How shading crops with solar panels can improve farming, lower food costs and reduce emissions

April 27 2023, by Joshua M. Pearce

Agrivoltaic farming — growing crops in the protected shadows of solar panels — can help meet Canada's food and energy needs. Credit: Alexis Pascaris, AgriSolar, Author provided

If you have lived in a home with a trampoline in the backyard, you may have observed the unreasonably tall grass growing under it. This is because many crops, including these grasses, actually grow better when protected from the sun, to an extent.

And while the grass under your trampoline grows by itself, researchers in the field of solar photovoltaic technology—made up of solar cells that convert sunlight directly into electricity—have been working on shading large crop lands with solar panels—on purpose.

This practice of growing crops in the protected shadows of solar panels is called agrivoltaic farming. And it is happening right here in Canada.

Such agrivoltaic farming can help meet Canada's food and energy needs and reduce its fossil fuel reliance and greenhouse gas emissions in the future.

When shade equals protection

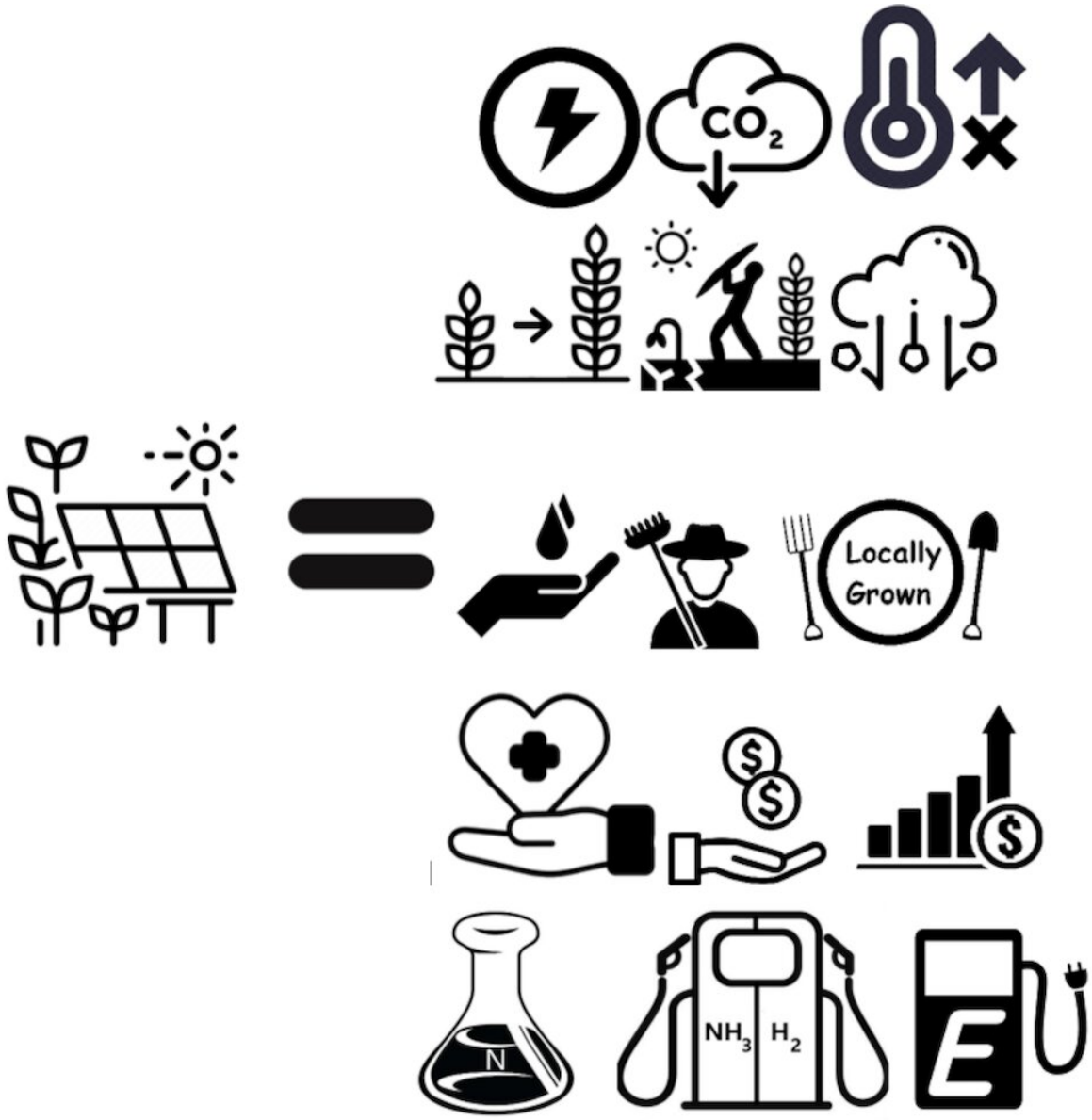
Our recently published paper found that Canada has an enormous agrivoltaic potential as it is a global agricultural powerhouse—with Canadian-produced food export goals set at $75 billion by 2025.

Many crops grown here, including corn, lettuce, potatoes, tomatoes, wheat and pasture grass have already been proven to increase with agrivoltaics.

Studies from all over the world have shown crop yields increase when the crops are partially shaded with solar panels. These yield increases are possible because of the microclimate created underneath the solar panels that conserves water and protects plants from excess sun, wind, hail and soil erosion. This makes more food per acre, and could help bring down food prices.

And as the costs of solar energy plummet, nations across the world are installing agrivoltaic systems and offsetting the burning of fossil fuels by profitably producing more renewable energy.

Solar farming is now globally trending



Agrivoltaics provide numerous services including renewable electricity generation, decreased greenhouse gas emissions, increased crop yield, plant protection and so on. Credit: U. Jamil, A. Bonnington, J.M. Pearce, Author provided

The agricultural industries in Europe, Asia and the United States have been aggressively expanding their agrivoltaic farms with wide public support.

In Europe, solar panels are put over different types of crops, including fruit trees. Meanwhile, in China, agrivoltaics is used to reverse desertification which is literally using solar panels to green former deserts.

In the U.S., social science studies have shown the photovoltaic industry, farmers and the general public are enthusiastically looking forward to the implementation of such projects.

Surveys of the rural U.S., from Michigan to Texas, show 81.8 percent of respondents would be more likely to support solar development in their community if it integrated farming. Rural residents generally like the idea of maintaining agricultural jobs, increased revenue from the sale of energy and the fact that it could provide a continued source of income. They believe it can act as a buffer against inflation and bad growing seasons.

It's time to expand Canadian solar farms

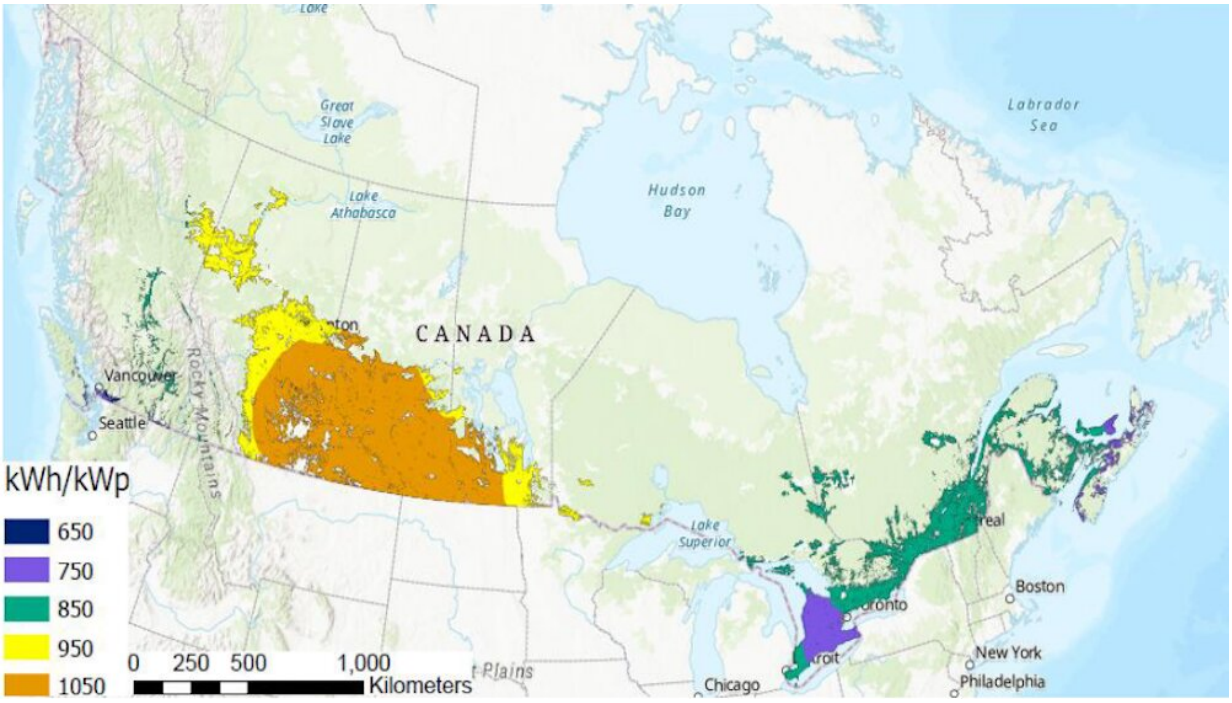
In Canada, agrivoltaics has primarily been applied to conventional solar farms and used by shepherds and their sheep. While the shepherds get paid to cut the grass on solar farms, the sheep use the grass and pastures under the solar panels for shade and grazing. Sheep-based agrivoltaics is found throughout Canada.

The life cycle analysis of agrivoltaics, which assesses its impact from its conception to use, found that these solar-covered farms emit 69.3 percent less greenhouse gases and demand 82.9 percent less fossil energy compared to separate food farms and solar farms-based production.

This is great, but to remain competitive with other major agriculture producers, Canada needs to start large-scale agriculture in the shadow of solar panels. This will enable the production of numerous crops that have been known to increase yield when covered.

This would include vegetables like broccoli, celery, peppers, lettuce, spinach and tomatoes as well as field crops like potatoes, corn and wheat.

Seriously embracing agrivoltaics in Canada would completely drop fossil fuel use. Less than one percent of Canadian land would be sufficient to support over 25 percent of the country's electrical energy needs using this system.



A map showing the agrivoltaic potential in Canada. The colours indicate the solar flux (amount of solar energy per unit area) in the areas that are currently farmed. Credit: U. Jamil, A. Bonnington, JM Pearce, Author provided

This in turn can help the nation honour its commitment to reducing greenhouse gas emissions by increasing the non-emitting share of electricity generation to 90 percent by 2030.

Agrivoltaic solar farms outstrip electricity demand

The potential of agrivoltaic-based solar energy production in Canada far outstrips current electric demand. This solar energy can be used to electrify and decarbonize transportation and heating, expand economic opportunities by powering the burgeoning computing sector and export green electricity to the U.S. to help eliminate their dependence on fossil fuels as well.

Electricity produced by agrivoltaic farms can also be stored by charging electric vehicles as well as hydrogen production, thus benefiting transportation. Solar can already profitably meet Ontario households' heating requirements by replacing natural gas furnaces with solar-powered heat pumps.

Lastly, any extra agrivoltaic electricity could be used to power computing facilities and cryptocurrency miners at profit and possibly be exported to the U.S. to help them clean up their much dirtier grid. This would help increase our trade surplus as well as the health and environmental benefits of decreasing the American pollution that wafts across the border.

When benefits outweigh the costs

Despite the numerous benefits of agrivoltaic farming, there are some barriers to its distribution in Canada. There are well-intentioned

regulations that are holding these farms back.

In Ontario for example, you cannot install solar in the Greenbelt because of the law to protect farms. Similar issues arise in Alberta on Crown Land.

In the old days that made sense. We did not want to repeat the U.S. fiasco of raising food prices for energy crops. Now we know that with agrivoltaics we can get more food while using solar technology to make electricity.

The other main issue holding agrivoltaics back is capital costs. Agrivoltaics has a much higher capital cost per acre than farmers are accustomed to, but the revenue is much higher. So even though it is profitable it is difficult for farmers to implement large agrivoltaic systems on their own.

This means we need new methods of financing, new partnerships and new business models to help Canada take advantage of the strategic benefits of agrivoltaics for our farmers and the country.

Provided by The Conversation