ALTERNATIVE ENERGY AND HEATING SOURCES

Lighting, controllers, and fans are the largest draws for electricity in production facilities. Most barns get their electricity from the grid, which means they are dependent on the rates set by electricity providers; however, there are opportunities to use solar power, wind turbines, biomass, or methane digesters/biogas to provide power to the farm. These systems provide an opportunity to stabilize energy costs, minimize fossil fuel use, and reduce greenhouse gas emissions. These practices allow producers the potential to become carbon neutral, and even carbon negative, by providing renewable energy back to power grids.

Solar Power

Solar panels, also called solar photovoltaic (PV) systems, are the most common way to produce on-farm renewable energy, by converting light into electricity. Solar power is becoming increasingly accessible and affordable, with most solar installations lasting at least 25 years and a payback of 10 to 15 years.

The most common installations include roof or ground mounted. The orientation and angle of the panels is important to catch the greatest number of sunrays; ground-mounted panels are often more efficient than roof mounted ones due to a less efficient angle present on roof-mounted panels. The steeper angle of the ground-mounted panels is able to collect solar radiation more consistently throughout the year. Manually adjustable tilt racks for solar panels to catch the most sunrays in summer and winter are available for both roof and ground-mounted systems. However, ground-mounted solar panels are easier to access to adjust the angle. Another advantage of the easier access is that it makes snow removal and maintenance easier as well. Having said that, solar panels require very little maintenance. Despite being more efficient, ground-mounted systems cover a lot of potentially valuable land, so a roof-mounted system might be more economical.

Table 10. Advantages and disadvantages of roof and ground mounted solar panels.

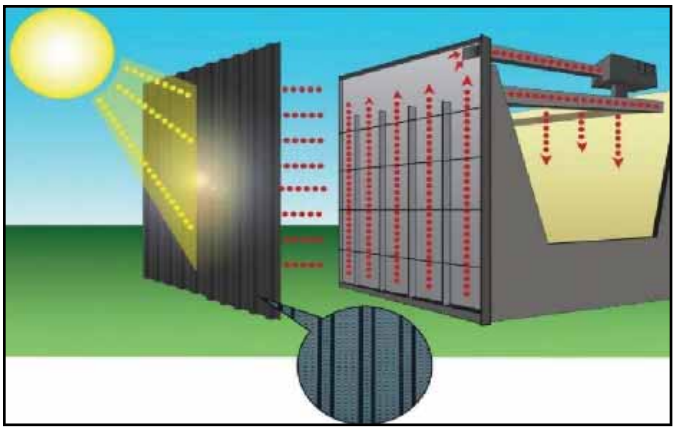
ADVANTAGES	DISADVANTAGES
Ground-Mounted Solar Panels	
• Can be installed to face any direction • Can be installed at multiple angles • Easy access for cleaning, removing snow, and maintenance • Stronger racking overall • System is not confined to the dimensions of the roof • Cooler panel temperatures mean higher energy output • No need to remove panels if roof is replaced	• Less expensive • Requires fewer materials to install (eliminates need to construct new solar foundation) • Installation cost is lower • Utilizes unused space • Easier to get permits • Panels can protect the roof from exposure to certain elements
Roof-Mounted Solar Panels	
• Installation is more labor-intensive • Installation is more expensive • Permitting process is more complex • Takes up space that could be used for other things • Requires upkeep of the land below the panels (such as mowing, weed control, etc.)	• Hard to access – especially if your roof is steep or slippery • Less accessible for cleaning, snow removal, and maintenance • Imperfect orientation and angle • Limited to the space on the roof • Need to install the panels again if the roof needs to be replaced within the panel's lifetime • Putting holes in your roof could lead to water damage • Higher panel temperatures mean lower panel output

Most solar installations tie into the utility grid, allowing the owner to sell excess electricity back during times of high production. In addition, at times of low or no solar electricity production, the utility grid provides access to backup power. Consult with your electric power supplier whether they have a net metering system in place, meaning the energy produced by your solar panels that you don't use is credited back to you. When you need to use electricity from the grid, it counts against the credits you've banked over time. As a solar customer, you will only be billed for your "net" energy usage. Some net metering systems use different prices for power produced and power consumed.

Benefits of an off-grid system include being self-sufficient; however, they require solar batteries to store electricity, which makes the system more expensive than one connected to the grid.

Example of a barn with a transpired solar collector, also called a solar wall

A simpler and much cheaper way to use the sun's power is by using a transpired solar collector, also called a solar wall. A solar wall converts the sun's energy into heat, through a typically dark-colored wall made entirely of metal sheeting with thousands of micro-perforations (tiny holes) in the surface. This wall is mounted to the building's structural wall, creating a 4-to-6-inch gap between the two, generally covering the south, west or east side of a barn. The solar wall sits over winter air intakes; air heated up on the surface of the dark wall is drawn through the micro-perforations by ventilation fans, increasing air temperature by as much as 22°C. The heated air flows to the top of the wall and is then distributed to the barn's interior through conventional ductwork. Solar walls can reduce heating cost up to 30% by using the sun's energy to heat incoming ventilation air, while improving indoor air quality and decreasing humidity. Systems have an estimated life span of 30 years, and a payback period of 3 to 12 years; payback is dependant on climate and type of fuel displaced.



Schematic showing how a solar wall uses the sun to warm up incoming ventilation air

SOLAR WALLS

- The solar wall has no moving parts and requires no maintenance.
- Converts as much as 80% of available solar radiation to heat.
- Ideal for use in sunny climates with long heating seasons.
- Less need to run heaters thanks to incoming air being pre-heated.
- Preheated ventilation air reduces draft potential.
- Warmed inlet air won't drop as rapidly as cold inlet air from a conventional system, thereby improving airflow in the room.
- Ventilation rates can be increased when solar walls are used to improve air quality without an increase in heating energy costs.

Close-up of a solar wall

Geothermal systems

A geothermal system utilizes the constant temperature of the ground to provide heating and cooling to buildings. The geothermal system, or alternatively known as ground source heating system is composed of a heat pump and a series of connected polyethylene pipes buried in trenches (vertical or horizontal) in the ground outside the barn, forming a closed loop. The buried pipes contain a solution that absorbs or deposits heat from the ground, depending on whether the outside air is colder or warmer than the soil. When air temperatures are colder than the ground, a geothermal heat pump removes heat from the collector's fluids, concentrates it, and transfers it to the building. When air temperatures are warmer than the ground, the heat pump removes heat from the building and deposits it underground. Conventional ductwork distributes heated or cooled air from the geothermal heat pump throughout the building. Heat pumps are usually electric powered, providing three to four units of heating energy for every one it uses for operation. This gives a geothermal system up to 400% efficiency rating on average. Geothermal systems have a high initial cost, but the underground loop systems last up to 50 years.

Geothermal heat pump installed in a grow-finish room at the Prairie Swine Centre

Work at Prairie Swine Centre

Prairie Swine Centre installed a geothermal system with a heat pump to examine the impact on cost and environment (heating/cooling) in one finishing room. The system consisted of 550 m of 1.9-centimetre diameter polyethylene pipes buried 2.6 - 3 m deep in trenches outside the barn, containing 20% methanol - 80% water solution. A 5-ton heat pump, using R-410a refrigerant, was installed in the geothermal room and its air-handling unit was connected to the room's air recirculation duct. A 22-kW forced convection heater served as a back-up heater in the room.

The project compared energy consumption (for heating and ventilation) in this room to a standard grow-finish room with a conventional gas-fired heater. Results showed the room with the geothermal system consumed about 45% less total energy for heating and ventilation during the cold season compared to the conventional room. The mean air temperature, relative humidity, and air quality within the two rooms were relatively similar during winter season. During the summer season, the use of the geothermal system to cool the room resulted in larger energy use compared to the control room, mainly for the operation of the heat pump. Levels of greenhouse gases (methane and carbon dioxide) were significantly lower in the geothermal room than in the room with the conventional gas-fired heater during both heating and cooling periods.

Building of a trench with a horizontal loop of polyethylene pipes as part of the Prairie Swine Centre geothermal system

Biomass

Another fuel source to consider is biomass. Biomass is organic material from plants or animals used as a fuel source to produce electricity or heat. Plant sources of biomass include wood and crop residues. Wood pellets have increased tremendously in popularity as a heating fuel during recent years, with many homeowners and commercial facilities choosing pellet stoves or boilers over traditional wood-fired equipment due to their relative ease of use. Wood pellets typically consist of sawdust, wood chips or shavings.

Wood pellets

An animal source of biomass that is abundantly available on hog farms is manure. Using a methane digester, methane from pig manure can be harnessed and used for power in the form of biogas. A methane digester is like a slurry lagoon, but it is fully covered, and it contains bacteria that digest the solids in the manure through anaerobic digestion to methane and carbon dioxide. This gas mixture is then captured and processed to convert it into pipeline quality gas. Unfortunately, methane digesters work better in warmer temperatures (35°C is ideal), meaning in Canada digesters would need to be heated in the winter to work properly, thereby using up a portion of the energy it produces. As such, methane digesters have limited applicability in Canada.

Funding opportunities

In 2022, Natural Resource Canada launched a $300 million funding opportunity that supports the deployment of clean energies in Indigenous, rural and remote communities. The funding will support communities launching clean heat and power projects, such as biomass, wind, solar, geothermal, and hydro. The funding also supports increased adoption of energy efficiency measures and is available until 2027. More information can be found by scanning the QR code:

The federal government also has other programs in place to fund sustainable farming practices. For an overview, go to https://agriculture.canada.ca/en/programs.

Each province has funding available through the Sustainable Canadian Agricultural Partnership (Sustainable CAP) program, a federal-provincial-territorial program to help producers implement projects that will support the sustainable growth of the agriculture and agri-food sector. To find more information, google 'Sustainable CAP' and the name of the province you are interested in to find province specific information.

Sustainable Canadian Agricultural Partnership

The Sustainable CAP program is a federal-provincial-territorial funding program