

DC / AC Ratio Optimization

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DC / AC ratio or power ratio compares the photovoltaic array power to the inverter capacity:

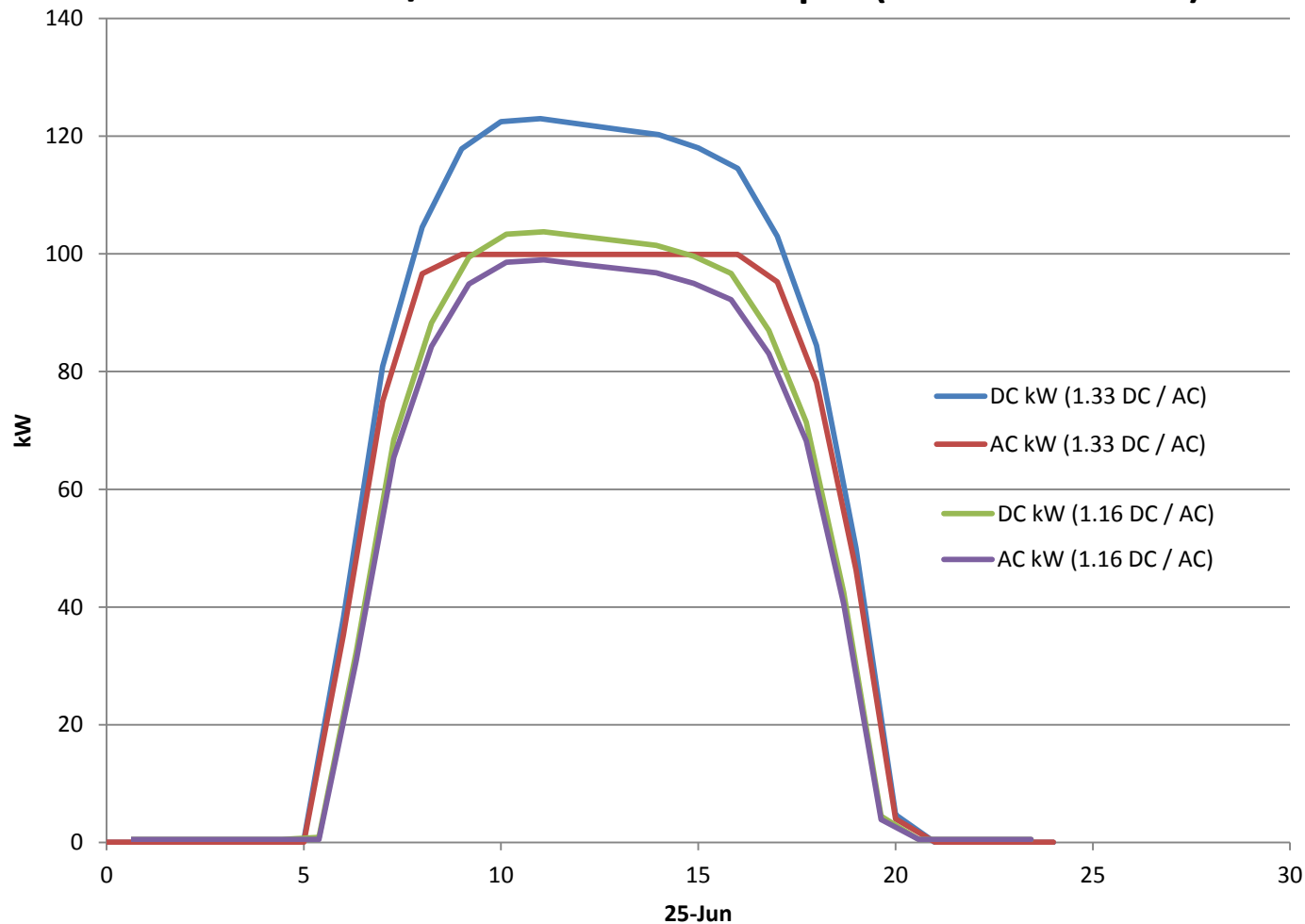
$$\text{Power ratio} = \frac{\text{Rated Array Power (DC kW)}}{\text{Rated Inverter Output (AC kW)}}$$

Net present value is the summation of a time series of cash flows brought into the present:

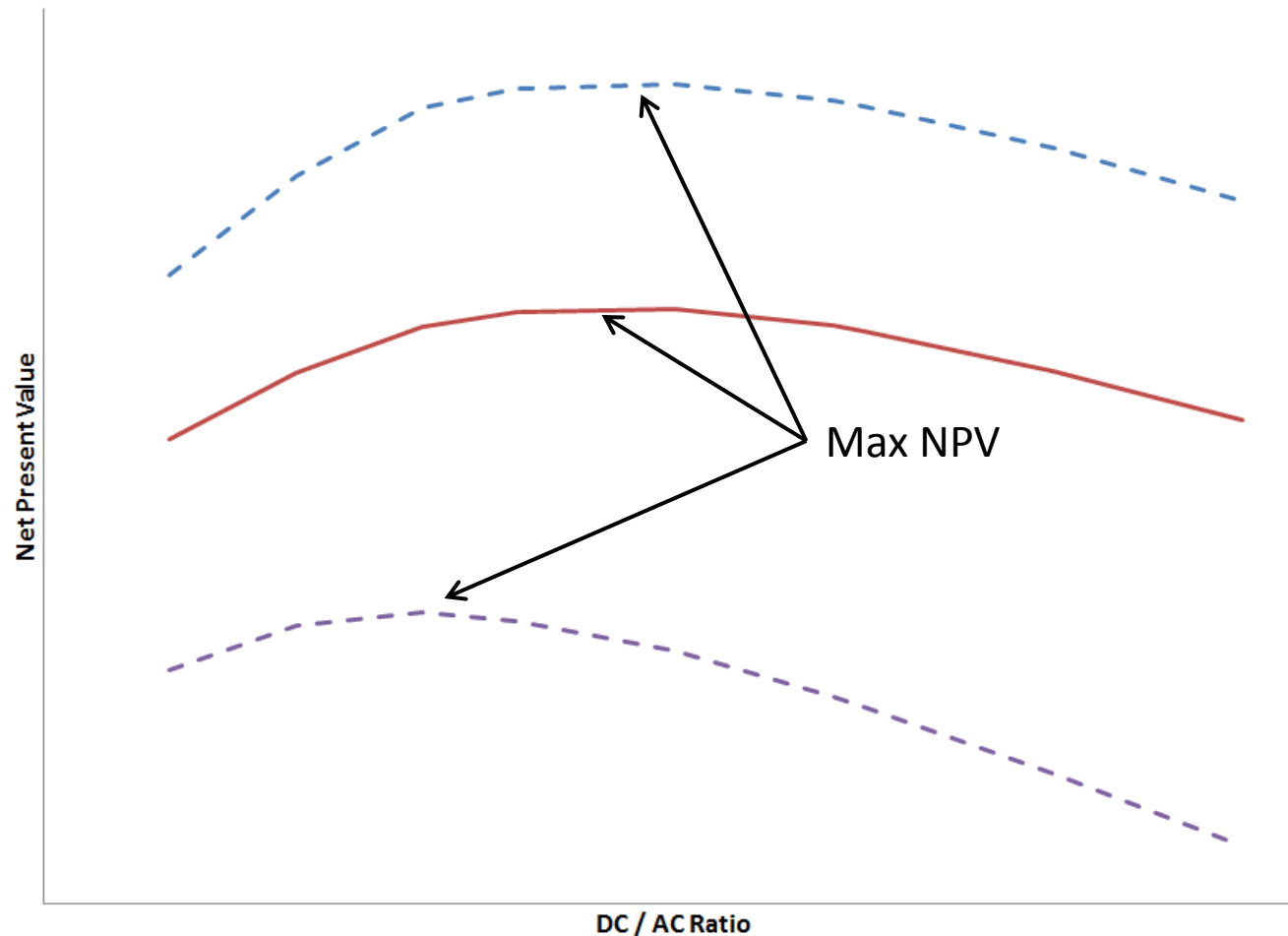
$$NPV (i, N) = \sum_{t=0}^N \frac{R_t}{(1 + i)^t}$$

As DC/AC ratio increases, the inverter is more likely to derate

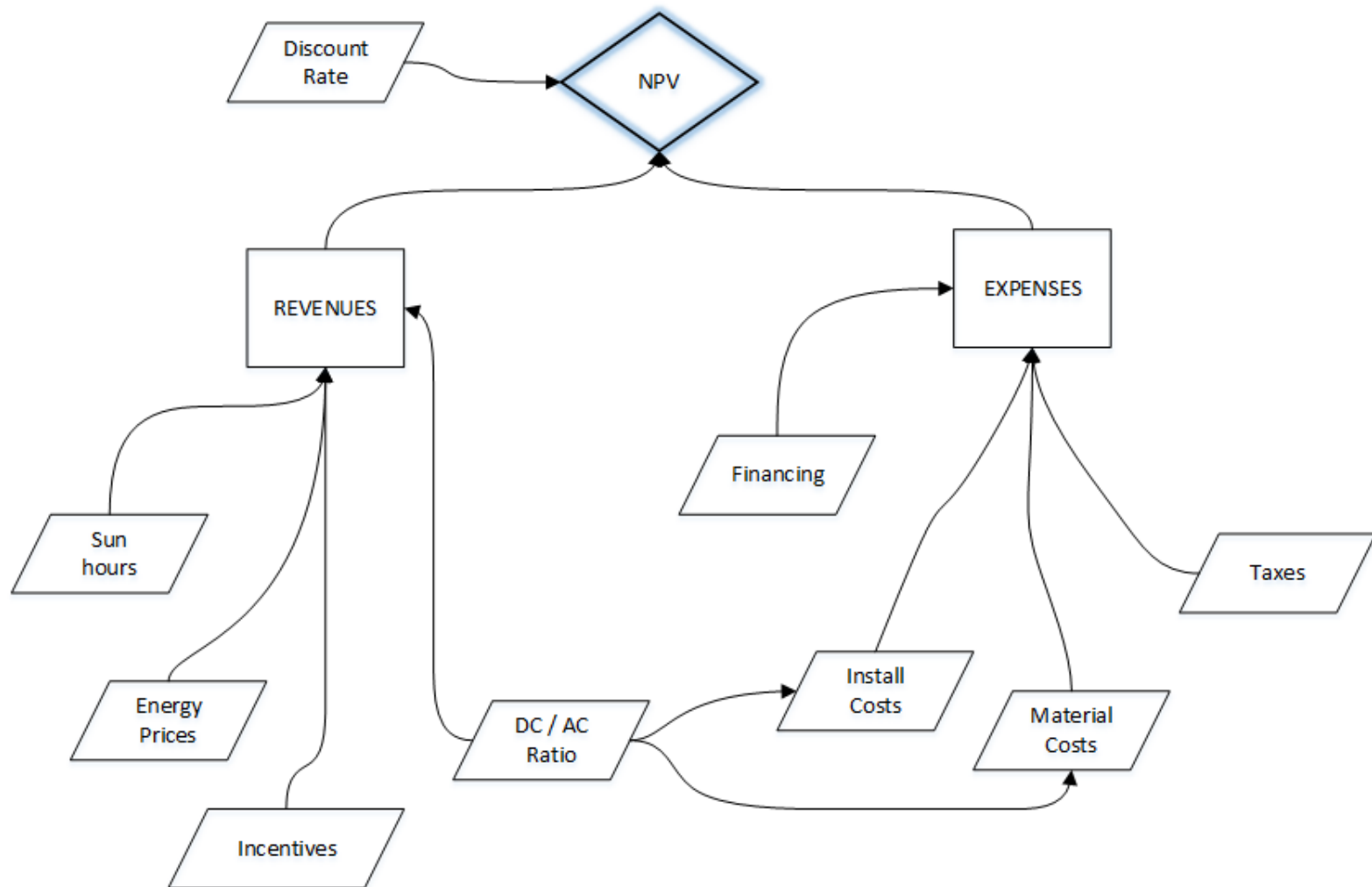
Effect of DC / AC Ratio on AC Output (100 kW inverter)



Choosing the ideal DC / AC ratio that maximizes net present value is a moving target



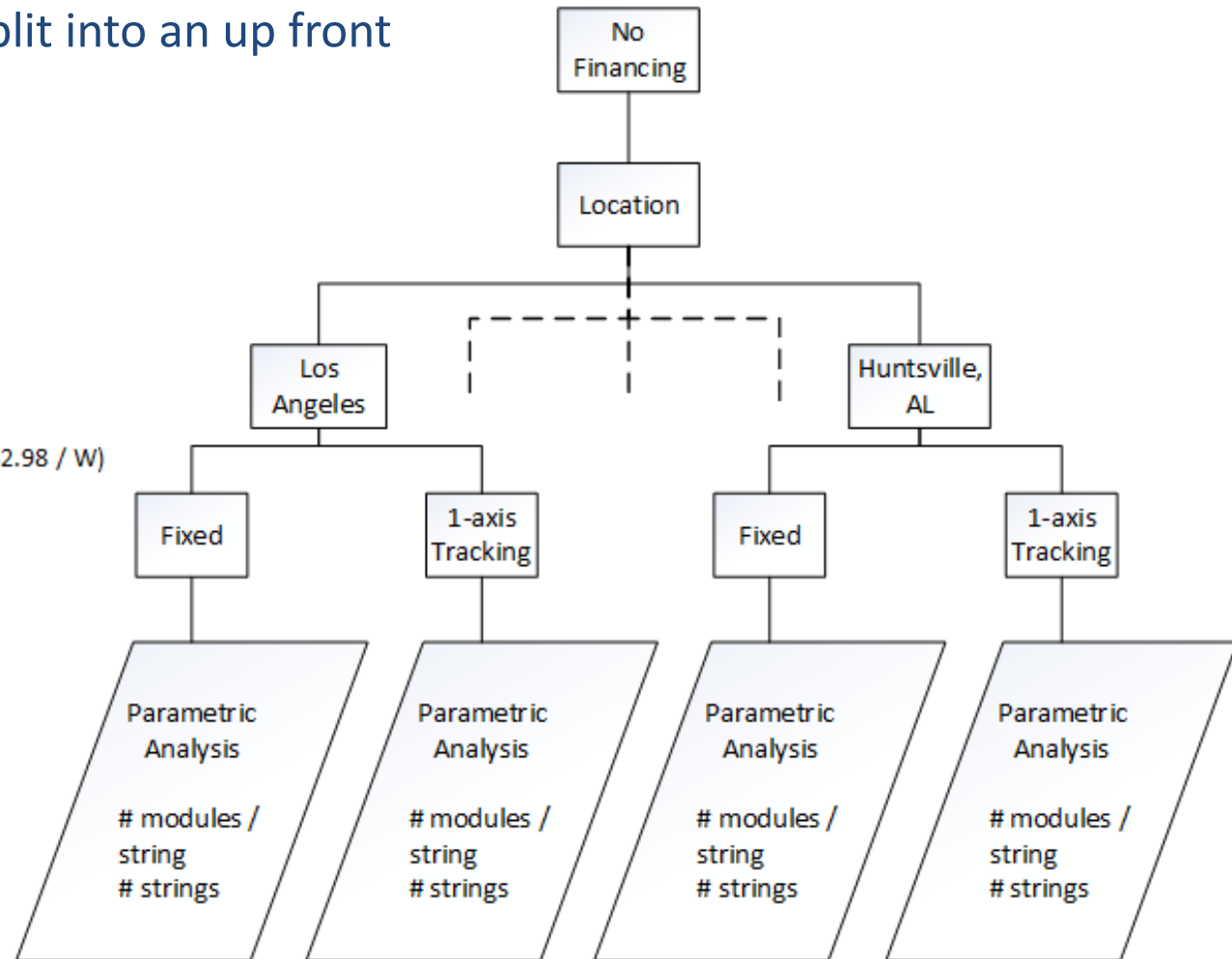
What are the significant variables and how do they interact?



The initial analysis is split into an up front cost block

Baseline Cases

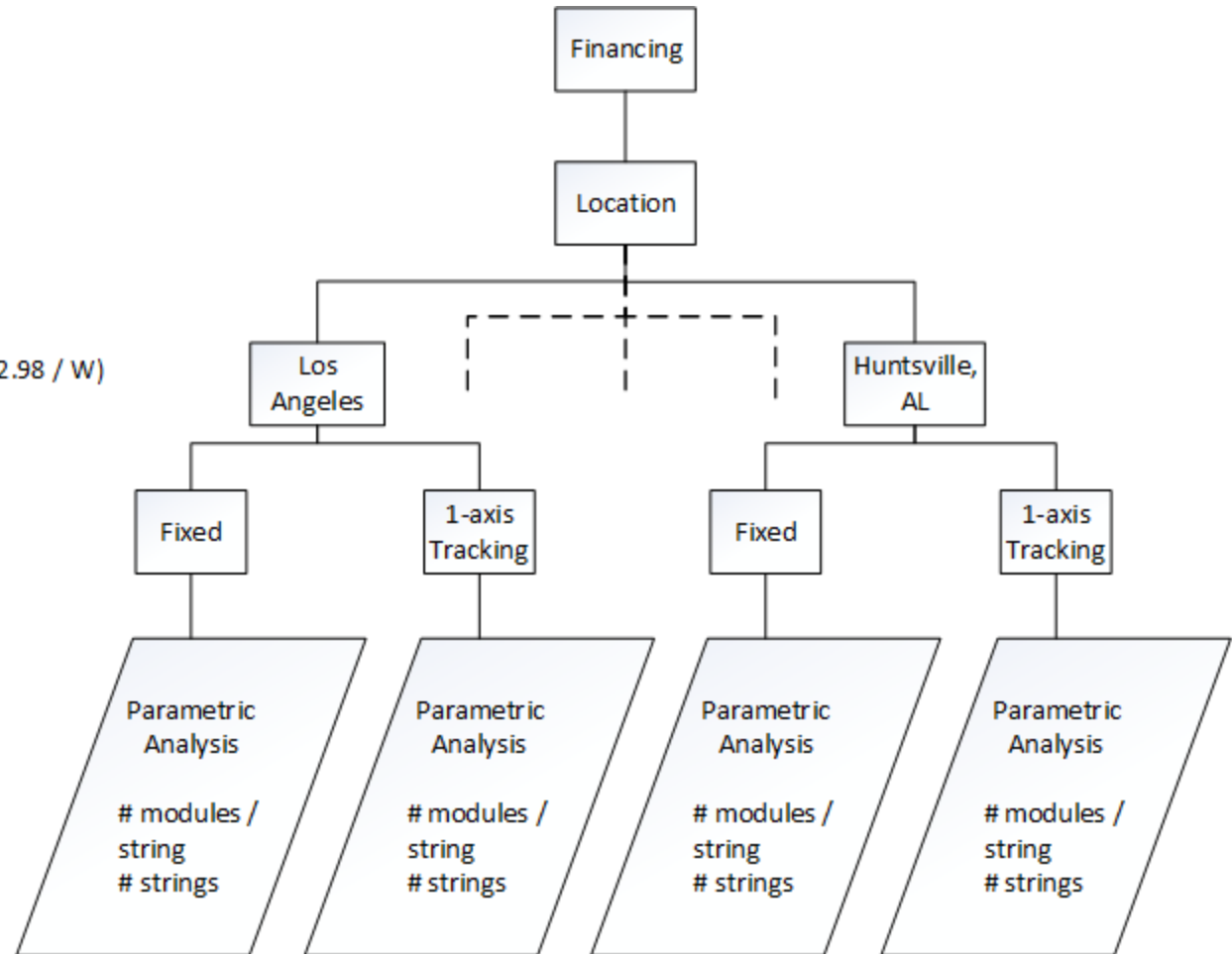
- * Fixed installed cost by location (\$2.51 / W to \$2.98 / W)
- * 6.8% nominal discount rate
- * 25 year analysis period
- * Utility rates by location
- * Incentives by location (tax credits, PBI, CBI)



... and a financing block

Baseline Cases

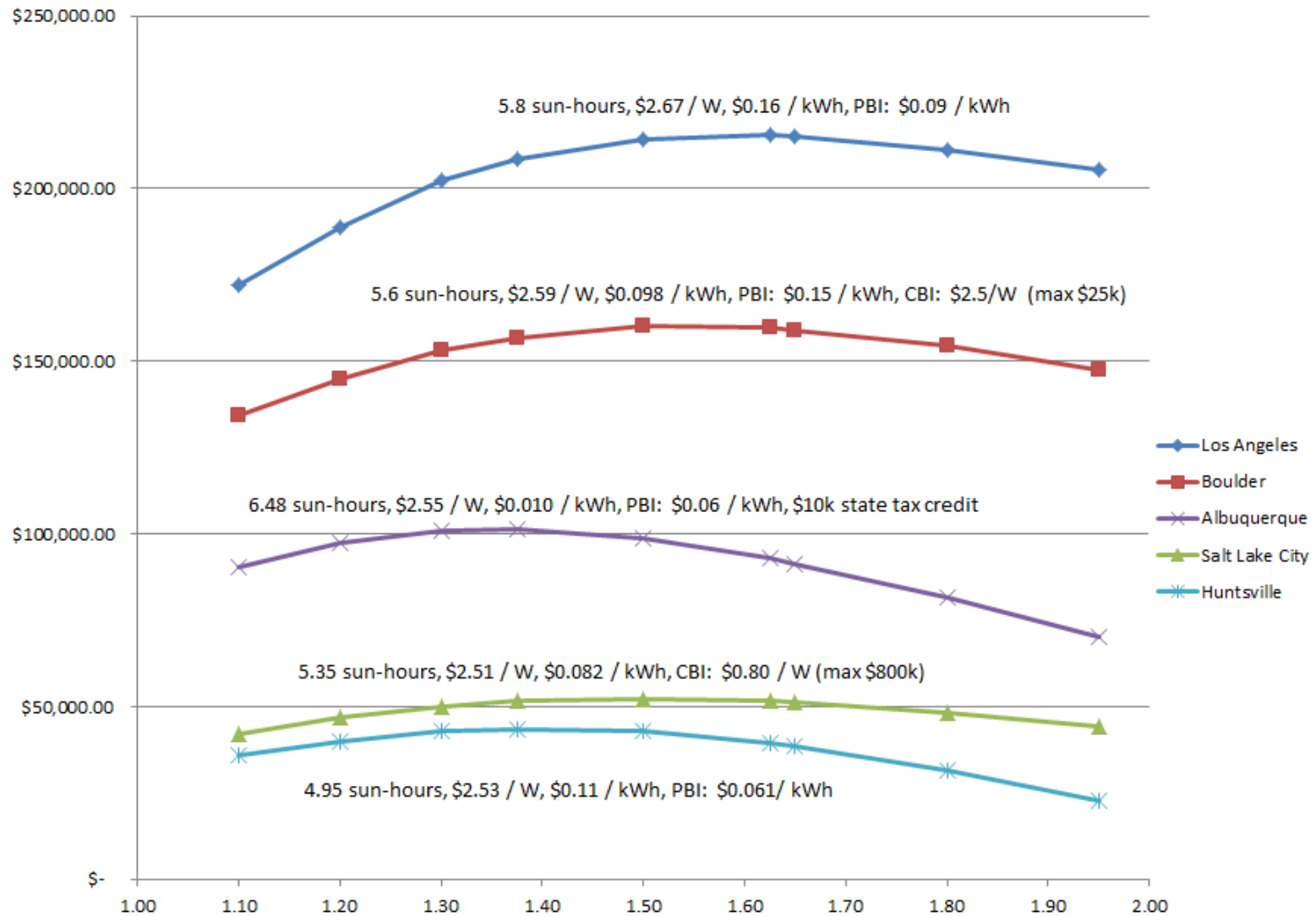
- *Fixed installed cost by location (\$2.51 / W to \$2.98 / W)
- *6.8% nominal discount rate
- *25 year analysis period
- *Utility rates by location
- *Incentives by location (tax credits, PBI, CBI)
- *Debt fraction (80%)
- *Loan term: 20 years
- *Loan rate: 6%



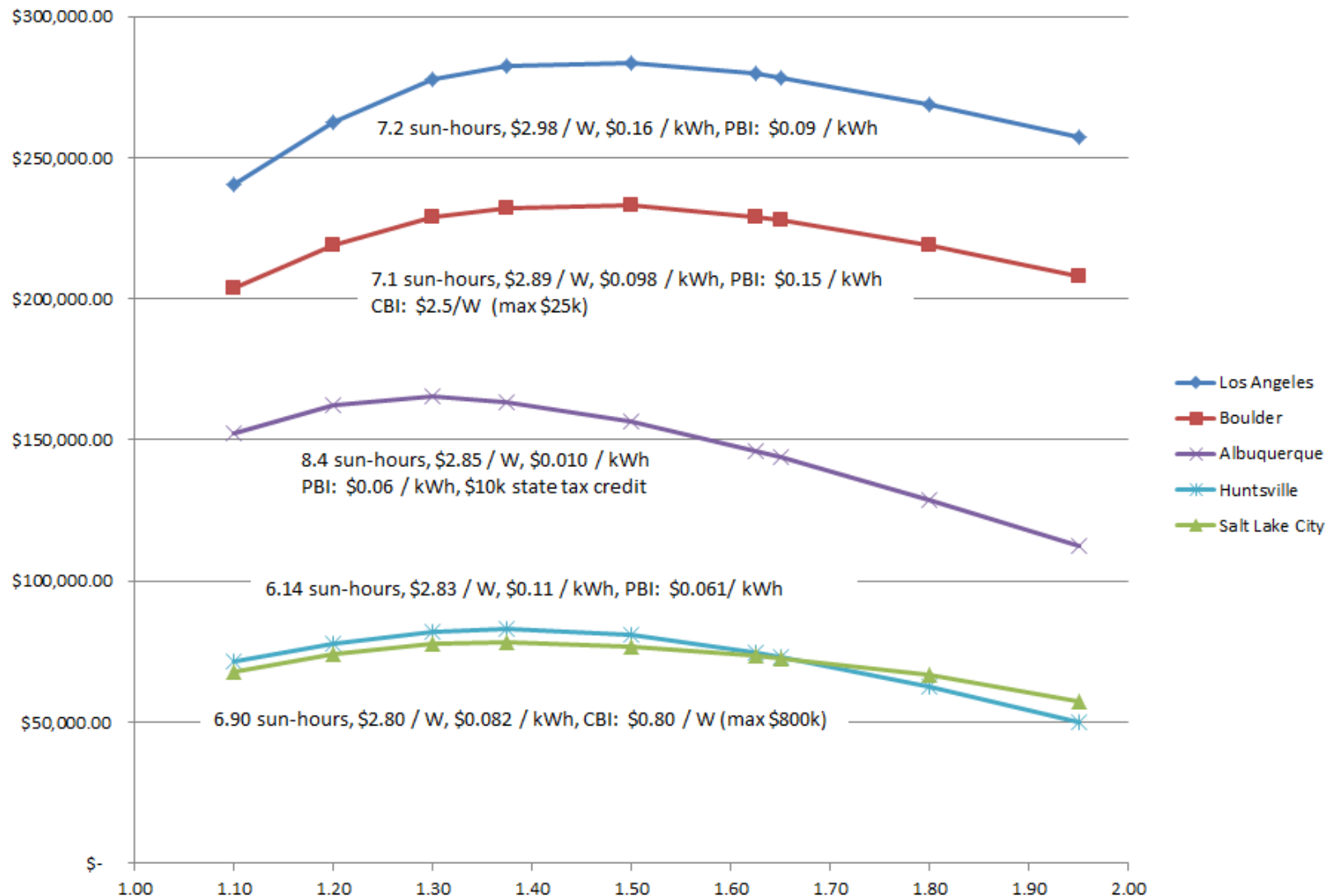
Several sources were used to approximate real world scenarios.



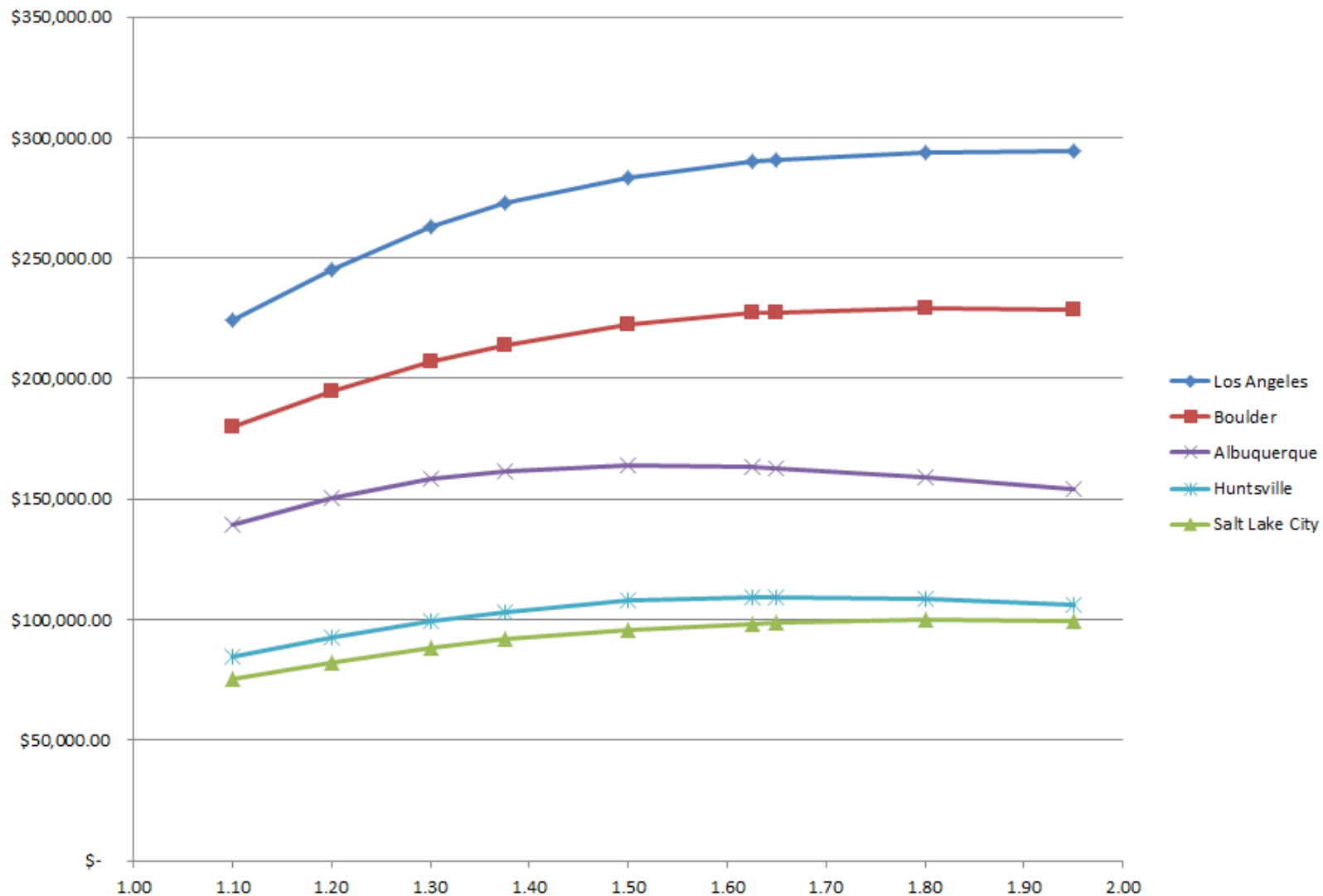
NPV by DC/AC Ratio, Ground Mounted Array, No Financing



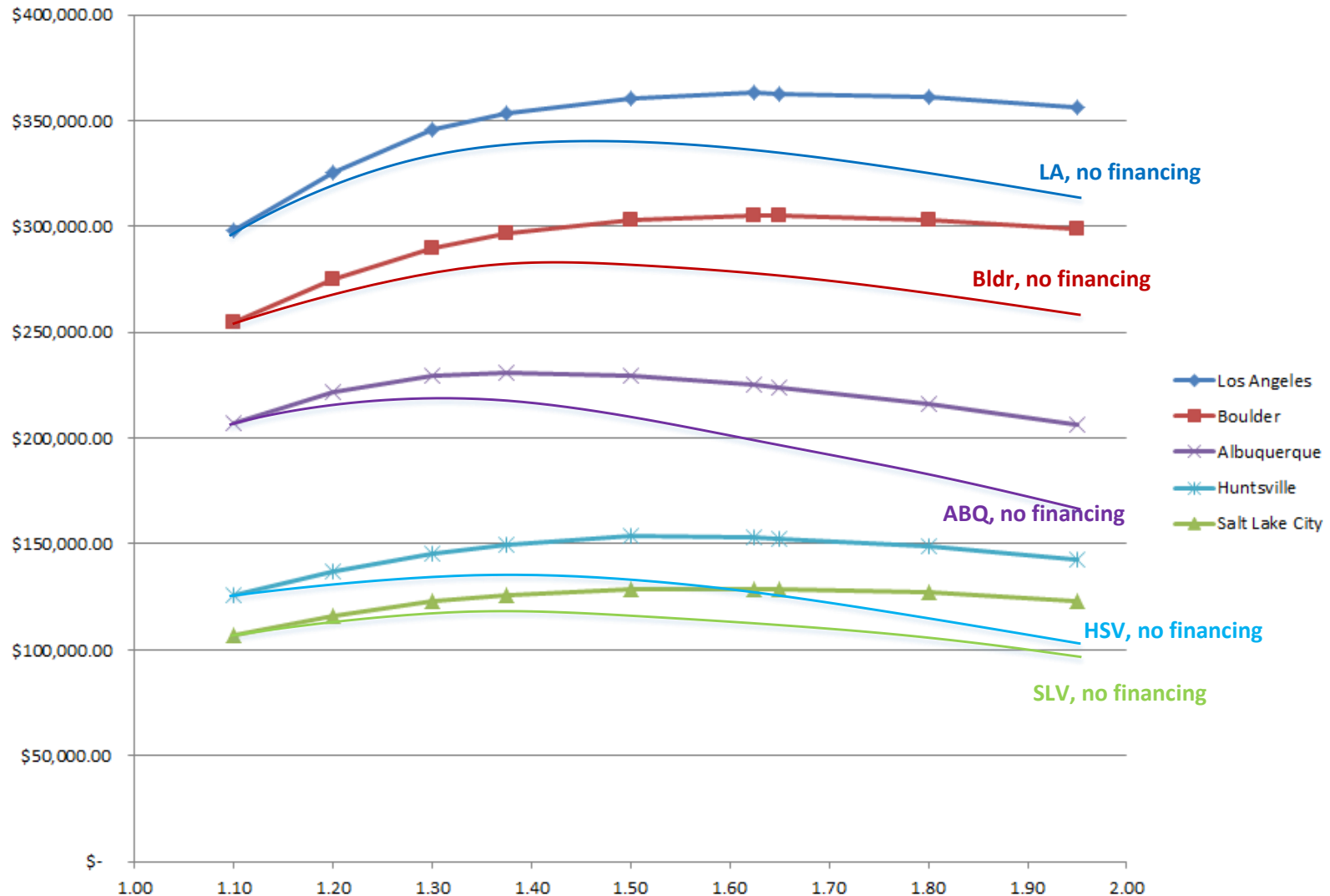
NPV by DC/AC Ratio, Single-axis Tracker, No Financing



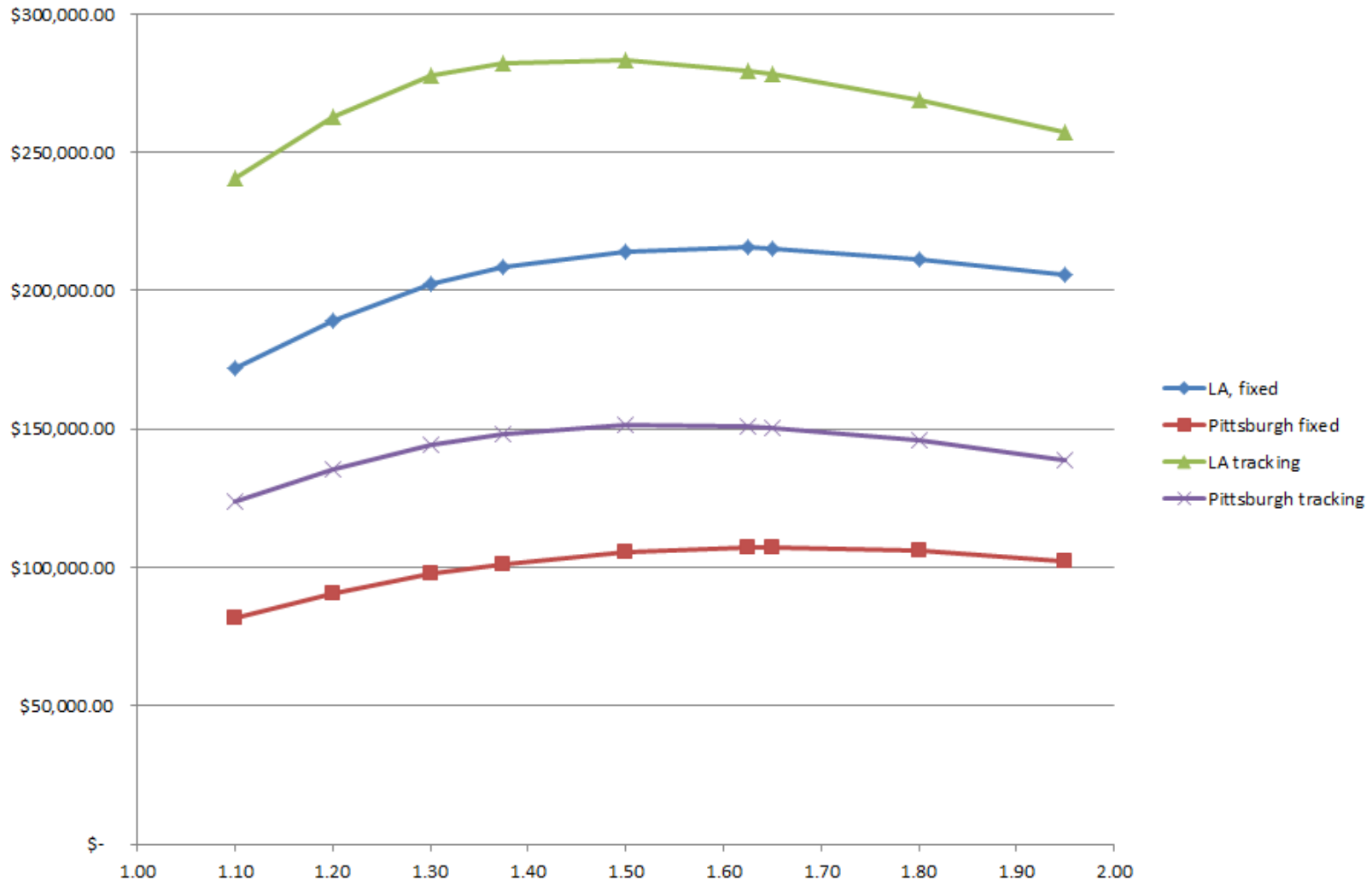
NPV by DC/AC Ratio, Ground Mounted Array, Financing



NPV by DC/AC Ratio, Single-axis Tracker, Financing



Effects of Sun-hours and Array Type on NPV by DC/AC Ratio, No Financing



Examining how NPV and DC / AC ratio interact provides the following benefits:

- Inverter manufacturers can build a business case for new product development around higher power ratios
- Developers and designers can optimize system size based on NPV while adhering to existing design rules
- Policy makers can see how taxes, incentives, and energy rates shift economic benefits

Next steps:

- Perform parametric analysis with additional variables (e.g, module price, inverter price, discount rate)
- Rank variables by significance, identify correlated factors