Mango Tango

Solar Swap

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Introduction

Solar power is the future of energy production. With panels directed at the sun, we can generate power for our electricity needs silently, renewably, and without disrupting the look of our communities.

But solar is not without its own shortcomings. One downside to solar is its variability; naturally, solar panels produce more energy when there is more sun, and none at night. This means that when a power rating is given for a solar panel system, it focuses on the peak power output, which the system maintains for only a few hours a day (if the weather is good).

Wind turbines share the variability issue with solar panels, but what wind does better than solar is spatial efficiency. A single wind turbine has the equivalent peak power of hundreds of solar panels. This means that if you have a large open space to create a renewable energy plant, particularly in a northern and coastal climate like Massachusetts, solar may not be the best option.

Yet, Massachusetts still has solar power as its number two energy generator[1], only behind natural gas. How is this possible? Where is this solar energy coming from?

Who generates solar power?

Unlike other energy sources, which rely on a few large plants to generate power, two-thirds of Massachusetts' total solar capacity comes from small-scale (less than 1 MW) systems[2].

Because of their size, these small-scale systems can really be placed anywhere, but many can be found on residential buildings or businesses. These solar systems do not just benefit the buildings they are installed on, though, because they are connected to the grid to be used by the whole region.

These small projects work because homeowners and businesses generally fund the installation of the systems and are then compensated by their utility company for the energy that the solar system produces. The financial incentive of this is a lower energy bill at the end of the month, as well as acquiring renewable energy certificates (RECs) from the government for every megawatt hour of electricity generated by their system.

RECs are important because they validate the generation of renewable energy. The Massachusetts state government has a quota of RECs for companies to have in order for their clean energy future to be reached. If companies do not generate their own RECs, they can be purchased from a source that did, giving small-scale system owners the opportunity to sell their RECs and make more money.

Benefits of small-scale generation

The immediately apparent benefit of small-scale generation is the use of space. No other source of energy (natural gas, nuclear, hydropower, etc.) can be placed into a residential area without interfering those living there.
In fact, solar panel systems often *increase* a home's value when installed, given their benefit to the resident's electricity bill.

This is also a benefit of spatial efficiency. Real-estate is expensive and can be a big limiting factor in getting renewable energy projects up and running. Solar re-uses space already occupied and is nearly limitless in where it can be installed.

Another benefit of small-scale solar is the load it takes off the grid. Because of solar's inherent weather dependency, it can be difficult to manage the ebbs and flows of a large system into the grid. When the many systems are distributed over a large area, some solar panels can still produce energy when others are in rainy weather. This reason is why governments all over the world are incentivizing smaller systems using RECs[3].

Limitations of small-scale generation

There are also problems that arise from such a wide spread of solar systems, namely forecasting. Because of the variability in generation, engineers try to predict the timing of the highest and lowest points of production each day[4].

If solar were produced in concentrated areas, the day-to-day fluctuations in the system would be more predictable and controlled. As of now, solar power forecasting technology is in its infancy and is not made any less difficult by the exponential growth of solar systems.

Another benefit to large systems is in upgradability. With the constant increase in solar panel efficiency[5] there is reason to believe that Massachusetts could benefit from having large, controlled systems. Since homeowners would be much less likely to revamp their systems with the latest technology, perhaps having energy companies in full control of their systems would be more beneficial for the future.

Alternative production methods

Despite small-scale systems making up the majority of Massachusetts' solar production, there are still larger systems throughout the state. The reality of the situation is that any and all methods of generating more clean energy are being used in Massachusetts. But as it stands now, small-scale systems are and will be the leading production method for solar in Massachusetts.

Outside of solar, offshore wind power is the latest technology to be pursued. Offshore turbines similarly avoid the issue of taking up valuable space (though real-estate on the water can be just as difficult to claim) and have the potential to generate gigawatts of power. However, offshore wind comes with its own long line of issues, including the problem of getting power back to shore.

Conclusion

Small-scale solar power systems combine to do the heavy lifting of clean electricity production in Massachusetts. These systems are great for using residential space and limiting the effect of weather on energy provided to the grid. Its shortcomings lie in the unpredictable nature of thousands of different systems spread across the entire state.

Moving forward, Massachusetts should continue investing in these small-scale systems by requiring more RECs from companies across the state. There is also a lot of work to be done in solar power forecasting, so that the grid is adequately prepared for the inherent variability of solar.

References

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