Solar Energy in Canada

Solar energy can meet three distinct applications: **heating water, heating air,** and **generation of electricity** in any residential or commercial setting. In most cases, solar energy provides the lowest lifecycle cost, and the lowest environmental impact from the release of greenhouse gases (GHG).

Designing a Commercial Solar System

Large solar thermal systems for institutional, commercial and industrial applications should be designed by a professional engineer who probably would use a simulation such as Watsun. Watsun is a computer program developed at the University of Waterloo 20 years ago and was required for all commercial solar systems. The program uses weather data on an hourly basis to simulate the performance of a solar system for a typical meteorological year, developed over three typical years in a particular location. The program assumes a collector area, then calculates the solar fraction and energy output. The collector area implies a certain cost and the energy output of the system implies certain cost savings. The cost and the savings allow a designer to analyze the potential solar system. This is especially valuable for large solar systems.

Rules of thumb for designing a solar system

A rule-of-thumb approach is a good way to get a first approximation for the size of a solar system. It begins with an assumed volume of hot water per sunny day per solar collector. Based on experience, a reasonable average is between 100 and 200 litres of hot water from a solar collector of 3 m^2 area (4 x 8') per sunny day. This method is suitable for a small system such as a residential application but may also provide a ballpark figure for larger systems.

There is no code regarding tank sizing but a rule of thumb for residential applications is one gallon of storage per square foot (45 litres/m^2) of collector area. In Canada, tanks range from 40 to 120 US gallons (150 to 450 litres) or custom-built tanks of larger sizes. They can be glass-lined in the smaller sizes and stainless steel in any size. They are also available with various linings including concrete.

Another computer program that can provide design assistance for solar water heating systems (as well as solar air heating and solar electric systems, too) is RETScreen, available from Natural Resources Canada. The pre-feasibility analysis tool allows a designer to calculate the economics of a solar water heating system and uses weather data for any location around the world. The software runs on Microsoft Excel and is provided for free download from the internet, at RETScreen.gc.ca.

Solar fraction

The solar fraction is the fraction of the sun's energy that is converted into useful form, such as hot water. When a large solar system is properly designed based on the energy demand and the cost savings, the solar fraction is normally one quarter of the total hot water load. The solar heated water may not rise to the final desired temperature but may produce half of the desired temperature rise.

Hot water demand

Hot water consumption for the building can be calculated from utility bills or water bills, or can be estimated from the ASHRAE Applications Handbook on Service Water Heating, which gives average figures for hot water use per person for a given building,. A large solar system may be designed to

supply a quarter of the total hot water load over an entire year, while providing much more in summer. For example, a canning factory uses more hot water in summer during the harvest season and should be designed to supply hot water for that skewed load.

Storage tanks vs. an on-demand heat exchanger

In many applications, it may not be necessary or wise to store energy as hot water in a tank. Storage tanks are expensive and, if the load matches the energy available from the sun, the cost for the tanks can be eliminated. Instead of storing energy this way, an on-demand heat exchanger can supply heat to the incoming cold water and heat it a modest amount for an application that matches the energy available from the sun. A car wash is a good instance because, in most cases, people wash their cars on sunny days and need only warm water. Energy is available when there is demand so there is no need for storage of hot water.

Other solar thermal design considerations

A major design consideration is positioning the collectors to get the most heat from the sun. The collectors are usually mounted on a roof or on a rack above the roof, at an angle to the horizontal called the tilt angle, and at an angle to the south called the azimuth angle. If the panels are tilted on a rack, they will be exposed to the wind, so the rack must be properly secured. Snow can accumulate around panels and cause an extra load on the roof. For a year-round solar system in Canada, the best performance is from collectors facing due south, tilted at an angle equal to the latitude of the location and never shaded. For a summer-only system, such as pool heating, the tilt angle will be at a shallow angle. If most of the use is in the winter, the panels will be a steeper angle, perhaps 65 degrees, to capture the lower angle of the sun's movement.

If possible, select a site that will keep the installation simple. Many non-residential applications are on buildings with flat roofs and will need racks to support the collectors. Note nearby trees and their type, and remember that small trees may shade the collectors as they grow. For a particular orientation, the shadows may exist for only one particular season, which may be a few months after the tree has lost its leaves.

The type of system and its application are important considerations. Solar water heating systems for heating non-residential applications are larger systems with many panels. Studies have shown the solar fraction (how much of the load is supplied by the sun) ranges from 15 to 95%, tending to the lower end of the range rather than higher for non-residential applications.

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The **Canadian Solar Industries Association** (CanSIA), with assistance from **Natural Resources Canada**, has produced this series of bulletins to explain the feasible applications of solar energy in Canada. To demonstrate how you can put the sun to work for you, CanSIA has posted these bulletins on its internet homepage, with additional information on solar energy and a comprehensive directory of companies that are involved in the design, sale and installation of solar energy across Canada. Members of CanSIA comply with a Code of Ethics. Please go to **www.CanSIA.ca**, or contact our office:

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