Solar Energy

Technical Frontiers to Global Adoption

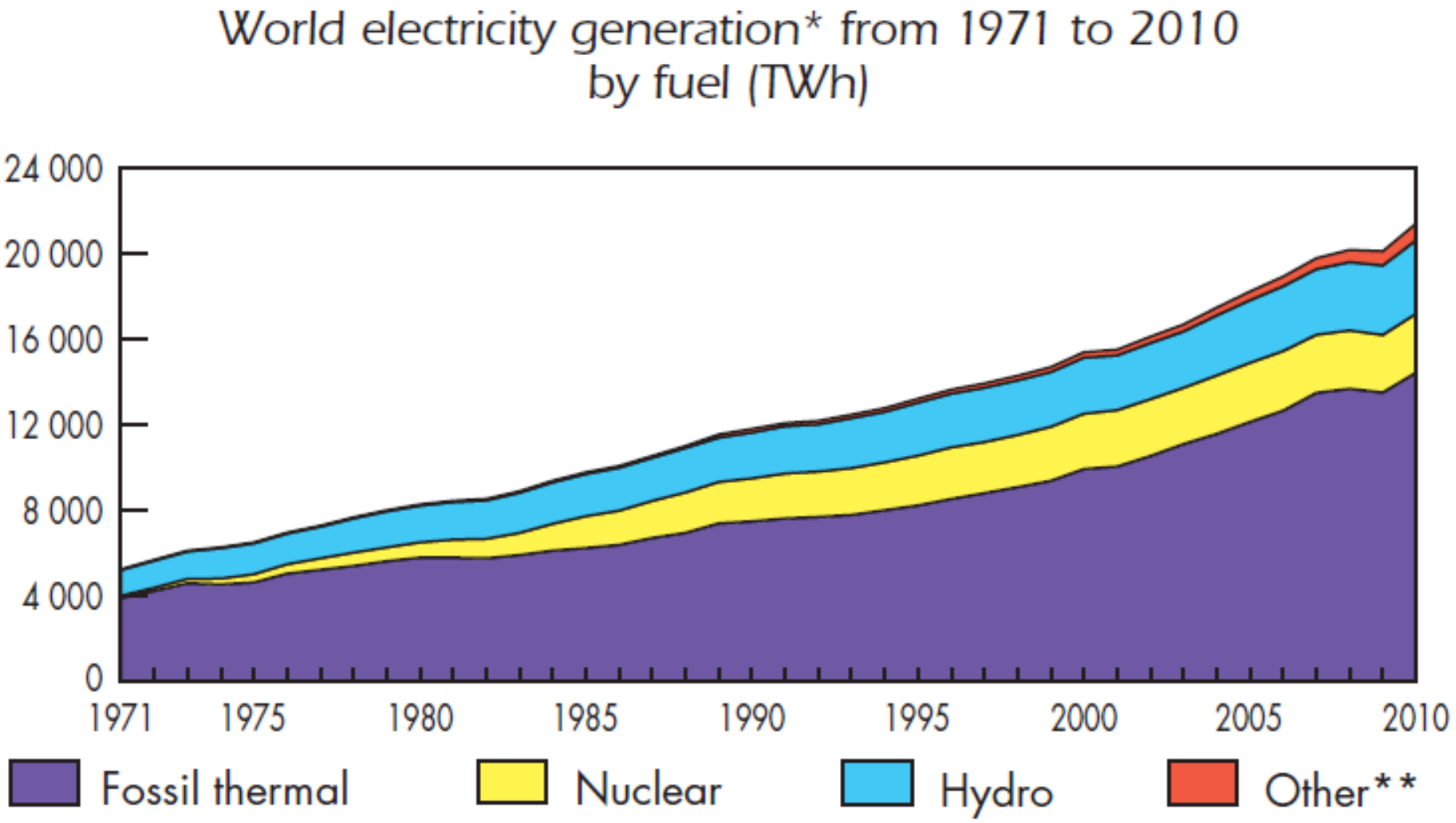
Co-Chairs Elizabeth Wayman and Ying Zhao

China-America Frontiers of Engineering

May 17, 2013

Beijing, China

Global Electricity Consumption



* Excludes Pumped Storage

** Other includes geothermal, solar, wind, biofuels, waste, and heat

Key World Energy Statistics 2012. International Energy Agency. Available at: http://www.iea.org/publications/freepublications/publication/name,31287,en.html

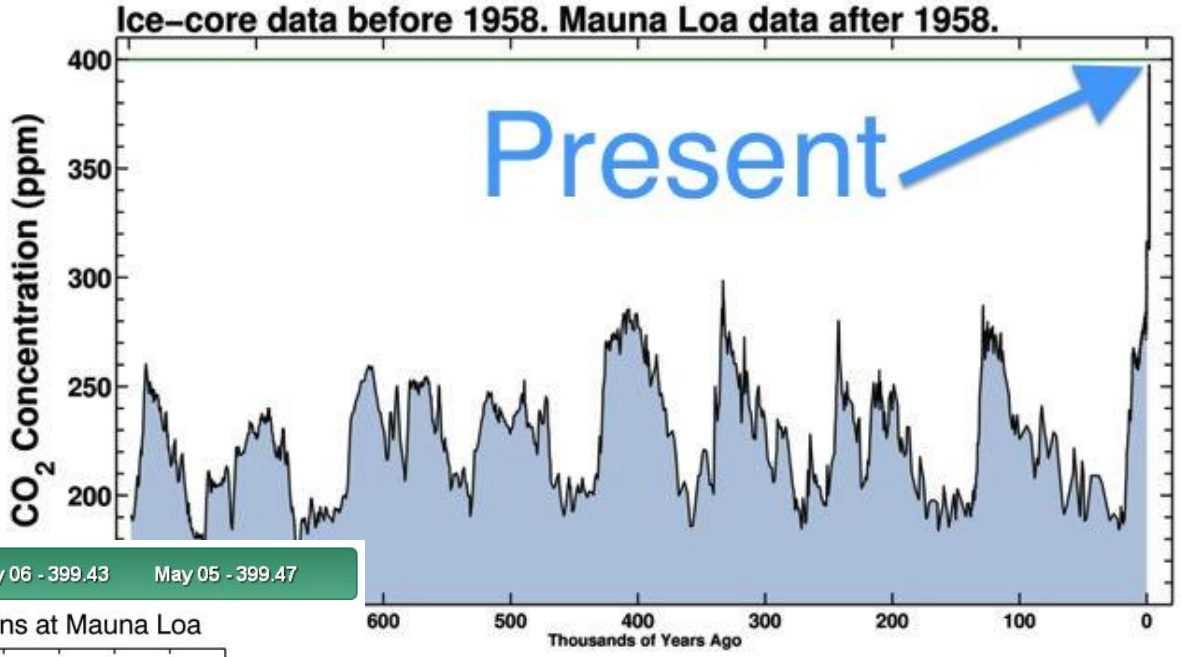
Global Electricity Consumption

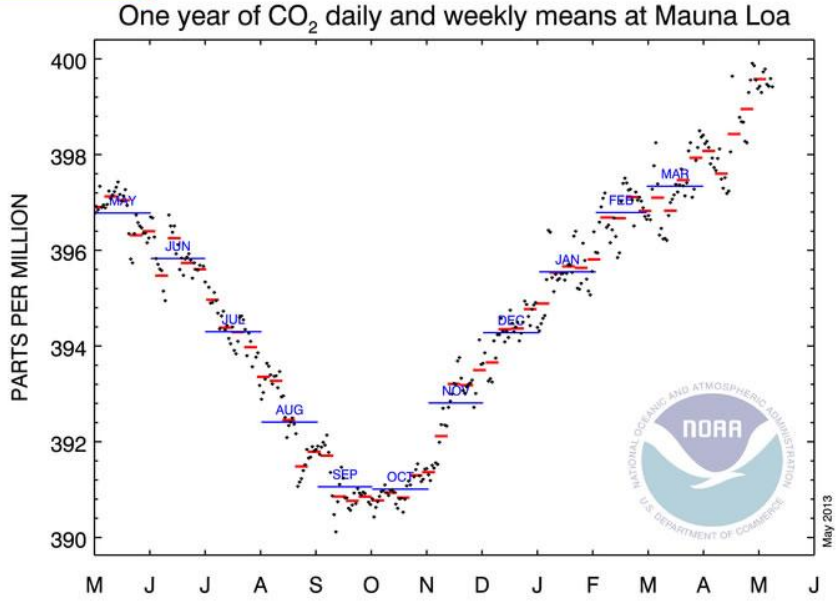
World electric

24 000

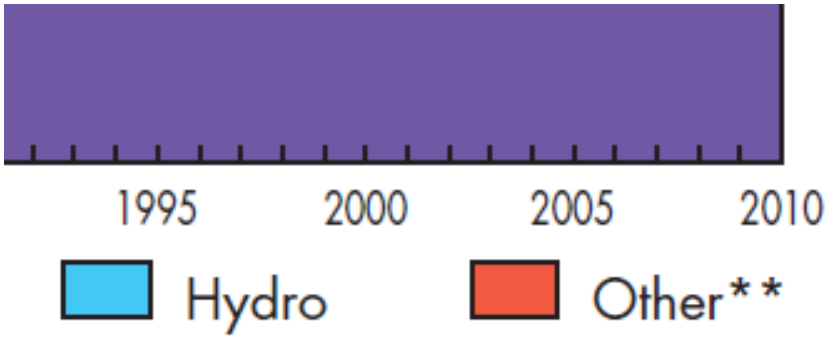
20 000

16 000





Scripps Institution of Oceanography



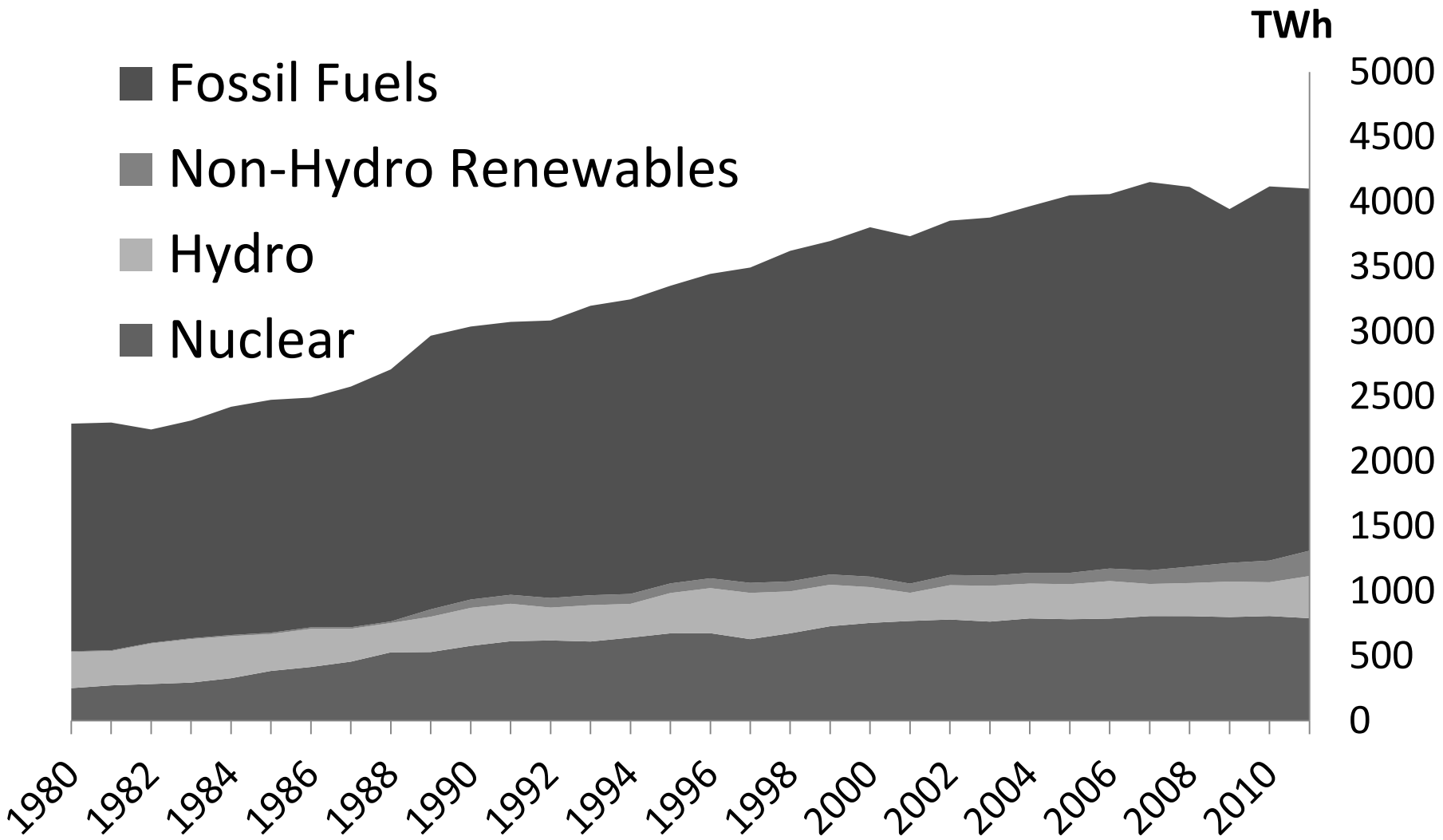
Pumped Storage

udes geothermal, solar, wind, biofuels, waste, and heat

ilable at:

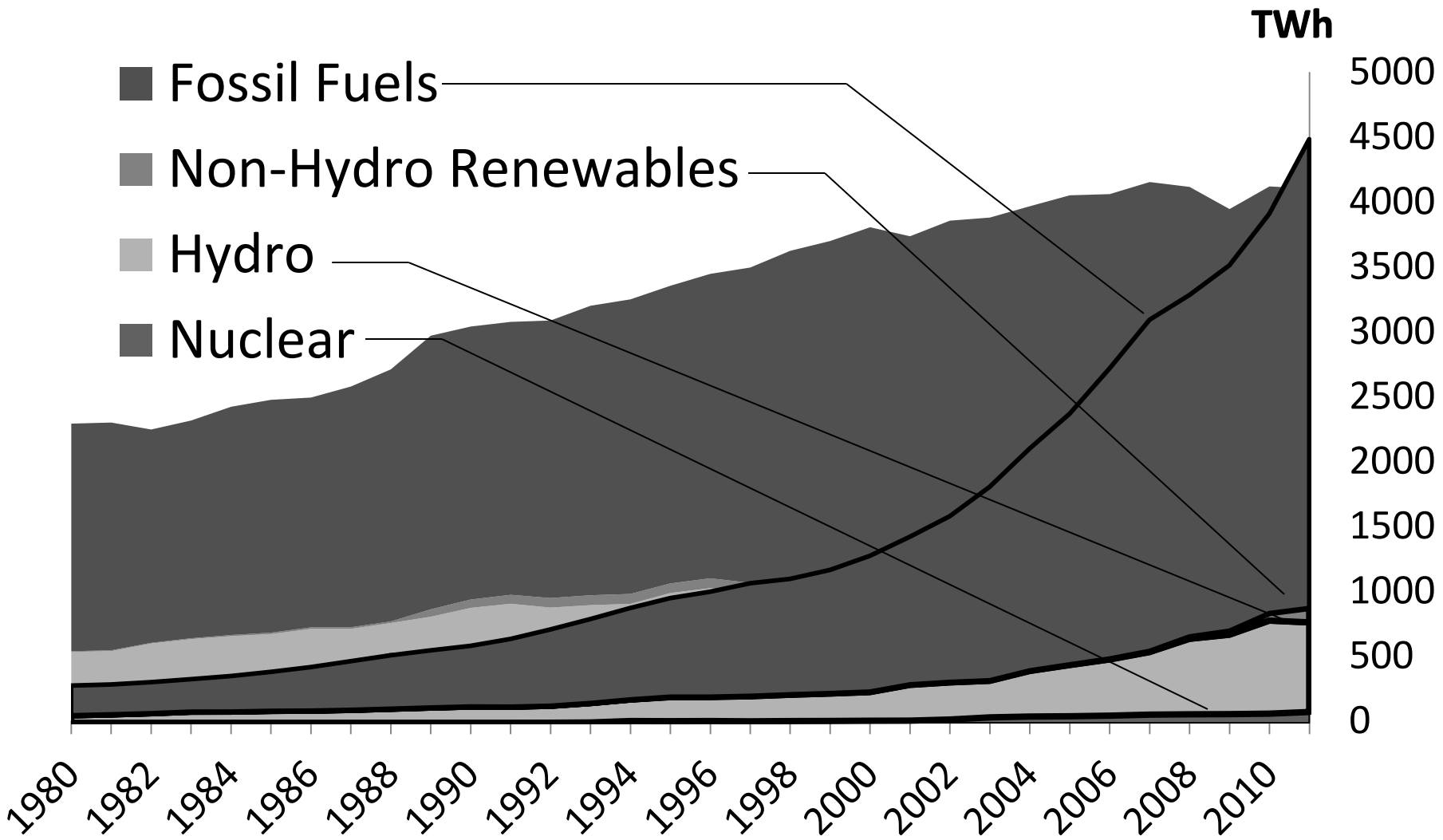
http://www.iea.org/publications/freepublications/publication/name,31287,en.html

Electricity Consumption – USA



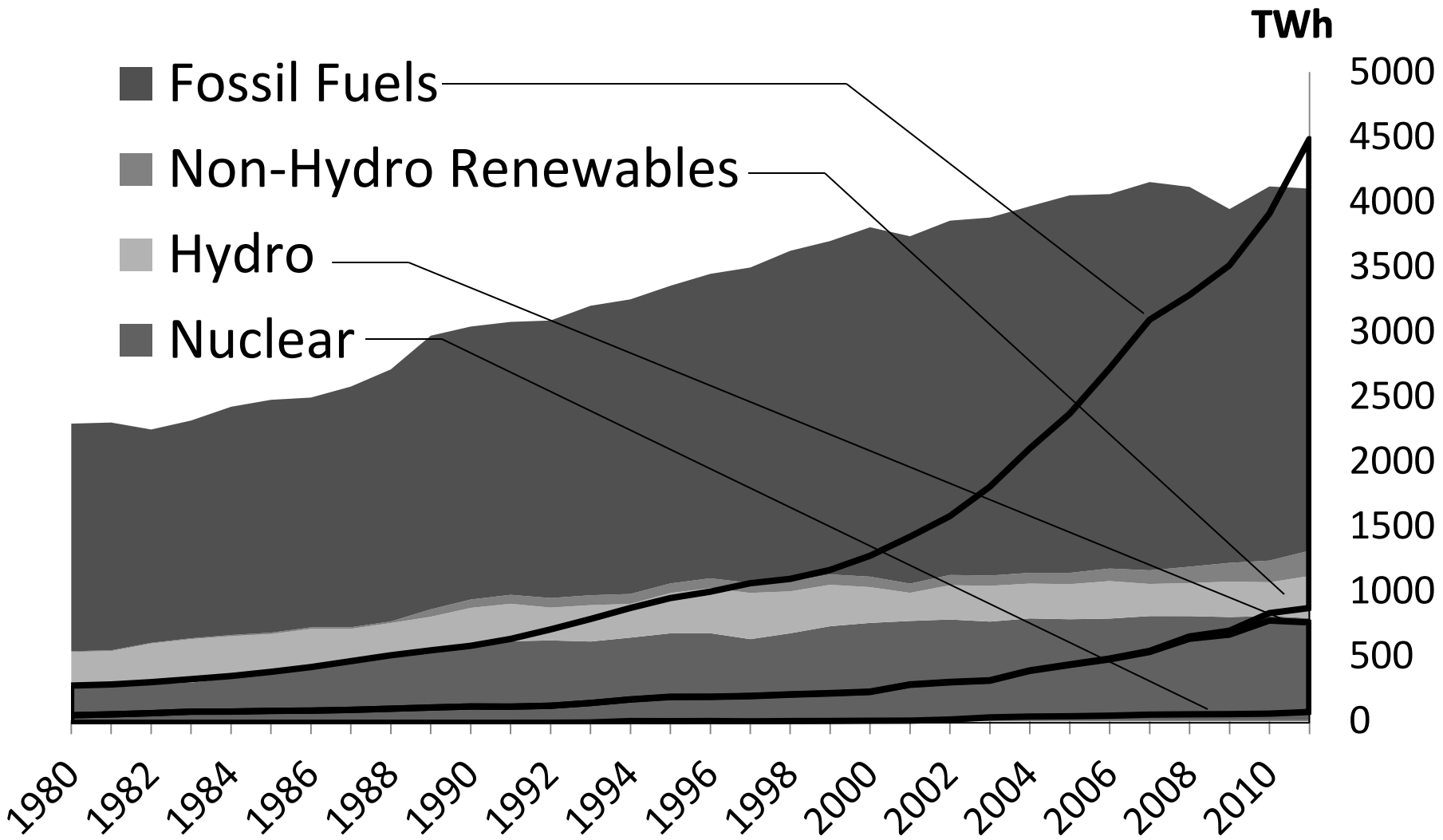
U.S. Energy Information Administration, International Energy Statistics Database. Available at: http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=2&aid=12&cid=CH,US,&syid=1980&eyid=2011&unit=BKWH, Accessed May 2013

Electricity Consumption – USA & China



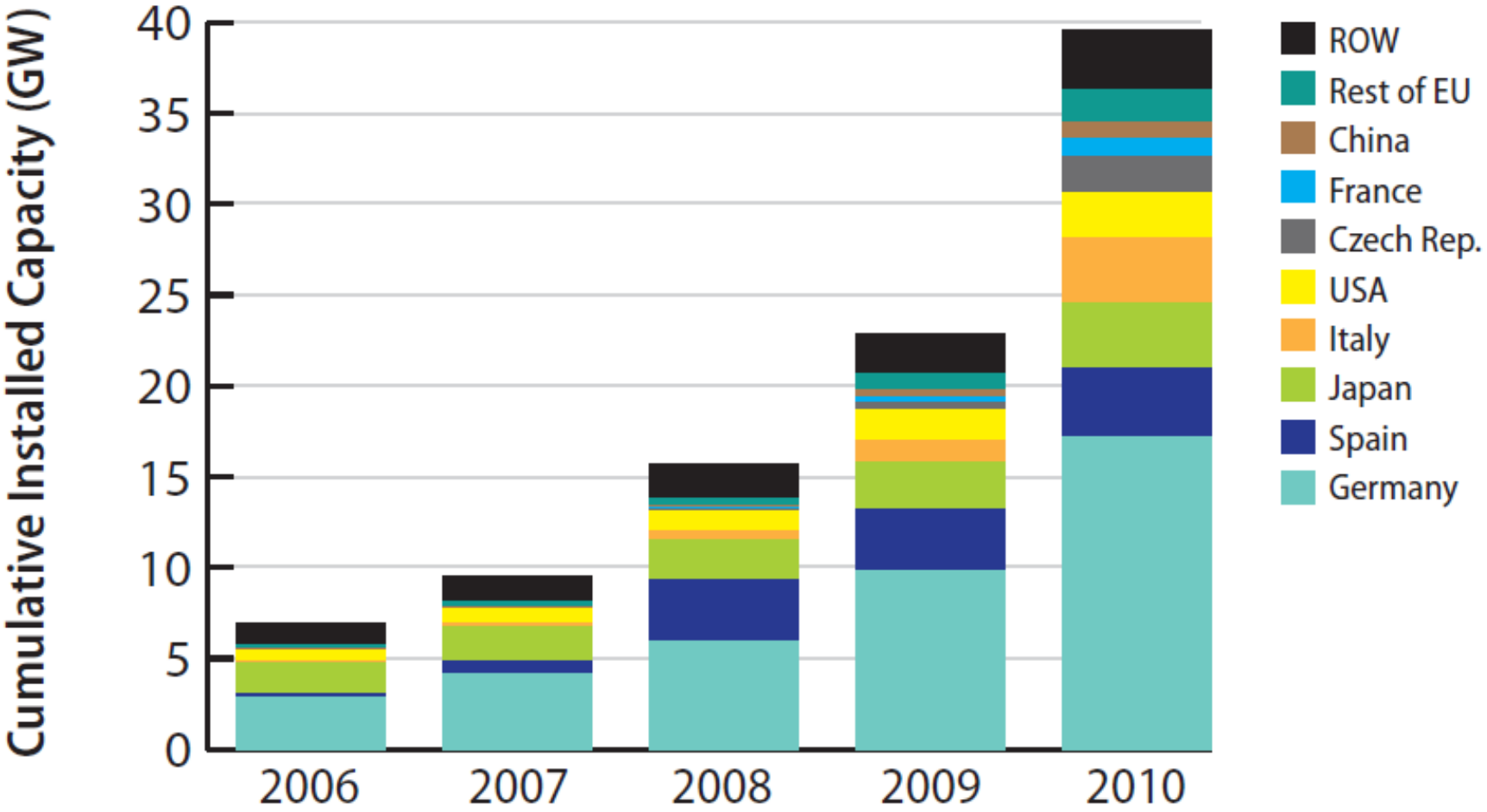
U.S. Energy Information Administration, International Energy Statistics Database. Available at: http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=2&aid=12&cid=CH,US,&syid=1980&eyid=2011&unit=BKWH, Accessed May 2013

Electricity Consumption – USA & China



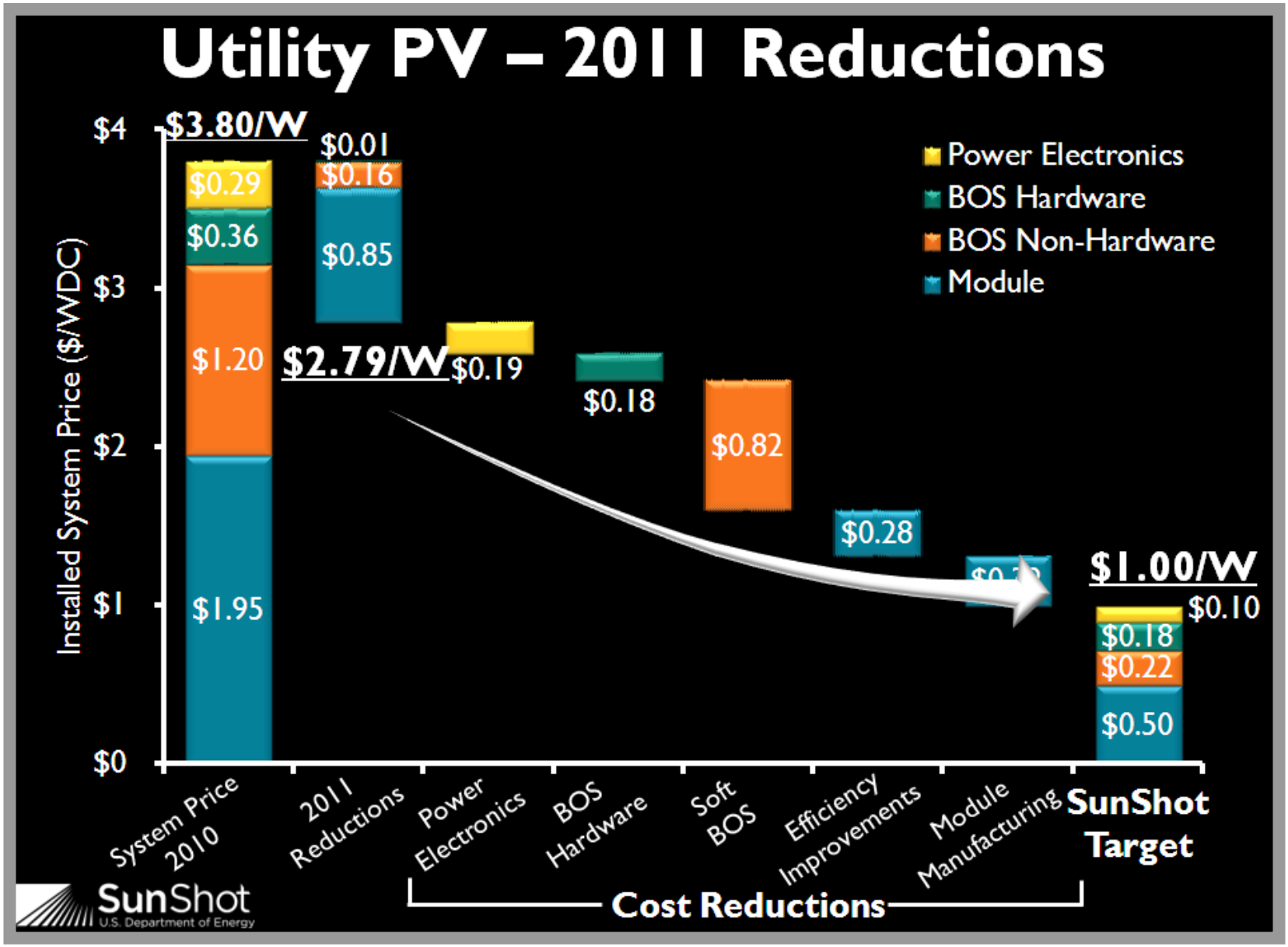
U.S. Energy Information Administration, International Energy Statistics Database. Available at: http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=2&pid=2&aid=12&cid=CH,US,&syid=1980&eyid=2011&unit=BKWH, Accessed May 2013

Photovoltaic Generation Capacity

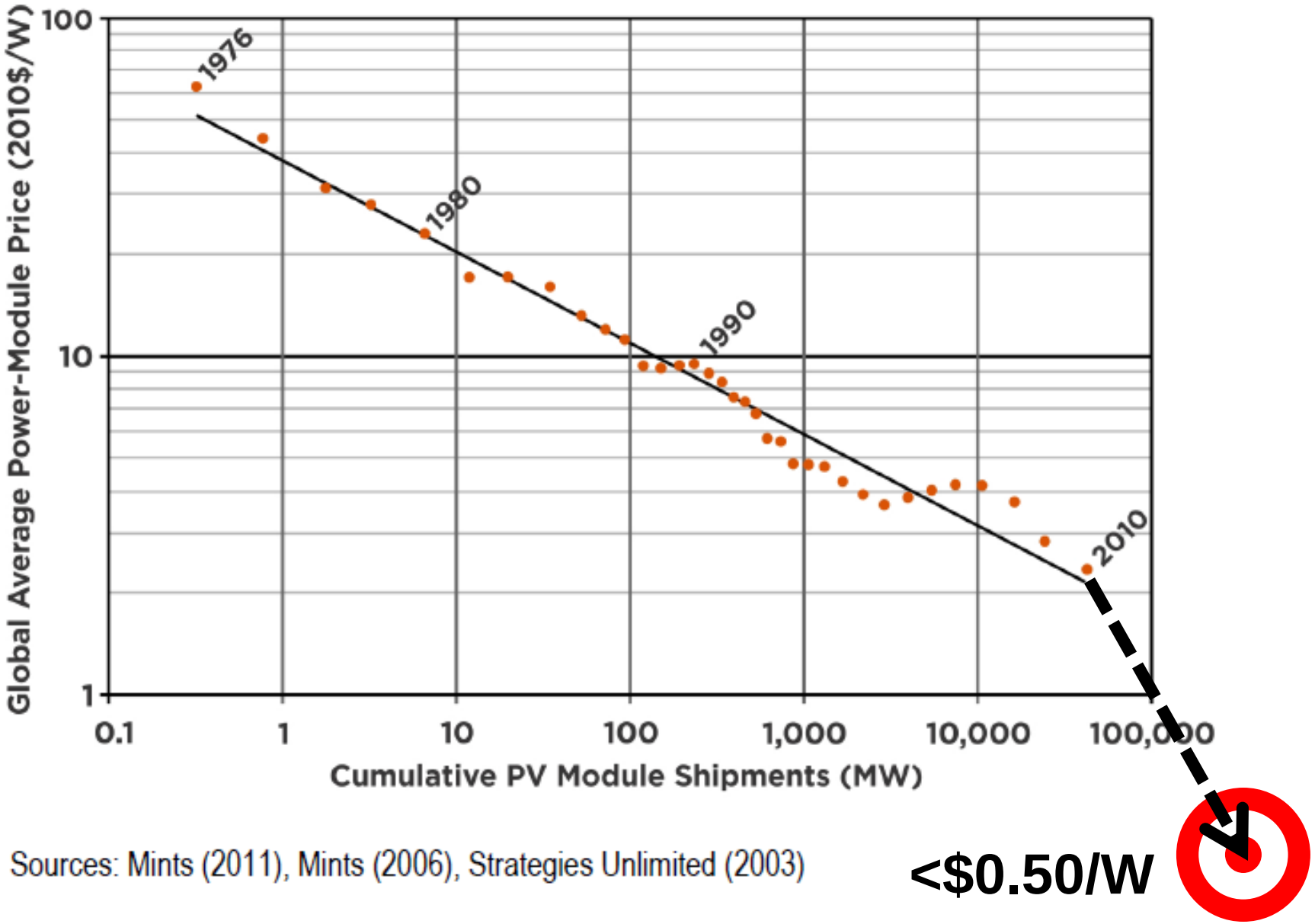


European Photovoltaic Industry Association (EPIA). (May 2010). Global Market Outlook for PV until 2014..

Roadmap to Subsidy-Free Solar

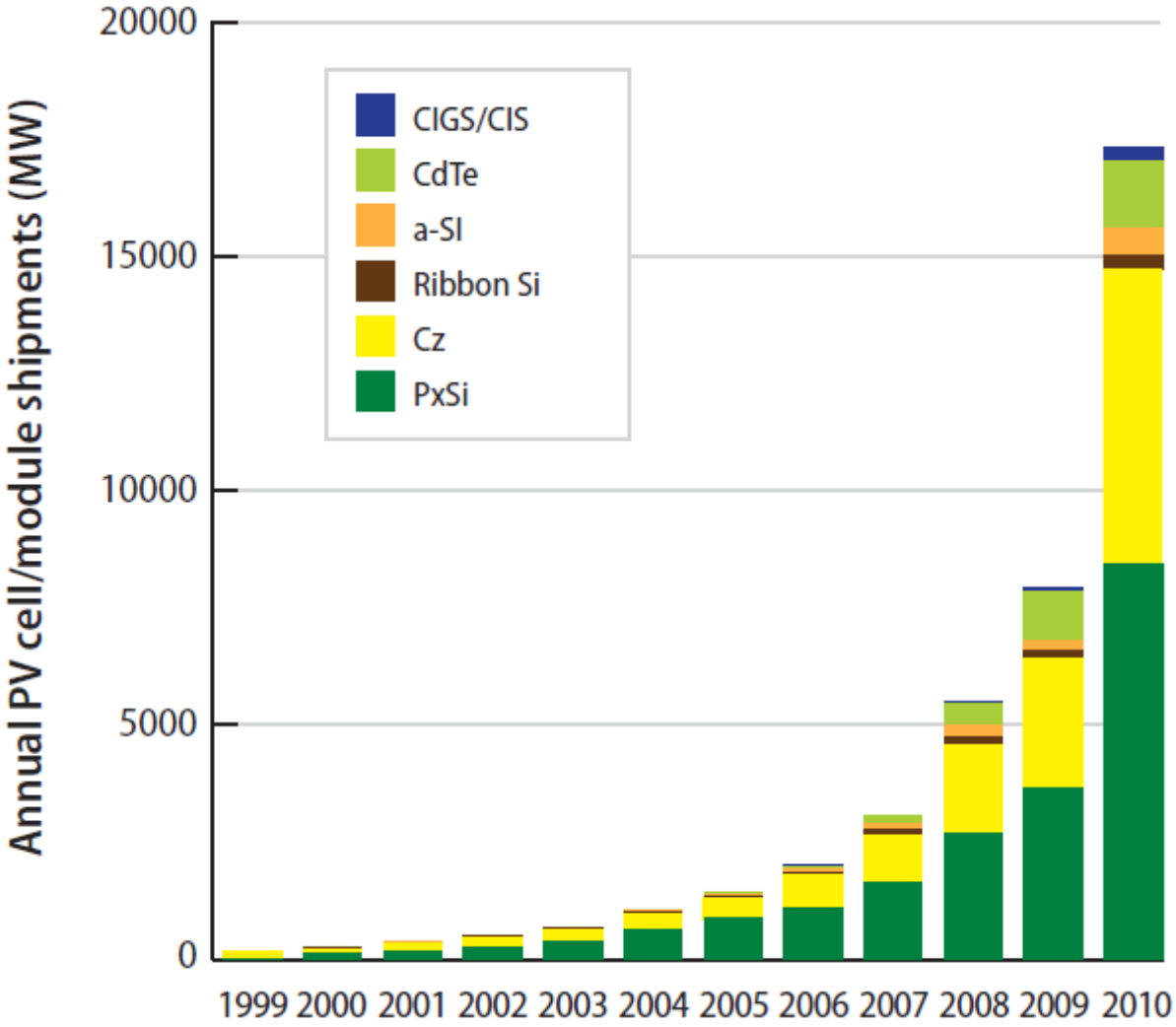


Solar Module *Prices* (Cost must be lower)



Sources: Mints (2011), Mints (2006), Strategies Unlimited (2003)

Technical Pathways



- Poly-Crystalline Silicon
- Crystalline Silicon
- Ribbon Silicon
- Amorphous Silicon
- Cadmium Telluride
- Copper Indium Gallium Selenide

Mints, P. (2011). *Photovoltaic Manufacturer Shipments, Capacity & Competitive Analysis 2010/2011*. Palo Alto, CA: Navigant Consulting Photovoltaic Service Program. Report NPS-Supply6 (April 2011).

Solar Energy

Technical Frontiers to Global Adoption

Technology Innovations toward a Sustainable, Subsidy-Free Global Photovoltaics Industry

Tonio Buonassisi, Massachusetts Institute of Technology

R&D for Advanced Industrial Solar Cells and Modules

Qiang Huang, State Key Laboratory of Photovoltaic Science and Technology

Research on High-Efficiency and Low-Cost Thin Film Silicon Solar Cells

Xiaodan Zhang, Nankai University

High-Efficiency Solar Cells for Concentrating Photovoltaics

Homan Yuen, Solar Junction