

A Low Cost Solar Concentrator

A simple solar concentrator for the developing world



Rationale

- 2 billion people without electricity
- 40% CO₂ from electrical power plants



Economics of Solar Energy

- \$100/square Meter annually
- \$12 dollars/square Meter average
- \$500 capital cost to get the \$12
- 2.5% ROI

Economics of Solar Energy

- Lots of energy available..Too expensive to utilize
- \$50,000/acre at 12% conversion
- Average house needs 20 square meters.
- “Cost was the rock on which, thus far all sun power propositions were wrecked”



Advantages Of Concentration

- Cheaper cost for large systems



Disadvantages of Concentration

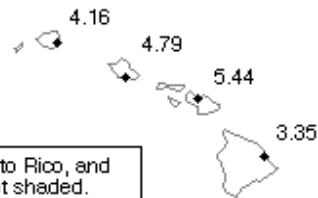
- Requires clear days
- Very hot
- Requires tracking/extra complication



Alaska

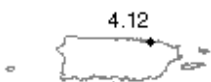


Hawaii



Hawaii, Puerto Rico, and Guam are not shaded.

San Juan, PR

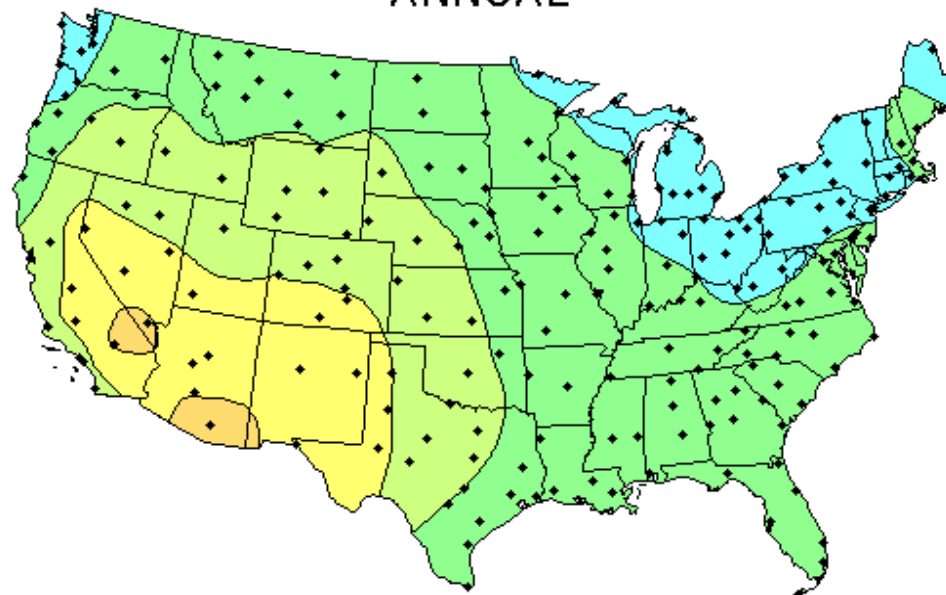


Guam, PI



Average Daily Solar Radiation Per Month

ANNUAL



North-South Axis Tracking Concentrator

Collector Orientation

One-axis tracking parabolic trough with a horizontal north-south axis: The trough reflects solar energy onto a tube at the focus of a parabola.

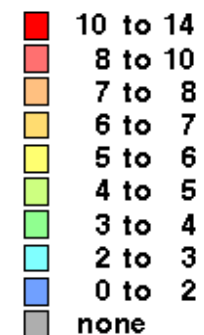
This map shows the general trends in the amount of solar radiation received in the United States and its territories. It is a spatial interpolation of solar radiation values derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). The dots on the map represent the 239 sites of the NSRDB.

Maps of average values are produced by averaging all 30 years of data for each site. Maps of maximum and minimum values are composites of specific months and years for which each site achieved its maximum or minimum amounts of solar radiation.

Though useful for identifying general trends, this map should be used with caution for site-specific resource evaluations because variations in solar radiation not reflected in the maps can exist, introducing uncertainty into resource estimates.

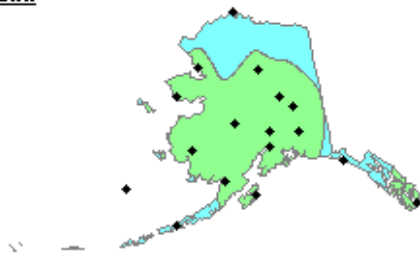
Maps are not drawn to scale.

kWh/m²/day

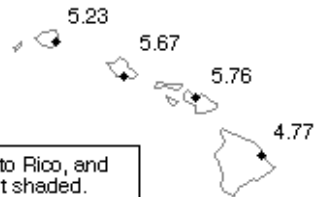


National Renewable Energy Laboratory
Resource Assessment Program

Alaska

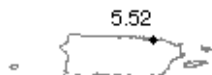


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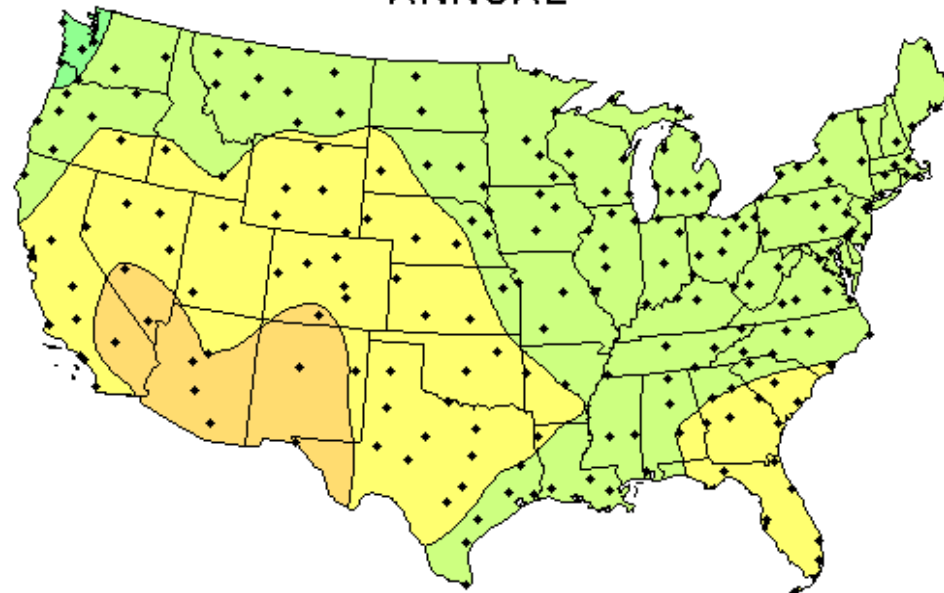


Guam, PI



Average Daily Solar Radiation Per Month

ANNUAL



Flat Plate Tilted South at Latitude

Collector Orientation

Flat-plate collector facing south at fixed tilt equal to the latitude of the site: Capturing the maximum amount of solar radiation throughout the year can be achieved using a tilt angle approximately equal to the site's latitude.

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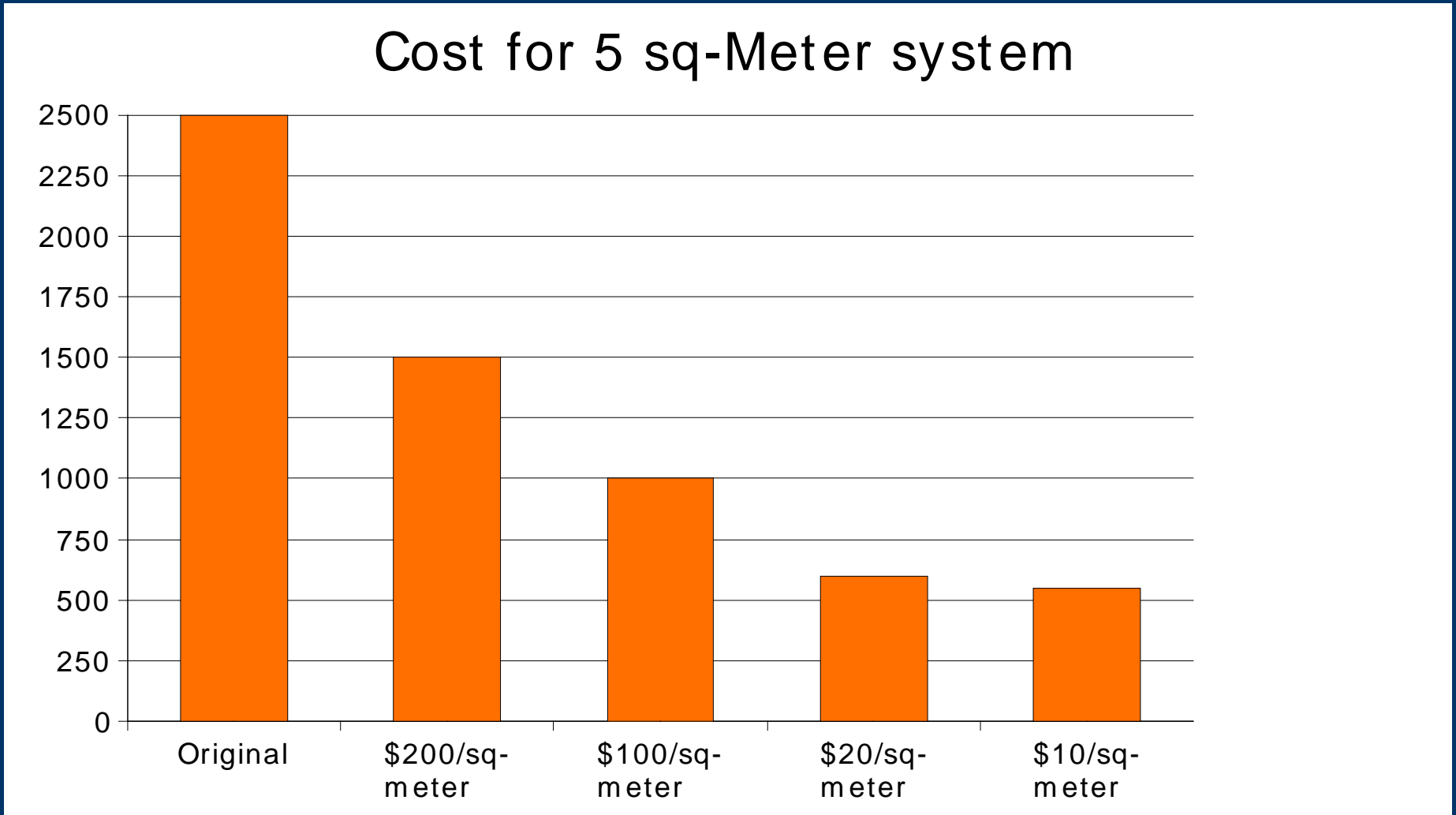


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kWh/m²/day



5:1 PV Concentrator Example



Higher Concentration

- Thermal or PV
 - Can have similar efficiencies/costs
 - Thermal has added benefit of heat
 - PV is simpler
 - Lower temp thermal very compatible with geothermal technology
 - Higher temp requires greater concentration/precision T^*^4 losses
 - Medium concentration most proven
 - HFC-245 very attractive working fluid
-
-

Current Concentrator Technologies

- Parabolic Trough
- Approx \$200/sq-m
- quietly working for 20 years
- mature technology



Current Concentrator Technologies

- Linear Fresnel
- Approx \$100/sq-m



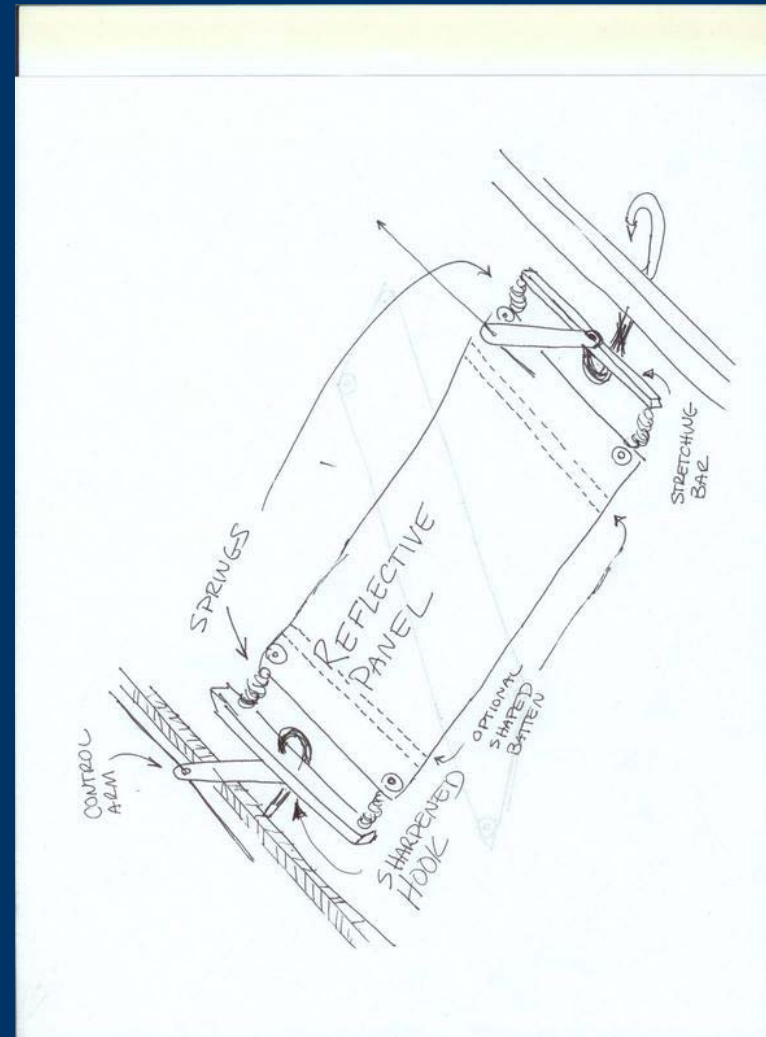
To Compete with Coal

- Coal Fuel Costs appx 2 cents/kwh
- At 20% capital costs, 10% efficiency cost must be \$20/square meter (about the price of carpet)



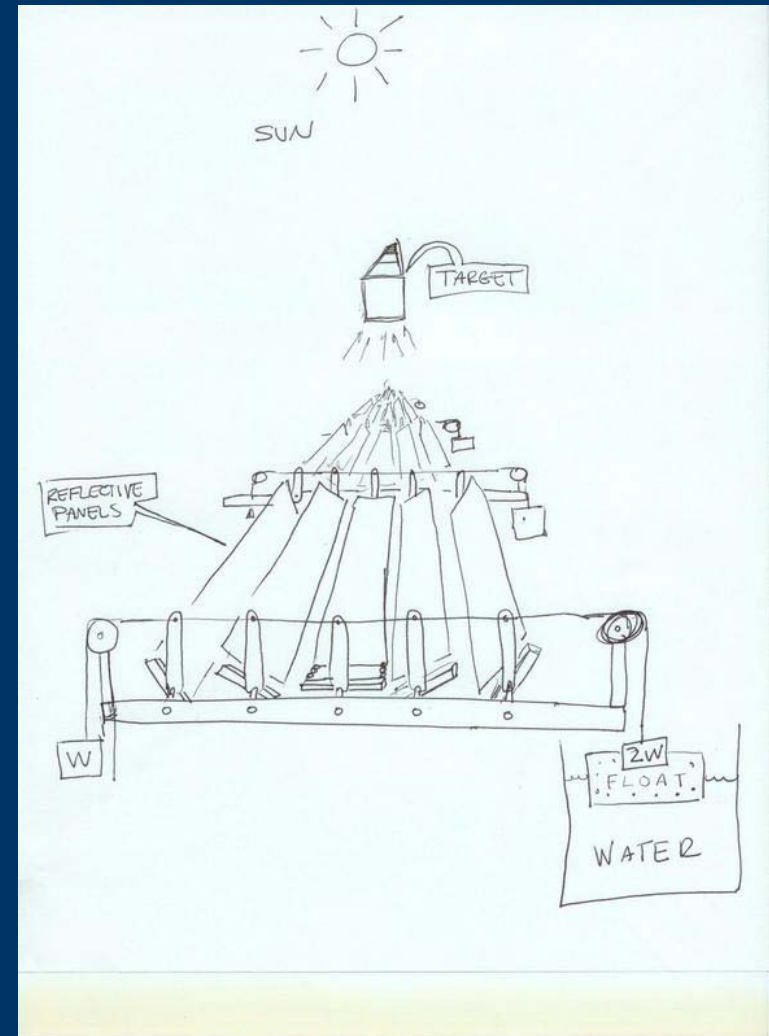
Stretched Membrane Concentrator

- Low cost reflector material (\$1-10/sq-meter)
- Support structure very minimal
- lightweight reflectors easy to move



Water-Float Tracking Mechanism

- Ganged Reflectors
common rate- different
phase
- Easy to fix/diagnose
problems
- Possible to control
1000's of panels with 1
pump



Prototype



Prototype



Prototype

- Reflector cost with tracking \$7.50/sq-meter (real home-depot prices)
- Mass production can reduce this
- Very hot! No one wants to stay on the ladder very long
- Need more testing/funding/pilot project



Questions?

