

# Arizona PV Costs

Environmental Portfolio Standard Cost Evaluation  
Working Group Cost Committee

**UPE<sub>x</sub> 2003**

by

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# Arizona EPS

- kWh driven mandate for the ACC
- 0.8% by 2004 and 1.1% by 2007-2012
- Replace non-renewable electricity generation with renewable electricity generation
- 60% solar
- Reduce cost of renewable generation especially solar

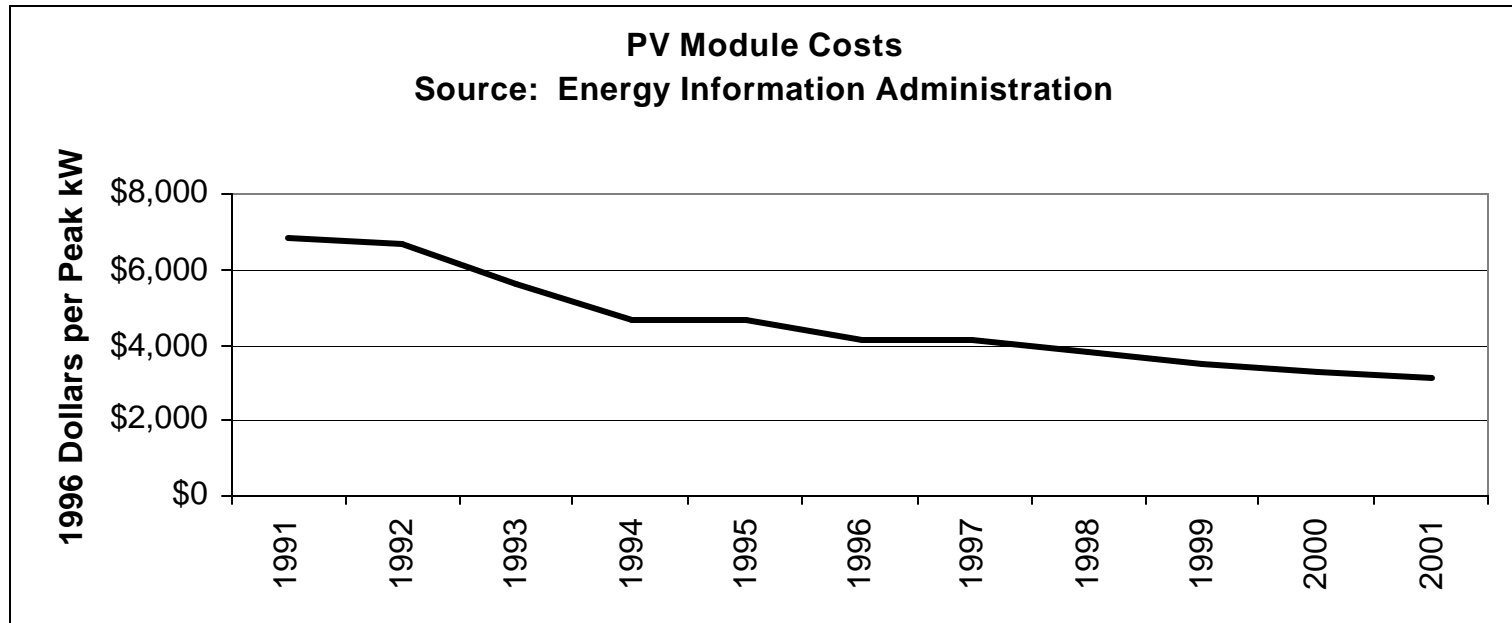
# Arizona EPS Cost Analysis

- Examine **simple** costs
  - actual installation costs per watt DC
  - actual system performance in AC kWh
  - equals actual simple cost/kWh
- Ignore
  - cost of capital - different for everybody
  - incentives - should directly reduce \$/kWh
  - O&M - little experience

# Goals

- Provides a foundation for all cost analysis
- Allowed accurate comparisons
- Provided real installation data
- Auditable
- 100% agreement

**Figure III-1**  
**PV Industry Cost Trend**



# Comparisons

- Compare different technologies for grid tied
  - fixed, tracking, concentrating, integrated, residential
- Off-grid
- Cost per watt
- Cost per kWh
- Cost per EPS credit

# Arizona EPS

## 1997-2002 Photovoltaic Installation Summary

			simple \$/watt			simple \$/kWh			simple \$/EPS credit	
Category	installations	total kW-dc	average cost per watt	low cost per watt	high cost/watt	average cost per kWh	low cost per kWh	high cost per kWh	average cost per EPS credit	avg. EPS multiplier
large grid-tied non-tracking*	26	2760	<b>\$6.17</b>	\$4.31	\$8.28	<b>\$0.131</b>	\$0.06	\$0.17	<b>\$0.106</b>	<b>2.22</b>
large grid-tied tracking	9	1917	<b>\$5.69</b>	\$4.77	\$7.50	<b>\$0.128</b>	\$0.10	\$0.17	<b>\$0.118</b>	<b>2.13</b>
large grid-tied concentrating	7	644	<b>\$7.16</b>	\$5.91	\$8.73	<b>\$0.159</b>	\$0.13	\$0.20	<b>\$0.172</b>	<b>2.20</b>
large grid-tied integrated	4	270	<b>\$5.65</b>	\$4.76	\$6.51	<b>\$0.202</b>	\$0.16	\$0.26	<b>\$0.201</b>	<b>2.13</b>
large off-grid utility owned	2	54	<b>\$20.50</b>	\$17.16	\$24.12	<b>\$0.410</b>	\$0.33	\$0.51	<b>\$0.392</b>	<b>2.09</b>
small grid tied utility owned	17	59	<b>\$8.93</b>	\$4.44	\$17.63	<b>\$0.224</b>	\$0.05	\$0.54	<b>\$0.214</b>	<b>2.27</b>

Represents 99% of installed capacity

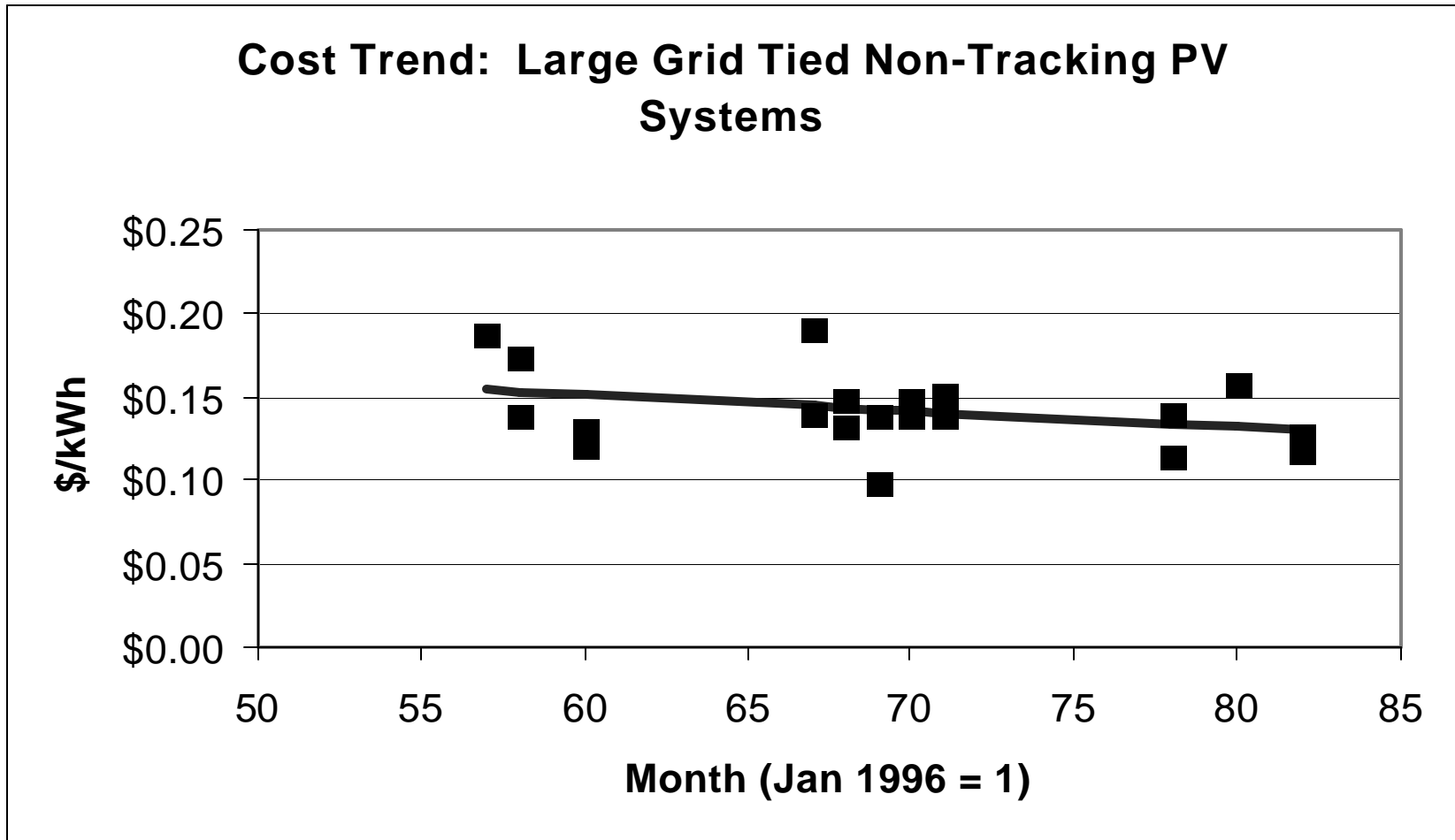


# Large, grid-tied, non-tracking PV systems

- Average 100 kWdc (26 units, 2760 kW)
  - 21 - 135 kW
- Average \$6.17 per watt dc
  - \$4.31 - \$8.28
- Average \$0.131 per kWh
  - \$0.06 - \$0.17 per kWh
- Average \$0.106 per EPS credit



Figure III-2

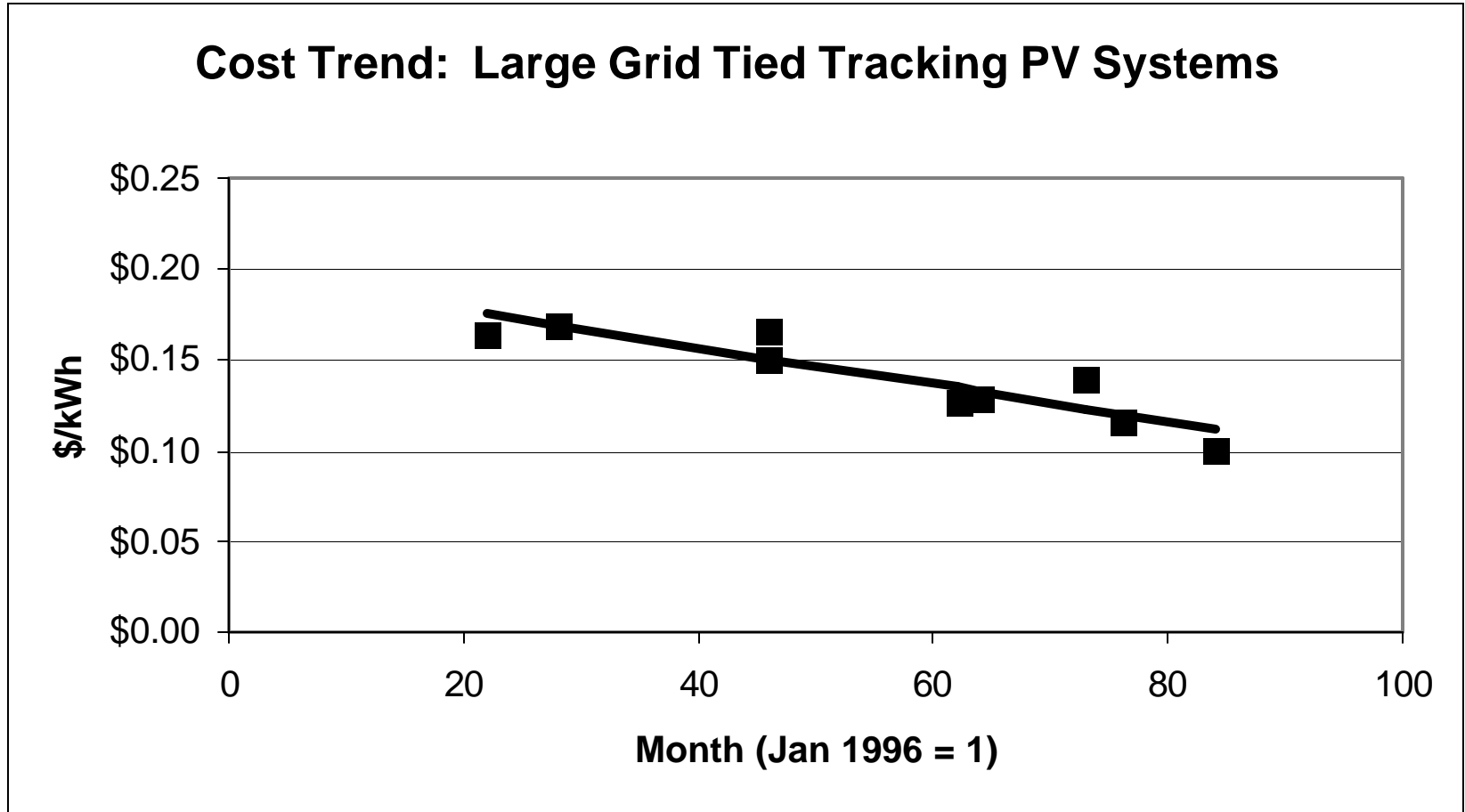


Slope is statistically significant at 0.10 level. Adjusted R squared = 0.095

# Large, grid-tied, single axis tracking PV systems

- Average install 190 kW (9 units, 1917 kW)
  - 91 - 732 KW (5 inverters)
- Average \$5.69 per watt
  - \$4.77 - \$7.50
- Average \$0.128 per kWh
  - \$0.10 - \$0.17
- Average \$0.118 per EPS credit

Figure III-3

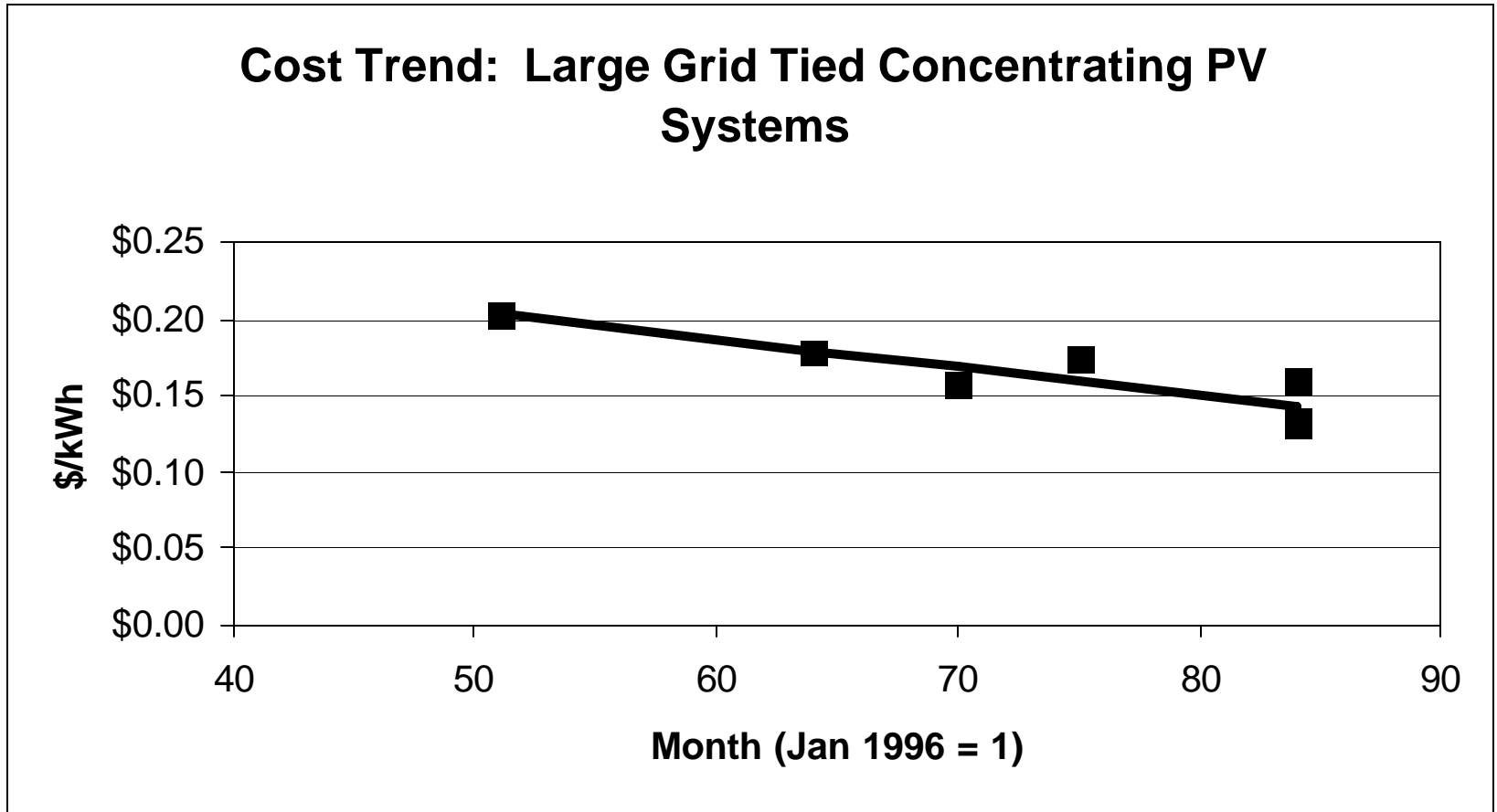


Slope is statistically significant at 0.01 level. Adjusted R squared = 0.787

# Large, grid-tied, concentrating PV systems

- Average install 92 kW (7 units, 644 kW)
  - 56 - 158 KW
- Average \$7.16 per watt
  - \$5.91 - \$8.73
- Average \$0.159 per kWh
  - \$0.13 - \$0.20
- Average \$0.172 per EPS credit

**Figure III-4**



Slope is statistically significant at 0.01 level. Adjusted R squared = 0.731

# Large, grid-tied integrated PV

- Average install 67 kW (4 units, 270 kW)
  - 20 - 127 KW
- Average \$5.65 per watt (w/o structures)
  - \$4.76 - \$6.51
- Average \$0.202 per kWh
  - \$0.16 - \$0.26
- Average \$0.201 per EPS credit

# Arizona EPS

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large grid-tied tracking	9	1917	<b>\$5.69</b>	\$4.77	\$7.50	<b>\$0.128</b>	\$0.10	\$0.17	<b>\$0.118</b>	<b>2.13</b>
large grid-tied concentrating	7	644	<b>\$7.16</b>	\$5.91	\$8.73	<b>\$0.159</b>	\$0.13	\$0.20	<b>\$0.172</b>	<b>2.20</b>
large grid-tied integrated	4	270	<b>\$5.65</b>	\$4.76	\$6.51	<b>\$0.202</b>	\$0.16	\$0.26	<b>\$0.201</b>	<b>2.13</b>
large off-grid utility owned	2	54	<b>\$20.50</b>	\$17.16	\$24.12	<b>\$0.410</b>	\$0.33	\$0.51	<b>\$0.392</b>	<b>2.09</b>
small grid tied utility owned	17	59	<b>\$8.93</b>	\$4.44	\$17.63	<b>\$0.224</b>	\$0.05	\$0.54	<b>\$0.214</b>	<b>2.27</b>



Represents 99% of installed capacity

# Arizona EPS Cost summary

- Solar costs continue to fall
  - better deals for all components
- The Arizona EPS is assisting with overall price reductions, primarily large scale installation knowledge and know-how
- The EPS is assisting with continued solar technology development - inverters, concentrators, new technologies (turbines)



# Future of the Arizona EPS

- Continue to emphasize solar energy but maintain flexibility
- Continued funding through the EPS surcharge
- Continued emphasis on lowest cost energy production from the sun, drive down costs
  - utility scale installations and emerging technologies
- Continued support for customer installs