

Technology and Policy for the Energy-Climate Challenge

John P. Holdren

Assistant to the President for Science and Technology
and Director, Office of Science and Technology Policy
Executive Office of the President of the United States



Opening Keynote

EIA Energy Conference

Washington DC • 11 July 2016

The energy-climate challenge

- Without energy there is no economy
- Without climate there is no environment
- Without economy and environment there is no material well-being, no civil society, no personal or national security

The essence of the challenge is that the world has long been getting most of the energy its economies need in ways that are now seriously disrupting the climate its environment needs.

In any case, whatever you think the essence of “the energy problem” is, advances in technology are an important part of the solution. They can...

- Reduce the costs of energy end-use forms to consumers
 - Further reduce costs of energy services by increasing end-use efficiency
 - Increase the productivity of manufacturing
 - Reduce dependence on imported oil in the USA and elsewhere
 - Increase the reliability & resilience of energy systems
 - Strengthen & sustain US competitiveness in global energy-technology markets
 - Minimize the ecosystem-disruption and biodiversity impacts of energy-resource exploration, extraction, and transport
 - Reduce the emissions of air pollutants harmful to health, property, and ecosystems
 - Improve the safety and proliferation resistance of nuclear energy
 - Enhance the prospects for environmentally sustainable & politically stabilizing economic development
- AND
- Reduce the energy sector's contributions to human disruption of global climate

But the most demanding driver of energy-technology innovation is the need to reduce energy's impact on climate, because of...

- the potentially unmanageable consequences of failing to adequately mitigate climate change;
- the dominant role of the energy sector in causing the ongoing climate change;
- the high proportion of US & global energy supply that comes from the offending fuels/technologies;
- the barriers to new technologies' achieving significant penetration in the massive US and global energy systems and the long lead times needed to do so; and
- the mismatch between those lead times and the pace of energy-system change that adequate climate-change mitigation will require.

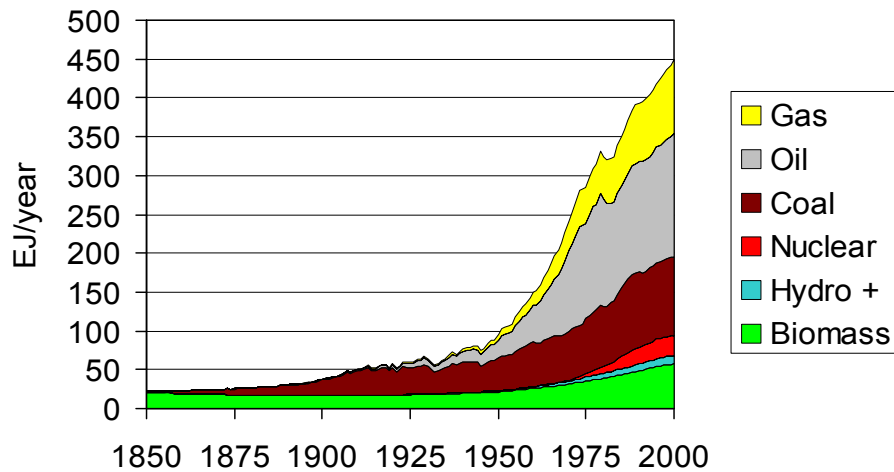
And we are not innovating fast enough to meet this need.

The rest of this talk elaborates on these propositions in terms of...

- the past and projected make-up of the global and U.S. energy systems;
- the resulting and projected greenhouse-gas emissions;
- the imminence of locking in unmanageable climate change;
- what the Obama Administration has been doing about it;
- what more needs to be done.

The past & projected make-up of the global & U.S. energy systems

Growth of world population & prosperity from 1850 to 2000 brought a 20-fold increase in energy use.



**Growth rate 1850-1950 was 1.45%/yr, driven mainly by coal.
From 1950-2000 it was 3.15%/yr, driven mainly by oil & natural gas.**

World, US, and Chinese energy supply, 2014

Growth since 2000 has averaged 2 percent per year.

	World	USA	China
Primary Energy (exajoules)	600	104	137
of which... Oil	31%	35%	17%
Natural Gas	24%	31%	6%
Coal	28%	19%	62%
Nuclear Energy	4%	9%	1%
Hydropower	6%	2%	7%
Biomass and Other	8%	7%	7%

In 2005 the USA was still using a third more energy than China. By 2014, the reverse was true.

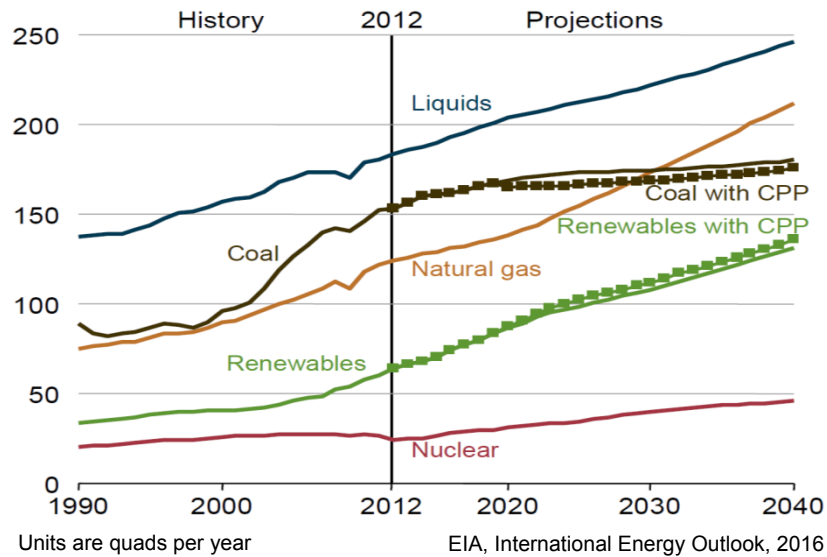
Energy Supply, 2014 (continued)

About 37% of primary energy is used to generate electricity

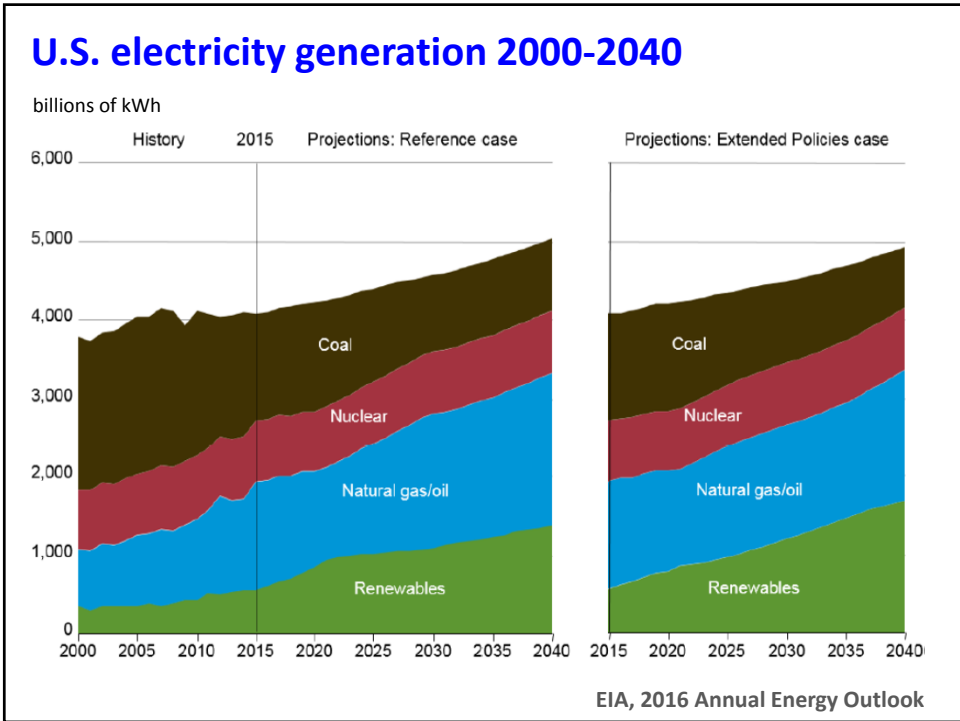
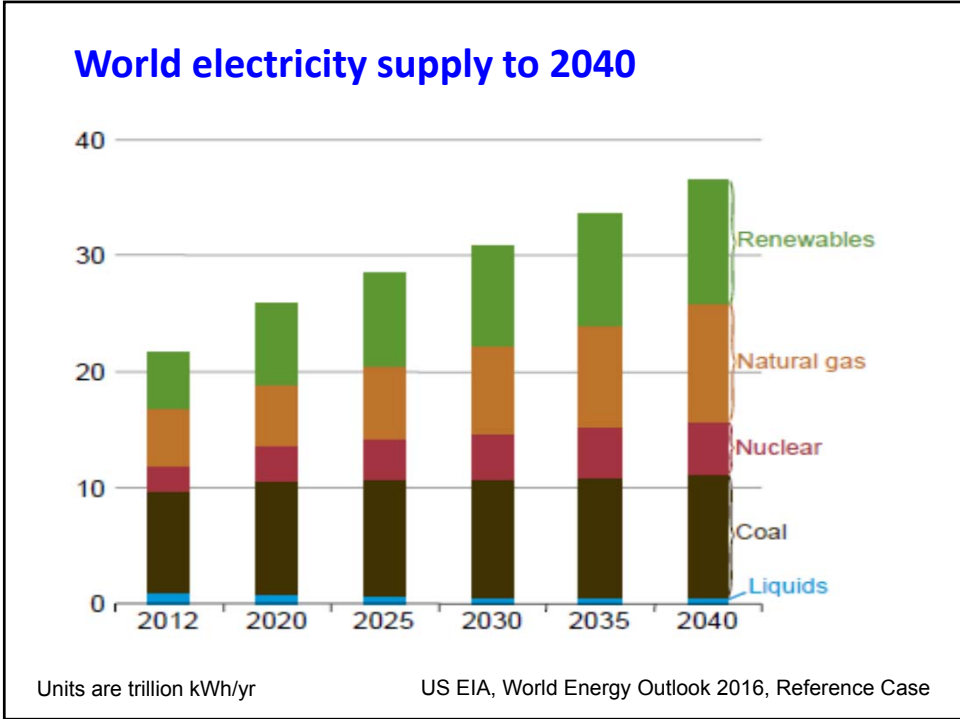
	World	USA	China
Electricity (billion kWh)	23500	4300	5700
of which...			
fossil	66%	68%	75%
hydropower	16%	6%	19%
other renewable	2%	7%	4%
nuclear	16%	20%	2%

Fossil fuels still supply 2/3 of the world's electricity.

World energy use to 2040 by source

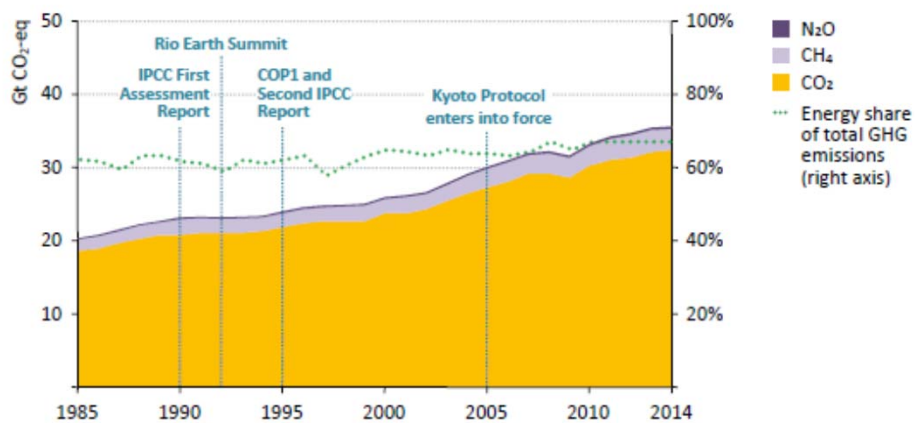


Renewables & nuclear double but fossil fuels continue to dominate.



The resulting and projected greenhouse-gas emissions

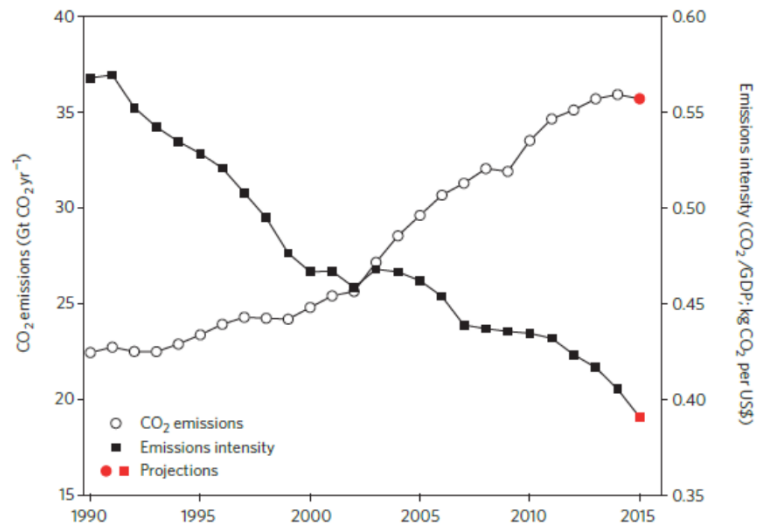
Global GHG emissions 1985-2014



The global energy system has accounted for 2/3 of global GHG emissions.

IEA World Energy Outlook Special Report, 2015

Global energy-industrial CO₂ emissions thru 2015

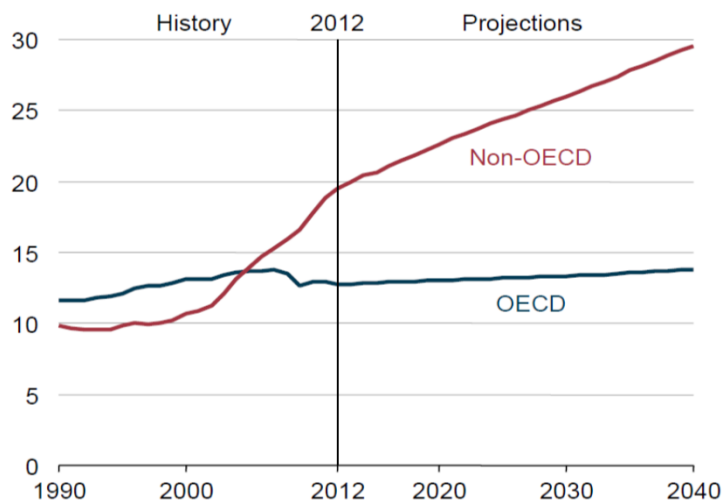


Could the 2015 decline be a trend, not a fluctuation?

Jackson et al., Nature Climate Change, January 2016

Global GHG emissions projected to 2040

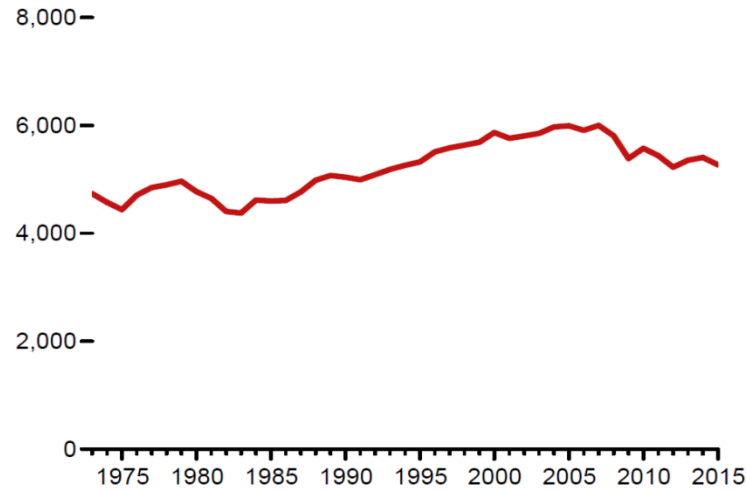
The EIA projects 2015 was are fluctuation.



Non-OECD emissions in 2040 are projected to equal world emissions in 2010.

Has the USA turned the corner on CO₂ emissions?

US CO₂ emissions from energy supply, MtCO₂



Source: DOE/EIA Monthly Energy Review, March 2016

**The imminence of locking in
unmanageable climate change**

Current harm is widespread

Around the world we're seeing, variously, increases in

- floods
- wildfires
- droughts
- heat waves
- pest outbreaks
- coastal erosion
- coral bleaching events
- power of the strongest storms
- geographic range of tropical pathogens

All plausibly linked to climate change by theory, models, observed "fingerprints"

Increased harm is inevitable

- Current, ongoing damages are the result of an increase of only $\sim 1^{\circ}\text{C}$ in global average surface temperature.
- Current atmospheric concentrations of GHG commit the world to $1.3\text{-}1.4^{\circ}\text{C}$ after the ocean comes to equilibrium with the altered atmospheric heat balance
- Continued emissions in excess of natural sinks make it extremely challenging to avoid a 2°C increase.
- Best estimate of long-term sea-level rise commitment is 2.3 meters (7.5 feet) per degree C of increase, hence 15 feet for 2°C .

There is no time to lose in shrinking emissions.

What the Obama Administration has been doing about it

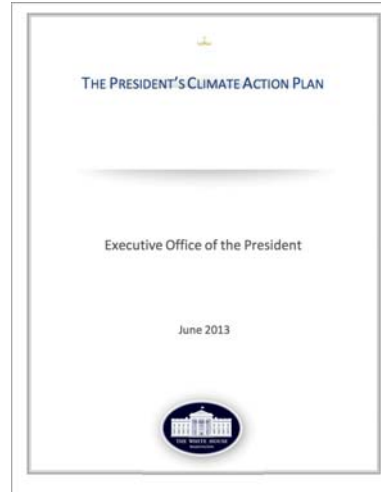
Action on the energy-climate challenge

- \$80 billion for clean & efficient energy in the Recovery Act
- funding for Advanced Research Projects Agency – Energy (ARPA-E) and six new Energy Innovation Hubs
- first-ever fuel-economy/CO₂ tailpipe standards for light-duty vehicles, plus fuel-economy standards for trucks
- re-invigoration of US Global Change Research Program
- budget increases for clean-energy & energy-efficiency R&D
- Quadrennial Technology Review QTR (2011, 2015) and Quadrennial Energy Review (phase 1 2014-15)
- Climate Action Plan (June 2013 to present)

President Obama's Climate Action Plan



Georgetown University, June 2013



- Cutting carbon pollution in America (mitigation)
- Preparing the United States for the impacts of climate change (adaptation)
- Leading international efforts to address climate change

<http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>

Principal ingredients of the CAP: Mitigation

- Reducing carbon pollution from power plants
 - standards for cutting CO₂ from new power plants (Sept 2013)
 - and from existing power plants (June 2014)
- Reducing other greenhouse gases
 - interagency strategy to reduce methane emissions (March 2014)
 - EPA proposal on hydrofluorocarbons (July 2014)
 - 2025 target to reduce methane emissions from the oil and gas sector by 40-45% from 2012 levels along with various actions to reduce methane emissions going forward, including EPA regulation (January 2015)
- Accelerating U.S. leadership on clean energy
- Doubling down on energy end-use efficiency
- Building a 21st-century energy infrastructure

Principal ingredients of the CAP: Adaptation

- Directing agencies to support climate preparedness/resilience
 - All agencies to develop & implement plans for integrating climate preparedness/resilience into their missions, policies, programs, investments, and grants. (Plans released 10-14.)
- Establishing internal & external task forces on resilience
 - Interagency Council on Climate-Change Preparedness & Resilience (~30 Federal agencies); established (11-13)
 - State, Local, & Tribal Leaders Task Force on Climate Preparedness & Resilience (26 elected officials from across the country; delivered recommendations to the Administration 11-14.)
- Managing flood, drought, and wildfire risks
 - Drought Resilience Partnership (11-13); USDA Agriculture Hubs (2-14); USDA/DOI Wildland Fire Strategy (4-14); HUD Urban Resilience Competition (6-14); Flood Risk Standard (1-15).

Ingredients of the CAP: International

- Enhancing bilateral engagement
 - U.S-China Joint Announcement in Nov. 2014 (with national targets, new joint research & demonstration projects)
 - Engagement with Mexico, Brazil, India, Indonesia to encourage ambition in their INDCs.
- Enhancing multilateral engagement
 - **G-20:** Agreement to phase out fossil-fuel subsidies and to develop a methodology for a voluntary peer-review process (09-13).
 - **UN:** Pursuit & achievement of a strong agreement in Paris in December 2015; commitments & partnerships on international assistance for preparedness/resilience (09-14).
- Mobilizing clean-energy and preparedness finance
 - \$3B US contribution to Green Climate Fund; US-German Global Innovation Lab for Climate Finance

What more needs to be done?

E-tech advances needing acceleration

- Improved coal technologies to make electricity & fluid fuels with CO₂ capture & storage
- Biofuels that don't compete with food & forests
- Cheaper photovoltaic cells
- An efficient H₂-producing solar cell
- Advanced nuclear reactors with high safety and efficiency, proliferation-resistant fuel cycles
- Nuclear fusion made practical
- A smarter, more efficient grid
- Improved batteries & fuel cells
- More efficient buildings & industrial processes

The path forward in the United States

- Defend the requests for clean-energy RD&D and for Earth observation in the President's FY17 Budget.
- Finalize EPA's Power Plant Rules.
- Improve the coverage, usability, and user base of the Climate Data Initiative and Climate Resilience Toolkit
- Strengthen partnerships across Federal-state-local governments, private sector, civil society
- Implement the President's Climate Education and Literacy Initiative to ensure continuing public support for all of the above.
- Insist that Presidential candidates commit to continue and build on President Obama's climate-change program.

The path forward internationally

- Build the public-private-global partnership for boosting resilience in developing countries announced at the 09-14 UN Climate Summit.
- Continue to push for full implementation of the Paris agreement and increased ambition in INDCs over time.
- Begin to plan for the challenges of the steep declines in global emissions that will be needed after 2030.
- To that end, substantially ramp up global research, development & demonstration of the improved and new clean-energy technologies that such cuts will require (Mission Innovation).



<http://www.ostp.gov>