SITN
science in the news

Star Power

Kevin Beier
Jacob J. Krich
Dan Recht

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1: Introduction to energy

2: Photovoltaics (Jacob)

3: Solar Thermal applications (Dan)

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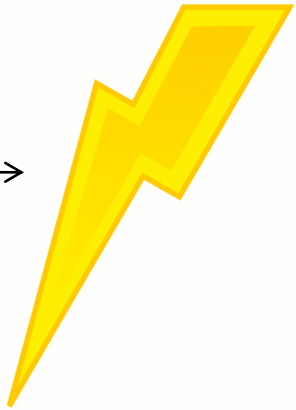
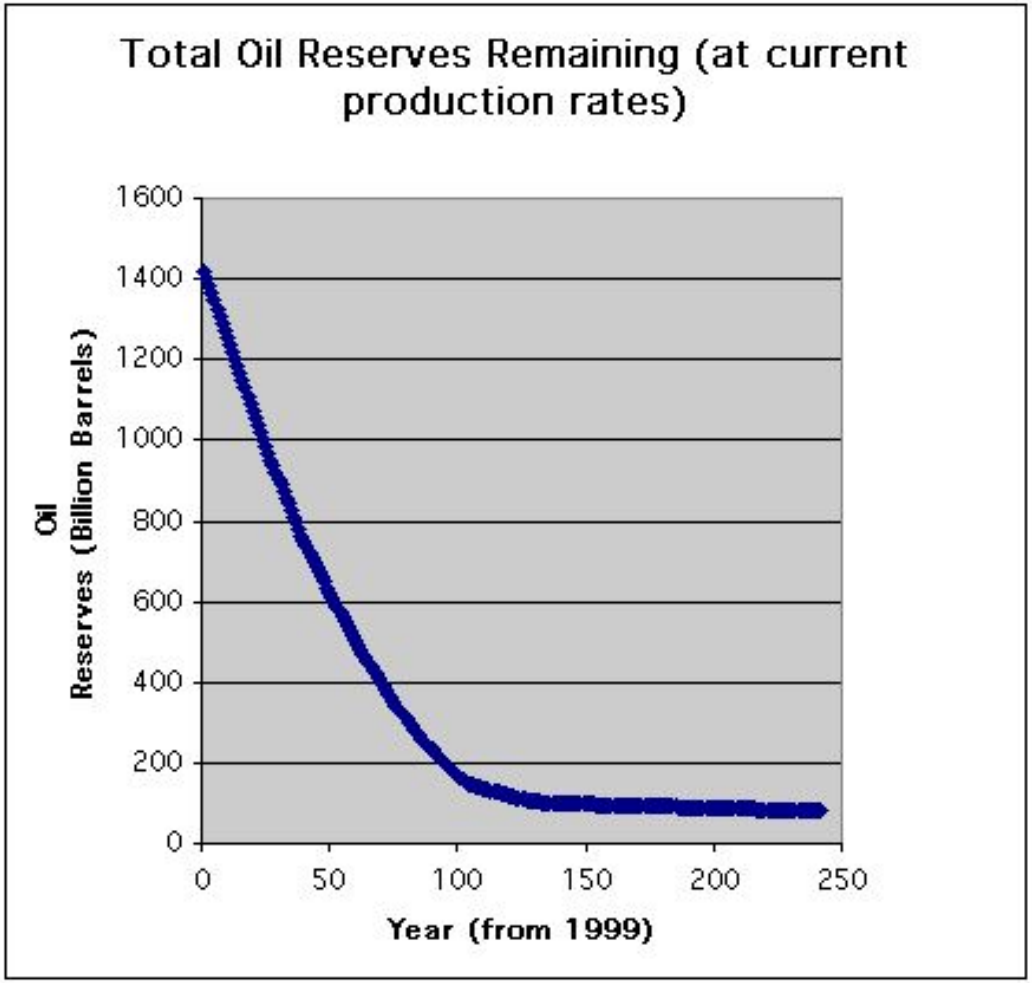
What is energy?



http://world-is-natural.org/page24/files/coal.jpg
http://www.cesd.az/img/oil.jpg http://www.etftrends.com/wp-content/uploads/2010/06/gasstove.jpg
http://jcwinnie.biz/wordpress/imageSnag/coal-fired-plant-jj-001.jpg

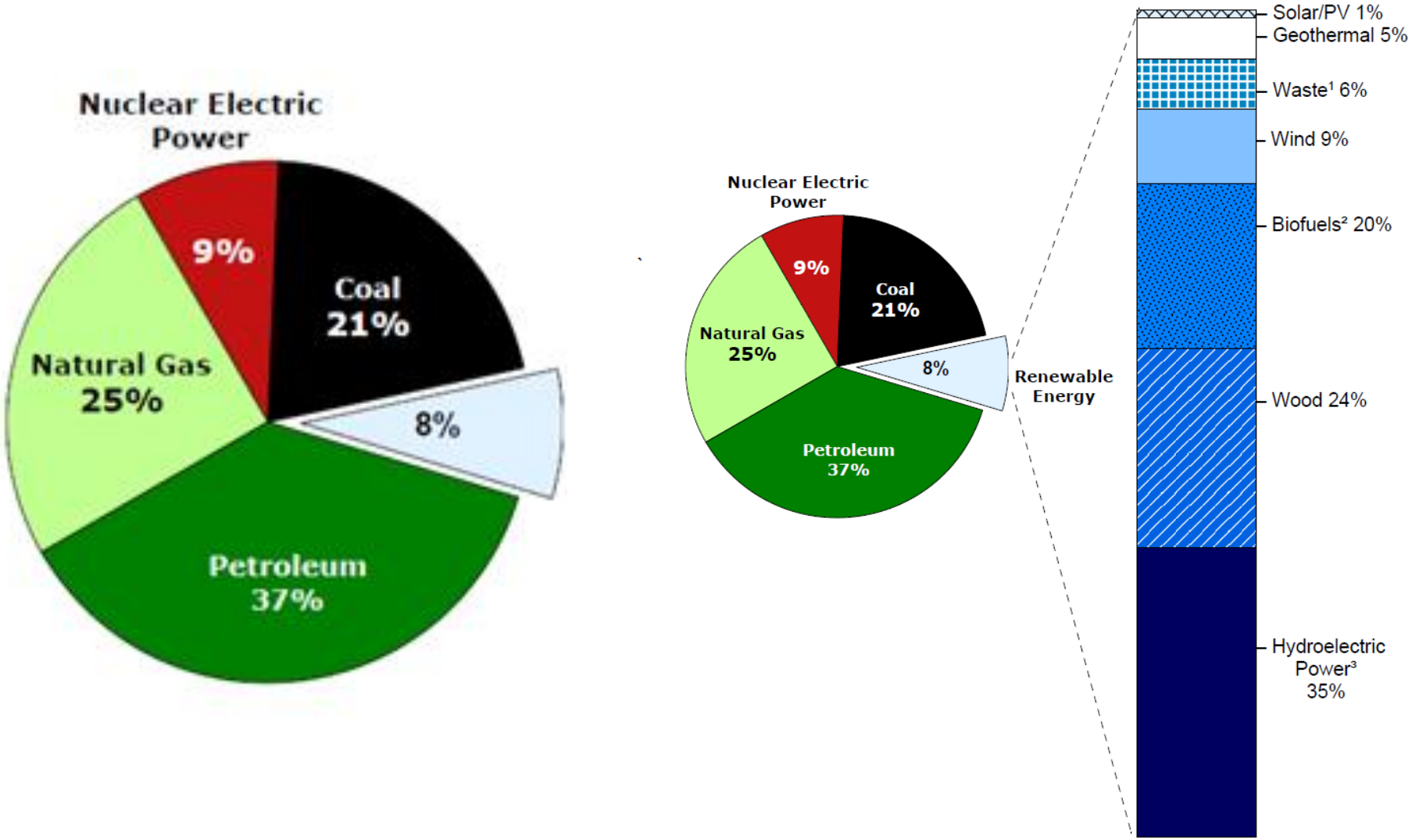
Pollution and availability are concerns



http://www.stuffintheair.com/images/control-pollution-and-save-planet-21304647.jpg

http://groupsites.ius.edu/physics/E/Reserves.html

US Primary Energy Consumption By Source, 2009

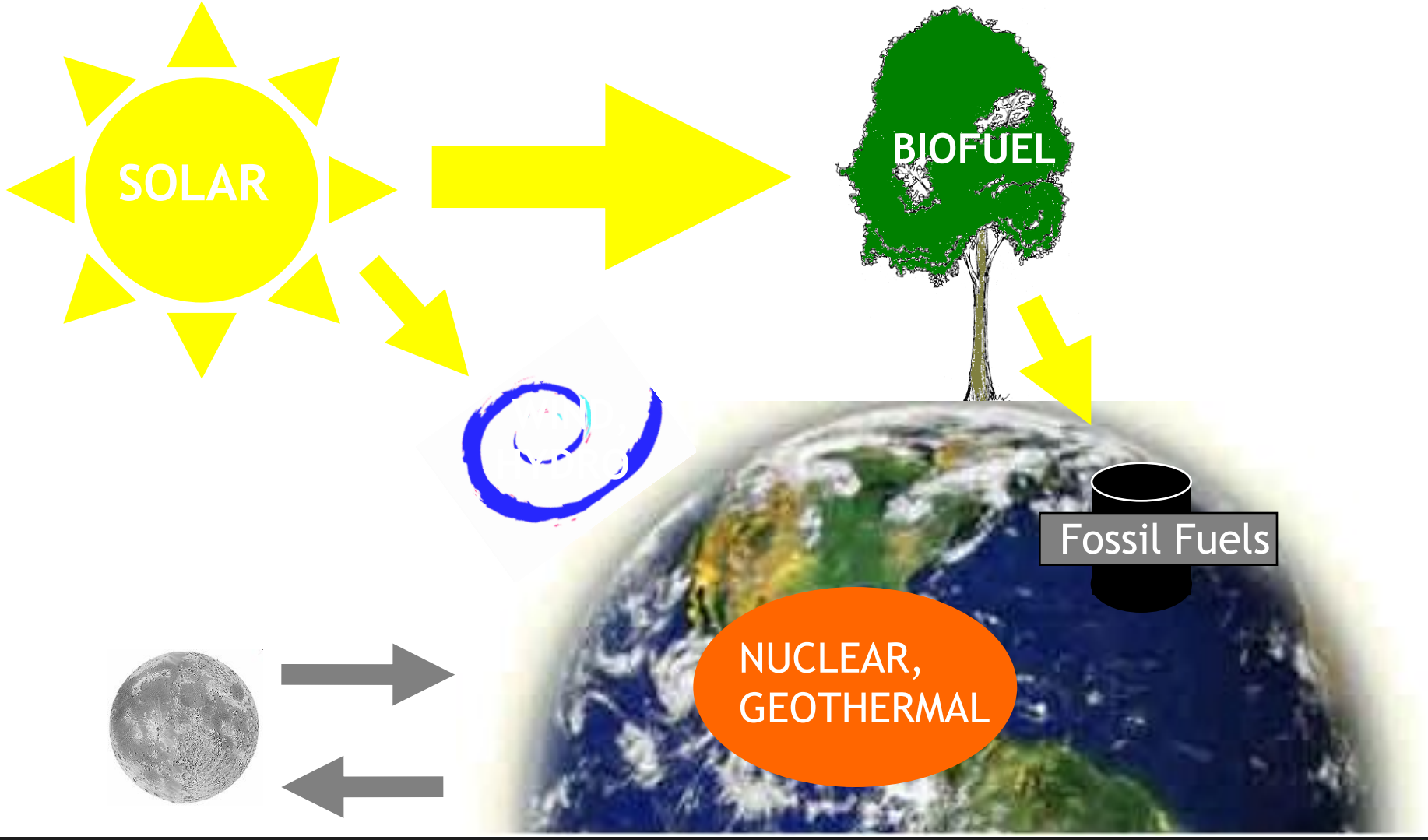


Source: U.S. EIA Annual Energy Review 2009, Figure 10.1

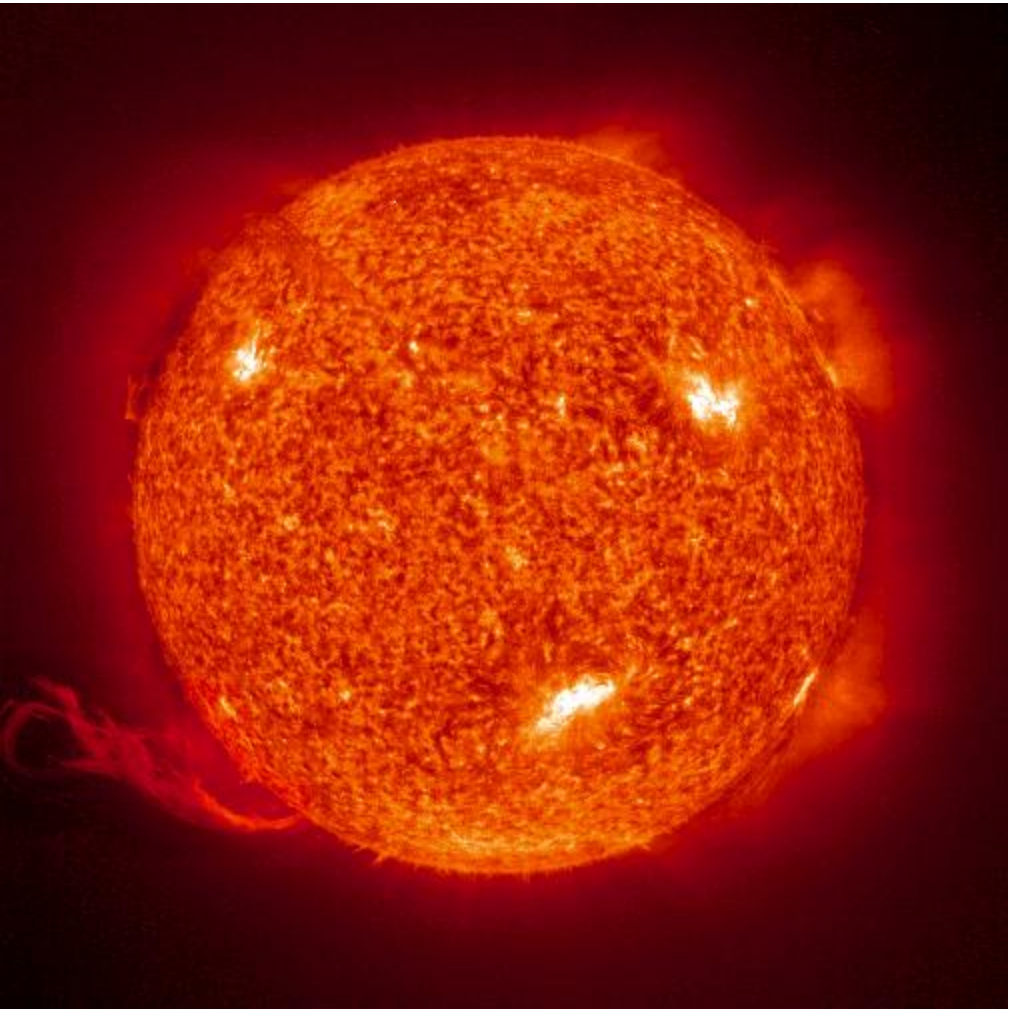
Green energies – non-carbon sources

http:/www.picture-newsletter.com/nuclear/nuclear-power-plant-9igh.jpg
http://www.vacationtopalmsprings.com/wp-content/uploads/2009/03/windmill-farm-palm-springs-588.jpg
http://helloworldbea.files.wordpress.com/2008/05/biofuel.jpg

Where do we get energy?



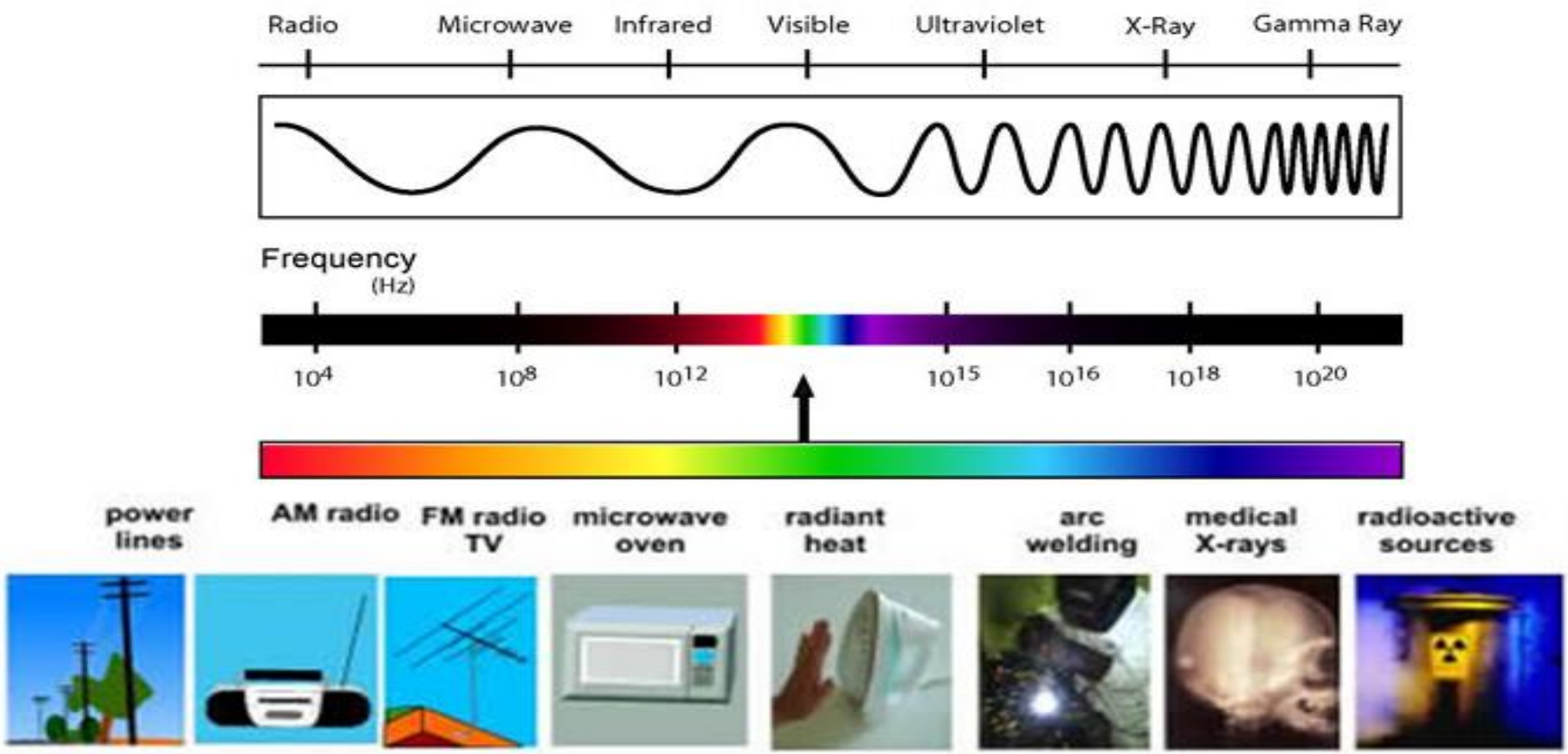
What is solar energy?



http://curious.astro.cornell.edu/images/xraysun.gif

http://www.liveindia.com/news/09oct08e.jpg

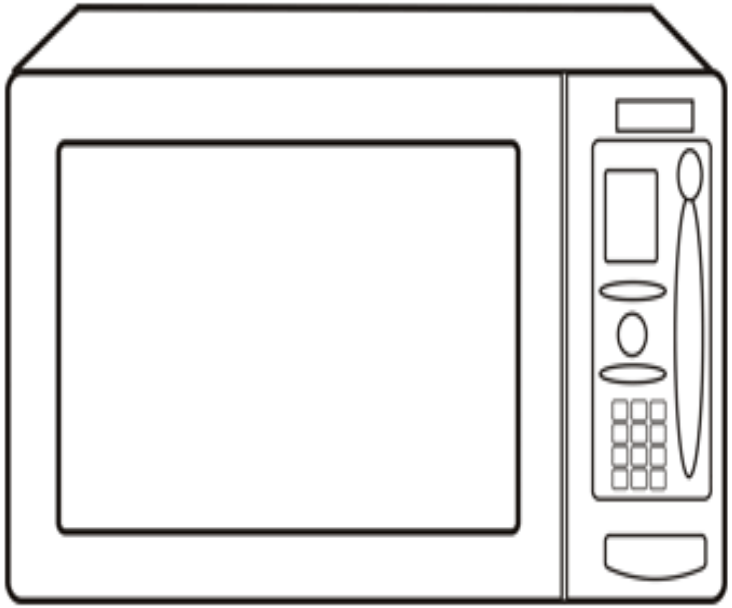
The EM spectrum contains energy



Energy

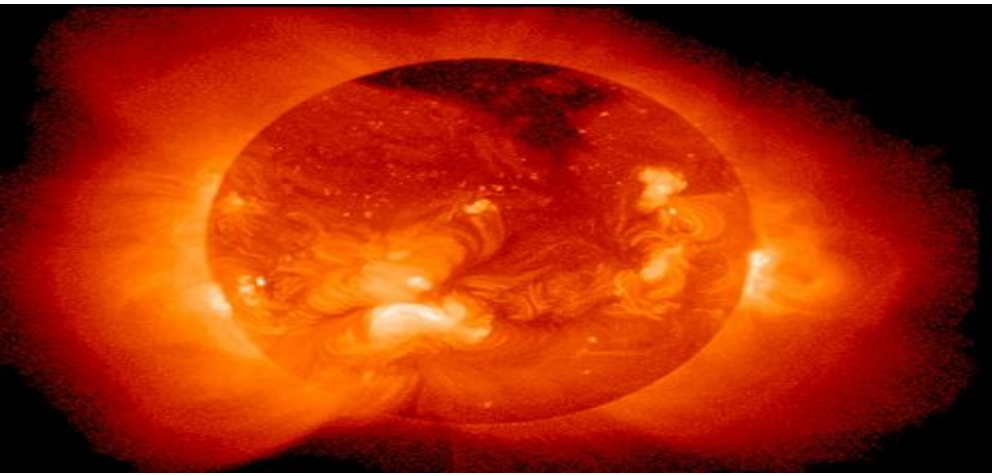
http://www.arpansa.gov.au/images/basics/emr.jpg

How is EM radiation "energy"?



Just how much energy is this?

- THEORETICAL MAXIMA:
  - Enough solar energy falls on the earth in ONE HOUR to power humanity's energy needs for ONE YEAR
  - energy stored in Earth's reserves of coal, oil, and natural gas is matched by the energy from just 20 days



http://scienceblogs.com/startswithabang/upload/2009/06/the_last_100_years_1950s_the_t/the-sun.jpg

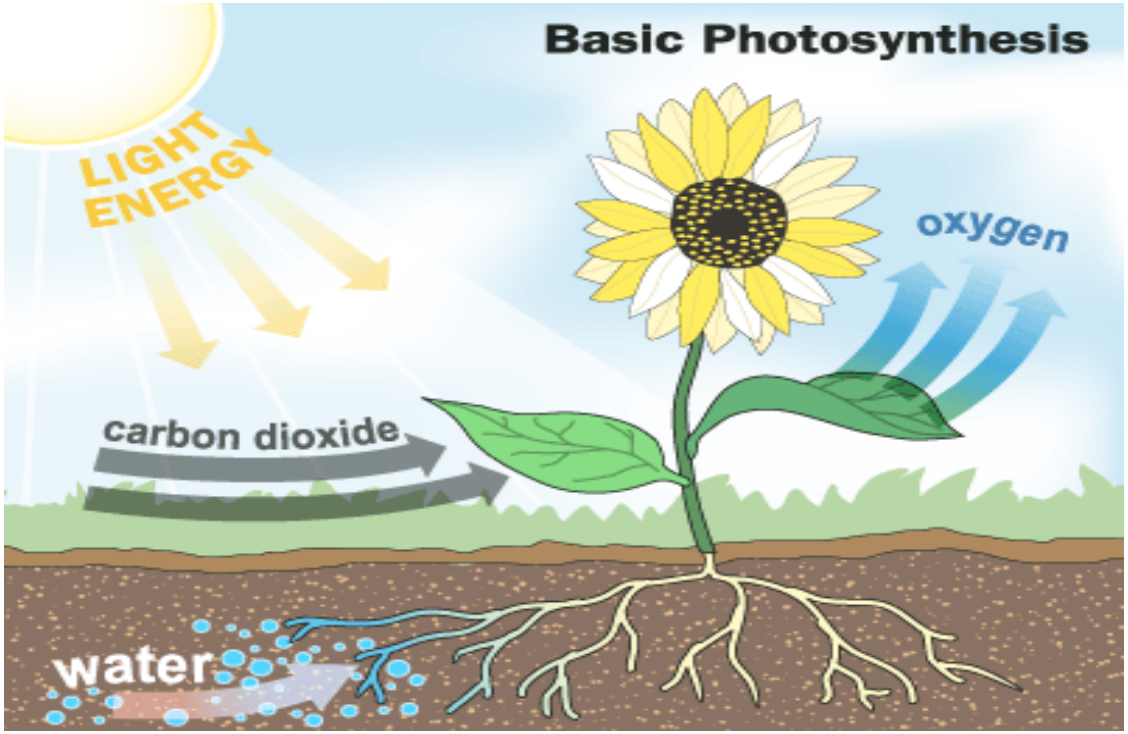
http://www.cbc.ca/news/background/oil/gfx/oil_barrels.jpg

Nature already has a light-collecting method

http://www.treehugger.com/solar-panels-bgbgb001.jpg

http://mike.jones247.co.uk/daintree_rainforest_canopy.JPG

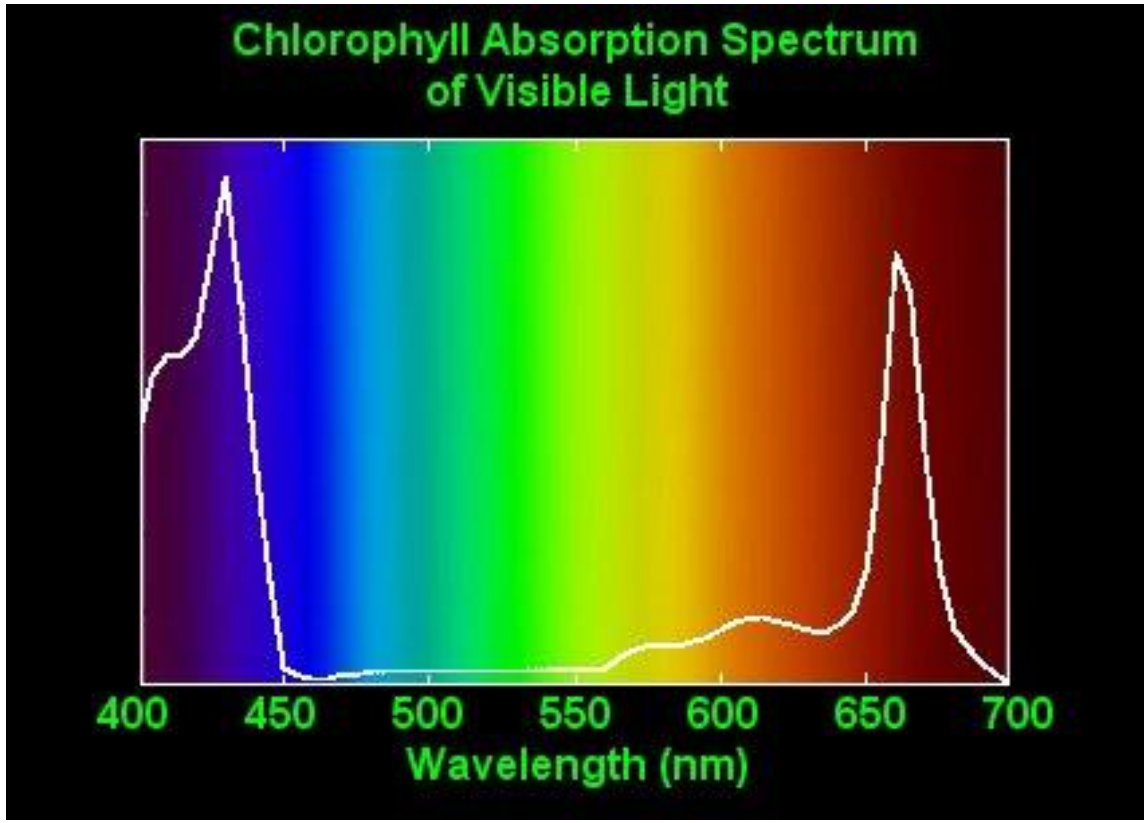
How do plants harvest light?



$$\text{Photons} + CO_2 + H_2O \Rightarrow O_2 + \text{Sugar}$$

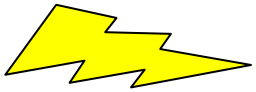
http://www.eoearth.org/files/121601_121700/121668/Irrigation-photosynthesis.gif

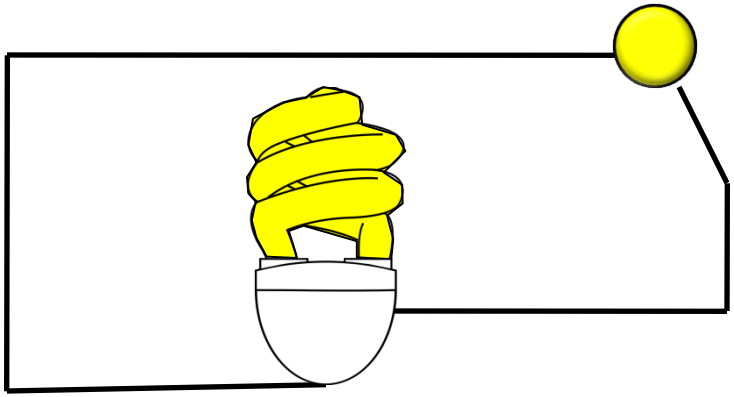
Not all wavelengths are equal



http://www.cbu.edu/~seisen/ChlorophyllAbsorption.jpg

Plants and photovoltaics use a common principle





http://media.photobucket.com/image/photovoltaic%20electrons/greenthoughts/solarcell.jpg
http://www.openclipart.org/detail/21570 (CFL)
http://www.scientificpsychic.com/health/vitamins.html

Alternative energy production?

http://www.technologyreview.com/energy/25077/

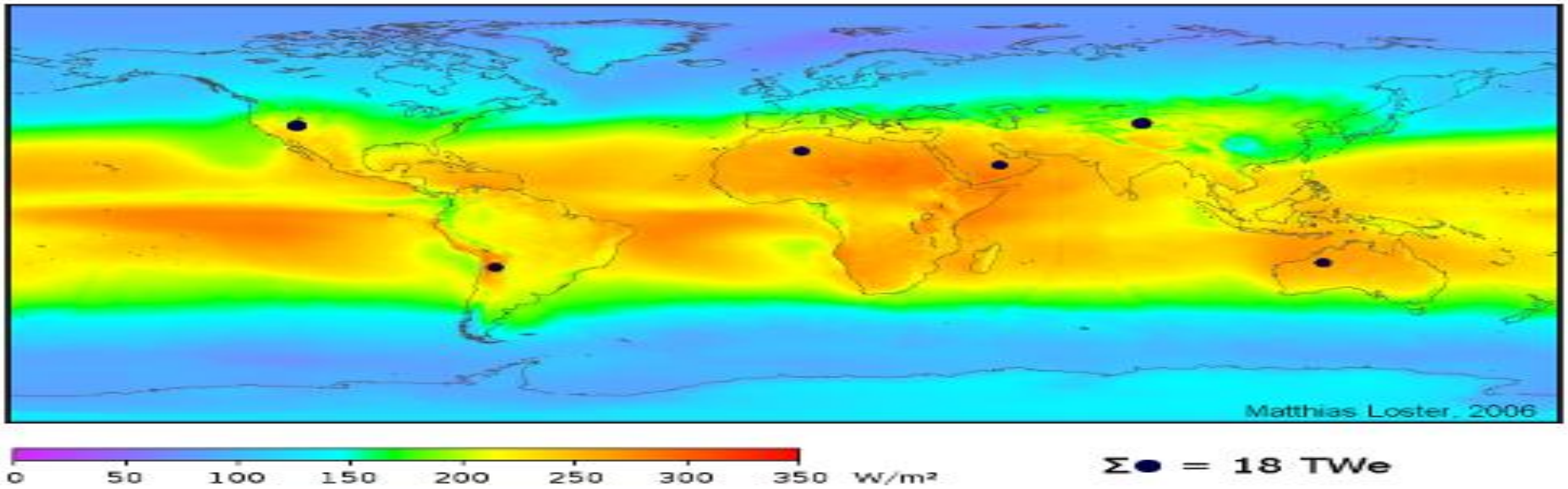
How can we optimize collection?

http://commons.wikimedia.org/wiki/File:Giant_photovoltaic_array.jpg

What are the prospects?

(8% efficient) solar arrays at the area of the black dots = all energy needs we may have in 20 years

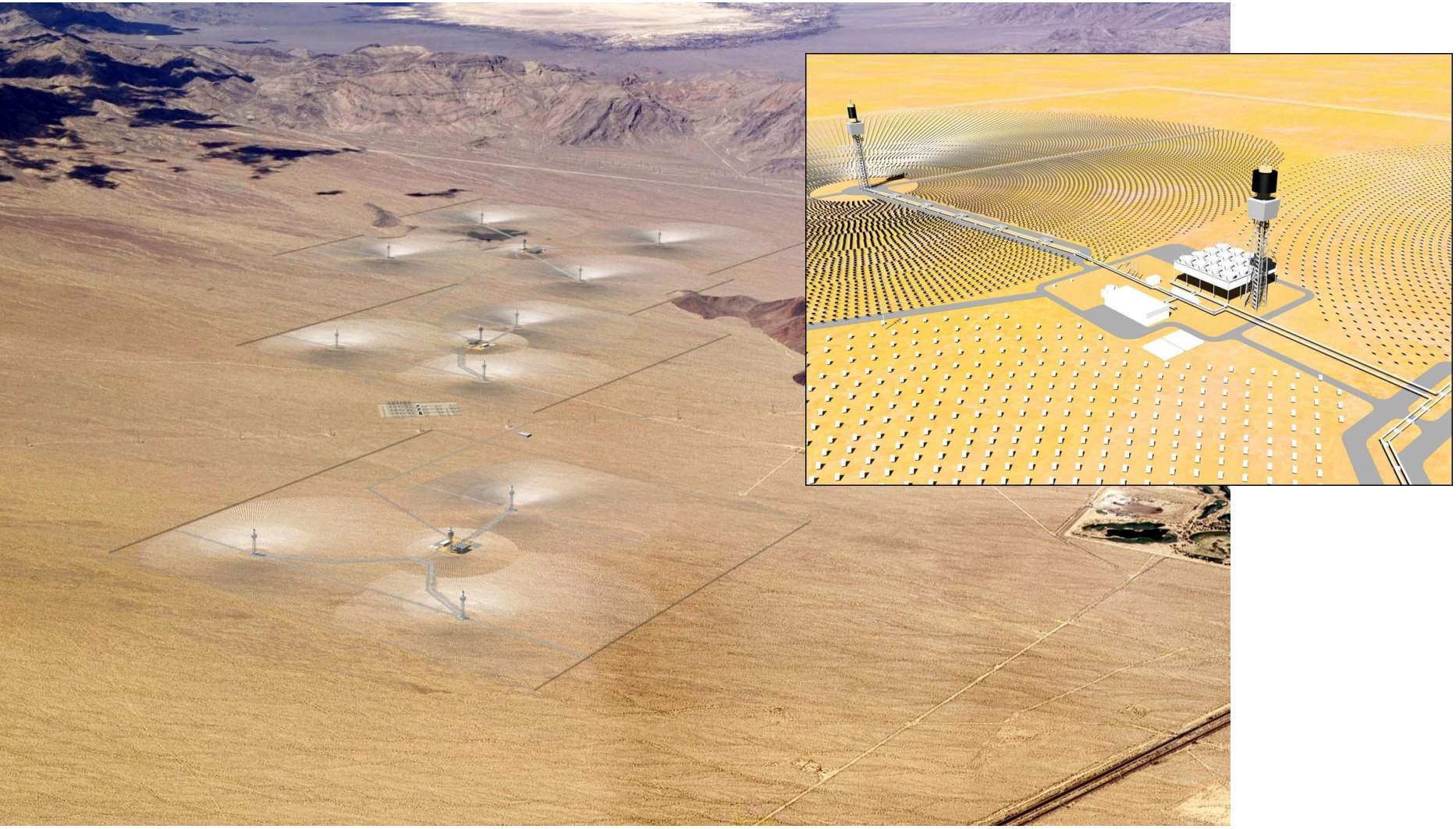
(That makes a total of about 18000 square kilometers for the entire country, or about 0.2% of US land area)



http://www.ez2c.de/ml/solar_land_area/sla.png

http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/atlas/colorgifs/130.GIF

Beyond photovoltaics – solar thermal



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