Solar Photovoltaic fun facts

A.D.Han '14
Lafayette College

Basic facts
•Solar PV is the cleanest and most reliable form of renewable energy available
•It converts sun's rays into electricity by exciting electrons into silicon cells using photons of sunlight
•Solar PV cells consist of both positive and negative film of silicon placed under thin slice of glass

Capacity
•Renewable generating capacity accounts for nearly 20% of total generating capacity in 2040, according to AEO2013 Reference case.
•Solar generation capacity leads renewable capacity growth.
    •Increasing by more than 1,000% (46 Gigawatts) from 2011 to 2040.
•Renewable generation increase from 524 Terawatthours in 2011 to 858 Terawatthours in 2040

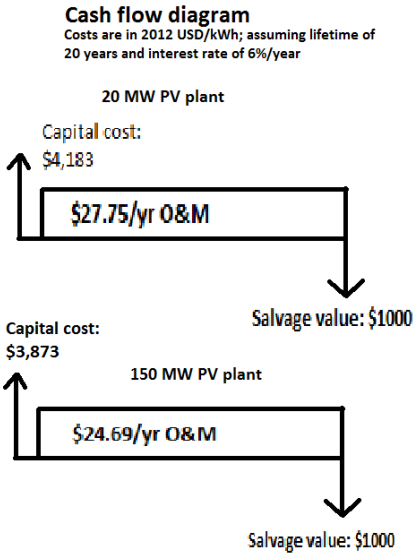
Cost of solar PV
•According to EIA's assumption in AEO2013, residential solar PV costs decrease 13% with doubling in increased capacity. Capacity increases would lead to cost reductions.
•As of 2013, overnight capital costs for Solar PV technologies decreased 22% for 150 MW photovoltaic units from the costs in the 2010 study
•Smaller photovoltaic units evaluated increased from 7MW in 2010 to 20 in 2013.
•Decline in costs on $/KW basis
•According to the Excel table 2: cost of 150 MW solar photovoltaic was 3,873 in 2013 and 4,943 in 2010, accounting for 22% decrease in cost (2012 USD/kW)
•20MW PV plant's capital cost is $4,183/kW
    •O&M is $27.75/kW-yr
    •Assuming 6% interest rate, lifetime of 20 years, and a $1,000 salvage value, annual present cost is $385.26
•150 MW PV plant's capital cost is $3,873/kW
    •O&M is $24.69/kW-yr
    •Assuming 6% interest rate, lifetime of 20 years, and a $1,000 salvage value, annual present cost is $335.17

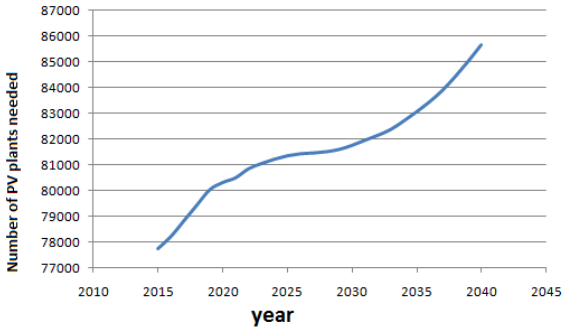
Prediction 2040
•It has been predicted that in 2040, 107.2 quadrillion BTU of energy would be used in 2040 in the United States . This is the equivalent to 3.14E13 kWh.
•If all power plants in the US were replaced with solar PV, then 85,676 of 150 MW PV plants would be needed in 2040
•The annual cost would be $4.3E12 per year in 2012 US dollars.

CO2 emissions
•99 grams of carbon emissions are created per kWh for solar power
•Approximately 6.9 x 10^-4 metric tons of CO2 are released for each kWh of electricity.
•If all electricity would be solar, then 21,672,420,991.7 metric tons of CO2 would be cut annually

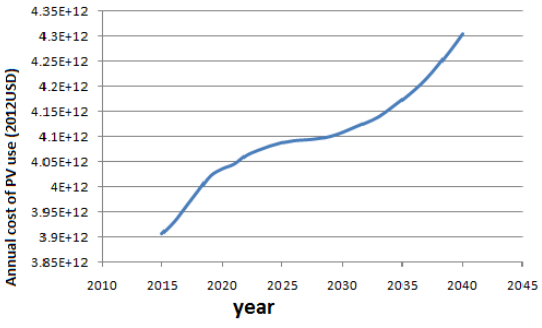
Renewable Energy Standards: Policies regarding renewable energy
•Renewable Electricity Standards (RES) were created as policies meant to increase generation from renewable resources to encourage electric producers supply a minimum share of their electricity from renewable resources within selected jurisdiction.
•RES of 20% of retail sales having been originally enacted in 2002, as of April 2011, RPS has a requirement for California's electric utilities to obtain 33% of retail sales from renewable resources in 2020. Step by step, by the end of 2016, 25% would be targeted.
•For solar generation, these policies would award bonus credits. Many states have net metering for solar PV to monitor usage and generation owners get compensated for power produced in excess of usage on-site.

Figures





Number of 150 MW power plants equivalency needed based on future predictions of energy usage in the US



References

Arif, Mashail S. Residential Solar Panels and Their Impact on the Reduction of Carbon Emissions. Rep. 2013. Berkeley University of California. p. 3-5 <http://nature.berkeley.edu/classes/es196/projects/2013final/ArifM_2013.pdf>.

"Modeling distributed generation in the buildings sectors." U.S. Energy Information Administration (EIA). Aug. 2013. <http://www.eia.gov/forecasts/aeo/nems/2013/buildings/pdf/distribgen.pdf>.

"Most states have Renewable Portfolio Standards." Most states have Renewable Portfolio Standards. 3 Feb. 2012. <http://www.eia.gov/todayinenergy/detail.cfm?id=4850>.

"NW Wind & Solar." How do solar systems produce energy? 2014. NW Wind & Solar. 15 Apr. 2014 </>.

" Growth in electricity use slows but still increases by 28 percent from 2011 to 2040." U.S. Energy Information Administration (EIA). Apr. 2014. <http://www.eia.gov/forecasts/aeo/MT_electric.cfm#solar_photo>.

"Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants." U.S. Energy Information Administration (EIA). Table 2. 12 Apr. 2013. <http://www.eia.gov/forecasts/capitalcost>.

"Utility-scale installations lead solar photovoltaic growth." U.S. Energy Information Administration - EIA - Independent Statistics and Analysis. 31 Oct. 2012. 15 Apr. 2014 <http://www.eia.gov/todayinenergy/detail.cfm?id=8570>.

"World energy demand and economic outlook." U.S. Energy Information Administration (EIA). Figure 13. 25 July 2013. <http://www.eia.gov/forecasts/ieo/world.cfm>.