

# Recent progress and future potential for concentrating photovoltaic power systems

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# Outline

- Is there a role for fields of PV systems?
- APS' experience shows: more electricity is generated by systems installed in fields
- Current status of concentrating PV (CPV)
- The potential for CPV in the future

# Is the future of PV limited to building-integrated applications?

*Is our goal to install PV  
or  
to generate solar electricity?*

Today's data reflects > 1 MW

# Arizona Public Service (APS)

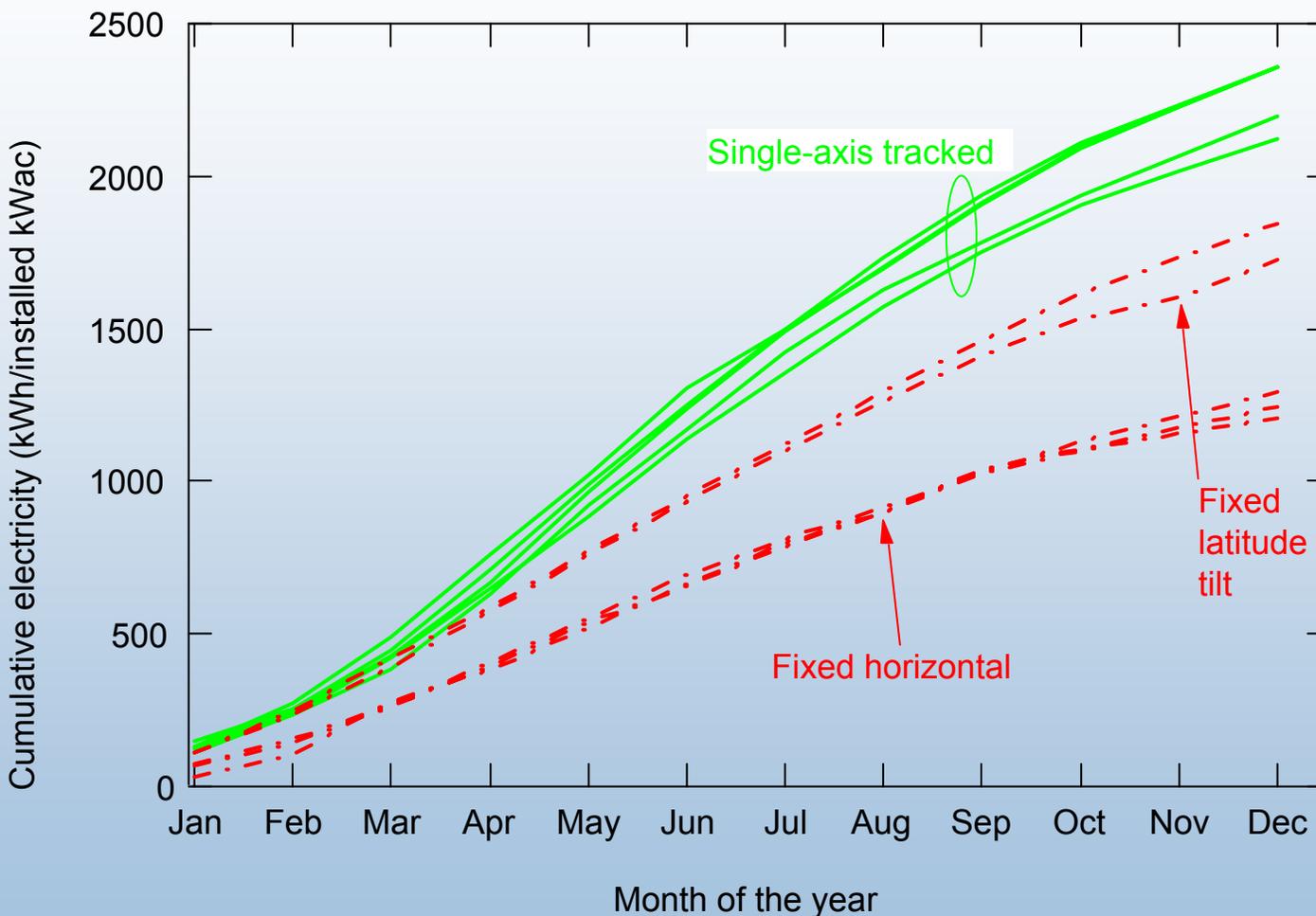
QuickTime™ and a  
TIFF (LZW) decompressor  
are needed to see this picture.

APS is installing megawatts of a variety of PV technologies  
for solar electricity generation

# Design of APS study

- Purchase many silicon flat-plate modules
- Install some on rooftops (fixed horizontal or fixed latitude tilt)
- Install some on single-axis trackers in fields

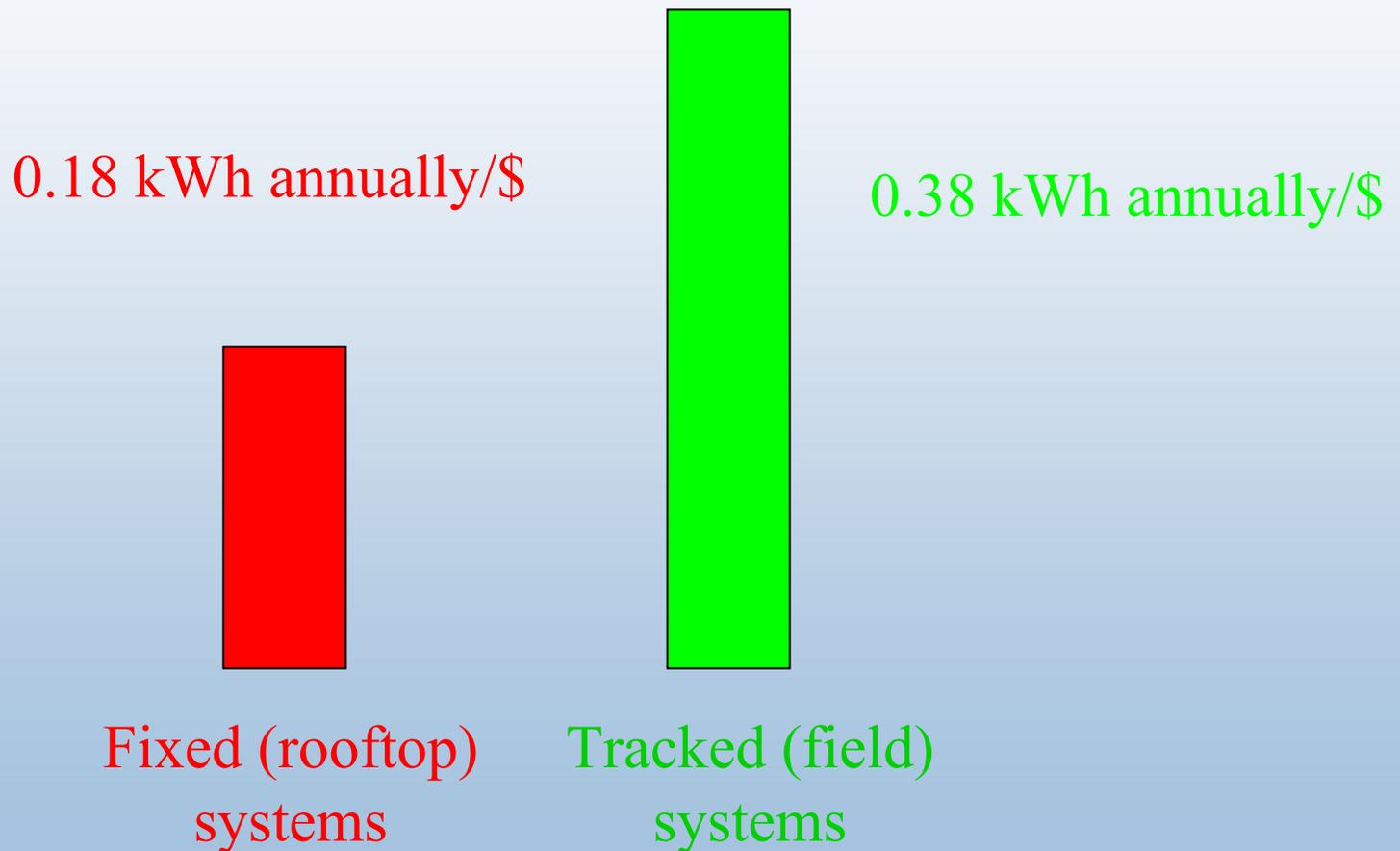
# Comparison of solar electricity from fixed and tracked systems



Average system cost of rooftop = \$9/Wac; for tracked = \$6/Wac

Study for systems installed in Arizona by APS

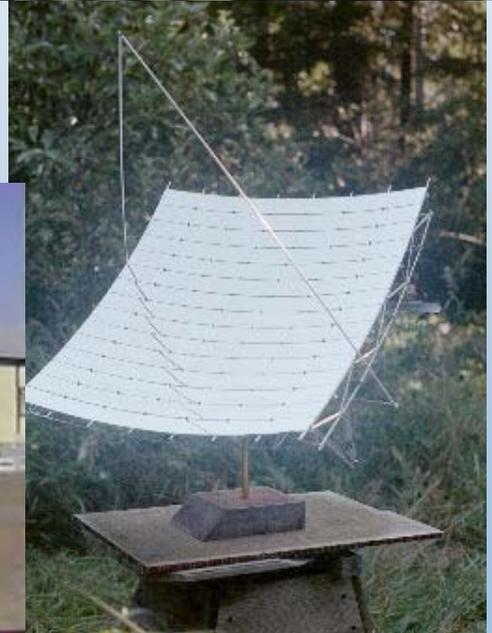
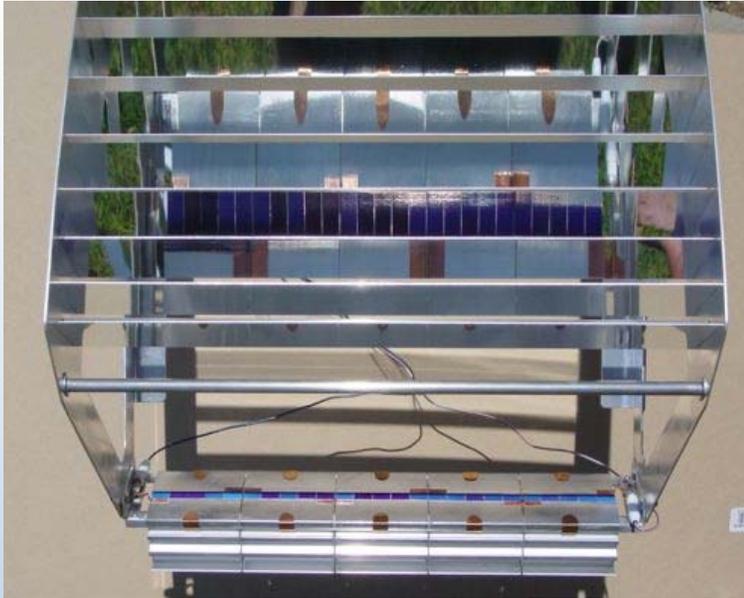
# Tracked systems deliver more electricity per dollar invested



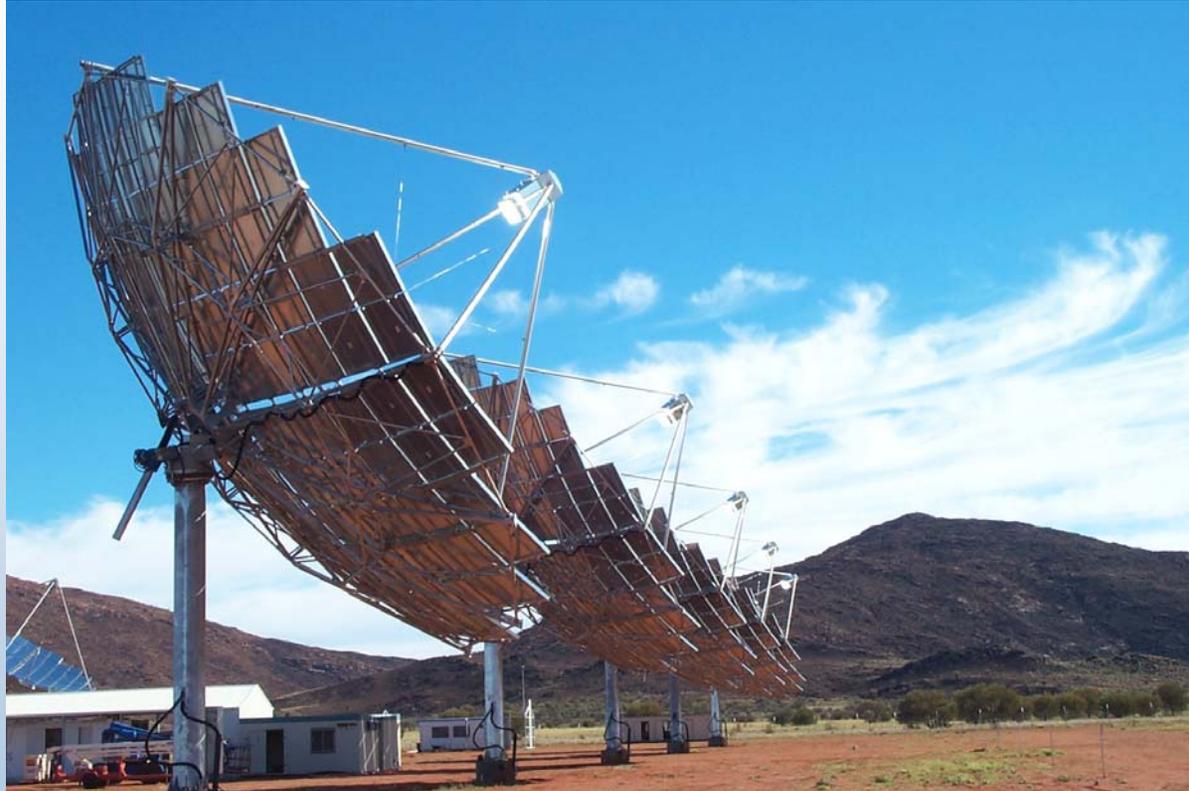
# Are tracked systems better?

- Wrong question
- Rooftop systems should be used to conserve land and place PV near load
- Field systems should be used where land is available and electricity generation is the goal
- *Pursuing both will allow PV to grow faster*

# Many companies are developing CPV technology!



# Current status of CPV



Solar Systems has installed 200 kW in Australia, is currently installing 750 kW, and are negotiating for 4 MW.

# Concentrator costs are coming down

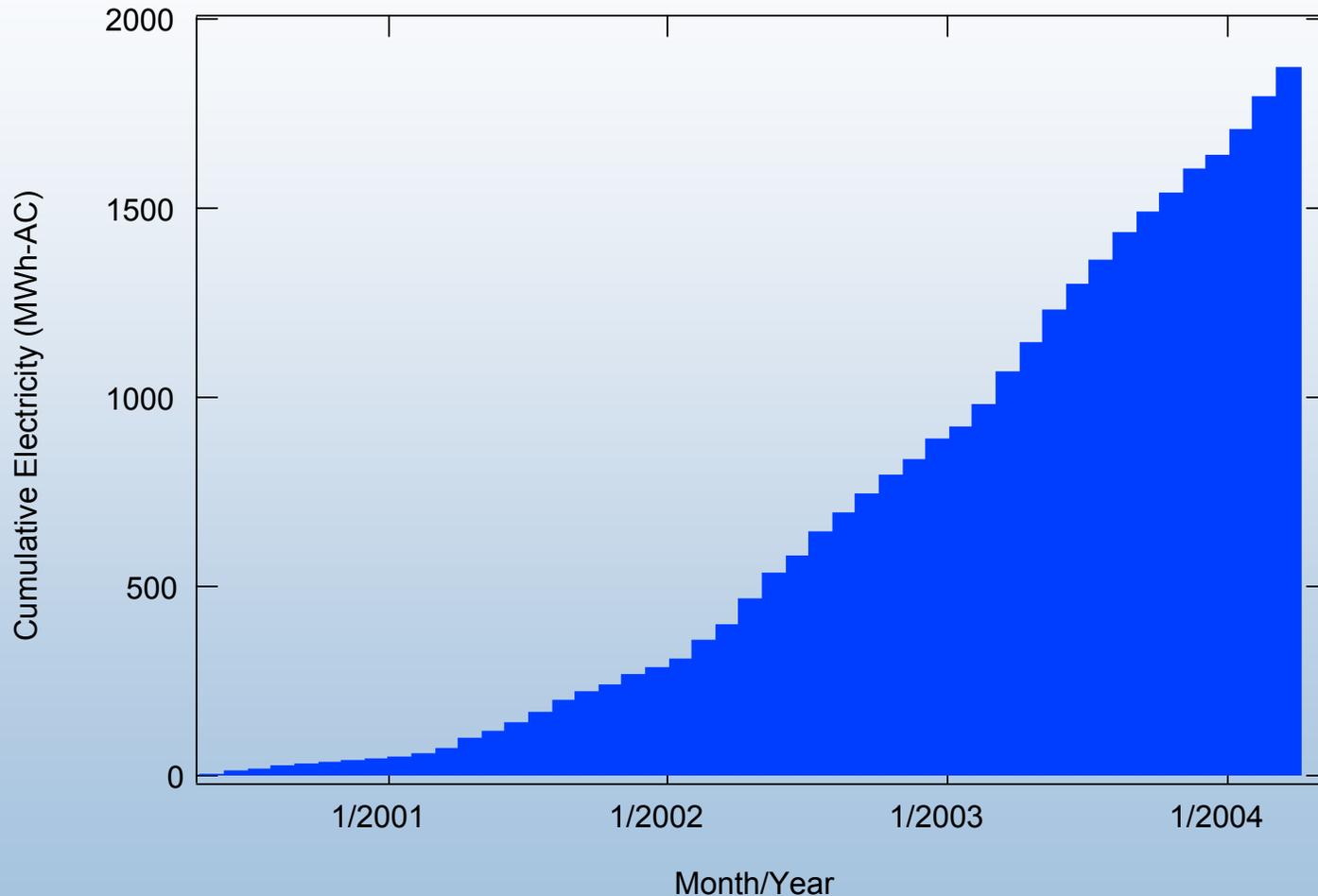
- Solar Systems is currently contracting CPV systems (for installation in the near future) at US\$5.50/Wac with expected annual production of 2700 kWh/kW installed

# Current status of CPV



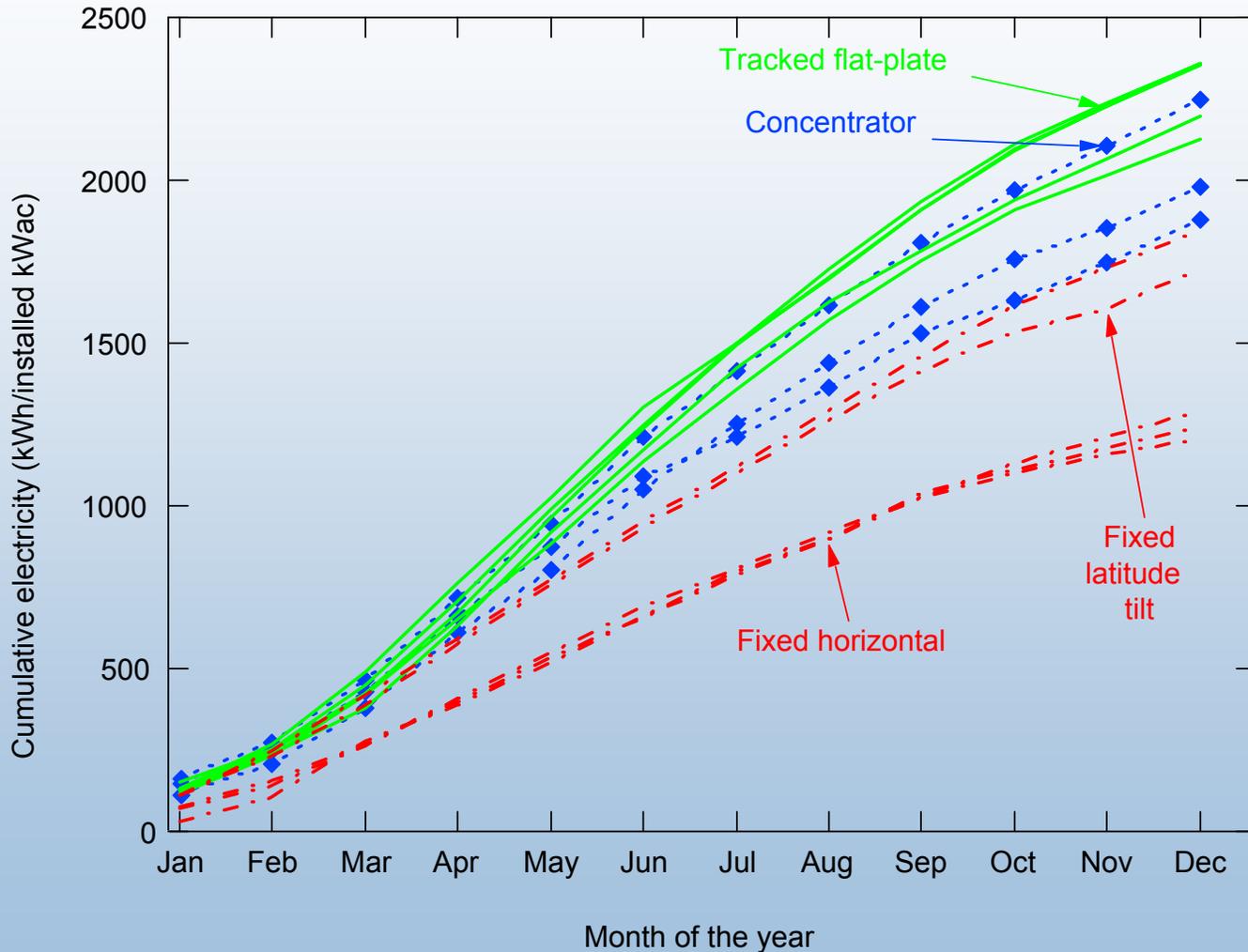
Amonix and Arizona Public Service have installed >570 kW of CPV in Arizona, and plan to install more each year under Arizona's portfolio standard.

# Electricity generation is going up - consistently!



Electricity generated by Amonix systems at APS

# Concentrator performance is consistent and high (data from APS)

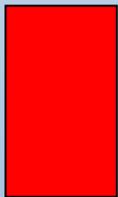


# Concentrator costs are already competitive despite low-volume

*If I invest \$1000 in PV installations,  
then measure the electricity generated in a year,  
how much electricity do I get?*

Fixed, flat-plate  
rooftop systems

180 kWh



1-axis tracked,  
flat-plate systems

380 kWh



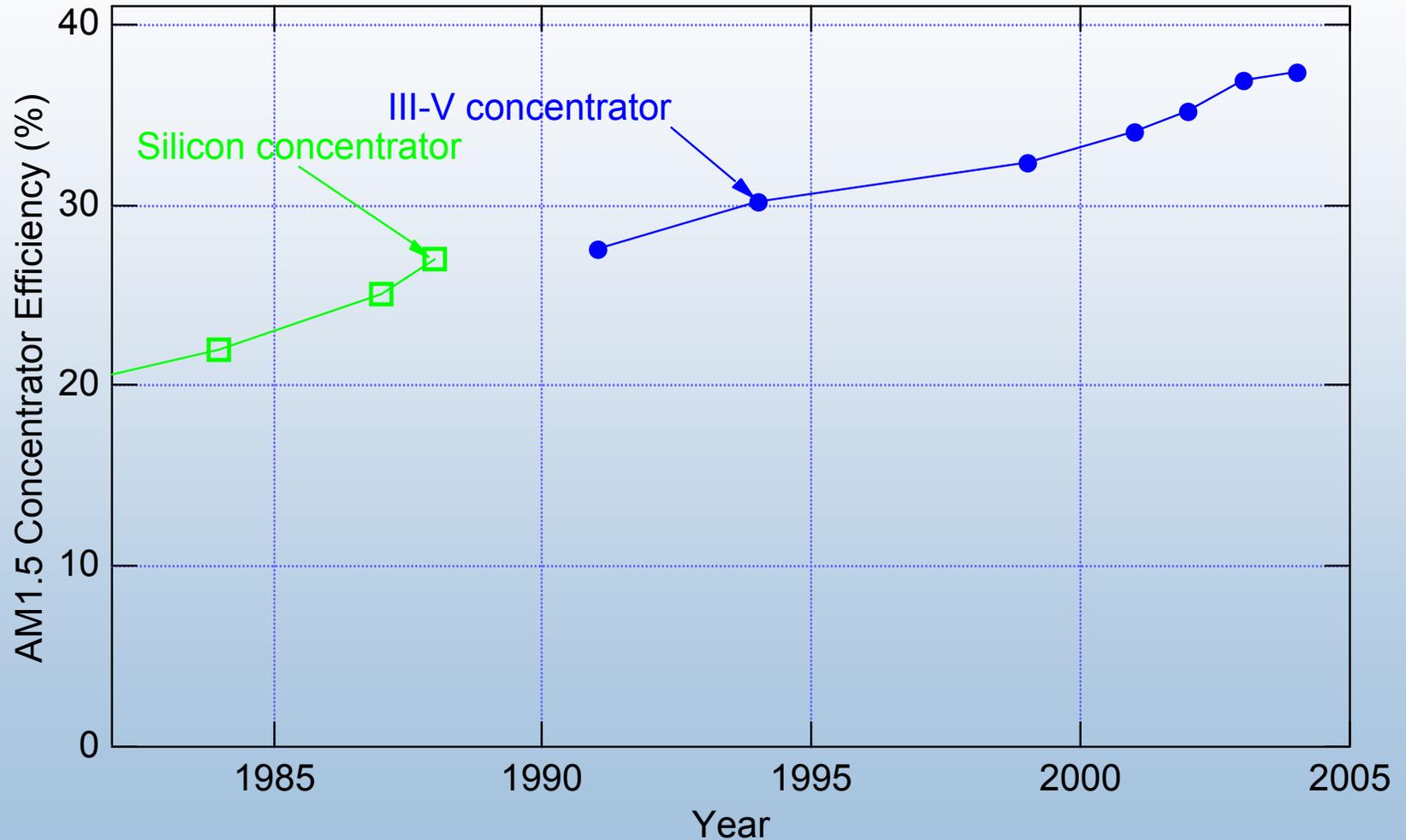
Concentrator  
systems

300 kWh



Data from installations in Arizona, by Arizona Public Service  
*Concentrator cost is already competitive!*

# Cell efficiencies are increasing



# Conclusions

- Study of APS systems installed in Arizona showed about twice as much electricity generated for \$ invested for tracked flat-plate systems compared with fixed, rooftop systems
- Makes sense to pursue both rooftop and utility PV markets, in which case CPV may have new opportunity
- CPV systems are being installed at 100s kW/yr
- Multijunction cell efficiencies have reached 37%
- Incorporation of multi-junction cells offer significant improvement in system output
- Outlook is bright for this developing technology