Electricity regulation has traditionally been defined by a relatively narrow public interest prerogative: ensuring just and reasonable rates for reliable electric service. The call to decarbonize, however, has injected a new diversity of values into the conversation. Transforming the electric power system to reduce greenhouse gas emissions is opening new opportunities to elevate values like community or public ownership and resource conservation as well. The debates over community solar program design, in particular, are fascinating sites of struggle over which of these values should drive decision-making, and how they should be considered in rulemaking and implemented in policy.

Community solar is a flexible concept that can and has been implemented many different ways. Community solar projects are bigger than rooftop solar arrays but much smaller than utility-scale solar farms. They facilitate some degree of participation by ratepayers, either as subscribers, members, or co-owners of the project. Projects typically participate in state- or utility-run community solar programs. These programs define how participants are compensated for the value of their solar projects and can shape how projects are structured or owned.

Proponents of community solar often argue that, although utility-scale solar arrays are less expensive than smaller-scale solar per kilowatt-hour (making them generally preferable based on the traditional metrics of public service commissions), this narrow focus misses many of the crucial benefits community solar projects can generate, for participants and the electric power system more broadly. Commonly cited benefits include lower bills for participants; resiliency gains; and reduction in need for utility-scale solar development, conserving undeveloped land. Proponents often also tout community solar's potential to reduce local air pollution and facilitate community ownership over and empowerment in the electric power system.

These benefits do not flow naturally from the installation of solar technology alone, however. Like electricity rates and like wholesale electricity markets, community solar programs are policy constructs and their success is contingent on policy design that draws out the desired benefits. Someone who sees community solar as a way to increase community-based ownership over renewable generation and someone who sees community solar as a way to increase grid resilience may well favor different program designs. The wide range of possible community solar designs invites ample opportunity for debate.

Determining which benefits should be prioritized is a political question; ensuring that the prioritized benefits are ultimately actualized is a question of program design, the regulatory backdrop, the ownership arrangement of a particular community solar project, and at times, tradeoffs between benefits. This post, along with several future posts, forgoes the question of which benefits should be prioritized, instead seeking to tease out a few considerations for how each potential benefit could be actualized in policy. Subsequent posts will explore compensation mechanisms and community solar ownership arrangements more deeply as they relate to these benefits.

Reducing Greenhouse Gas Emissions:

Like all solar generation, community solar is favored for its ability to reduce systemwide greenhouse gas emissions. The primary way community solar can reduce emissions is by displacing fossil-fuel generation. The way a given solar project can accomplish this is largely a function of how the project is integrated into the grid. The distinction between projects designed to send power into the common pool of the grid versus those that primarily serve electricity needs onsite, for example, implicates different relationships with the system as a whole, and therefore with the way a project has the potential to displace fossil fuel generation.

How and the extent to which a project displaces fossil fuel generation also depends on the existing generation portfolio in the region, among other factors.

As background: Utility-scale solar projects displace fossil fuel generation by competing with fossil fuel generators in wholesale markets. System operators rely on principles of economic dispatch to orchestrate the operation of the lowest cost generation that can meet reliability needs. With its near-zero fuel costs, utility-scale solar can typically compete easily with fossil fuel generation on short time frames. In contrast, solar projects designed to serve onsite needs, like rooftop solar, displace fossil fuel generation primarily by reducing demand for grid electricity. In this case, a project's impact on greenhouse gas emissions depends on the system's generation portfolio. Maximizing the resulting reduction in greenhouse gases for each kind of solar generation looks different, since different systems mediate the way these generation sources displace fossil fuel generation.

A key question for community solar program design is whether community solar projects should be designed and conceived of more like utility-scale solar, more like rooftop solar, or as distinct third model—each has implications for benefits, including a given project's impact on emissions. (A concrete version of this general question was a key and highly controversial legal issue at stake in California's recent community solar proceeding.)

In a sunny place like California, where new solar generation competes primarily with existing solar generation while the sun is shining, a community solar project is more likely to displace fossil-fuel generation if it includes energy storage. Storage allows the project to feed the grid into the evening, when California system operators typically have to call on fossil fuel generation, instead of flowing to the grid during midday. In a jurisdiction with a lot less existing solar generation than California (which includes most other states), a community solar project might not need storage capacity to reduce greenhouse gas emissions because that jurisdiction may well be relying on fossil fuel generation even during solar primetime.

Community solar programs can also be designed to reduce greenhouse gas emissions a second way: by supporting parallel efforts to electrify. By offsetting the cost of building electrification or otherwise bundling building electrification efforts with community solar participation, community solar programs can be designed to help reduce emissions from buildings and vehicles.

Grid Resilience:

Grid-integrated community solar projects can offer important resiliency benefits by providing backup generation in the event that grid power is unavailable. For this benefit to be actualized, community solar projects must be sited and designed in a way that allows them to deliver the power they generate to nearby consumers. Projects must actually be sited closer to electricity use. The nearby consumer base need not be the project's subscribers, but to improve on resilience, the project must closer to some consumers than existing generation.

Pairing community solar with battery storage and microgrids can further enhance resiliency benefits. Solar plus storage is particularly valuable because it can help compensate for the variability of sunlight, whether the resulting energy is used to feed the grid or to reduce onsite demand. These additions are especially valuable in places where outages are common or where the costs of outages are especially high. While a community solar project may not be able to cover the full need of a given community in the event of an outage, projects can be designed to cover the kinds of critical infrastructure or community resources that will be increasingly crucial as climate-related extreme weather becomes more common, such as public cooling or heating centers.

Conservation from Reducing Utility-Scale Generation and Infrastructure:

Because the sun shines at certain times and not others, community solar projects often compete more directly with other solar generation than with fossil fuel generation in places with high rates of solar penetration. One implication of this is that programs must be thoughtfully designed in order to displace fossil fuel generation, but the flipside is often viewed as a benefit: Because community solar competes with other solar generation, it has the potential to reduce conversion of currently undeveloped land to utility-scale solar generation.

This benefit is perhaps most appealing in regions with large untouched tracts of land well-suited to utility-scale solar in need of conservation. In practice, however, many of the states where community solar programs seem to have been more successful are relatively more densely developed and lacking these large undeveloped, sunny tracts, like Massachusetts, New York, and Illinois.

The degree to which a community solar program reduces the need for utility-scale solar depends on many factors, including the economic drivers of utility-scale generation, a given state's Renewable Portfolio Standard targets, and a region's capacity requirements. Where the goal of a community solar program is to reduce the need for utility-scale solar, the program should be responsive to these factors. Regardless of whether they reduce the need for utility-scale solar, strong locational incentives or requirements for community solar projects can also promote community solar development in parking lots, brownfields, and roofs, instead open land or greenfields.

If designed carefully, community solar programs can also conserve resources by installing renewable generation "closer to the consumer," reducing the need for some amount of new distribution or transmission infrastructure. Here success depends on community solar projects reducing peak demand specifically in their area and by extension reducing the need for more of the high voltage transmission lines that import electricity from further afield. Pairing community solar with storage can compound this benefit, by further reducing the need for imported energy when the sun isn't shining.

Community solar could also reduce strain on existing infrastructure, like transformers, helping it last longer. These benefits are highly dependent on the location of the community solar project.

In conclusion, community solar has great potential to reduce greenhouse gas emissions and enhance grid operations—outcomes from which we all benefit. Specific prescriptions to actually achieve these outcomes depend on the characteristics and needs of the electric power system and nearby communities. Project location and the inclusion of additional technologies like storage and building electrification are key decision points.

There is an additional set of prized benefits from community solar, however. This second set of benefits accrue to individual participants (whether as subscribers, members, or co-owners) and at the local level. While the systemwide benefits addressed here can often be maximized by systemwide planning, at least some of the individual and local benefits of community solar prioritize individual and community agency. The next post in this series will explore three individual and local benefits: financial benefits of participation, reductions in local air pollution, and community empowerment and control over the electric power system.