

Responsible Solar Approach

A practical guide to emerging best practices for solar energy projects



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About the author

Alyssa Edwards

Senior Vice President of Environmental Affairs and Government Relations

Alyssa is the Senior Vice President of Environmental Affairs and Government Relations at Lightsource bp, a global market leader in the development, financing, construction, and management of large-scale solar projects. With more than 18 years of experience in the renewable energy sector, her expert knowledge of wildlife regulations, permitting and environmental siting have helped advance more than 12GW of executed projects. She has highly established governmental agency and stakeholder relationships regionally and nationally and has served on advisory councils, committees and boards throughout her career.

In her role as Senior Vice President, Environmental Affairs and Government Relations, Alyssa leads Lightsource bp on environmental compliance and permitting for development, construction and operations for their U.S. portfolio. She has built a leading, innovative biodiversity program in the U.S. that supports the company's global sustainability objectives through integration of biodiversity initiatives and agrivoltaics, changing the way solar projects are developed by adding a multitude of environmental benefits beyond clean, renewable energy.

At Lightsource bp Alyssa also leads government relations in the United States. Through extensive stakeholder engagement with legislators, regulators and environmental organizations she promotes and advocates for renewable energy policies and legislation at state and federal levels.

Executive summary

Solar energy has grown in popularity around the world, and that enhanced visibility has led to more questions about siting and land use. In proactively addressing community concerns, solar developers have an opportunity to raise the bar and provide benefits to host communities. Responsible Solar goes beyond generating clean electricity, by boosting biodiversity, supporting farmers, stimulating job creation, bringing tax benefits, developing recycling and supporting local organizations.



Overview

The benefits of Responsible Solar

Solar power is one of the fastest growing energy sources, with installations in Q2 of 2023 up 20% from the previous year, according to the latest SEIA/Wood Mackenzie Power & Renewables U.S. Solar Market InsightTM [report](#). As the world races to meet the urgency of the climate crisis and low-cost solar outcompetes fossil fuels, more Americans are likely to encounter solar projects in their communities.

At Lightsource bp, we've embraced the concept of going beyond solar by layering in environmental co-benefits, giving our host communities confidence that their new neighbors are good stewards of the land. We've made it our hallmark to increase biodiversity throughout our portfolio. We do this not only to be good neighbors, but because it is part of our Lightsource bp ethos.

Solar farms are an important part of the clean energy transition, and communities can be proud of them. Lightsource bp is leading the industry in employing a range of best practices as part of our [Responsible Solar Approach](#).



Delivering clean, reliable and affordable energy at scale



Careful habitat creation and biodiversity enhancement



Improved soil health



Combining solar with farming to support agrivoltaics



Promoting circularity through a commitment to recycling

The Responsible Solar approach

– the energy transition

The transition to clean energy is more urgent now than ever.

Data from the Mauna Loa Observatory in Hawaii shows – as of the writing of this e-book in October of 2023 – we [are now at 418 parts per million \(ppm\) of carbon in the atmosphere](#), which is far above “safe” levels of 350 ppm. The quicker we decarbonize, the better. Every degree, even every tenth of a degree, of extra warming has consequences for the earth’s inhabitants now and into the future. Climate change is already [costing us billions](#) from disasters and extreme weather events.

A FUTURE WORTH PROTECTING

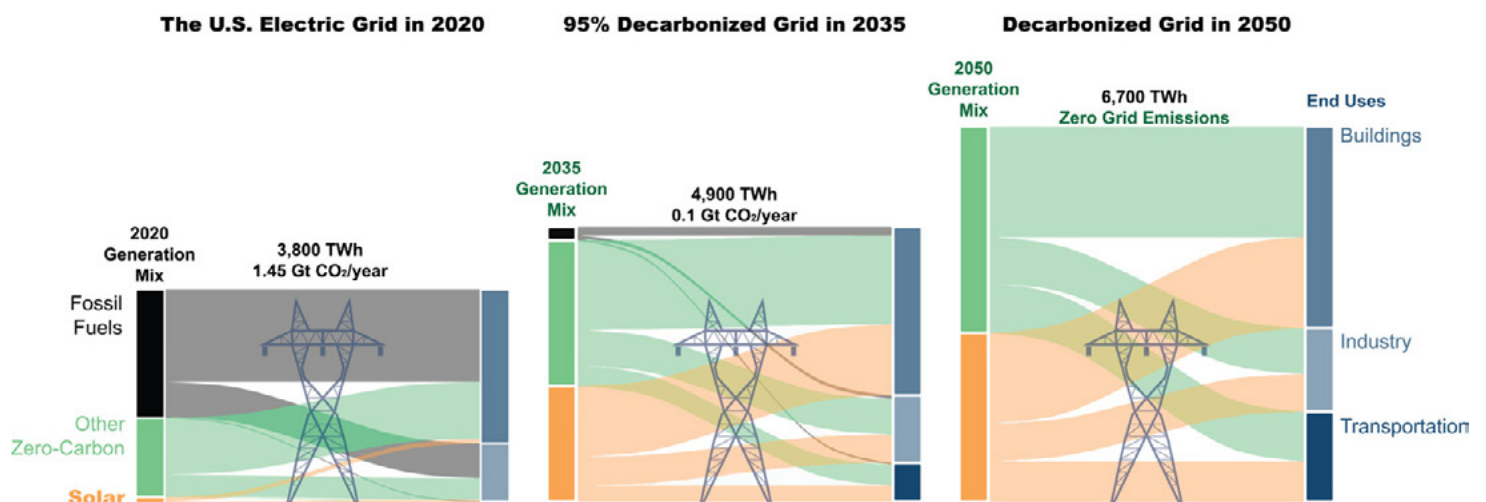
The stakes could not be higher. Unabated, climate change puts our future at risk, where droughts and wildfires become the new normal. Coastal cities face a combination of deadly heat, sea level rise and more intense hurricanes. Climate change threatens our health too, as warmer, wetter weather spreads tropical diseases like dengue or West Nile virus.

Meeting our energy needs with clean solar power displaces other forms of energy generation and reduces pollution. The U.S. Department of Energy (DOE) [Solar Futures Study](#) projects that by 2035, solar energy has the potential to power 40% of the nation’s electricity and drive deep decarbonization of the grid.

AFFORDABLE ENERGY

Solar is one of the lowest-cost sources of energy on the market today

Solar costs have declined dramatically – prices [dropped 90%](#) in the last decade. It’s the lowest cost form of [energy today](#), and it’s taking off with lightning speed. According to American Clean Power, in 2021, utility-scale solar power was [the third largest source of renewable energy](#) in the country, generating enough energy to power 12.1 million homes.



Grid mixes and energy flows in 2020, 2035, and 2050, as envisioned in the Solar Futures Study. Newly electrified loads from buildings, transportation, and industrial sectors mean that the electric grid will deliver more energy in 2035 and 2050. This energy will come almost entirely from solar and other zero-carbon sources. Source: U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy.

REDUCE POLLUTION

Take a breath of fresh air from clean power

Another great thing about clean energy is the health benefits of cleaner air and cleaner water. Soot, particulate matter, smog, and other fossil pollutants reduce life expectancy, and foul our airways. A 2020 study in the journal [Nature](#) found that closing coal-fired power plants reduced asthma morbidity in the local community.



ENERGY INDEPENDENCE

Reduced threats, more security and greater energy independence

[Even the Pentagon has sounded the alarm](#) citing climate change as a source of heightened armed conflicts, and mass migrations, referring to climate change as a “threat multiplier.”

Consider these additional unique benefits of solar power:

No fuel required

Solar panels require no fuel, so there’s no chance for a spike in fuel costs, or a need to transport dirty fuels.

No water required

Unlike conventional power plants, solar panels do not need a constant source of water to cool their operations, and most solar panels can be cleaned without machines, requiring little or no water.

Given the global conflicts underway, the transition to clean energy is what will help us gain real energy independence. The faster we move to clean, local sources of energy that diversify our power supply, the faster we reduce dependence on fossil fuels and create more local jobs. We will also reduce our country’s vulnerability to geopolitical crises and market volatility.

There are so many benefits to clean, low-cost solar power. Less pollution, fewer health problems, and a safer, more secure nation. Solar is one of the sharpest tools in our toolbox to reduce rising emissions and take on the climate crisis.

Solar farms can grow a lot more than electricity

Conventional wisdom has it that the only thing a solar farm can grow is electricity. But we've found that layering in additional benefits creates conditions where both the developer and the community can thrive. That starts with investing in soil health and biodiversity.

PRESERVE THE LAND

Unlike residential and retail development, solar preserves much of the land below projects. The soil around and under the panels can support plants to reduce erosion and attract the insects needed to pollinate nearby crops.

Introducing renewable energy projects to skeptical communities requires more than soothing platitudes. It requires evidence, good faith and a track record of demonstrated results. These steps may cost a little more, but they build community acceptance and goodwill that make the investment worthwhile.

The needs are clear: The climate crisis requires us to triple solar development to reach 30% of U.S. electricity generation by 2030 – that is almost 125 GW a year. Reaching that goal means overcoming local opposition. We're taking extra steps to be good stewards: improving soil health and promoting biodiversity to nurture community support.



IMPROVE SOIL HEALTH

At first blush, it seems that a solar farm can cover a lot of previously unused acreage, but its footprint is lighter than other land uses. A subdivision or strip mall, for example, permanently transforms the land, while solar arrays can accommodate other land uses while also generating power. At the end of a solar farm's useful life, its pilings and equipment are easily removed.

Preserving farmland and promoting soil health means keeping soil available and healthy for future generations. For example:

Rest and recuperation

Solar farms developed on agricultural land are often on acreage that has been cultivated for decades. At the very least, the land's use as a solar farm will give the soil a chance to rest, a practice similar to farmers who allow some of their acreage to lie fallow for a few growing seasons.

Vegetation that generates nutrients and prevents erosion

At two of our solar farms in Pueblo, Colorado, Lightsource bp is conserving thousands of acres of native shortgrass prairie habitat. These revegetation projects can boost carbon sequestration, reduce water runoff, and enhance soil stabilization – as well as provide important habitat for wildlife.

Soil and biodiversity best practices can have a positive cumulative effect on the environment. That could mean planting native hedgerows, shrubs and trees around the edge of a field or adding bug hotels, open drainage structures, nesting and roosting boxes, log piles, ditches or ponds.

BOOST BIODIVERSITY

Soil health and preservation also happens simultaneously with efforts to encourage biodiversity. Consider:

Pollinators

Around the country, pollinator species are at risk from pollution, development and other threats. But well-curated vegetation provides a productive habitat for bees and other pollinator species, which will pollinate nearby farms. The bees can also produce honey, providing additional revenue streams for landowners.

Helping other farms

In Pueblo County, Colo., for example, there are local farms that depend on bees and other pollinating insects to thrive. The presence of pollinators is known to [increase crop yield](#), and one study showed that [wildflower plantings](#) adjacent to agricultural fields increased wild pollinator abundance. The total economic benefit of native insect pollination in the United States has been estimated at more than [\\$9 billion](#) per year.

Creating new habitats

To support reptile and lizard habitat we built five hibernacula at Lightsource bp's [Impact Solar](#) site in Texas. These consist of an underground hole, backfilled with rocks, and covered with logs and soil to mimic nature. Large open spaces can be difficult places to live for lizards and other small reptiles, so these simple structures provide a haven.



LEVERAGE LOCAL EXPERTISE AND RESEARCH

These steps aren't cookie-cutter plans. They're developed with local experts and farmers to develop the practices that work best in their community. We utilize research, ecological surveys and we gather feedback from the community to create a tailored plan for each site.

Establishing those local connections enhances support and makes each solar project a trusted and vital part of their community.

Our experiences show these strategies work. Every site is different, and not all locations can take every measure, but a thoughtful approach to siting and development will generate cumulative benefits.

It's important to share what we've learned with the wider community. Respondents to government inquiries show a consensus that more research is needed to develop strategies for habitat and vegetation management at solar farms. Research findings can benefit the entire solar industry as it strives to create more clean energy.



Agrivoltaics

Multi-use land initiatives are changing how solar integrates with farm communities

Multi-use solar describes the multiple uses at a solar site. Think of the different uses as ways to layer in co-benefits. The image below depicts how different uses, or layers, interact and support each other.

Multiuse solar farms

Solar farms temporarily set aside land and protect it from permanent loss due to industrialization and urbanization – and they afford countless opportunities to layer on the benefits of solar since the land under and around the panels is protected for decades.

Ground-mounted solar panels sit on posts, several feet in the air. The posts themselves cover less than 10% of the ground.

On our solar farms, the ground is seeded with grasses and pollinator-friendly flowers prior to construction.

Agrivoltaics is the co-location of solar and agriculture. At some facilities, small livestock graze beneath the panels.

As vegetation and manure decompose, they enrich the soil with carbon and nutrients.

Underground, the soil remains undisturbed for decades.



This leaves plenty of open space underneath to maximize the sustainable benefits of solar.

This helps stabilize the soil during construction and provides habitat for insects and wildlife throughout the project life.

We are also working to co-locate food crops with solar.

Your next sip of tequila could have started in the shade of a solar array. So could the wool in your sweater. That’s because [agrivoltaics](#), the co-location of solar and agriculture, could make it possible.

What is Agrivoltaics?

According to the Energy Department's Solar Energy Technology Office, Agrivoltaics is [defined](#) as agricultural production, such as crops, livestock grazing and pollinator habitat that exist underneath solar panels and/or in between or around rows of solar panels.

Examples of agrivoltaics on solar farms include [sheep grazing around solar arrays in Pennsylvania](#), [agave cactus growing within arrays](#) in the Southwest and Mexico. Ground cover, such as native wildflowers under arrays create pollinator habitat, which supports nearby crops that are not directly on the solar farm.

According to the DOE's [Solar Energy Technologies Office](#), combining energy production with farming can pay off with increased support from local communities and stronger local partnerships.

It's an emerging field. While exploratory research is currently evaluating fruit and vegetable crops, the most common and successful forms of agrivoltaics we see at solar projects right now are sheep grazing and bee keeping.

SHEEP FARMING



Did you know that sheep farming industry is a [nearly \\$700M industry](#)? There are four main products made from sheep: lamb, mutton, wool, and dairy.

Sheep grazing solar sites is growing in popularity, but in order for this to work, the site must be ready for sheep to graze. That means establishing the soil and habitat first to ensure the plants are nutritious for sheep.

Meet [Lexie Hain](#), our Director of Agrivoltaics and Land Management. Lexie owns a farm in upstate New York and she has built a solar sheep grazing business. Lexie is a founding member of the [American Solar Grazing Association](#), which develops best practices to support shepherds and solar developers to both effectively manage solar installations and create new agribusiness profits.

At our solar farm in Deport, Texas, shepherd Ely Valdez grazes 1,700 sheep around the solar arrays. Money earned from his flock have paid off his home. ["It's changing all of our lives," he told the Wall Street Journal.](#)

Solar panels provide shade — a **welcome respite to the unforgiving summer heat, and reduced transpiration rates**. The sheep benefit from the shade, requiring less in the way of irrigation or drinking water on a solar array than they do traditionally, out in an open field.

But plenty of research remains to determine what works best for the solar industry and communities.



PICKING AGRICULTURAL PRODUCTS

Many factors determine which agricultural products make sense. Typically, the process begins with determining which solar technology is used on a site. Then, a crop suited to production in the region is put up for consideration. The crop cannot shade the panels or impede production—for example, vines would twist in the racking and hinder the performance of the trackers—and the crop should have some tolerance for shade.

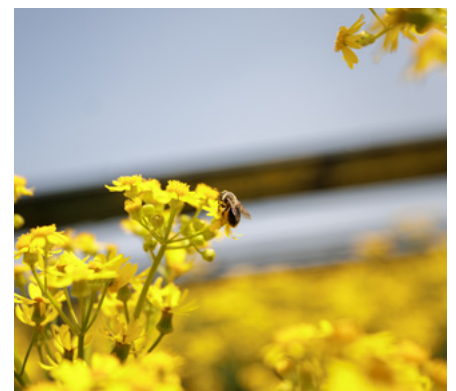
We are exploring possibilities at the [Bellflower Solar Project in Indiana](#), where we will generate 173 megawatts of electricity for Verizon Communications. We're working there to expand [pollinator habitats](#) and to [graze sheep on the land](#) around the solar arrays.

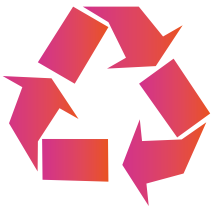
Our work at Bellflower is part of a larger effort to [further the scientific research](#) into the creation of diverse pollinator habitats in the same acres as the grazing habitats. That's a true experiment in multi-use solar.

Later this year, the DOE will issue grants to solar developers and other researchers for its [Foundational Agricultural Research for Megawatt Scale \(FARMS\)](#) program. This program is needed because, despite its obvious promise, we need more research into the most effective ways to use agrivoltaics. Which types of plants or animals are the most suitable, economic, and beneficial?

Applicants for the FARMS program provide an encouraging vision for the future. Some are developing solar panels with a [light-splitting technology](#) that allows 100 percent of the colors needed for chlorophyll to reach the plants below the panels. Others are exploring techniques that allow solar arrays to thrive in [areas with high demand for available land](#), such as Hawaii.

There's so much to learn, and the applications are enticing. Whether it's a margarita made with tequila born under a desert solar array, or honey raised from bees living on a solar farm, the possibilities are ours to explore.





Join us in building a recyclable future for solar panels

It's a question we hear every time we discuss developing a new solar farm:
Where will the panels go at the end of the project's life, or how will you manage the infrastructure that's not in service from your project when the solar farm is decommissioned?

Sometimes the questions come from residents concerned about how the panels will be disposed if they break during construction or operation.

The solar industry is confronting concerns about solar's end of life head-on. As the solar industry expands, so too will the materials needed to produce the panels that power this renewable energy revolution.

That's why recycling is such an important topic.

Lightsource bp is committed to being an industry leader in recycling and promoting circularity. We are also committed to ensure that the solar panels we procure are safe for people and the environment.



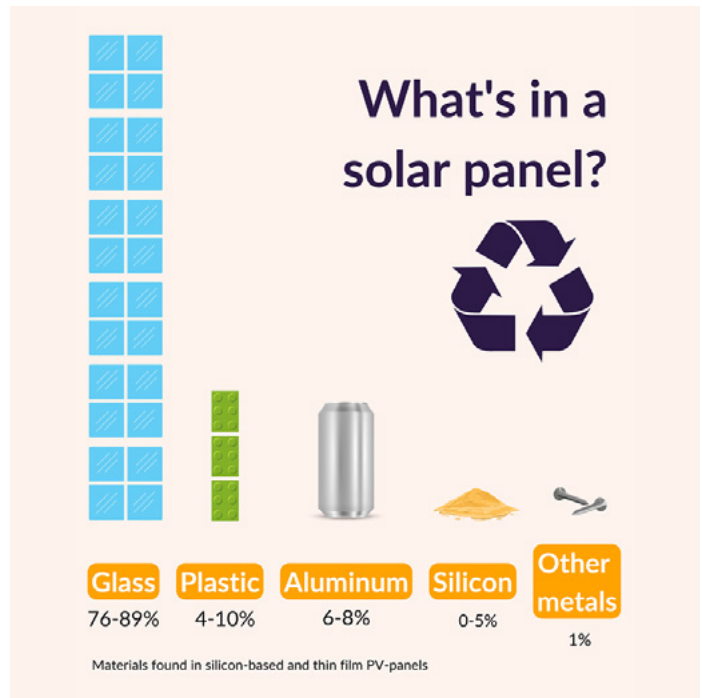
STEPS TOWARD EFFECTIVE RECYCLING

- Use the right materials
- Commit to recycling all contents
- Find the proper allies
- Build a recycling community

Our **first step** is that all solar panels we use must pass Environmental Protection Agency (EPA)-defined testing for toxic materials. The Toxicity Characteristic Leaching Procedure (TCLP) testing tracks the mobility of organic and inorganic wastes in materials that could possibly seep into groundwater. So, we’re making sure that even if a panel breaks, it won’t release harmful amounts of hazardous material into the environment.

Next, we’ve **committed to recycling solar panels** on all our solar farms in the U.S. versus disposing in a landfill. That includes any panels damaged or non-functioning during construction, operations, and all panels at the end of life/ decommissioning.

According to the EPA, solar panels provided about [40 percent of the new U.S. electric generation capacity in 2020](#). That percentage will grow because of last year’s passage of the Inflation Reduction Act, which invests hundreds of billions of dollars in renewable energy generation.



VALUABLE ALLIES

We have powerful allies in developing this new recycling environment. **The Solar Energy Industries Association (SEIA)** has created the [National Recycling Program](#) to help the industry recycle PV panels and develop collection and recycling process for the solar industry.

SEIA vets recycling and refurbishment facilities, looking to approve those that are the most environmentally responsible while extracting the most possible material from each panel. The nationwide partner network SEIA is building is a valuable resource for the industry, and we at Lightsource bp rely upon it.

Much of our work starts before a solar farm is built. Not only do we use panels that pass EPA tests, we identify the recycling facilities to handle any panels broken during a solar farm’s construction or panels decommissioned during the lifetime of the facility. [We only use recycling facilities approved by SEIA.](#)

Together, we’re building a national recycling industry so whenever a panel goes out of commission there’s a facility to turn the panel’s materials into something that can be used again.



RECYCLING COMMITMENT

Recycling succeeds when there are companies committed to recycling their materials properly and companies willing to purchase items made from recycled materials.

By 2030, the global cumulative value of recoverable raw materials from end-of-life panels will be about \$450 million, which is equivalent to the cost of raw materials currently needed to produce about 60 million new panels.

Diverting solar panels from landfills to recycling saves space in landfills in addition to capturing the value of the raw materials.

Recycling demand will only grow. By 2030, the United States will have about 1 million tons of solar panel waste, according to EPA estimates. By 2050, the United States will have the second-largest number of end-of-life solar panels in the world – about 10 million total tons, according to the International Renewable Energy Agency.

While these numbers may sound large, it’s important to note that solar waste is a tiny fragment when compared to other waste streams. A study in the journal Nature quantifies the differences in the chart below, you can see that solar waste is dwarfed by plastic waste, coal-ash, and even e-waste.

This gives us the chance to develop a new recycling industry.



Source: Mirlitz, H., Hieslmair, H., Ovaite, S. et al. Unfounded concerns about photovoltaic module toxicity and waste are slowing decarbonization. Nat. Phys. 19, 1376–1378 (2023).

The good news is that the vast majority of solar panel components are recyclable. At least 75 percent of a panel is glass, while other easily recycled materials are a panel’s aluminum frame, copper wire, and plastic junction box.

Help is also coming from the tax credits included in the Inflation Reduction Act, which will boost investment that will build recycling facilities, which, in turn, will boost the industry’s commitment to recycling.

And, in March 2022, the DOE announced a five-year plan to enable safe handling of PV materials through the Solar Energy Technologies Office End-of-Life Management for Solar Photovoltaics.

But a lot still needs to happen.



CREATE MARKET CERTAINTY

Commitments to recycle panels, and demand for recycled content help create the certainty necessary for a successful circular marketplace.

We’re looking for responsible recycling vendors who can optimize processes and maximize materials successfully extracted and put back into new products. We’re looking for owner/operators of solar farms who will join us in our commitment to recycling.

Conclusion

Creating an enduring solar energy system means doing it responsibly. We at Lightsource bp remain committed to the approach that emphasizes soil health and biodiversity, agrivoltaics and recycling.

These steps help create an environment that not only generates electricity but promotes a healthy planet.

A completely renewable future is upon us. Each project takes us one step closer to achieving that goal.



400 Montgomery Street,
8th Floor
San Francisco,
CA 94104

2000 Market Street,
Suite 720
Philadelphia,
PA 19103

1125 17th Street,
Suite 2540
Denver,
CO 80202

11921 MoPac Expressway
Suite 110
Austin,
TX 78759

USAdmin@lightsourcebp.com

www.lightsourcebp.com/us

lightsourcebp



bp