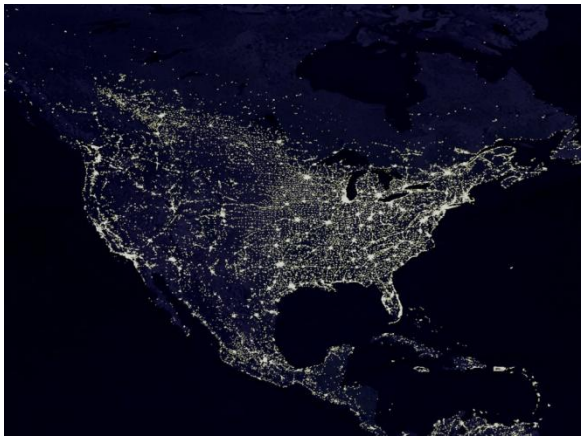
Solar Thermal Electricity

Dan Recht

Photovoltaic electricity faces challenges

Cost

Scale

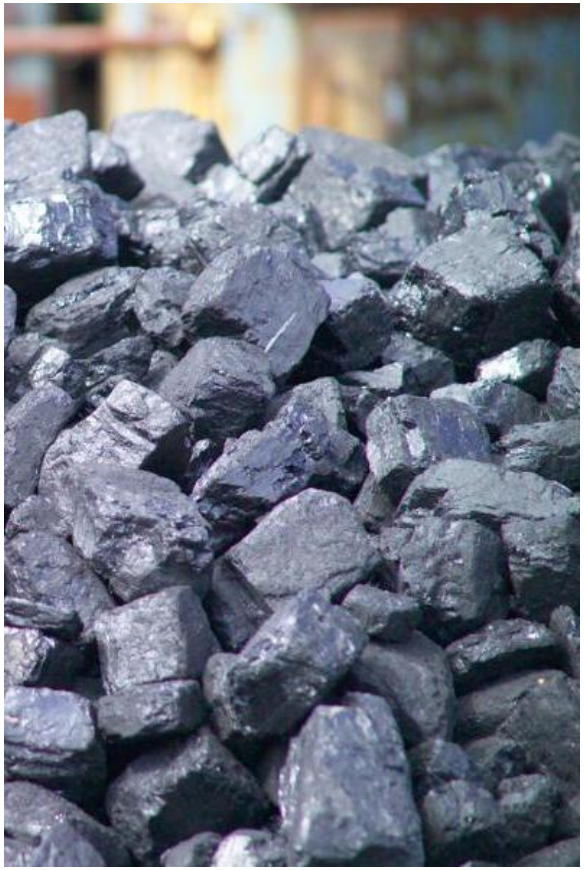


Storage

Ian Britton: http://www.freefoto.com/preview/04-12-14?ffid=04-12-14
NASA/GSFC: http://www.flickr.com/photos/wwworks/2712986388/
Tracey Olson: http://www.flickr.com/photos/tracy_olson/61056391/sizes/l/in/photostream/

Heat can come from many sources

Fossil Fuels



Biomass

The Sun

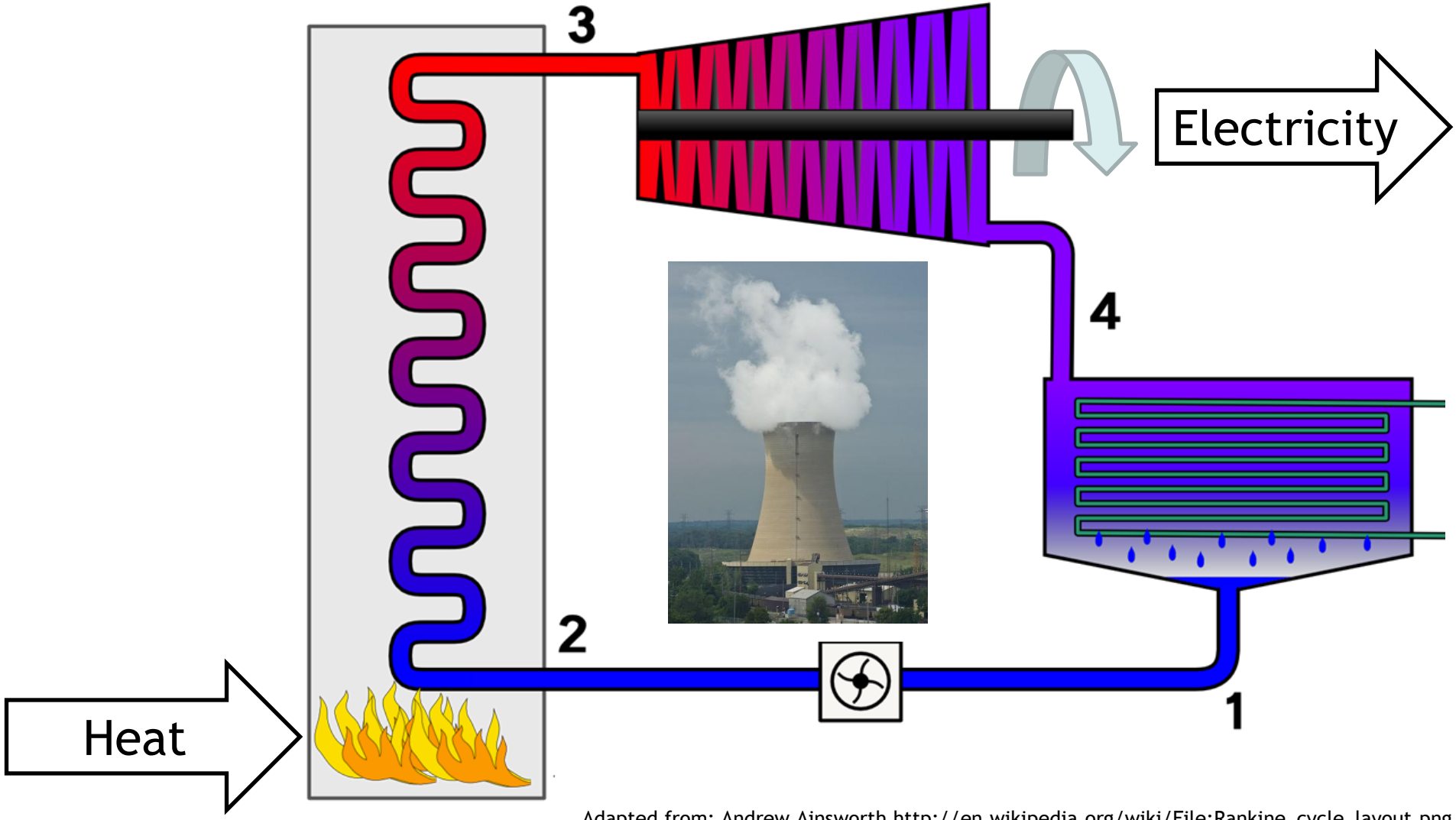
Also: nuclear, geothermal, chemical, etc.

Left to Right: Ian Britton http://www.freefoto.com/preview/13-25-7?ffid=13-25-7&k=Coal
Pat Schmitz http://en.wikipedia.org/wiki/Image:Miscanthus_giganteus.jpg
Arun Kulshreshtha http://commons.wikimedia.org/wiki/File:The_Sun.jpg

Water heaters can use sunlight as fuel

Adapted from Inkwina http://commons.wikimedia.org/wiki/File:Thermal-solar.svg
Stan Zurek http://en.wikipedia.org/wiki/File:Solar_panels,_Santorini.jpg

Most power plants rely on steam turbines

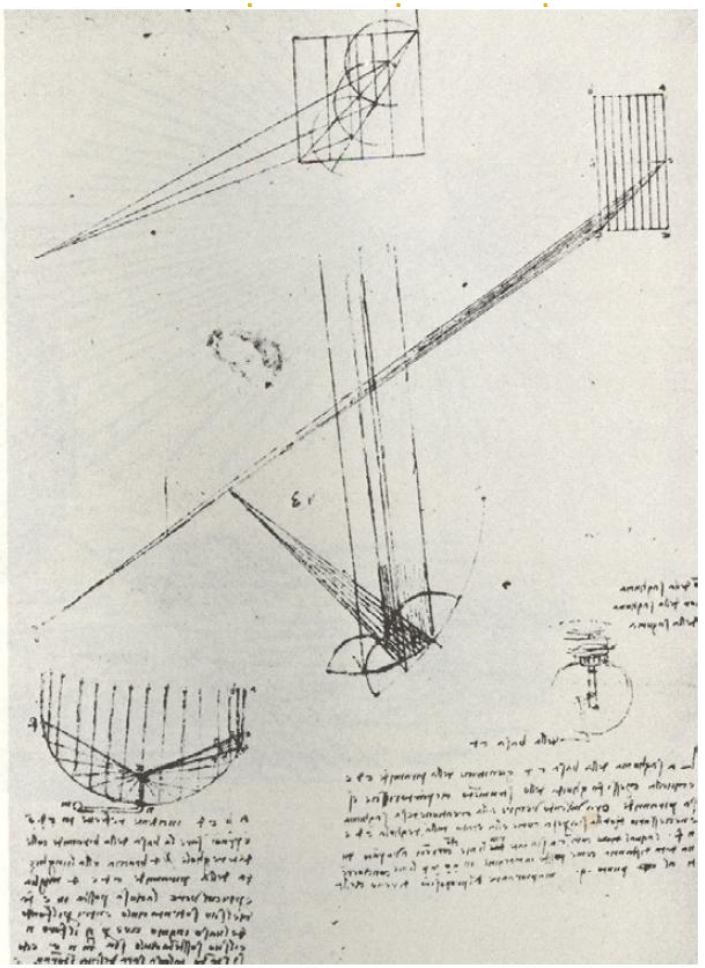


Adapted from: Andrew Ainsworth http://en.wikipedia.org/wiki/File:Rankine_cycle_layout.png

Concentrated sunlight can boil water

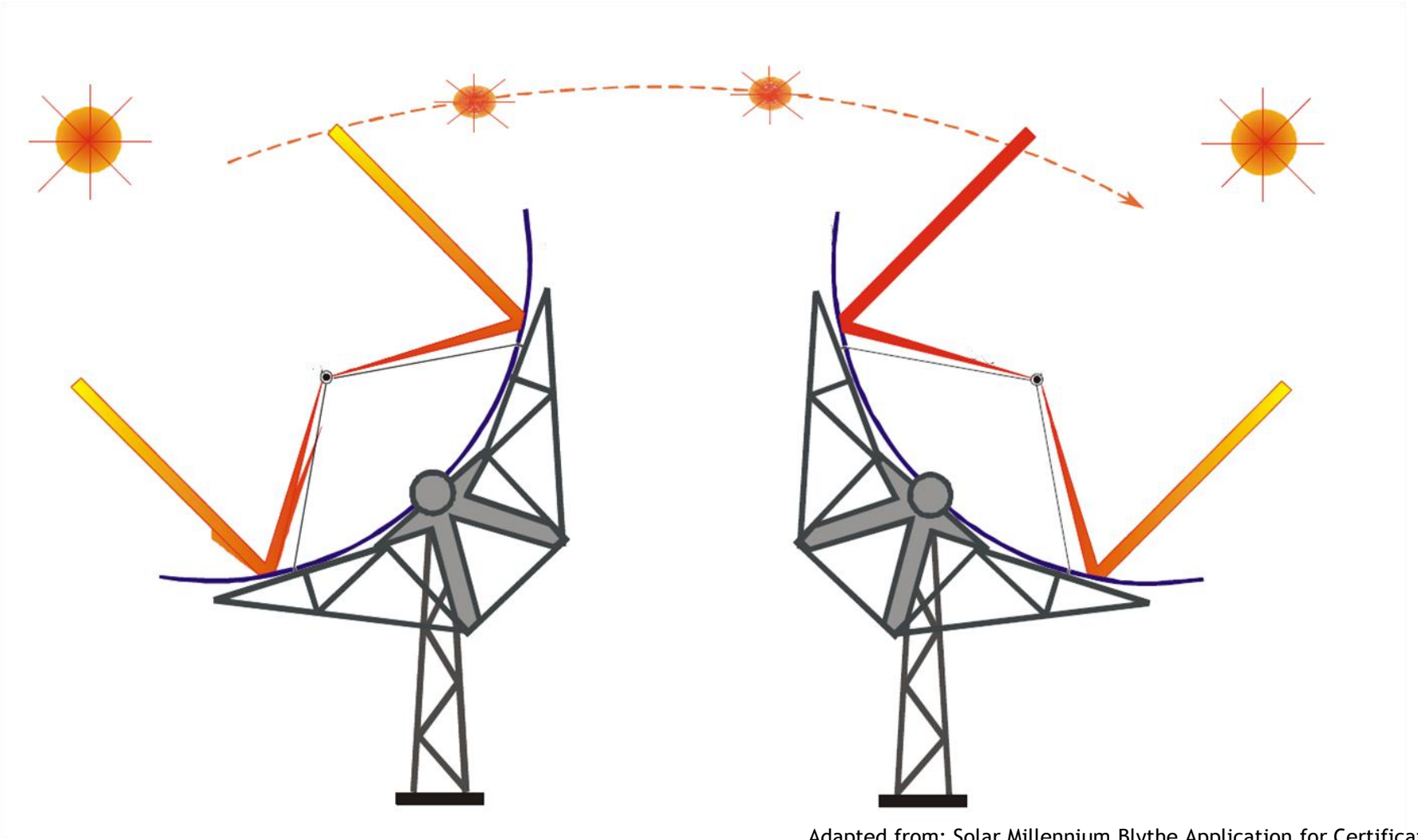
Dave Gough: http://www.flickr.com/photos/86381820@N00/1505372433/

Parabolic mirrors concentrate sunlight



Andrew Buck: http://en.wikipedia.org/wiki/File:Parabolic_trough.svg

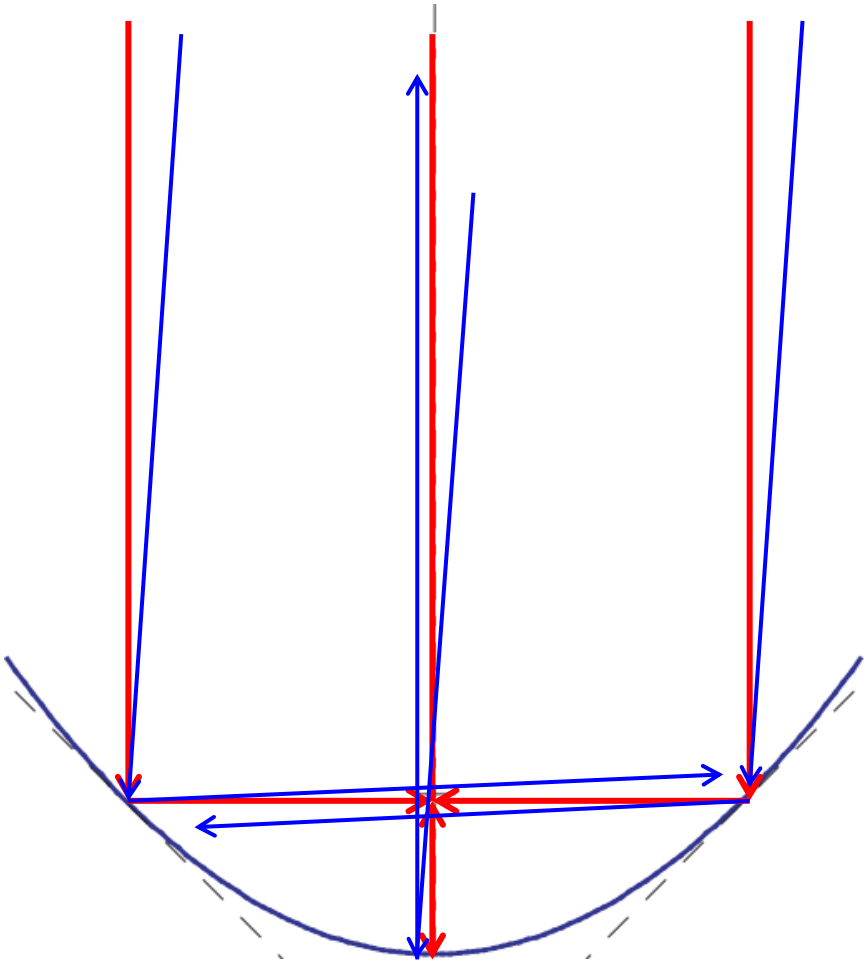
Concentrators must track the sun



Adapted from: Solar Millennium Blythe Application for Certification
http://www.energy.ca.gov/sitingcases/solar_millennium_blythe/documents/applicant/afc/index.php

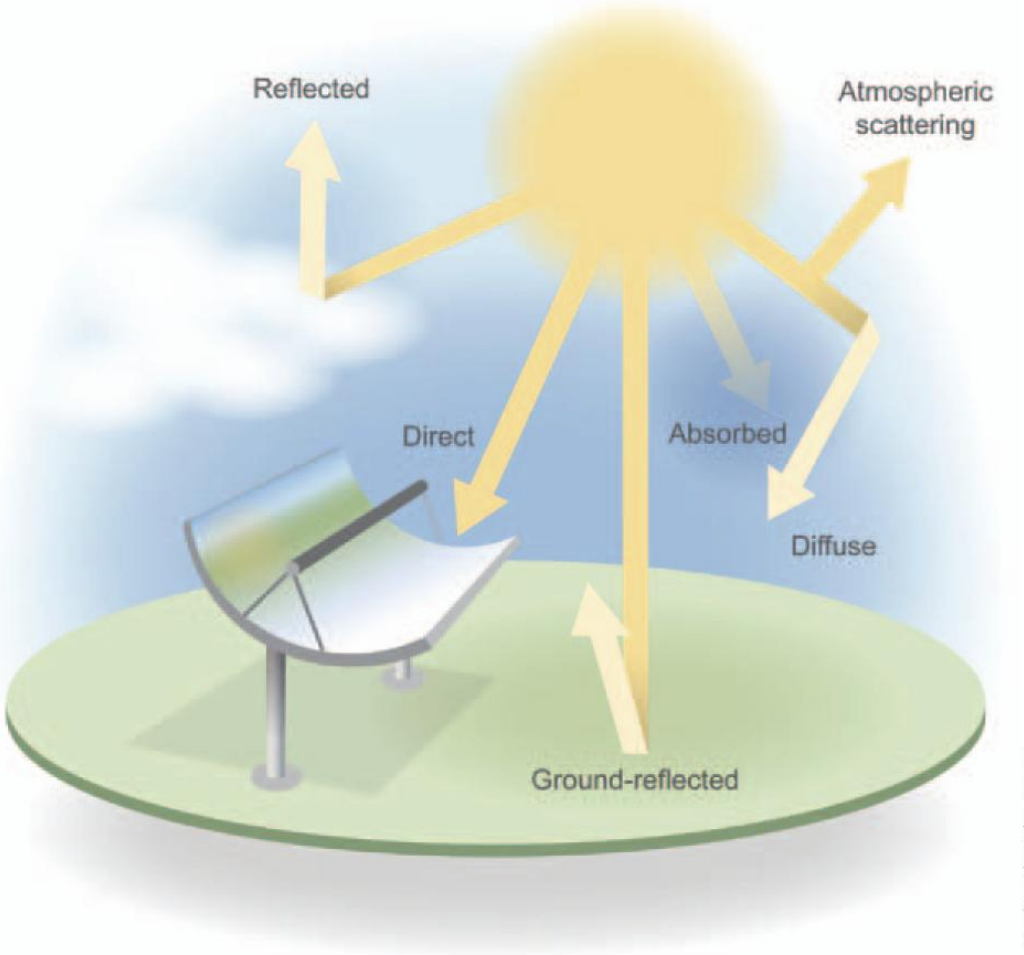
Geometry limits concentration

rays from left edge of sun (exactly on axis)



rays from right edge of sun (0.5° off axis)

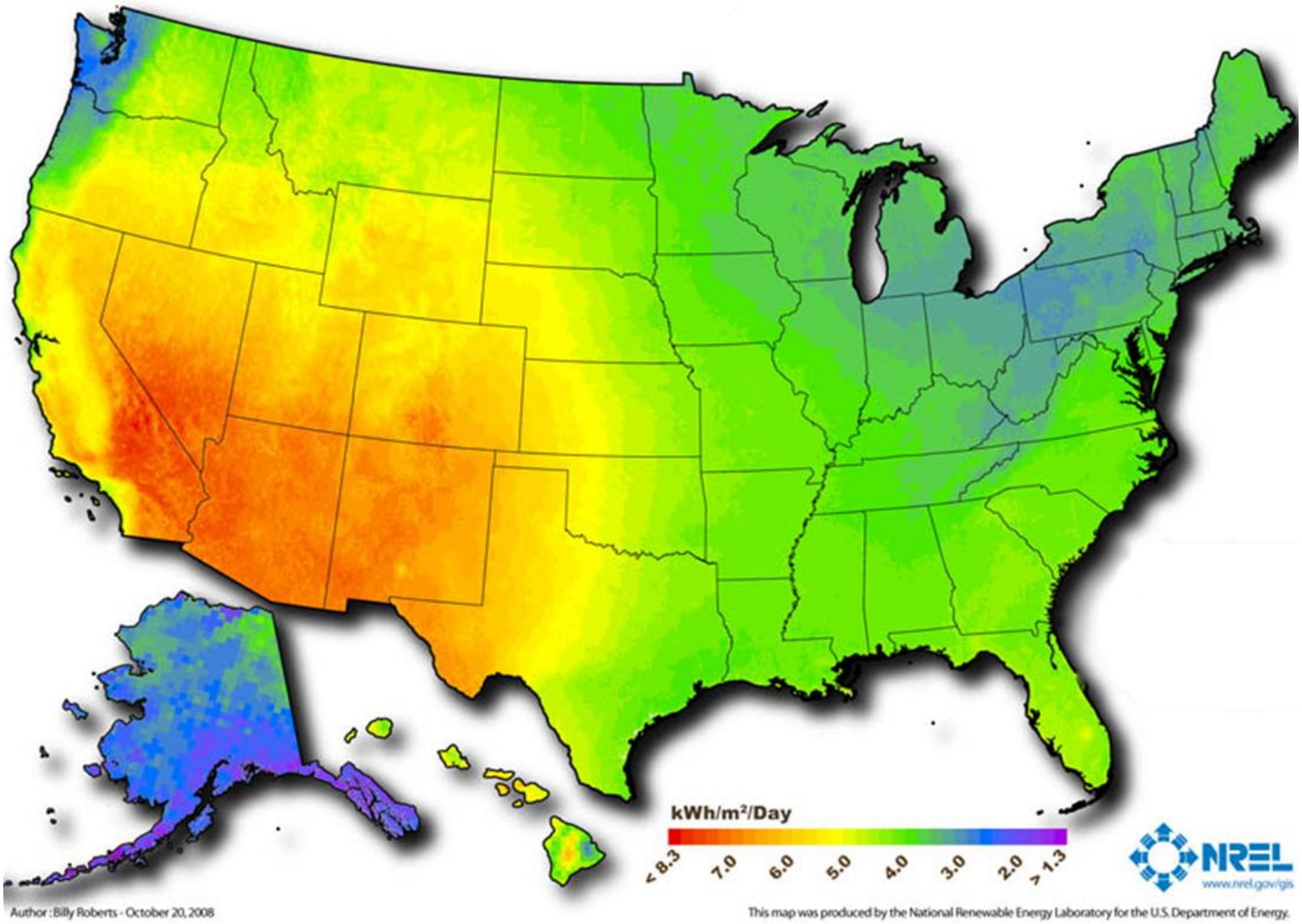
Only direct sunlight can be concentrated



Credit: Al Hicks, NREL

NREL Best Practices Handbook for the Collection and Use of Solar Resource Data

Concentrating makes sense in the Southwest



Solar thermal plants were built in the 1980s

NREL Best Practices Handbook for the Collection and Use of Solar Resource Data

A heat exchanger is used to generate steam

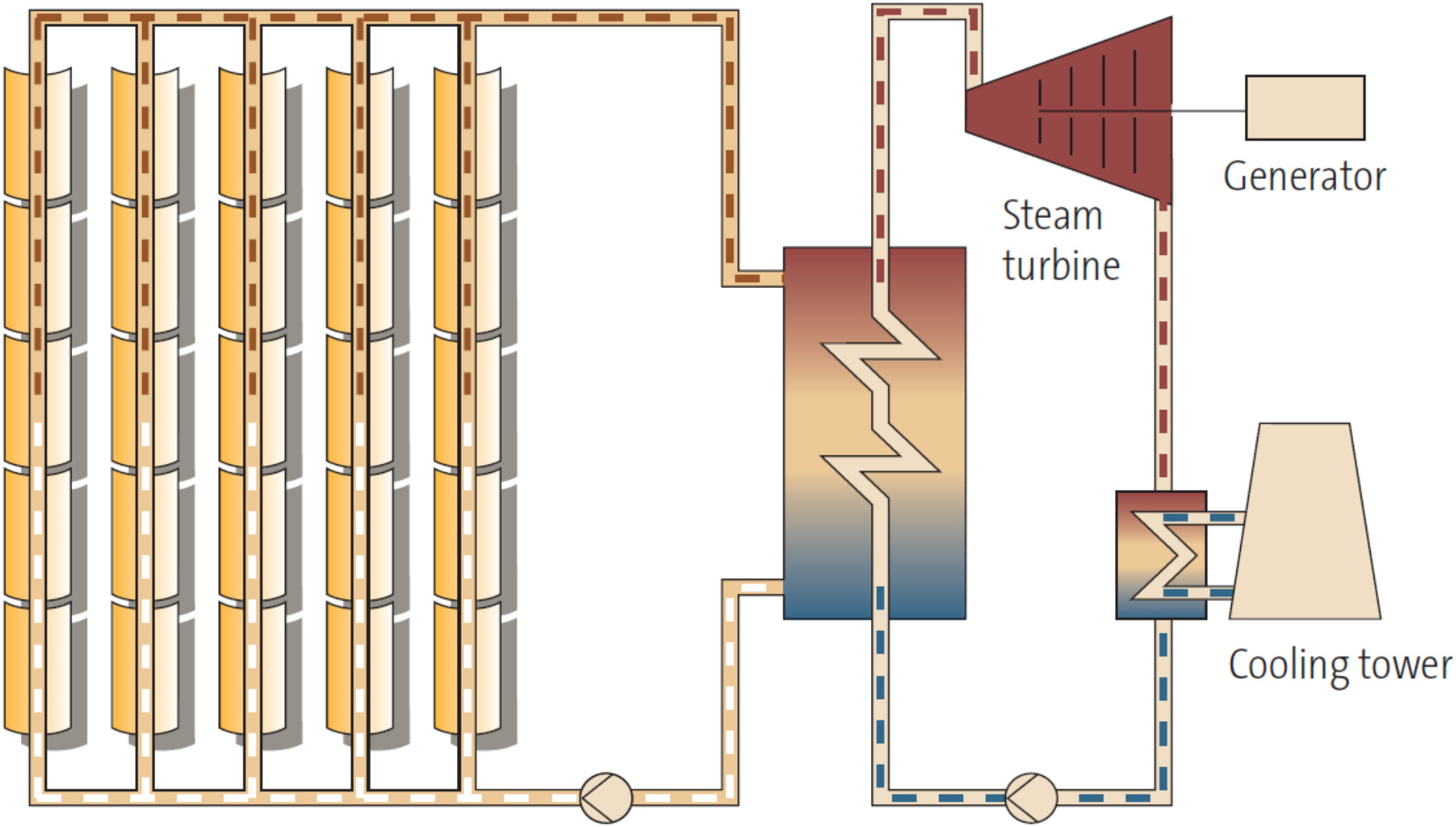
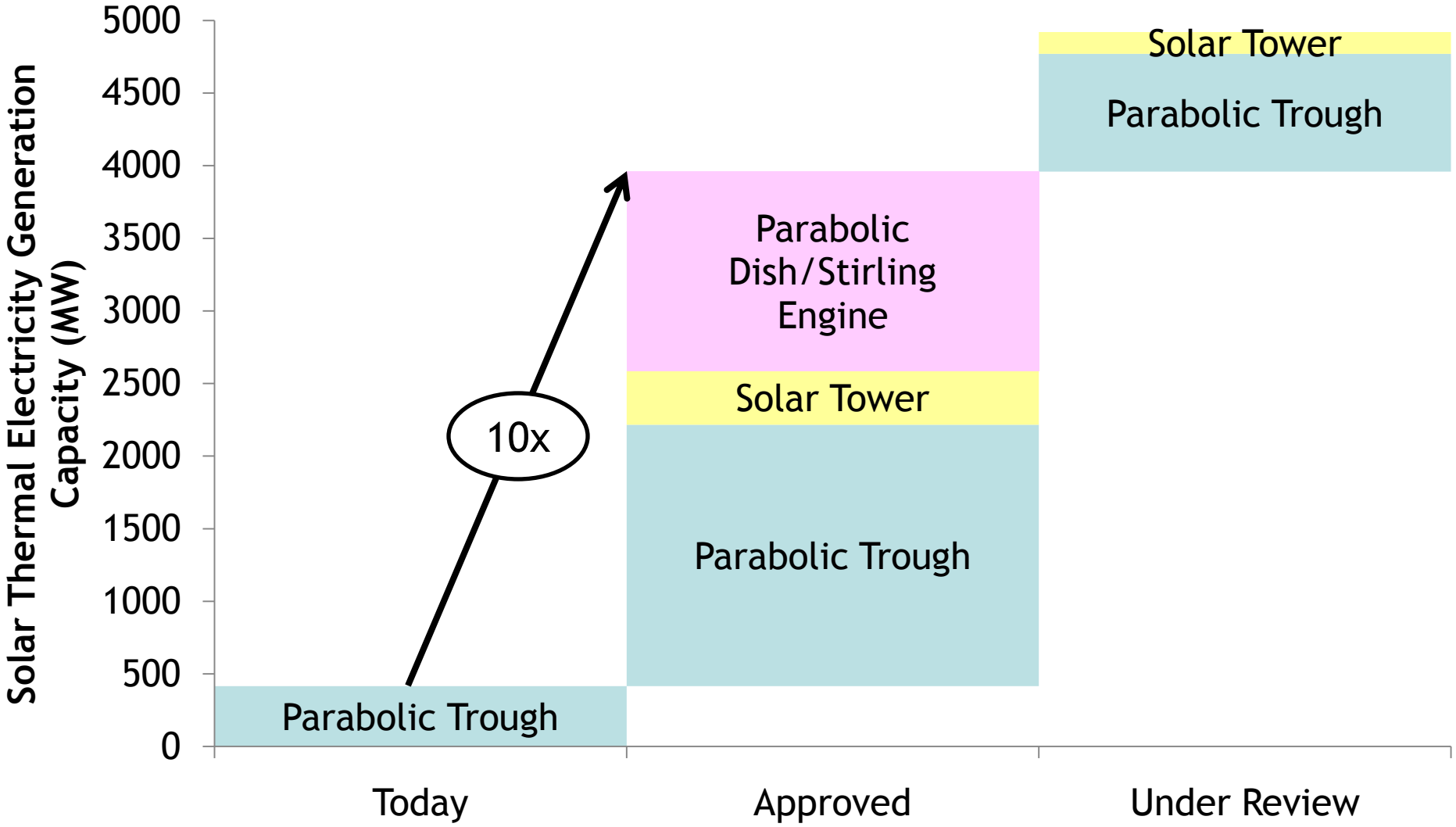


Image used with permission from Solar Trust of America, LLC

There is a solar thermal boom in California

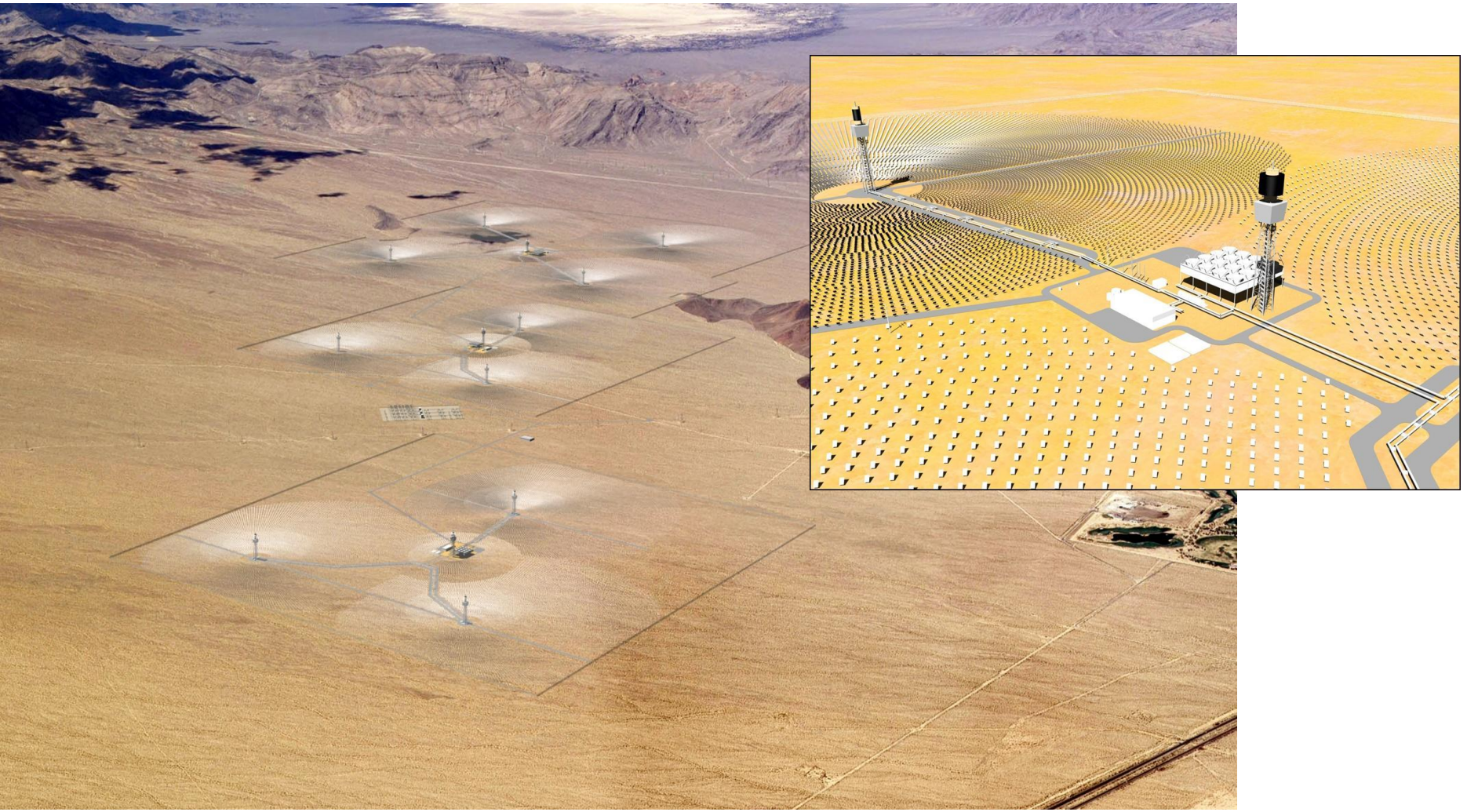


Many mirrors focus light onto a solar tower

The 11 MW Planta Solar 10 facility in Spain

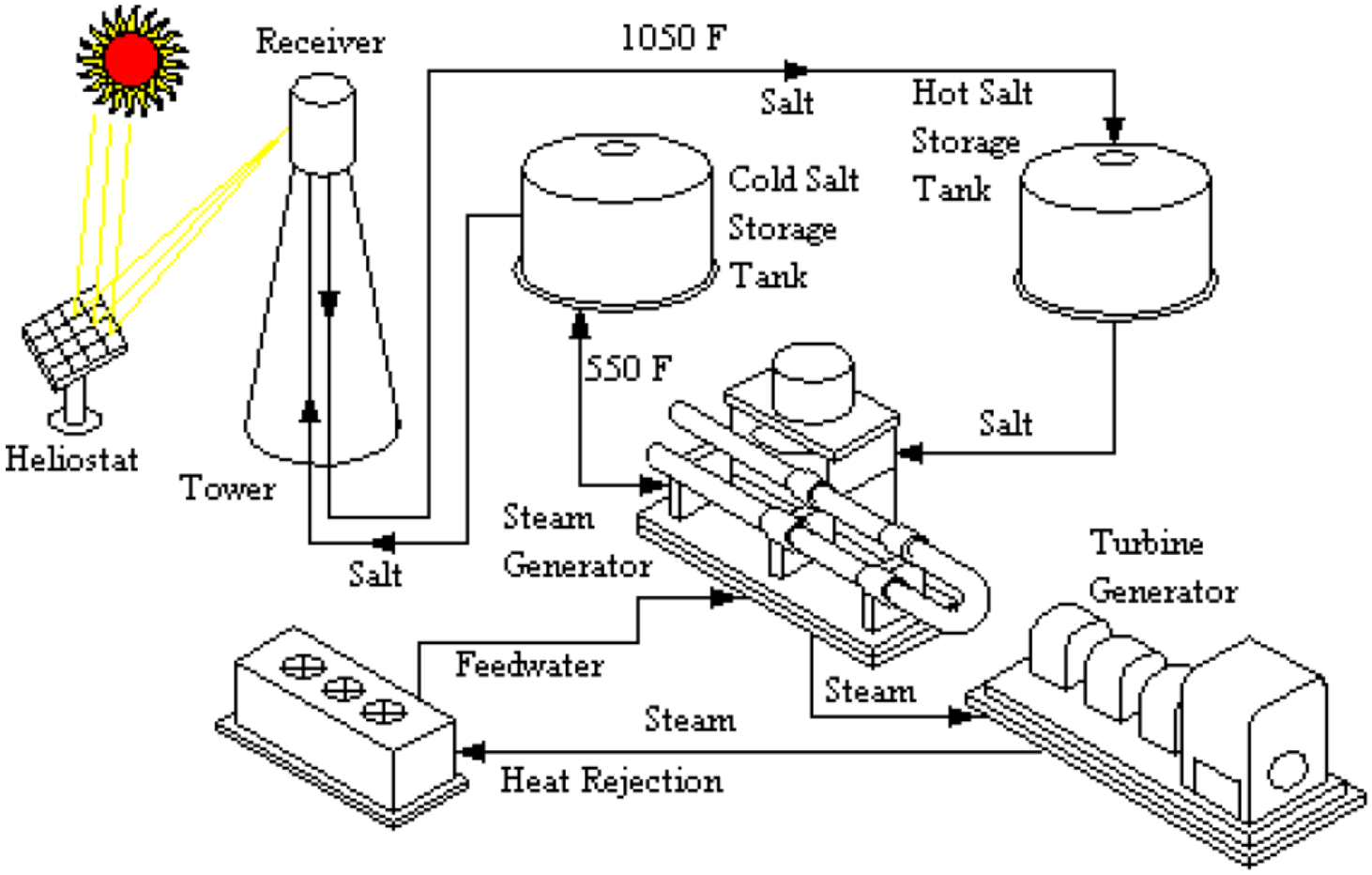
afloresm: http://en.wikipedia.org/wiki/File:PS10_solar_power_tower_2.jpg

Ivanpah will be nearly 40x larger than PS10



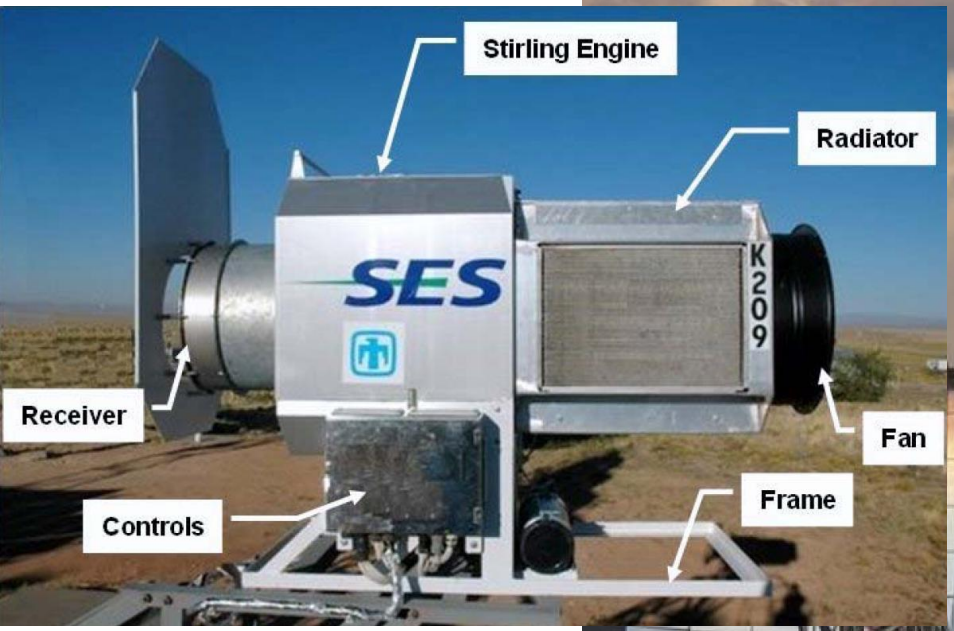
PG&E green energy: http://www.flickr.com/photos/26715412@N03/2922574552/in/set-72157607824510018/
http://www.flickr.com/photos/26715412@N03/2922575158/in/set-72157607824510018/

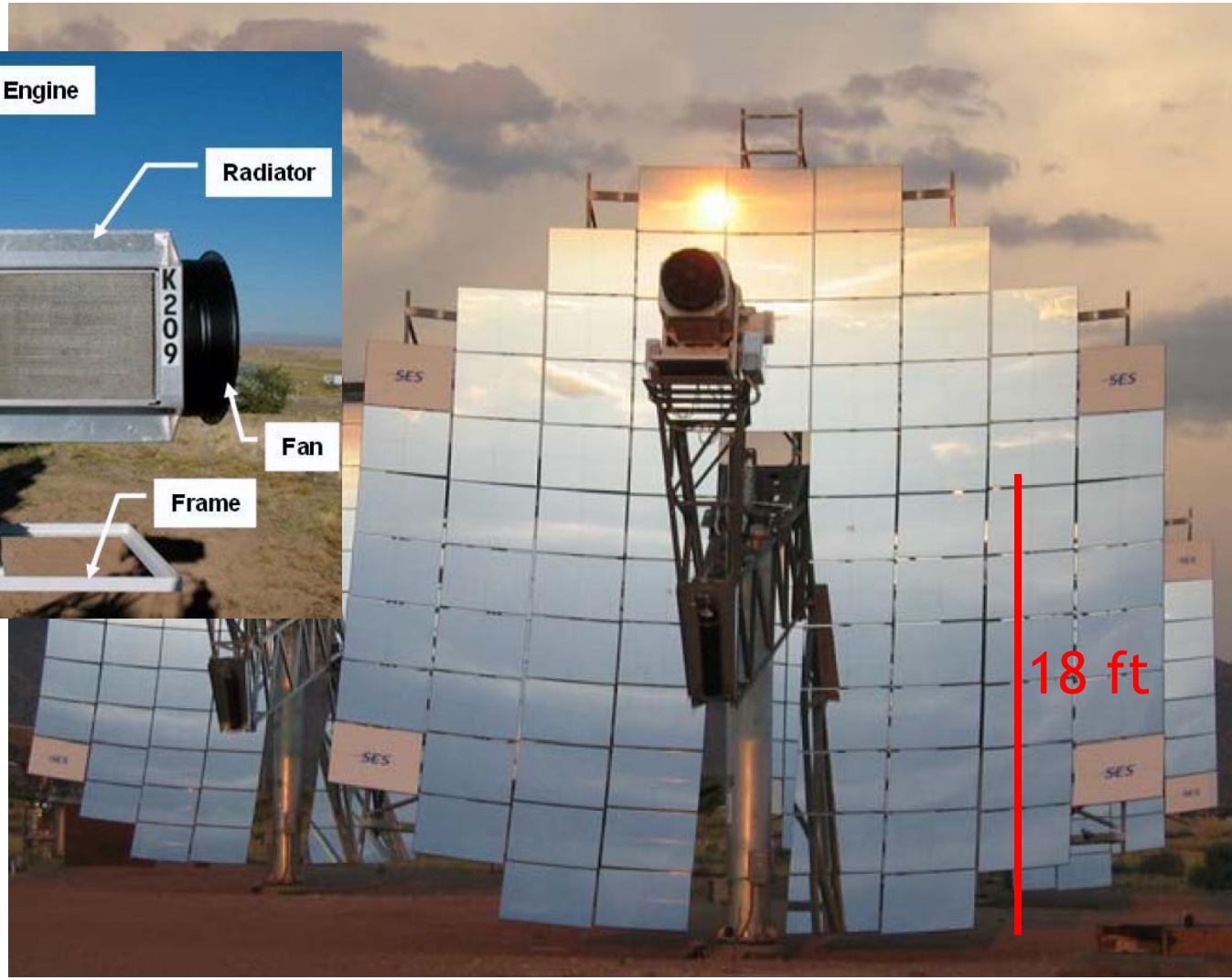
Molten salt can store solar energy



NREL Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts

Heat from the sun can power a generator





SES solar two application for certification: http://www.energy.ca.gov/sitingcases/solartwo/documents/applicant/afc/index.php

Imperial valley will host 28,000 engines

SES solar two application for certification: http://www.energy.ca.gov/sitingcases/solartwo/documents/applicant/afc/index.php

The sun is an abundant source of energy

- Energy from the sun reaches the Earth as **electromagnetic radiation** with a characteristic spectrum

- Solar energy can be turned directly into electricity by **photovoltaic cells**

- Solar energy can also be used in **solar thermal plants** to make steam that powers an electricity-generating turbine

Thank you!

SITN would like to acknowledge the following organizations for their generous support:

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- Restaurant Associates

- SITN is a student organization at Harvard GSAS-