Identifying a Suitable Location for a Solar Renewable Energy Site within Dufferin County Using a Multi-Criteria Evaluation Model

Scott Crawford, Asvini Patel & Sajeen Sundaresan
GEOG 4480 Applied Geomatics

Abstract
The global populations’ reliance on fossil fuels has increased exponentially, leading to a pandemic of environmental problems and a depletion of fuel reserves. Solar renewable energy is expected to become essential as the world transitions to sustainable efforts and management practices. Dufferin County is an ideal location to introduce solar renewable energy due to its rural landsmasses, absence of solar programs, and priorities concerning the county’s Energy Conservation & Demand Management Plan. To help meet these initiatives, we created a multi-criteria evaluation model to help identify the most optimal site in Dufferin County to develop a solar facility that renders the non-renewable energy sector in the county obsolete while providing enough electricity to a quarter of the county’s dwellings (5608).

Our MCE model was based on environmental, legal, technical, social and economical constraints and factors. The model derived a suitability map that indicated possible sites to develop a solar facility. To find the most optimal site to expend 24.5% market share owned by the non-renewable sector and provide sufficient electricity to power 5608 dwellings in Dufferin County, the facility would need to generate 15MW of power annually. A careful calculation deemed the facility would need to occupy an area of 24.2 hectares to meet these standards. Our findings presented the township of East Garafraxa, located in the Southwest Region of Dufferin County, to be the most optimal location for constructing a solar facility.

Research Objectives
1. To determine relevant factors and constraints with the consideration of technical and legal accessibility necessary for the development of solar renewable energy infrastructure;
2. To develop a multi-criteria evaluation (MCE) model to generate an index of suitability;
3. To apply the model to locate the most optimal solar renewable energy site within Dufferin County;
4. To assess the strengths and weaknesses of the research approach.

Purpose of Research
The purpose of this research is to locate the most suitable site for the development of a solar facility within Dufferin County with the capacity to remove the non-renewable energy sector and power a quarter of all county dwellings.

Methodology
1. Conducted a comprehensive literature analysis on the regulations of the solar industry to ensure that the proposed site satisfies all technical and legal requirements.
2. Accessed open data portals to acquire necessary datasets for the study.
3. Created a multi-criteria evaluation model to generate an index of suitability for solar site development.
4. Identified the most optimal 24.2 hectare site through calculations.
5. Addressed research gaps and potential for future studies.

Table 1. Pairwise Comparison Table ranking relevance of factors pertaining to solar facilities

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Potential</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Impact on Environment</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Technical Feasibility</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Financial Aspect</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Legal Accessibility</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Social Acceptance</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Conclusion
This study was conducted with the purpose of identifying the most suitable location within Dufferin County to construct a solar facility with the capacity to generate enough power (15MW) to supply a quarter of all dwellings and eliminate its non-renewable energy sector (Dufferin County, 2020). To comply with such standards, our calculations concluded the site would need to be 24.2ha in size which would be built in the southwest corner of the township of East Garafraxa. The MCE administered this area to host the most suitable site due to it being a densely populated and functioning area within Dufferin county. Townships are within proximity to the most important variables to a solar facility (utility lines, roads) and are generally isolated from important constraints (i.e., ecological features).

Future studies should choose not to treat Dufferin County as a separate entity, yet a piece of a more complex system. This is due to the fact that decisions made in Dufferin have adverse effects on neighbouring counties. Finally, the potential for solar rooftop implementation should be further examined as accompanying rooftop solar can drastically reduce the area occupied by a solar facility. We omitted finding rooftops for solar panels as the study requires a vastly different analysis and was not appropriate to carry out for a project of our time frame.

References
2. Doi: 10.1017/cbo9780511802638.004