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)

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

Fixed (rooftop) systems: 0.18 kWh annually/$

Tracked (field) systems: 0.38 kWh annually/$
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

- Silicon concentrator
- III-V concentrator
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.