

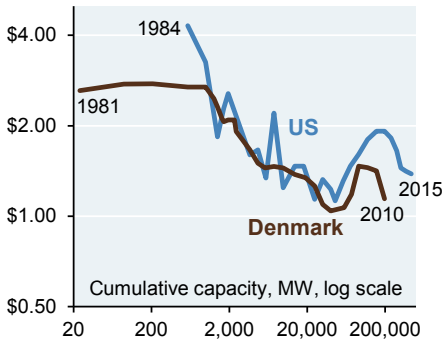


Appendix VI: Energy learning curves

The first 3 charts show learning curves for solar, wind and storage; capital costs fell as capacity rose. In the case of wind, the learning curve was interrupted in 2004 by a period of rising costs for raw materials (steel, iron, copper, aluminum, fiberglass), energy and labor which led to rising turbine prices.

Wind learning curve

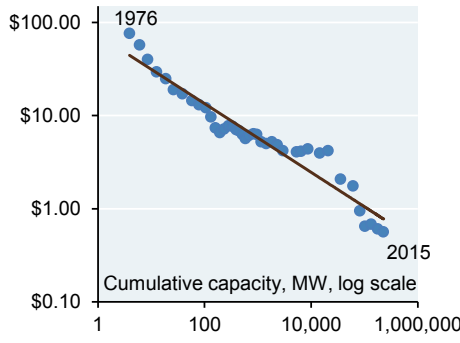
Capital cost, 2005 USD per watt, log scale



Source: NREL, GWEC, JPMAM. 2015.

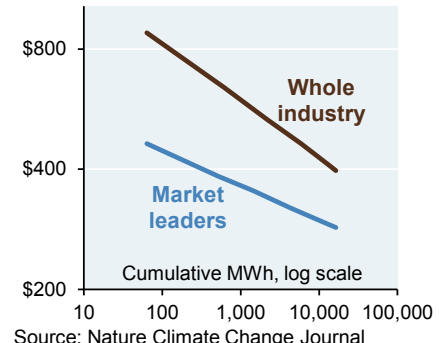
Solar photovoltaic learning curve

Module* price, 2011 USD per watt, log scale



Source: Bloomberg, IEA. 2015. *Crystalline silicon

Lithium-ion battery pack learning curve, 2014 USD per kWh, log scale

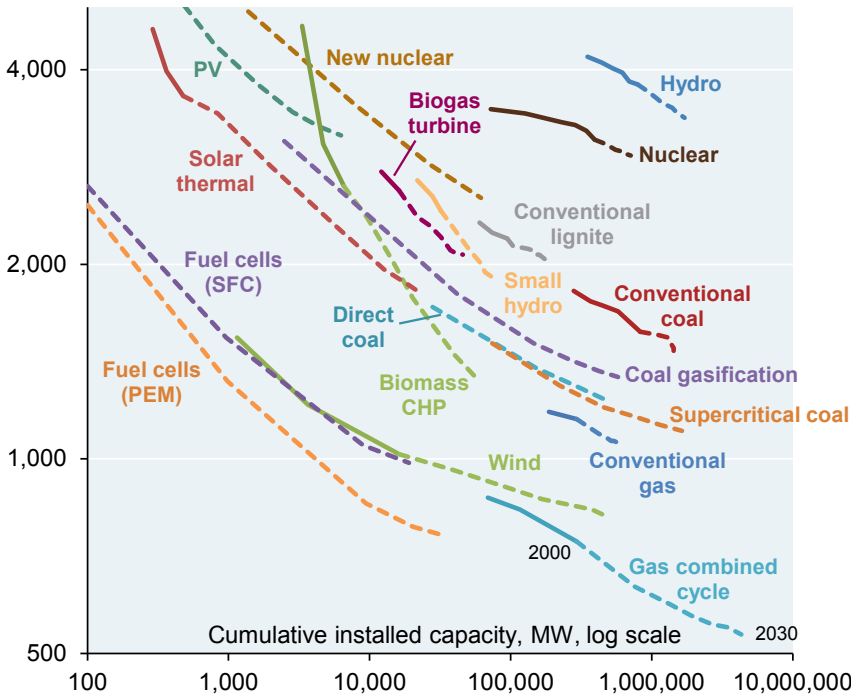


Source: Nature Climate Change Journal (Nykqvist & Nilsson). March 2015.

The next chart was produced in 2003 for the European Commission's 2030 World Energy, Technology and Climate Outlook report. It's a bit outdated, but does a good job conveying how analysts used historical data available at the time to project learning curve progress in the future.

Learning curves for power generation technologies

Total investment cost, 1999 EUR per kW, log scale



Source: European Commission, Silvana Mima, POLES model, UPMF Grenoble. 2003. Dotted lines represent projections for costs after 2000 until 2030.