From: neillgalist@googlegroups.com on behalf of neillherring@earthlink.net
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This Unusual Renewable Energy Is A Game Changer

Bountiful clean energy, increased efficiency, climate change-resistant crops, and basically no habitat loss.

Will Lockett

The recent unprecedented global heat has been a wake-up call for everyone. The terrible consequences of climate change are starting to dig in, and we are feeling the effects. But this is just the beginning. Hopefully, this wake-up call will kick the world powers into action and enact the mammoth measures we need to save Planet Earth and save ourselves from our terrifying fate. But luckily, a recent paper from Aarhus University, Denmark, has shown we can kill three birds with one stone, protect nature, protect our food supply, and supply enough renewable energy to reach net-zero, all from a single technology. Welcome to the world of Agrivoltaics.

Agrivoltaics are brilliantly simple. The general idea is to install solar panels over farmland for arable farming and livestock. At face value, you might think this is a little silly. The panels will get in the way of machinery and maybe even hamper the growth of the crops by blocking light. But if you engineer it correctly, it can be enormously advantageous for both the farm and the solar panels.

You see, not all crops need direct access to sunlight 24/7; some grow better with a bit of shade. You can “tune” the solar array to give the right amount of shade and sunlight by changing the spacing between the panels and how far off the ground they are mounted, ensuring the crop gets optimal conditions for growth. The crops that require lots of light can be grown in alternating rows with solar panels, as you still get the other benefits of agrivoltaics this way (which we will come onto in a second). This is why basil, broccoli, celery, peppers, corn, lettuce, potatoes, spinach, tomatoes and wheat have all been shown to have increased crop yields when grown with agrivoltaics.

But this setup has a plethora of other advantages. Firstly, climate-resistance. In summer, the solar panels keep the temperature of the crops low, reduce evaporation rates and keep moisture close to the ground, which can dramatically help the crops survive heat waves and droughts. Both of these are set to become far more potent, frequent and last longer thanks to climate change. But this can also help the crops become far more water-efficient; for example, tomatoes grown under agrivoltaics are 65% more water efficient. As such, crops grown under agrivoltaics can have a far more negligible environmental impact. A similar effect can also be felt in winter, where the solar panels act to trap heat against the crops and help protect them against frost and cold snaps, again, a problem that will get worse with climate change.

But this thermal management also helps the solar panels. Solar panels in agrivoltaics run significantly cooler than their solar farm counterparts. This reduces internal electrical resistance, which boosts the efficiency of the solar panel, and increases its life span.

Agrivoltaics also drive less habitat loss than solar farms, as dual use is more efficient than having them separately (and converting farmland to solar farms just means more new farmland needs to be made elsewhere, driving habitat loss). It's also cheaper and quicker to build than roof-mounted solar (which also doesn't drive habitat loss), as you don't need to work from heights, gaining planning is very simple, and construction is also just as simple.

There are some downsides, however. Some arable land is lost to solar array support structures, and areas under the solar panels are too shady. Moreover, very little research has been done to determine the total available capacity of agrivoltaics and how it will affect our climate goals, food supply, or nature.

That is, until now. Researchers at Aarhus University in Denmark recently released a paper investigating different styles of agrivoltaics, how they affect different crops, and what the total capacity is for agrivoltaics in Europe. What they found is an absolute game-changer!

The model they used to calculate this total capacity was targeted to maintain at least 80% of the arable land area. Now, this won't directly correlate to a 20% reduction in crop outputs, as many crops grow better under agrivoltaics, so the number will be less. But for our purposes today, let's be conservative and say it does equate to a 20% drop in crop outputs.

This conservative crop production assumption means that if Europe is to fully utilise its potential agrivoltaic capacity, it would have to expand its arable farmland by 25% to keep crop production stable. The EU currently has 981,000 square km of arable farmland, meaning a 25% expansion would require 245,250 square km of nature to be converted to arable pastures. That is roughly the same area as the UK, but that isn't a problem at all.

To understand why it isn't an issue, we all need to look at the total potential agrivoltaics capacity of Europe calculated by this study. All in all, they found that Europe could build 51 TW of agrivoltaics on its current arable farmland while retaining 80% of arable land area! Or, as the paper put it, "The potential for agrivoltaic is enormous, as the electricity generated by agrivoltaic systems could produce 25 times the current electricity demand in Europe."

Now, for a stand-alone solar farm, each TW of capacity takes up roughly 50,000 square km. This means that building this 51 TW capacity as a stand-alone solar farm would take up a whopping 2,170,000 square km of space! For some sense of scale, that's around the same size are Saudi Arabia.

This means that expanding solar power in Europe through agrivoltaics and expanding farmland to compensate rather than building stand-alone solar farms has the potential to reduce humanity's land usage in Europe by an insane 1,924,750 square km! Or, about the same land area as Mexico. So counterintuitively, agrivoltaics actually reduce habitat loss dramatically.

Now, 51 TW of solar capacity sounds like a lot, but this study only gets more impressive when you find out just how much power that is! Current predictions estimate that for us to transition to carbon neutrality by 2050, we need to build 75 TW of global solar capacity by then. That means that by using agrivoltaics, Europe could supply the world with nearly 70% of the solar energy it needs to meet net-zero. If that doesn't give a sense of scale, another way of looking at it is the total amount of currently deployed solar, which is hovering just north of 1 TW. This means European agrivoltaics could supply us with over 50 times the current global solar supply.

What's more, this monstrous capacity is only for using agrivoltaics over arable farmland. The EU has 593,000 square km of livestock farms that can have even more agrivoltaics, and these livestock will still benefit from the same moisture retention and thermal management as the crops do.

So, that’s how, in one fell swoop, Europe can increase the climate resistance of its food supply, dramatically reduce its habitat loss, supply itself and most of the world with enough renewable energy to go net-zero, and even potentially reduce the environmental impact of its farming industry. This goes to show that we need to think of renewables differently from our old energy sources. They can be decentralised, spread out, and we can utilise them to help increase efficiencies in other industries. Agrivoltaics is one of the most potent ways to deploy solar technology, and as this study shows, it has the potential to dramatically help us reach net-zero and survive climate change. The challenging part will be putting this technology into use, as there are a lot of political and potentially economic hurdles for agrivoltaics to overcome. This is why the future of this game-changing technology still hangs in the balance.

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[Written by Will Lockett]()