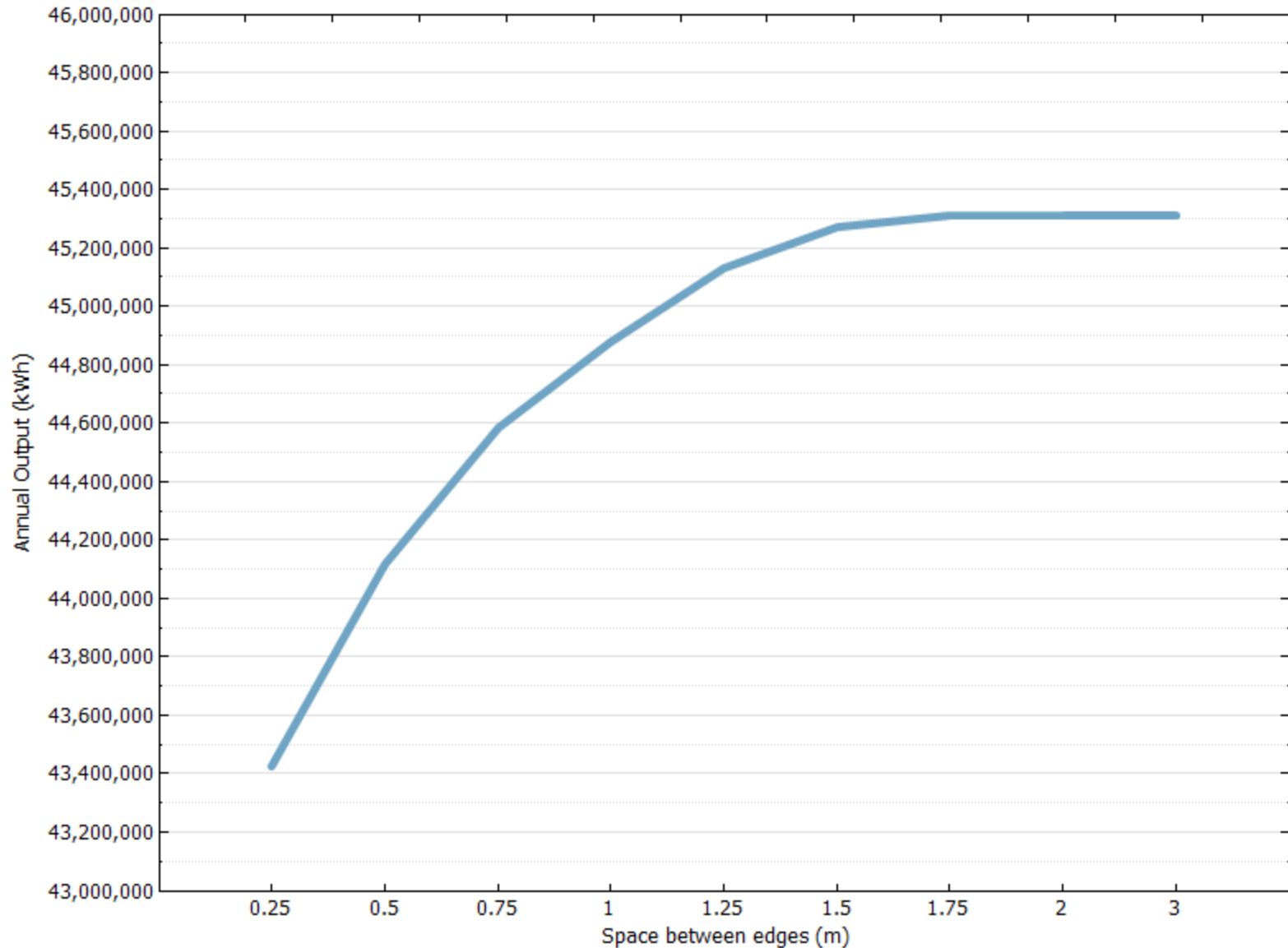


SAM Backtracking Test

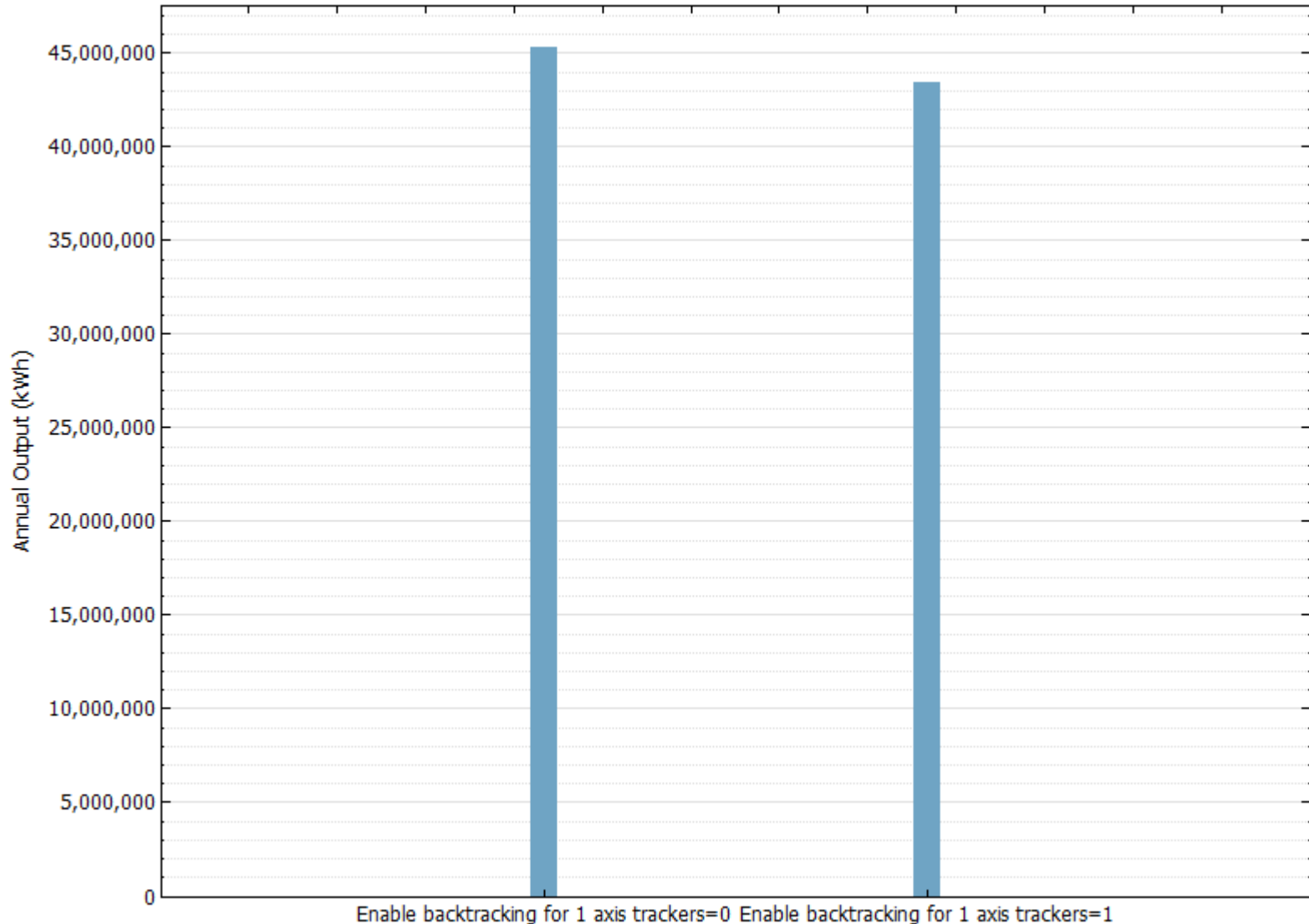
Paul Gilman

March 5, 2013

With backtracking, annual energy increases with space between edges. (20 MW system with 45 degree tracker rotation limit)



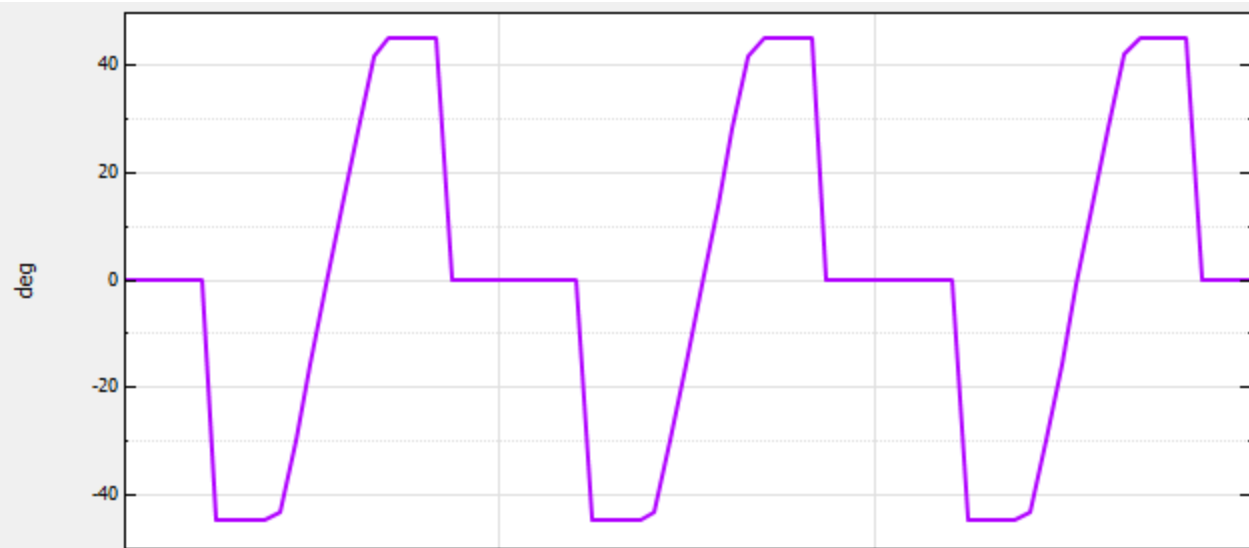
Note! The annual output with backtracking is less than without backtracking because SAM does not model row-to-row shading when backtracking is disabled. (20 MW system with and without backtracking)



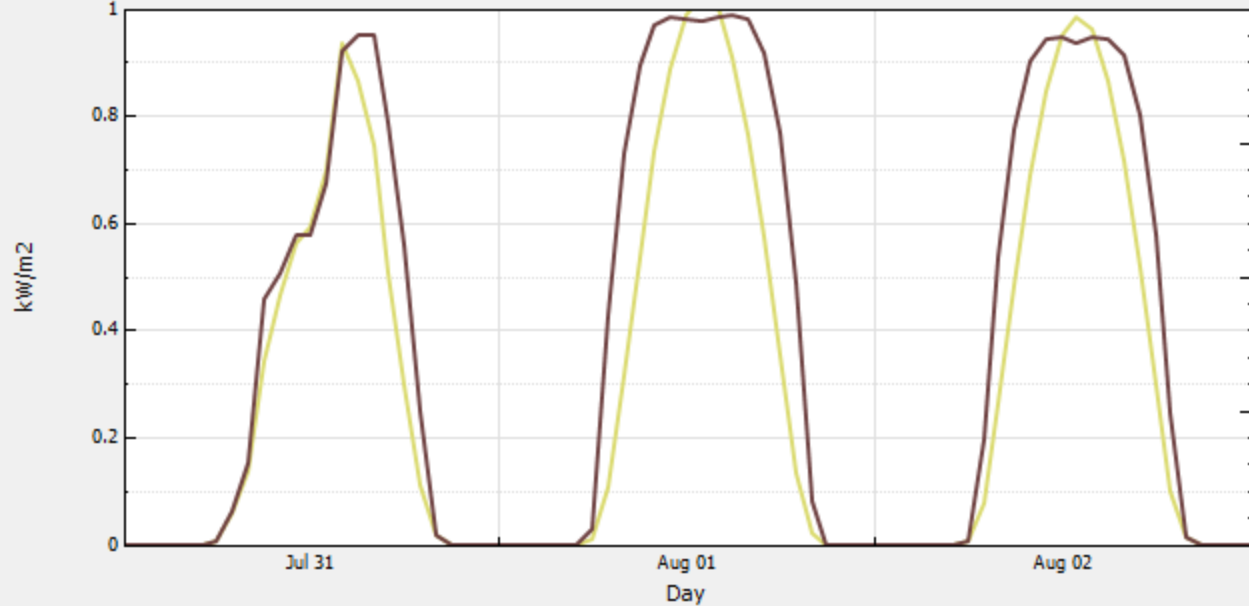
- With backtracking disabled, SAM assumes that there is no row-to-row shading
- Comparing a case with backtracking to one without backtracking does not show the benefit of backtracking

Backtracking disabled and 45 degree rotation limit, summer

Axis rotation

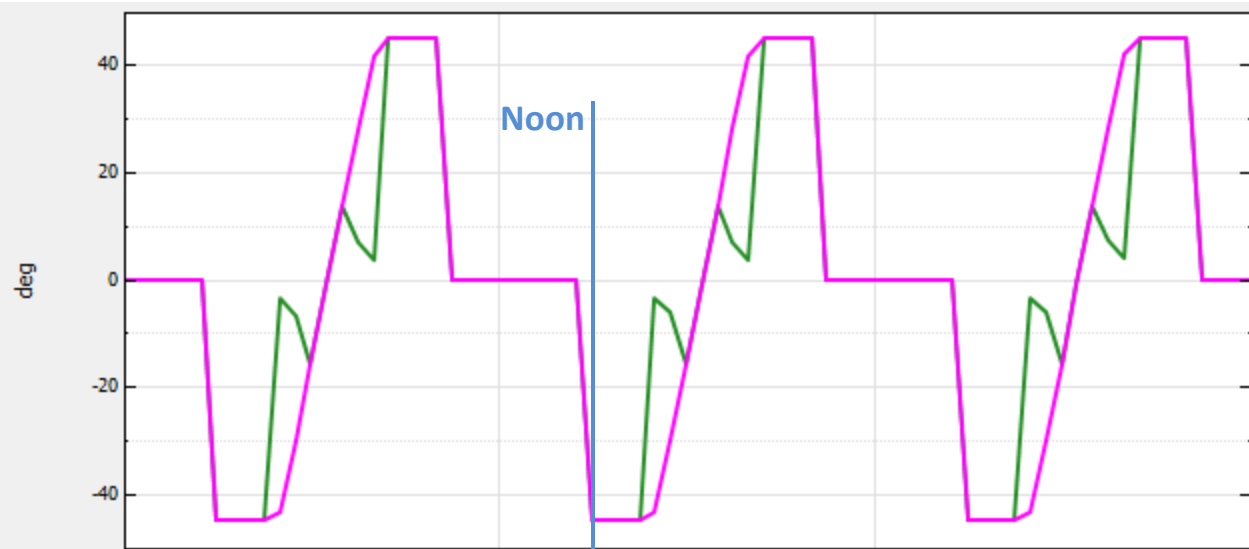


GHI (yellow) and total incident (brown) radiation

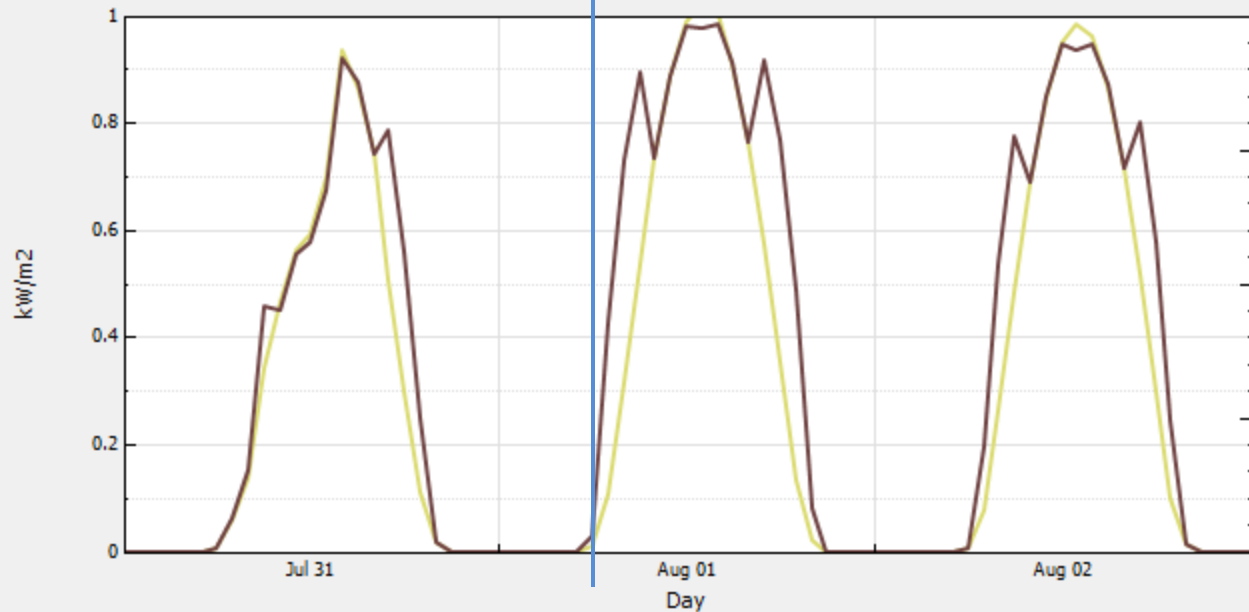


Backtracking enabled and 45 degree rotation limit, summer

Ideal (equivalent to no backtracking, pink), and with backtracking (green) axis rotation.

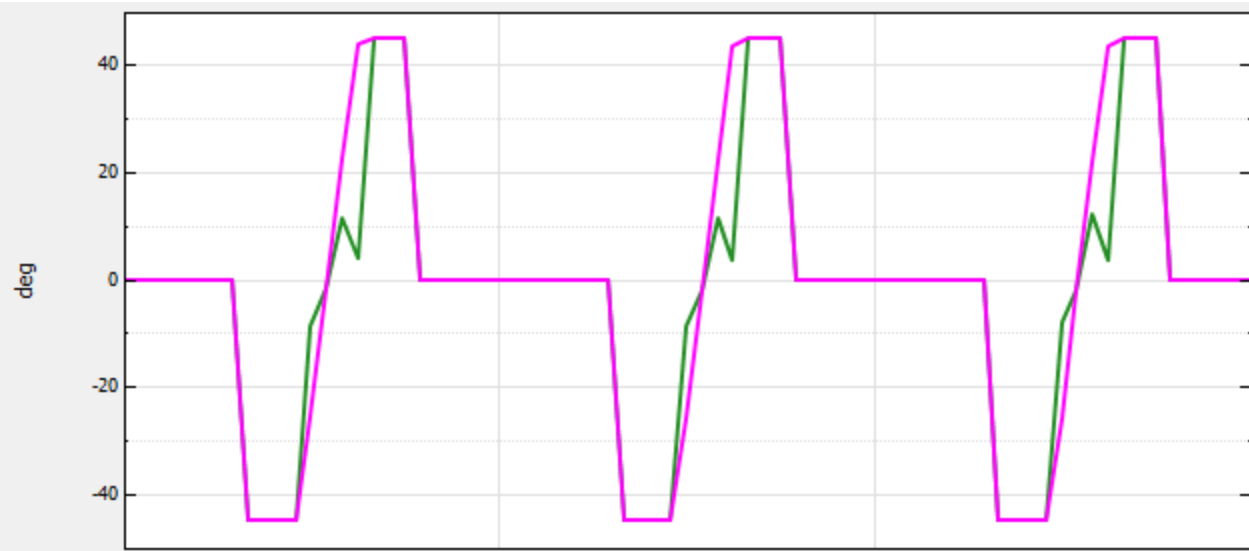


GHI (yellow) and total incident (brown) radiation: Total incident radiation over a 24-hour period is more than with backtracking in previous slide.

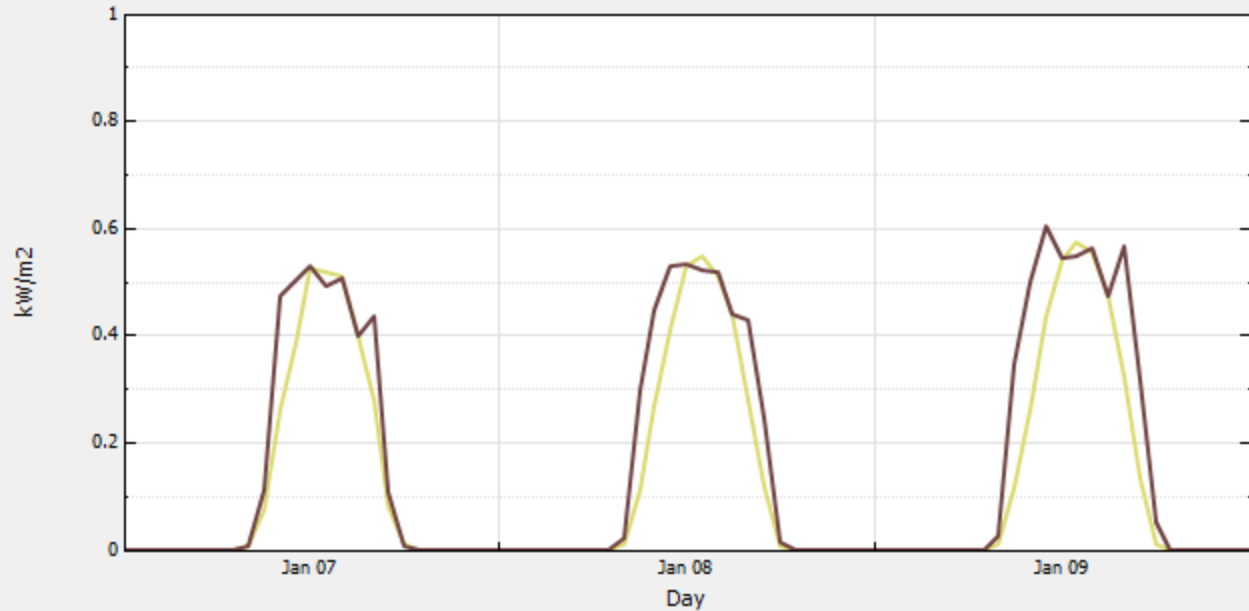


Backtracking enabled and 45 degree rotation limit, winter

Ideal (pink), and with backtracking (green) axis rotation.



GHI (yellow) and total incident (brown) radiation



Axis rotation angle for different rotation limits (backtracking disabled)

Hour	Limit = 15°	Limit = 30°	Limit = 45°	Limit = 60°	Limit = 75°
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	-15	-30	-45	-60	-75
9	-15	-30	-45	-60	-75
10	-15	-30	-45	-60	-63.6057
11	-15	-30	-45	-46.092	-46.092
12	-15	-24.8934	-24.8934	-24.8934	-24.8934
13	-0.624509	-0.624509	-0.624509	-0.624509	-0.624509
14	15	23.7328	23.7328	23.7328	23.7328
15	15	30	45	45.1133	45.1133
16	15	30	45	60	62.7907
17	15	30	45	60	75
18	15	30	45	60	75
19	0	0	0	0	0
20	0	0	0	0	0
21	0	0	0	0	0
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0

Rotation limit forces tracker to stop during hours when the ideal rotation angle is greater than the rotation limit.

Axis rotation angle for different rotation limits (backtracking enabled)

Hour	Limit = 15°	Limit = 30°	Limit = 45°	Limit = 60°	Limit = 75°
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0
7	0	0	0	0	0
8	-15	-30	-45	-60	-75
9	-15	-30	-45	-60	-75
10	-15	-30	-45	-60	-1.60573
11	-15	-30	-45	-3.09202	-3.09202
12	-15	-8.89345	-8.89345	-8.89345	-8.89345
13	-0.624509	-0.624509	-0.624509	-0.624509	-0.624509
14	15	9.7328	9.7328	9.7328	9.7328
15	15	30	3.11331	3.11331	3.11331
16	15	30	45	60	1.79069
17	15	30	45	60	75
18	15	30	45	60	75
19	0	0	0	0	0
20	0	0	0	0	0
21	0	0	0	0	0
22	0	0	0	0	0
23	0	0	0	0	0
24	0	0	0	0	0

Tracker only backtracks during hours when it would have rotated without backtracking.

Possibilities for improvement

- Include row-to-row shading effects for 1-axis trackers with no backtracking.
- Allow backtracking during hours when ideal axis rotation angle is greater than the rotation limit.