NC STATE UNIVERSITY

Project Part 3: PV Production Modeling and Financial Optimization

Course: ECE 592: Utility Scale Solar PV Systems

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Content

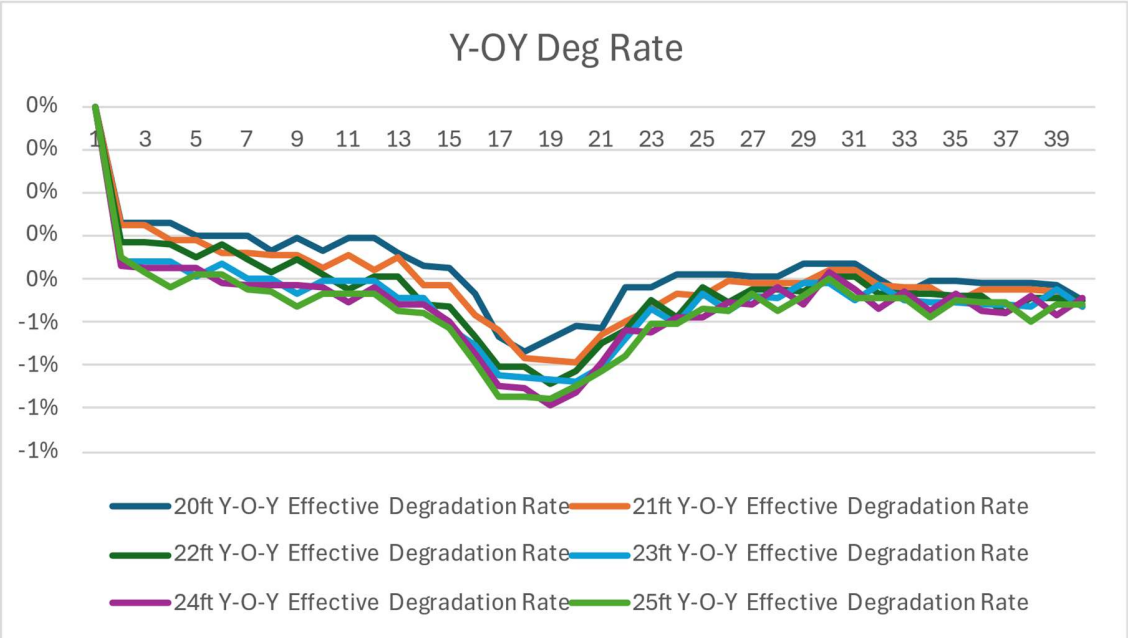
1. North Carolina

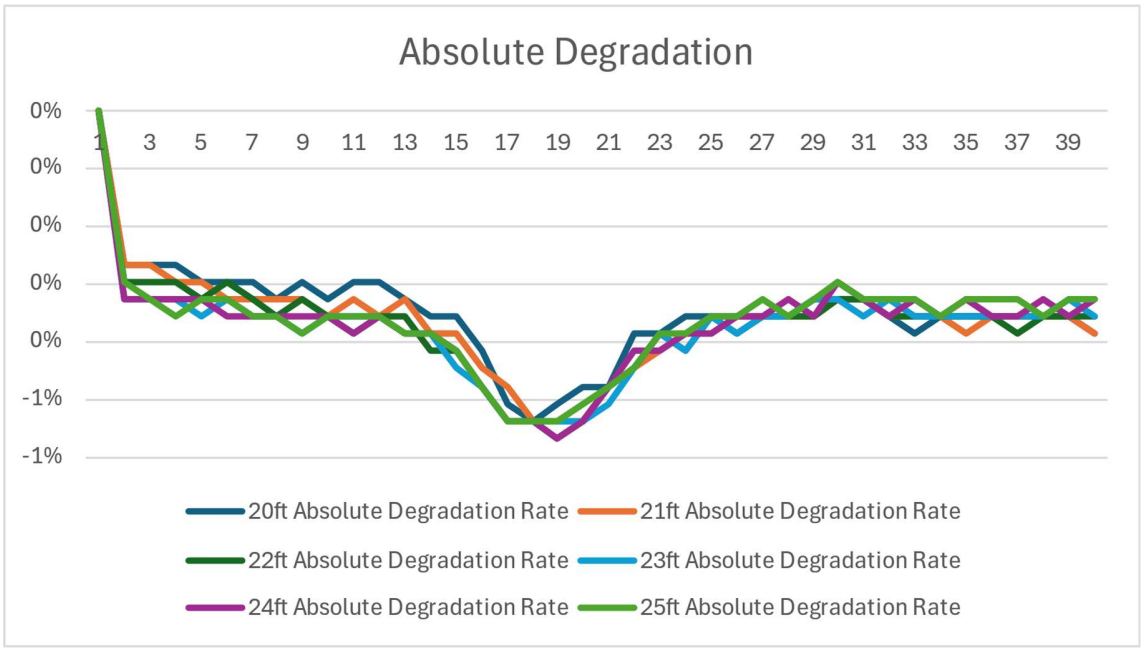
A. Production Modeling

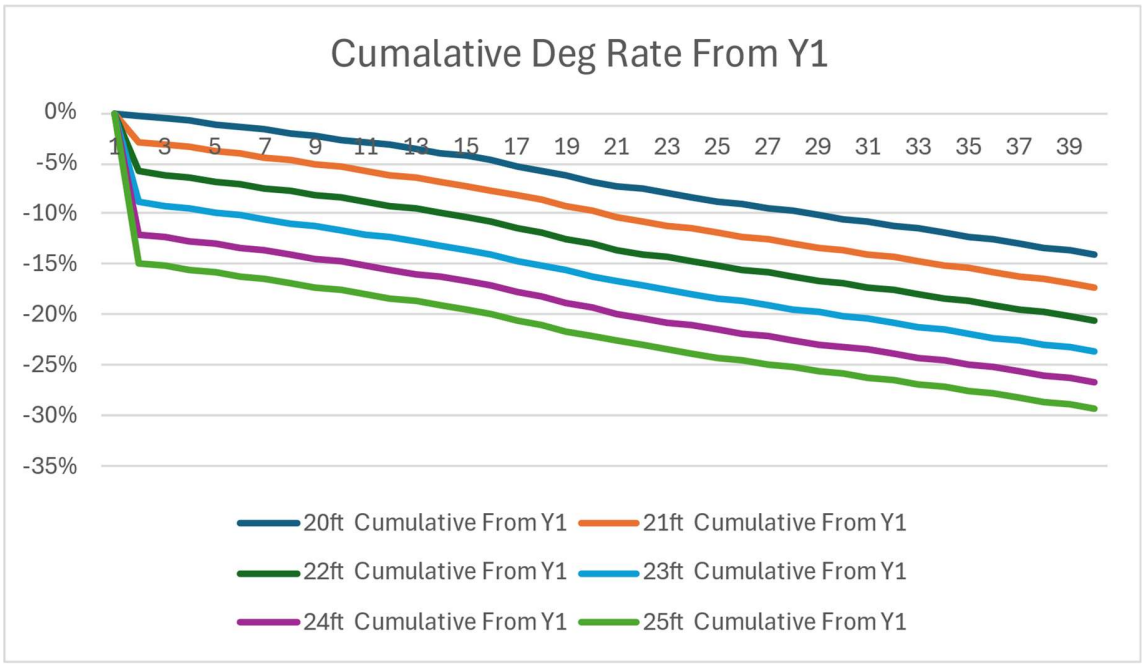
1) Soiling Losses & Albedo

Month	Soiling Losses				Albedo
	PVRADAR (PlantPredict)	Fracsun (PlantPredict)	CPR	Average	NSRDB (PlantPredict)
1	0.10	0.17	16.90	5.72	0.68
2	0.09	0.04	11.90	4.01	0.46
3	0.15	0.08	1.70	0.64	0.20
4	0.10	0.02	0.20	0.11	0.23
5	0.09	0.00	0.10	0.06	0.16
6	0.16	0.00	0.20	0.12	0.17
7	0.13	0.09	0.20	0.14	0.19
8	0.14	0.08	0.10	0.11	0.19
9	0.17	0.07	0.10	0.11	0.17
10	0.09	0.12	0.20	0.14	0.18
11	0.15	0.11	1.60	0.62	0.18
12	0.16	0.08	13.20	4.48	0.35

2) Calculate Degradation for 40 years (Non-Shade)

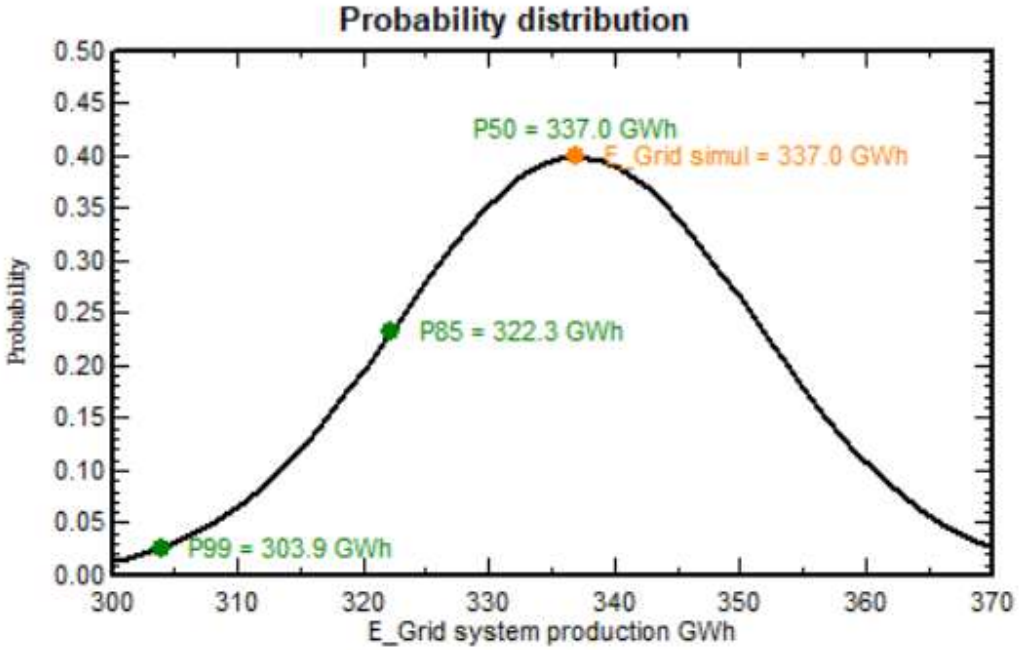



Absolute Degradation
0%
0%
0%
0%
0%
-1%
-1%
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
20ft Absolute Degradation Rate
21ft Absolute Degradation Rate
22ft Absolute Degradation Rate
23ft Absolute Degradation Rate
24ft Absolute Degradation Rate
25ft Absolute Degradation Rate


Cumalative Deg Rate From Y1
0%
-5%
-10%
-15%
-20%
-25%
-30%
-35%
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39
20ft Cumulative From Y1
21ft Cumulative From Y1
22ft Cumulative From Y1
23ft Cumulative From Y1
24ft Cumulative From Y1
25ft Cumulative From Y1

3) Uncertainty analysis

Probability of Exceedance	First-Year Downside Results (Normalized to P50)	
P50	100 %	337.0 GWh
P75	97.15 %	327.4 GWh
P80	99.27 %	325.0 GWh
P85	99.17 %	322.3 GWh
P90	98.91 %	318.8 GWh
P95	98.40 %	313.7 GWh
P99	96.88 %	303.9 GWh



4) Sub-hourly analysis for Each Scenarios

Pitch (m)	Pitch (ft)	Number of Strings	E_Grid (GWh)
6.1	20	12011	335.3
6.4	21	11466	326.5
6.7	22	10942	316.7
7.01	23	10460	306.8
7.32	24	10012	296.2
7.62	25	9629	286.7

B. Financial Modeling

1) NPV for Each Scenarios

Pitch (ft)	20	21	22	23	24	25
After Tax IRR	11.49%	11.35%	10.95%	10.65%	10.24%	9.82%
After Tax NPV	$45,281	$40,849	$34,107	$29,050	$23,297	$18,095

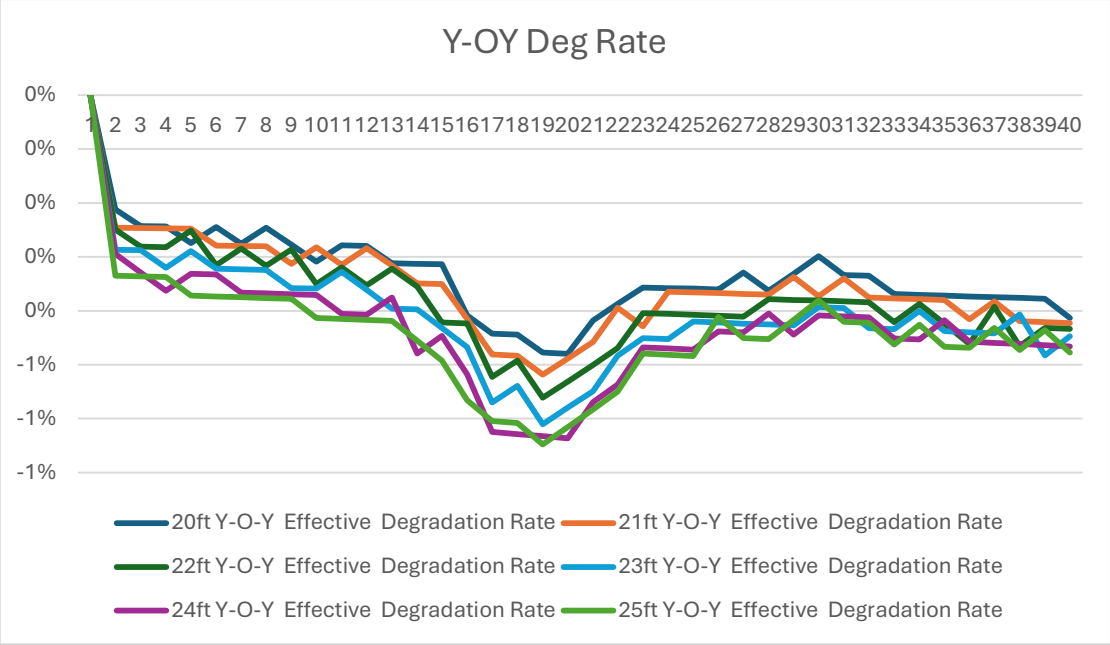
2. Illinois

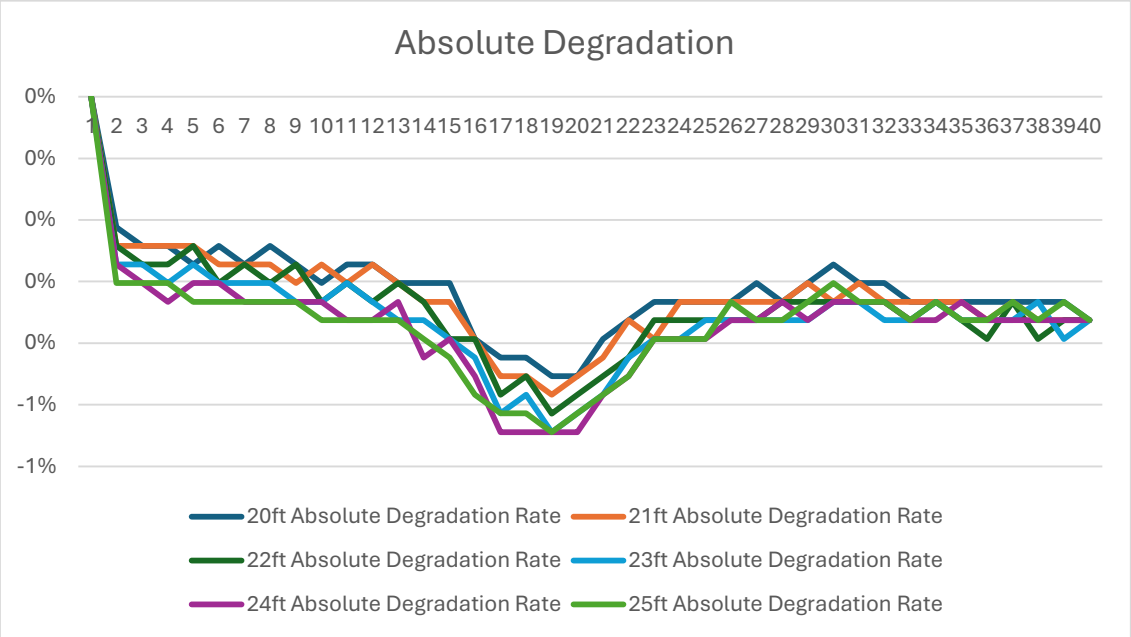
A. Production Modeling

1) Soiling Losses & Albedo

Month	Soiling Losses				Albedo
	PVRADAR (PlantPredict)	Fracsun (PlantPredict)	CPR	Average	NSRDB (PlantPredict)
1	0.06	0.02	2.20	0.76	0.14
2	0.07	0.01	1.20	0.43	0.16
3	0.10	0.02	0.40	0.17	0.17
4	0.10	0.01	0.10	0.07	0.16
5	0.15	0.00	0.20	0.12	0.17
6	0.10	0.00	0.20	0.10	0.18
7	0.08	0.02	0.20	0.10	0.17
8	0.09	0.13	0.20	0.14	0.17
9	0.20	0.09	0.20	0.16	0.16
10	0.27	0.08	0.20	0.18	0.14
11	0.15	0.12	0.10	0.12	0.13
12	0.07	0.06	0.40	0.18	0.14

2) Calculate Degradation for 40 years (Shade)




Absolute Degradation
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0%
0%
0%
0%
-1%
-1%
20ft Absolute Degradation Rate
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22ft Absolute Degradation Rate
23ft Absolute Degradation Rate
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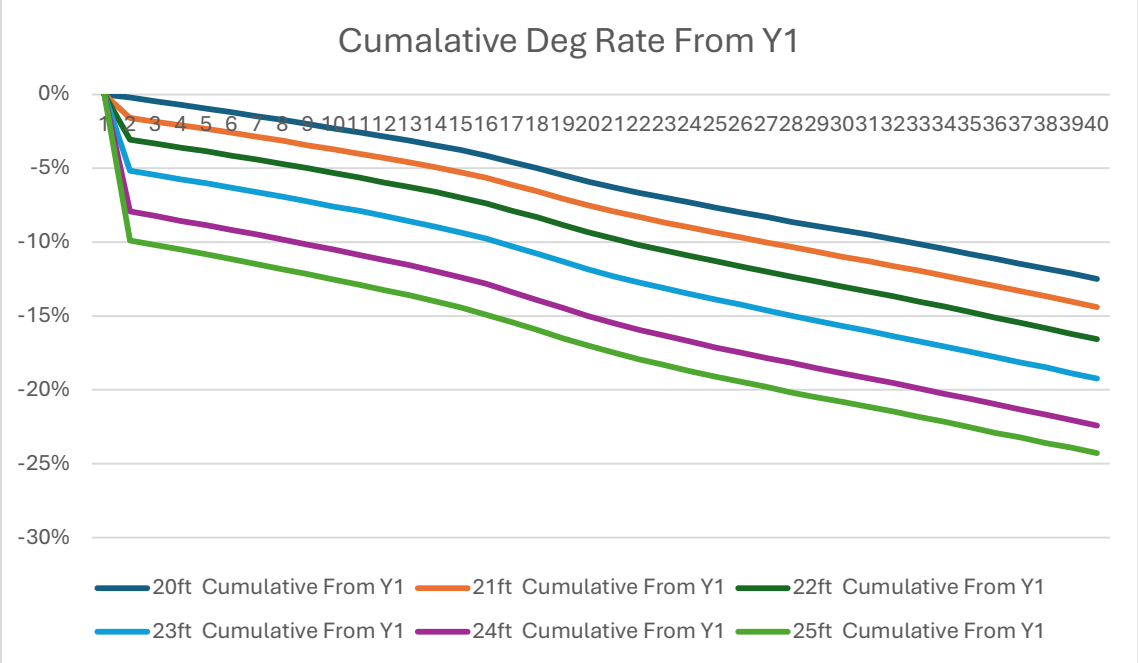
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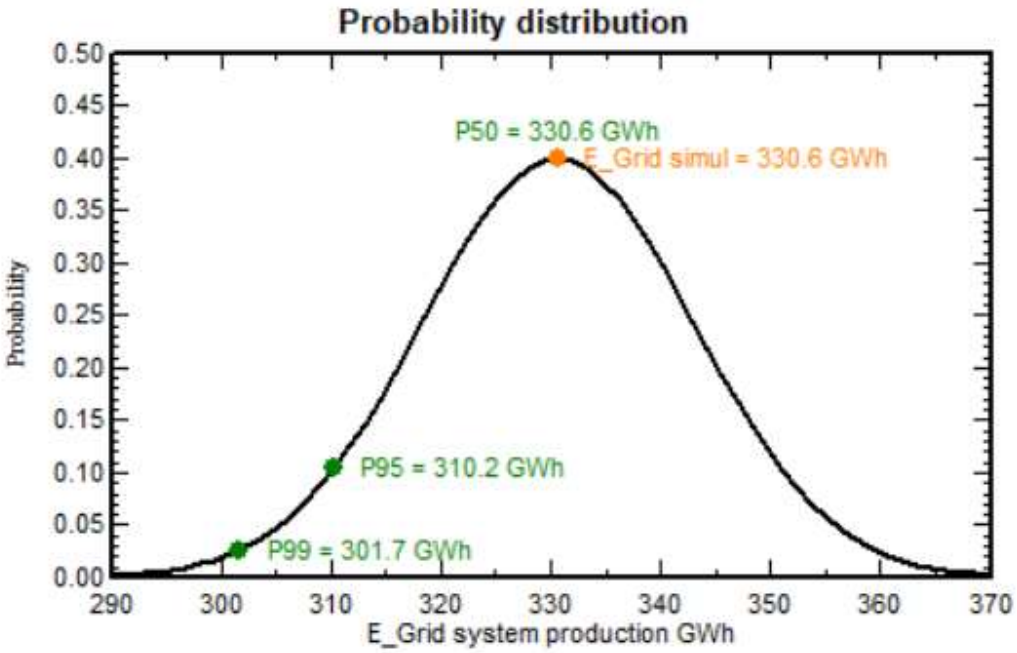
22ft Cumulative From Y1
23ft Cumulative From Y1
24ft Cumulative From Y1
25ft Cumulative From Y1

5) Uncertainty analysis

Probability of Exceedance	First-Year Downside Results (Normalized to P50)	
P50	100 %	330.6 GWh
P75	97.46 %	322.2 GWh
P80	96.85 %	320.2 GWh
P85	96.10 %	317.7 GWh
P90	95.19 %	314.7 GWh
P95	93.83 %	310.2 GWh
P99	91.26 %	301.7 GWh



6) Sub-hourly analysis for Each Scenarios

Pitch (m)	Pitch (ft)	Number of Strings	E_Grid (GWh)
6.1	20	13756	326.2
6.4	21	13344	320.4
6.7	22	12826	312.6
7.01	23	12325	304.3
7.32	24	11769	293.9
7.62	25	11293	284.1

B. Financial Modeling

1) NPV for Each Scenarios

Pitch (ft)	20	21	22	23	24	25
After Tax IRR	10.05%	9.59%	10.03%	9.48%	9.19%	9.13%
After Tax NPV	$29,169	$22,684	$27,933	$19,167	$14,648	$13,265