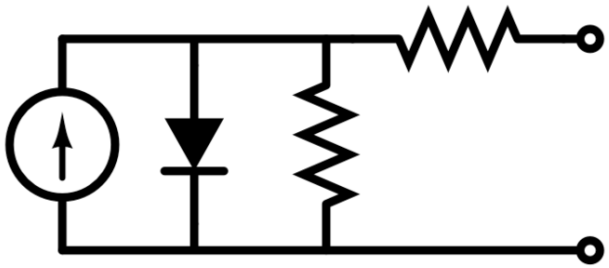
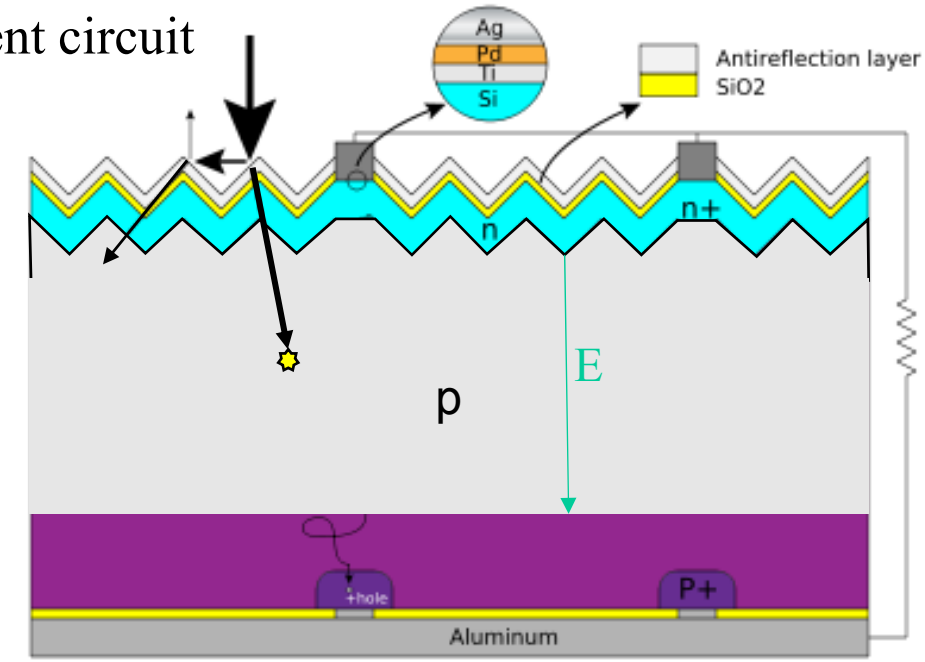
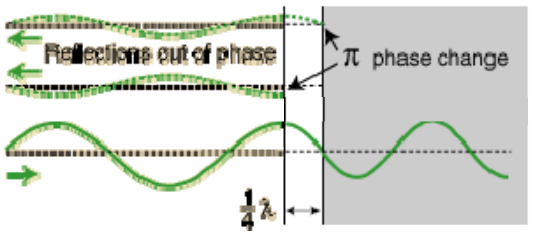
Solar Cells

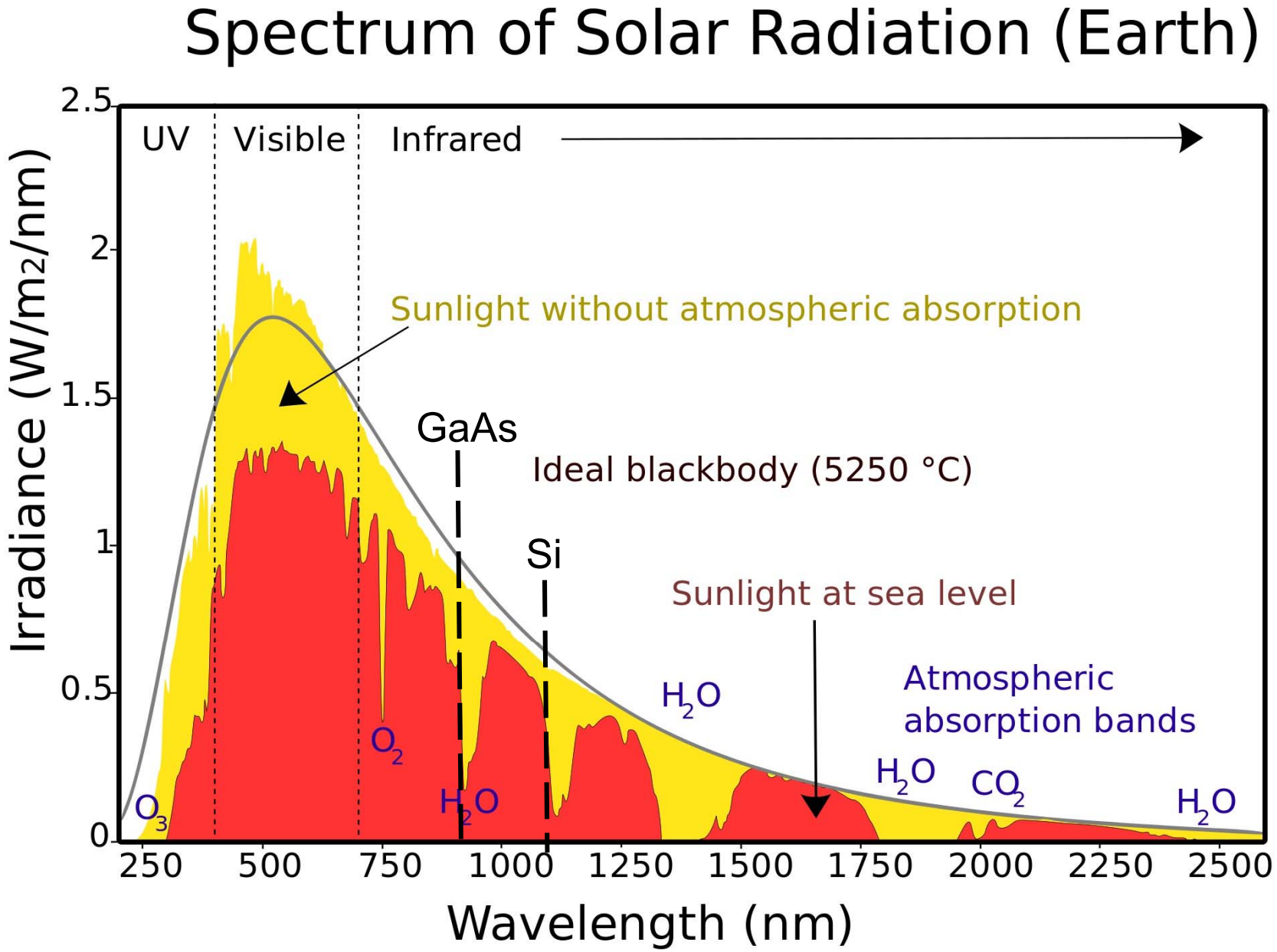
Solar cell



Equivalent circuit

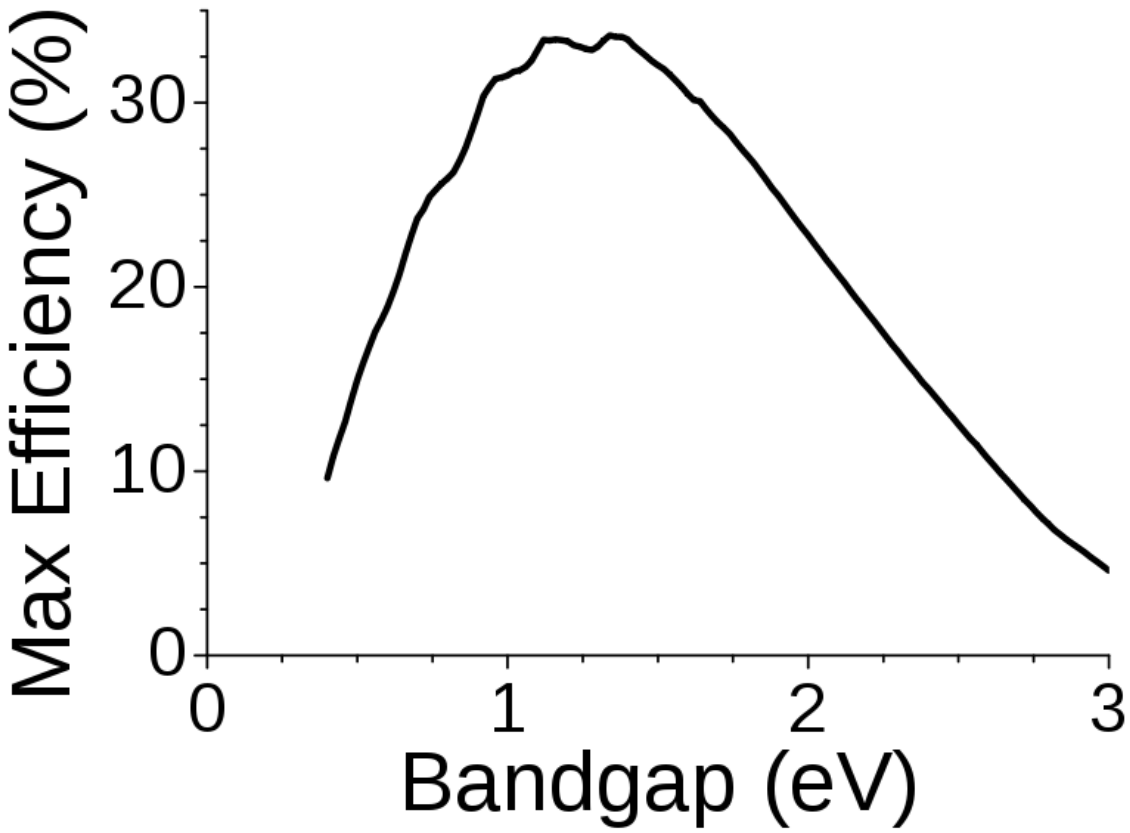




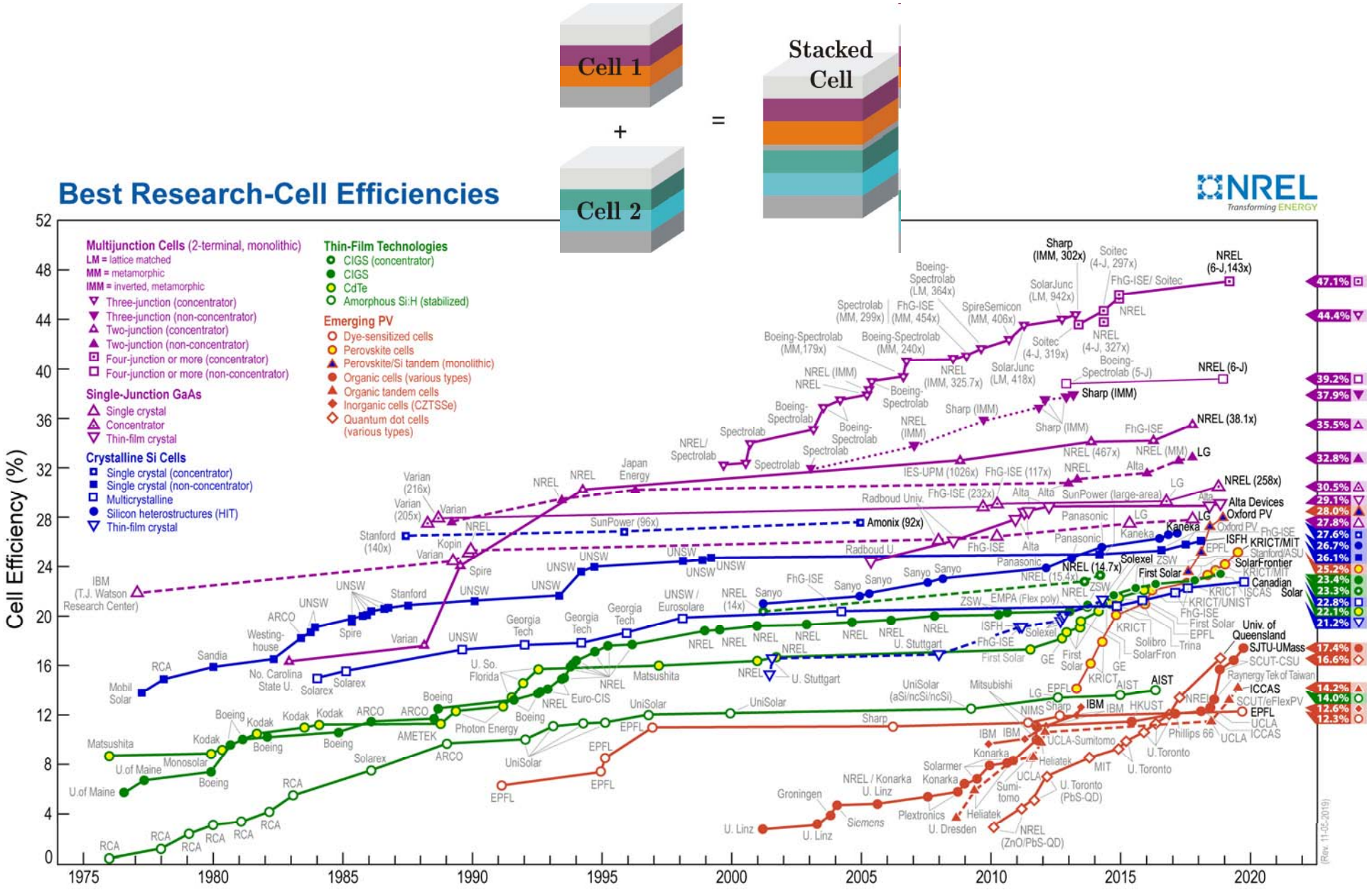


Wu, H.W. & Emadi, A & Graaf, G & Leijtens, Johan & Wolffenbuttel, R.F.. (2011). Design and Fabrication of an Albedo Insensitive Analog Sun Sensor. Procedia Engineering. 25. 527-530. 10.1016/j.proeng.2011.12.131.

Shockley–Queisser limit

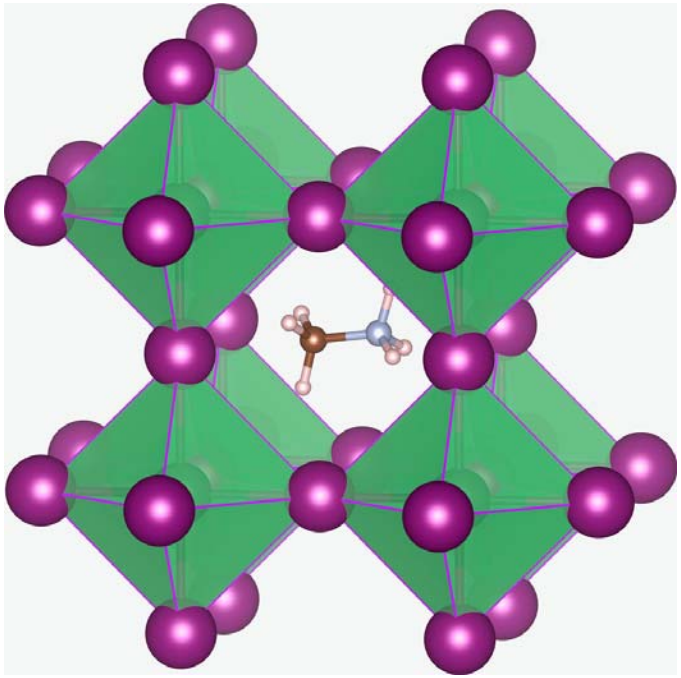


http://en.wikipedia.org/wiki/Shockley-Queisser_limit



Biofuel efficiency ~ 1%

Perovskite solar cells



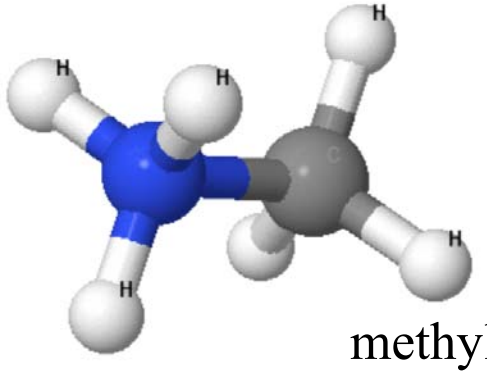
https://en.wikipedia.org/wiki/Perovskite_solar_cell#/media/File:CH3NH3PbI3_structure.png

methylammonium lead trihalide ABX_3
$CH_3NH_3PbX_3$, where X is I, Br or Cl
Optical bandgap 1.5 - 2.3 eV

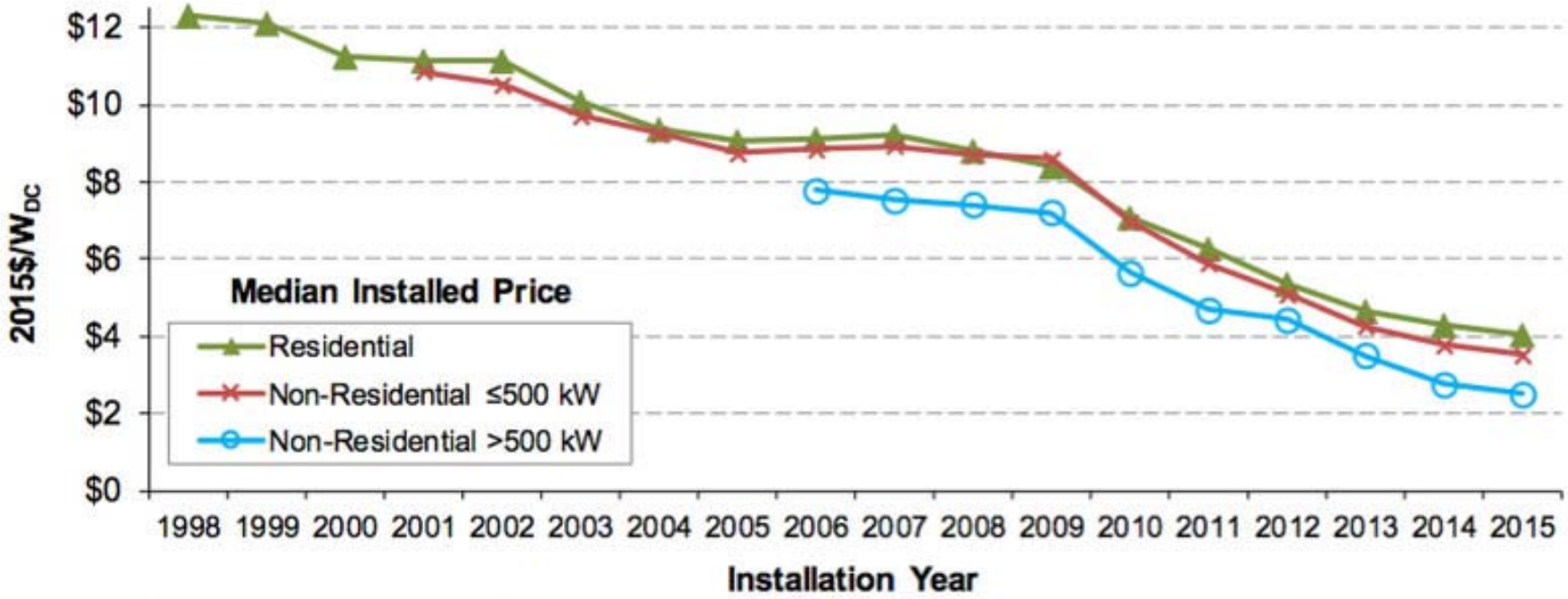
+ Cheaper to fabricate than Si solar cells.
(silicon cells require > 1000 C)

- Contains lead
Also less efficient $CH_3NH_3SnI_3$ version

- Not stable



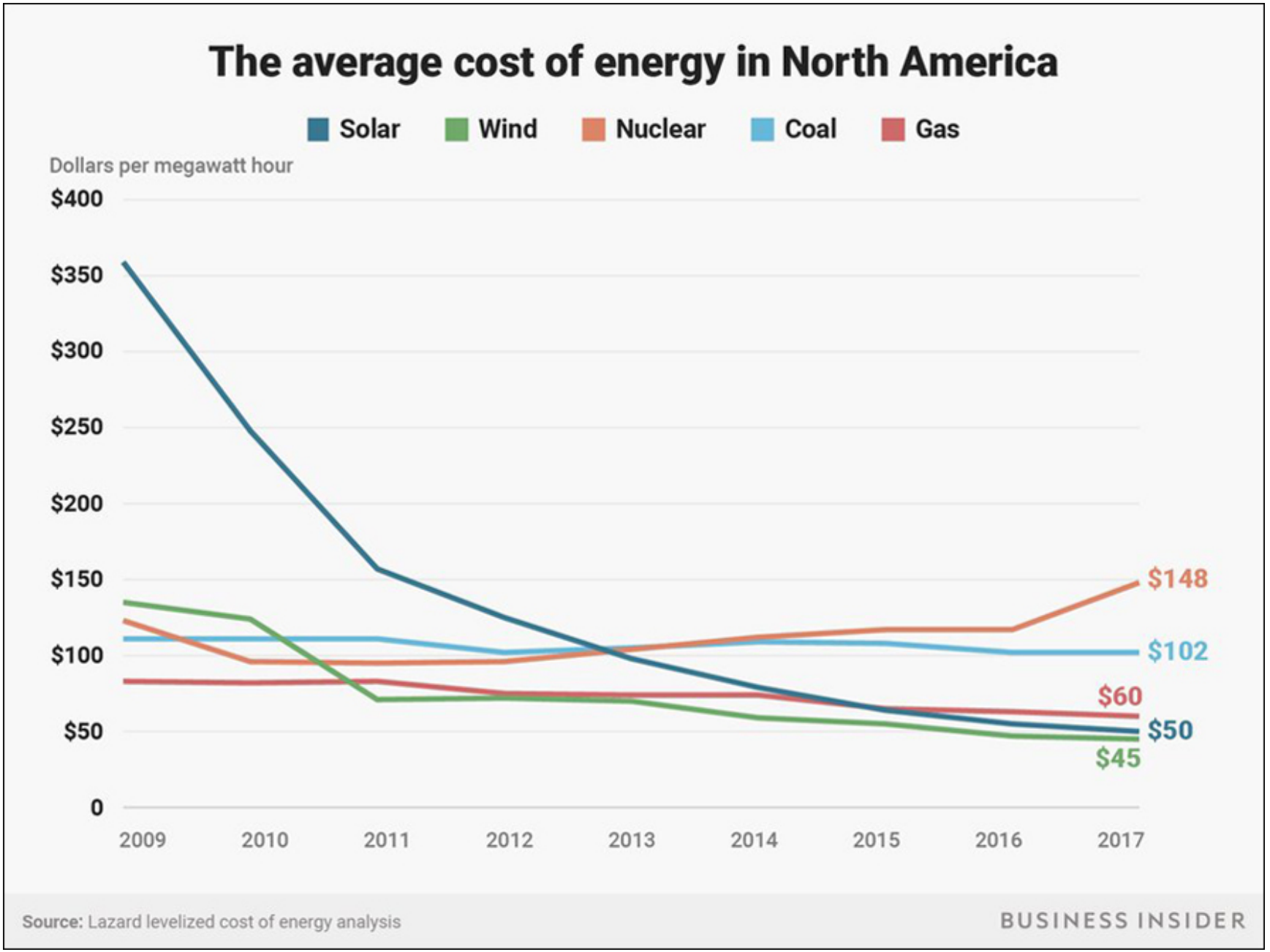
methylammonium



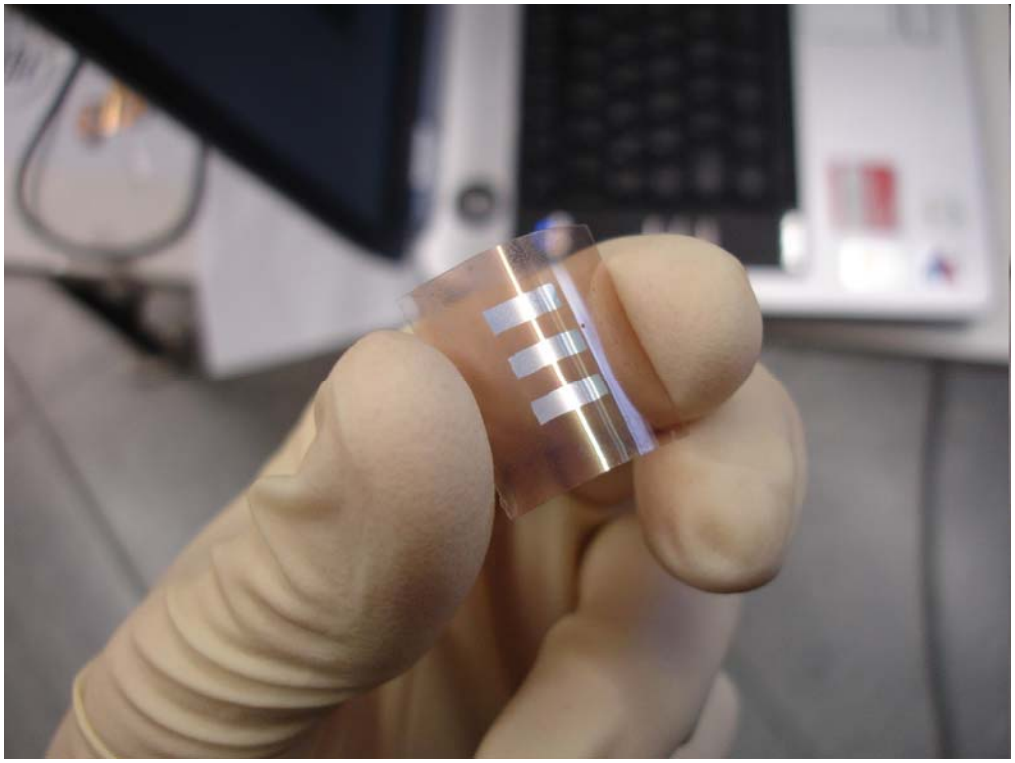
Notes: See Table 1 for sample sizes by installation year. Median installed prices are shown only if 20 or more observations are available for a given year and customer segment.

Figure 6. Median Installed Price Trends over Time

https://www.vox.com/2016/8/24/12620920/us-solar-power-costs-falling


The average cost of energy in North America
Solar
Wind
Nuclear
Coal
Gas
Dollars per megawatt hour
$400
$350
$300
$250
$200
$150
$100
$50
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
$148
$102
$60
$50
$45
Source: Lazard levelized cost of energy analysis
BUSINESS INSIDER

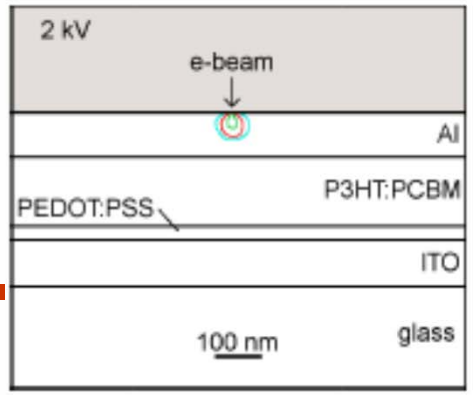
Printable solar cells



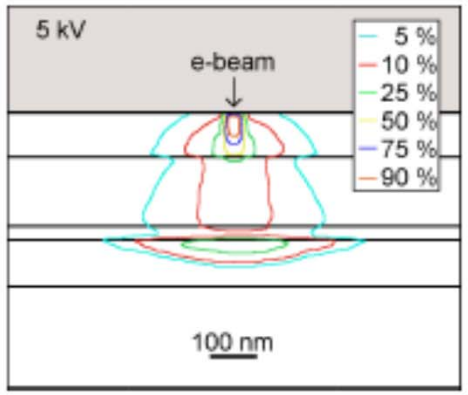
CD labor - TU Graz

Konarka

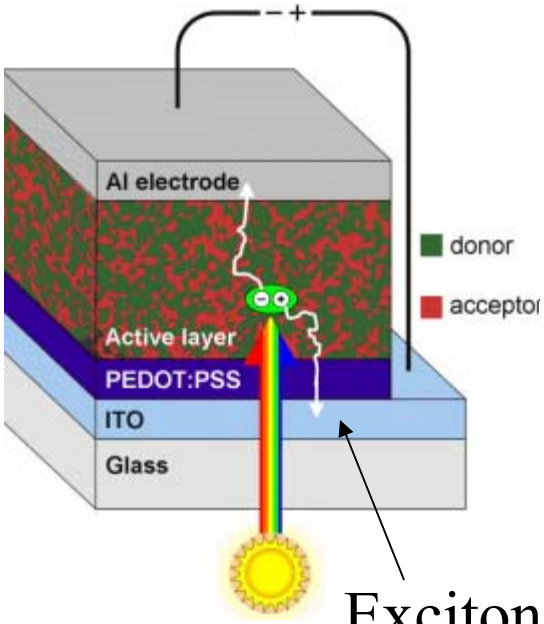
organic solar cells



(a)



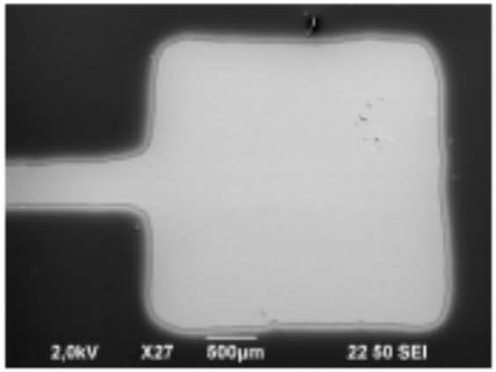
(b)



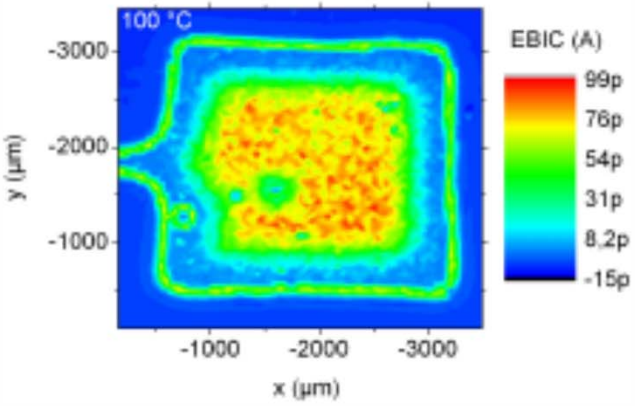
Excitons

Bulk heterojunction

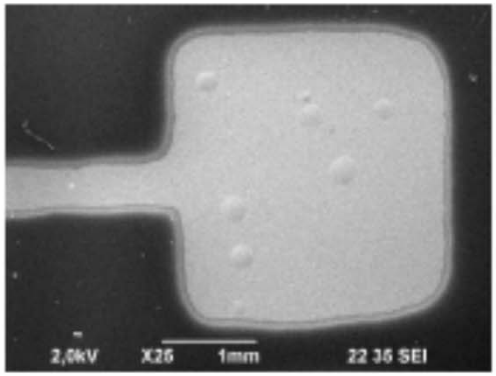
(a)



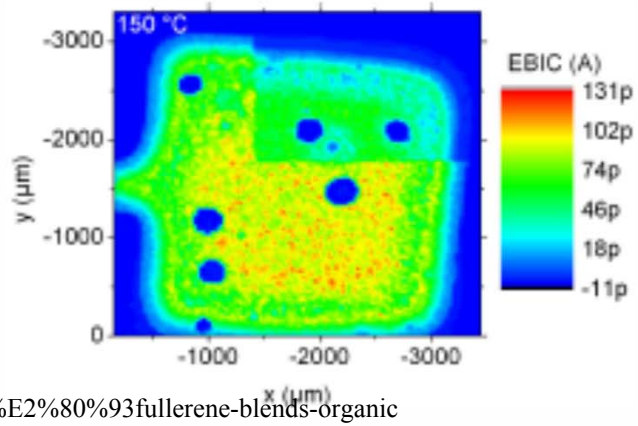
(b)



(c)



(d)



http://www-ssrl.slac.stanford.edu/science-highlight/2011/january/effects-thermal-annealing-morphology-polymer%E2%80%93fullerene-blends-organic