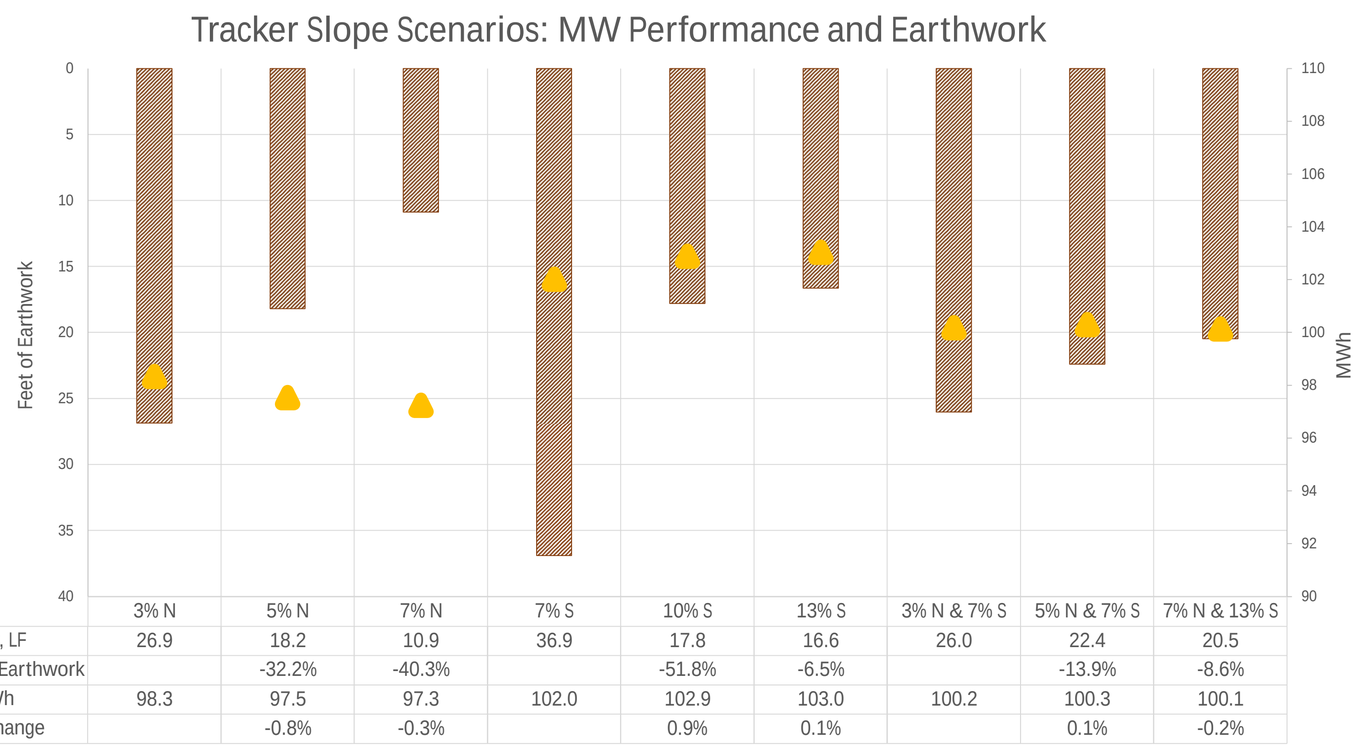
Incorporating terrain and top of pile elevations increases the accuracy of energy performance models.

Incorporating PV Tune civil and structural software with PV lib to incorporate new constraints into production modeling

Erik Strock, PE; Ben Hunter, PE; Alan Toppan, PE



	3% N	5% N	7% N	7% S	10% S	13% S	3% N & 7% S	5% N & 7% S	7% N & 13% S
Earthwork, LF	26.9	18.2	10.9	36.9	17.8	16.6	26.0	22.4	20.5
% Change Earthwork		-32.2%	-40.3%		-51.8%	-6.5%		-13.9%	-8.6%
Yearly MWh	98.3	97.5	97.3	102.0	102.9	103.0	100.2	100.3	100.1
% MWh Change		-0.8%	-0.3%		0.9%	0.1%		0.1%	-0.2%

Intro

- Current methods for modeling energy performance do not accurately account for the diversity of terrain and top of pile elevations, especially with the recent implementation of terrain following trackers.
- There is an industry need to account for these civil and structural constraints in performance modeling.
- We hypothesized that incorporating torque tube span slopes into energy performance models (using Kimley-Horn's proprietary solar analysis tool, PV Tune and Sandia National Labs PV Lib), would result in more accurate output estimates compared to traditional methods.

Method

1. Researchers used PV Tune to generate accurate torque tube slopes (see figures 1-3). These slopes were split into individual torque tube sections between tracker piles or spans.
2. 9 different scenarios with various span slopes were created: 3 for a north facing tracker, 3 for a south facing tracker, and 3 for the terrain following tracker.
3. The 9 different scenarios were all run in PV Lib and a yearly MWh per tracker was generated.

Results

- Increasing the north facing slopes resulted in a 0.8% and 0.3% reduction in yearly MWh and a 32.2% and 40.3% reduction in earthwork cut/fill depths.
- Similarly, increasing the south facing slopes resulted in a 0.9% and 0.1% increase in yearly MWh with a 51.8% and a 6.5% decrease in earthwork cut/fill depths.
- Terrain following trackers showed a relatively consistent yearly MWh across all scenarios but there was a 13.9% and 8.6% decrease in cut/fill depths.

Discussion

- Failure to account for the varied tracker span slopes in a solar array could account for inaccuracies in performance modelling.
- Allowing for steeper slopes in energy modelling in both the north and south direction can significantly decrease earthwork needs.
- Modelling multiple different slope scenarios should be performed during early-stage site designs should be done by designers to determine the optimum set of slope constraints.

Figure 1. North Facing Slope

Figure 2. South Facing Slope

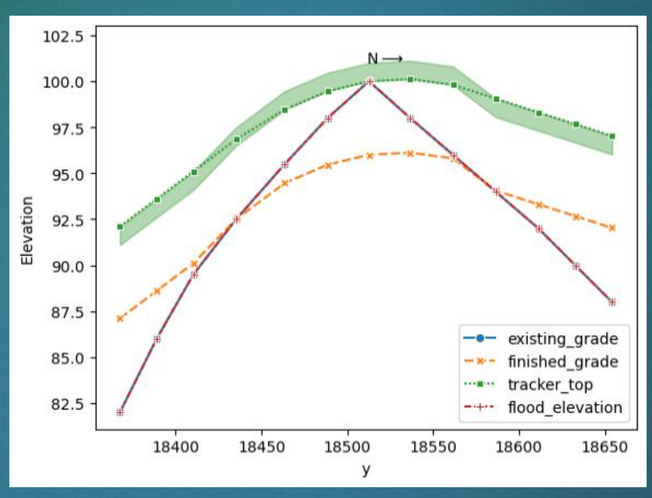


Figure 3. Terrain Following Tracker

Contact Us


Erik Strock, PE | Denver, CO
Erik.Strock@kimley-horn.com


Ben Hunter, PE| Sacramento, CA
Ben.Hunter@kimley-horn.com


Alan Toppen, PE| Reston, VA
Alan.Toppen@kimley-horn.com

References

Anderson, K., Hansen, C., Holmgren, W., Jensen, A., Mikofski, M., and Driesse, A. 'pvlib python: 2023 project update'. Journal of Open Source Software, 8(92), 5994, (2023). DOI: 10.21105/joss.05994

Kimley-Horn. *PV Tune* [Software]. (2024). Retrieved from https://www.kimley-horn.com/solutions/renewable-energy/pv-tune/

Learn more about PV Tune and Kimley-Horn's cutting-edge solar consulting work!

SITING + PERMITTING

Kimley»Horn

Expect More. Experience Better.