



Looking Ahead: Trading Trees for Solar Energy – Which Saves More CO₂e?

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Electrical power is an essential requirement for day-to-day living. However, the demand for power is the single largest source for greenhouse gases in the United States. According to the *US Environmental Protection Agency*, electricity accounts for 37% of total U.S. CO₂e (Carbon Dioxide equivalent) emissions¹. While solar energy ‘distributed generation’ projects can greatly reduce the amount of CO₂e produced by fossil fuels, they require large areas of land to be effective, often requiring the cutting of trees. As a renewable energy company concerned about both our environment and sustainable power supplies, we wondered which was a ‘better use’ of an acre of land from a CO₂e perspective – leaving the trees alone or installing solar panels?

The reality is that in weighing the environmental benefits for trees over solar energy, solar beats out trees within the immediate and long-term future by a large margin. Going forward, the most reliable and economical way to reduce fossil fuel consumption and CO₂e emissions is to look towards replacing fossil fuels with solar fields, and not relying on the trees alone to save our environment – the forests need a lot of help.

In actual numbers, the math is significant. The forestry group *American Forests* calculates that each year, an acre of 55-year-old trees absorbs about 7,500 lbs of CO₂e². On the other hand, the *US Environmental Protection Agency* data draws us to the conclusion that an acre of solar panels saves the equivalent of 532,600 lbs of fossil fuel emissions from being sent out into the atmosphere per year³. So the net environmental impact of transitioning to solar energy offsets roughly *70 times* the amount of carbon dioxide emissions than mature trees can absorb per year. If we consider the fact that manufacturing the acre of solar panels in the first place will emit some 353,000 lbs of CO₂e into the atmosphere, we see that the ‘payback’ of using solar energy over fossil sources will offset its own environmental costs in less than two years^{2,3,4}. *Over the lifespan of a solar panel, the amount of CO₂ emissions saved heavily outweighs the amount of CO₂e that would be sequestered by trees.*

This does not mean that we should clear-cut our forests and replace them with solar panels. Our forests have many other intrinsic values. But for those who are weighing the benefits of solar energy vs. cutting trees, the choice should be clear. Solar energy is an investment in a carbon neutral future. Shifting the reliance for energy from fossil to solar is a great preventative measure lead to a sustainable planet.

References

1. “Overview of Greenhouse Gases.” *Environmental Protection Agency*. n.d. Web. <http://www3.epa.gov/climatechange/ghgemissions/gases/co2.html>
2. “Assumptions and Sources.” *American Forests*. n.d. Web. <http://www.americanforests.org/assumptions-and-sources/>
3. “GHG Equivalencies Calculator – Calculations and References.” *Environmental Protection Agency*. n.d. Web. <http://www2.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>
4. “Life Cycle Analysis of High-Performance Monocrystalline Silicone Photovoltaic Systems: Energy Payback Times and Net Energy Production Value.” Fthenakis, V. Betita, R. Brookhaven National Laboratory and Center for Life Cycle Analysis at Columbia University. n.d. Web. https://www.bnl.gov/pv/files/pdf/242_27EUPVS_Fthenakis_SunPower_6CV.4.14.pdf

Calculations to Support “Looking Ahead: Trading Trees for Solar Energy – Which Saves More CO₂e?”

Statements:

1. “The forestry group *American Forests* calculates that each year, an acre of 55-year-old trees absorbs about 7,500 lbs of CO₂e.”

American Forests found that 410,060lbs of CO₂ emissions are sequestered by one acre of trees in 55 years. While younger, smaller trees would absorb less CO₂e than larger mature trees, simply dividing that value by 55 years yields an average of 7,456lbs of CO₂ emissions sequestered by each acre of ‘trees’ per year.

2. “On the other hand, the US Environmental Protection Agency data draws us to the conclusion that an acre of solar panels saves the equivalent of 532,600 lbs of fossil fuel emissions from being sent out into the atmosphere per year. “

a. In Massachusetts, approximately 1 acre of land is needed for a solar PV array equal to 250kW in size. Assuming a 327 watt solar panel is used, such an array would require $(250,000 \text{ watts}/327 \text{ watts/panel} =)$ 764 panels.

b. Assuming a 10% ‘Capacity Factor’ (the sun doesn’t shine all day), such an array would produce approximately $(250 \text{ kilowatts} \times 8760 \text{ hrs/yr} \times 16\% =)$ 350,400 kWhrs/yr.

c. The Environmental Protection Agency’s “Emissions & Generation Resource Integrated Database” (eGRID) for U.S. annual non-baseload power plants lists a conversion factor to convert reductions of kilowatt-hours into avoided units of carbon dioxide emissions to be 6.89551×10^{-4} metric tons CO₂ per kWh.

d. How many pounds of CO₂e equivalent emissions would 1 acre of solar panels save per year?
Answer: $(350,400 \text{ kWh/year}) \times (6.89551 \times 10^{-4} \text{ metric tons CO}_2/\text{kWh}) \times (2204.62\text{lbs}/1 \text{ metric ton}) =$ 532,637 lbs of CO₂e/year.

3. “If we include the fact that manufacturing the acre of solar panels will emit some 353,000 lbs of CO₂e into the atmosphere, the payback of using solar energy over fossil sources will offset its own environmental costs in less than two years.”

The paper published by Columbia University states that to make one 327W SunPower Module, 210kg of Carbon Dioxide will be emitted into the atmosphere.

Therefore: $(764 \text{ modules/acre}) \times (210\text{kg CO}_2 \text{ Emissions/module}) \times (2.2\text{lbs/kg}) = 352,968 \text{ lbs CO}_2/\text{acre}$ of solar panels.

References

1. “Overview of Greenhouse Gases.” *Environmental Protection Agency*. n.d. Web. <http://www3.epa.gov/climatechange/ghgemissions/gases/co2.html>
2. “Assumptions and Sources.” *American Forests*. n.d. Web. <http://www.americanforests.org/assumptions-and-sources/>
3. “GHG Equivalencies Calculator – Calculations and References.” *Environmental Protection Agency*. n.d. Web. <http://www2.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>
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