

Measuring Maximum Plane of Array Irradiance

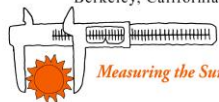
Jim Augustyn

Detecting the Tilt Angle of Maximum Plane of Array Irradiance

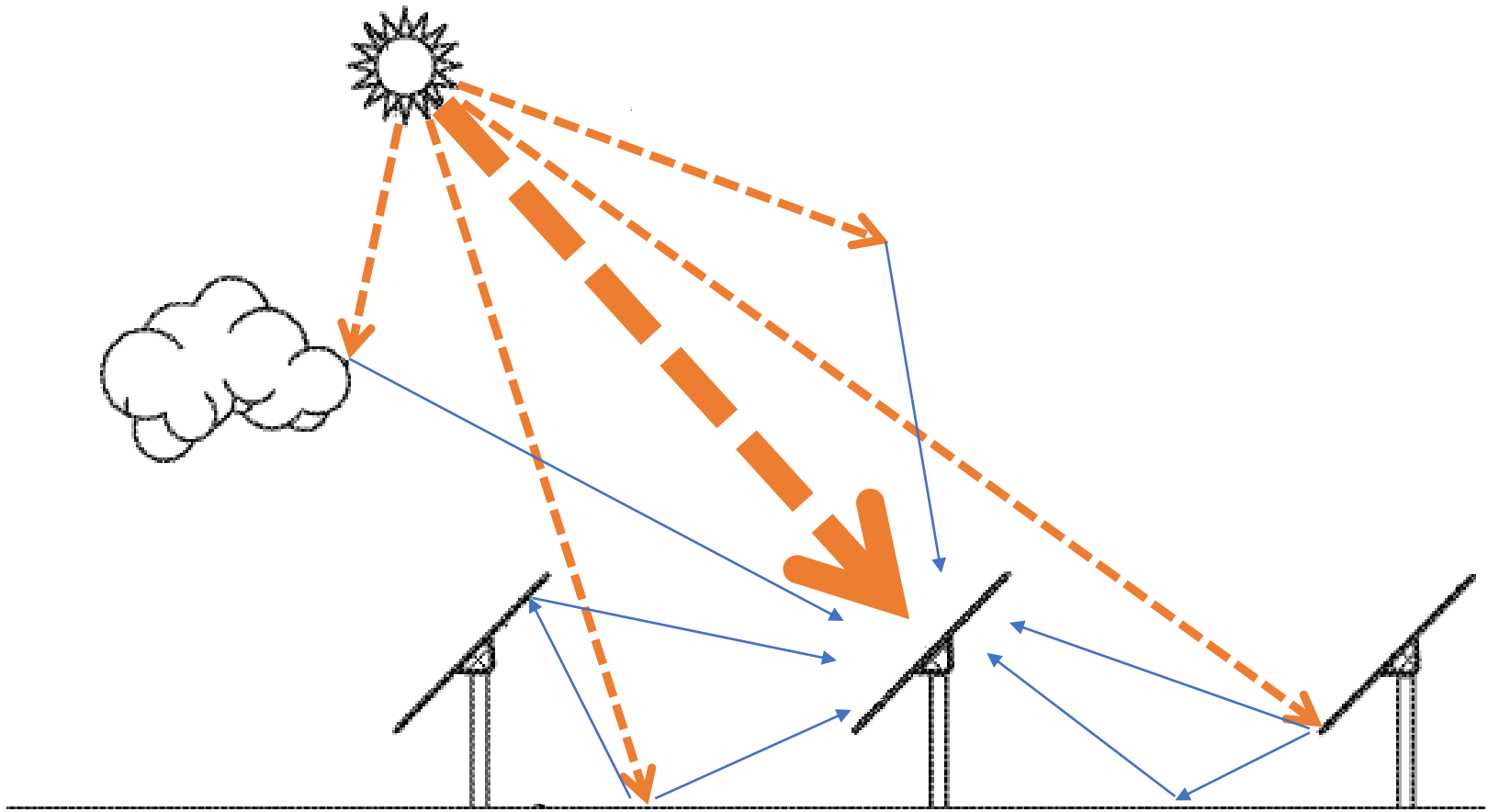
**1986 PG&E
Kerman California
400kw PV Demo Plant
1-axis passive tracking
\$9/watt**



Augustyn & Company
Berkeley, California



Measuring the Sun since 1983



Augustyn & Company

Berkeley, California

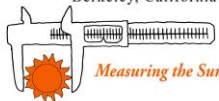


Measuring the Sun since 1983

Irradiance



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Measuring the Sun since 1983

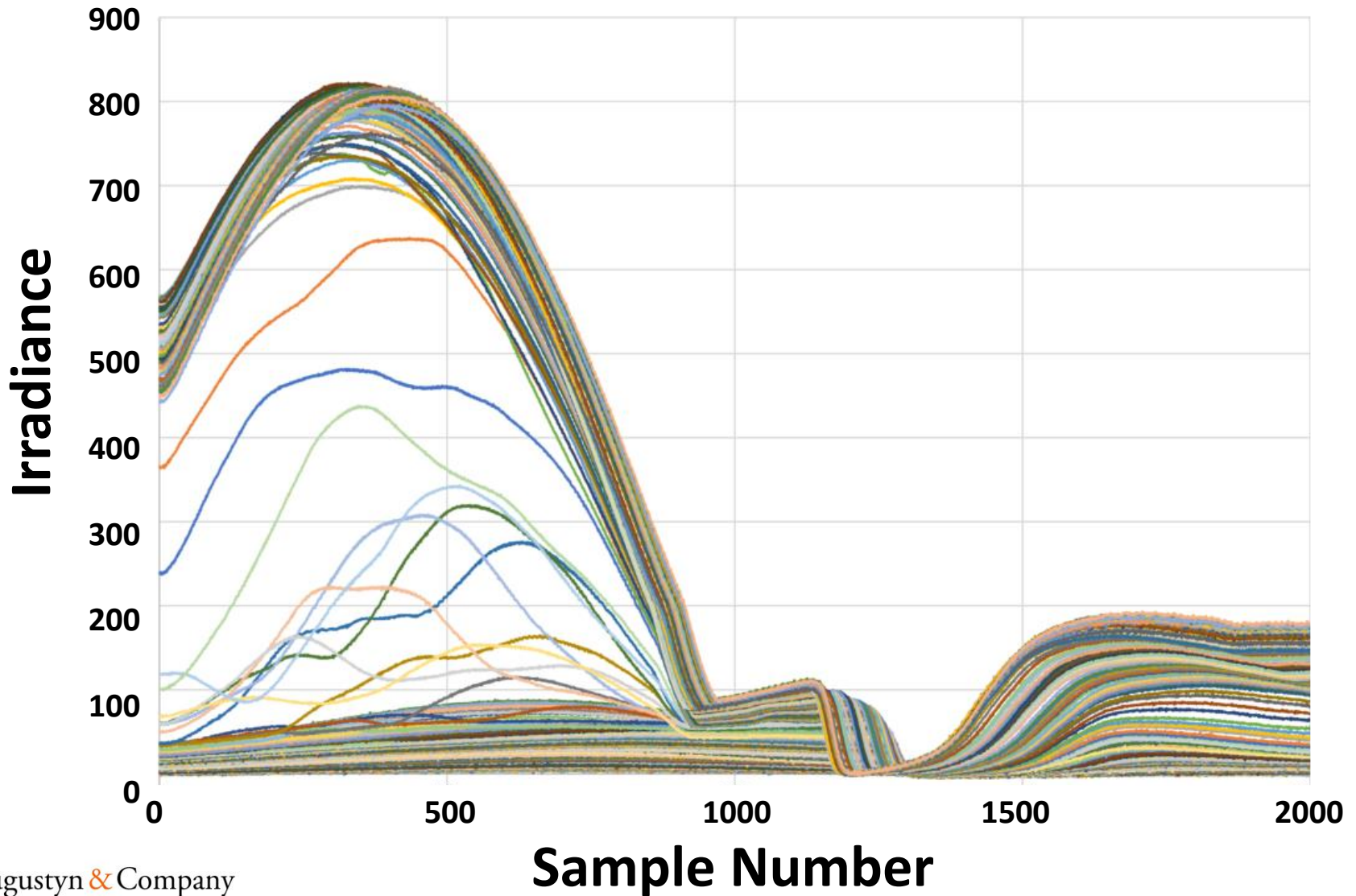
The Rotating Pyranometer Version 1

-patent pending

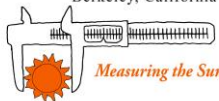


Irradiance vs Sample Number

2017-04-04 Berkeley CA, Sun-Azimuth 85 to 138



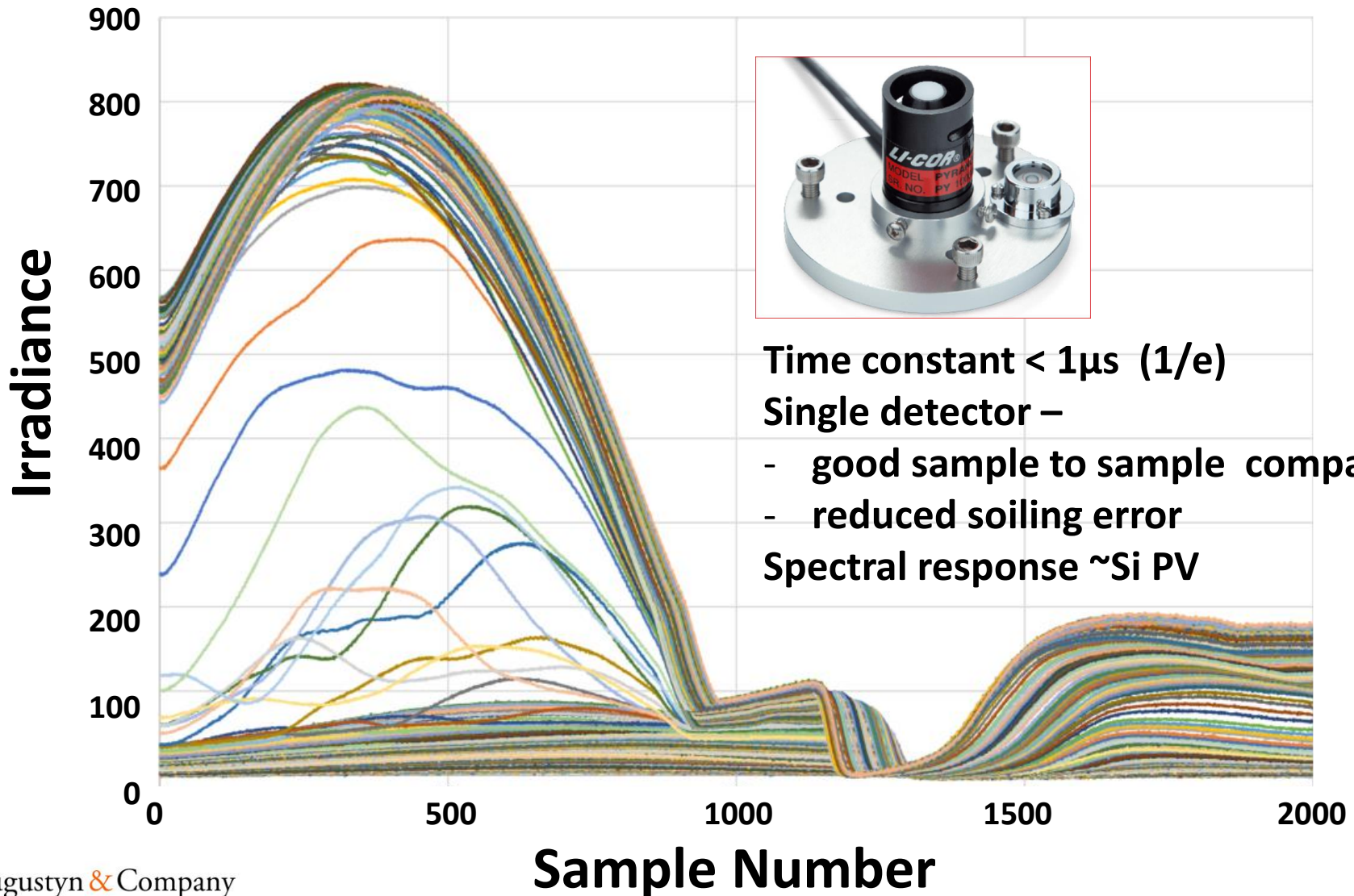
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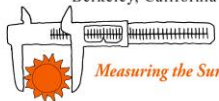
Measuring the Sun since 1983

Irradiance vs Sample Number

2017-04-04 Berkeley CA, Sun-Azimuth 85 to 138



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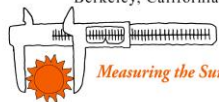
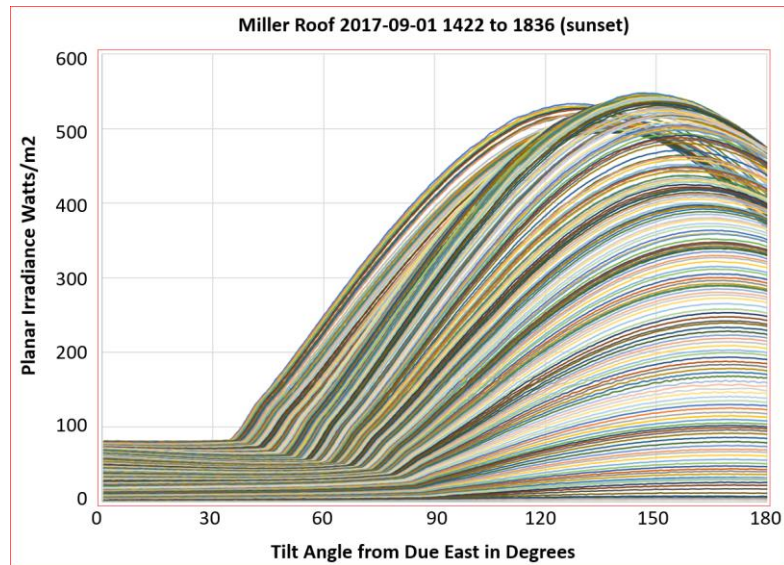
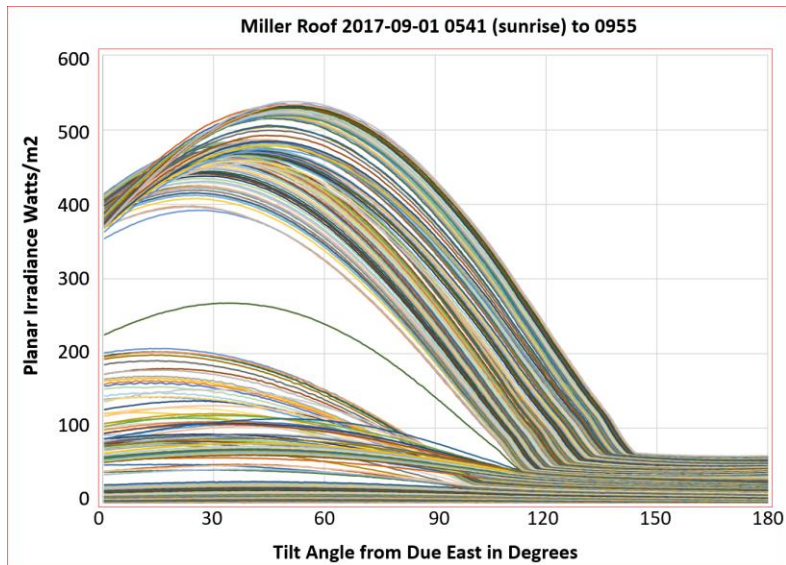
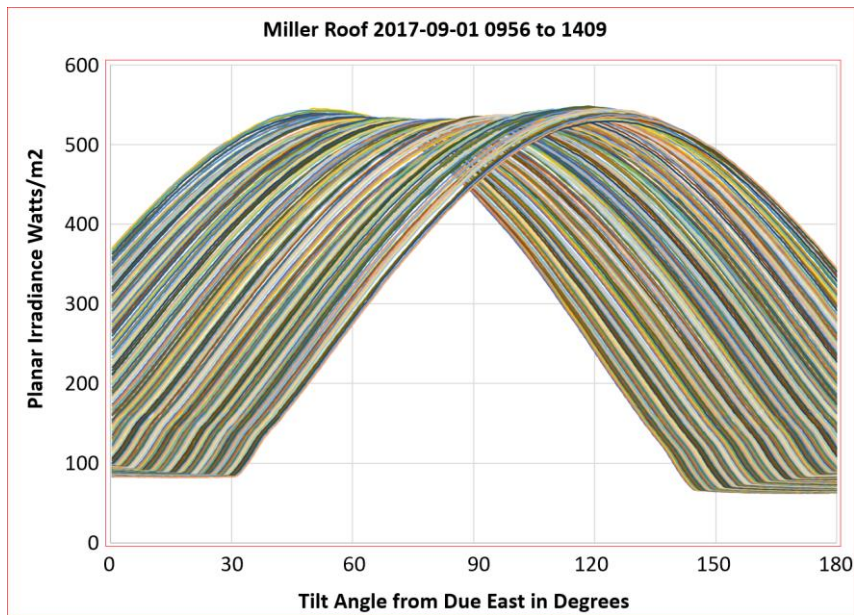
Measuring the Sun since 1983



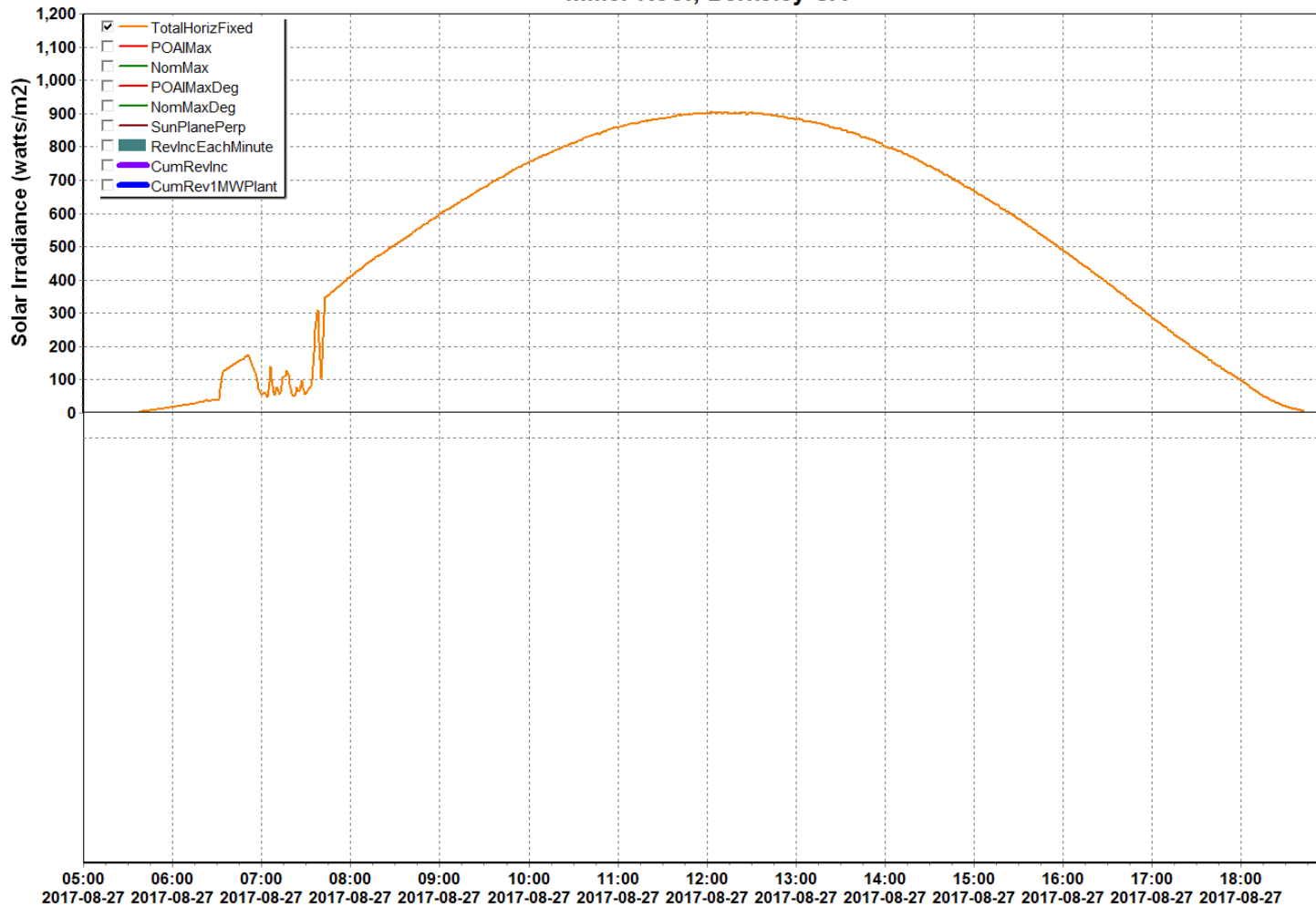
The Rotating Pyranometer Version 2

-patent pending

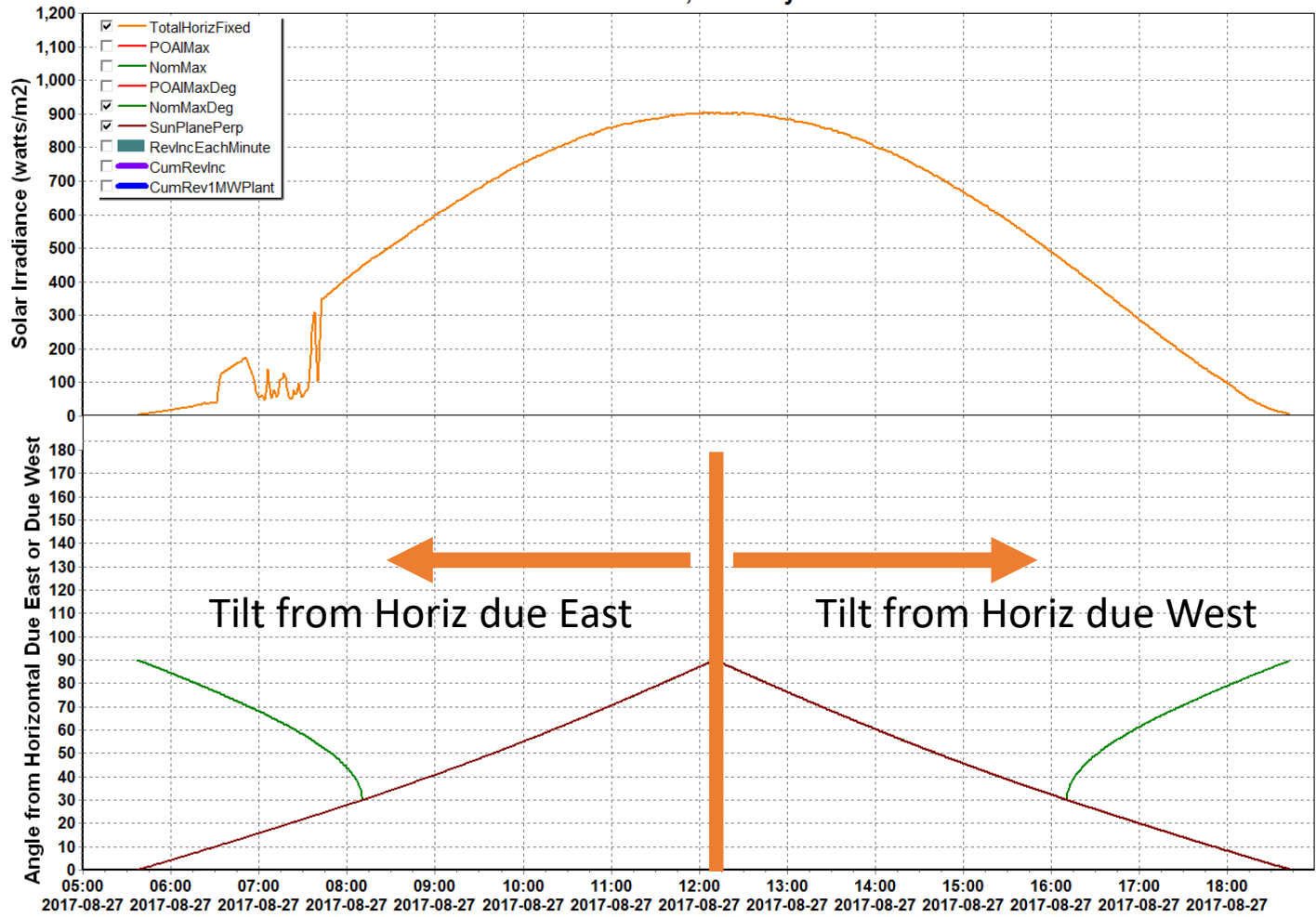




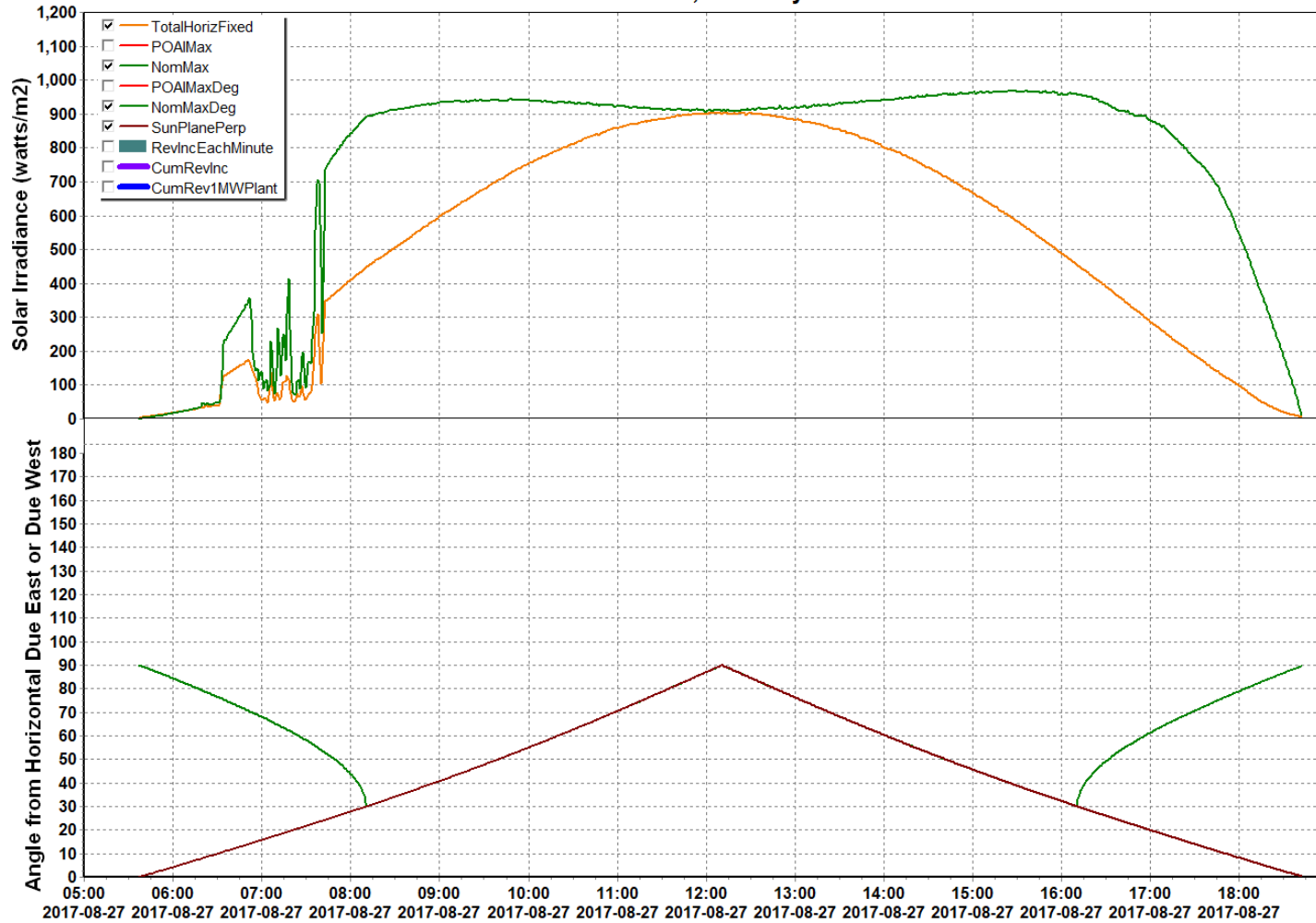
Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



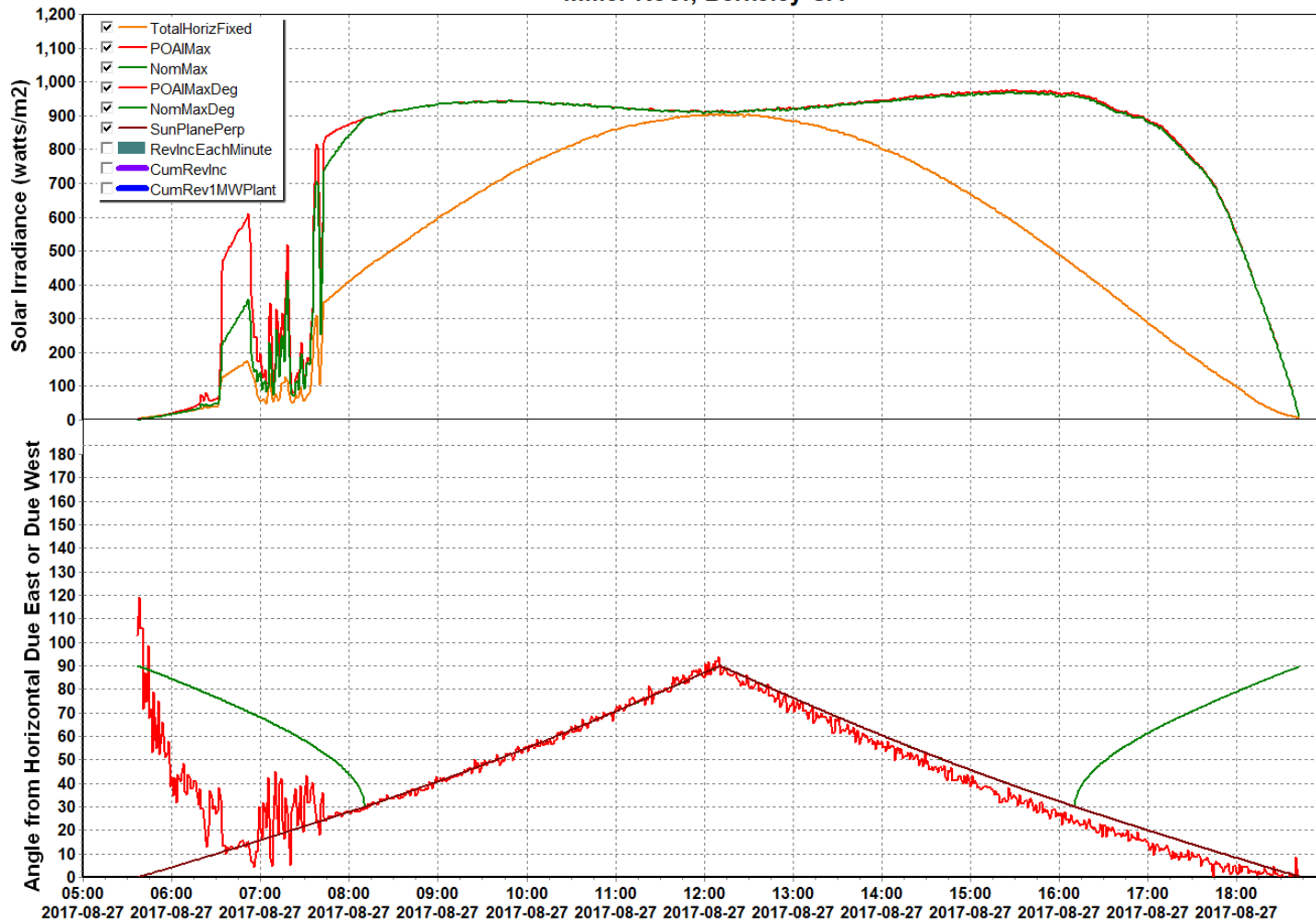
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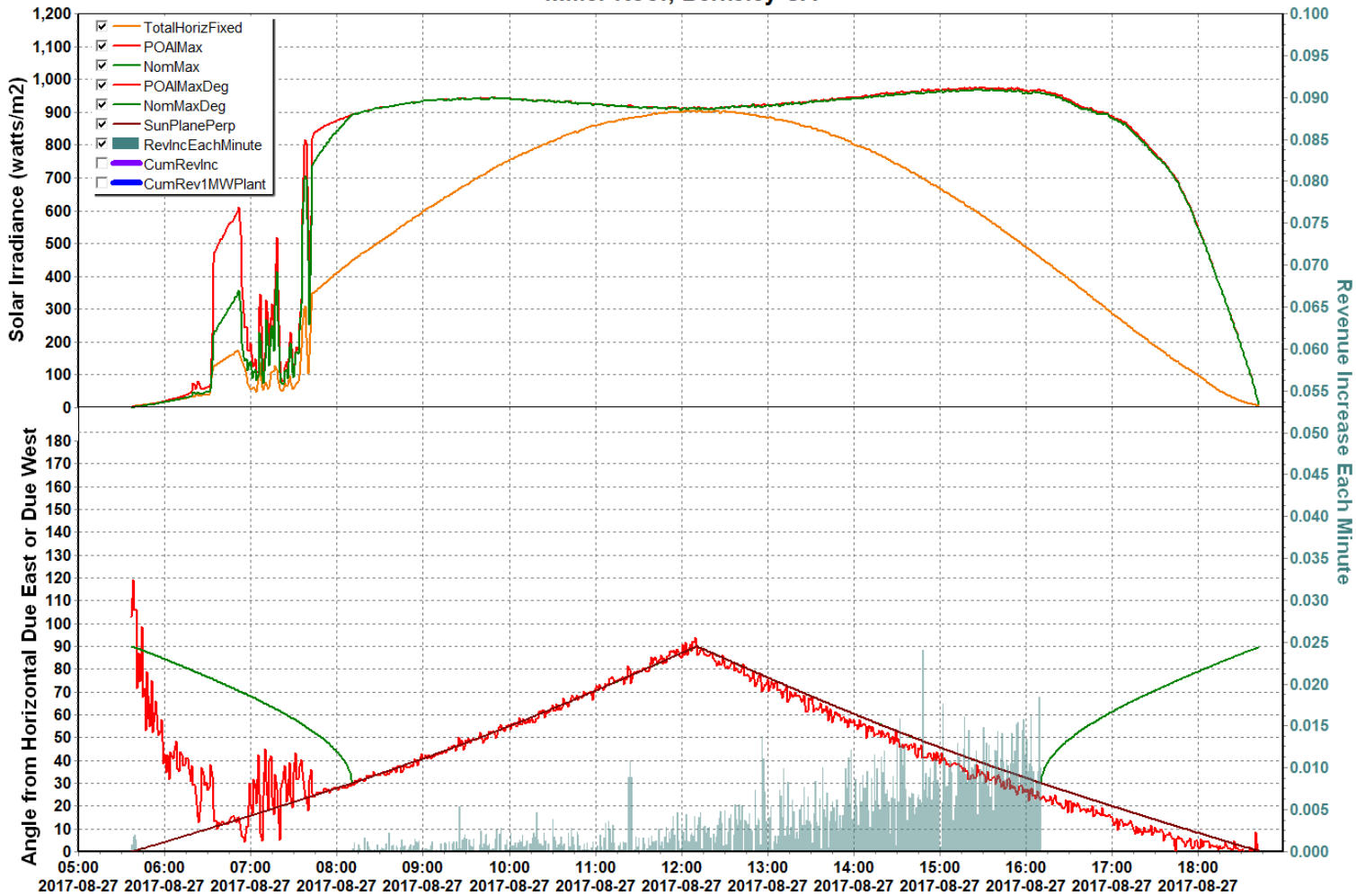
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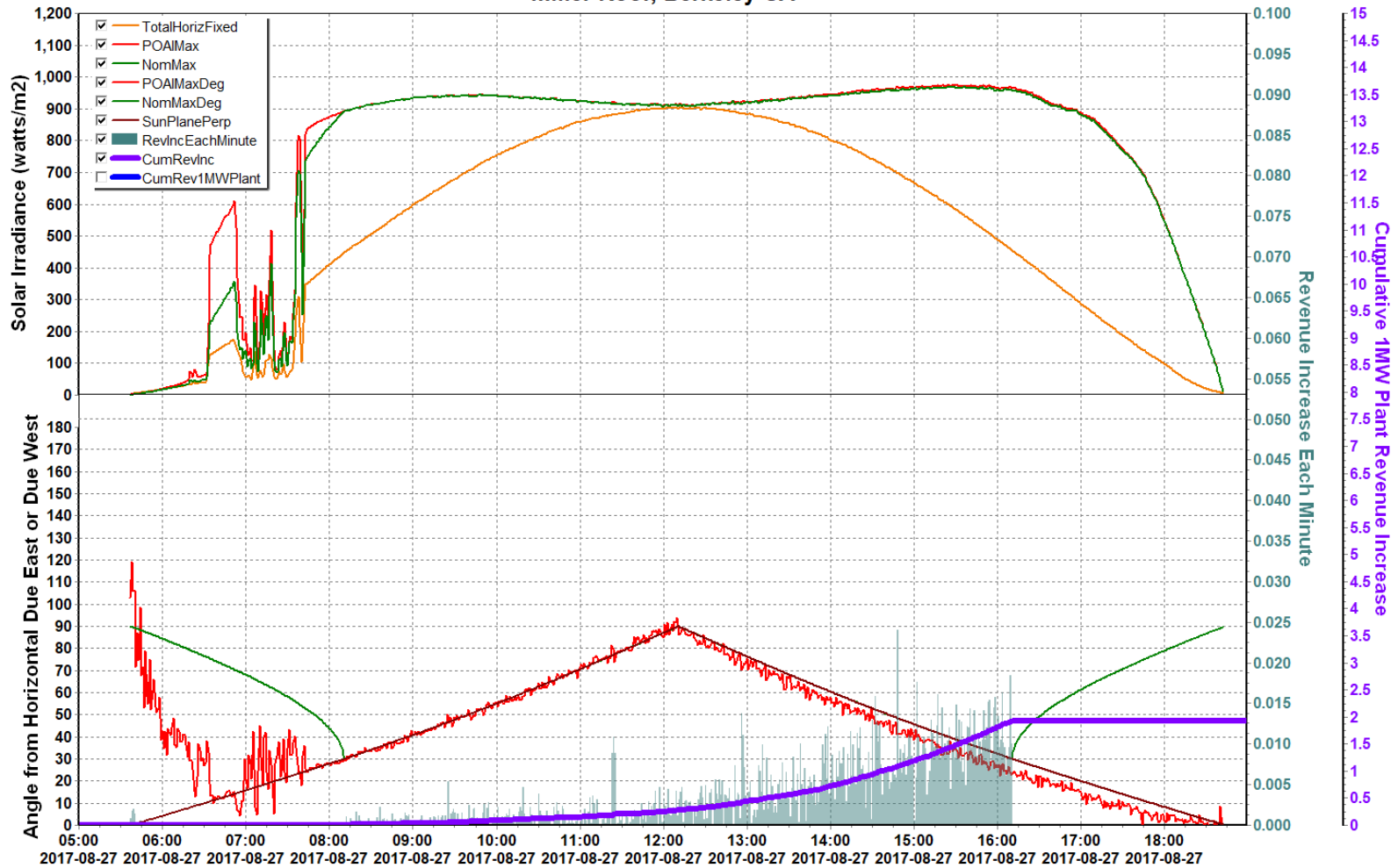
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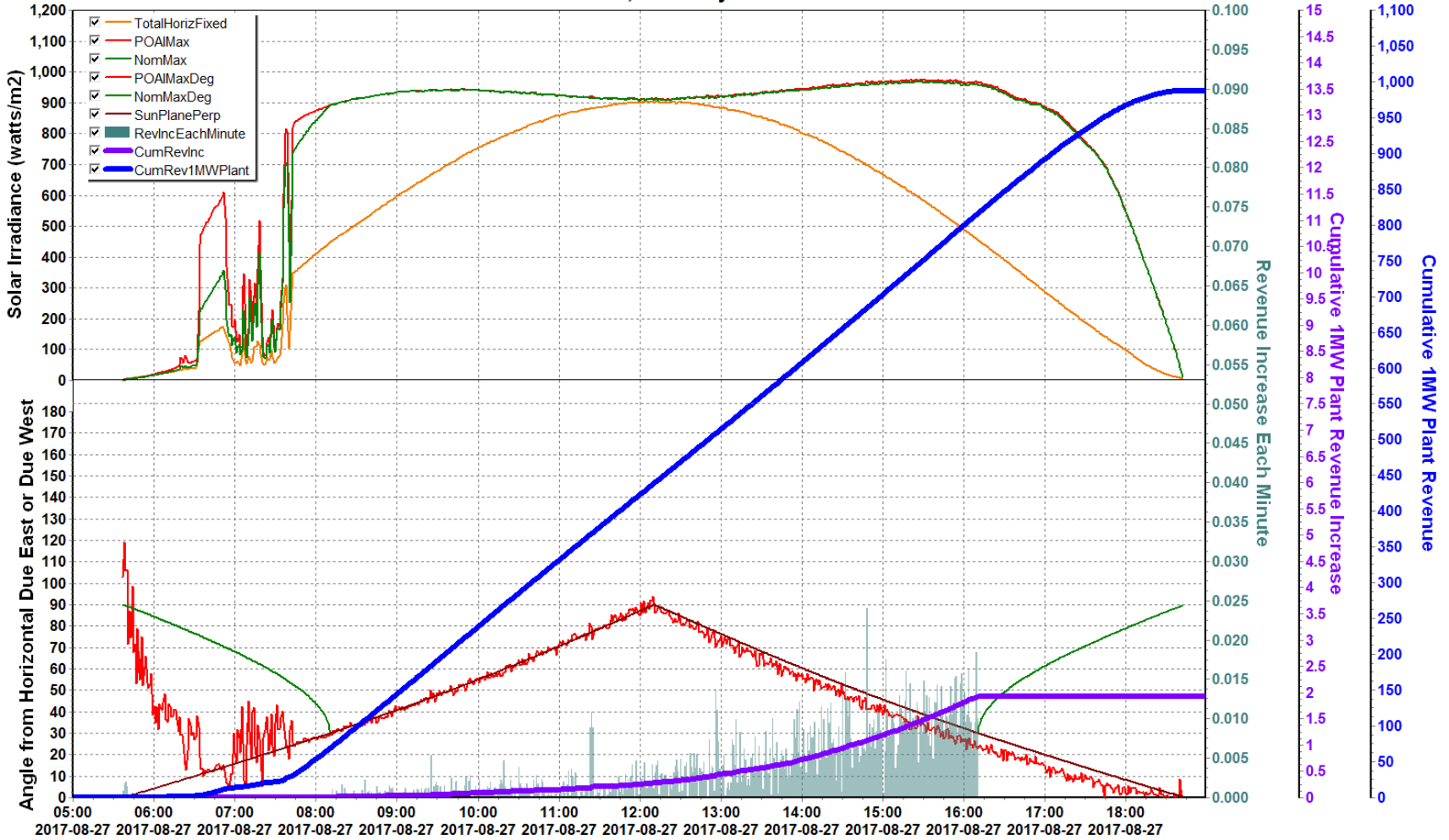
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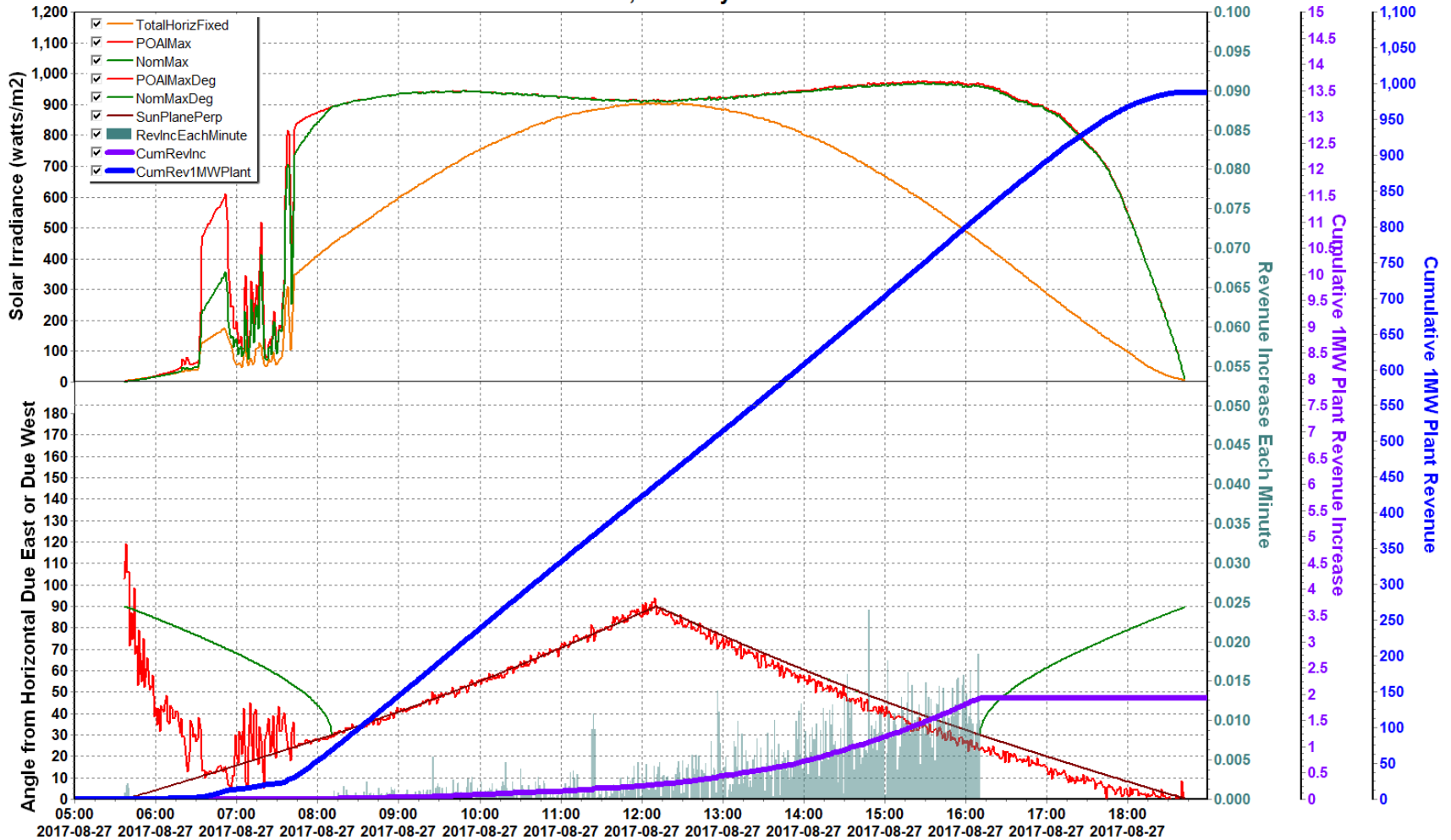
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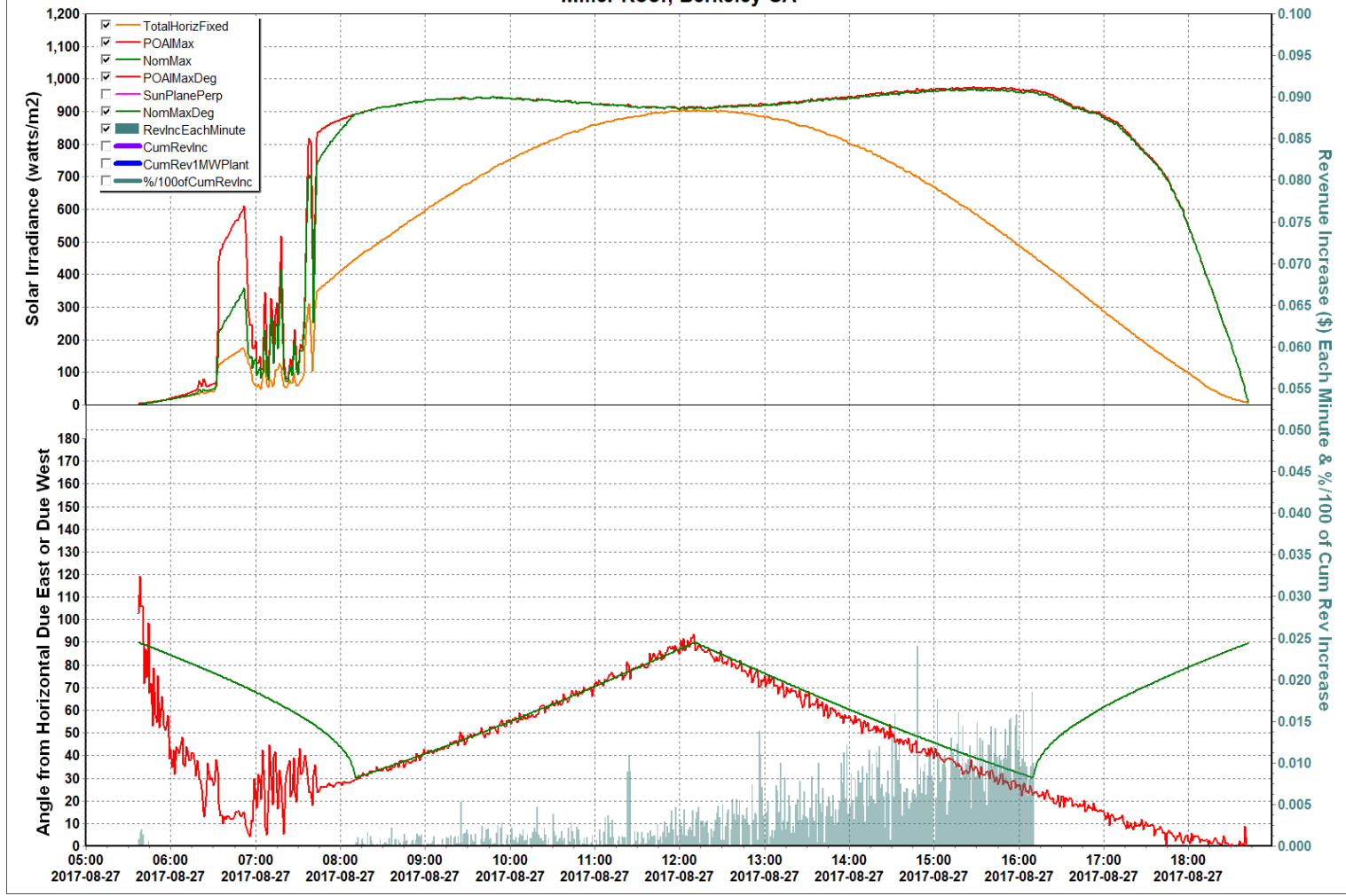


Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



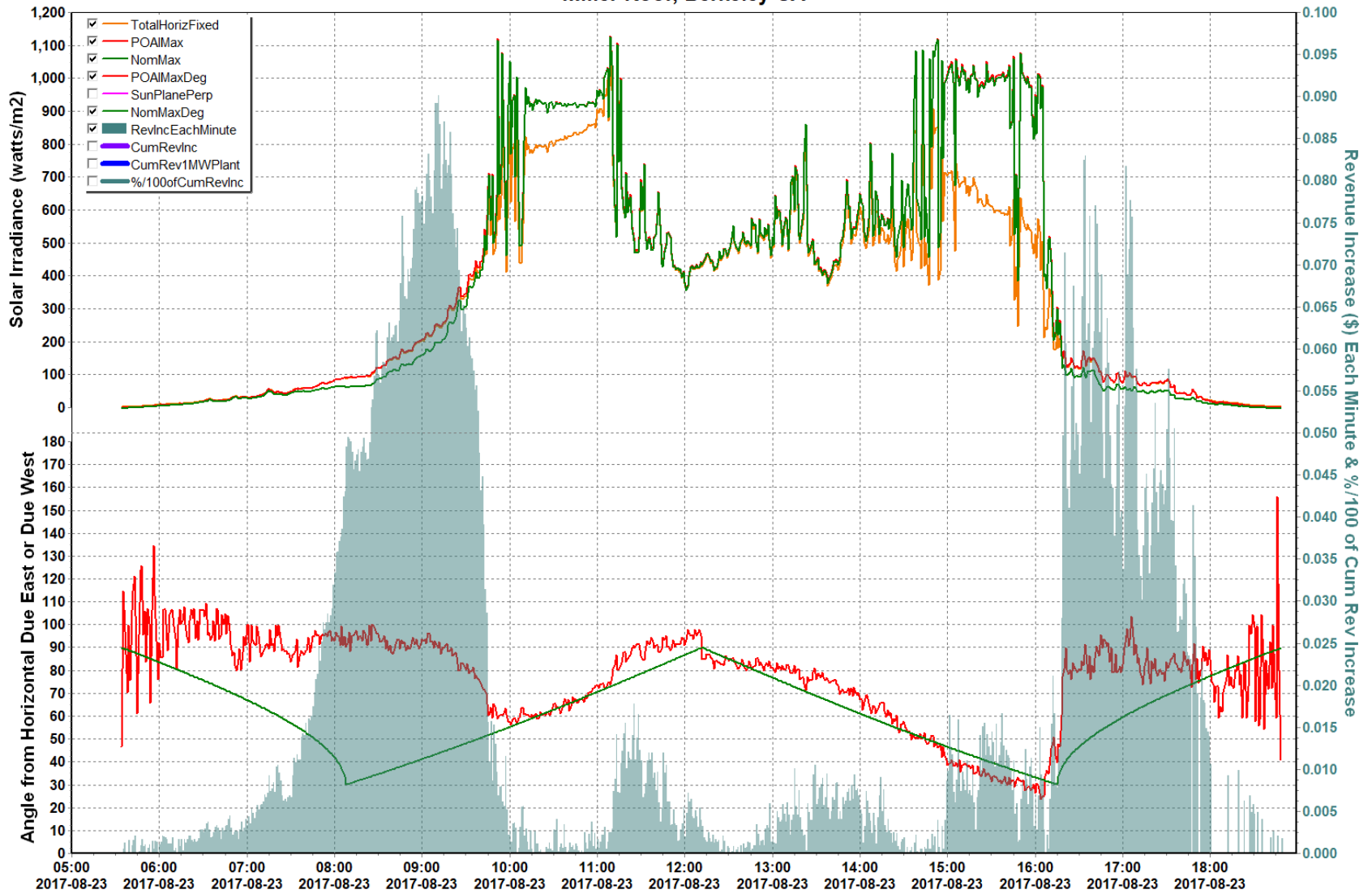
Potential Revenue Gain = 0.2% (\$2 / \$1000)

Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



Potential Revenue Gain = 0.2% (\$2 / \$1000)

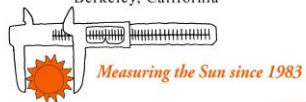
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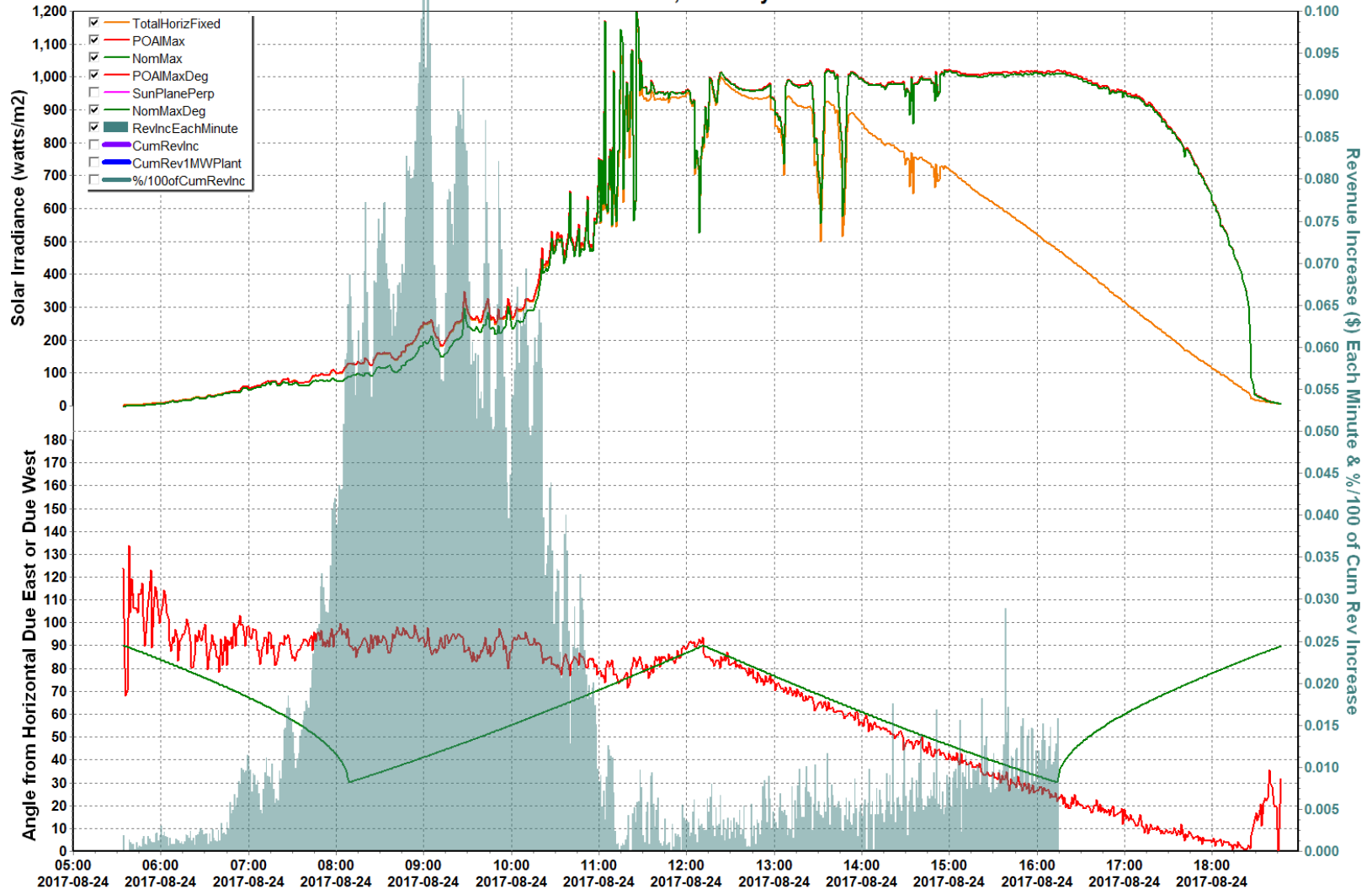
Potential Revenue Gain = 2.8%

(\$14 / \$503)

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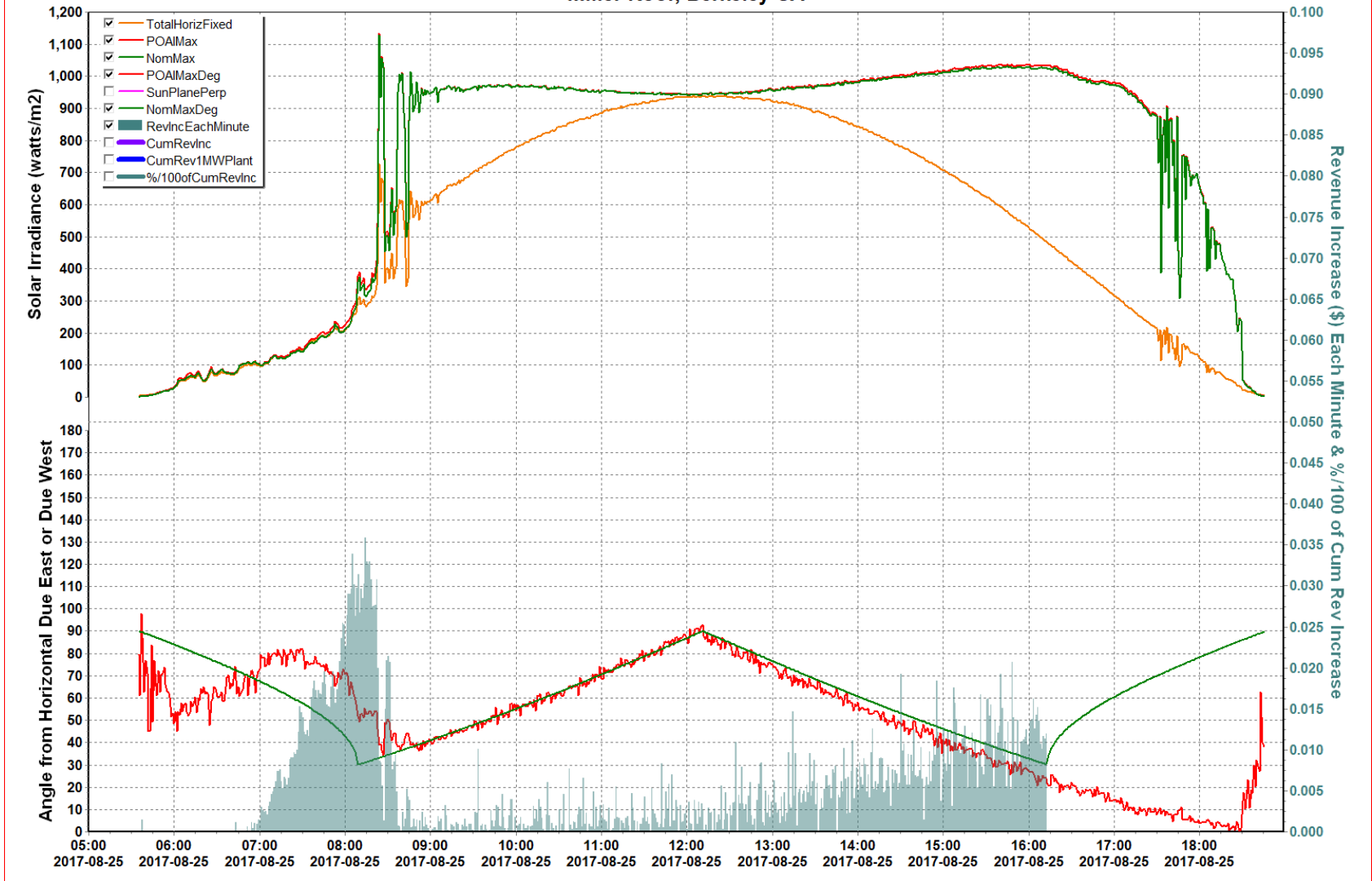
Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



Potential Revenue Gain = 1.8%

(\$14 / \$761)

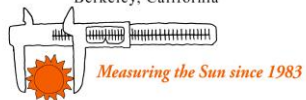
Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



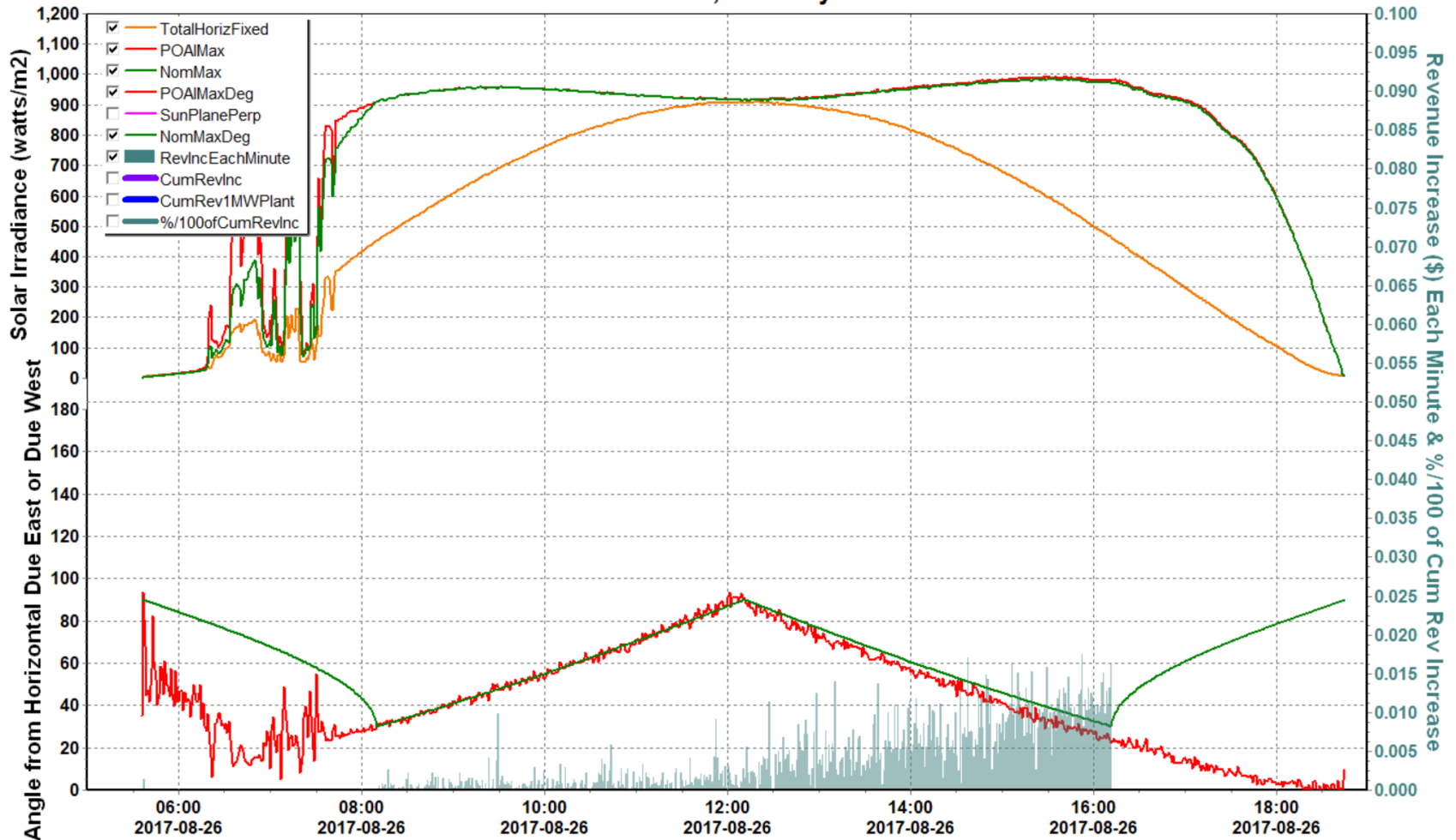
Potential Revenue Gain = 0.4%

(\$4 / \$970)

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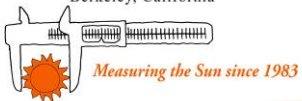
Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



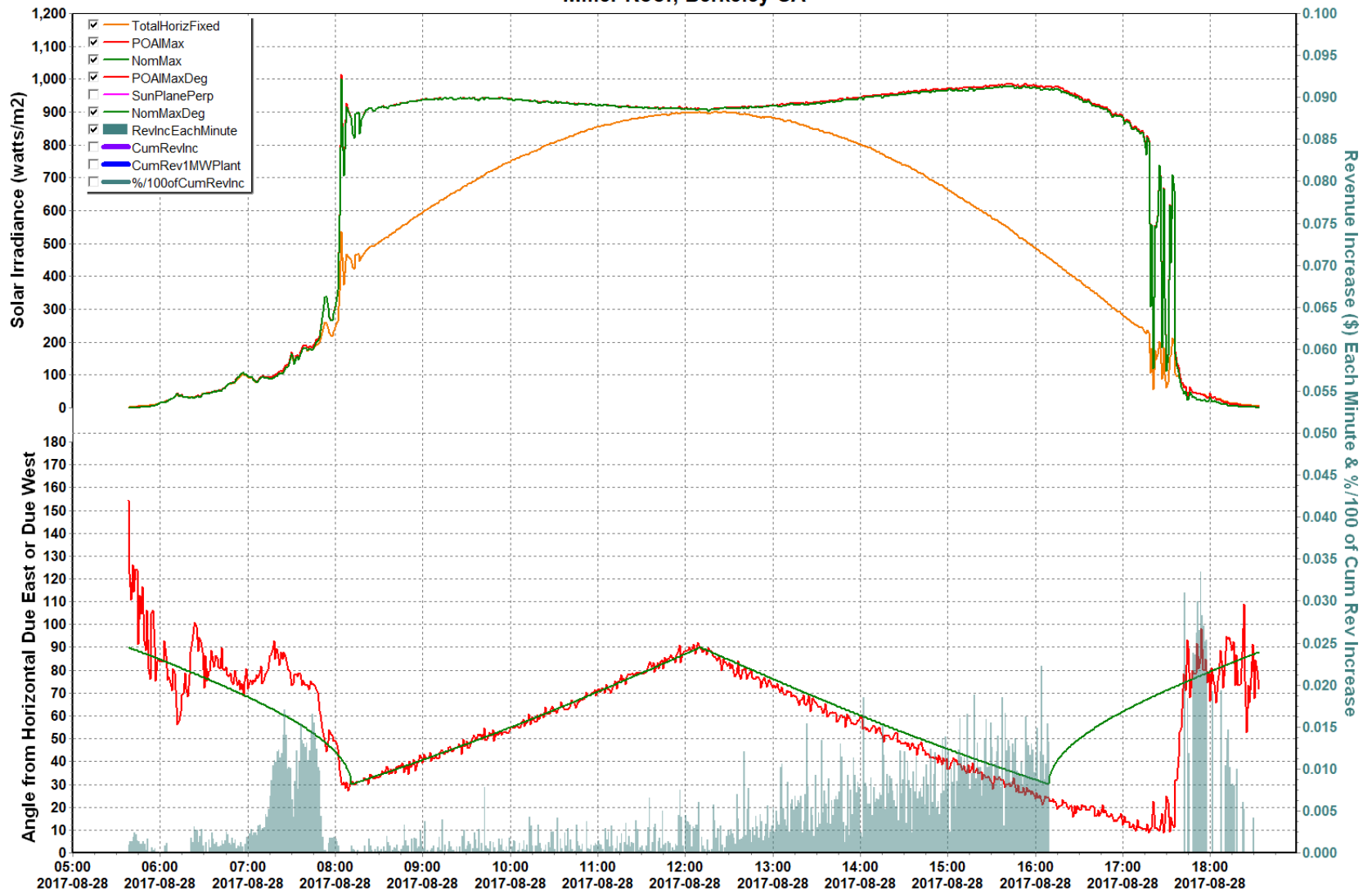
Potential Revenue Gain = 0.2%

(\$2 / \$1015)

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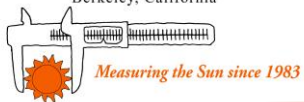
Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA



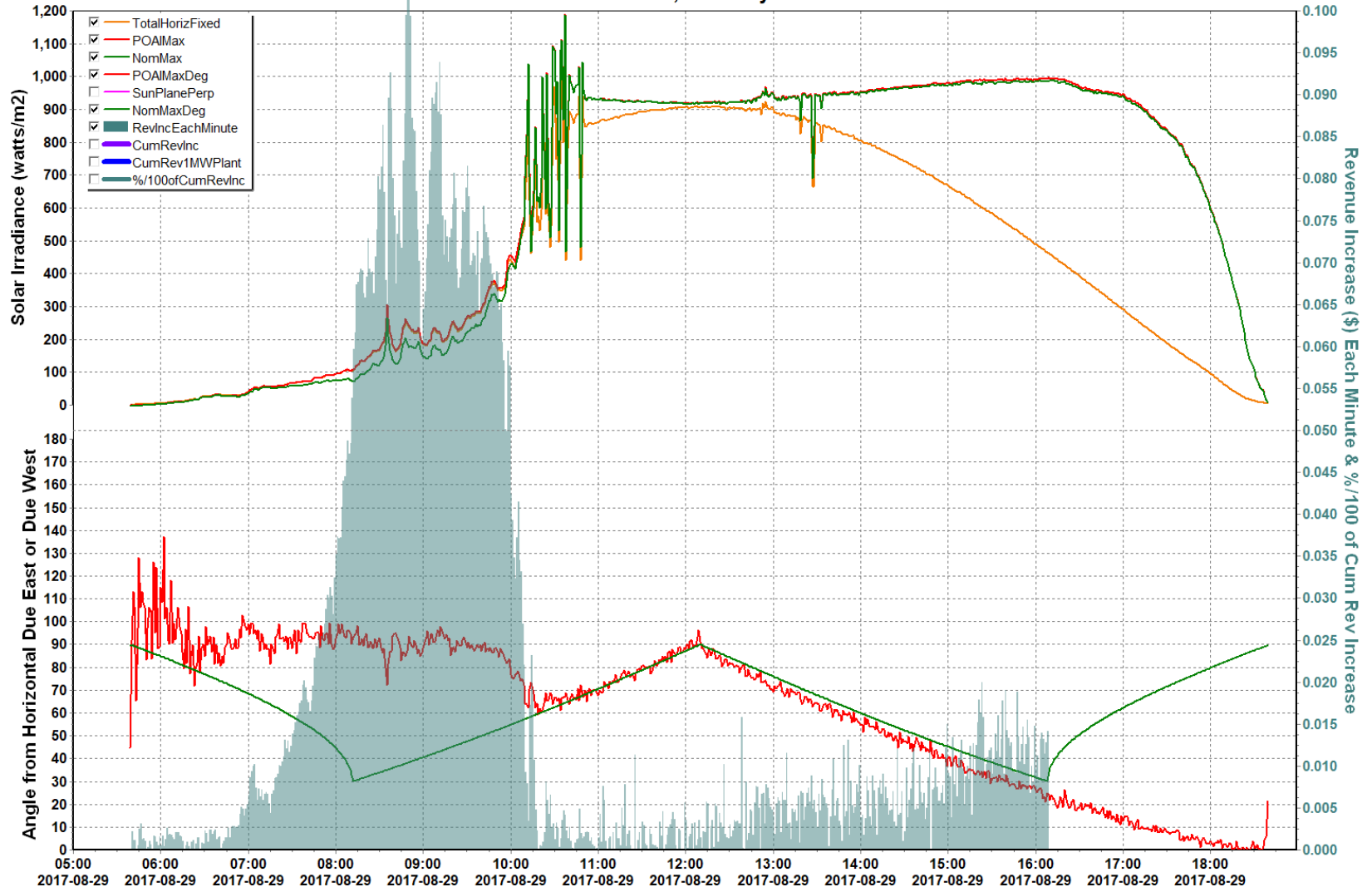
Potential Revenue Gain = 0.3%

(\$3 / \$890)

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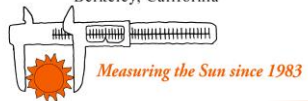
Rotating Pyranometer Measurements of POA Irradiances & Tilt Angles Miller Roof, Berkeley CA

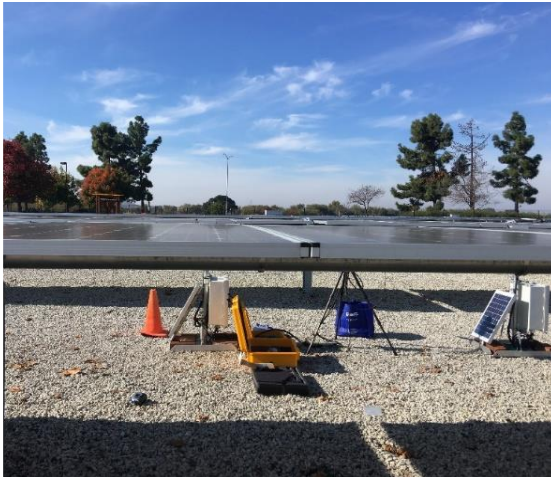


Potential Revenue Gain = 1.2%

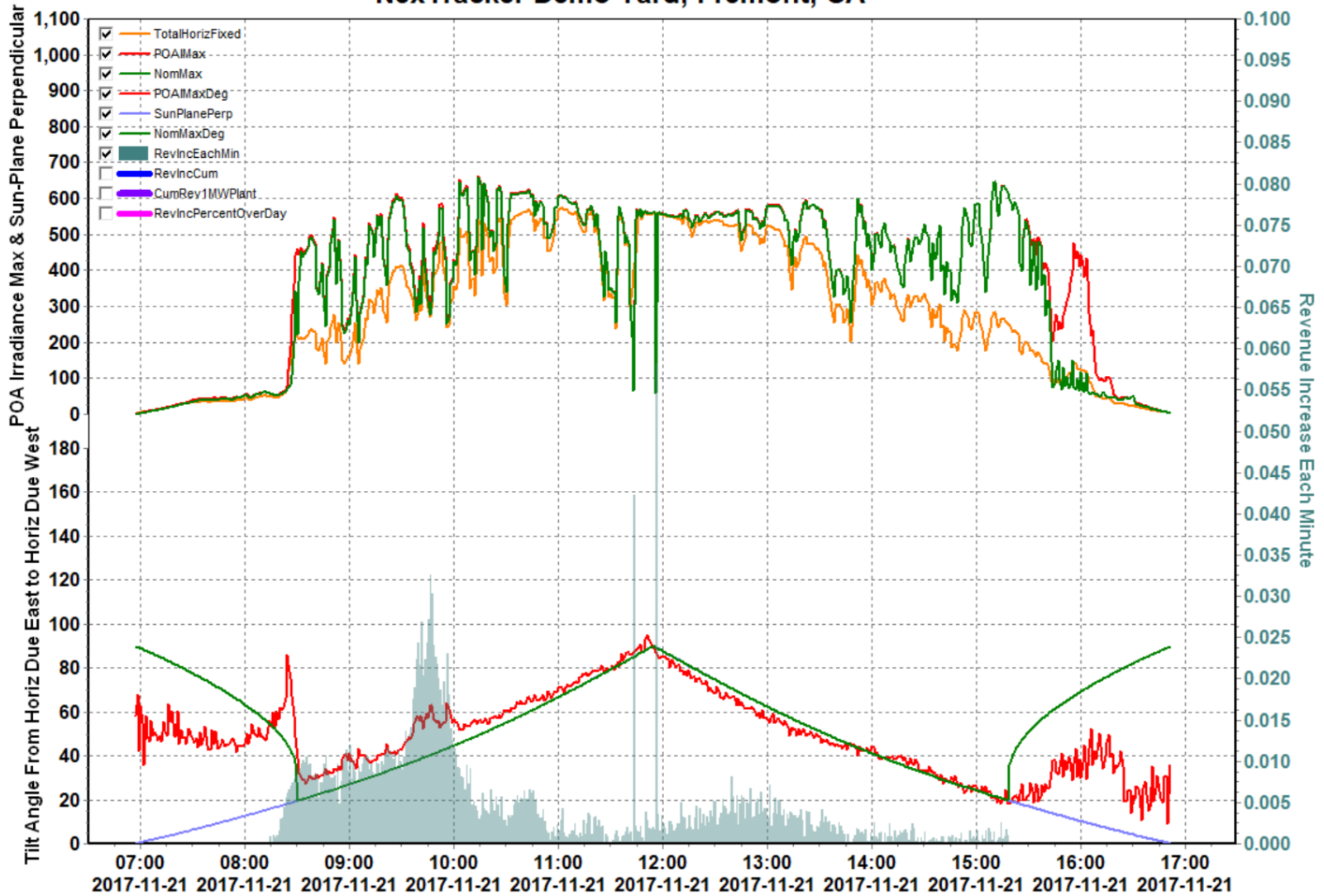
(\$12 / \$793)

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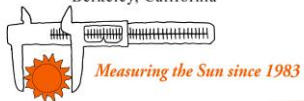
Rolling Cat Eye Measurements of POA Irradiances and Tilt Angles NexTracker Demo Yard, Fremont, CA



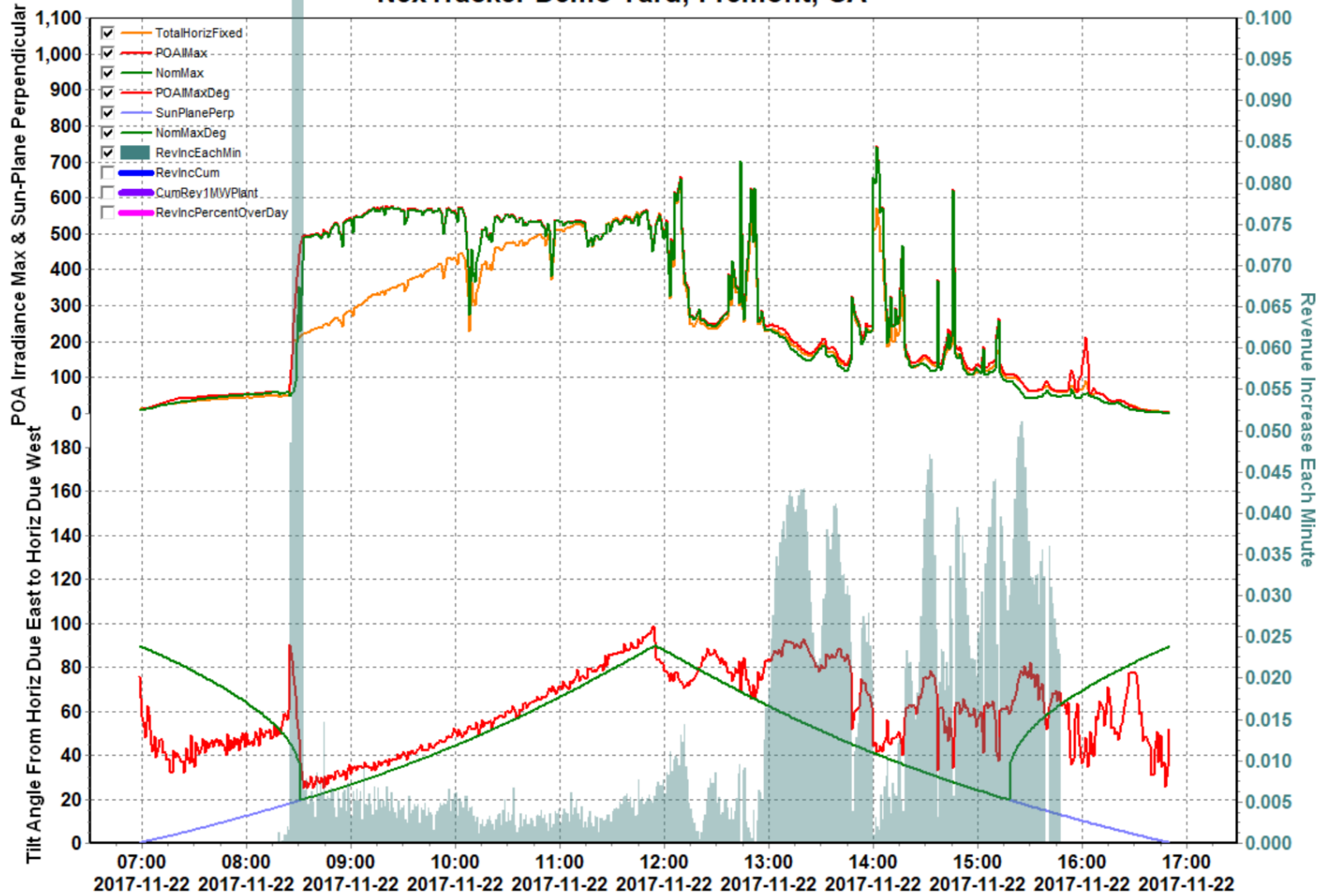
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Potential Revenue Gain = 0.6%

(\$2 / \$366)



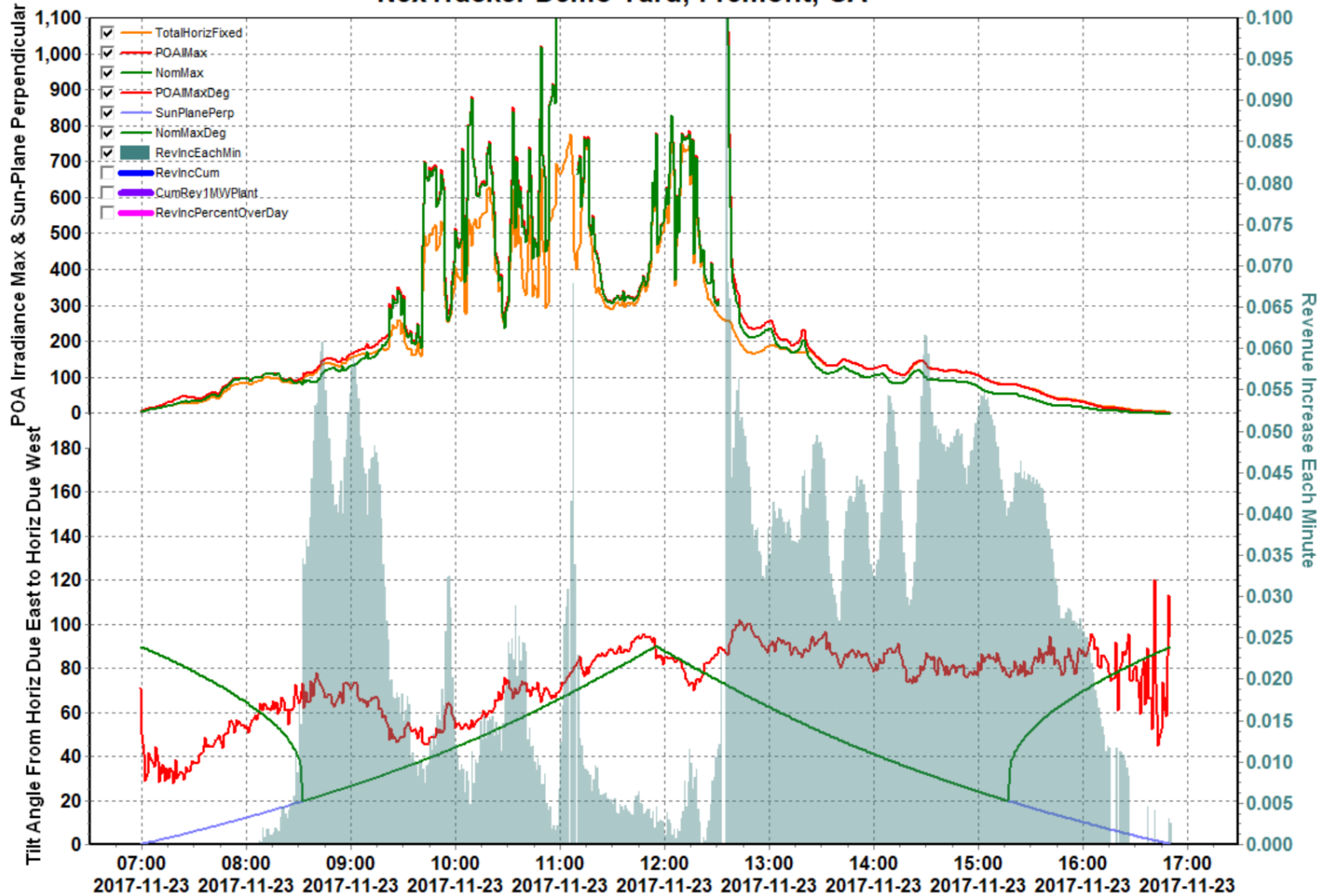
Rolling Cat Eye Measurements of POA Irradiances and Tilt Angles NexTracker Demo Yard, Fremont, CA



Potential Revenue Gain = 2.8%

(\$8 / \$286)

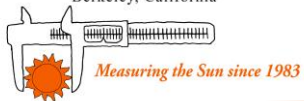
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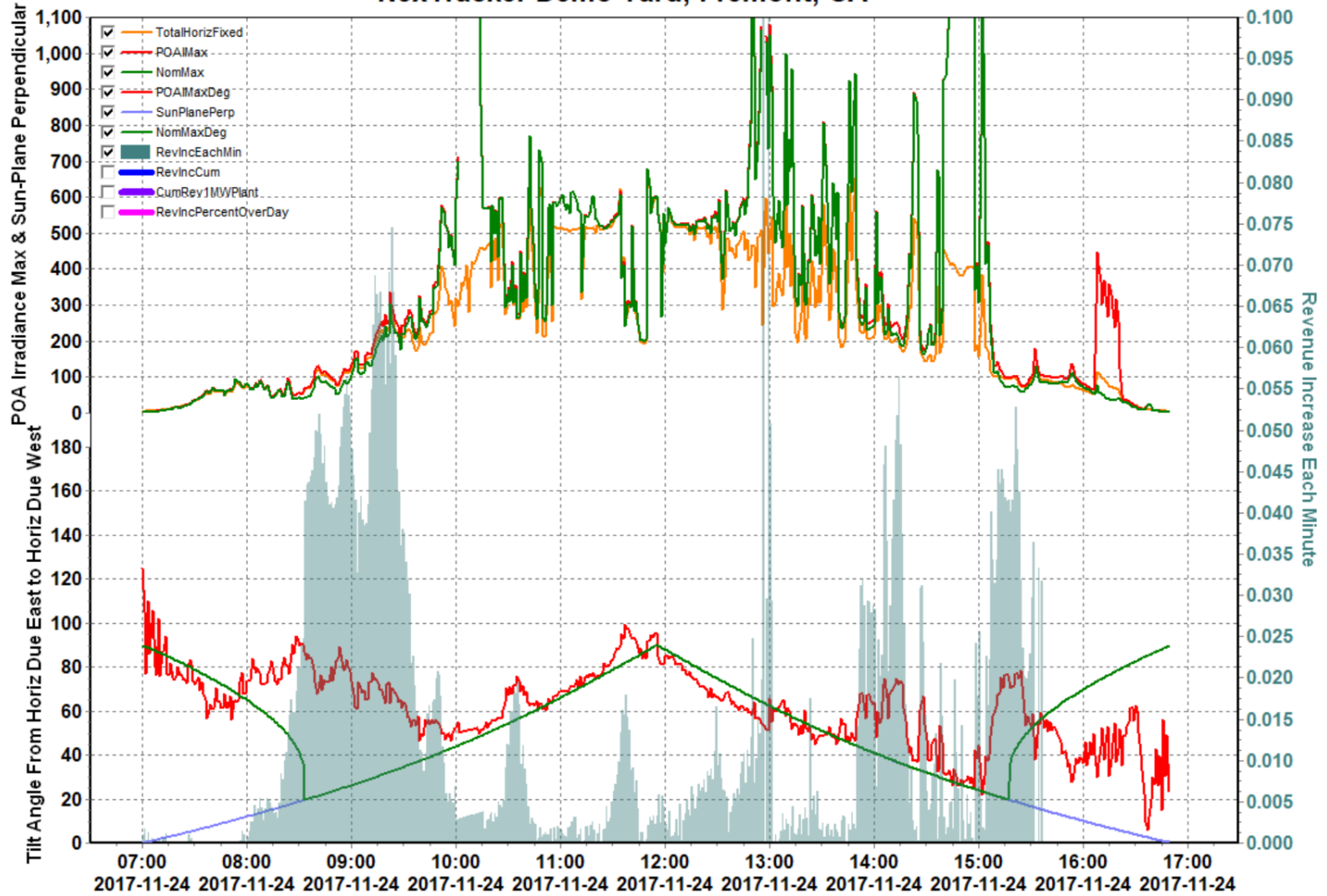
Potential Revenue Gain = 5.7%

(\$14 / \$241)

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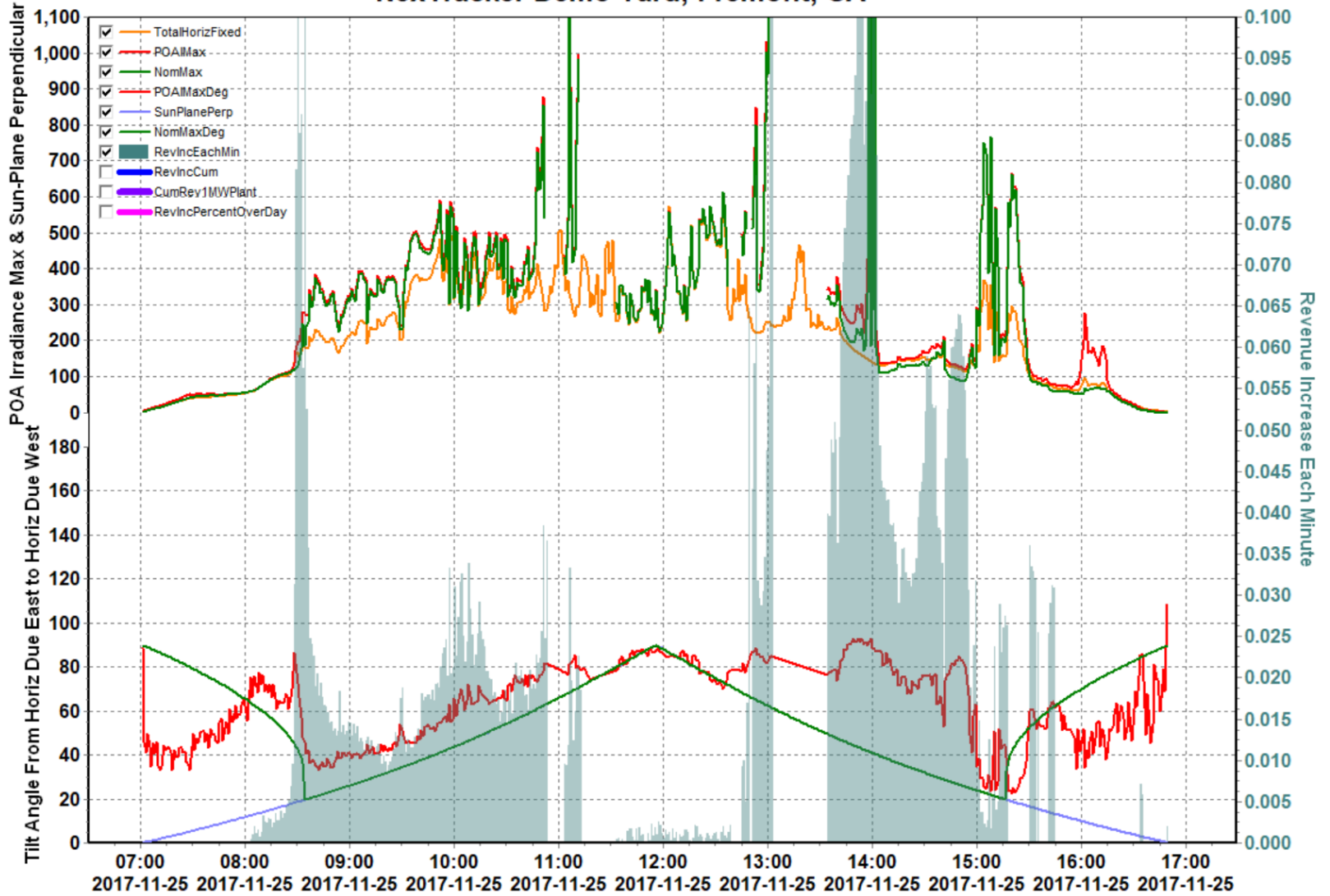
Rolling Cat Eye Measurements of POA Irradiances and Tilt Angles NexTracker Demo Yard, Fremont, CA



Potential Revenue Gain = 2.2%

(\$8 / \$336)

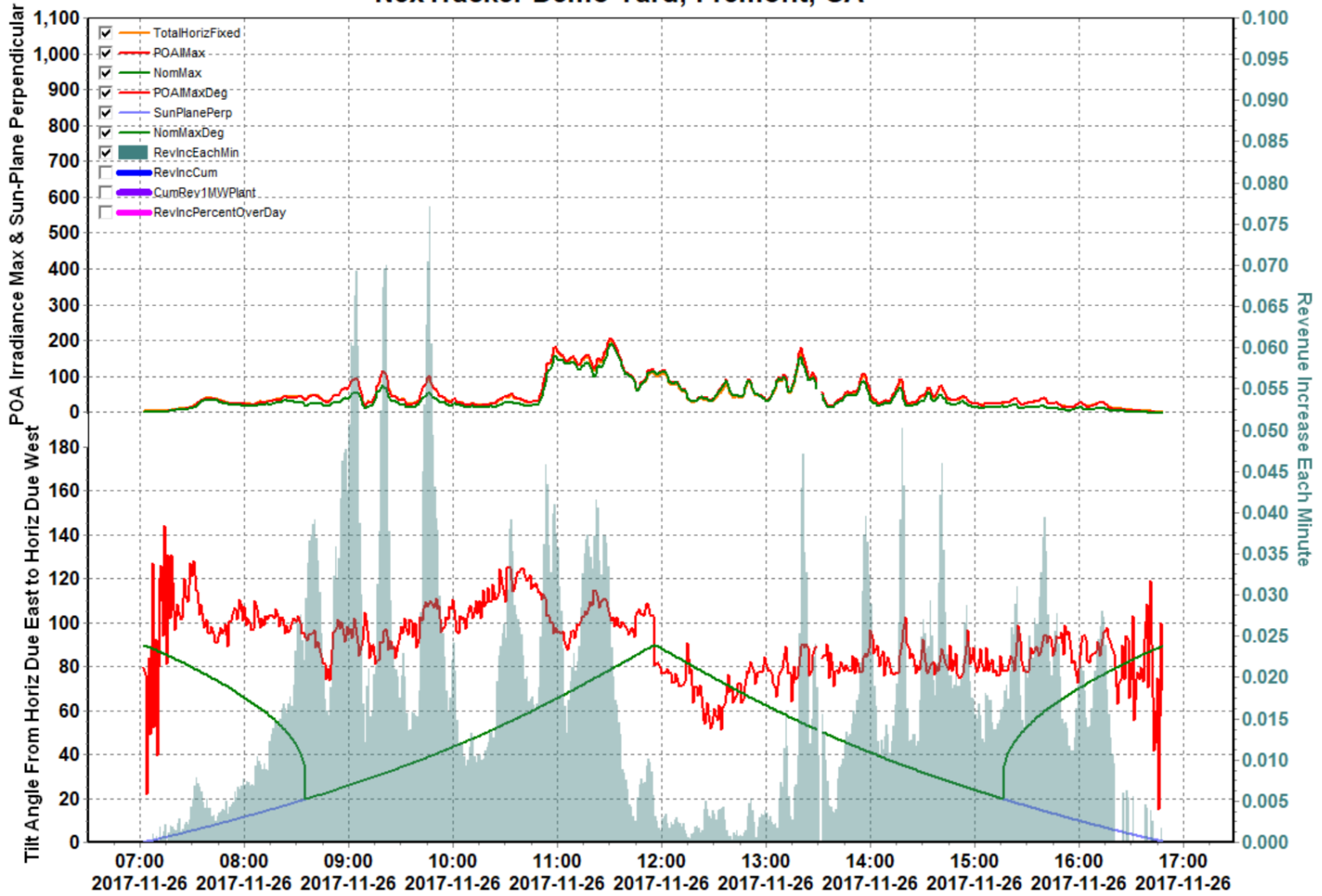
Rolling Cat Eye Measurements of POA Irradiances and Tilt Angles NexTracker Demo Yard, Fremont, CA



Potential Revenue Gain = 4.3%

(\$11 / \$247)

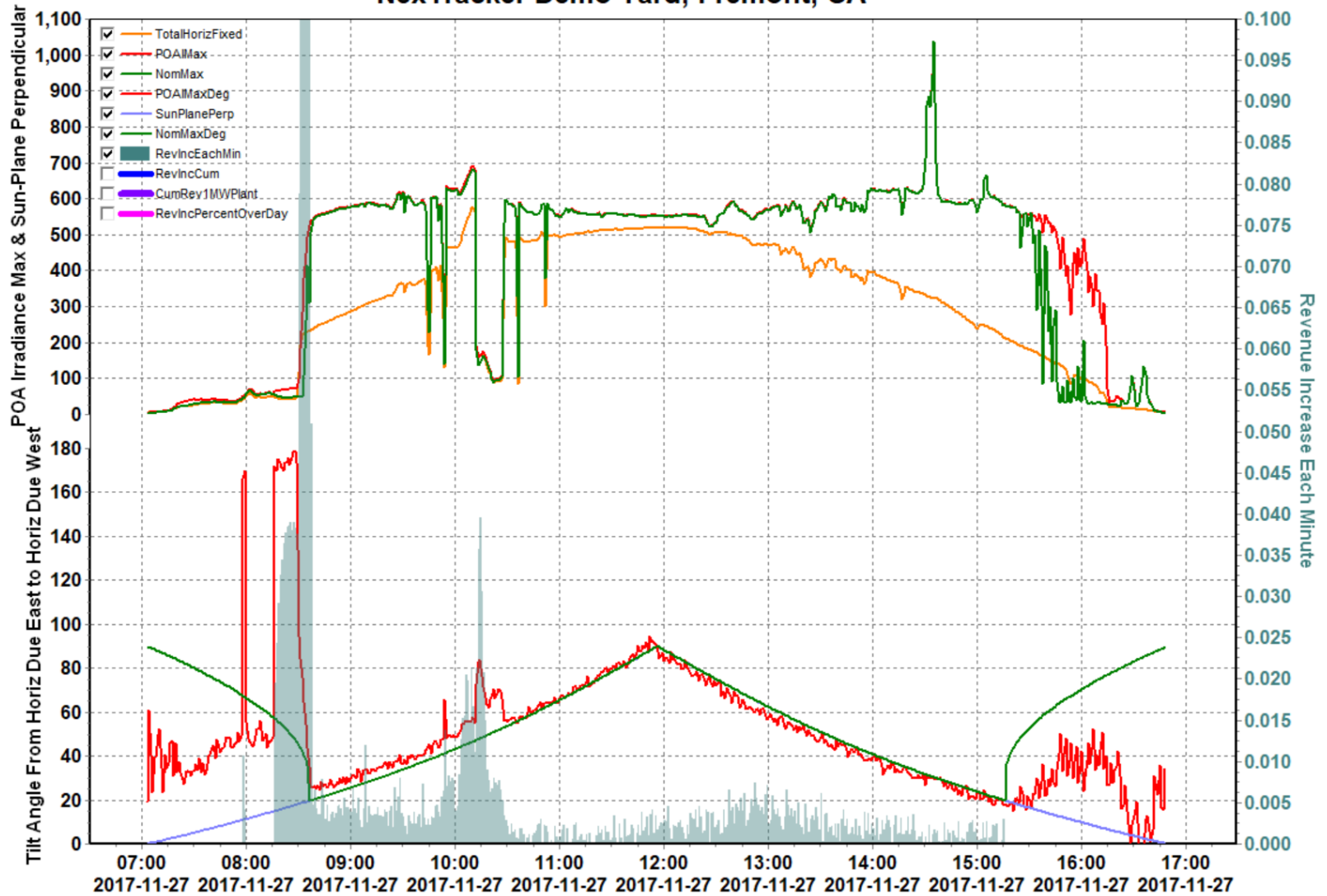
Rolling Cat Eye Measurements of POA Irradiances and Tilt Angles NexTracker Demo Yard, Fremont, CA



Potential Revenue Gain = 27.2%

(\$10 / \$37)

Rolling Cat Eye Measurements of POA Irradiances and Tilt Angles NexTracker Demo Yard, Fremont, CA



Potential Revenue Gain = 0.9%

(\$4 / \$406)

Revenue Increase Potential

Miller Roof Berkeley

	Plant	Bump	Bump
2017-08-23	503	14.2	2.8%
2017-08-24	761	13.8	1.8%
2017-08-25	970	3.6	0.4%
2017-08-26	1,015	2.0	0.2%
2017-08-27	987	1.9	0.2%
2017-08-28	890	3.1	0.3%
2017-08-29	793	12.0	1.5%
Totals	\$5,919	\$50.6	0.9%

NexTracker Yard Fremont

	Plant	Bump	Bump
2017-11-21	366	2.1	0.6%
2017-11-22	286	7.9	2.8%
2017-11-23	241	13.7	5.7%
2017-11-24	336	7.7	2.3%
2017-11-25	247	10.7	4.3%
2017-11-26	37	10.0	27.2%
2017-11-27	406	3.9	0.9%
Totals	\$1,919	\$ 56.0	2.9%



Next?

- Compile multi-climate measurement record? Where?

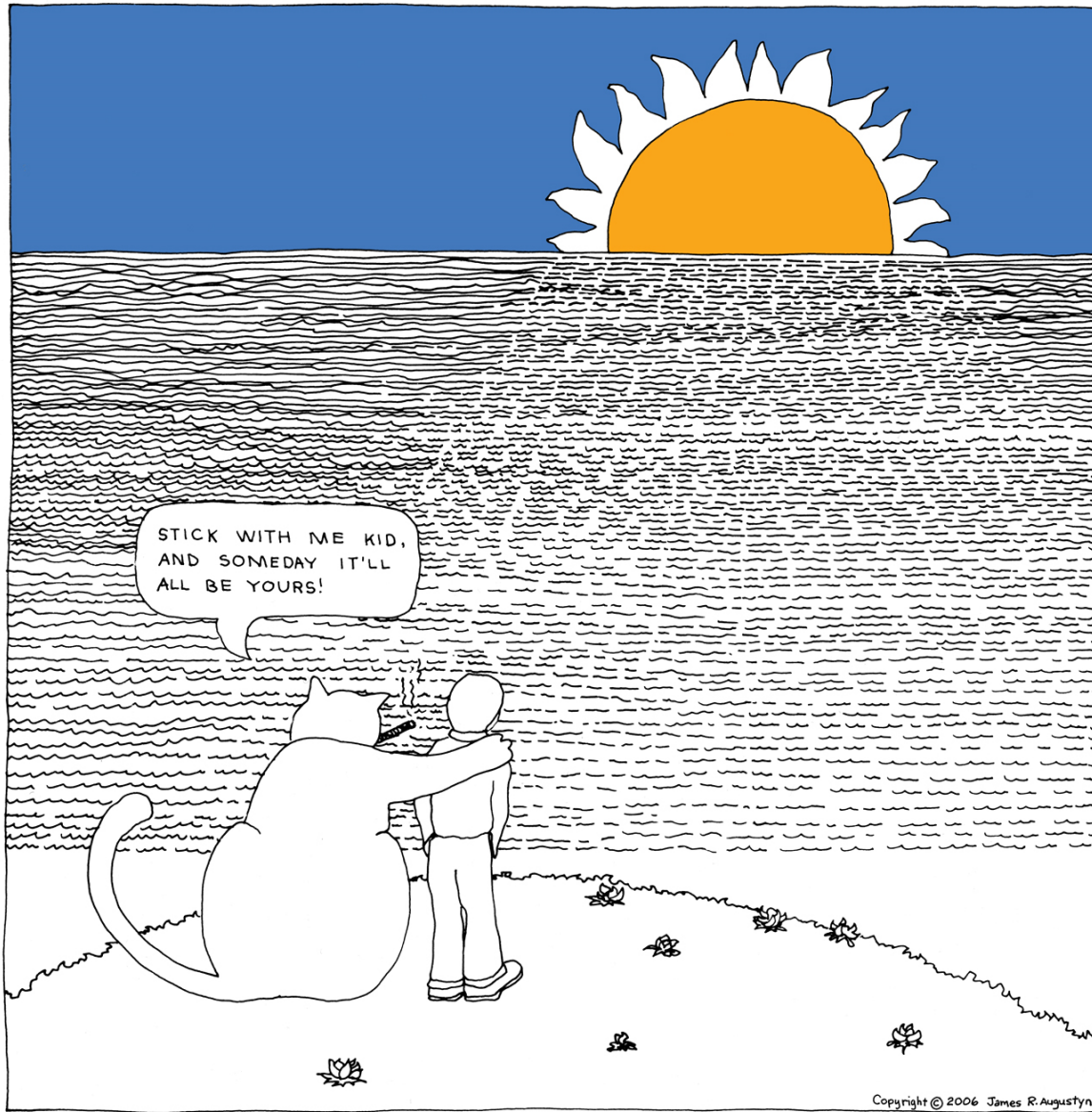
Best use(s)?

- Model validation/development tool?
- Project Development/site evaluation?
- Direct PCS feedback?
- Need/way to predict persistence of latest measurements?
- Bifacial applications?
- Other embodiments . . . ?



Rotating Pyranometer Or Rotating Purranometer?





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