



Global Energy Trends

**Western States Land Commission,
Austin, TX**

**Michael E. Webber, Ph.D.
January 10, 2012**

Americans Are Confused About What They Want from U.S. Energy Policy

- **Two ideological camps for energy in the U.S.**
 - **High production and high consumption**
 - **Low production and low consumption**
- **US energy policy has been the worst of both worlds**
 - **Low production and high consumption**

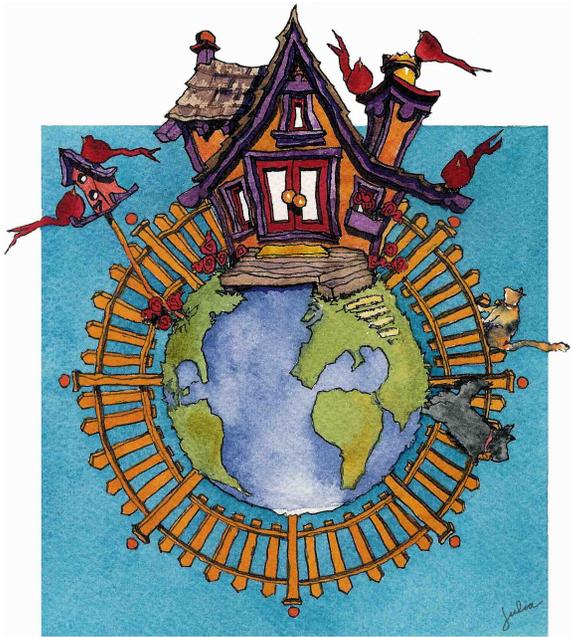


Americans Are Confused About What They Want from U.S. Energy Prices

- **High prices are good for:**
 - Energy companies (and therefore jobs)
 - Saudi Arabia
 - Environment
- **Low prices are good for:**
 - Consumers
 - Our foreign policy stance towards Iran

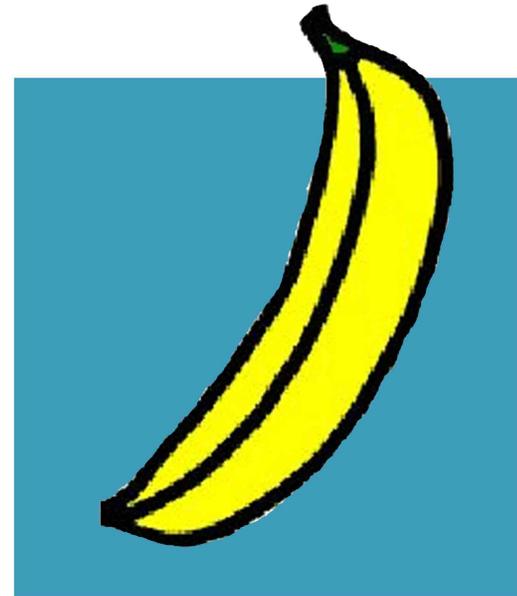
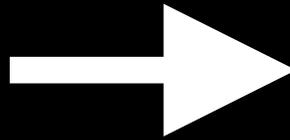


American Attitudes About Energy Have Evolved Over Time from NIMBY to BANANA



NIMBY

Not In My Back Yard



BANANA

Build Absolutely Nothing
Anywhere Near Anyone



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American Attitudes About Energy Have Evolved Over Time from BANANA to NOPE

NOPE

Not On Planet Earth



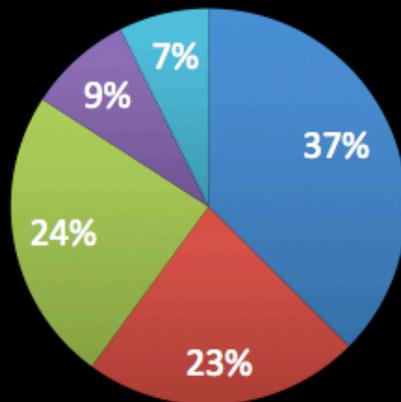
Today's Energy System



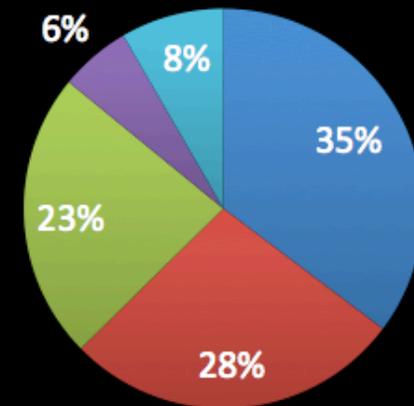
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The USA and World Consume Energy In Similar Ways: 85% is From Fossil Fuels

**USA 2008 Energy Consumption:
100 Quads**



**World 2008 Energy Consumption:
500 Quads**



- Petroleum
- Coal
- Natural Gas
- Nuclear
- Renewables

Source: EIA



The Energy Problem



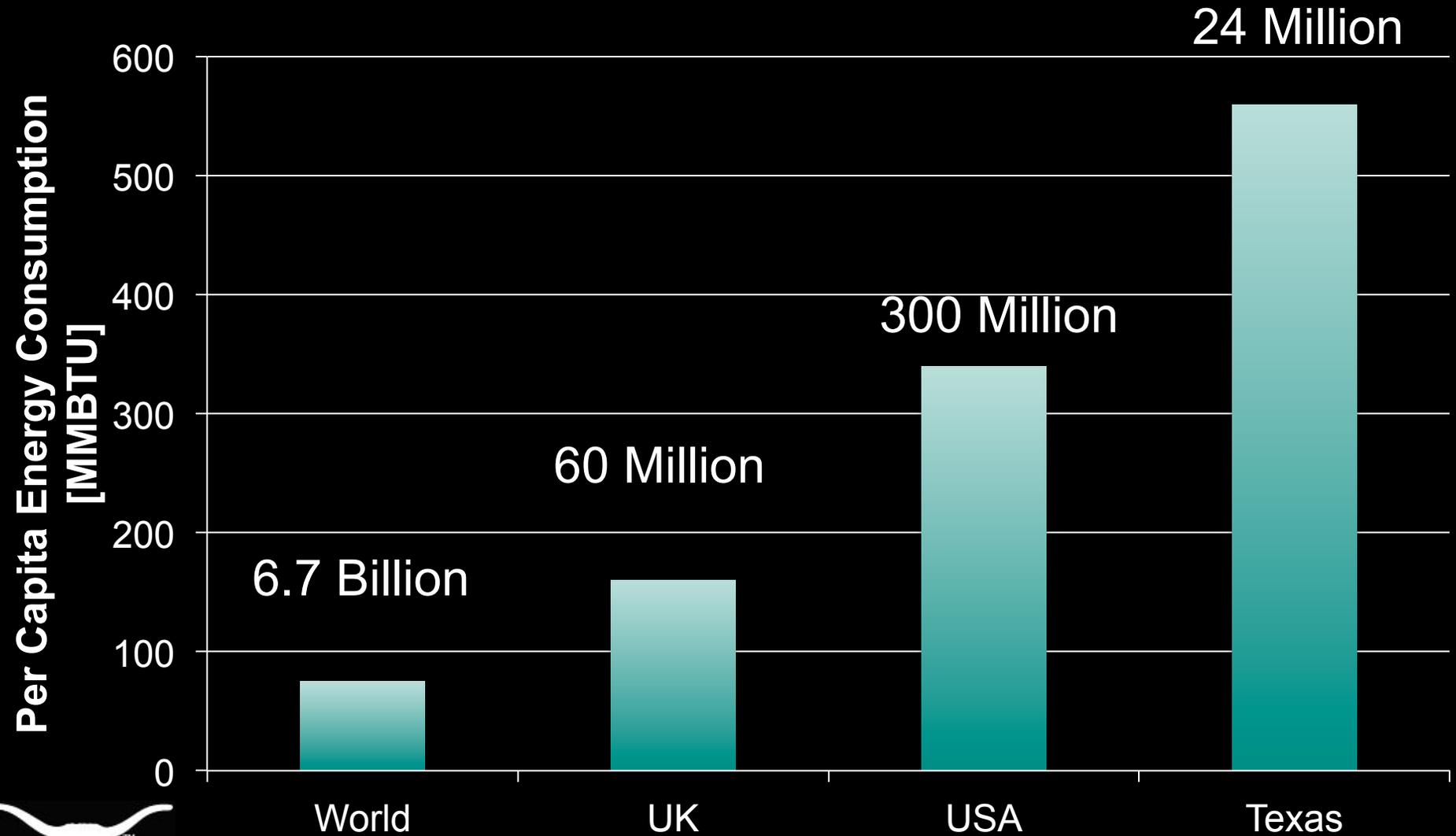
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The Energy Problem Is Comprised of Three Converging Crises

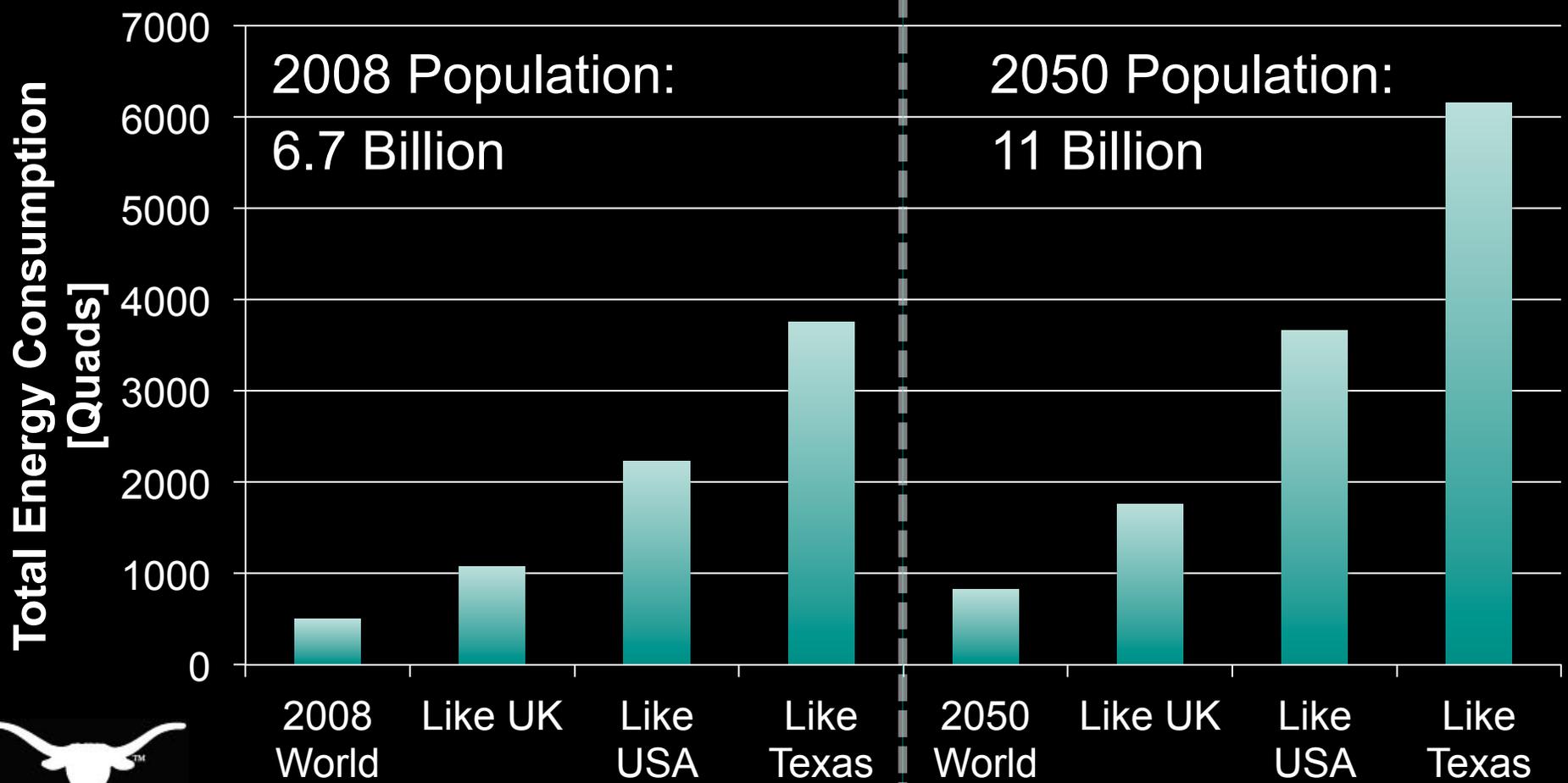
- **Three energy crises:**
 - **Resource Depletion**
 - **Environmental Degradation**
 - **National Security & Violent Extremism**
- **All three are related and amplify each other**



Annual Per Capita Energy Consumption Varies From 75 (global) to 560 (Texas) MMBTU



Total Energy Consumption Will Increase If The World Changes Per Capita Consumption to Match the UK, USA or Texas

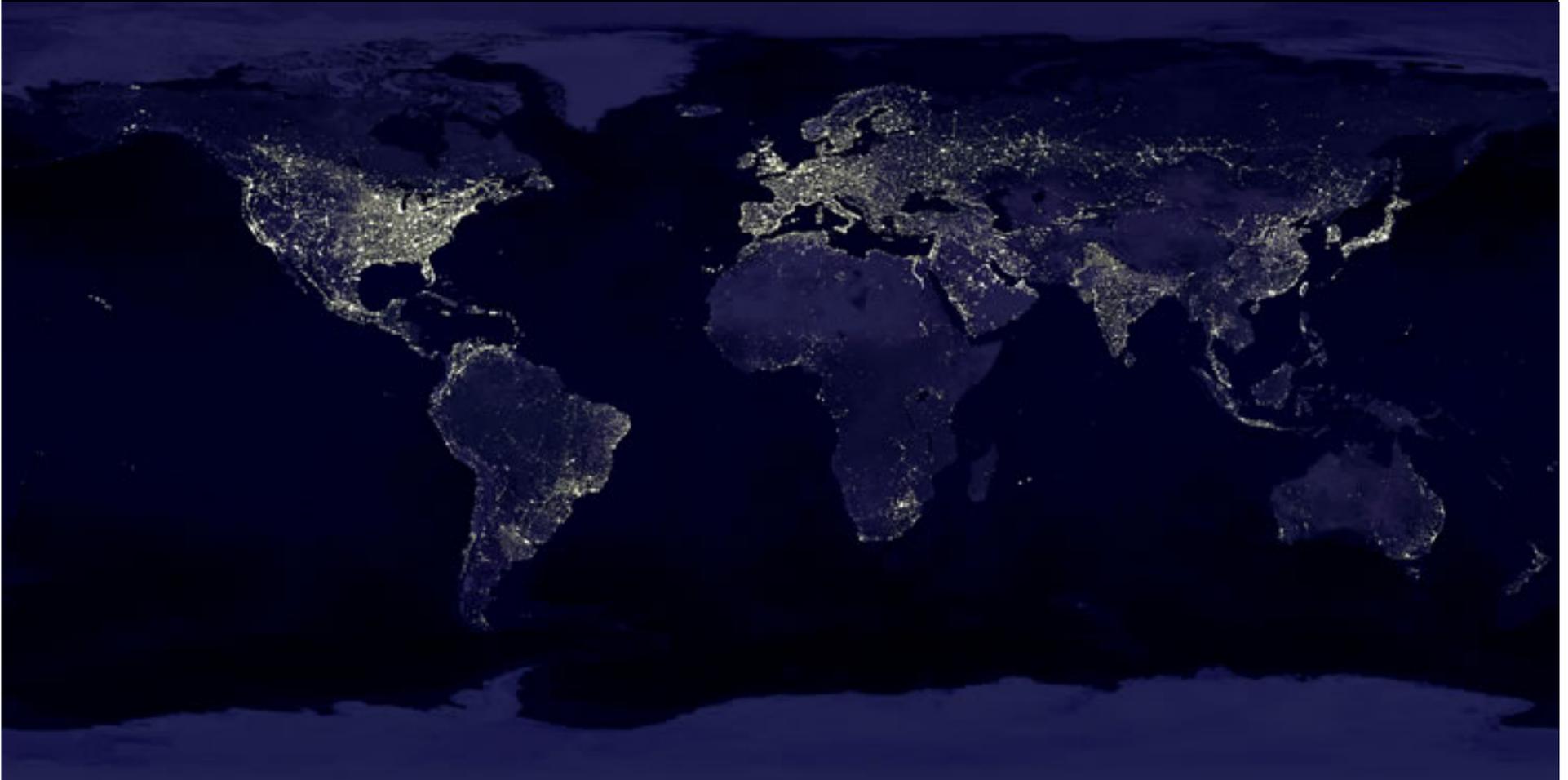


We Need To Create Robust Solutions



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These Solutions Will Be Complicated by Global Energy Trends



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Several Global Trends Are Driving The Energy System

- **Population Growth**
- **Economic Growth**
- **Urbanization**
- **Industrialization**
- **Electrification**
- **Motorization**



The Energy Transition Will Be Comprised of Three Shifts

- **A change in total demand for energy**
 - **Population growth pushes total demand up**
 - **Economic growth pushes per capita demand up**
- **A change in our end uses of energy**
 - **All societies electrify over time**
 - **All societies motorize over time**
- **A change in our sources of energy**
 - **Domestic sources**
 - **Low-carbon sources**
 - **Sustainable sources**



Approximately 1 Billion People Suffer From Chronic Hunger



Source: UN World Food Program



Approximately 1 Billion People Do Not Have Access to Clean Drinking Water

- **Plus 80% of global population at high risk of threats to water security**



Source: UN, *Nature*

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Approximately 2.5 Billion People Do Not Have Access to Sanitation



Source: UN

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Approximately 5 Billion People Do Not Have Access to Computers or the Internet



Source: Internet Worldstats

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At least 2 Billion People Do Not Have Access to Telephones

- There are 5 billion mobile phone accounts globally
 - Maybe an allegory for distributed energy leapfrogging centralized energy?



Source: ITU



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There are only 600 million cars and 250 million trucks globally



Source: WorldMapper

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All Those People Want...

- Food
- Water
- Sanitation
- Computers
- Phones
- Cars



A Vision of the Future



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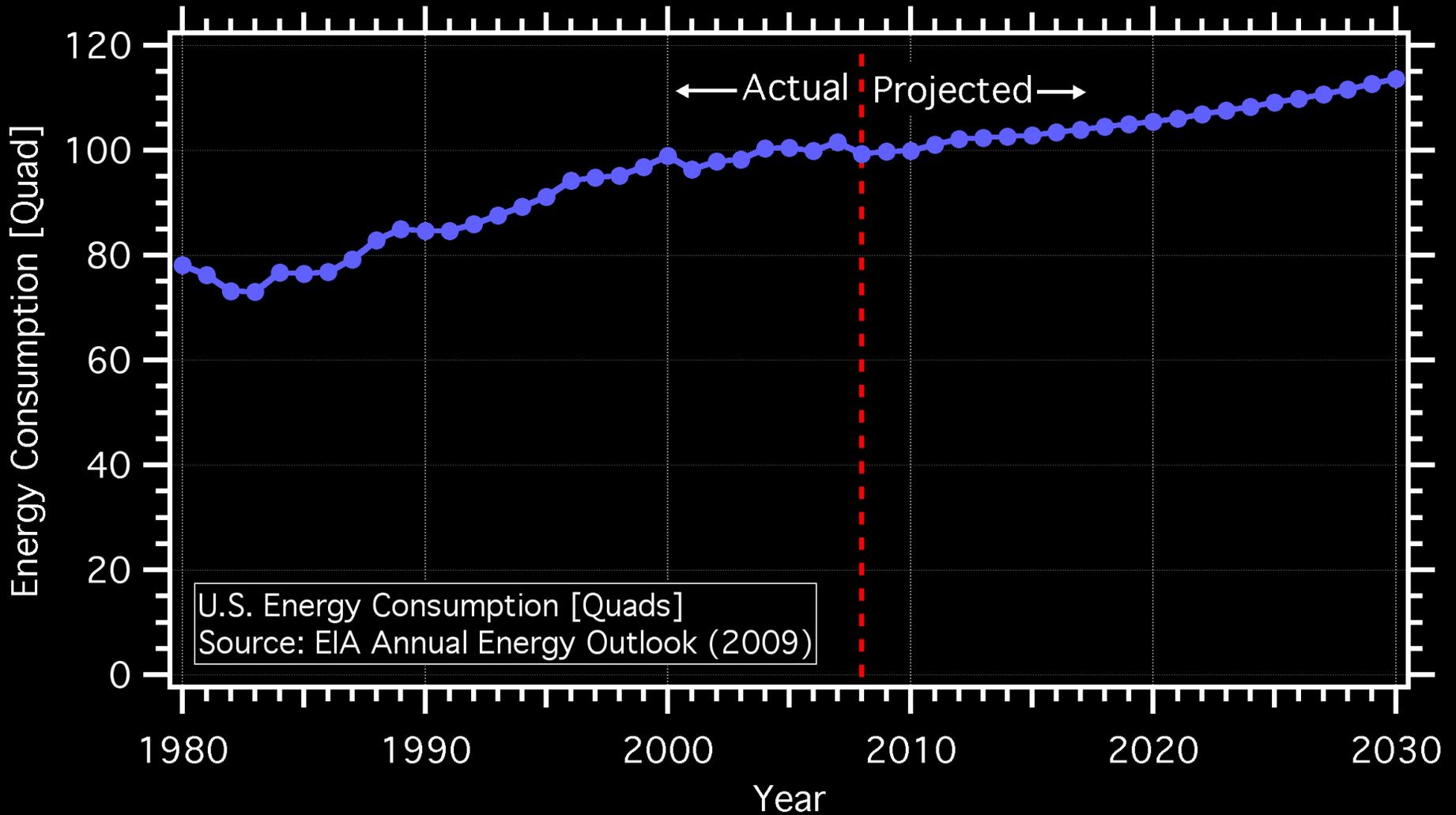
So What's the Future of Energy?

*“It's tough to make predictions,
especially about the future.”*

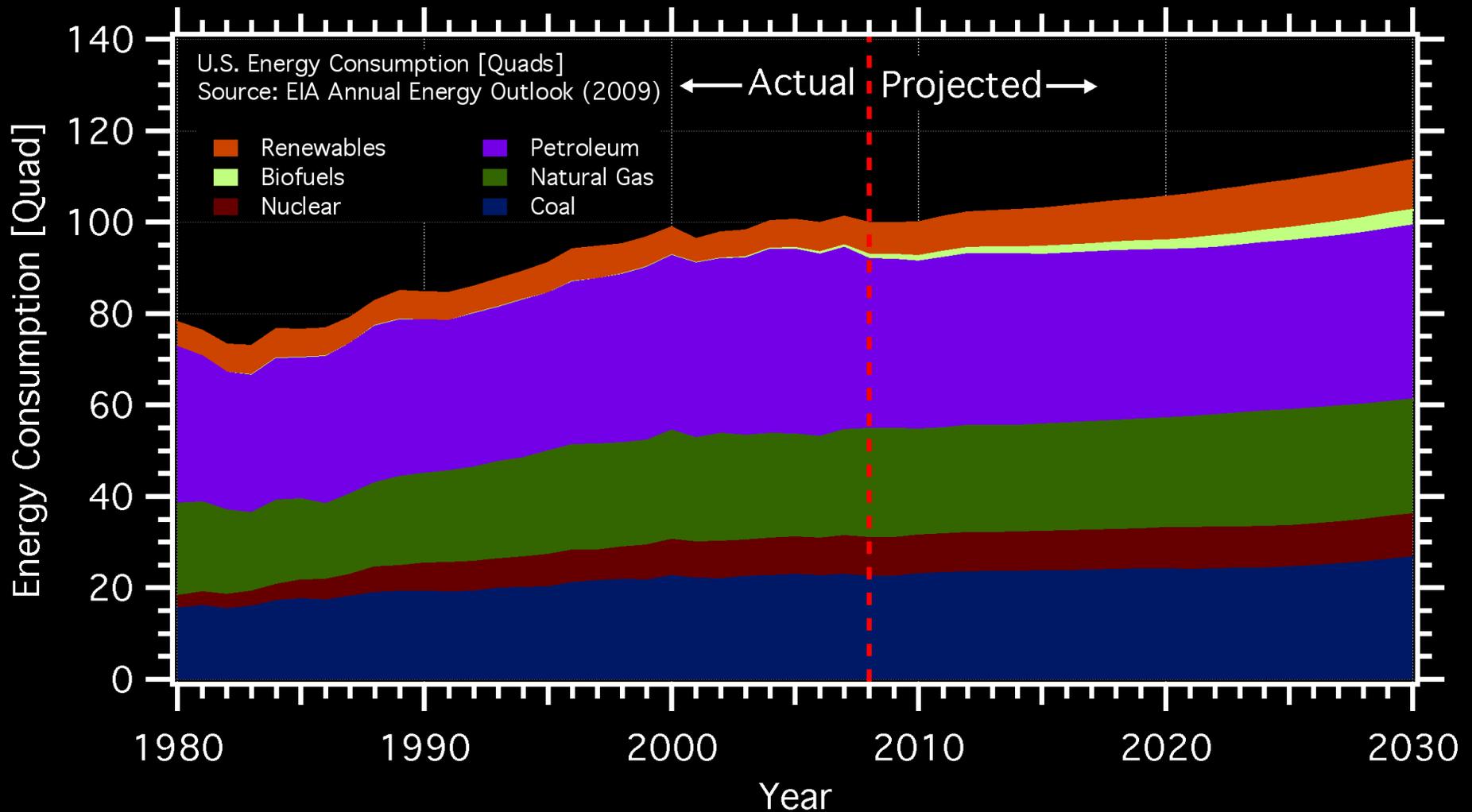
Yogi Berra



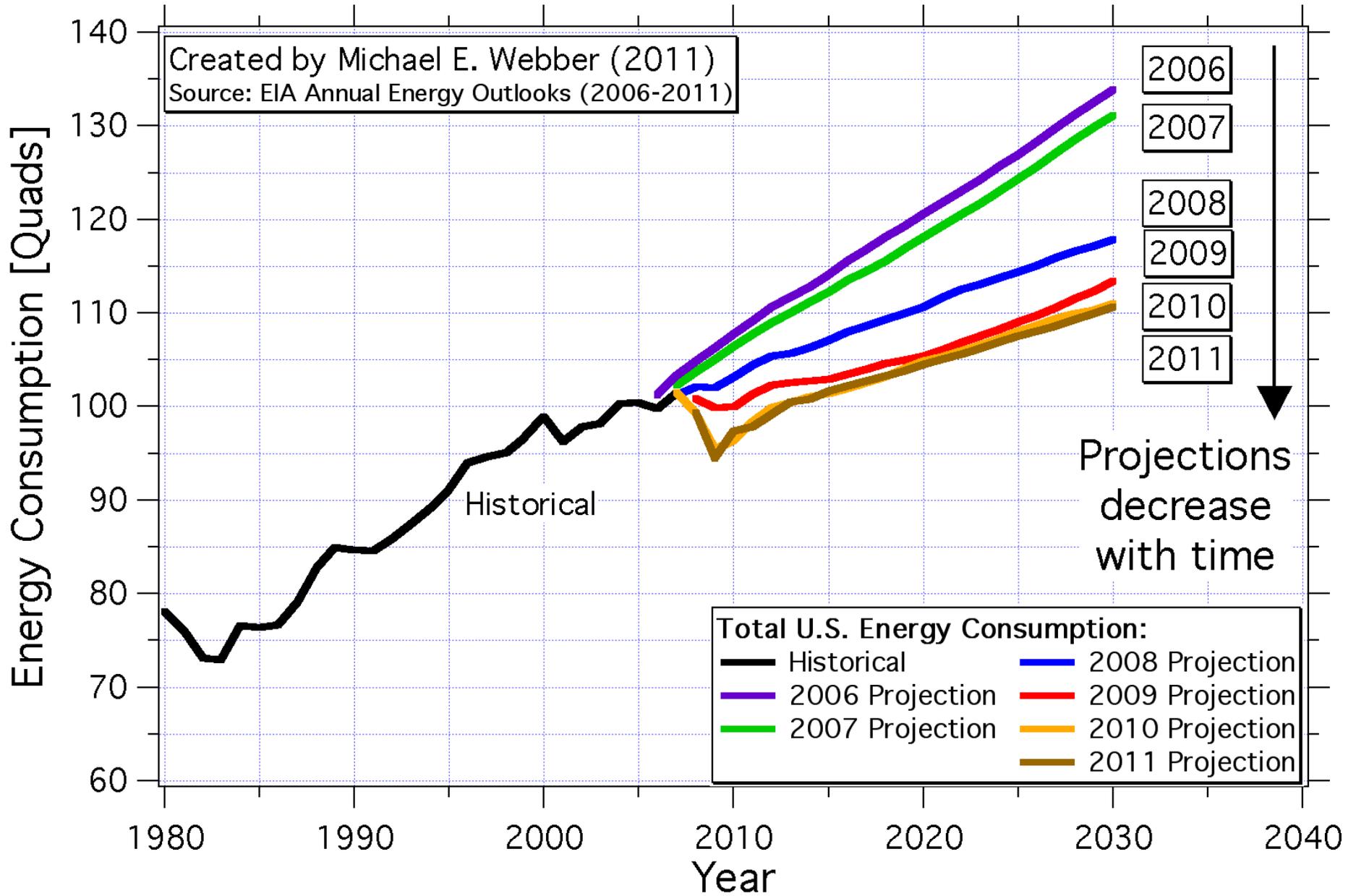
Analysts Expect U.S. Consumption Will Increase from 100 to 113 Quad in 20 Years



Sources of U.S. Energy Supply Are Expected to Change Very Little in the Coming 20 Years



Projections Are Often Wrong



We Know That the Energy System of the Future Will Be Different, We Just Don't Know What They Will Be, Yet



Many Energy Trends Are Negative

- **Upward price pressure for traditional energy sources**
- **Accelerating effects of climate change globally**
- **National security threats haven't dissipated**
 - **Nuclear facilities in Iran**
 - **Ongoing attempts at terrorist attacks**



Trends Imply Upward Price Pressure

- **Coal:**
 - Prohibitions on mountain-top removal
 - Increased safety regulations for below-ground
- **Oil:**
 - Tightened supplies
 - Increased protections for water bodies



Trends Imply Upward Price Pressure

- **Nuclear:**
 - Significant financing, insurance challenges
 - Additional safety costs
- **Natural Gas:** Uncertain regulations for shale production
- **Renewables:** Siting, transmission, economic models



An Optimistic Vision of the Future

- **Energy will get smarter**
 - Real-time, flexible, self-healing,...
- **Energy will get cleaner**
- **Energy will be Self-fueled for Transportation**
 - Electric cars with home-charged solar panels
 - NG vehicles with home filling
- **Systems will become distributed**
 - Distributed power generation
 - Distributed water collection, treatment and use



A Vision of the Future, cont'd...

- **Micro-nuclear (at subdivision scale?) will arrive**
- **Full-cost pricing, real-time pricing**
 - **CO₂, pollutants, land disturbance, security**
 - **Prices to vary with supply and demand**
- **Renewable energy will keep dropping in price**



The Trend for Renewable Energy, Especially Wind and Solar Energy, Is Very Positive

- **National/state mandates for renewables**
 - **20% by 2020 goals**
 - **RPS (renewable portfolio standards)**
- **Major incentives for renewable energy**
 - **PTC (Production Tax Credits)**
 - **ITC (Investment Tax Credits)**
 - **REC (Renewable Energy Credits)**



Solar PV Prices Drop Over Time

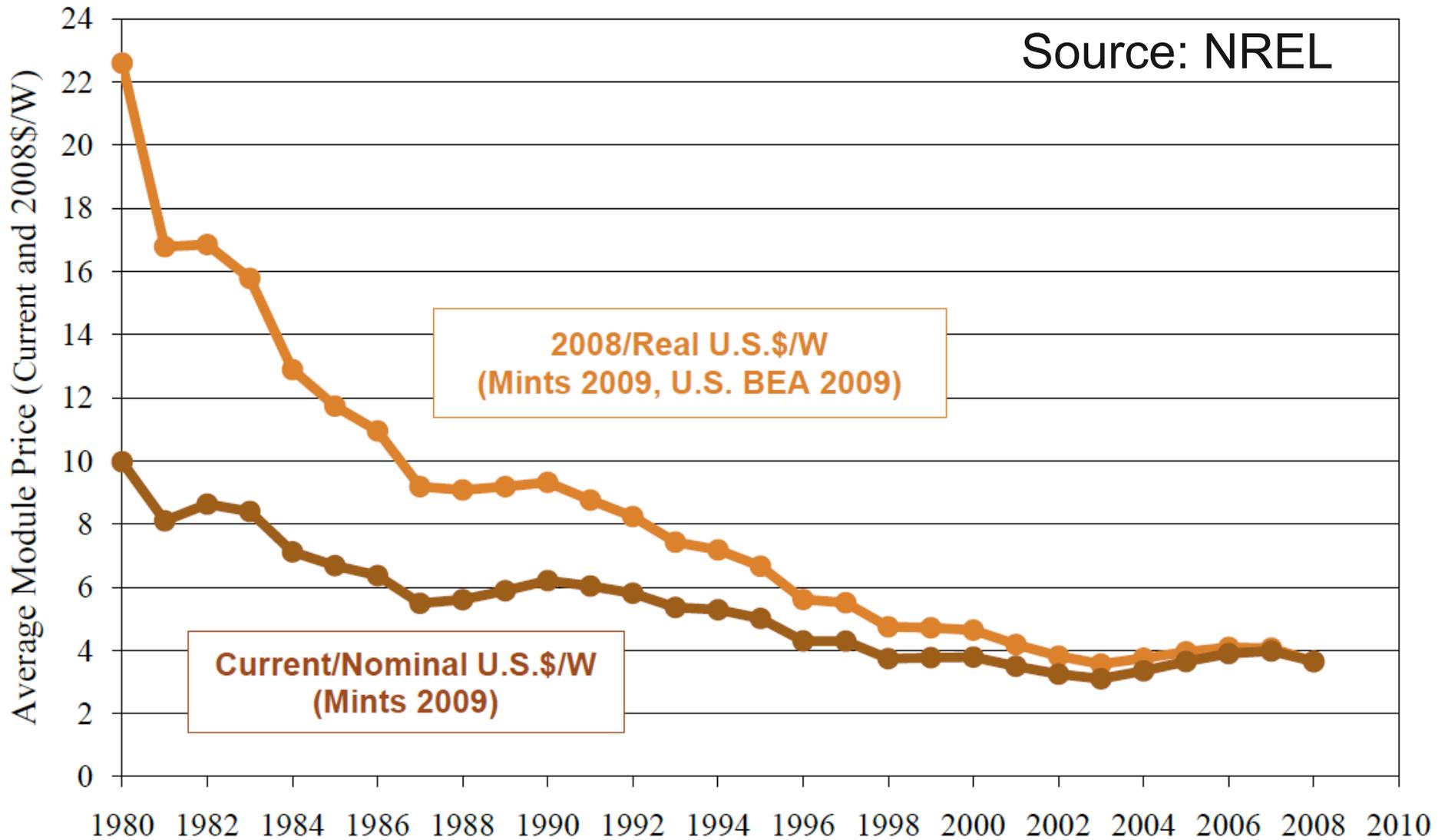
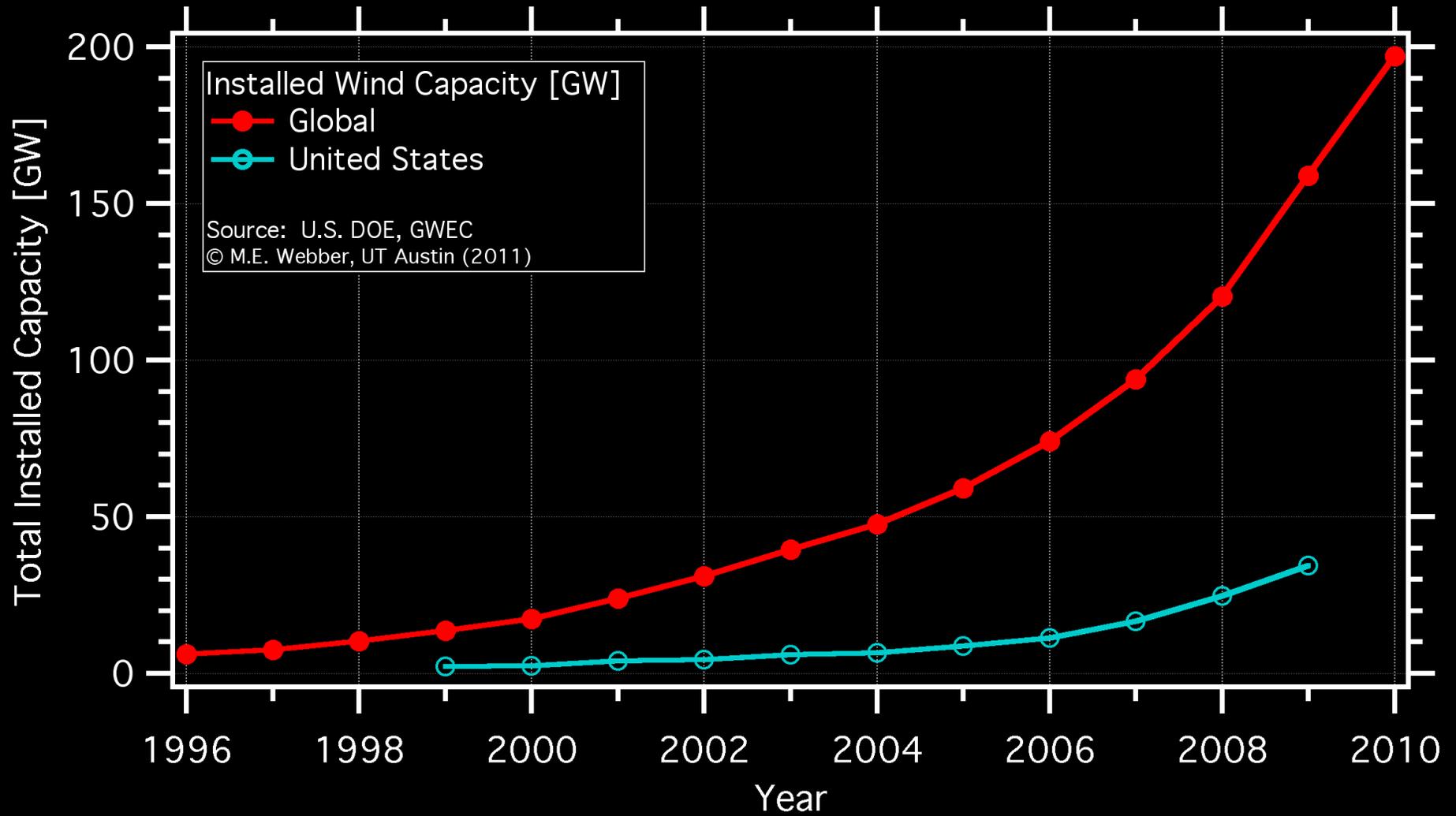


Figure 3.8. Global, average PV module prices, all PV technologies, 1980–2008 (Mints 2006, Mints 2009, U.S. Bureau of Economic Analysis 2009)^{38 39}

Wind Has Enjoyed Phenomenal Growth



Wind Has Some Drawbacks



- Intermittency
 - Might be solved with geographic distribution
- Failures
 - Gear oil fires
 - Over-rotation



People Want A Few Things in the Future

- *Wind power:* Larger turbines, many offshore
- *Solar power:* Embedded in asphalt, roof tiles, walls
- *Shale Production:*
 - Natural gas
 - Shale oils/liquids
- *Resolving the Energy-Water Nexus:*
 - Reduce energy's vulnerability to water scarcity
 - Reduce water's vulnerability to energy scarcity



Many of the Challenges and Opportunities Are in the Western States

*If we can solve these issues in the western
states, then we can solve them anywhere*



Thank You



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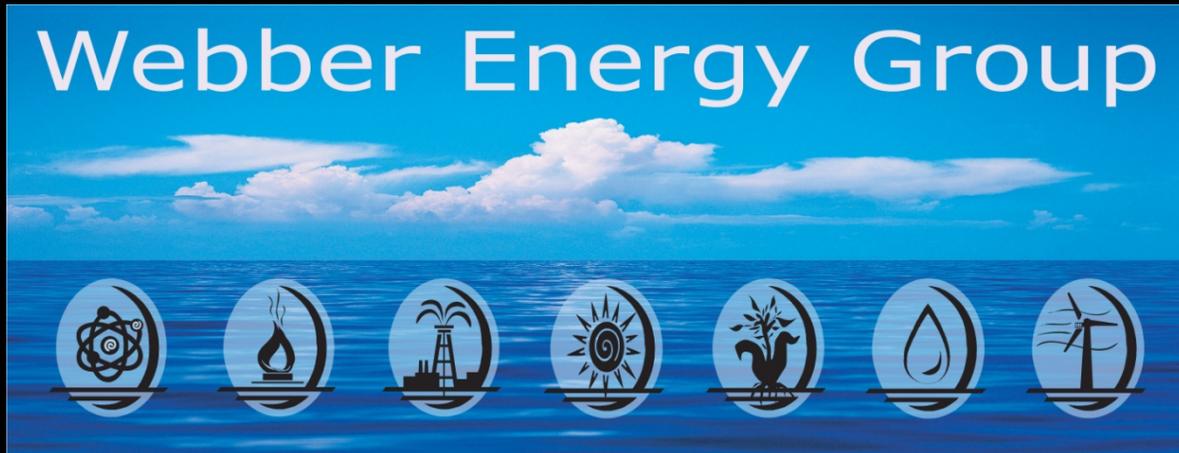
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