

# **Solar PV Carousel Trackers for Building Flat Rooftops: Three Case Studies**

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**Solar 2010, May 19, Phoenix, AZ**

# Simply Follow the Sun



**JX Crystals**

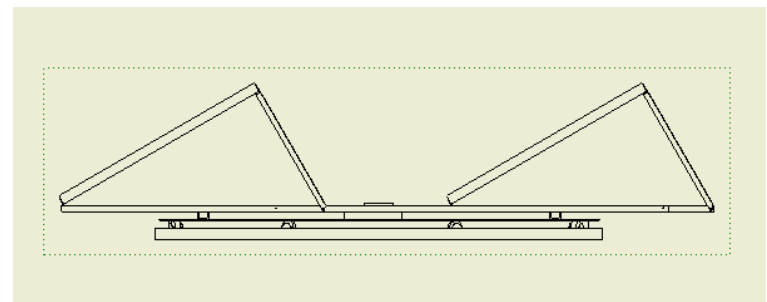
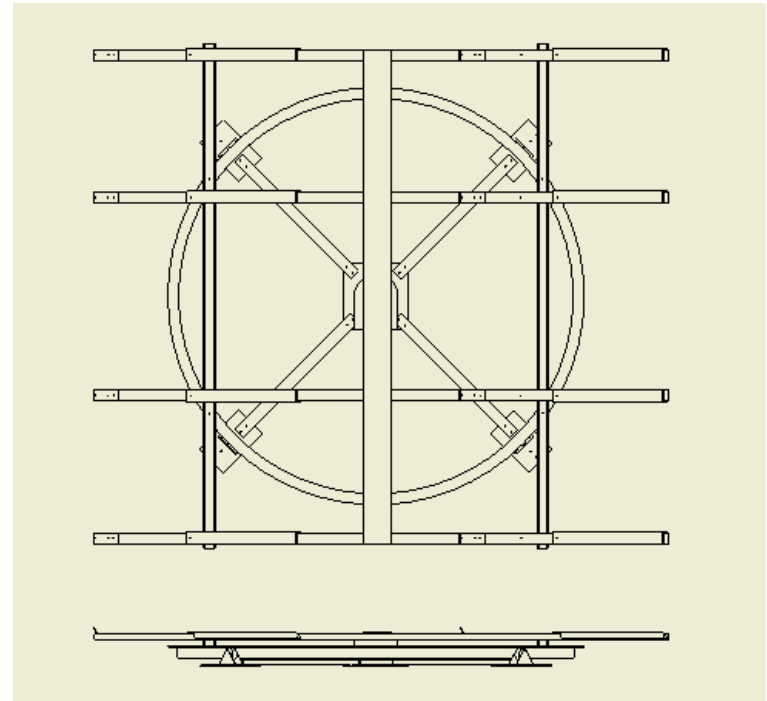
**1.2 kW Carousel Sun Tracker**

**Made in Washington**

# JX Crystals Sun Tracking Carousel for Building Flat Roofs

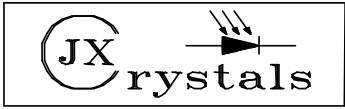
- **Single axis azimuth tracker**
- **1.3 x more kWh/kW vs fixed**
- **Fits on 8 ft flat-bed truck**
- **Low Cost Installation**
- **Low wind resistance**
- **No roof penetration**
- **Ballast or Tether Mount**
- **Folds down for shipping**

**Module support arms lift  
up for solar panel  
installation**

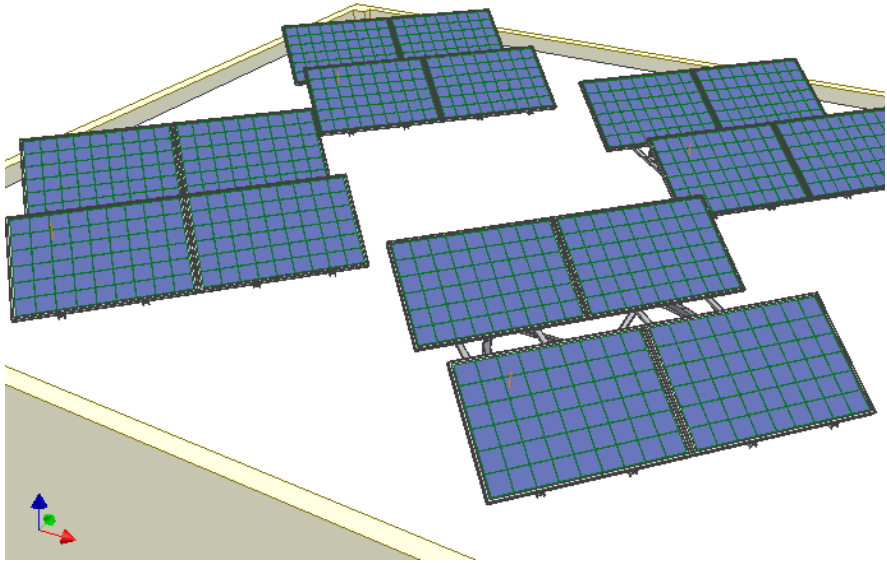
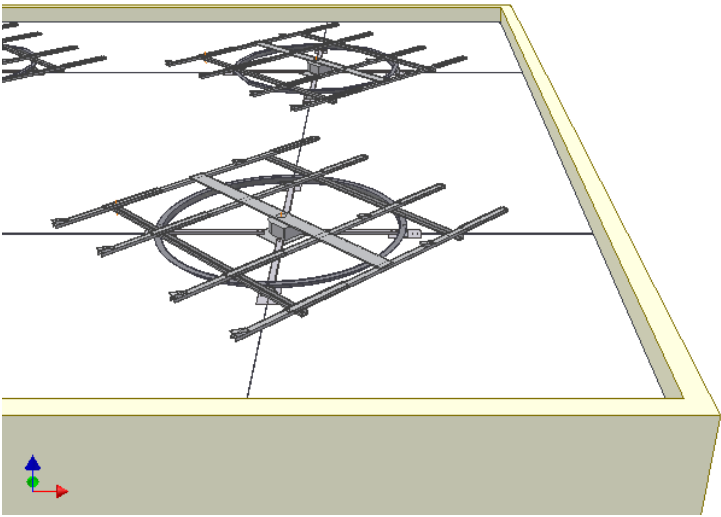
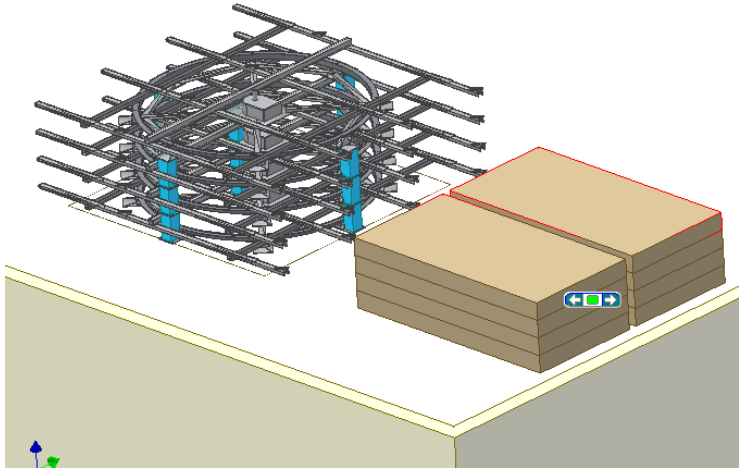
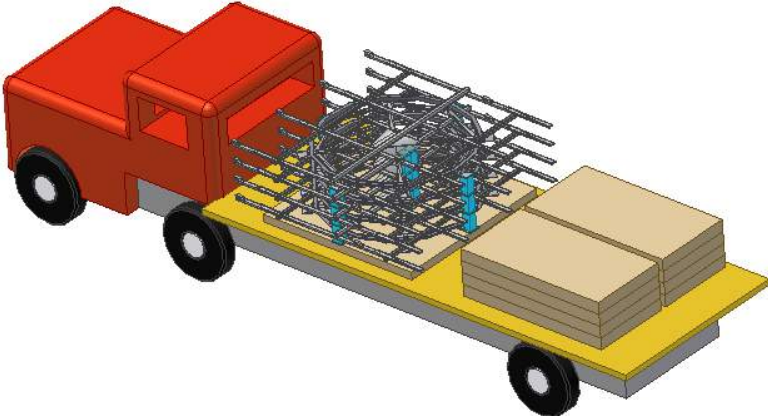


# JXC Carousels in Eastern WA





Intelligent Alternative Energy





**Photos of JX Crystals  
1.2 kW carousel on  
church rooftop in  
San Diego, CA  
April 2009**

**Carousel produces  
1.3 times more kW-hr  
relative to fixed tilt  
thereby reducing cost of  
solar electricity and  
reducing payback time  
by 30%**



# 4 JX Crystals Inc SunTrack Carousels on rooftop in Tucson AZ (4.5 kW)

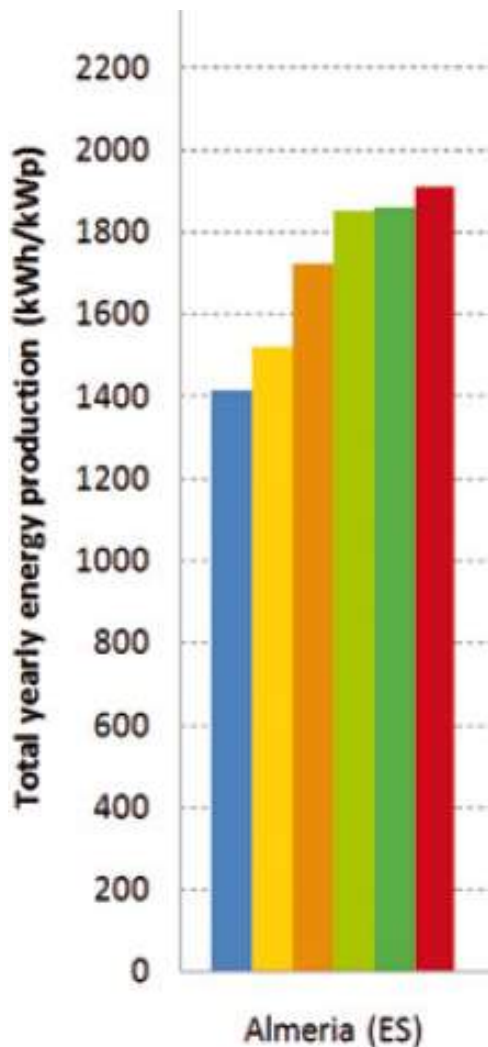


# Various module options for mounting on the JXC SunTrack Carousel with the resultant carousel STC power ratings

Module Type	Module Dimensions	Module Configuration	Carousel STC Power Rating
Sharp 235 W NU-U235F1	39.1''x64.6''x1.8'' 994x1640x46mm	2 rows with 2 modules per row	0.94 kW
Sharp 176 W ND-176UC1	39.1''x52.3''x2.3'' 994x1328x57.5mm	2 rows with 3 modules per row	1.06 kW
Sanyo 200 W HIP-200BA19	34.6''x51.9''x1.8'' 880x1319x46mm	2 rows with 3 modules per row	1.2 kW



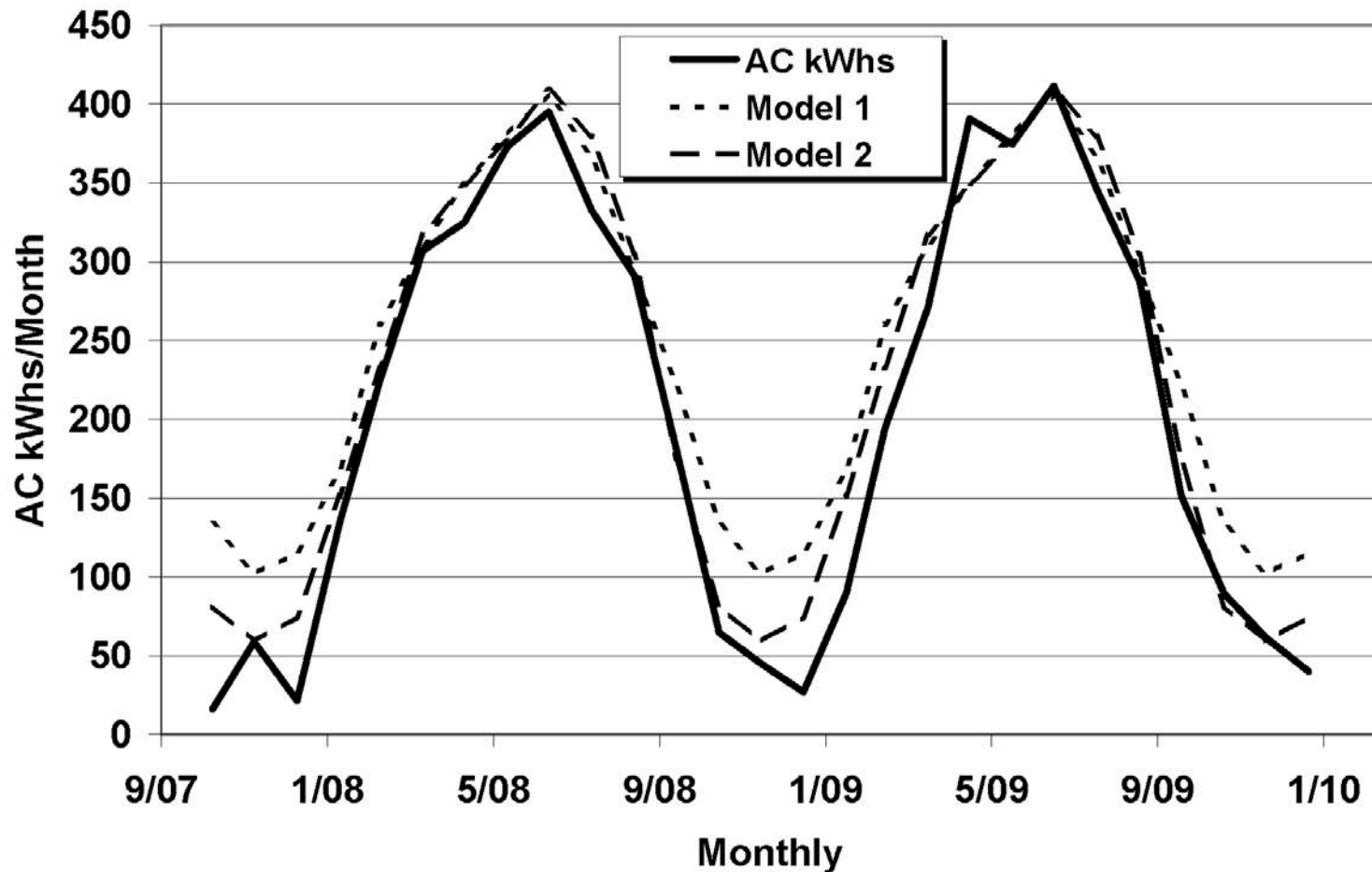
# Tracking the sun is beneficial but various tracker types are possible



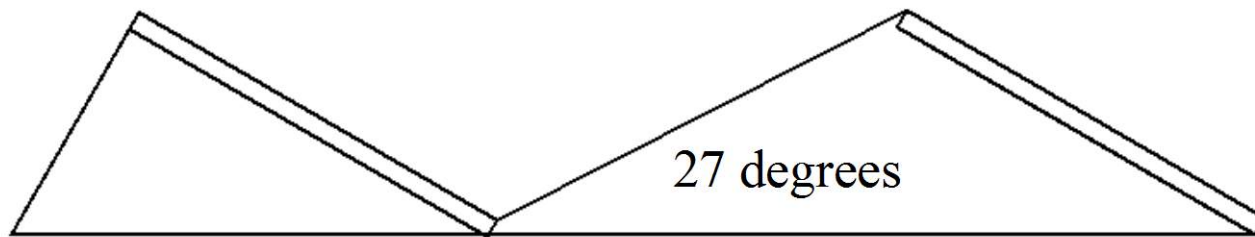
T. Huld, M. Suri, T. Cebecauer,  
“Performance of Single-Axis Tracking Photovoltaic  
Systems in Europe”, Photovoltaic International  
2009, [www.pv-tech.org](http://www.pv-tech.org).

- Fixed, optimum angle
- Horizontal E-W axis
- Horizontal N-S axis
- Vertical axis, optimum angle
- Inclined N-S axis, optimum angle
- Two-axis tracking

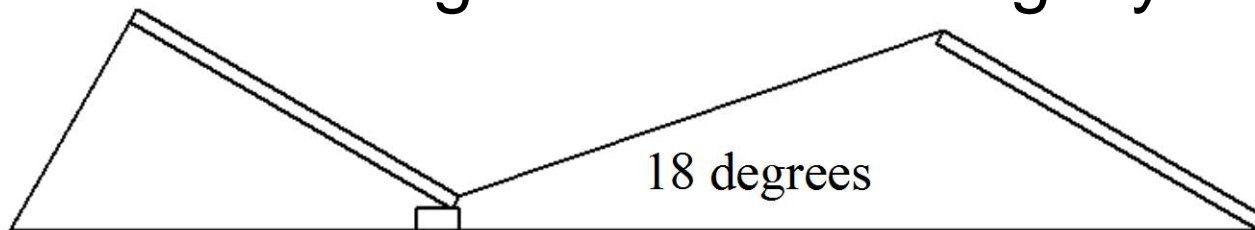
**Carousel AC energy output is compared with model predictions for a 27 month period for the carousel in operation in Eastern WA**



The front row of modules can shade the back row of modules in northern latitudes



but this problem can be reduced by elevating the back row slightly

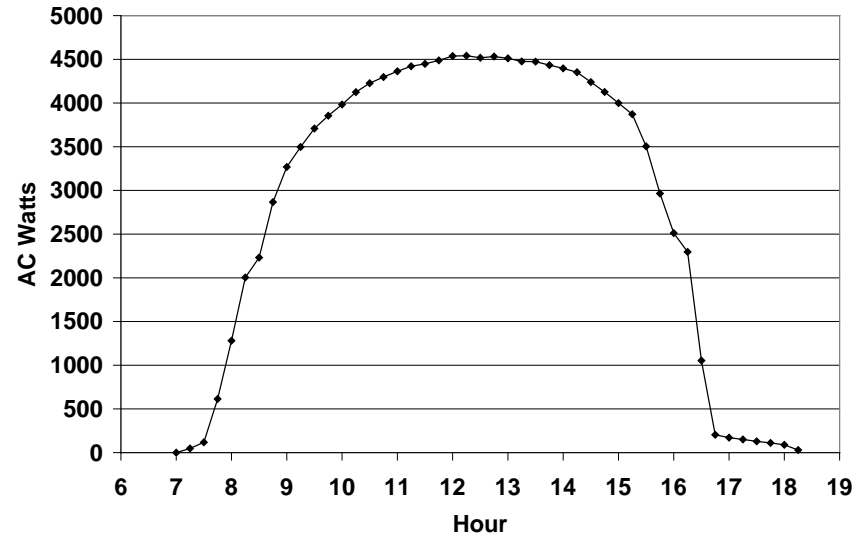


Performance data in AC kWh/day per kWp for the 10 months of operation for the carousel in San Diego in comparison with RETScreen model predictions.

No problem with Back to Front Ratio.

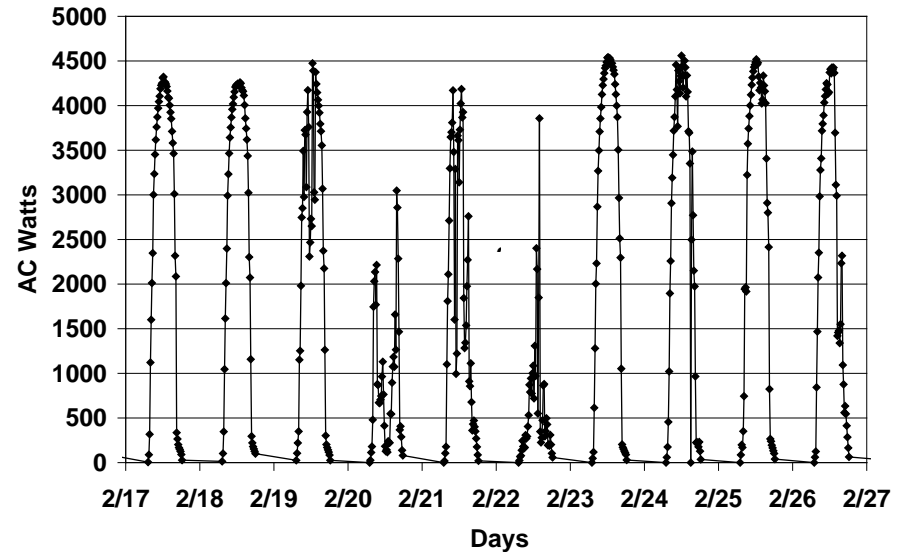
<b>Month</b>	<b>RetScreen</b>	<b>Front Row</b> <b>Ave</b>	<b>Back Row</b> <b>Ave</b>	<b>Back/Front</b> <b>Ratio</b>
<b>APR 09</b>	<b>6.45</b>	<b>6.9</b>	<b>6.79</b>	<b>0.98</b>
<b>May 09</b>	<b>6.63</b>	<b>5.74</b>	<b>5.69</b>	<b>0.99</b>
<b>JUN 09</b>	<b>6.5</b>	<b>7.6</b>	<b>7.57</b>	<b>0.99</b>
<b>JUL 09</b>	<b>7.28</b>	<b>7.79</b>	<b>7.67</b>	<b>0.99</b>
<b>AUG 09</b>	<b>7.08</b>	<b>7.32</b>	<b>7.12</b>	<b>0.97</b>
<b>SEP 09</b>	<b>5.88</b>	<b>6.23</b>	<b>5.93</b>	<b>0.95</b>
<b>OCT 09</b>	<b>5.53</b>	<b>6.0</b>	<b>5.53</b>	<b>0.92</b>
<b>NOV 09</b>	<b>4.6</b>	<b>4.42</b>	<b>3.98</b>	<b>0.90</b>
<b>DEC 09</b>	<b>4.28</b>	<b>4.43</b>	<b>4.03</b>	<b>0.91</b>
<b>JAN 10</b>	<b>4.4</b>	<b>5.13</b>	<b>4.82</b>	<b>0.94</b>
<b>10</b> <b>Month</b>				
<b>Average</b>	<b>5.86</b>	<b>6.16</b>	<b>5.91</b>	<b>0.95</b>

AC Watts from 4.68 kWp (DC)  
Tucson carousel installation  
during Feb 23, 2010.



4.68kW Tucson Carousel, 10 days in Feb 2010

AC Watts from 4.68 kWp (DC)  
Tucson carousel installation  
For several days in February.



## Cost to benefit analysis assuming high volume production.

Metric	Case 1: Historical	Case 2: Current	Case 3: Future
PV Module Cost	\$4 per Watt	\$2 per Watt	\$1.5 per Watt
PV System Cost	\$6.5 per W	\$4.5 per W	\$3.5 per W
Efficiency	12%	16%	20%
Fixed rack (FR) cost	\$0.45 per W	\$0.40 per W	\$0.25 per W
Single-Axis (S/A) cost	\$0.75 per W	\$0.55 per W	\$0.35 per W
S/A – FR	\$0.30 per W	\$0.15 per W	\$0.10 per W
S/A cost penalty	(4.6%)	(3.3%)	(2.9%)
S/A energy gain	30%	30%	30%

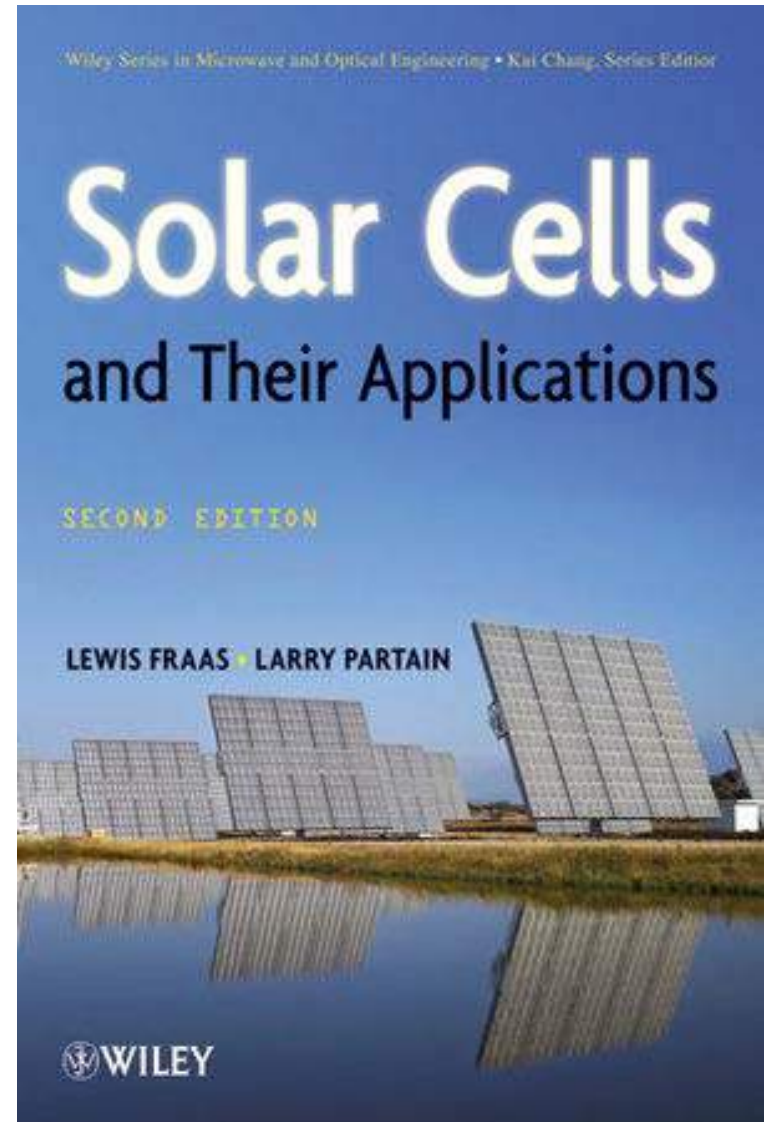
# Conclusions

**Solar trackers increase the kWh per kW for PV installations thereby reducing the payback time.**

**This is already proven for large utility PV installations. However, utility installations produce electricity at wholesale prices.**

**Carousel trackers can be mounted on flat rooftops for commercial and residential customers paying retail prices for electricity also reducing system payback time.**

**There is a chapter on solar trackers in a new Wiley book entitled: *Solar Cells and Their Applications*, 2nd Edition. ISBN: 978-0-470-44633-1. Hardcover. 640 pages. Sept 2010**



[www.wiley.com/WileyCDA/.../productCd-0470446331.html](http://www.wiley.com/WileyCDA/.../productCd-0470446331.html)