



Answering an unnecessary question:  
*What are the carbon tradeoffs between forest and solar?*

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*What are the carbon tradeoffs between  
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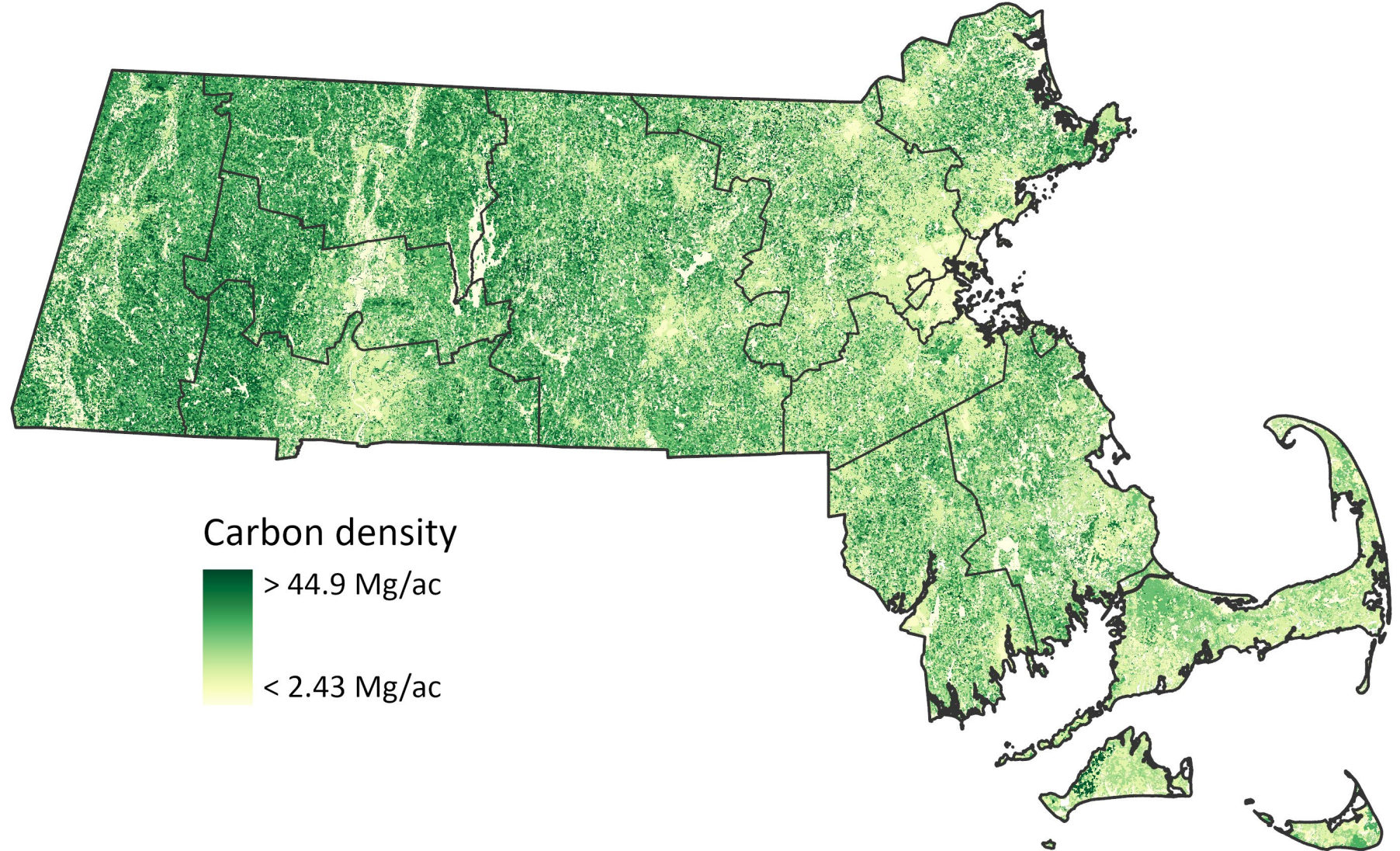
***Why is it unnecessary?***

Because it's a false choice.

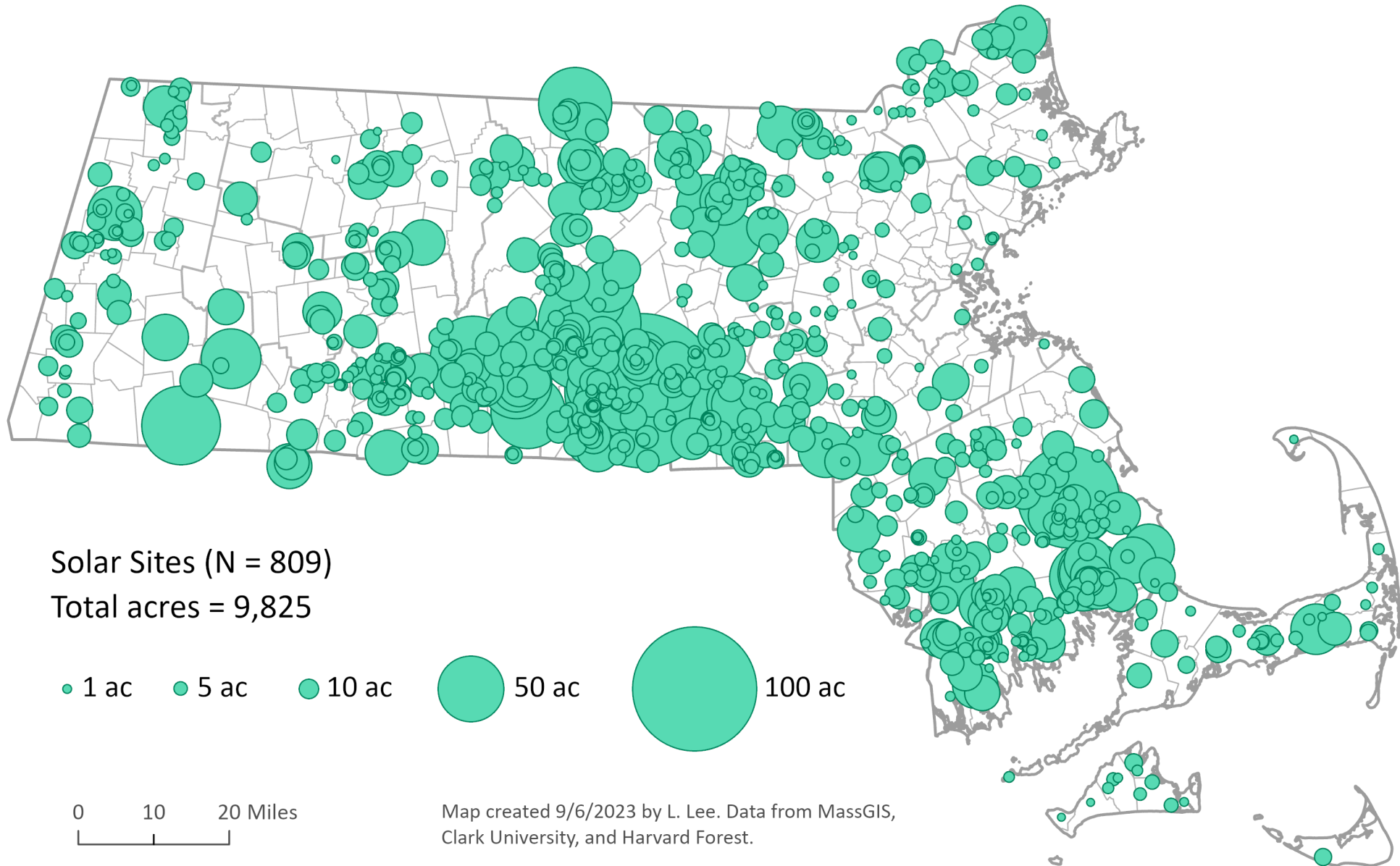
**We can have both!**



# Massachusetts' Forests



# MA Ground-Mounted Solar Arrays by Size



Solar Sites (N = 809)

Total acres = 9,825

● 1 ac

● 5 ac

● 10 ac

● 50 ac

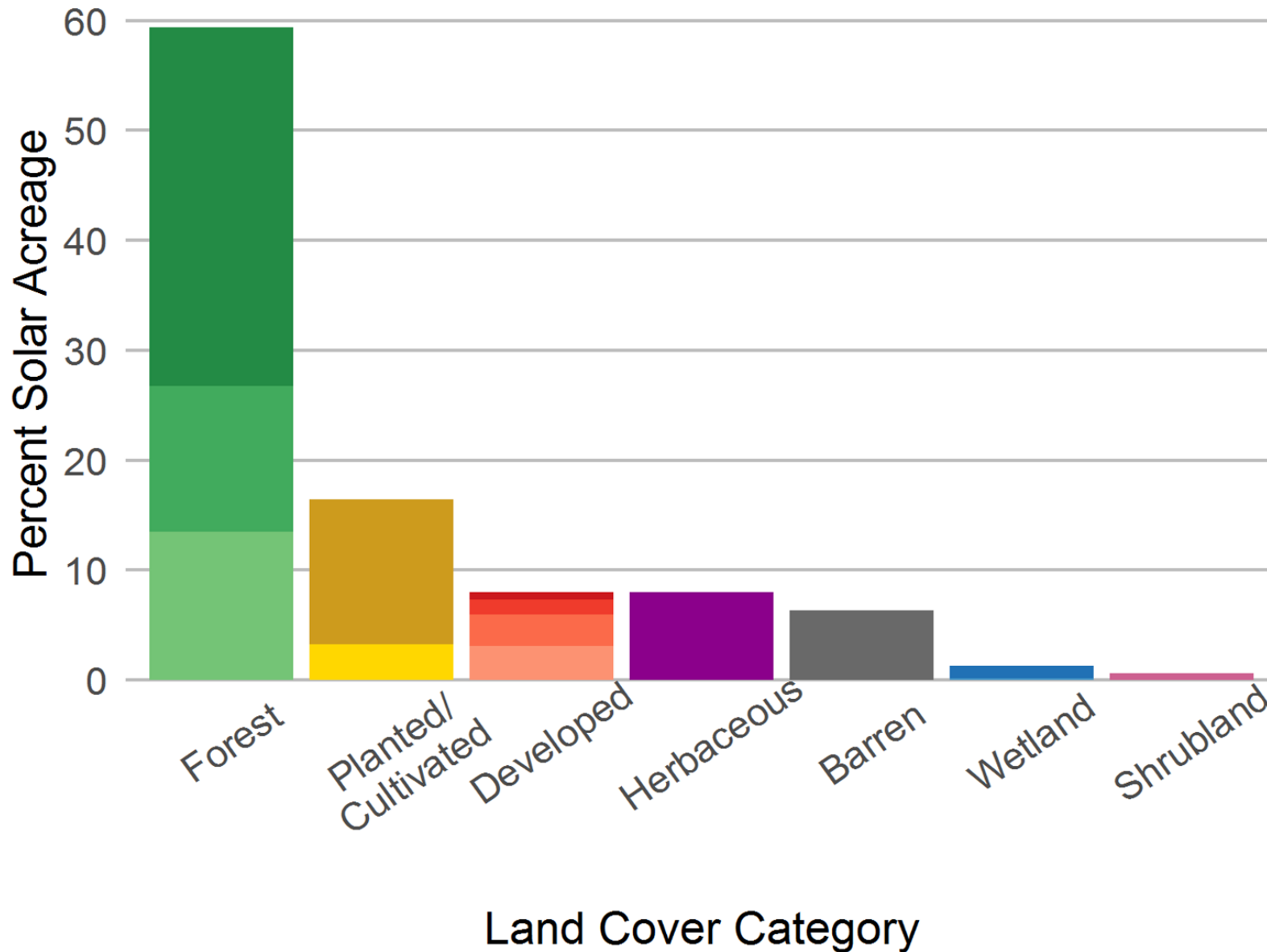
● 100 ac

0 10 20 Miles  
|-----|-----|

Map created 9/6/2023 by L. Lee. Data from MassGIS, Clark University, and Harvard Forest.



# Percent of Solar Acreage 2010-2020 Overlapping with Land Cover Types

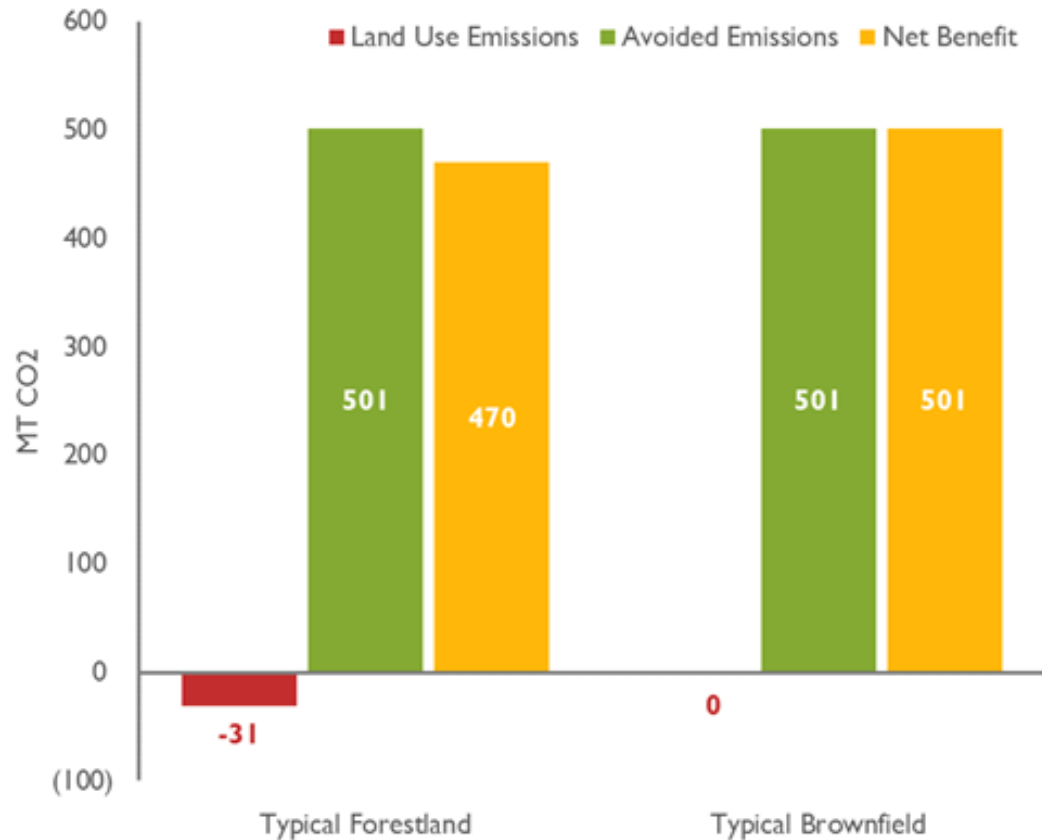


60% of ground-mount solar installed in MA between 2010 & 2020 impacted forests

Carbon emissions from forest loss were ~513,854 MTCO<sub>2</sub>e, roughly equal to annual emissions of 112,000 cars

*The typical answer looks something like this...*

**Net CO<sub>2</sub> emissions for typical 1-acre New England solar PV array built on forestland or brownfield**



# Carbon Calculator: Solar Development on an Acre of Forest



**Year of Site Clearing**  
2030

**Capacity per Acre**  
1/6 MW (167 kW)

**Forest Carbon Stock**

- Low (25th percentile, 25.9 Mg/ac)
- Average (50th percentile, 35.8 Mg/ac)
- Above Average (75th percentile, 46.7 Mg/ac)
- Exceptional (90th percentile, 57.4 Mg/ac)

**Downed Wood**

- Off
- On (low)
- On (high)

**Soil Carbon Emissions**

- None
- Exponential Decay

**Percent of Site Biomass in Durable Goods**  
Average (20%)

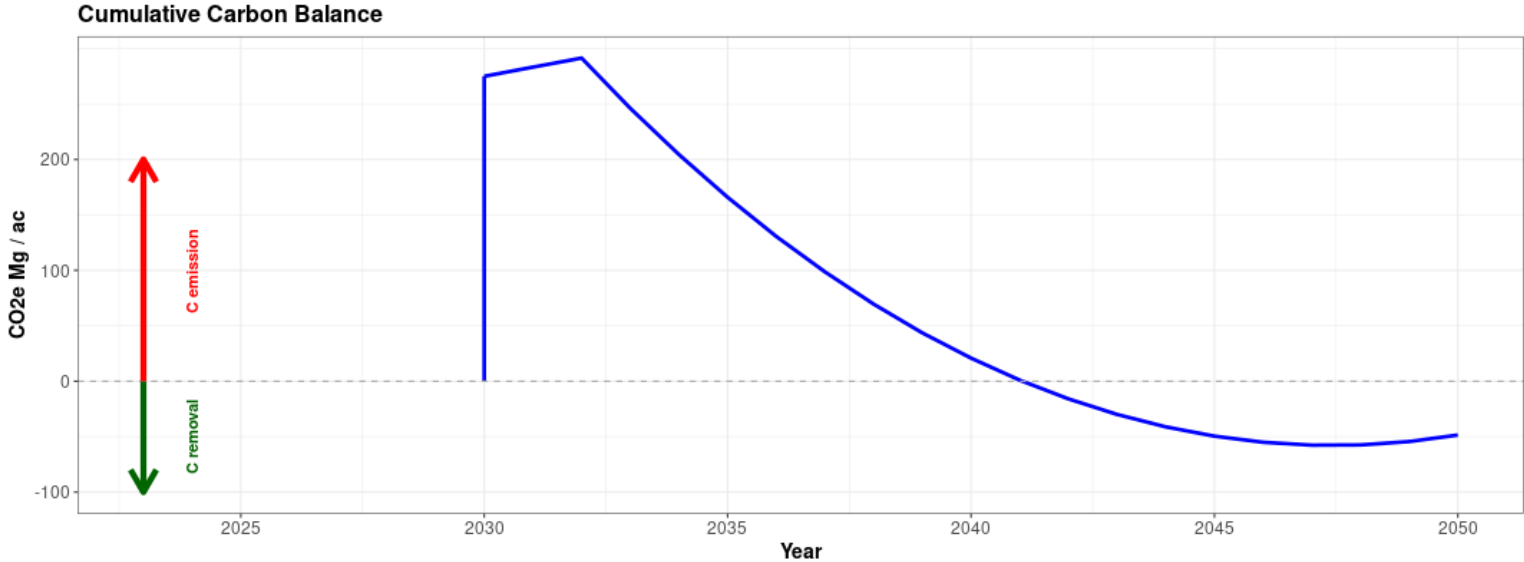
**Emissions from Electricity Generation in 2050**  
MA Decarbonization Roadmap (3.7 g/kWh)

**Curtailment**

- None
- Low (~5% in 2050)
- Medium (~15% in 2050)
- High (~25% in 2050)

**Freeze Grid Emissions in Project Year**

- No
- Yes



Using the following selections:

- Year of site clearing:** 2030
- Capacity per acre:** 1/6 MW (167 kW)
- Forest carbon stock:** Above average
- Downed wood:** 5% of living above ground carbon
- Soil emissions:** Spike during clearing then release slowly
- Percent of site biomass put in durable goods:** Average (20%)
- MA electricity decarbonization trajectory:** On track to achieve the MA Decarbonization Roadmap All Options pathway by 2050
- Curtailment:** Moderate, with 15% of solar energy curtailed by 2050
- MA electricity emissions:** Continue to decline through 2050 as renewable energy sources enter the grid

The conversion of the acre of forestland to solar arrays results in a **net carbon sink** by 2050, **removing 48.5 metric tons** of carbon dioxide in the atmosphere. This is roughly equivalent to the annual emissions of **11 cars** (source).

# Carbon Calculator: Solar Development on an Acre of Forest

What year is the solar built?

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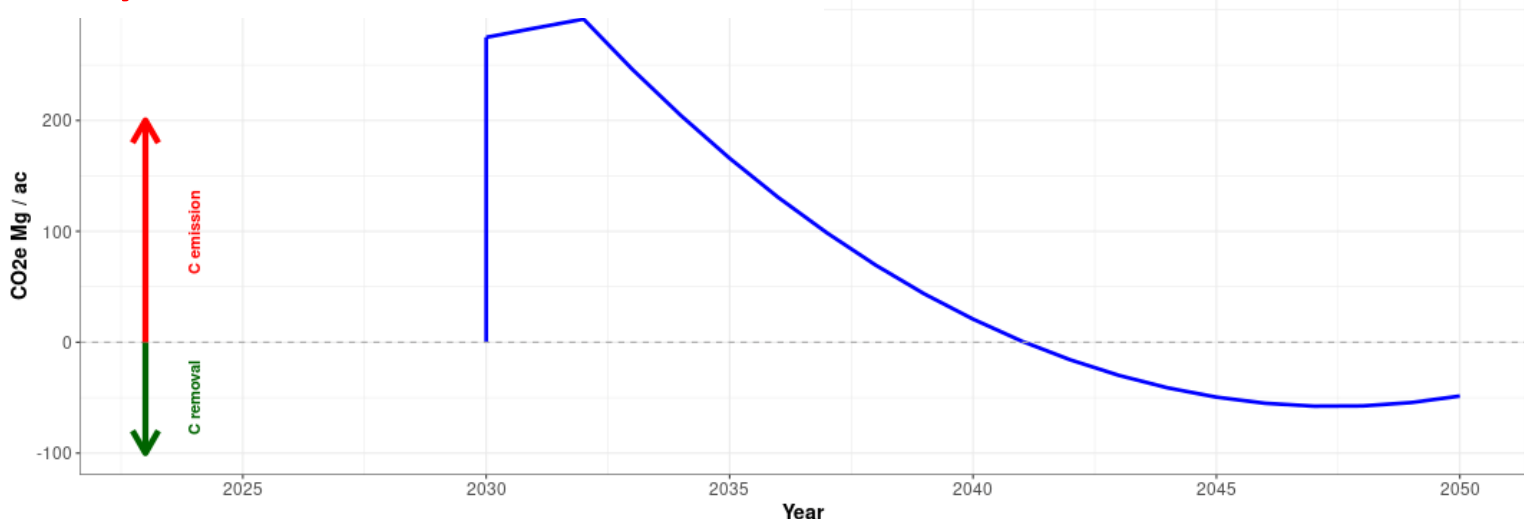
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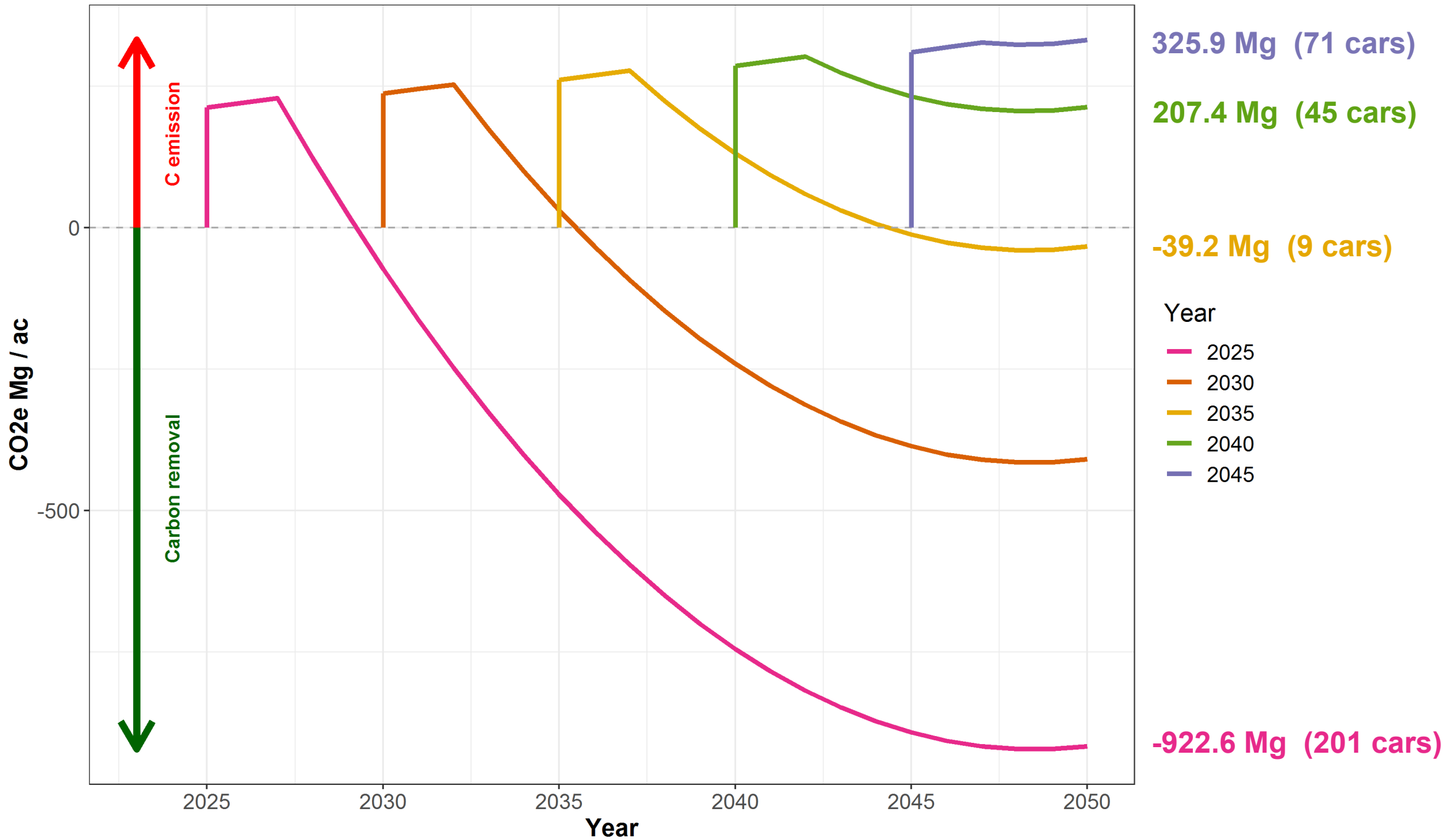


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# Cumulative Carbon Balance



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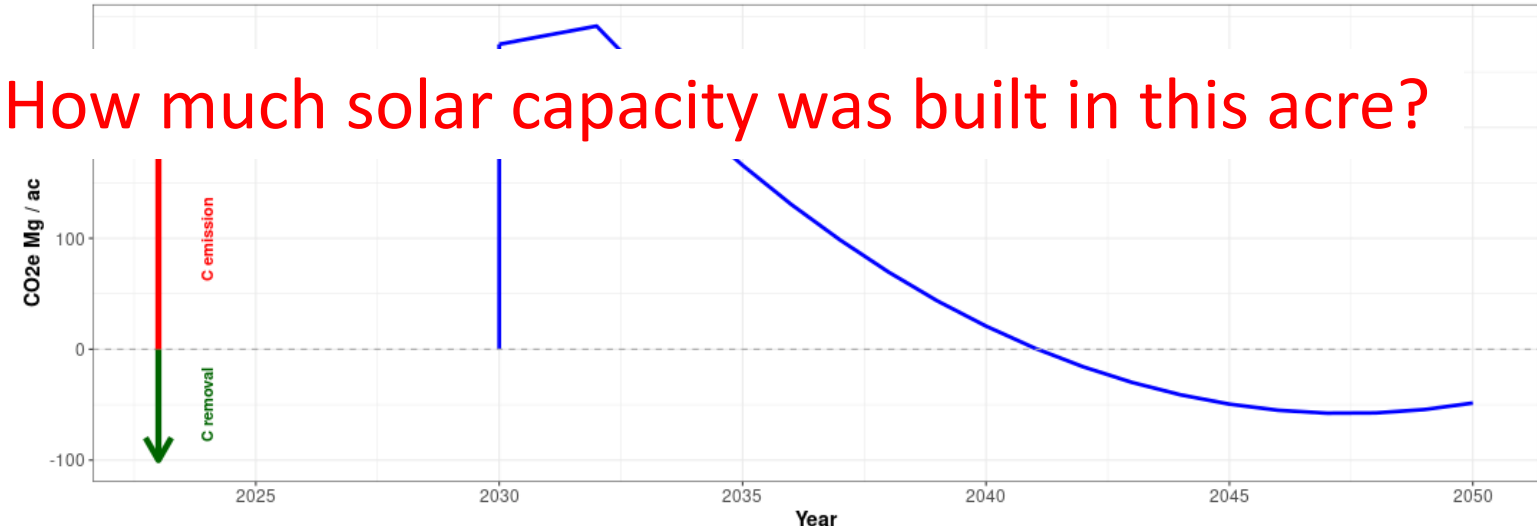
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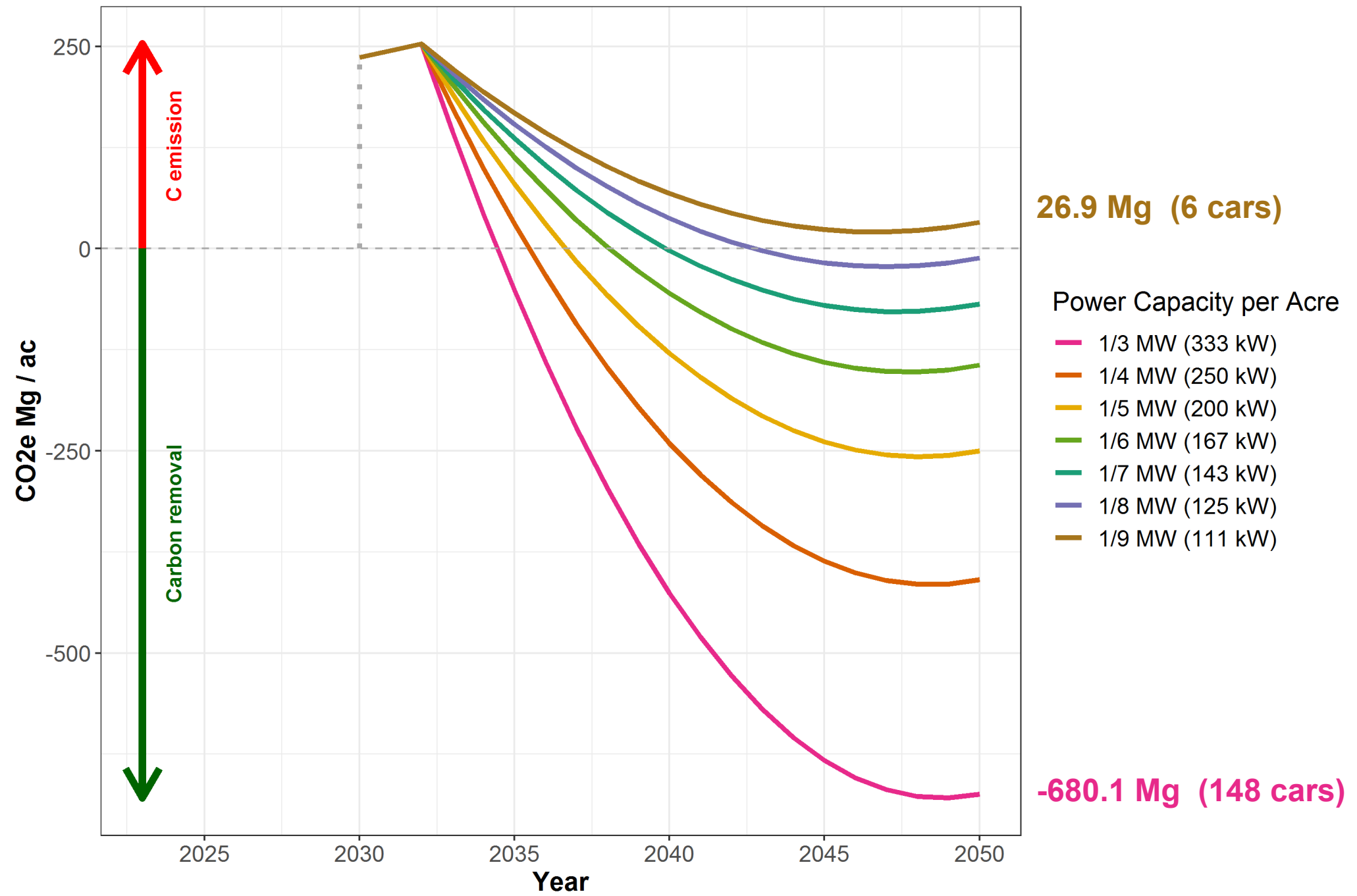
How much solar capacity was built in this acre?

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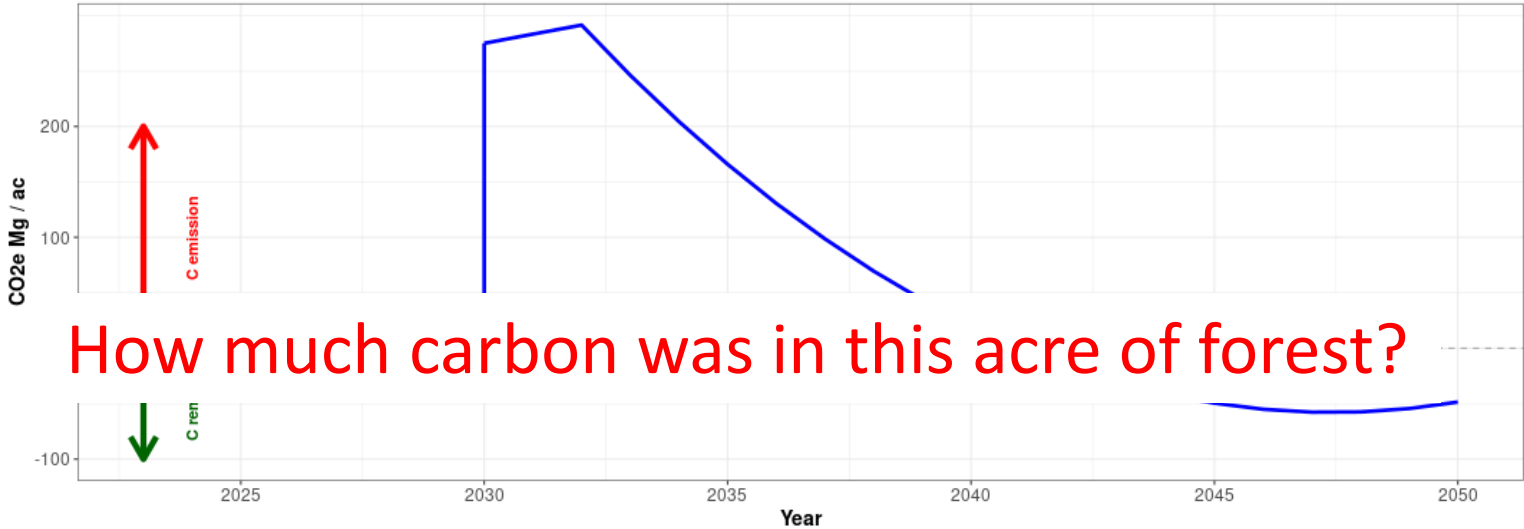
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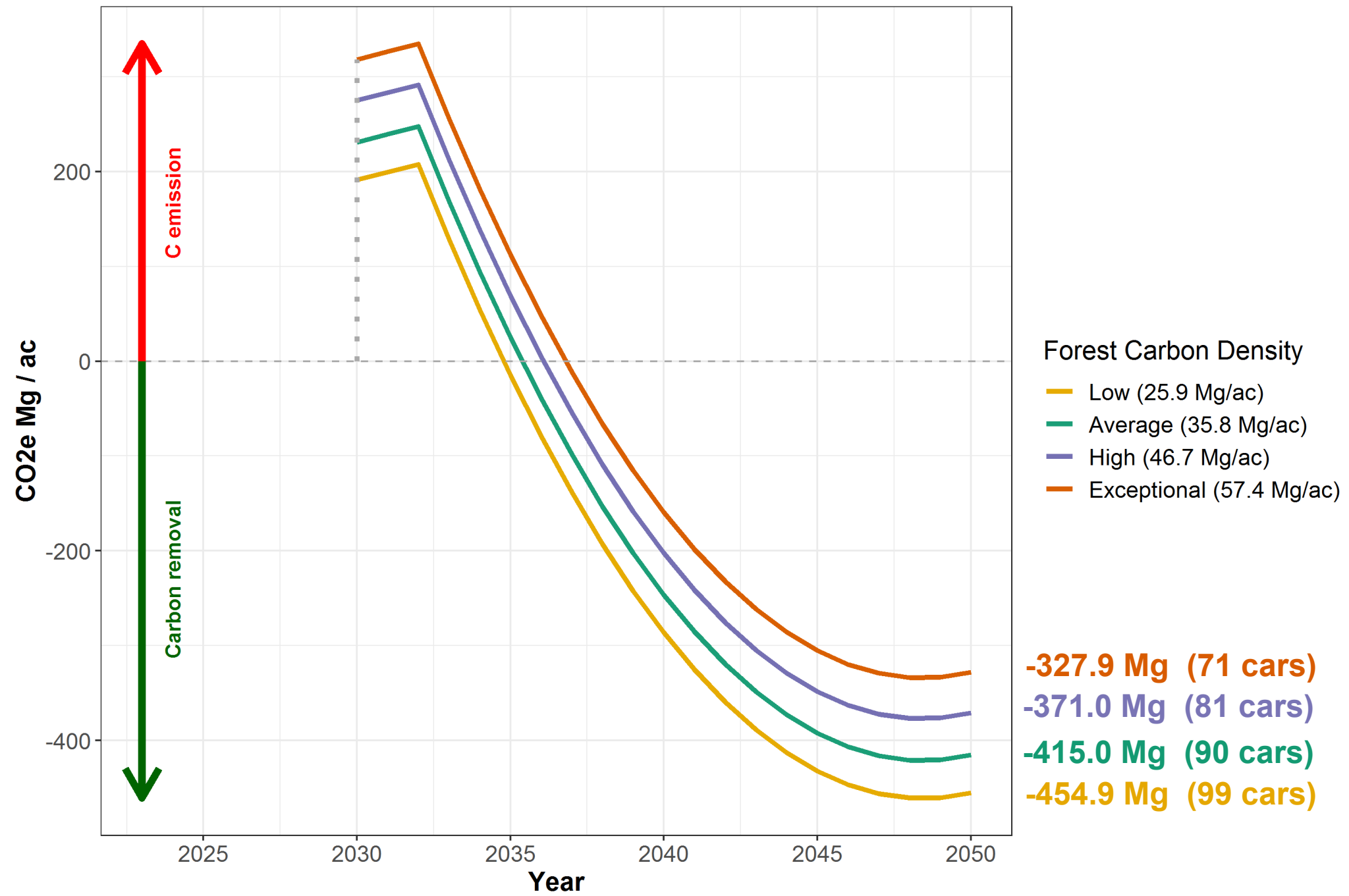
How much carbon was in this acre of forest?

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How much down wood was on the site?

What happened to the carbon in the soil?

What happened to the removed wood?

How fast is the electric grid decarbonized?

What happens to excess production (curtailment)?



**Website:** [bit.ly/carbon-story](https://bit.ly/carbon-story)

**Calculator:** [bit.ly/hf-carbon-calc](https://bit.ly/hf-carbon-calc)

Please contact Lucy Lee with questions: [lucylee@fas.harvard.edu](mailto:lucylee@fas.harvard.edu)