# Summary report on renewable energy resource data in New Brunswick: Focus on wind, solar, and biomass resources


## Abstract

Theoretical resources are typically presented as a map that indicates the measured or modeled energy potential across a geographic area (e.g., wind speed; solar irradiance; biomass productivity). This is assessed using some combination of in situ data collection and geophysical modeling. This report assesses the availability and quality of such data in New Brunswick.

Table of Contents

# 1.0 Introduction

This report assesses the availability and quality of resource data and resource maps for primary land-based renewable energy resources in New Brunswick: wind, solar, and biomass. These maps do not serve as an assessment of any project site, but rather outline areas with relatively high or relatively low energy potential based on the nature of the resource alone. In other words, these maps are a starting point, but by themselves insufficient, as a basis upon which to assess actual, realizable renewable energy development prospects in an area. The maps and data considered within this report have been created at provincial, national, or international scales, and are therefore suitable for use in renewable energy assessment across New Brunswick.

# 2.0 Wind Energy Resource Maps

Wind energy maps are typically created by joining atmospheric circulation models with local topographic data to create a model of wind speed, power, and direction at varying heights above Earth's surface. In most cases, geophysical models are used to spatially interpolate measured data collected at weather stations. Typically, this work is undertaken by government agencies, often working with consulting firms, although more detailed and localized data are produced by and for wind energy developers. Wind maps can be created at a regional level (mesoscale) with a spatial resolution ranging from 1.5 to 2 km, or at a local level (microscale) with a typical spatial resolution ranging from 100 - 200 m. For the purposes of informing municipal planning, working with microscale data is ideal. For the purpose of communications and planning, resource data are classified according to the International Electrotechnical Commission (IEC), per table 1 below.

*Table 1: IEC Standardized Classification System for Wind Resources. For more information about the IEC wind classification system visit: https://www.lmwindpower.com/en/stories-and-press/stories/learn-about-wind/what-is-a-wind-class*

| | **Class 1 (High)** | **Class 2 (Medium)** | **Class 3 (Low)** | **Class 4 Very Low)** |
|---|---|---|---|---|
| **Reference Wind Speed** | 50 m/s | 42.5 m/s | 37.5 m/s | 30 m/s |
| **Annual Average Wind Speed** | **10 m/s** | **8.5 m/s** | **7.5 m/s** | **6 m/s** |
| **50-year Return Gust** | 70 m/s | 59.5 m/s | 52.5 m/s | 42 m/s |
| **1-year Return Gust** | 52.5 m/s | 44.6 m/s | 39.4 m/s | 31.5 m/s |

## 2.1 Preferred Data Source: The New Brunswick Wind Atlas

The New Brunswick Wind Atlas was made in partnership between the New Brunswick Department of Energy and Resource Development and the University of Moncton. The Atlas is currently hosted on the Energy and Resource Development webpage of the New Brunswick Government

*Table 2. Summary of the New Brunswick Wind Atlas*

| | |
|---|---|
| Name of Dataset | The New Brunswick Wind Atlas |
| Creation Date | November, 2007 |
| Map Distributor | New Brunswick Energy and Resource Development - https://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/resource_maps/wind.html |
| Resolution | 200 metre grid |
| Mapped category | Wind speed (m $s^{-1}$) at an elevation of 80 metres above ground level |
| Map Creation | The Atlas was created using the Wind Energy Simulation Toolkit (WEST) model, developed by the Canadian Meteorological Centre of Environment Canada. WEST statistical-dynamic downscaling to create maps at both the mesoscale and microscale. |
| Data Source | The Atlas is based upon the Canadian Wind Energy Atlas (CWEA), a mesoscale wind atlas produced using the WEST. The CWEA is based upon long term wind climate data known as the NCAR/NCEP Reanalysis 1, as well as 1km topography and land cover data from the United States Geological Survey. |
| Ease of use and Accessibility | The Atlas can be viewed as a selection of PDFs. Currently, the geospatial data behind the New Brunswick Wind Atlas are not publicly available for download. |

### 2.2 Alternative Data Source: Global Wind Atlas

If the data described above are not accessible, the Global Wind Atlas (https://globalwindatlas.info/) provides an alternative. This atlas was created in partnership between the Technical University of Denmark and the World Bank Group. The main concern with the Global Wind Atlas is accuracy. When compared to local wind maps for other regions in Canada, the Global Wind Atlas seems to overestimate wind speed. These data provide mean wind speed and mean power density at a 200m spatial resolution.

## 3.0 Solar Energy Resources

Maps of incident solar models are typically created using data from satellite imagery or environmental reanalyses that are then calibrated with irradiance measurements taken at weather stations. Factors that affect the irradiance at a specific location include longitude (angle of incidence), surface albedo (how reflective the ground is), typical atmospheric profile (absorption and reflectivity of incoming radiation), slope, aerosols, and shading. Typically, irradiance maps are created at coarse spatial resolutions, as variation in irradiance is minimal over short distances and varies meaningfully only over relatively large geographic areas. For this reason, when siting solar energy production facilities, the intensity of solar radiation is not as strongly considered as other variables such as the availability of land or distance to transmission lines.

### 3.1 Preferred Data Source: National Solar Resource Database Physical Solar Model v.3.0.1

The Physical Solar Model v.3.0.1 is the latest iteration of the National Renewable Energy Laboratory's (NREL) National Solar Resource Database (NSRDB). For over 25 years, the NREL has been maintaining the

NSRDB, updating irradiance maps yearly. While not specifically developed for use within New Brunswick, the NSRDB PSM is an excellent resource that is readily available for use.

*Table 1. Summary of the National Solar Radiation Database's Physical Solar Model*

| | |
|---|---|
| Name of Dataset | National Solar Radiation Database Physical Solar Model v.3.0.1 |
| Creation Date | March, 2016 |
| Model Distributor | National Renewable Energy Laboratory (NREL) - https://maps.nrel.gov/nsrdb-viewer/ |
| File Format | ESRI Shapefile |
| Spatial Resolution | 4 km (Nominally) |
| Map Categories | Annual average ground horizontal irradiance (kWh $m^{-2}$ $day^{-1}$) within +/- 5% accuracy |
| Model Creation | The Fast All-Sky Radiation Model for Solar applications (FARMS) was used to calculate ground horizontal irradiance for the PSM using numerous inputs. |
| Data Sources | Data from numerous earth observation satellites and affiliated projects are used to create the PSM. Data sources include satellites, projects, and sensors such as GOES, MERRA2, MODIS, and IMS. |
| Ease of use and Accessibility | The Physical Solar Model can be viewed on the NSRDB Data Viewer, and can be downloaded in the ESRI Shapefile format from the NSRDB website. |

### 3.2 Additional Data Sources

An alternative solar map is the Solar Energy Resource Map of New Brunswick (SERM). While the map was developed specifically for use in New Brunswick, the SERM does not seem to have the same rigorous documentation available as the PSM, and as of last attempt the SERM is not currently available for download or use in a geospatial format (see https://www2.gnb.ca/content/gnb/en/departments/erd/energy/content/resource_maps.html#solar)

## 4.0 Biomass Energy Resources

Biomass energy is broadly defined as organic matter that is used as a fuel source in the production of energy (heat, transport/motor power, electricity). The focus of this project is on cellulosic biomass potential (crop residues and forestry residues). The study is not considering the use of whole crops (i.e., we are not considering corn-to-ethanol and other 'first generation' sources of biomass for energy/fuel). Mapping theoretical biomass resources requires a combination of land-use maps and agricultural / forestry census statistics, as described below.

### 4.1 Preferred Data Sources, Forestry: NB Forest Resource Inventory

The New Brunswick Forest Resource Inventory is used to map forest resources located in private and crown owned lands. While the majority of the province's forestry stock is included in the inventory, key areas such as federally owned lands and industrial freeholds are not present within the map.

*Table 2. Summary of the New Brunswick Forest Resource Inventory*

| | |
|---|---|
| Name of Dataset | Forest Resource Inventory |
| Creation Date | March, 2017 |
| Model Distributor | New Brunswick Department of Energy and Resource Development |
| File Format | ESRI Shapefile, ESRI File Geodatabase |
| Map Categories | Forest cover polygons interpreted from aerial imagery on a 10 year cycle. Attribute information includes stand characteristics |
| Ease of use and Accessibility | Available for download from the GeoNB Data Catalogue |

For more information on how these data are used to assess RE potential, see a comprehensive study here: www2.gnb.ca/content/dam/gnb/Departments/en/pdf/Maps-Cartes/201210BiomassReport.pdf

#### 4.1.1. Additional data resources

The National Forestry Database includes province-level data on harvest volume and areas, broken out by land tenure (e.g. Provincial, Federal, Private) and type (e.g. hardwood, softwood, etc.). These data can theoretically be coupled with spatially distributed species coverage data (250 m spatial resolution) from the National Forest Inventory to 'fill in the gaps' with estimations for federally owned lands and industrial freeholds. Note that federally owned lands are mostly CFB Gagetown, and may not be appropriate to rely on for RE potential.

### 4.2 Preferred data source, agriculture: the AAFC Annual Crop Inventory

The Annual Crop Inventory (ACI) created by Agriculture and Agri-food Canada is a crop inventory that covers that entire extent of agricultural activity since 2009. The ACI is based upon satellite imagery collected at varying times throughout the year from varying spaceborn sensors. Improvements in thematic precision have increased at every iteration of the project. There may be some difficulty in pairing agricultural yield data to the ACI for New Brunswick as yields are reported at the provincial level, rather than on a county by county basis as is common in other provinces.

*Table 3. Summary of the Agriculture and Agri-food Canada Annual Crop Inventory*

| | |
|---|---|
| Name of Dataset | Annual Crop Inventory 2018 |
| Creation Date | February 2019 |
| Model Distributor | Agriculture and Agri-food Canada |
| File Format | GeoTIFF |
| Spatial Resolution | 30 m |
| Map Categories | Over 60 categories for varying crop and land cover types |
| Model Creation | The map was created using a decision-tree based classification approach upon optical and infrared satellite imagery, and the map was validated using field measurements taken by insurance companies and provincial ministries |
| Data Sources | Satellite Imagery from the Landsat-8, Sentinel-2, Gaofen-1, and RADARSAT-2 satellites |
| Ease of use and Accessibility | The AAFC Annual Crop Inventory Map for 2016 is available for download from the Canada Open Data portal. Additional Crop Inventory Maps from 2011-2017 are also available for download. |