



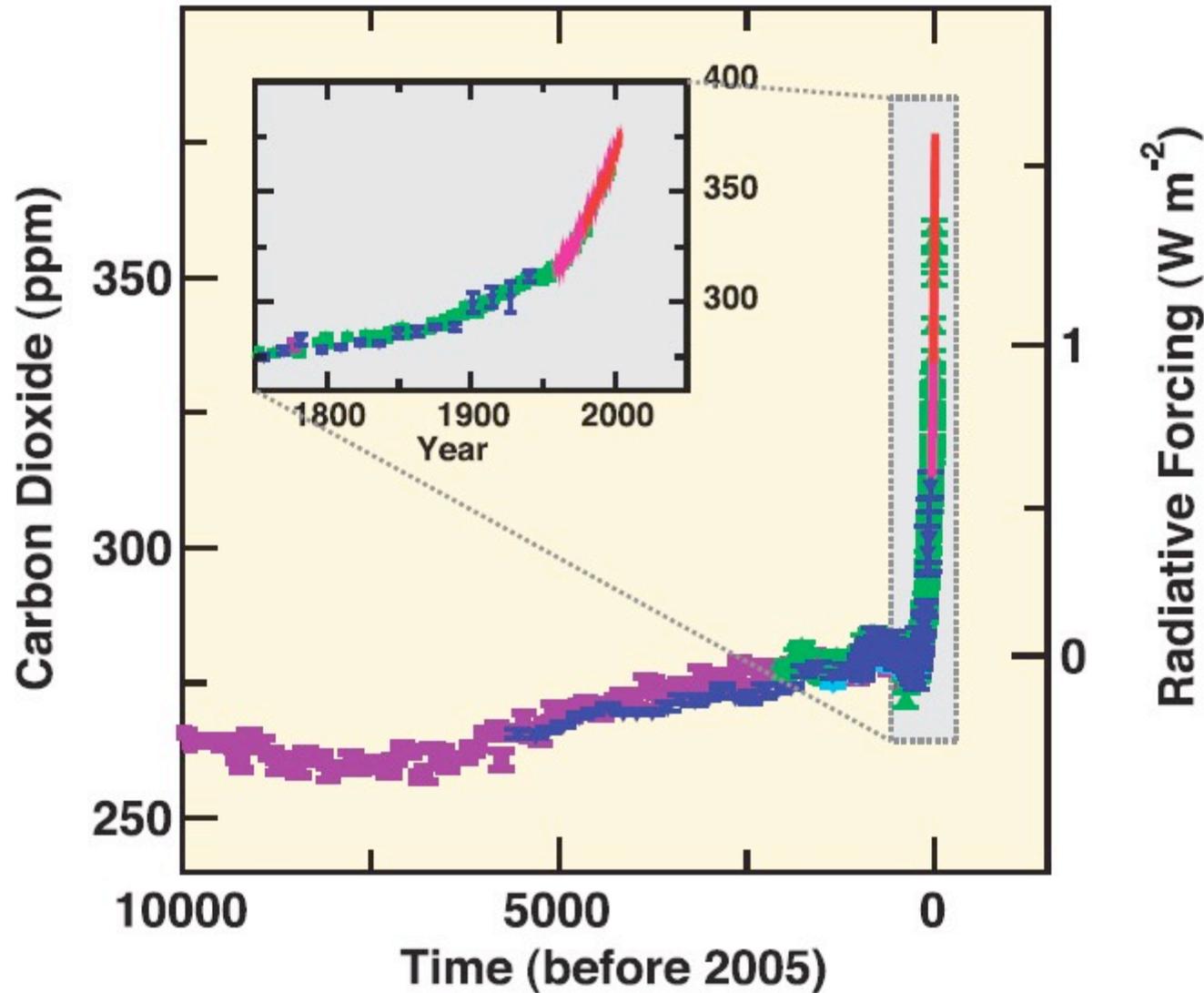
Rapid Innovation and Growth in Renewable Energy

Jessika E. Trancik
Engineering Systems Division, MIT

September 25, 2014
Polytechnique Montréal

Seminar hosted by:
Trottier Institute for Sustainability in Engineering and Design, McGill University
Trottier Energy Institute, École Polytechnique de Montréal

climate change risks



150th anniversary of John Tyndall's conclusion that carbon dioxide traps heat



images from AP



images from Washington Post, Aug. 2013

Texas wildfires: Is drought the new climate?

September 7, 2011 | 5:08 pm

✉ AA

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image from NASA



image from AP

Relocation of Alaska's sinking Newtok village halted

Setback for tribal communities threatened by climate change as government freezes funding over local political dispute

Suzanne Goldenberg, US environment correspondent



theguardian.com, Monday 5 August 2013 08.00 EDT

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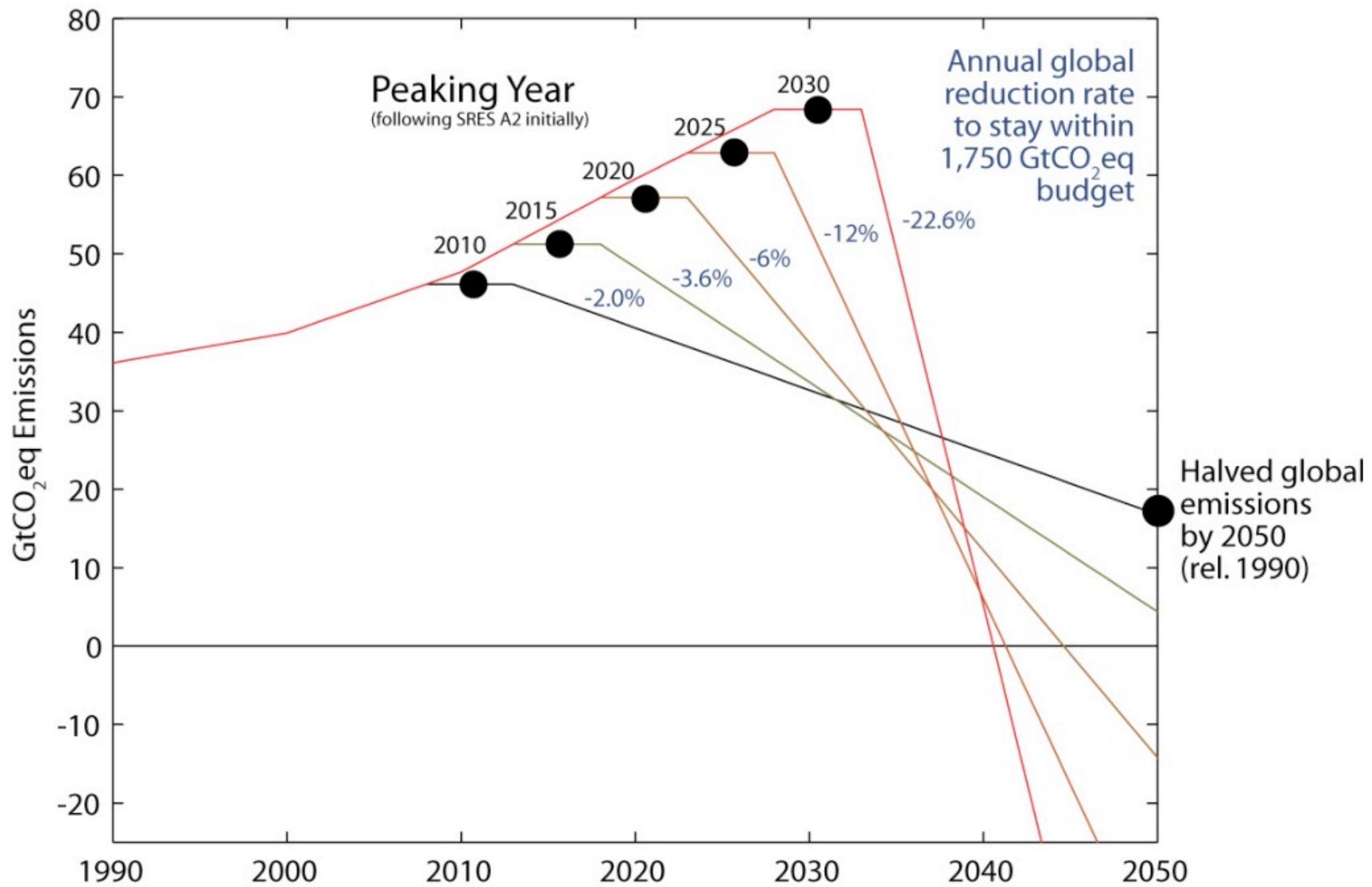


An aerial view of Newtok, Alaska where the eroding bank along the Ninglick River has long been a problem for the village. Photograph: Al Grillo/AP



image from The Guardian: Newtok village, Alaska

climate change mitigation



- Parliament's back
- Franklin expedition
- Sable Islar
- Northern li

Global CO2 emissions break record ahead of UN Climate Summit

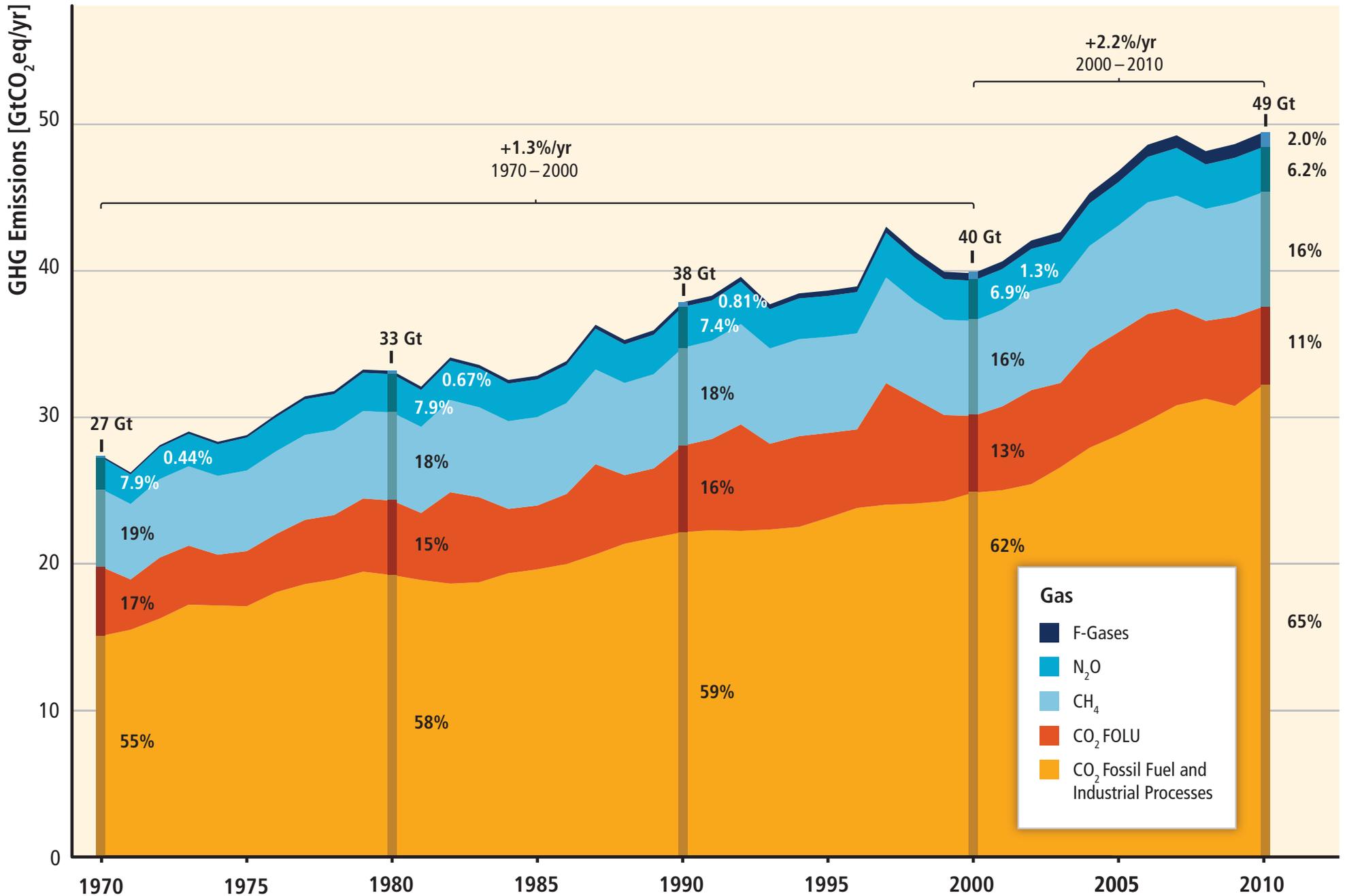
Top carbon emitters China, U.S. and India all show jumps in emissions, Canada 10th in world

The Associated Press | Posted: Sep 22, 2014 9:58 AM ET | Last Updated: Sep 22, 2014 2:12 PM ET



Sept. 22, 2014

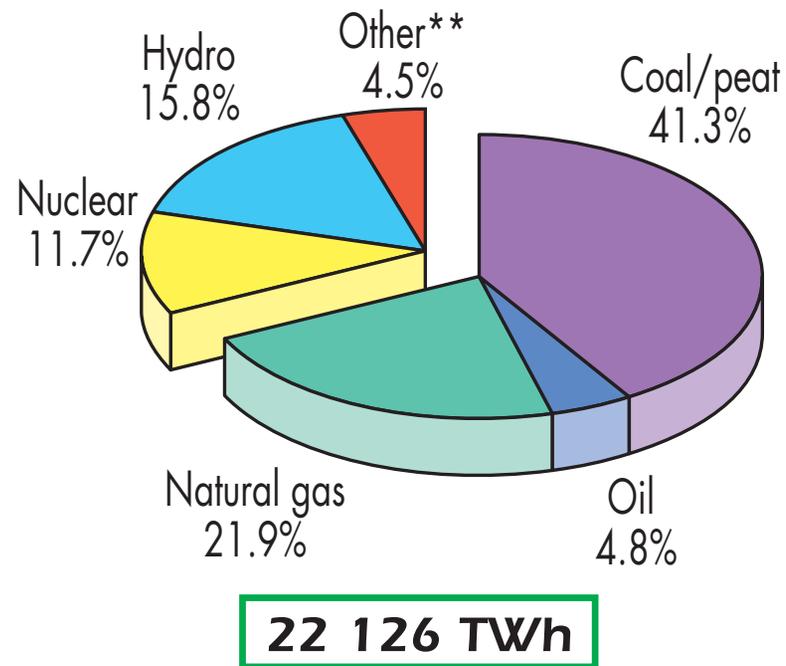
Total Annual Anthropogenic GHG Emissions by Groups of Gases 1970–2010



role of renewables

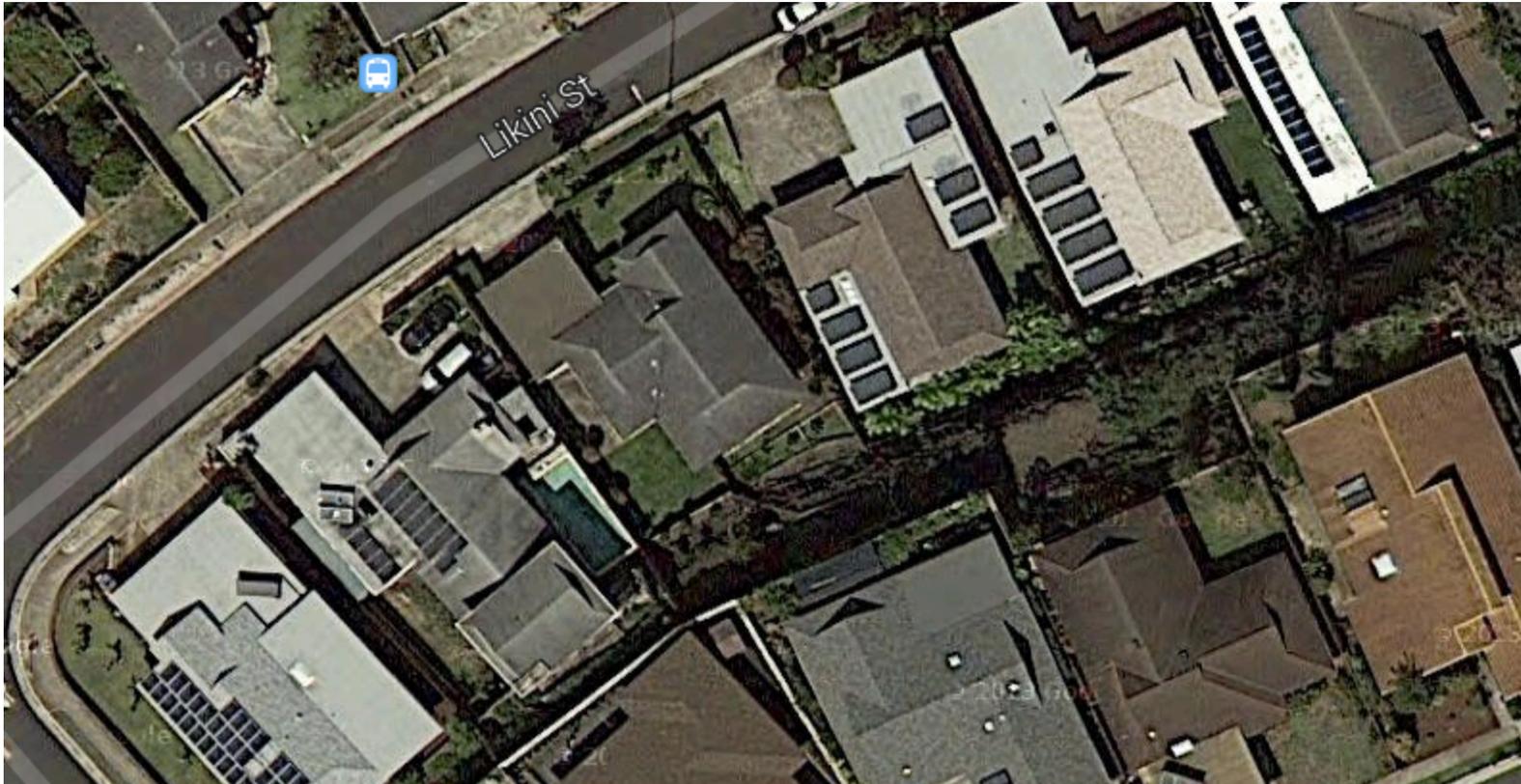
Global electricity

2011

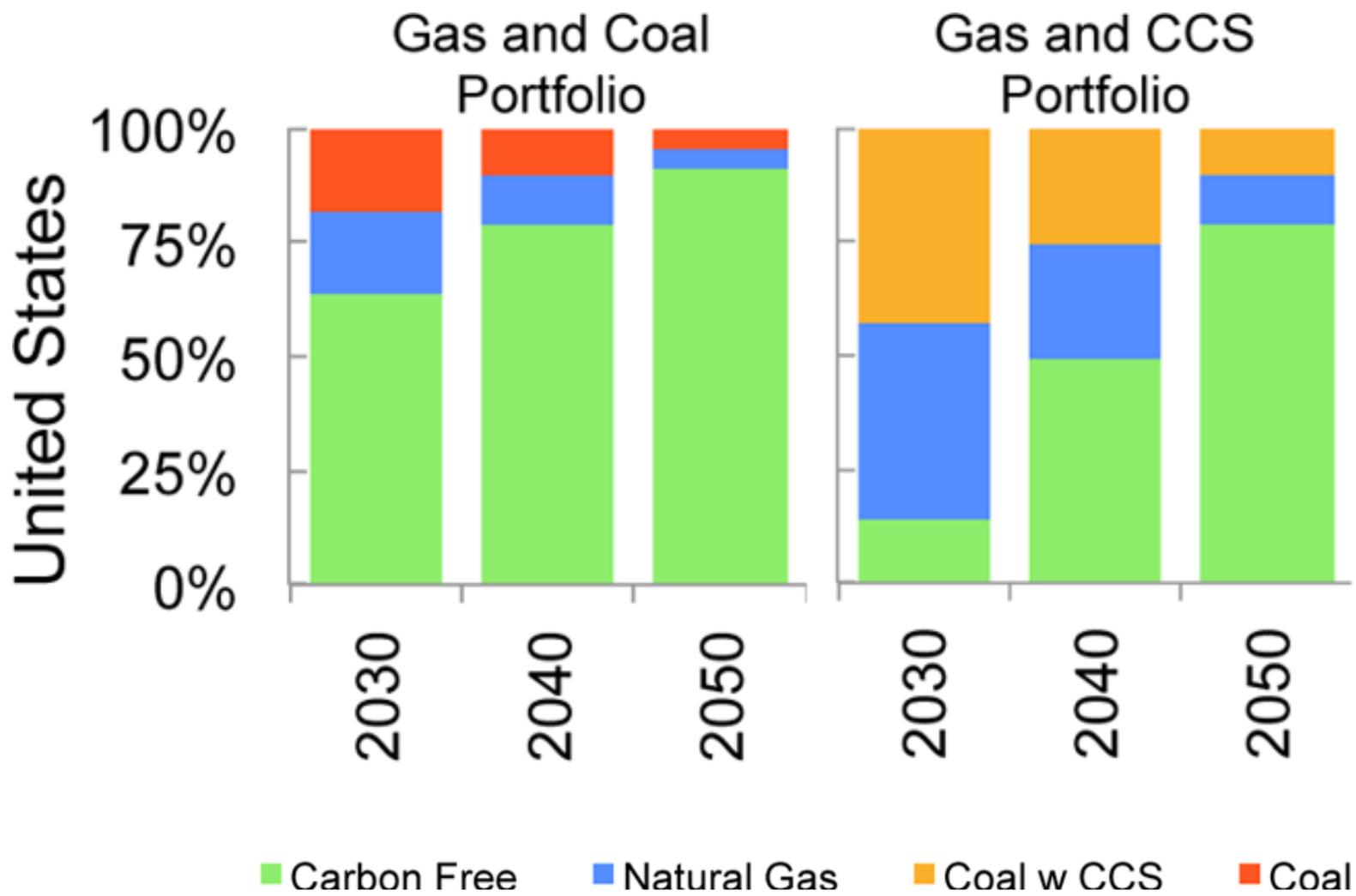


***Other includes geothermal, solar, wind, biofuels and waste, and heat.*

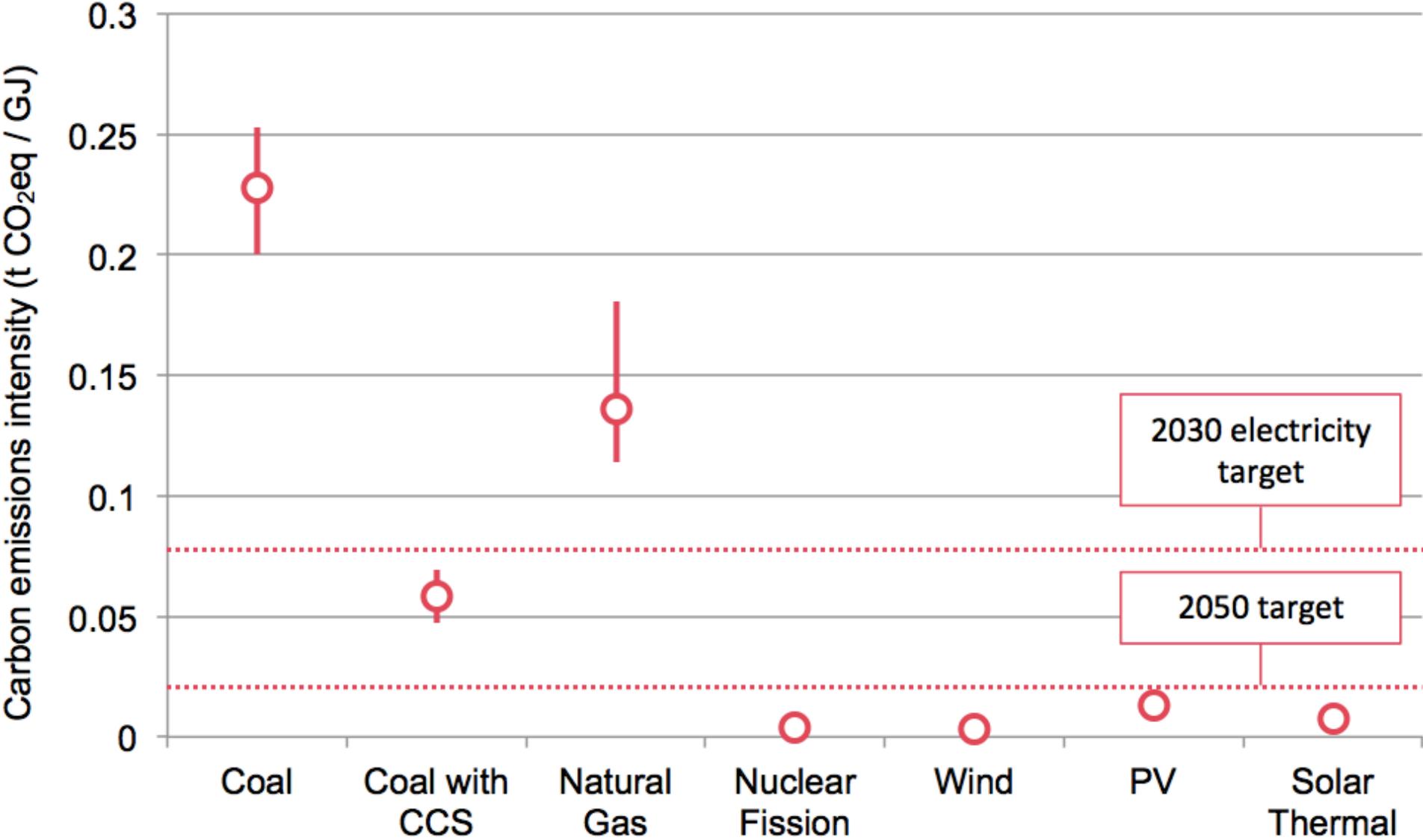
solar panels

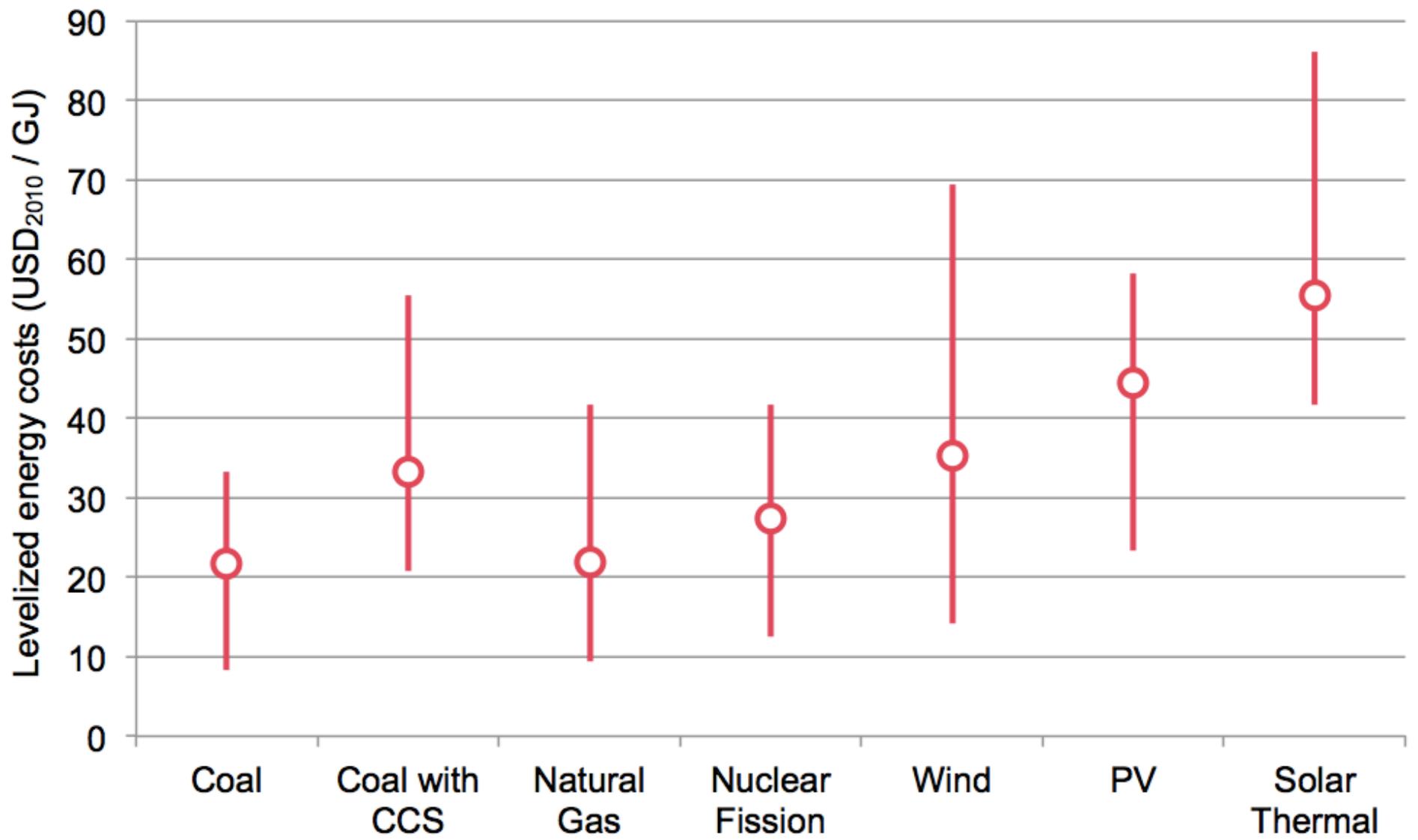


randomly selected Honolulu neighborhood

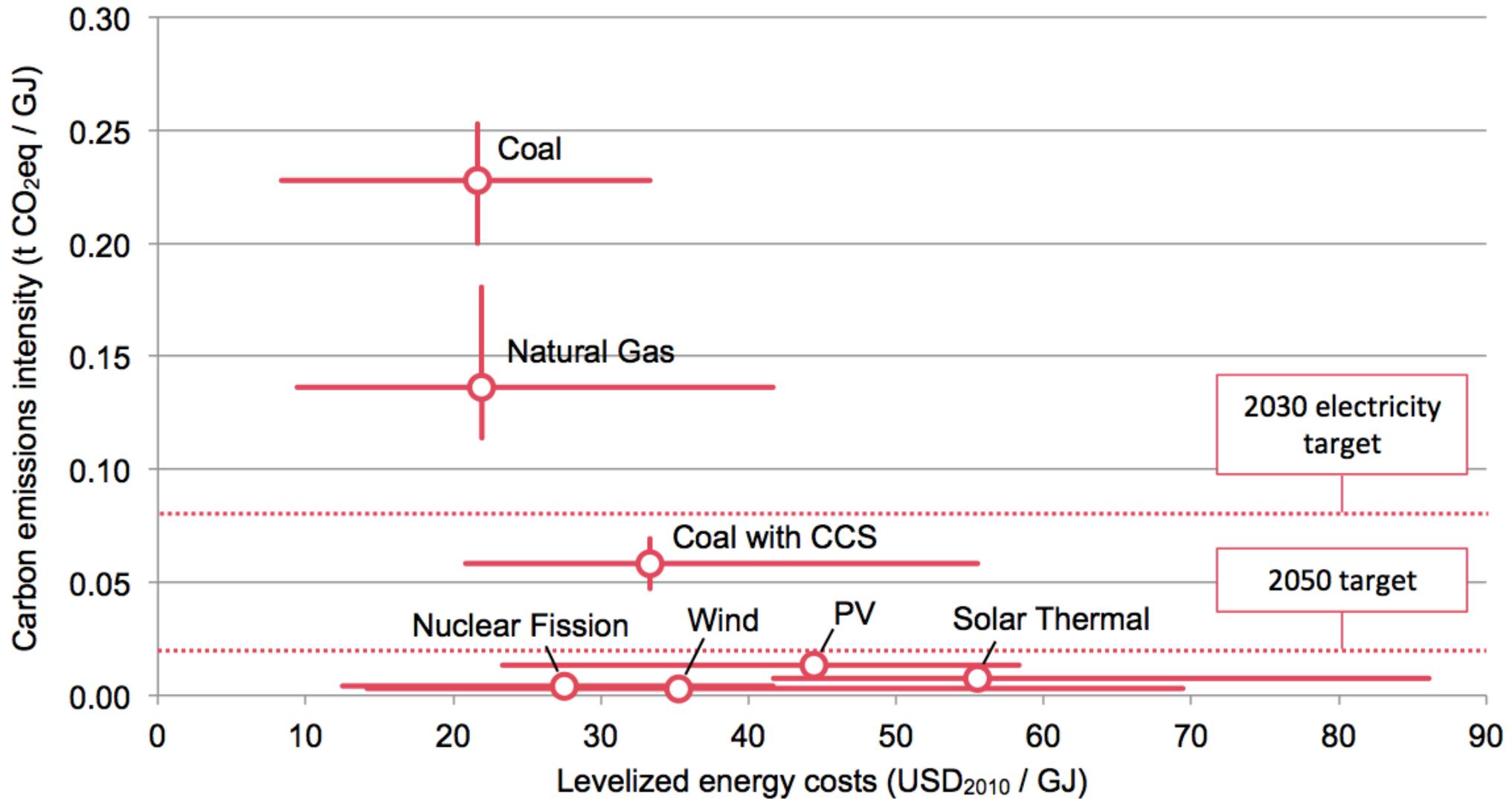


U.S. carbon intensity target





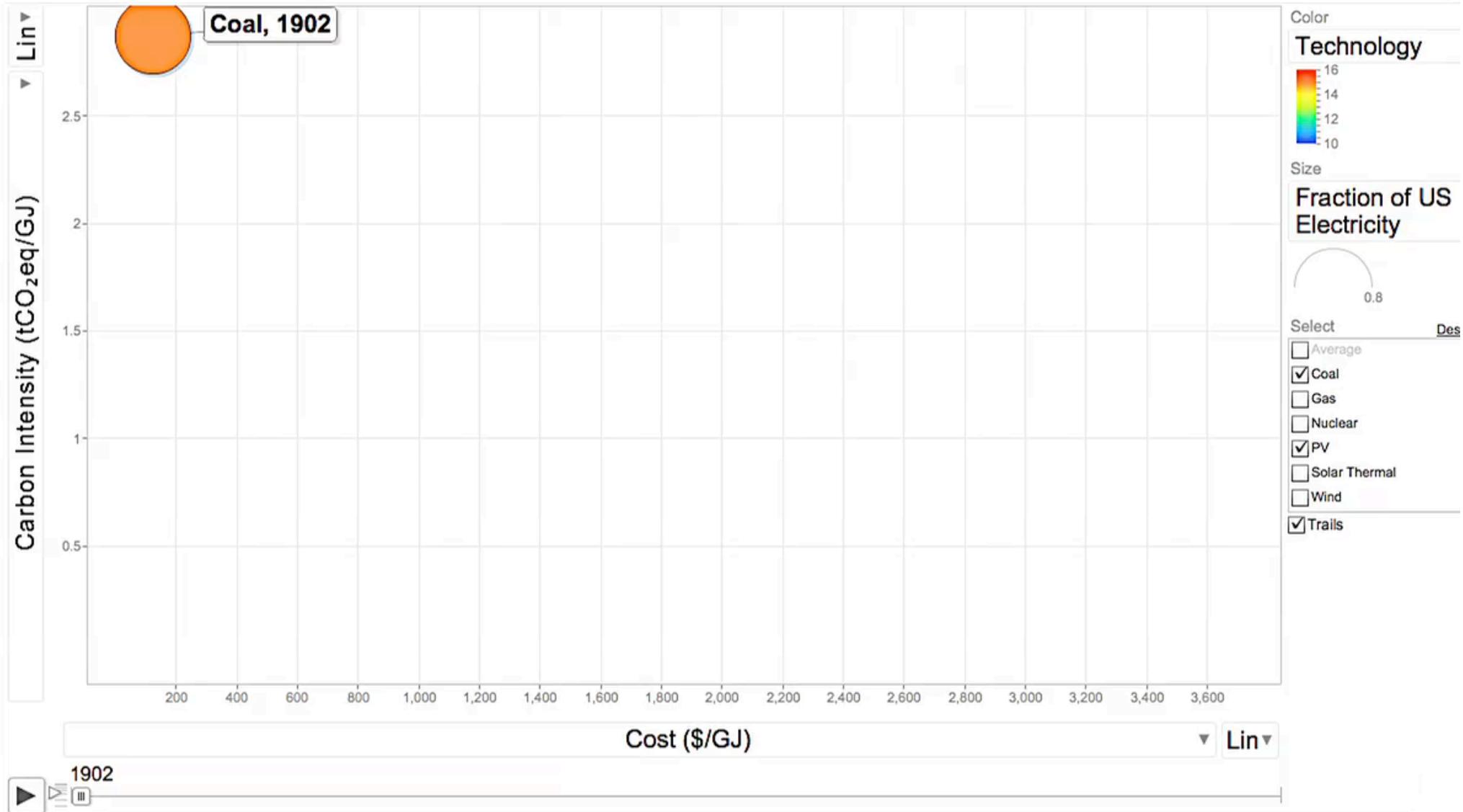
Cost-carbon curve

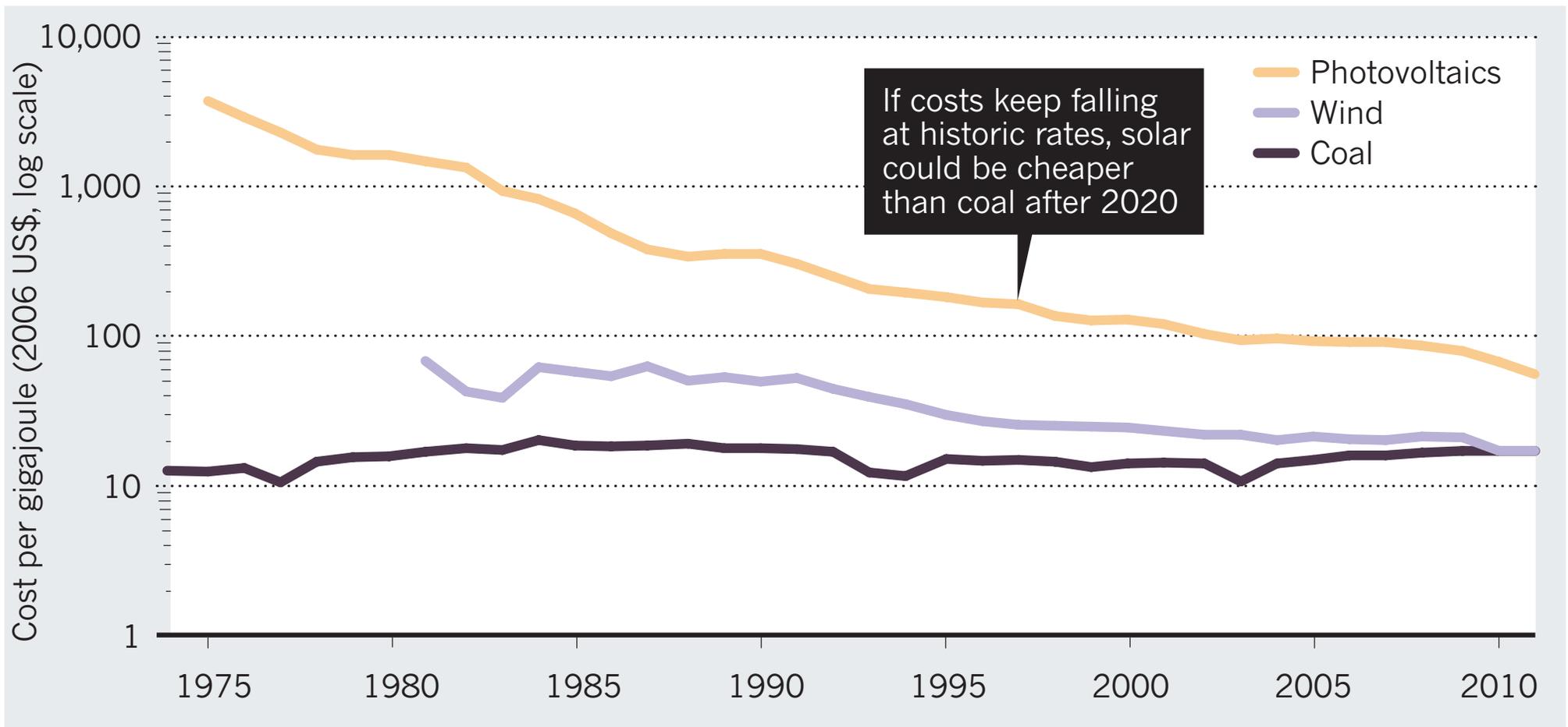


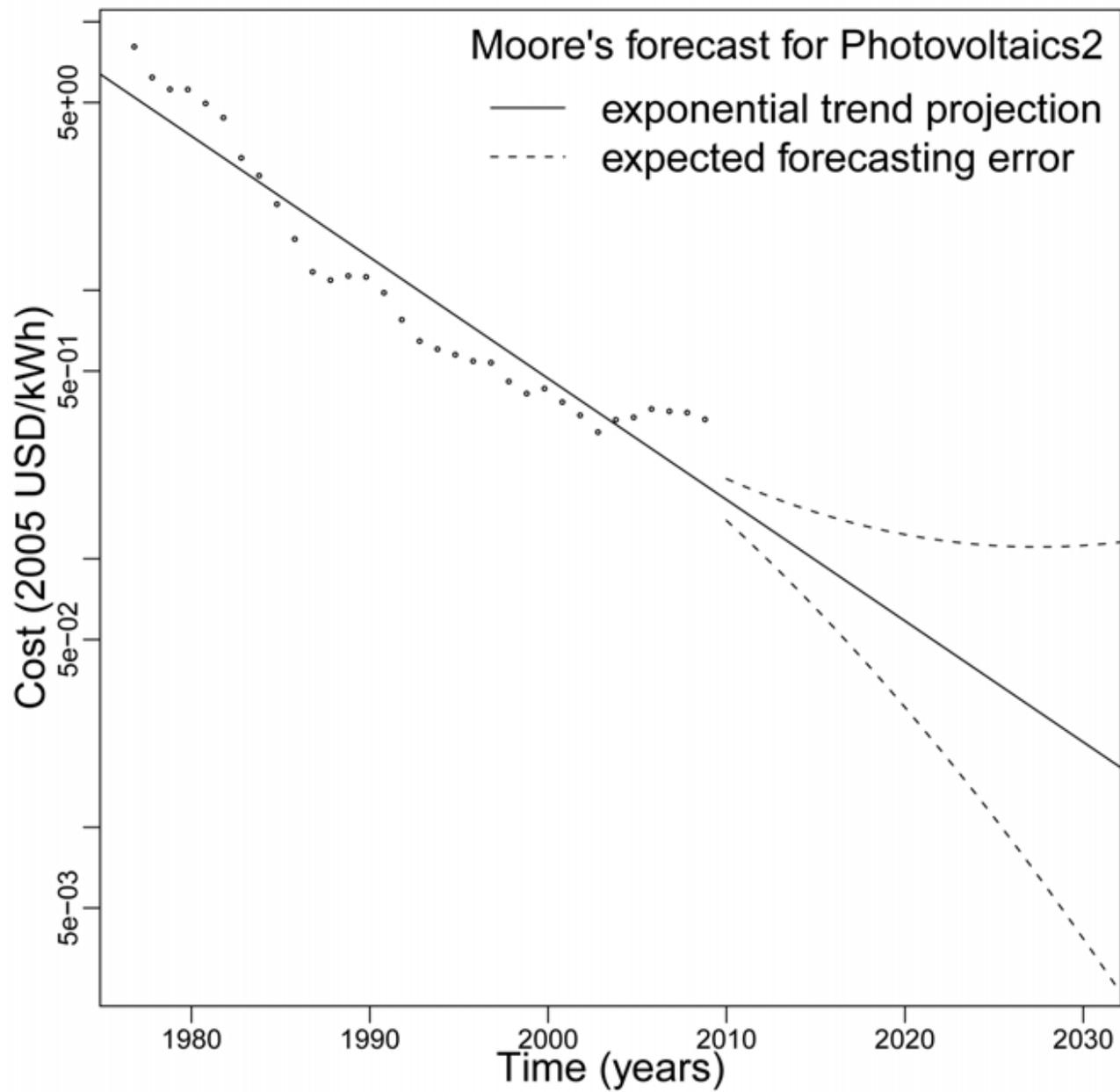
Trancik, *Nature*, 2014

Trancik, Cross-Call, *ES&T*, 2013

Dynamic cost-carbon curve







nature

International weekly journal of science

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NATURE | NEWS



Moore's law is not just for computers

Mathematical laws can predict industrial growth and productivity in many sectors.

Philip Ball

05 March 2013



1975



today

*100 times the power for the same price!
(inflation adjusted dollars)*

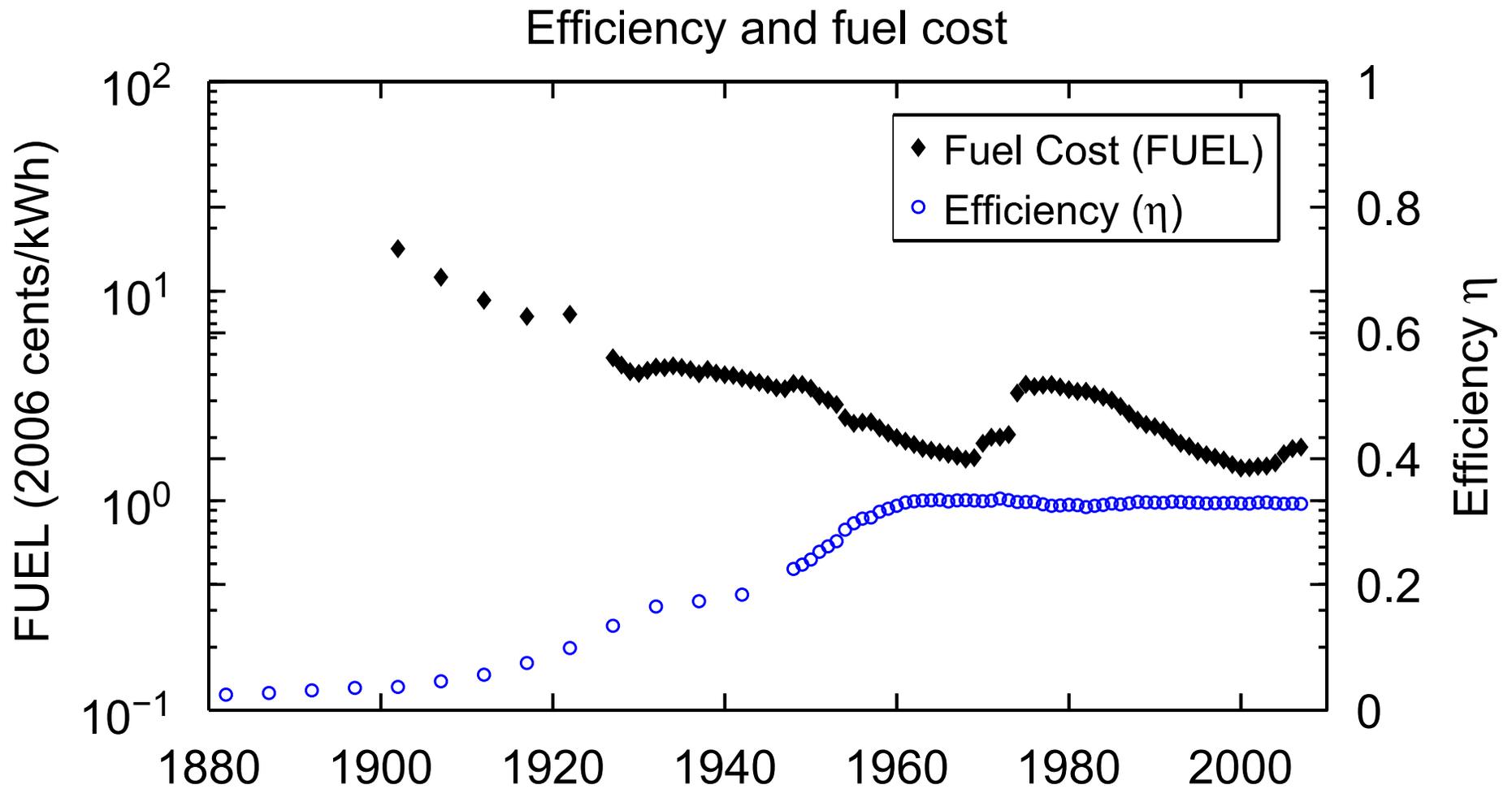
Explanation for photovoltaics rapid improvement?

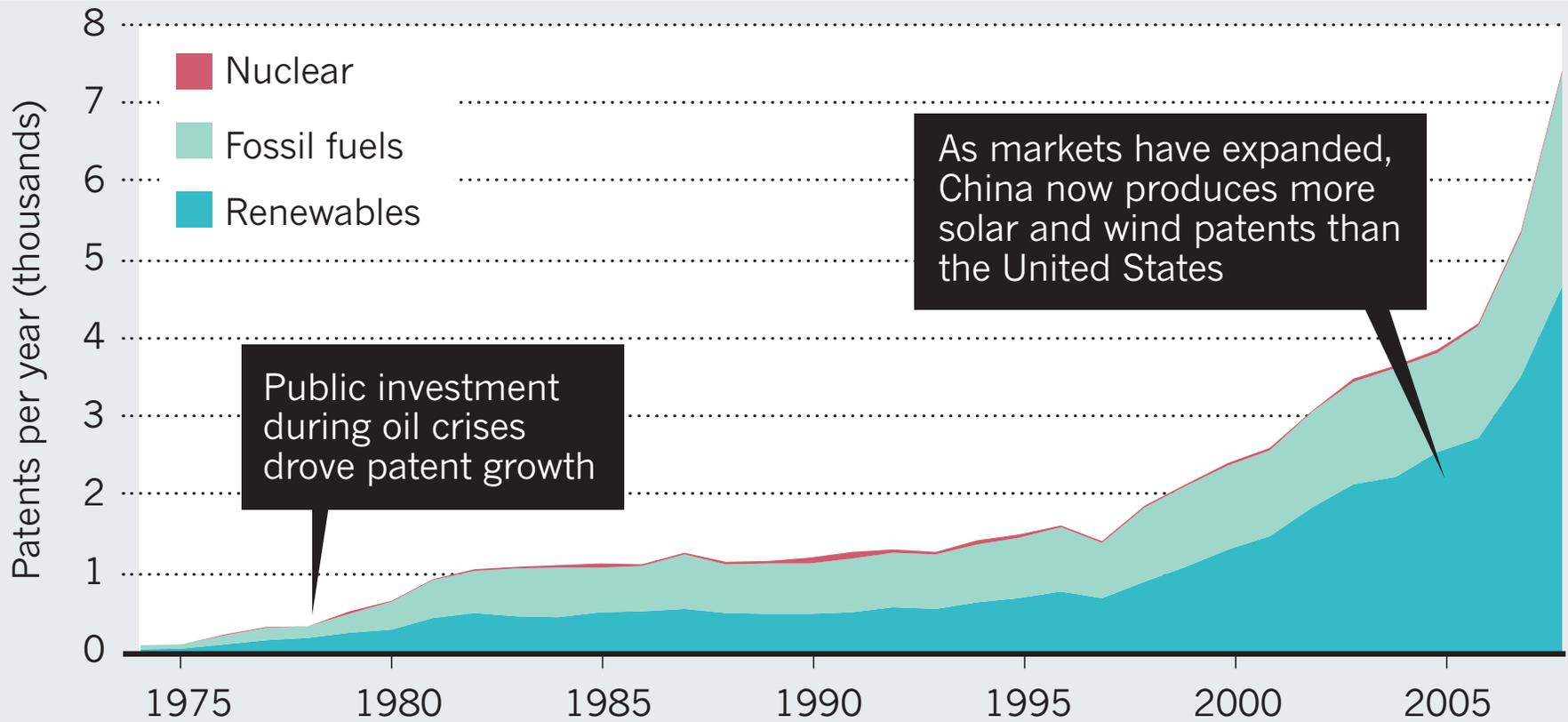
- small unit scale
- raw material a small fraction of total costs

Trancik, *ERL*, 2006

McNerney, Farmer, Trancik, *Energy Policy*, 2011

U.S. coal-fired electricity



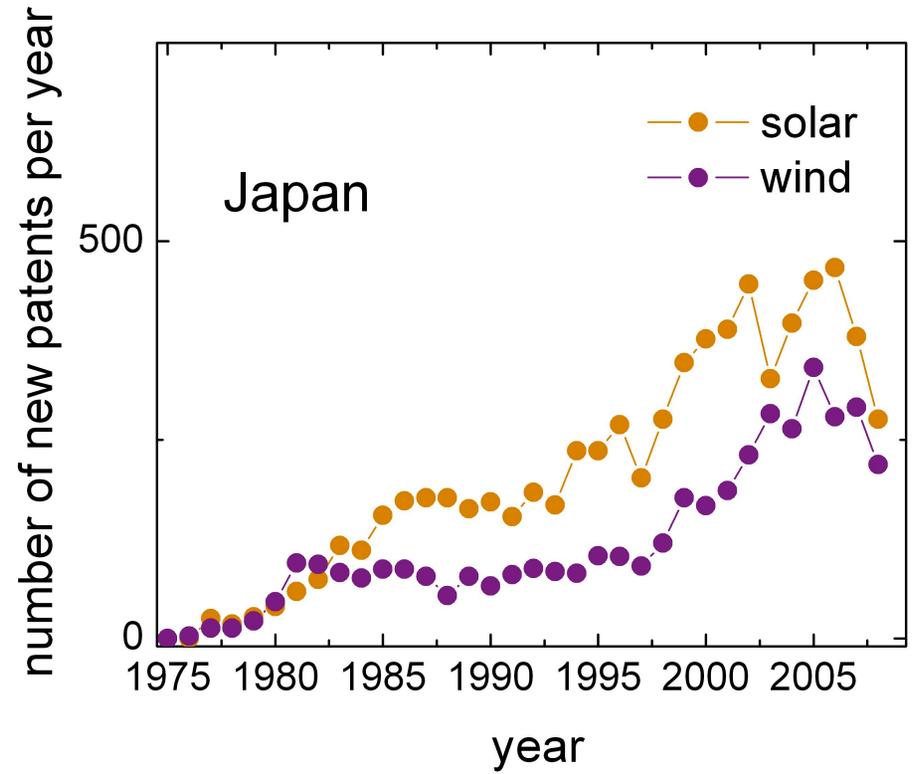
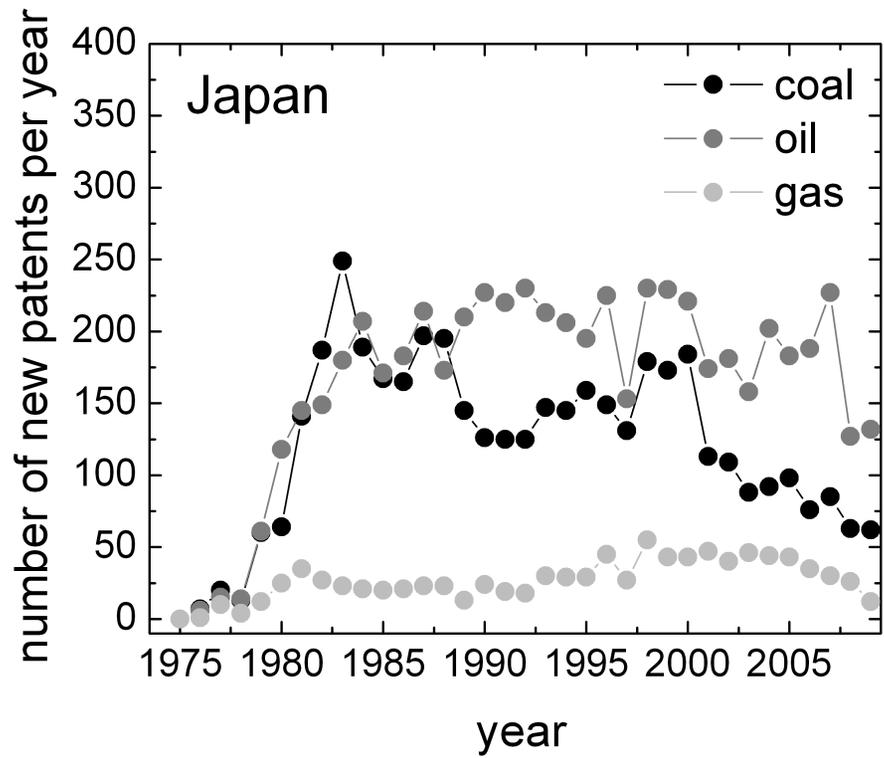


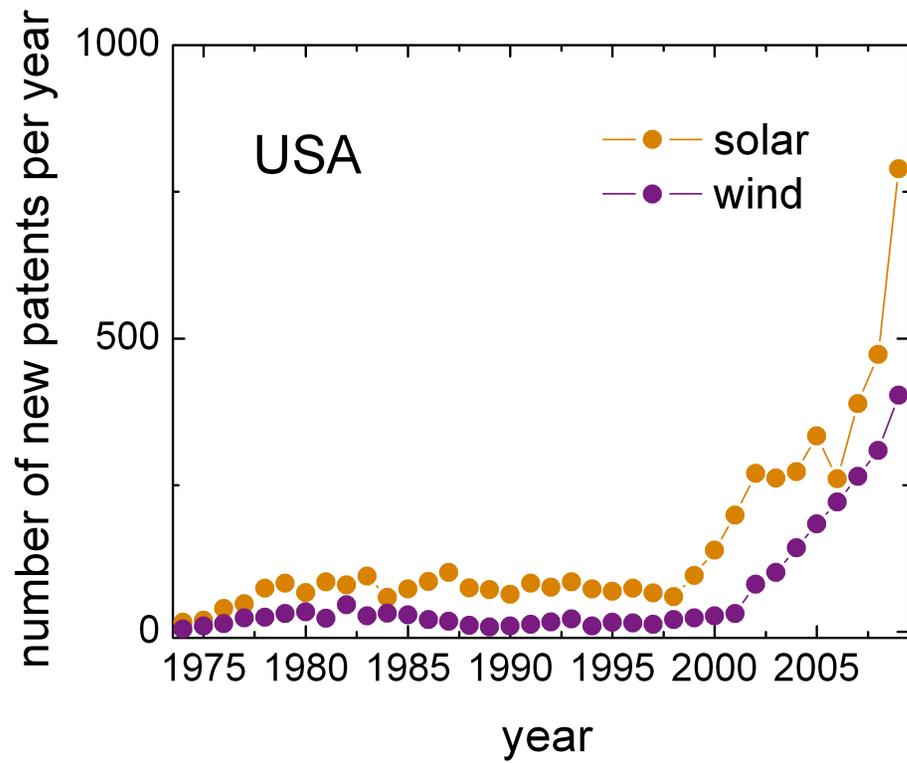
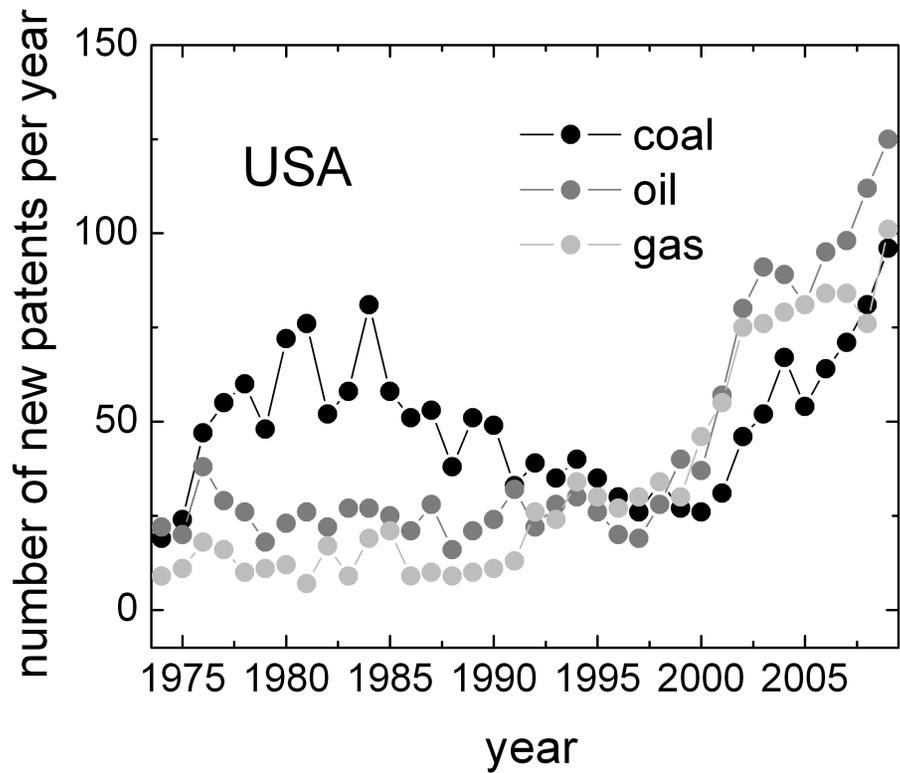
Solar and wind innovation reflected in booming patents

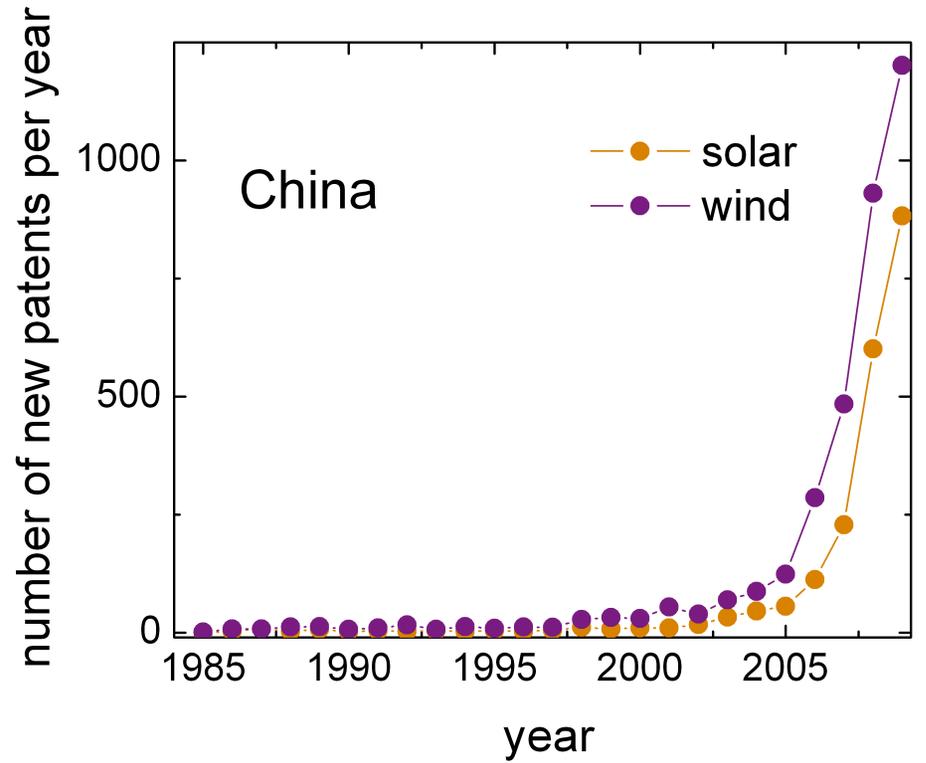
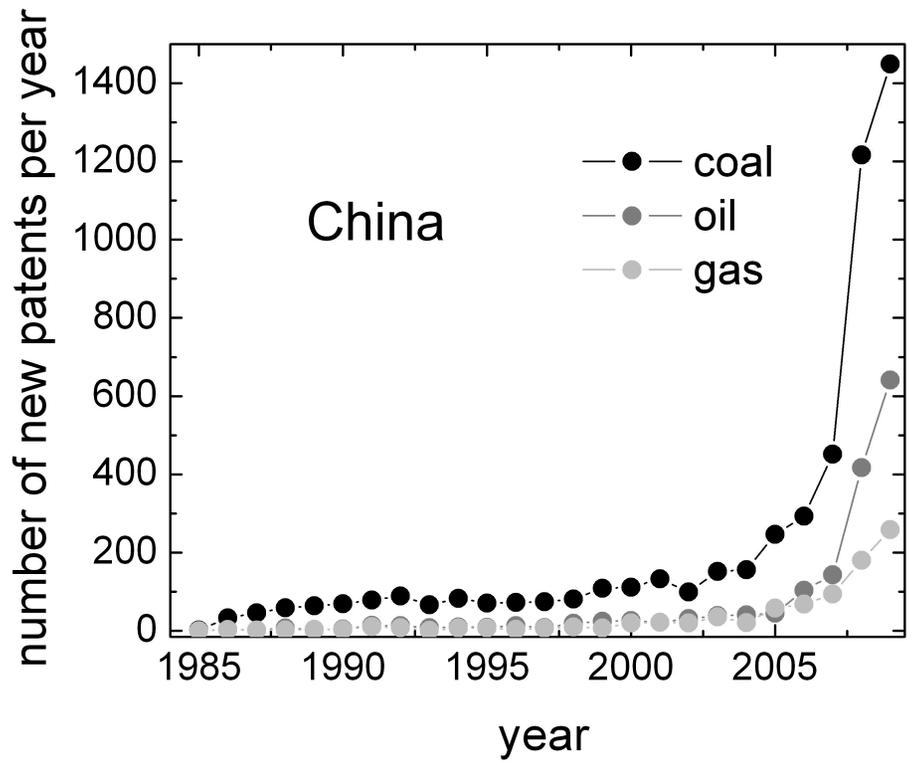
Wendy Koch, USA TODAY

11:12 a.m. EST November 27, 2013

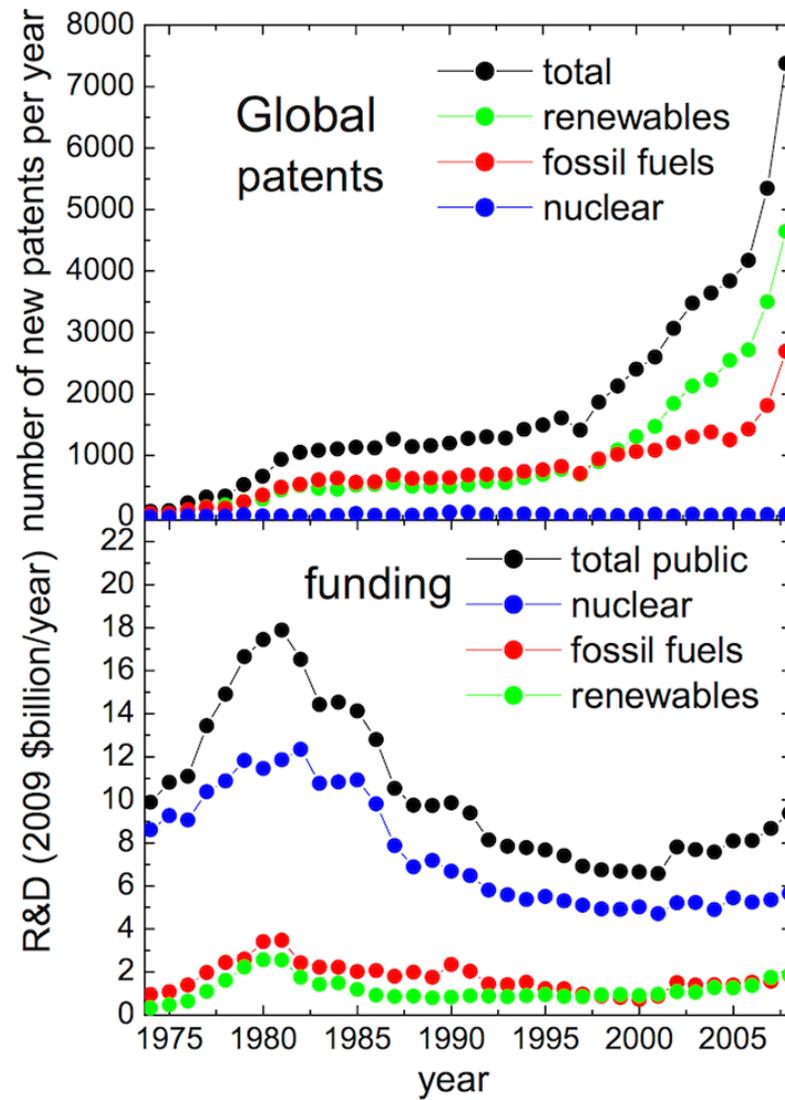
Innovation in solar, wind and other renewable power is booming worldwide, especially in China, and is now eclipsing that in fossil fuels — an about-face that occurred in just one generation, new research shows.







Role of policy



Examples of segmental policies

region	supply-side policies
China	Target: 15% of electricity from renewables by 2020; 15 GW solar and 70 GW wind by 2015 (passed). Policy framework: Five- Year Plan; Feed-in tariffs (passed). ³⁷
European Union	Target: 20% of electricity to come from renewable resources by 2020 (passed). ³⁸
India	Target: 20 GW of solar capacity by 2022. Policy framework: National Solar Mission (passed). ⁴¹
United States	Target: Clean Energy Standard to meet 80% of electricity demand with clean energy by 2035 (proposed). ^{8,15,16}



A solar power plant on a former military air base in Finowfurt, Germany.

Back the renewables boom

Low-carbon technologies are getting better and cheaper each year, but continued public-policy support is needed to sustain progress, says **Jessika E. Trancik**.