhere as does nuclear which | | | | | | | |

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|---|---|---|---|---|---|---|---|
| is not considered renewable by some analysts<br>**not environmentally benign e.g., release of organic mercury into the water | | | | | | | |

## Conclusion

We believe this brief analysis demonstrates a need for a mix of technologies and organizations, both generation and management, to provide proven, reliable, cost effective renewable energy that is capable of achieving the current target of 62 MW increase by 2050. There is a need to look at the ways and means of improving chances of achieving the target in the context of a fluid provincial energy policy environment and to be able to keep pace with the rapid changes occurring in the renewable energy sector and bring this information to bear on updating Orillia's Climate Future to ensure an effective and efficient achievement of optimized climate actions.

There is a realization that while City staff have and continue to do an excellent job on the climate action file that there will always be limited staff resources. It is also recognized that for Orillia's Climate Future to be fully effective the Community must play a very significant role and take both individual and collective action to continue to evolve actions to achieve climate action targets.

Orillia is a community that is recognized for supporting community-based actions. There is an opportunity to make climate action a key component of community-based actions receiving strong community support toward common goals and objectives.

## General Recommendations

While Orillia's Climate Future is an excellent document and has served us well for several years the factors behind the recommendations for Big Move #1 are very dependent upon changes in technology and upper level government policy. Accordingly it is recommended that:

### 1. Develop a Renewable Energy Strategy

1. That City Council develop a Renewable Energy strategy and action plan, capable of evolving with changing technologies and government policies. This would be supplementary and would inform the next version of Orillia's Climate Future.

### 2. Strengthen and Formalize the CBSC

The current Community Based Steering Committee (CBSC) has provided input to staff on climate action planning and has been valuable. This model of community input can be even more effective if strengthened and made a more formal advisory committee.

2. It is recommended that the City of Orillia design and implement an updated community based climate change steering committee to include City staff, necessary external consultants and key individuals, community organizations and businesses. It should report to Council with recommendations on climate action policies and practices with a view to updating Orillia's Climate Future as soon as possible; The terms of reference could include:

- An analysis of how upper tier government policies can and are affecting the assumptions, business case and targets in Orillia's Climate Future.
- An analysis of technologies and market trends that will affect the recommendations and actions in Orillia's Climate Future.
- Make recommendations with respect to strategies, tactics, objectives, targets and resources in order to review and refresh the background and the targets in Orillia's Climate Future.

It is further recommended that the Committee be empowered and resourced to include social, economic and environmental analysis in support of its outcomes.

## Summary of Recommendations Regarding Specific Technologies

### Hydroelectric Recommendations

- OPGC should determine added potential for hydroelectric generation within their operating area and undertake a risk analysis of how climate change needs to be considered in the future of hydroelectric power generation.

## Hydrogen Recommendations

- The Mayor and Council agree to the idea of Orillia aspiring to become a regional hydrogen hub and request City staff to work collaboratively with partners to provide a more detailed proposal for presentation to Council over the next few months that would outline the fundamentals of hydrogen as a key element of the Orillia Renewable Energy Strategy.
- The Mayor, with support from staff and Sustainable Orillia, arranges a meeting with the local MP and MPP as well as MPP from Barrie in order to provide them with an initial sense of interest that the City of Orillia has in becoming a hydrogen hub. At this time the Mayor would ask for the MPPs and MP to investigate what interest and support their respective governments would have in establishing Orillia as a hydrogen hub for Central Ontario.
- Continue the discussions began in 2022 with a follow up meeting in early 2023 between the Mayor's office and Atura with respect to developing a partnership that would see the City support Atura (or any other hydrogen producer) in development of a Hydrogen production facility in Orillia or nearby with the concept that Orillia would become a regional Hydrogen Hub located on the Highway 11 freight corridor with a view to beginning detailed financial and technical discussion in 2026.
- In preparation for the 2026 date, develop an analytical framework, probably in collaboration with Atura, for a high-level business feasibility case for an Orillia Hydrogen Hub - Any grants that might be forthcoming from either senior levels of government will need to be considered in this framework.

## Solar PV Recommendations:

In the short term, develop a business case to enable approval for a program of installing solar panels on the roof of the Orillia Recreation Centre.
In the long term:

- City to spearhead a review of rooftop solar potential in Orillia.

- City to investigate collaborative funding opportunities to install rooftop solar with a focus on re-evaluating external funding opportunities e.g., Speedier, Bullfrog Power.
- Orillia Power to determine what expansion opportunities there may be.
- Economic Development to undertake an employment opportunity study associated with solar e.g., manufacturing, installation, maintenance etc.

## Utility Level Wind Recommendations:

- Consideration should continue to be given to utility level wind. As energy security becomes more of an important issue and wind becomes recognized as a key element of any renewable energy strategy, some of the current opposition to large wind installations may be lessened.

## Micro Wind Recommendations:

- Orillia should investigate planning and building bylaw considerations to enable the installation of these systems.
- It is also recommended that Orillia approach several of these micro wind companies and offer to pilot their technologies in the City on City owned buildings.
- Information should also be made available to the general public to promote investment in these technologies when it is certain that they are proven to be cost effective and reliable sources of renewable energy.

## Geothermal Recommendation

- The City of Orillia to investigate policy options needed to promote this technology using the current grants available for its residents as well as commercial and industrial sectors. If not familiar with this technology a site visit to UOIT would be helpful for staff.

## Renewable Natural and BioGas Recommendation

- The City to approach Enbridge Gas and the surrounding agricultural community to ascertain the potential for the generation and use of this renewable resource.

## Energy Storage Recommendations:

- Orillia Power Generation Company to investigate how this technology might be used locally.
- Further technical analysis will be required to ascertain the most cost-effective path forward for Orillia.
- Determine the feasibility of converting old unused transformer stations into Energy Storage facilities.

## Small Modular Reactor Recommendation

- The City to monitor developments as required. This technology is unlikely to be appropriate solely for Orillia.

## Heat Exchange and Recovery Systems Recommendation

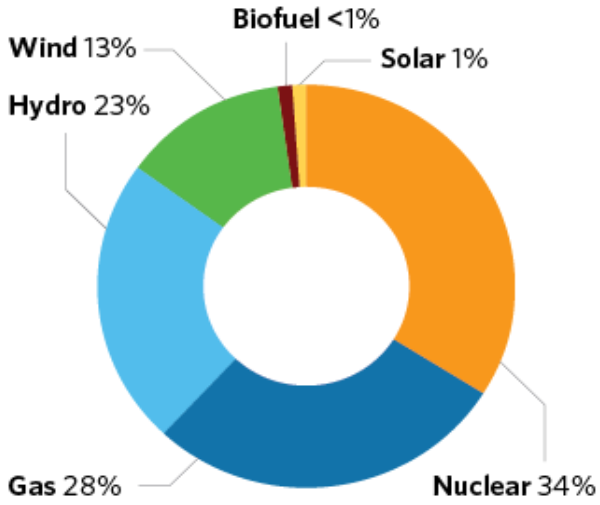
- The City to explore financial options for residents to install these technologies as part of the CCAP implementation program.
- The City to explore opportunities for installations on larger e.g., 750mm municipal piping that could benefit from the economy of scale offered.

## General Technical Conclusions and Grid Related Recommendations

This document shows that there are various options that the City can take to increase its generation and use of renewable energy. Each technology will have its own niche and a combination of these is most likely the best economic option.

Orillia has the great advantage that it already owns an electrical generating company, the distribution portion was sold to Hydro One. Building on this foundation, SO is of the view that OPGC should expand its generating capabilities into these other generating sources to help Orillia achieve its CCAP goals. However, in other jurisdictions community energy corporations exist and recently the Ontario government has indicated strong support for such initiatives. (news.ontario.ca/en/release/1000890/ontario-supporting-renewable-energy-for-sustainable-communities) Having both OPGC and community energy corporation(s) contributing to Orillia's renewable energy requirement should be considered.

The current generation mix in Ontario on the transmission grid (as of December 2022) is given in Figure 16. Only about 37% is from renewables (or about 70% if nuclear is included).




| | |
|---|---|
| **Nuclear** | 13,089 MW or 34% |
| **Gas/Oil** | 10,482 MW or 28% |
| **Hydro** | 8,868 MW or 23% |
| **Wind** | 4,883 MW or 13% |
| **Biofuel** | 296 MW or <1% |
| **Solar** | 478 MW or 1% |

Source: https://www.ieso.ca/en/Learn/Ontario-Electricity-Grid/Supply-Mix-and-Generation

Figure 16

## Grid and Local Generation Recommendations

- The City and OPGC enter into a short-term agreement with Lakeland to explore next steps as part of the CCAP implementation and to determine what GHG reductions will accrue as a result of this option.
- Over the longer term (1 year) OPGC to investigate the option of replicating Speedier in Orillia.
- The City of Orillia and OPGC consider the issuance of "green bonds" to finance the necessary expansion of renewable energy production.
- The City of Orillia to explore opportunities for attracting new inward investment by companies who require guaranteed electrical connections as well as by those renewable technology companies who could play a role in this solution.
- Consider how renewable energy needs can be embedded into any new greenfield developments. It is cheaper to do this at the start rather than retrofit at a later date.
- It is further recommended that a report be prepared updating the state of renewable energy production in the City from all sources including costs, technologies being used and incentives and barriers.
- Energy Security is an important socio-economic consideration and it is recommended that the creation of a community energy corporation with resident shareholders be investigated. Sustainable Orillia can provide leadership in bringing important local organizations together for further discussion and determination of feasibility.

### Energy Conservation Recommendation

Conservation has and will continue to play an important role in closing on the renewable energy gap necessary to achieve the City of Orillia corporate and community net zero targets. Accordingly, it is recommended that any renewable energy strategy include serious consideration of the ways and means that the City and community use energy conservation programs and incentives to assist in achieving net zero emissions.

## Additional Next Steps

In addition to consideration of the General and Technology Specific Recommendations, it is suggested that the following additional information is needed in order to further develop this initial Strategy.

- Confirm that the "gap" is indeed 62 MW that needs to be provided by renewable sources of energy or through reductions to get to net zero by 2050.
- Assess the most economical way of generating this amount via renewables or combination of renewables.
- Determine the spin off benefits e.g., job creation for each method being assessed.
- Evaluate the future options for OPGC in providing the necessary services to Close the Gap.

# III Detailed Technical Discussion : This section provides details and recommendations associated with each technology

## Hydroelectric

Orillia Power Generation Corporation (OPGC) already operates 6 hydroelectric facilities in Ontario, considered small hydroelectric plants.

- Swift Rapids - 8 MW
- Minden - 4.4 MW
- Matthias -3 MW
- Elora - 1 MW
- Fenelon Falls - 2.6 MW
- Marmora - 1 MWH

Hydroelectric resources can be operated with flexibility in order to ramp up and down to match changes in electricity supply or demand. Canada's existing hydroelectricity capacity, which accounts for about 60% of the country's electricity generation, provides significant flexibility to complement variable resources like wind and solar. Orillia's 20 MW generation is no exception. The potential for future hydro expansion in the Orillia area is not known.

However, there are disadvantages to this renewable energy source:

- There is environmental damage from reducing the run of river water flows, an example is the impact on fish, fish breeding and migrations.
- There are high capital costs for turbine construction and installation; however, this is offset by the lower ongoing maintenance costs.
- Under a climate change scenario, there are possible issues with local droughts which ultimately results in less power being generated than anticipated; it is not known to what extent the local water regime in Orillia is affected by this issue but there is some evidence that flows are less dependable than they have been in the past.
- Hydroelectric reservoirs do emit both methane and carbon dioxide so are not entirely GHG free. This results from the rotting vegetation under the water. It has been estimated that 24 grams CO2e/kWh is emitted on a life cycle basis[12].
- Other issues such as potential geological damage and dam safety are also known.

There is the potential of run of river plants, but these systems are considered "unfirm" in that the turbine is installed directly into the river flow without storage capacity.[13] Some of the same issues noted above exist with this option. It is not known what the potential for this source is for OPGC to exploit. Water current turbines can be installed in any flow with a velocity greater than 0.5 m/s.[14]

### Recommendations

- OPGC should determine added potential for hydroelectric generation within their operating area and undertake a risk analysis of how climate change needs to be considered in the future of hydroelectric power generation.

## Hydrogen

[12] https://www.hydropower.org/factsheets/greenhouse-gas-emissions
[13] https://en.wikipedia.org/wiki/Run-of-the-river_hydroelectricity
[14] https://zero.no/wp-content/uploads/2016/05/small-scale-water-current-turbines-for-river-applications.pdf

Both Ontario and the Federal Governments are developing strategies that will support the development and use of hydrogen as a new low carbon energy source to meet their respective carbon reduction targets. The energy sector, particularly natural gas, is also looking at what pathways, also using Hydrogen, are available to help meet this required GHG reduction. We believe that Orillia has the potential to capitalize on upper-level government strategic directions and on the natural advantages that our City provides.

The Federal Government's Hydrogen Strategy has 6 key principles:

- ***Momentum****: The interest in hydrogen is growing throughout the world. Canada needs to act now to ensure we are not left behind.*
- ***Action****: There are specific things we can focus on now, such as ensuring supply and demand grow at the same pace and creating hubs to bring multiple stakeholders, across value chains, together.*
- ***Signature projects****: Increased focus can be brought to the creation and implementation of large-scale projects that could be highlighted and promoted internationally.*
- ***Domestic deployment****: Canada needs a strong domestic hydrogen market to ensure it can take advantage of and seize opportunities internationally.*
- ***Low carbon intensity****: As the market grows, so should our focus on ensuring that hydrogen is produced using methods that have the lowest environmental impact.*
- ***Head start****: Canada has a burgeoning hydrogen industry that gives us a significant competitive advantage.*

Ontario's Low carbon Hydrogen discussion paper states that Ontario's role in the hydrogen economy is:

*"Low-carbon hydrogen production is ramping up and jurisdictions are committing resources to accelerate this process as they see this fuel as a key component of their long-term climate strategies.*

*Ontario is well-positioned to drive growth in a low-carbon hydrogen economy, with our low-carbon electricity supply supported by an extensive natural gas distribution system as well as several projects and companies already established and/or in development."*

Orillia has many of the required infrastructure needs to develop the necessary hydrogen production and distribution system that would form a regional hydrogen hub. This could be replicated across the province in similar smaller communities across the Province and indeed across the country. These include an abundant supply of fresh water, access to locally generated renewable energy (with possibility for expansion), its location on the primary Highway 11 north-south transportation corridor heavy long freight vehicles and buses and when H2 injection into the TransCanada Gas Pipeline, which also runs down Highway 11, becomes feasible, the GTA with its large population and energy use requirements is a nearby large market.

## Production of Hydrogen

There are a number of ways that hydrogen can be produced. When it is produced from the hydrolysis of water using renewable electricity it is called "Green Hydrogen". The other "colours" of hydrogen such as "Grey" and "Blue", are produced from natural gas and these are discussed in Appendix 1

Green Hydrogen is the preferred type of hydrogen from a sustainability standpoint as the process does not emit any GHG. Green hydrogen is a completely clean, non-emitting fuel source from start to finish. Unlike hydrogen made from emitting energy sources, like oil and gas, green hydrogen is produced using wind and solar energy. In Powering Canada's Journey to Net-Zero: CanREA's 2050 Vision, CANREA points out that Canada is not yet on track to meet its commitment to decarbonize by 2050, and that they advocated for governments to develop hydrogen strategies that prioritize green hydrogen.[15]

[15] https://renewablesassociation.ca/the-green-light/

## Uses of Hydrogen

### Transportation

There are opportunities to use hydrogen in every mode of the transportation sector, although some, like on-road vehicles, are more advanced than others. Trucking, rail, marine and aviation applications have energy-intensive duty cycles and long ranges, making them well suited for hydrogen. Fuel cells, which produce electricity for electric motors, is the most common application. In some cases, it can be combusted either directly or in fuel blends. The availability of hydrogen has limited adoption of these technologies in most areas of the world.

A hydrogen fuel cell combines hydrogen and oxygen to produce electricity and water (Figure 1). When it is the source of power for a vehicle it can be seen as another type of electric vehicle (Figure 2) along with a Battery Electric Vehicle.

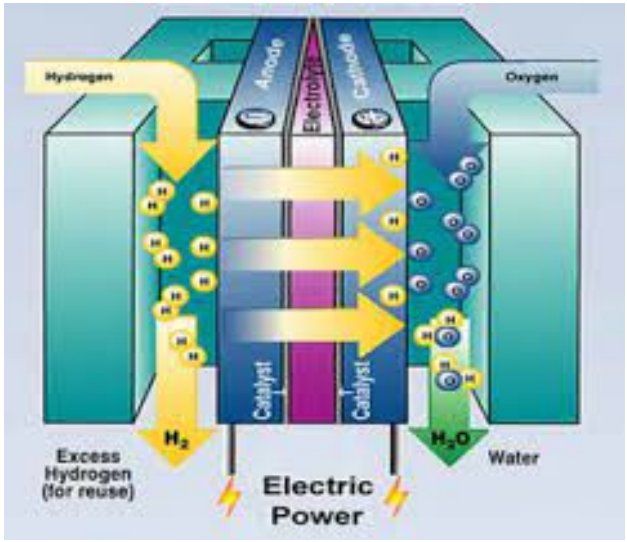
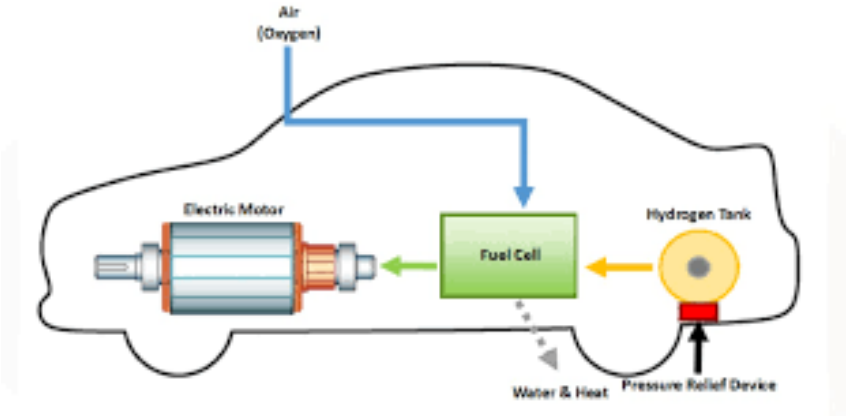



Figure 1 - Hydrogen Fuel Cell (Battery University)




(Firehouse Magazine)

Figure 5 How a fuel cell powers a vehicle (firehouse)

Power Generation

Hydrogen can be used as a fuel for power production through either hydrogen combustion in turbines or use in stationary fuel cell power plants.

Heat for Industry and Buildings

As a fuel, hydrogen is a cleaner-burning molecule that can be used instead of fossil fuels where high-grade heat is needed both for industrial processes and in the built environment.

Feedstock for Industry

The largest current use for hydrogen, both in Canada and globally, is as a feedstock in emission-intensive industrial sectors, such as oil refining, ammonia production, methanol production and steel production.

## The Importance of $H_2$ in Meeting GHG Targets

Hydrogen, when combusted, does not emit any GHGs, just water. So it is an important component for reducing GHG emissions. Use of hydrogen in natural gas is a recognized method of reducing GHG emissions from the combustion process of natural gas. However, in the context of Orillia, its use as a heavy transportation and heavy equipment fuel and as a synergistic option for the electrical grid is where SO sees its value. These characteristics mean that the development of a hydrogen production capability can contribute to both Renewable Energy Production (Big Move 1) and electrifying transportation (Big Move 2)

## Electricity and Water Required to Produce Hydrogen

The production of green hydrogen uses renewable electricity to split water molecules into hydrogen and oxygen, with roughly $9m^3$ (9,000 litres) of purified $H_2O$ required for each tonne of $H_2$. (Recharge News) This is not very much water when we consider that a tonne of hydrogen delivers 33 MWh of electricity.

Typically, we need about 48 MWh of electricity to produce 33 MWh of Hydrogen. This means that the energy conversion is usually about 68% efficient. The energy density of hydrogen compared to lithium-ion batteries and gasoline is the reason that we accept this loss of efficiency.

## The Current and Forecast Hydrogen Market Size

The Canadian Hydrogen strategy has estimated that the domestic market revenue is of the order $50 billion by 2050, with an estimated 350,000 jobs. www.osler.com/en/resources/regulations/2020/federal-government-announces-canada-s-hydrogen-strategy

If it is assumed that Ontario contributes 25% of this total, this translates to about $12 billion and about 87000 jobs. In summary, based on the Canadian Federal hydrogen strategy, the market is going to be significant by 2050.
Globally, hydrogen is seen as a key method for future energy requirements and significant investments are being made in its generation, distribution and ultimate uses.

Ontario also has developed a low carbon hydrogen strategy where the government portrays its vision for a future low carbon hydrogen economy.[16] In this document a number of hydrogen hubs were identified: Niagara Falls, Halton Hills, Windsor, Nanticoke, Sarnia-Lambton and they are looking to establish new hydrogen hubs; Orillia could be one of these.

## Orillia's Competitive Hydrogen Advantage

The future of hydrogen is envisaged to be significant in Canada as it is recognized as a world leader in hydrogen production. Developing expertise and supporting research in this area will be an important component of any future economic development and is one in which the Ontario government is already exploring, and the Federal government is supporting.

Orillia has many commercial and competitive advantages which makes it a suitable hydrogen generating hub. We believe these advantages are:

- Orillia is located on the HWY 11 transportation/Freight corridor,
- Atura's interest in working with Orillia as one of a number of regional Hydrogen Hubs
- We have an abundance of water.
- The market area could stretch from Bradford in the south, Huntsville in the north, Midland, Wasaga Beach and Collingwood in the West and adjacent communities of Rama First Nations and Rama, even into the western part of the City of Kawartha Lakes.

[16] https://ero.ontario.ca/notice/019-2709#connect-with-us

- Local use of renewable energy generated by Orillia Power Generation or by a Community Renewable Energy Corporation or by a third party outside provider could assure "green" Hydrogen production. Even "grid" electricity would currently be about 94% "green" but based on plans of the Ontario government to increase natural gas electrical power generation we will see a much "dirtier" grid in the future.
- The TransCanada natural gas pipeline also runs along the Highway 11 corridor and so proximity to that national pipeline is also an advantage for Orillia.
- Enbridge's local distribution pipeline system is in the city, especially the newer lines, which may be suitable for H2 injection up to about 5%.
- Lakehead University and Georgian College could provide courses related to hydrogen.
- Orillia is on the cusp of significant population expansion.

## Main Components of an Orillia Hydrogen Hub:

- The production of green hydrogen through a public/private partnership
- The use of locally generated renewable electricity from Orillia Power's renewable energy generation or other renewable energy source(s)
- The storage of hydrogen
- The use of hydrogen for transportation (e.g., Orillia buses and large vehicle fleet, local trucking firms, heavy equipment)
- Possible hydrogen injection into Enbridge Gas' local distribution system for their local customer's use in Orillia and elsewhere as determined by Enbridge.

## Anticipated Stakeholders in the Hydrogen Hub Project

- City of Orillia
- Atura (Division of Ontario Power Generation (OPG)
- Hydro One
- Orillia Power Generation Corporation (OPGC)

- Enbridge Gas Distribution
- Pollution Probe Energy Ambassador program (information and education role)
- Provincial and Federal governments both of which have hydrogen strategies that this project can support.
- Sustainable Orillia - in a coordinating and facilitating role.
- Ontario Provincial Government

## Possible Customers ("off takers" of the H2 produced)

In the language of hydrogen production, a customer is often referred to as an "offtaker". It simply means a user who takes hydrogen from the storage or distribution system. Some potential offtakers from the Orillia Hub are:

- City of Orillia and surrounding municipalities with fleet operations and bus transportation systems
- Area Long Haul Trucking companies
- Heavy Transport using Highway 11
- Local Heavy equipment operators
- Local large natural gas consumers e.g., Kubota heat treating.
- Residential and commercial natural gas customers

## The local benefits of such a project include:

- Development of a Hydrogen Hub capability and market for the Orillia area as a renewable energy source and as a foundation for economic development.
- A key element of Orillia's Climate Future in reaching GHG reduction targets.
- Local learning experience in managing hydrogen as a commodity.
- An onsite practical demonstration for the community and other jurisdictions- "one picture is worth a thousand words".
- Development of local hydrogen-related jobs.
- Development of local trade-related education programs to support the future hydrogen economy.

- Springboard for other entrepreneurial opportunities to help Orillia and Ontario implement their respective hydrogen strategies.

## Hydrogen Recommendations

- The Mayor and Council agree to the idea of Orillia aspiring to become a regional hydrogen hub and request City staff to work collaboratively with partners to provide a more detailed proposal for presentation to Council over the next few months that would outline the fundamentals of hydrogen as a key element of the Orillia Renewable Energy Strategy.
- The Mayor, with support from staff and Sustainable Orillia, arranges a meeting with the local MP and MPP as well as MPP from Barrie in order to provide them with an initial sense of interest that the City of Orillia has in becoming a hydrogen hub. At this time the Mayor would ask for the MPPs and MP to investigate what interest and support their respective governments would have in establishing Orillia as a hydrogen hub for Central Ontario.
- Continue the discussions began in 2022 with a follow up meeting in early 2023 between the Mayor's office and Atura with respect to developing a partnership that would see the City support Atura (or any other hydrogen producer) in development of a Hydrogen production facility in Orillia or nearby with the concept that Orillia would become a regional Hydrogen Hub located on the Highway 11 freight corridor with a view to beginning detailed financial and technical discussion in 2026.
- In preparation for the 2026 date, develop an analytical framework, probably in collaboration with Atura, for a high level business feasibility case for an Orillia Hydrogen Hub - Any grants that might be forthcoming from either senior levels of government will need to be considered in this framework.

## Solar PV

OPGC owns and operates 7 rooftop solar systems. There are 4 sites in the City of Orillia and 3 in the Town of Cobourg, which, in total, have the capability of producing 2.5 MW of electricity.[17] There are some 30 FIT solar rooftop contracts in the Orillia area and

[17] Orillia Power Website - https://orilliapowergeneration.ca/our-facilities/

three solar ground mounted systems at 1.1 MW not operated by Orillia Power.[18] While this is an excellent start, current rooftop solar only represents a small portion of the electricity being produced or used in Orillia. While the total number of potential rooftops that might be suitable for a rooftop installation is currently unknown, some opportunities exist for installations now, but this will depend on Hydro One's distribution power lines capability to take any increased solar power.

Ontario's FIT program ended in 2018, resulting in the government not accepting any more applications and developers having to create their own contracts if needed with no price guarantee. The incentive program ended as it was found essentially to be too expensive.

In Canada there are currently more than 43,000 solar PV installations. Solar installation is poised for significant growth due to cost reductions and the need for non-emitting power generation.[19] More than one quarter of all installed solar capacity was installed in 2022 alone, with Alberta leading the way at 1391 MW. Ontario installed 10 MW.

Solar is an important job creation driver, primarily in the construction of new facilities, but also in the ongoing operations and maintenance of these sites. The wind and solar industry added 4462 person years of employment in 2022.[20] This is an aspect that Orillia and OPGC should take seriously to help local employment issues.

Sustainable Orillia fully supports the deployment of solar PV throughout the community and in past developments has promoted solar related projects as noted below:

- Confirmthe role of OPGC in developing additional solar and other renewable sources. It seems counterintuitive to create a "community renewable energy corporation" when the City "owns" an existing one and until OPGC has exhausted its potential as a generator of renewables.

[18] https://www.ieso.ca/-/media/Files/IESO/Document-Library/power-data/supply/IESO-Active-Contracted-Generation-List.ashx
[19] https://renewablesassociation.ca/solar-energy/
[20] https://renewablesassociation.ca/news-release-canada-added-1-8-gw-of-wind-and-solar-in-2022/

- Secure funding for rooftop installation on the Orillia Rec Center. The original plan was to install 150 KW of solar. This project was proposed back in 2020, some progress was made but shelved due to funding issues at the time. City agreed to provide up to $30,000 in support of a $300,000 project at the time. It was estimated that this would cost $2/watt.[21]
- Research and explore available Federal/provincial grants (if any), private or corporate sponsorships.
- Lakeland Solutions, in cooperation with several partners, has developed a micro grid in Parry Sound known as project SPEEDIER, building towards a net-zero smart community. Meetings have been held and SO recommends follow-up technical meetings on this issue. See page 40 below.
- Survey of suitable city buildings/rooftops for solar PV installations.
- Public presentations re: solar potential, costs, benefits etc
- Set up information/educational modules on website/social media/articles for on-line newspapers.

The local benefits of such a project include:

- Short and long term cost savings
- Energy resilience (power generated locally)
- Environmental benefits
- Local employment opportunities e.g., installation and maintenance

The Regional benefits of such a project include.

- reduction of installation of high voltage power lines from central generating plants like Darlington and Pickering leading to reduced costs
- as above increased resilience from extreme weather events
- development of local expertise

[21] OCE presentation provided by Gord Ball; April 2019.

## Solar PV Recommendations:

In the short term, develop a business case to enable approval for a program of installing solar panels on the roof of the Orillia Recreation Centre.
In the long term:

- City to spearhead a review of rooftop solar potential in Orillia.
- City to investigate collaborative funding opportunities to install rooftop solar with a focus on re-evaluating external funding opportunities e.g., Speedier, Bullfrog Power.
- Orillia Power to determine what expansion opportunities there may be.
- Economic Development to undertake an employment opportunity study associated with solar e.g., manufacturing, installation, maintenance etc.

## Wind Turbines

Wind energy is now the lowest-cost source of new electricity generation in Canada. There has been more wind-energy capacity installed in Canada over the last decade than any other form. Higher wind speeds and consistency in direction means offshore installations require fewer turbines to produce the same amount of energy as onshore wind farms. Offshore wind turbines could be considered for both Lakes Simcoe and Couchiching but as is noted below, micro wind turbines may be a more acceptable option.

Wind turbines use the power of the wind to generate electricity. The wind turns the blades of the turbine rotor, which are attached to a driveshaft. The driveshaft then spins a generator to create electricity. The production of electricity from wind energy generates no greenhouse-gas emissions, no air or water pollution, and no toxic or hazardous waste. Wind turbines come in different sizes and can be deployed in different configurations.

In Canada, the overwhelming majority of wind turbines are utility-scale and deployed onshore, in a variety of configurations, to feed power directly into the electricity grid. Canada's largest wind farm, Black Spring Ridge, located in Vulcan County, Alberta, is made up of 166 wind turbines. Some communities have installed a single wind turbine to feed power into the grid. So this technology can be installed at all sizes.

Sustainable Orillia is not aware of any large-scale utility wind projects in the local area.

Wind and weather statistics for Port of Orillia, contains detailed information about average local wind speed and air temperature since 2012.[22] Average wind speeds range from 6 - 10 mph[23] and in our view this is more appropriate for micro wind generation rather than large scale generation.

The potential for large-scale wind generation in Orillia is not known at the present time. Establishment of large scale 2MW sized turbines may not be appropriate given the land requirements and local neighbour impacts. Lakes Couchiching and Simcoe may be possible locations given the offshore and onshore wind regime. Higher wind speeds and consistency in direction means offshore installations require fewer turbines to produce the same amount of energy as onshore wind farms, but installation of large turbines here may generate significant local opposition from boaters and locals and so micro wind turbines may be a more acceptable option. Regardless of type, wind energy is key to the development of meeting the targets in Big Move #1 and the green hydrogen economy is necessary if Canada is to meet its 2050 net zero emission targets.[24] So, this technology should be viewed in association with the hydrogen technology to be complementary.

[22] https://windy.app/forecast2/spot/2651921/Port+of+Orillia/statistics
[23] https://www.windfinder.com/windstatistics/orillia_lake_couchiching
[24] https://renewablesassociation.ca/2050-vision/

According to the Natural Resources (NRCanada) website "Our team is working to improve the availability of wind energy datasets and ensuring accurate, complete, and timely data are accessible to Canadians. We are addressing data gaps with respect to performance and location data of existing wind farms and turbines, while looking ahead to identify prospective future wind development areas in support of investment and policy decisions and continued growth of the wind energy sector. The following sections describe some of our current research activities." For new power capacity both wind and solar are apparently the cheapest form for generation. Wind is already cheaper than gas powered generation in 2020.[25]

Wind power forecasting

- "The variable and fluctuating nature of wind plant power output adds significant complexity for utilities with respect to power quality, system stability, and energy dispatch. Improving wind power forecasts can reduce the risks of the uncertainty of wind power and improve power system stability. CanmetENERGY Ottawa is working with the University of New Brunswick, and the Canadian Meteorological Centre (CMC) at Environment and Climate Change Canada, to develop new software products for short-term wind power forecasting based on CMC's Numerical Weather Prediction (NWP) models. These products are intended to complement the suite of wind power forecasting tools currently available to utilities and system operators."

Canadian Wind Turbine Database

- CanmetENERGY Ottawa, in collaboration with the Centre for Applied Business Research in Energy & the Environment (CABREE) at the University of Alberta, has launched the Canadian Wind Turbine Database (CWTDB), Canada's first-ever comprehensive, open-access, interactive wind turbine map. The database contains key information on commercial-scale wind turbines across Canada, including their latitude and longitude, rotor diameter, tower height, rated capacity, model and commissioning date. The underlying data is available in multiple file formats, and through the interactive map, users can view areas of interest, toggle data layers, filter by various categories and export all or part of the database.

[25] https://www.iisd.org/articles/deep-dive/canadian-energy-security-renewables

Although wind is a variable resource, it is very complementary to other renewable sources such as hydroelectric and the generation of hydrogen, solar and energy storage. In cases where wind energy is being generated but not required on the grid, using storage and making hydrogen are options that allow wind energy to be used at a later date.

### Utility Level Wind Recommendations:

Consideration should continue to be given to utility level wind. As energy security becomes more of an important issue and wind becomes recognized as a key element of any renewable energy strategy, some of the current opposition to large wind installations may be lessened.

## Micro Wind Turbines

Small scale micro turbines are an option which can generate up to 20 KW and are suitable for residential applications.

Figure 6
Example of a micro wind turbine used for a home.
Source; https://energyeducation.ca/encyclopedia/Micro-wind_turbine

Until recently, micro wind turbines (Figure 6) have been scaled down versions of traditional "wind farm" style horizontal turbines with their very large blades and head assemblies. Most recently, designers and builders of micro wind turbines are most often using more vertical axis configuration or other adaptations that generate electricity from wind.

Also, unlike blade style turbines which do not work well in an urban environment where buildings tend to block and redirect wind making for gusty and variable winds, Micro wind turbines are specially designed to operate in urban situations. Micro wind installations may also enable local renewable generation in shaded areas where solar PV is not possible.

Wind turbines are considerably more efficient than solar PV (photovoltaic) per area covered. Solar PV panels convert only about 20% of the energy that strikes them in contrast to wind turbines which are able to convert about 60% of the wind energy into electricity.

This contrast in efficiency is demonstrated by the preference for wind by major utilities as can be seen in the figure below.

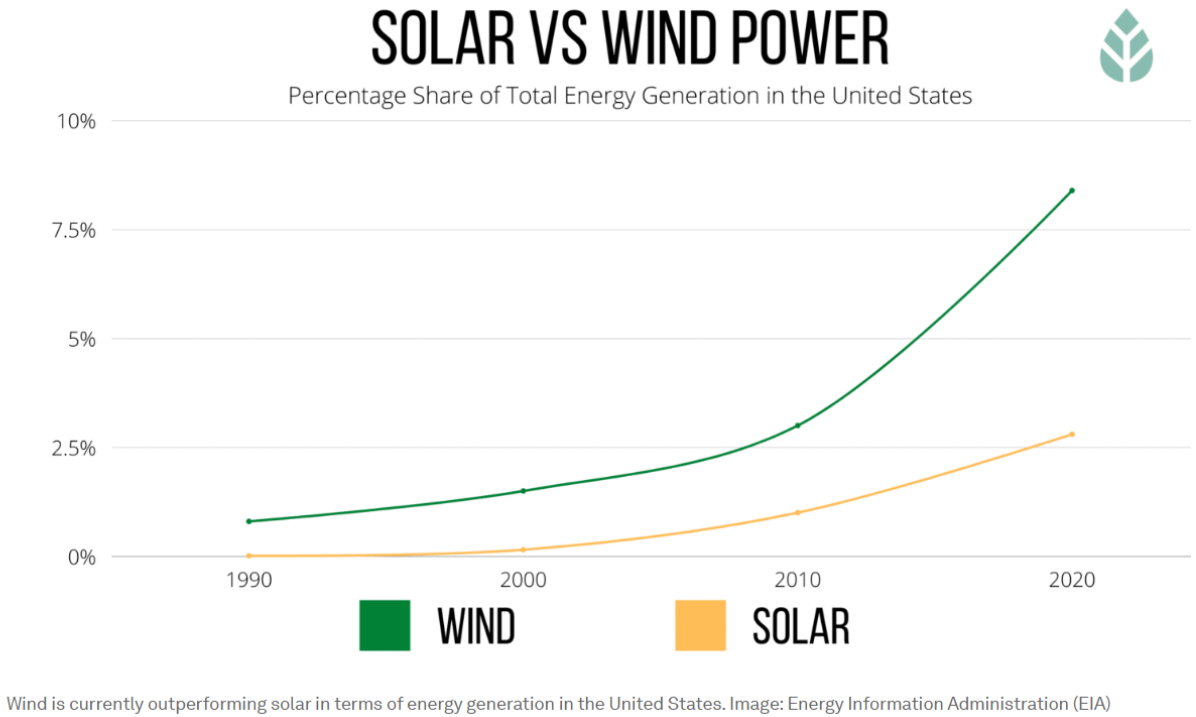



Figure 7: Solar and Wind Power Share of Generation in the US

The efficiency difference is most pronounced for the horizontal large blade configurations, but it also is true of micro wind turbines and in some cases claims of as much as 10 times greater efficiency are being made.

The market for micro wind in urban settings is large and research and development is occurring around the world to design the most efficient and cost effective micro wind solutions.

Recently CBC's "What on Earth" wrote a special on micro wind turbines that is one of the most up-to-date available and we have borrowed heavily from that feature article which presented information on 5 of the latest innovations in this rapidly developing technology. It should be noted that even with micro wind turbines they work best on the flat roofs of taller buildings and for the most part are not suitable for smaller residential buildings unless the buildings are well exposed to the prevailing wind or a number of wind exposures but as you read on you will realize that some of the innovations do not have many limitations to their installation criteria other than wind intensity, duration and frequency.

Flower Turbines, based in New York City, creates vertical wind turbines that look like large, skinny tulips as can be seen below (Figure 8). They're designed to be installed on the ground or on a flat roof. The vertical-axis turbines can start generating power at low wind speeds of just 0.7 metres per second, compared to 3.5 m/s (or 12.6 km/h) for traditional wind turbines. The company sells one- and three-metre-high models in the U.S and Europe.

Figure 8

The next innovation is a hybrid solar pv and microwind that demonstrates a lot of potential.

**PowerNEST**, made by IBIS Power in Eindhoven, the Netherlands, is a rooftop unit that integrates wind and solar in what the company describes as a "flowing kinetic sculpture" (Figure 9). It uses fins on the edges of the rectangular frame to direct air to vertical turbines that sit underneath a roof of solar panels. The wind helps cool the panels and increase their efficiency. The company says the system

can capture six to 10 times more electricity than rooftop solar panels alone. So far, the company has created a handful of demonstration projects in the Netherlands.

Figure 9

Apparently wind turbines don't even really need to move - or at least not visibly. **Aeromine Technologies**, based in Houston Texas, has a technology with no external blades, so it isn't really a turbine. Instead, it captures air between stationary, hollow airfoils (similar to those used to stabilize race cars) and funnels it to a partially enclosed propeller underneath. The company says this harnesses and amplifies building airflow in wind speeds as low as 2 m/s (or 8 km/h), while also allowing the unit to generate power at high wind speeds in "most extreme weather conditions." The company has a pilot running in the U.S. and says it will be announcing several pilots in Canada later this month.

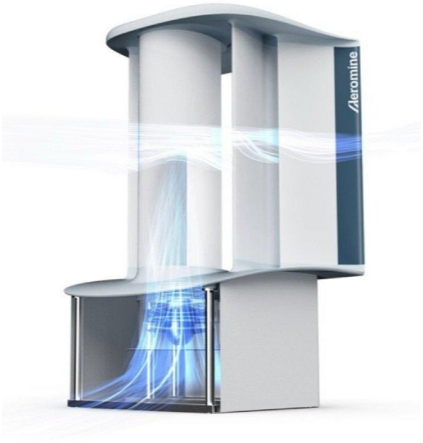



Figure 10

A very versatile innovation in microturbines comes from **O-Wind**, made by O-Innovations in Lancaster, U.K., was featured in one of *What On Earth? 's first* **issue**, in 2018. Its inventors won the **International James Dyson Award** that year for a soccer ball-sized prototype designed to harvest wind from any direction when mounted on the side or roof of a building. Since then, they have honed and patented the design and produced a larger functional prototype. They have received grant funding to install pilots in urban areas. In figure 11, three of these turbines are mounted on the side of a building.

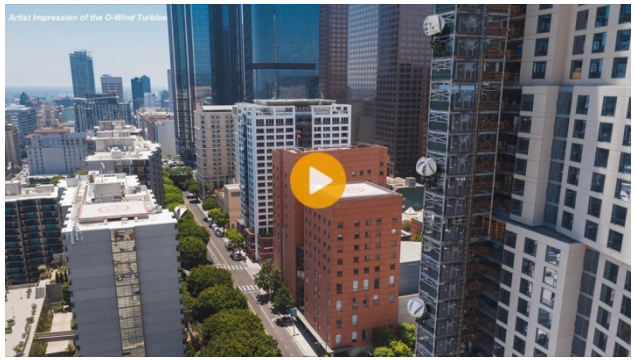



Figure 11

Canada also has a company that is in the Research and early development stage of microwind turbines. There has been at least one Canadian design: **RidgeBlade**, made by Kingston, Ont.-based The Power Collective. However, in researching the article on microwind as of January 2023, CBC News had not been unable to reach the company; the phone and email listed on its website have been disconnected.) However, in preparing this report SO was able to access the Power Collective website to provide a picture of the

installation. Figure 12. The RidgeBlade was designed to use the existing surface of a pitched roof to focus wind and boost its speed as it travels through turbines along the roof's ridge. "Placing the turbine in this high-flow area means that up to nine times the energy is available to it compared to a [traditional horizontal-axis wind turbine] system," the company said on its website, which offers residential and commercial modular units for sale. The "turbine" portion of the device is similar to that of a "squirrel cage" fan shown in figures 12 and 13 but elongated.

Figure 12

Figure 13

### Micro Wind Recommendations:

- The City of Orillia should investigate planning and building bylaw considerations to enable the installation of these systems.
- It is also recommended that the City of Orillia approach several of these microwind companies and offer to pilot their technologies in the City on City owned buildings.
- Information should also be made available to the general public to promote investment in these technologies when it is certain that they are proven to be cost effective and reliable sources of renewable energy.

## Ancillary Energy Systems

### Geothermal

Underground pipes are filled with an ethanol solution, which absorbs heat from the earth and transports it to the geothermal unit located inside your home. The geothermal unit interfaces with your forced air or water radiator system, enabling the transfer of heat to your home. In the summer months, the geothermal furnace works in reverse to help keep your home cool. A geothermal heating and cooling system will reduce your household energy emissions by 50%, in addition to reducing your family's overall environmental footprint.[26] It is a proven technology with about 700 systems installed across Canada reducing C footprint by 1.9 million kg of carbon.

[26] https://www.questgeothermal.com/how-does-it-work/

The underground pipes can be installed either horizontally or vertically. But the City of Orillia needs to clarify how and where these systems can be used within the city boundaries. Commercial and industrial buildings are likely the most suitable locations with which to start.

For example, Ontario Tech University in Oshawa has Canada's largest geothermal system and the second largest in North America, a 1,500-ton Borehole Thermal Energy Storage System (BTESS) that sits hidden beneath the 7,500 square-metre quad at the center of the complex. The installation includes more than 370 bore holes (180 metres deep), which are used to heat and cool the campus buildings. Water circulates through the underground network (150 km of polypropylene piping). In the winter, the geothermal system takes heat from the earth and carries it to the buildings. In the summer, the same system removes heat from the buildings and disperses it into the ground. The innovative system links each building to a central heating, ventilation and air-conditioning (HVAC) plant.[27]

So, this is a well known and proven technology. For example, Quest has installed over 700 systems and saved their customers about $14 million as well as avoiding 1.9 million kg CO2 from being emitted.[28]

To make this option more affordable there are significant government grants available:

- the Canada Greener Homes program can loan up to $40,000
- Canada Greener Homes Grant program of up to $5000; in this case one needs a home energy audit undertaken.

[27] https://sites.ontariotechu.ca/sustainability/initiatives/on-campus/energy.php
[28] https://www.questgeothermal.com/

## Geothermal Recommendation

- The City of Orillia to investigate policy options needed to promote this technology using the current grants available for its residents as well as commercial and industrial sectors. If not familiar with this technology a site visit to UOIT would be helpful for staff.

## Biogas/Renewable Natural Gas (RNG)

RNG is created by capturing biogas,usually methane emissions from organic waste, landfills and wastewater treatment plants and refining it to "pipeline ready" specifications. RNG will play an important role in Ontario's clean energy future. RNG can be used to fuel transit fleets, power industry and heat homes and businesses, and is an effective solution to help companies and communities reduce greenhouse gas (GHG) emissions.[29]

It is not clear which are the major sources of this in Orillia, but the landfill and wastewater treatment plants are obvious ones. Compared with other renewable sources, this option may not be a primary one for Orillia's future as the volumes generated may not be sufficient from within the City. However, agricultural sources should not be excluded as livestock and crop residues are also potential sources. The Canadian Biogas Association has issued a guide for Municipalities on the implementation of RNG.[30]

However, in the event of new infrastructure being planned, this option should be included in the primary planning principles, particularly as Orillia's population is set to expand significantly.

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[29] https://www.enbridgegas.com/rng?utm_source=Google&utm_medium=Responsive_Search&utm_campaign=ENB_1103_Google_Responsive_Search_RNG_General&utm_id=ENB_1103&gclid=CjwKCAiAy_CcBhBeEiwAcoMRHAhRoIBtWtJkI2uNO2S1mqORzjzZrH_YMdTxxa3GZfpL00YAAu_41xoCiDQQAvD_BwE

[30] https://biogasassociation.ca/resources/page/national_renewable_natural_gas_rng_handbook_for_canadian_municipalities/

## Renewable Natural and BioGas Recommendation

- The City to approach Enbridge Gas and the surrounding agricultural community to ascertain the potential for the generation and use of this renewable resource.

## Energy Storage

Energy storage needs to play a critical role if Canada and Ontario is to succeed in reaching their 2050 GHG reduction targets. Energy Storage Canada has recently released a report in which they estimate that there is some 8 - 12 GW of potential energy storage by 2035. Ontario was identified as having the highest peak demand reduction potential of between 4700 MW and 5500MW.[31] Over 10,000 MW of gas fired generation will need to be replaced to meet the reduction goals.

In this context, Ontario has recognized the importance of energy storage by directing the IESO to acquire an additional 4000 MW of energy storage. [32] Energy storage can be used in all sectors; commercial, industrial and residential and even at the utility level. Storage helps provide stability to the power grid. An example of a utility system is given in Figure 14.

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[31] https://www.newswire.ca/news-releases/energy-storage-canada-commissions-report-estimating-installed-capacity-in-canada-province-by-province-842614653.html

[32] newsroom@ontario.ca, October 7, 2022

Figure14: Utility Scale Battery Storage System

Source: https://www.hresys.com/sol.php?id=334

In February 2023, the Ontario Government further promoted and supported this technology by announcing a project to build the largest battery storage system in Canada. Importantly, this project is being done in conjunction with both the Federal Government

and the Six Nations of the Grand River. Called the Oneida Energy project, it is about 250 MW and will be designed to meet peak power. It is due to come into operation in 2025.[33] It will reduce GHG emissions by about 2.2 - 4.1 million tonnes.

Residential sized systems include, for example, the 10 kW Tesla Powerwalls, Tesla Megapack Storage Battery – "This project demonstrates the benefits of battery energy storage System for the purpose of peak shaving and demand management, reducing constraints, providing visibility and enabling the support for future opportunities in renewable energy."

An example of how energy storage might work is provided in an Alectra Utilities 2015 demonstration project called Power.House. In this project the POWER.HOUSE pilot was designed to evaluate the economic and grid benefits that residential solar storage can contribute to electricity customers and the electricity system in Ontario. The pilot program enabled the deployment of 20 residential solar storage systems in homes within Alectra Utilities' service territory. The pilot enables participating customers to displace a significant portion of the electricity they source from the grid and better manage the electricity that they do use, resulting in reduced energy costs, lowered carbon footprint and improved efficiency. The system was also used by the utility to contribute to grid reliability and resiliency[34]

In view of Orillia's net zero commitment and concomitant increased electrical energy usage, long term energy storage will undoubtedly be one component of this energy transition. Interest in longer duration energy storage technologies that can cost-effectively deliver 8 to 12 hours of power. The promise of durations that eventually will be measured in days or even months raises the potential value of long duration storage even more. As well, like solar there has been a dramatic price decrease in battery packs as shown in Figure 15.

[33] https://www.thestar.com/amp/opinion/editorials/2023/02/19/a-welcome-step-to-enable-renewable-energy.html
[34] https://www.alectra.com/sites/default/files/assets/pdf/Alectra_GREATCentre_PowerHouse_Feasibility_Study.pdf

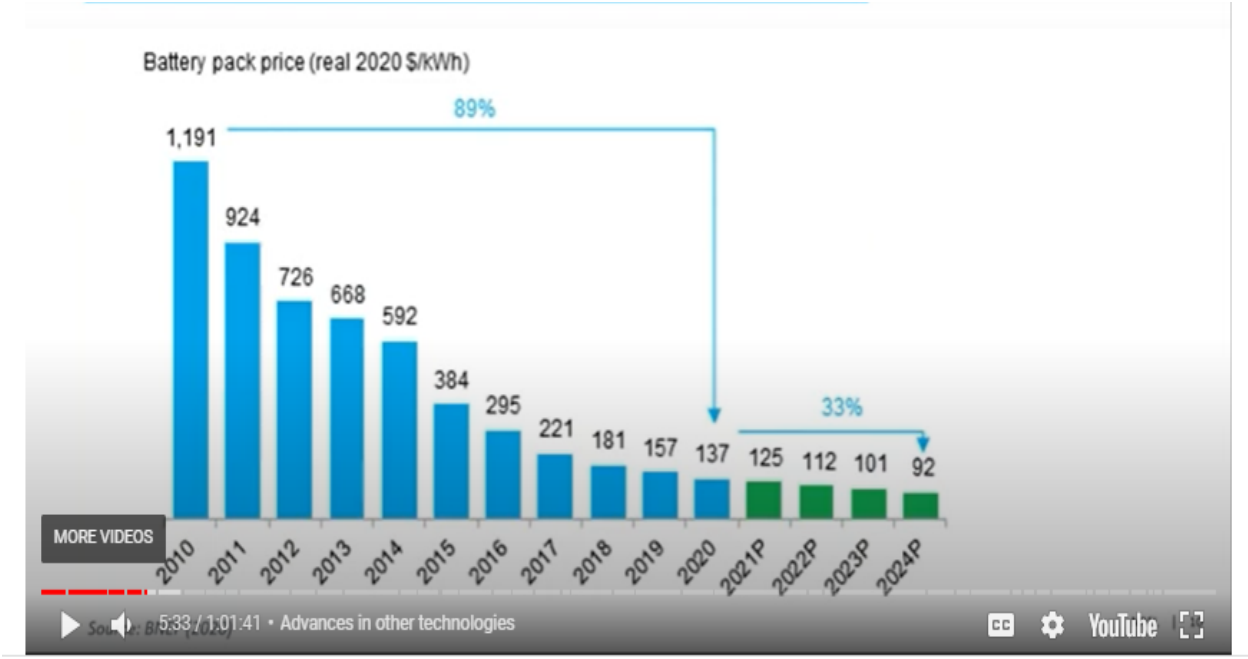


Figure 15: Battery Pack Price

Source: https://energystorage.org/event/save-the-date-long-duration-webinar/

Energy storage therefore will be a key component of any future renewable energy transition. The issue for Orillia is how can this be implemented locally and what should the energy storage component comprise. Further detailed studies on this will be required to confirm this.

## Energy Storage Recommendations:

- Orillia Power Generation Company to investigate how this technology might be used locally.
- Further technical analysis will be required to ascertain the most cost effective path forward for Orillia.
- Determine the feasibility of converting old unused transformer stations into Energy Storage facilities.

## Micro Grids

Electricity supply from the main grid is increasingly becoming less reliable. To counteract this, microgrids using distributed generation are being promoted. A microgrid is a group of interconnected loads (for example this could be 30 residences as in the Power.House example) and distributed energy resources (this could be batteries or cogeneration units) that acts as a single controllable entity with respect to the grid. It can connect and disconnect from the main grid to operate in grid-connected or island mode. Microgrids can improve customer reliability and resilience to grid disturbances.[35] In a world where there will be increasing use of renewable generation, microgrids will be part of that transformation. The SPEEDIER example discussed below is an example of a micro grid.

## Small Modular Reactors (SMR's)

[35] https://www.nrel.gov/grid/microgrids.html#:~:text=A%20microgrid%20is%20a%20group,and%20resilience%20to%20grid%20disturbances.

Nuclear power has never quite lived up to its promise and proved to be more expensive than hoped[36]. But governments committed to ambitious climate-change targets have been giving the technology a second chance. In January the European Union added nuclear power to a list of projects eligible for green finance.

Ontario has now started work on the first grid-scale small nuclear reactors at Darlington to provide affordable green electricity for the future.[37] Currently nuclear power provides about 50% of Ontario's electrical grid. Waste is being temporarily stored at secure above ground facilities until a more permanent solution is developed.

SMRs are nuclear reactors that are significantly smaller and more flexible than conventional nuclear reactors. SMRs would be small enough to be built in a factory and shipped by truck, rail or ship. They will still generate waste.

A typical SMR would generate between 2 and 300 MW of electricity, which could provide power for a village or small city. In comparison, a conventional nuclear reactor can generate 600 to 1,000 MW of electricity or more, which can provide power for a large city.

SMRs could operate independently or be linked to multiple units, depending on the required amount of power.

Given that Orillia is looking for about 100 MW of additional power to become net zero, this technology in theory could provide the solution, but in the opinion of Sustainable Orillia, there are issues, the most notable being that of managing and disposing of the high level radioactive waste and end of life abandonment. However, solutions to these issues may be forthcoming.

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36

https://www.economist.com/science-and-technology/developers-of-small-modular-reactors-hope-their-time-has-come/21808321?utm_medium=cpc.adword.pd&utm_source=google&ppccampaignID=18798097116&ppcadID=&utm_campaign=a.22brand_pmax&utm_content=conversion.direct-response.anonymous&gclid=Cj0KCQiA_P6dBhD1ARIsAAGI7HCcgqmoXshASJKhqITqlRY6jY-W99UMV8hdbqqTte6ttdPffMjDSJ4aAvYSEALw_wcB&gclsrc=aw.ds

37 https://news.ontario.ca/en/release/1002543/ontario-breaks-ground-on-world-leading-small-modular-reactor

## Small Modular Reactor Recommendation

- The City to monitor developments as required. This technology is unlikely to be appropriate solely for Orillia.

## Heat Exchange and Recovery Systems

Different types of heat exchange systems exist and are well known technologies. Three examples are given below:

- Waste water heat exchange systems capture the heat from waste water in residences to be used to preheat the hot water in the tank thus saving energy. Solar hot water uses the sun to preheat cold water prior to going into the hot water tank using a glycol circulating system. Others also exist in the marketplace.
- Solar hot water systems generally use a glycol circulating system heated by solar energy in panels that, via a heat transfer system, pre-heats water prior to entering the standard domestic hot water tank. This saves either natural gas usage or electrical use.
- Heat pumps, while not considered a renewable source of energy, do reduce the use of conventional energy drastically and will have a role to play in the future energy distribution and use systems. Heat pumps extract heat from the cold outside air and transfers it into the inside by the use of a compressor; in the summertime, heat from the inside of the home gets transferred outside to cool the home.[38] They are very energy efficient.

All of these are known technologies but generally are not heavily promoted. They are usually relatively simple to install.

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38 https://www.nrcan.gc.ca/energy-efficiency/energy-star-canada/about/energy-star-announcements/publications/heating-and-cooling-heat-pump/6817#:~:text=A%20heat%20pump%20extracts%20heat,indoor%20air%20to%20the%20outside.

## Heat Exchange and Recovery Systems Recommendation

- The City to explore financial options for residences to install these technologies as part of the CCAP implementation program.
- The City to explore opportunities for installations on larger e.g., 750mm municipal piping that could benefit from the economy of scale offered.

## Building Energy Conservation

Energy conservation also helps reduce emissions from the use particularly of oil, natural gas and propane. The Ontario government has launched the new Peak Perks program to help families save money by conserving energy, as part of the government's $342 million expansion of Ontario's energy-efficiency programs that will reduce demands on the provincial grid.[39] In addition, there is the Enbridge Home Efficiency Rebate 2023 is a program designed to incentivize investments in energy efficiency improvements for homes in Ontario. Through this program, homeowners can receive rebates of up to $5,000 when they undertake eligible home energy improvements.

One of the criticisms of the energy conservation programs is that there are so many incentive programs available that the public are confused…there is no "one stop shop" for advice. Nevertheless, governments have recognised the importance of energy conservation and Orillia should build on these incentive programs. Another criticism is that there is too much "red tape" in being able to secure the funding, so much so that this is seen as a barrier to adoption.

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39 https://news.ontario.ca/en/release/1003094/ontario-launches-peak-perks-and-expanded-energy-efficiency-programs#:~:text=TORONTO%20%E2%80%93%20The%20Ontario%20government%20is,demands%20on%20the%20provincial%20grid.

Home Energy Efficiency

ENERGY STAR certified space cooling products help homeowners to reduce consumption by 2 percent, appliances by 13 percent, water heating systems by 19 percent, and space heating solutions by 62 percent.[40] Our conclusion is that this is a very effective way of reducing emissions and helping Orillia achieve its reductions.

Businesses

A wide array of advanced solutions helps businesses to cut back on energy consumption, including office and industrial equipment and commercial heating solutions and appliances. Refrigeration appliances help reduce consumption by 16 percent, lighting solutions by 13 percent, and food preparation equipment by 35 percent. Commercial cooling and heating solutions also contribute to improved energy efficiency. These include lighting solutions, auxiliary motors and equipment, and water and space heating equipment. The list of commercial equipment also includes heat pumps, vertical and terminal air conditioners, gas unit heaters, and internal water loop heat pumps that are used for heating and cooling. Gas heaters are equipped with a fan and are usually automatically controlled. [41]

Energy Conservation Recommendation

Conservation has and will continue to play an important role in closing on the renewable energy gap necessary to achieve the City of Orillia corporate and community net zero targets. Accordingly, it is recommended that any renewable energy strategy include serious consideration of the ways and means that the City and community use energy conservation programs and incentives to assist in achieving net zero emissions.

[40] http://www.ohecip.ca/
[41] http://www.ohecip.ca/

## Example of Implementation of a Combination of Renewable Technologies

### SPEEDIER:

The Lakeland Solutions team graciously offered their time to provide a presentation and a Q&A session for City staff and members of Sustainable Orillia.[42] Lakeland Solutions, in cooperation with several partners, has developed a micro grid in Parry Sound known as project SPEEDIER, which has helped them build a net-zero smart community in Parry Sound.[43]

SPEEDIER is an acronym for:
**S**mart
**P**roactive
**E**nabled
**E**nergy

[42] Meeting held Jan 19, 2023
[43] web site: https://www.speedier.ca/

**Distribution**
**I**ntelligently,
**E**fficiently and
**R**esponsive

This is a convoluted acronym, but the SPEEDIER solution was proposed in order to help to address a previously identified need for costly electrical system upgrades required for the growing energy demands of the community.

This is also a potential issue for Orillia. With development expansion, rather than upgrading the local grid electrical system and incurring those significant capital costs, designing a localized distributed energy generation system was seen to be more economic over the long term. Such a system can effectively integrate current renewable energy generation options and storage technologies in combination with available intelligent IT designs to operate the system. Project boundaries were established so that residents (165 residents) within this boundary can be seamlessly unplugged from the grid when required. Lakeland is an Ontario regulated utility, so this work was conducted under the regulated requirements of the OEB and the IESO as part of their market renewal program. It cost about $8 million, but it is not presently clear how much of this was recovered under their rate program.

In this particular case the combination of technologies used were:

Tesla Mega Pack storage battery 2.54 MWh
500 kW PV solar array
1 Level III charging station
10 Tesla Residential Powerwalls 50 kW
50 Mello HWT controllers
3 Level II charging stations

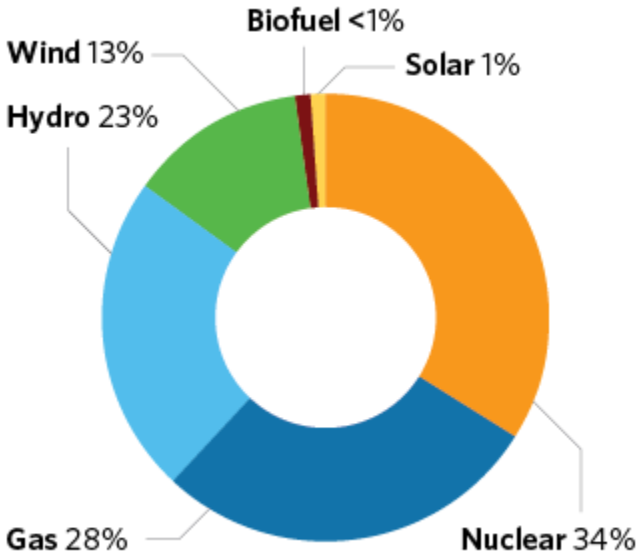
So, this project is about networks, establishing a microgrid, with the ability to unplug those customers from the grid as required and making sure the electrons are sent to where they are needed as seamlessly as possible. Significant planning was involved in this project. The most relevant issue for Orillia is that this is a practical example of how we can reduce our dependence on the Ontario grid which has GHG emissions, and thus contribute towards reaching a net zero goal. The combination of technologies used will likely be different for Orillia; this will be part of the planning process.

## General Technical Conclusions and Grid Related Recommendations

This document shows that there are various options that the City can take to increase its generation and use of renewable energy. Each technology will have its own niche and a combination of these is most likely the best economic option.

Orillia has the great advantage that it already owns an electrical generating company, the distribution portion was sold to Hydro One. Building on this foundation, SO is of the view that OPGC should expand its generating capabilities into these other generating sources to help Orillia achieve its CCAP goals.

The current generation mix in Ontario on the transmission grid (as of December 2022) is given in Figure 16. Only about 37% is from renewables (or about 70% if nuclear is included).




| | |
|---|---|
| **Nuclear** | 13,089 MW or 34% |
| **Gas/Oil** | 10,482 MW or 28% |
| **Hydro** | 8,868 MW or 23% |
| **Wind** | 4,883 MW or 13% |
| **Biofuel** | 296 MW or <1% |
| **Solar** | 478 MW or 1% |

Source: https://www.ieso.ca/en/Learn/Ontario-Electricity-Grid/Supply-Mix-and-Generation

Figure 16

## Grid and Local Generation Recommendations

- The City and OPGC enter into a short term agreement with Lakeland to explore next steps as part of the CCAP implementation and to determine what GHG reductions will accrue as a result of this option.

- Over the longer term (1 year) OPGC to investigate the option of replicating Speedier in Orillia.
- The City to explore opportunities for attracting new inward investment by companies who require guaranteed electrical connections as well as by those renewable technology companies who could play a role in this solution.
- In a separate but linked concept, consider how this concept can be embedded into any new greenfield developments. It is cheaper to do this at the start rather than retrofit at a later date.
- It is further recommended that a report be prepared updating the state of renewable energy production in the City from all sources including costs and the technologies being used with consideration of incentives and barriers.

Major factors impacting Ontario's future supply include:

- decommissioning e.g., Pickering Nuclear Station by 2025
- Refurbishments
- Increased demand e.g., from Ev's

Future demand will be met with a competitive procurement process.[44] A SPEEDIER type of project in Orillia could provide a solution with financing coming into OPGC. Natural gas generation has been shown to be an integral part of the future of electrical generation in Ontario as renewables are not sufficient, new technologies are not yet proven (such as SMR's) and cost.[45] Therefore for Orillia to meet its target, increased renewable generation will be paramount.

Technology in the renewable energy sector is moving at an increasingly rapid rate and it is difficult to keep abreast of these new developments and their potential implications for Orillia. Costs are declining significantly as has been seen in the PV solar sector below:

[44] https://www.ieso.ca/en/Learn/The-Evolving-Grid/Securing-New-Energy-Supply
[45] https://www.ieso.ca/Corporate-IESO/Media/News-Releases/2021/10/Natural-Gas-Phase-Out-Study

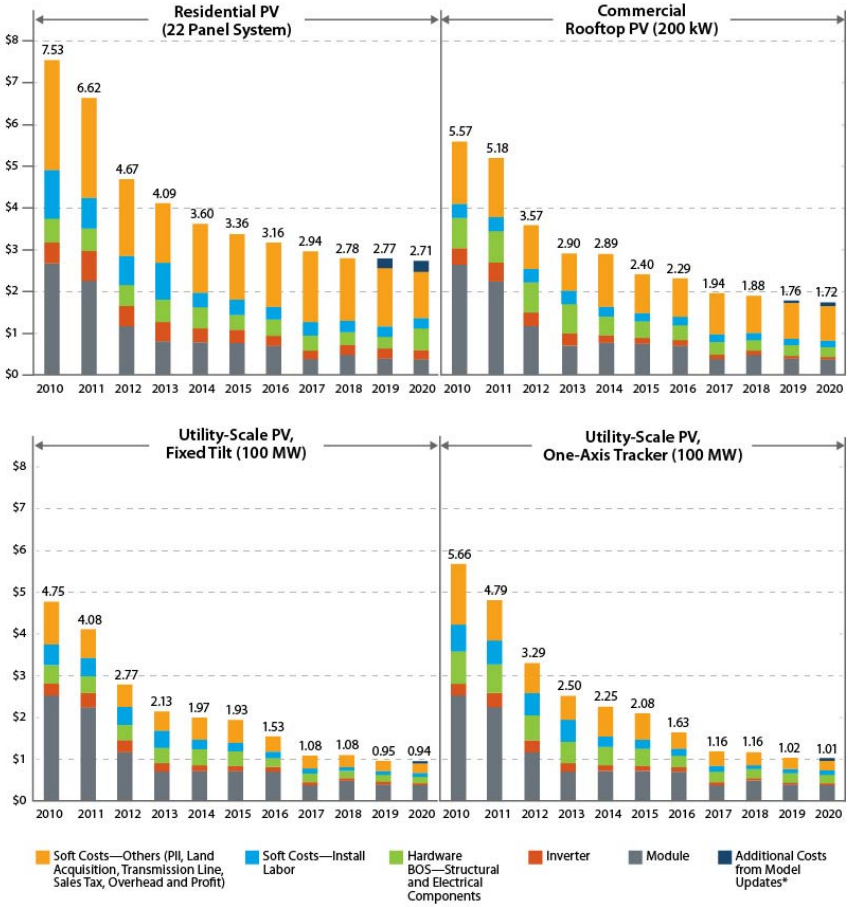
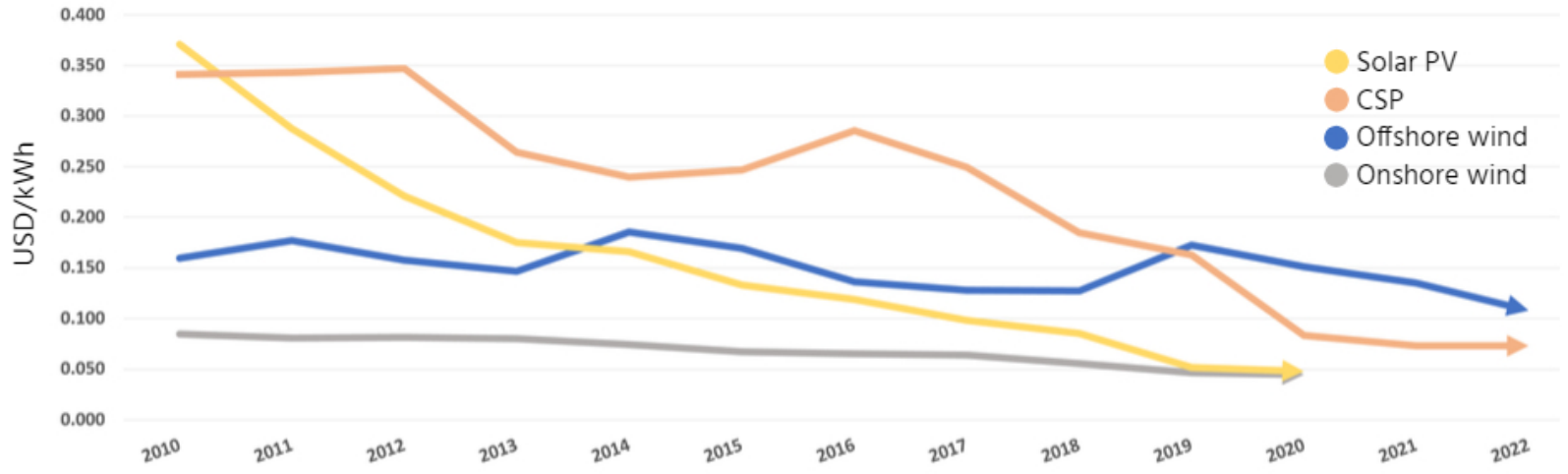



Figure 1 Source: https://www.nrel.gov/news/program/2021/documenting-a-decade-of-cost-declines-for-pv-systems.html

By 2020, **onshore wind** and **solar PV** will be a less expensive source of new electricity than the cheapest fossil fuel alternative.




RENEWABLE POWER GENERATION COSTS IN 2018 IRENA International Renewable Energy Agency



Sustainable Orillia

There seem to be multiple options for Orillia and Orillia Power Generation to expand into the renewable/sustainable energy sector. However, primary data collection will be needed to determine what priorities need to be focused on and timelines in order to help support the Climate Change Planning process.

## Additional Next Steps

In addition to consideration of the General and Technology Specific Recommendations, it is suggested that the following additional information is needed in order to further develop this initial Strategy.

- Confirm that the "gap" is indeed 62 MW that needs to be provided by renewable sources of energy or through reductions to get to net zero by 2050.
- Assess the most economical way of generating this amount via renewables or combination of renewables.
- Determine the spin off benefits e.g., job creation for each method being assessed.
- Evaluate the future options for OPGC in providing the necessary services to Close the Gap