



A Square-Off on Nuclear Policy



RESOLVED: Retaining nuclear capacity is necessary to secure a reliable, cost-effective, low-emissions supply of electric power in the United States.

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Clean Energy *Emergency*

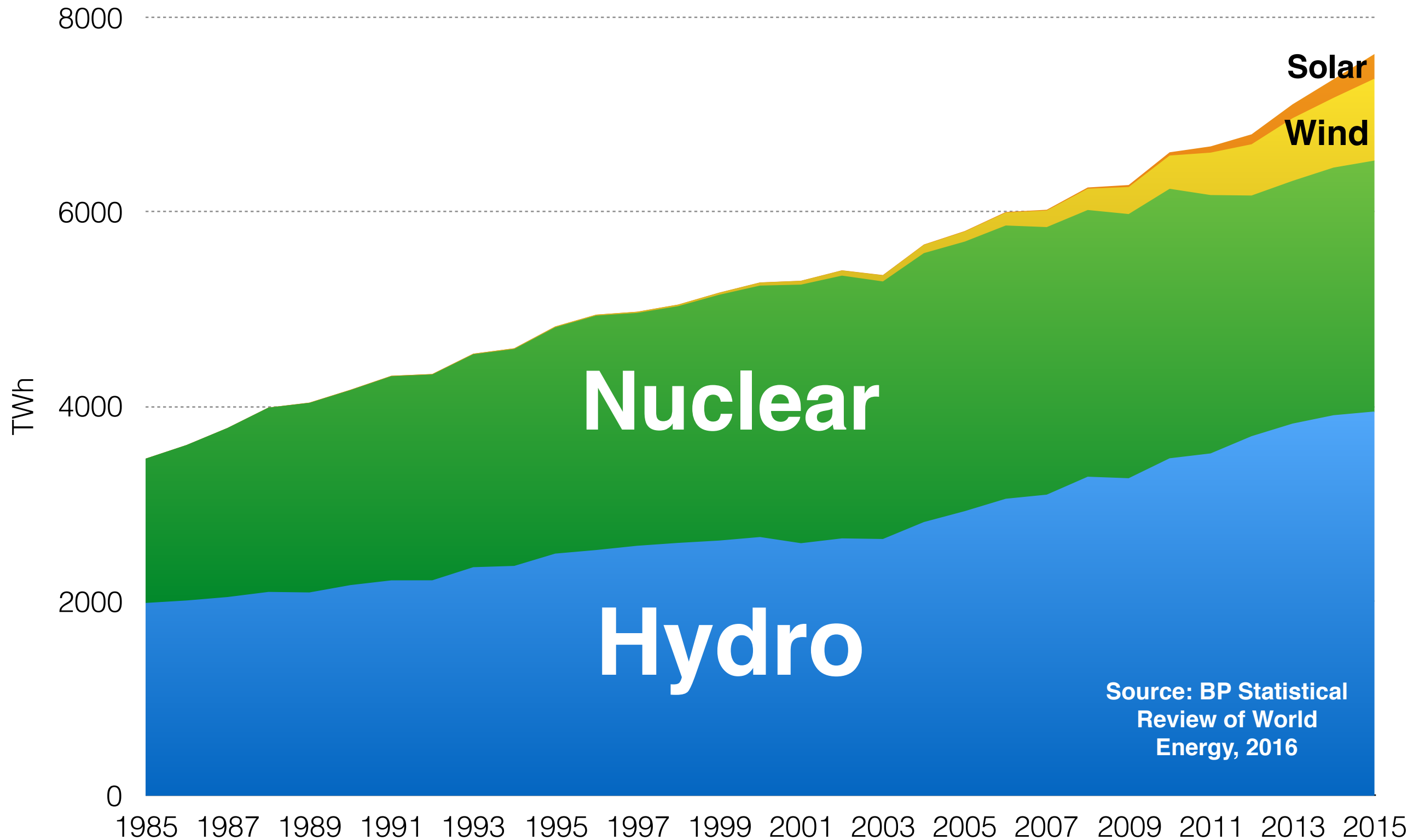
by Michael Shellenberger
Updated Nov. 1, 2016



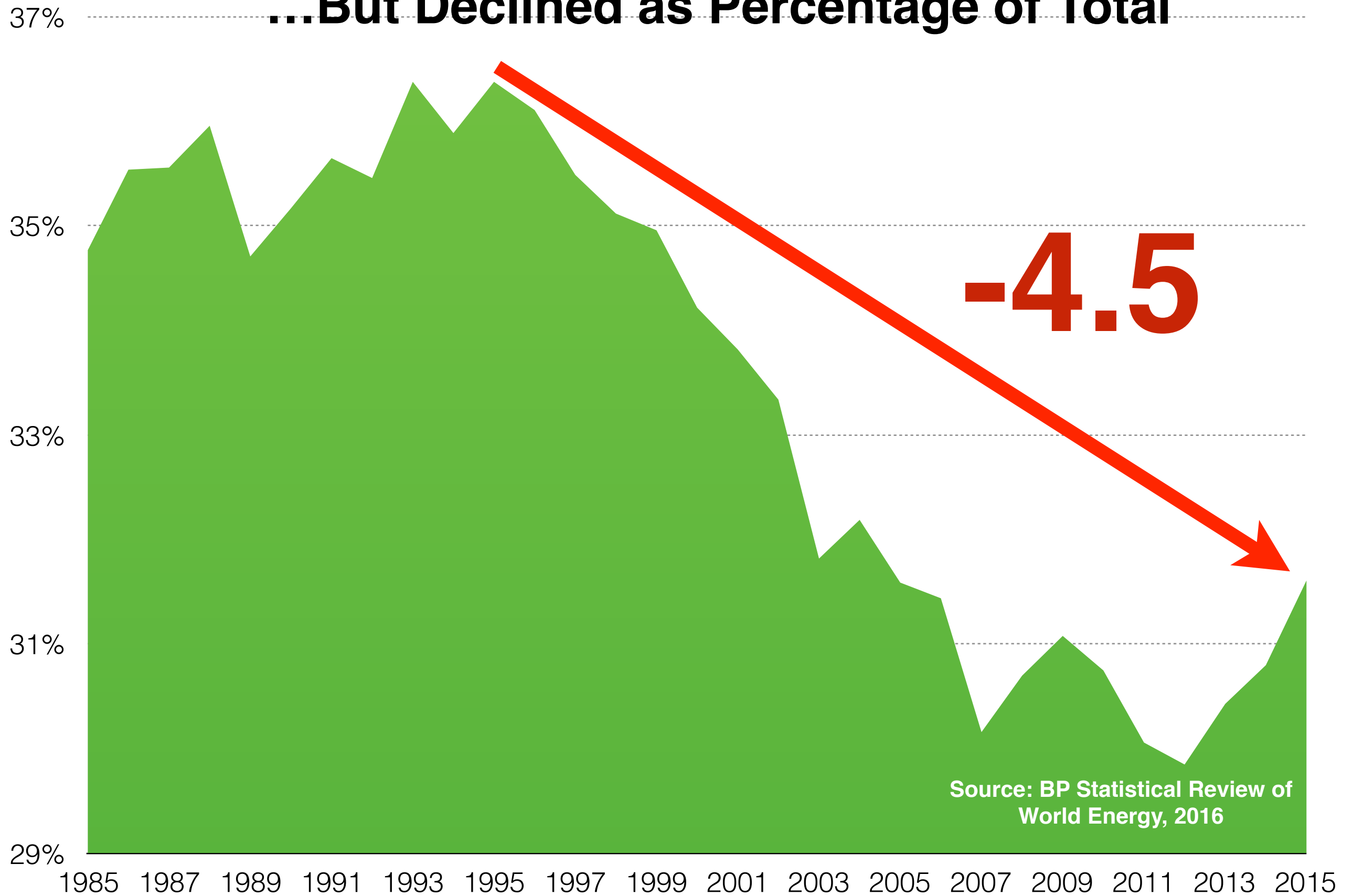
Environmental Progress
nature and prosperity for all

1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015

Low-Carbon Power Has Grown in Absolute Terms...



...But Declined as Percentage of Total



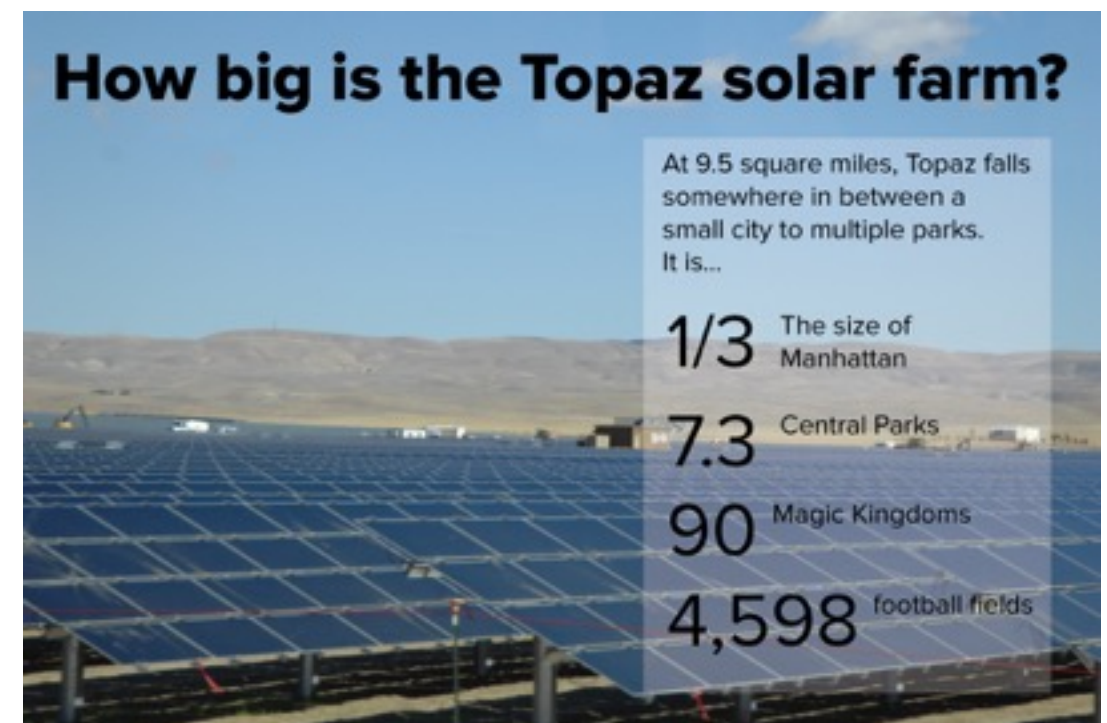
Source: BP Statistical Review of World Energy, 2016

**4.5 percentage points of global
electricity =**

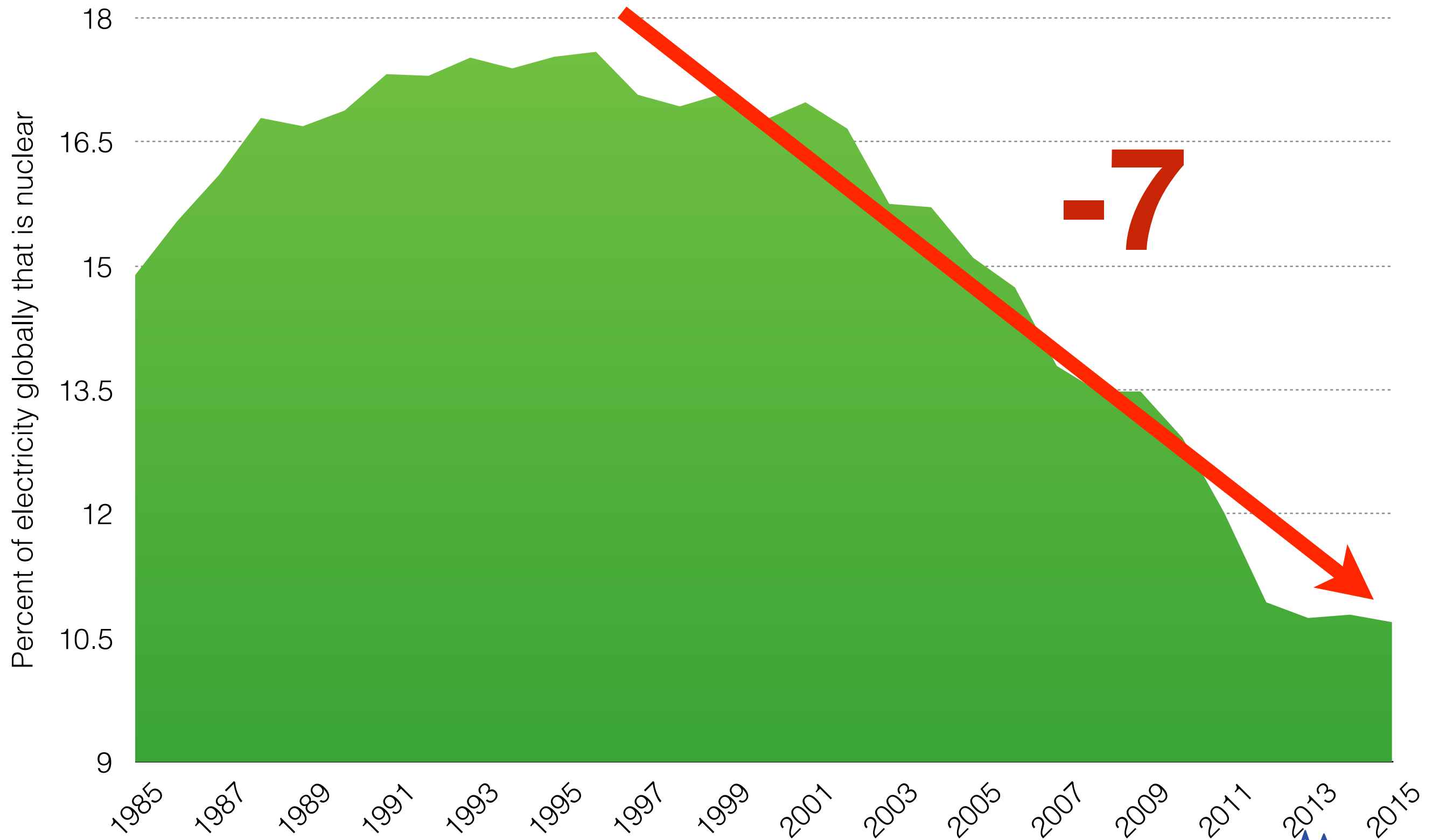
**60 nuclear plants the size
of Diablo Canyon**

or

**900 of one of largest solar
farms (Topaz, in California)**

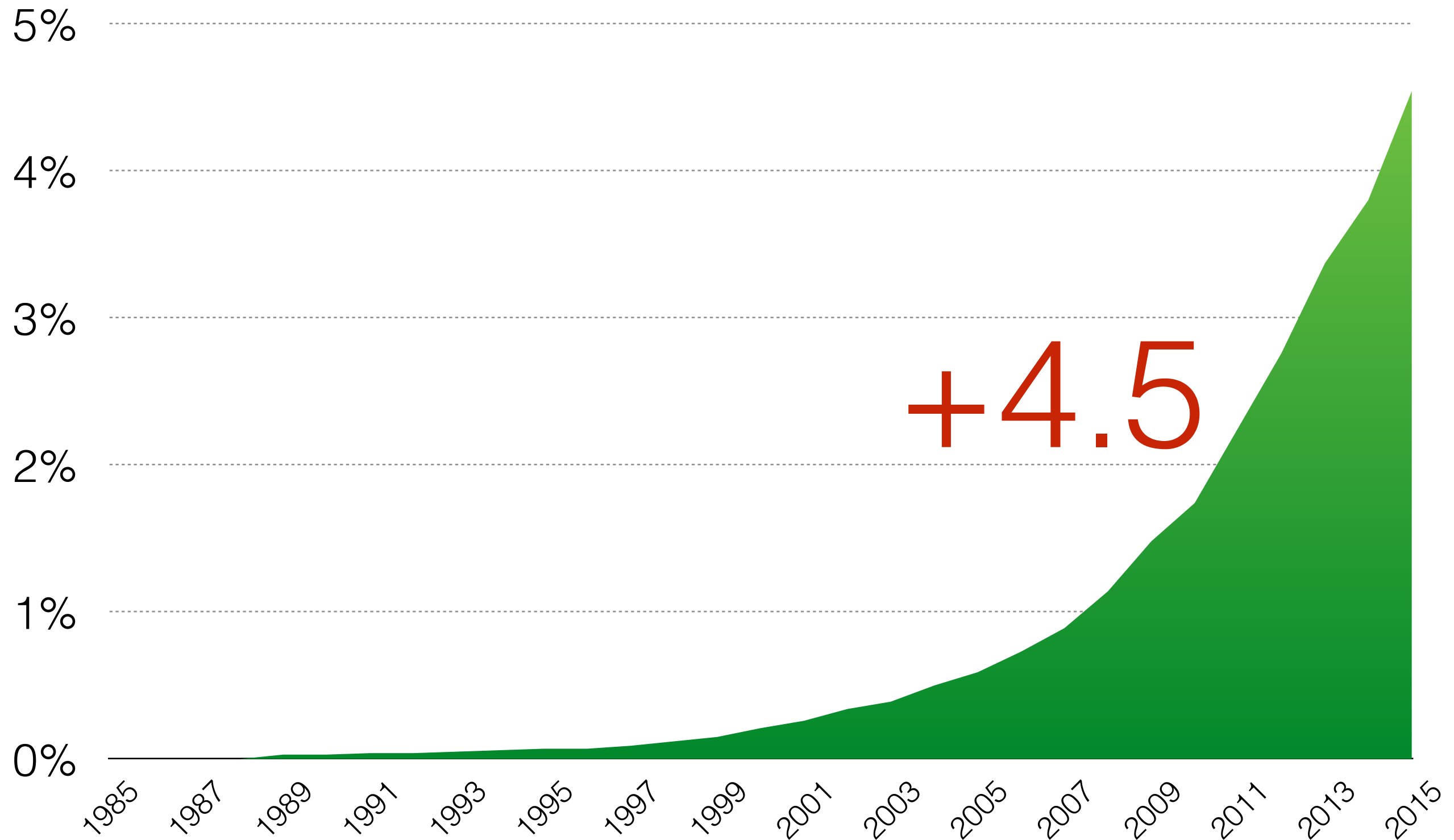


Declining power from nuclear energy...



Source: BP Statistical Review of World Energy, 2015

...was not made up by solar & wind



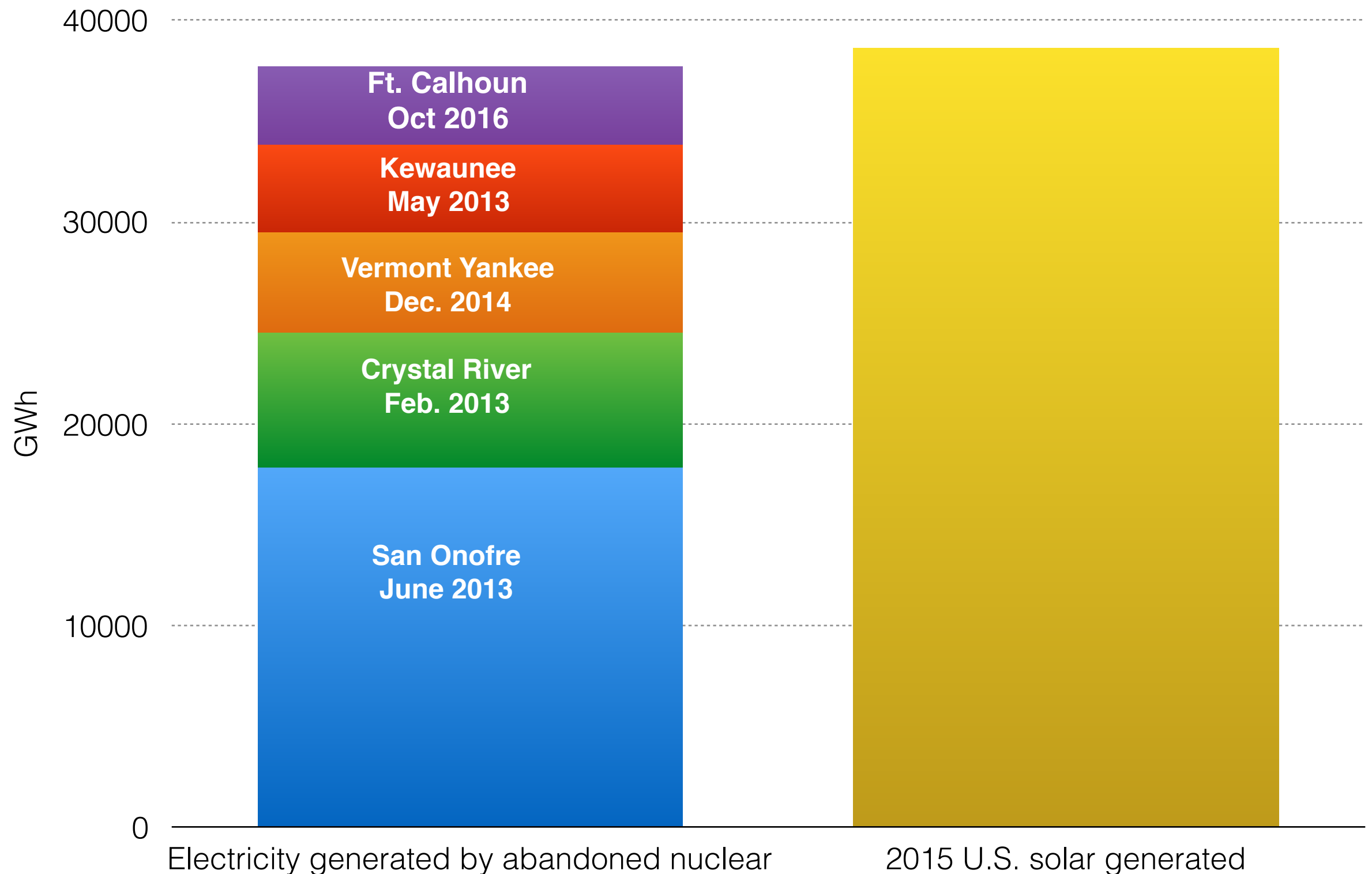
Source: BP Statistical Review of World Energy, 2015



Environmental Progress
nature and prosperity for all

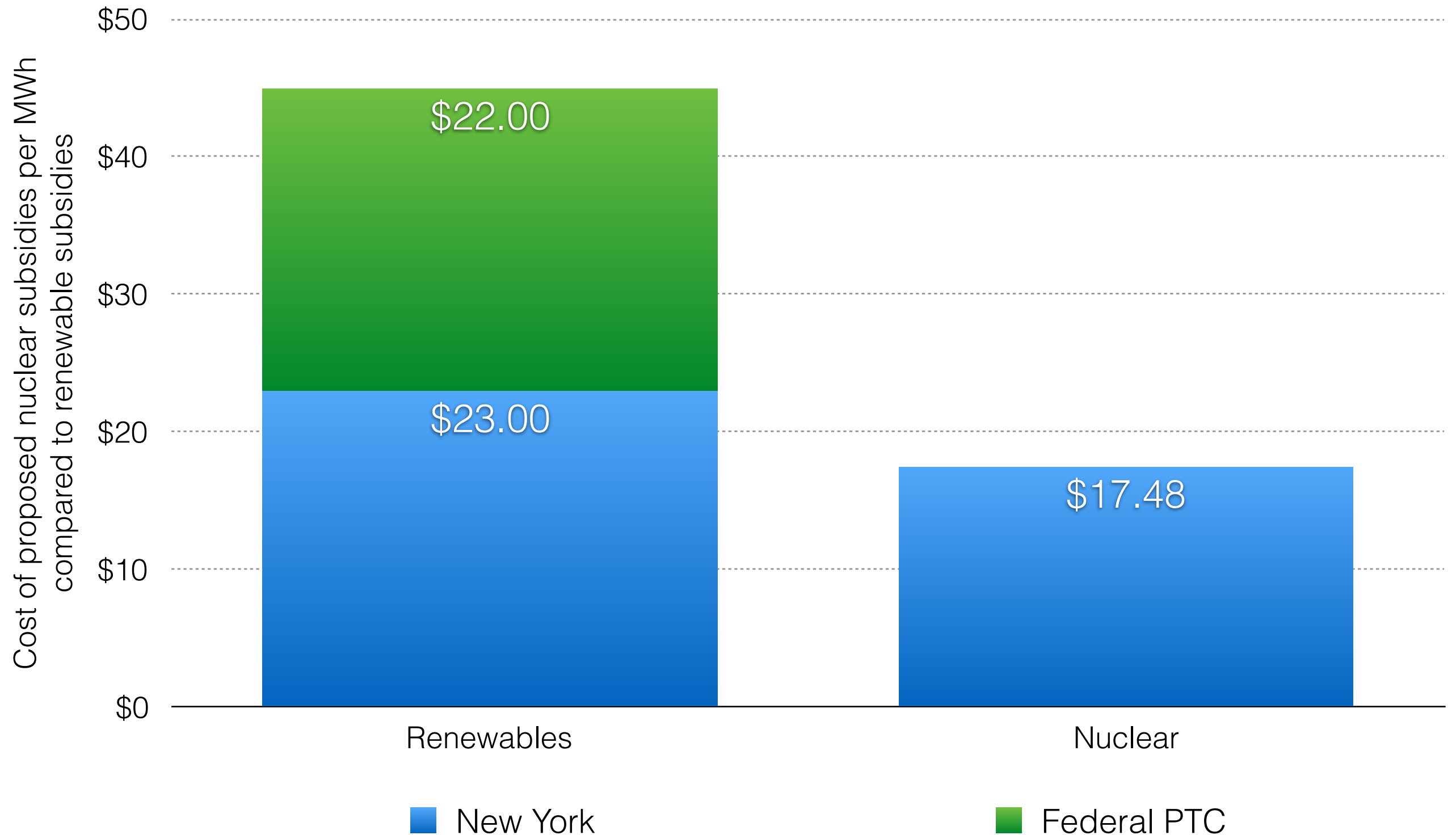
Over half of US nuclear fleet at risk of premature closure by 2030

Five Abandoned Nuclear Plants Generated Almost Exact Same Amount of Power as All US Solar



Source: EIA. Assumes 90% capacity factor

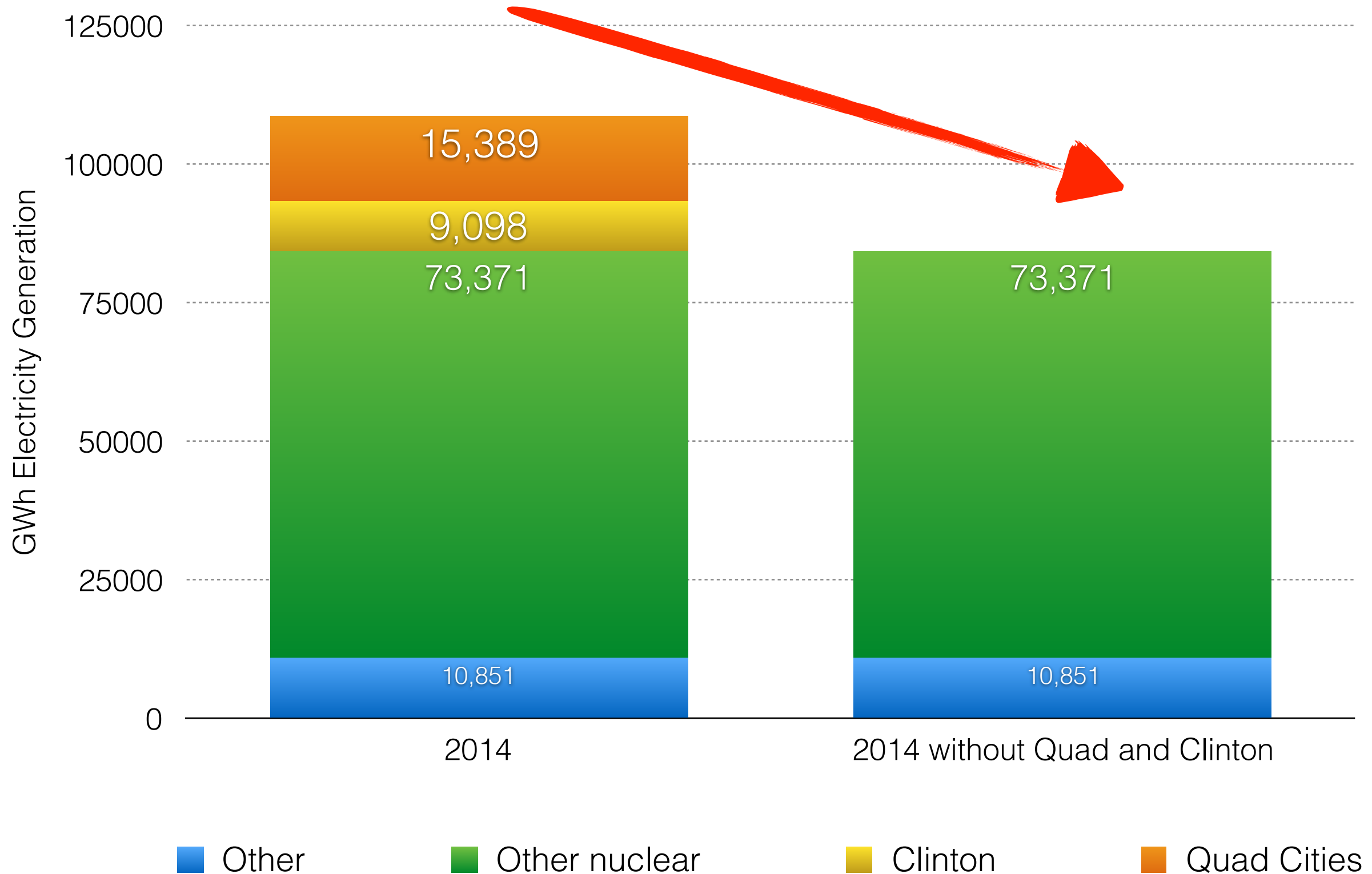
Renewables Subsidies 2x More Expensive than Proposed New York Nuclear Subsidies



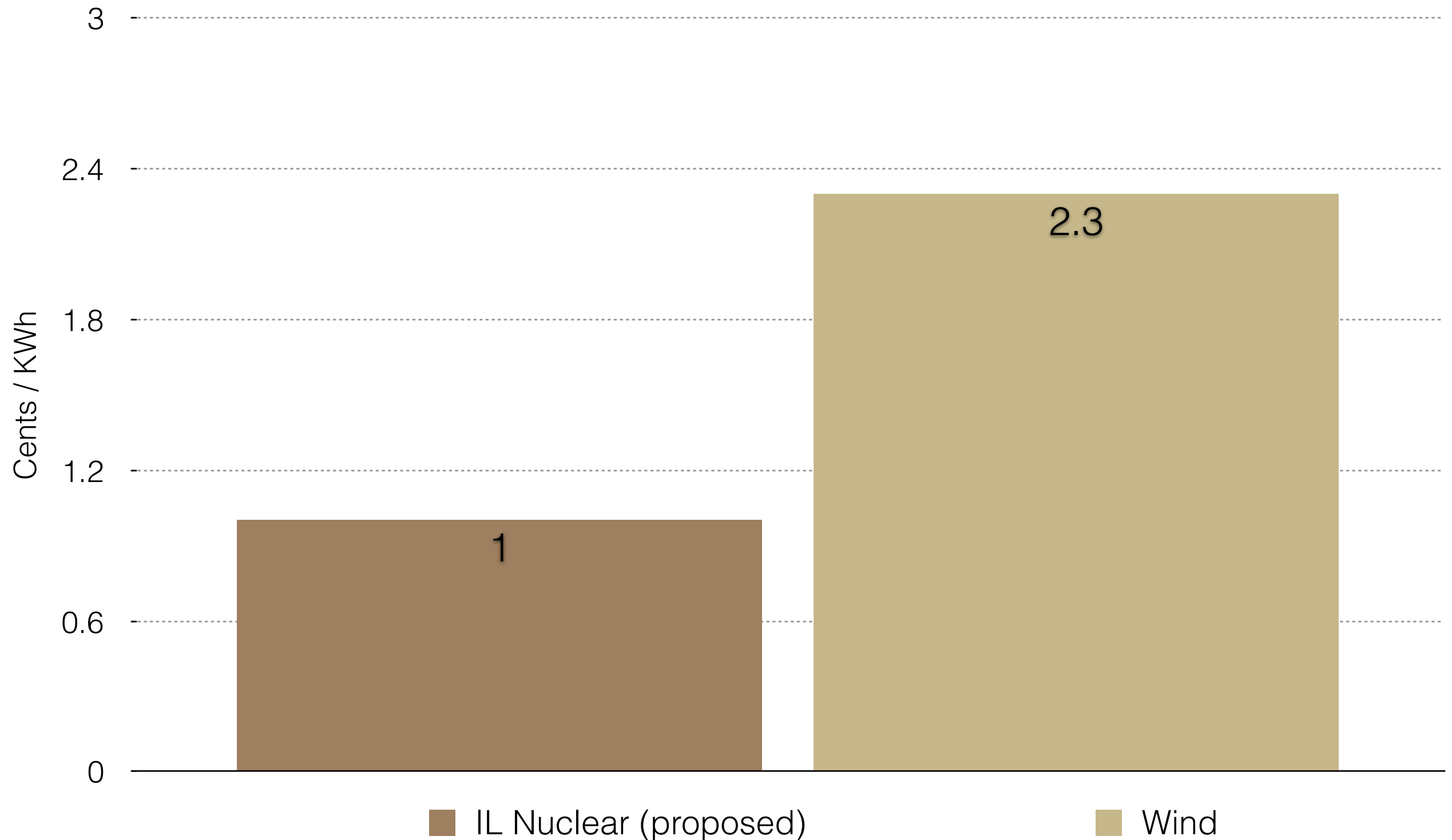
Source: NYSERDA, PSC

New York victory buys us time but
gives no incentive to replace much
less expand nuclear.

If Quad Cities and Clinton close, 23% of Illinois's clean electricity would be lost

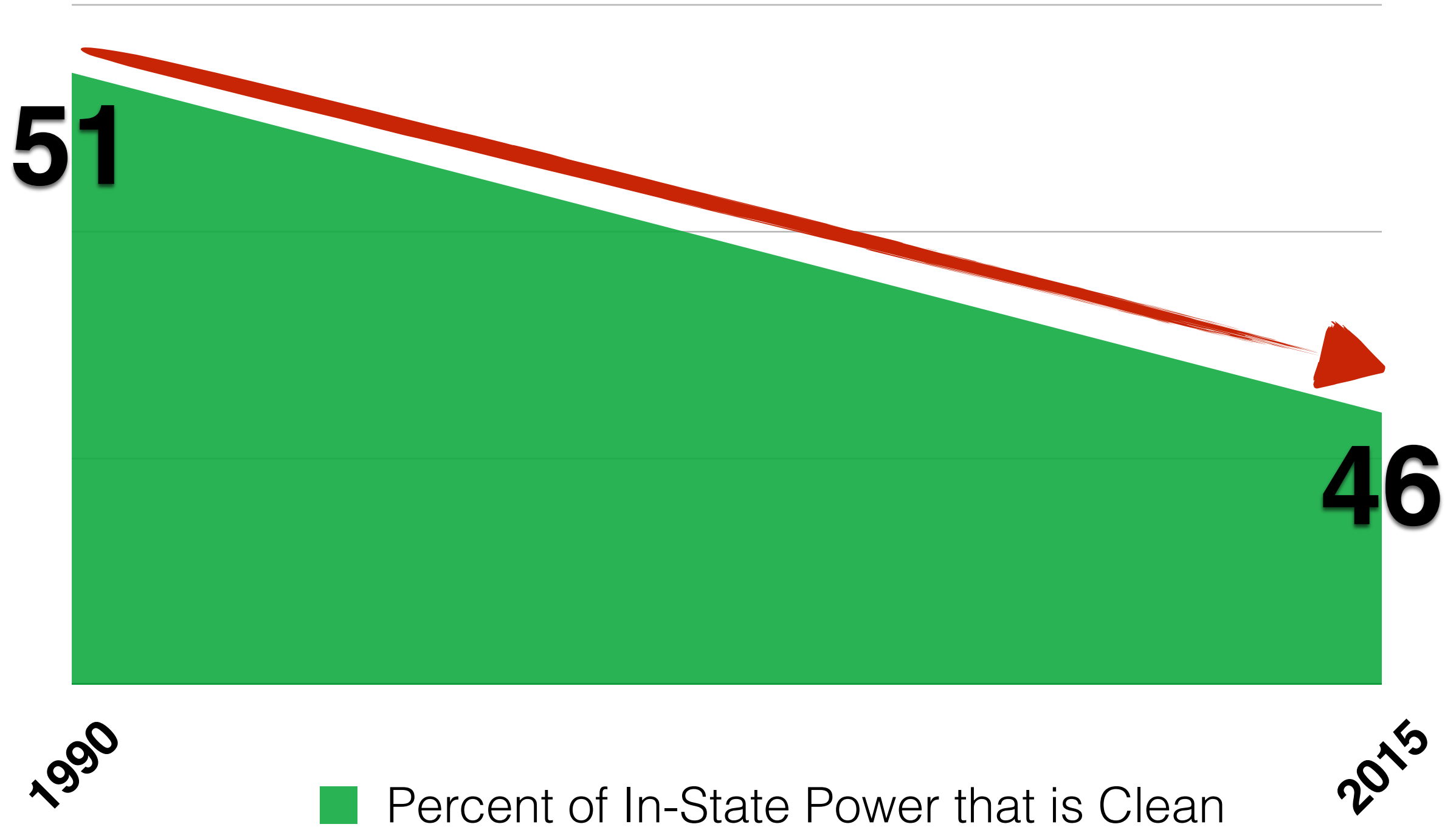


Proposed Illinois Nuclear Subsidy Would Cost Less than Half of Wind Subsidy



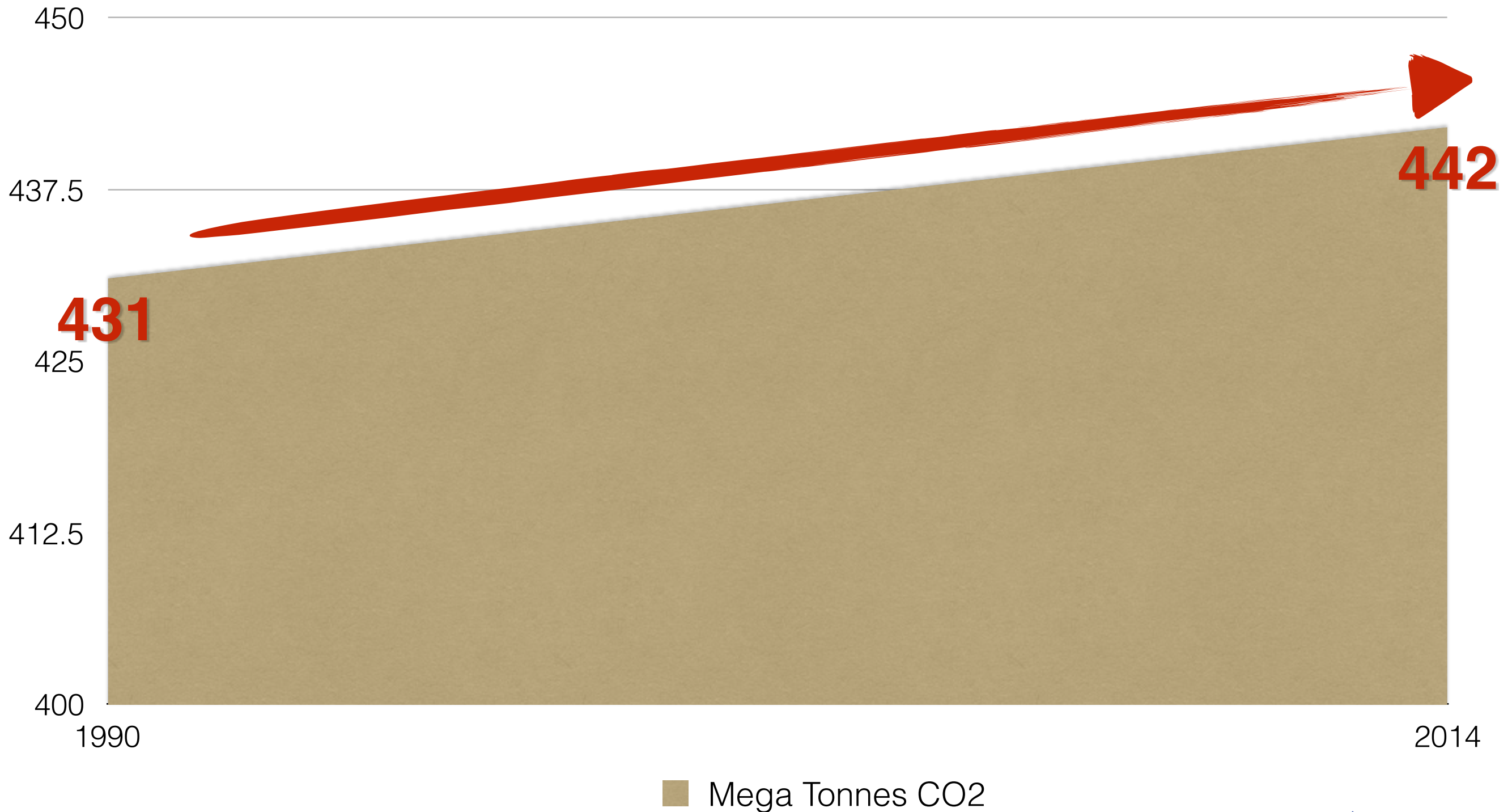
Source: Calculations based on \$250 million/year subsidy (high end estimate) from Steve Daniels, Crane's, May 19, 2016. DOE Wind PTC.

Clean California Power Declined



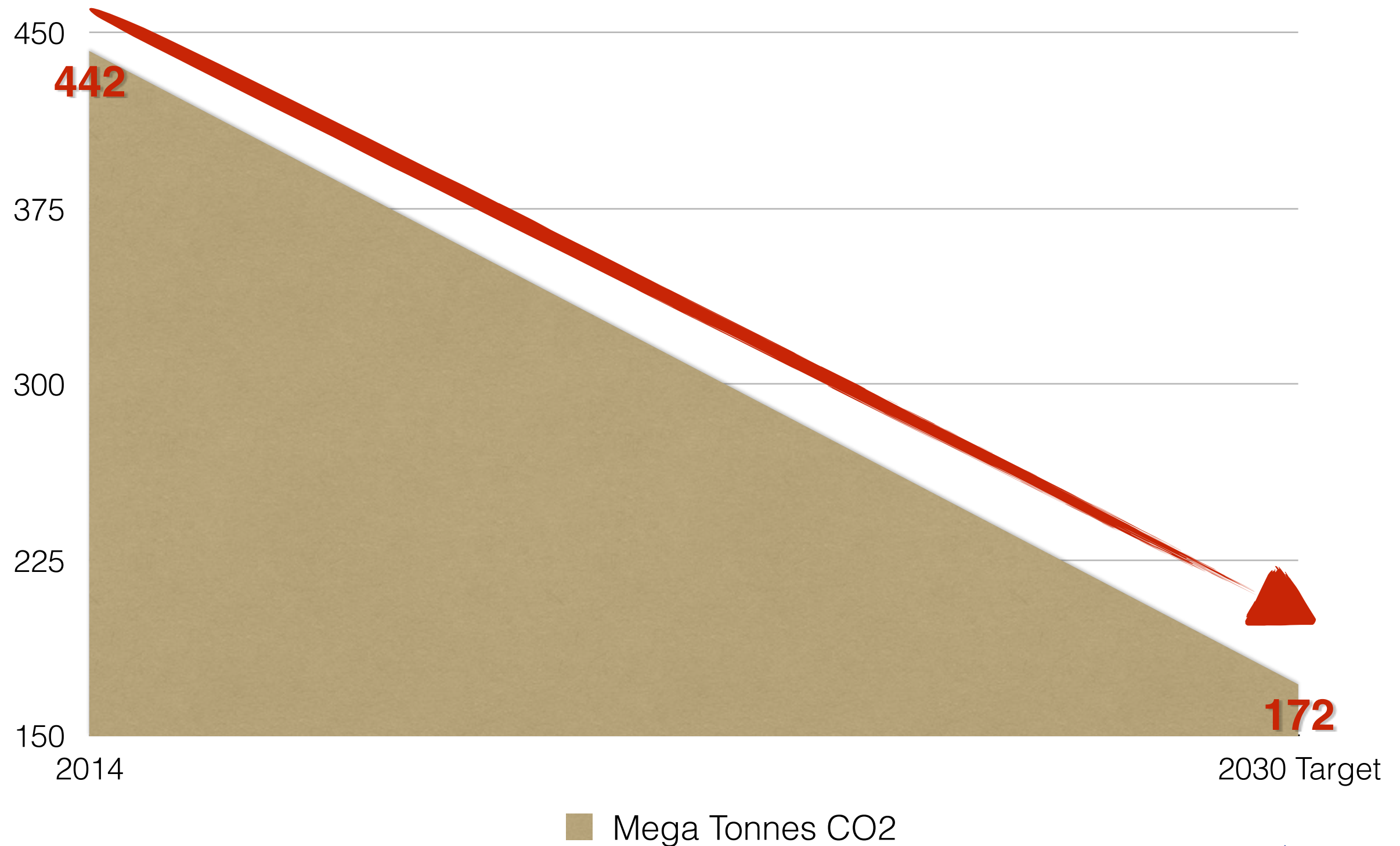
Source: California Almanac, "In-state System Power," 2016; **Rooftop Solar Added;**
https://docs.google.com/spreadsheets/d/1uXuqaE-BBvdNLnmuUic5mmhCkqOoU0VTunn3meS_dAU/edit?usp=sharing

California Emissions Rose Since 1990



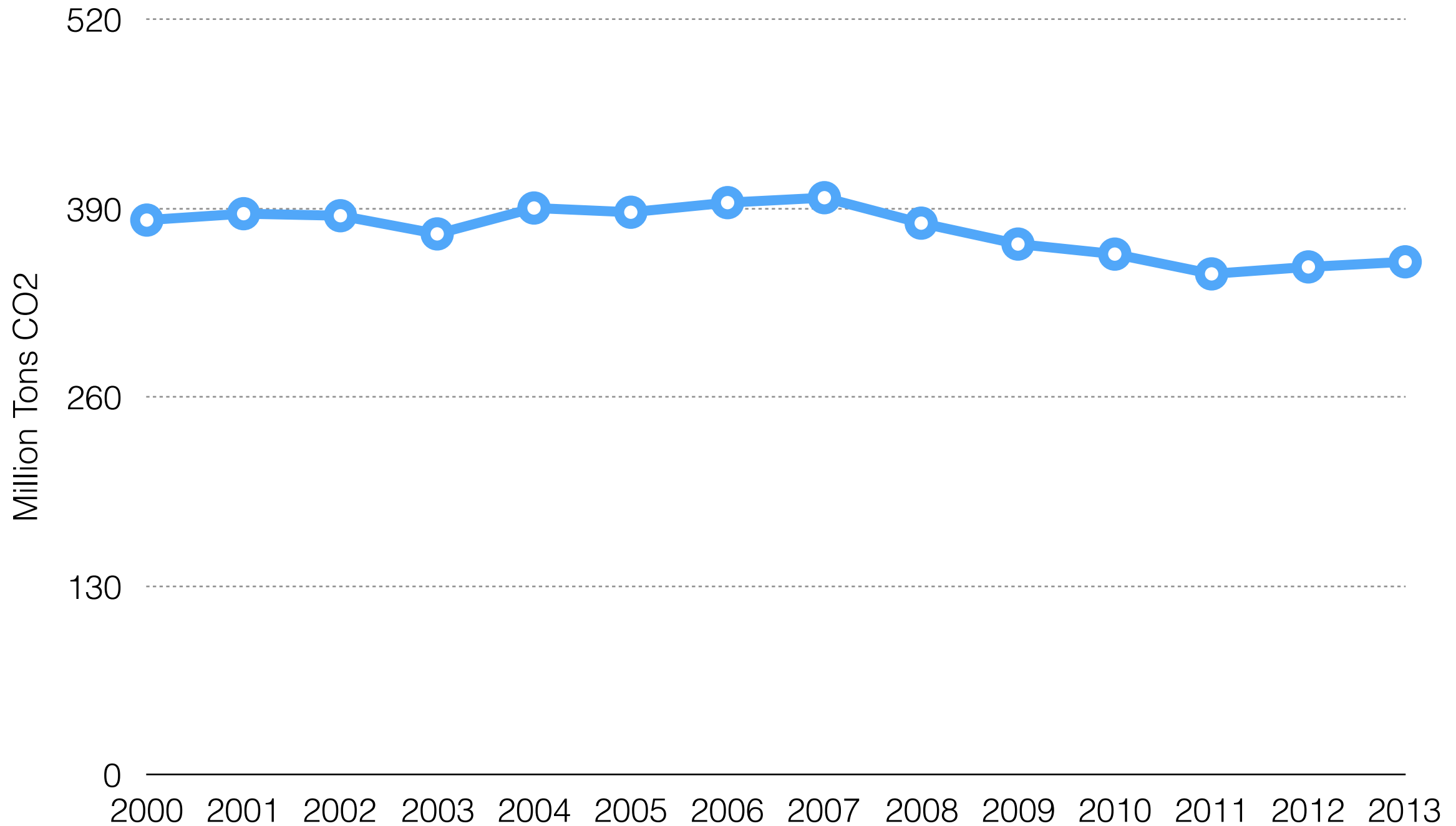
Source: California Air Resources Board (CARB), "2016 Edition California Greenhouse Gas for 2000-2014 — by Sector and Activity," 2016

California Emissions Actual & Target



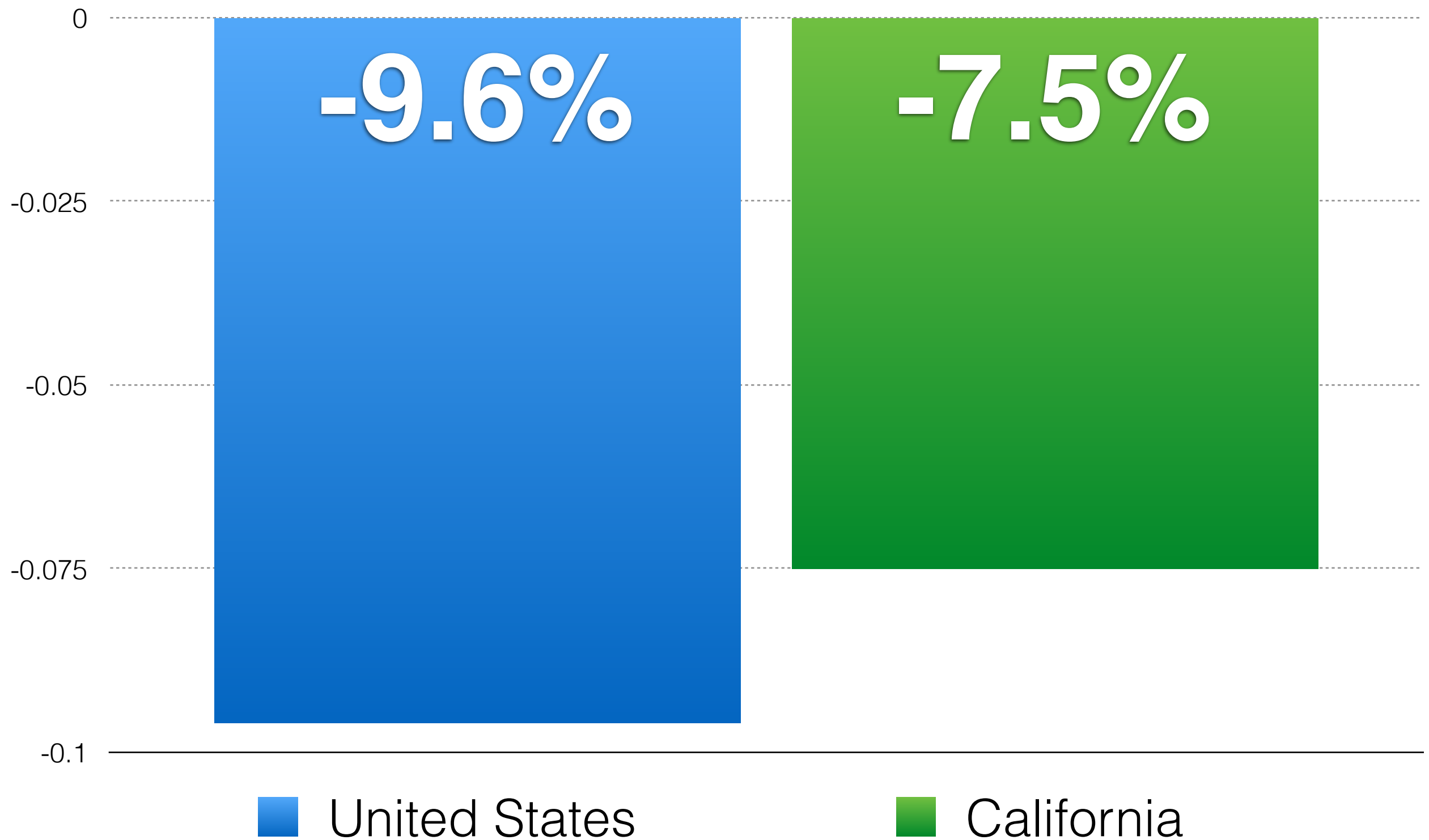
Source: California Air Resources Board (CARB), "2016 Edition California Greenhouse Gas for 2000-2014 — by Sector and Activity," 2016

California Emissions did decline since 2000...



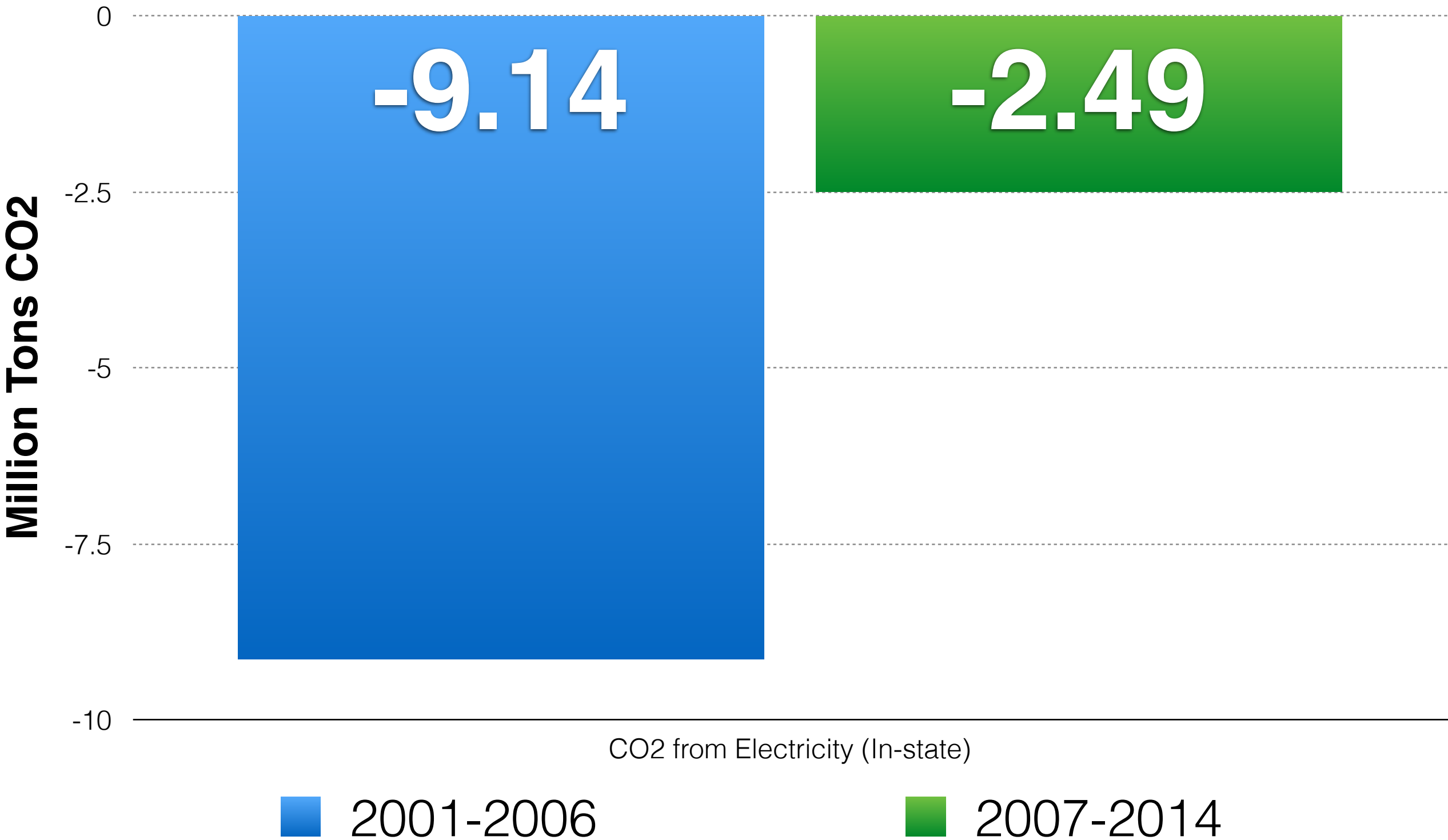
Source: EIA, State Energy Emissions Data, 2016

...but less than national average



Source: EIA, State Energy Emissions Data, 2016

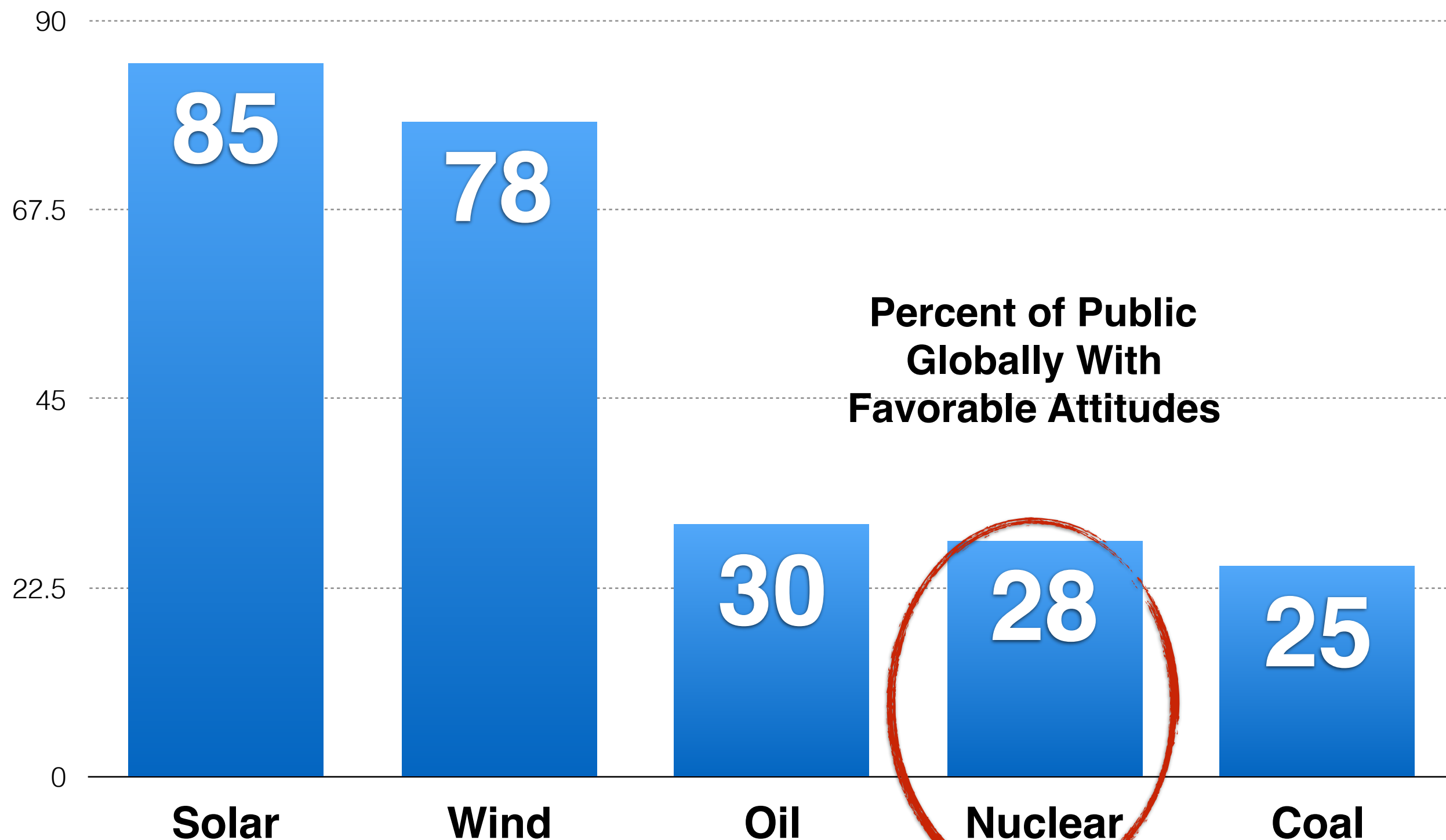
...and less after passage of climate legislation than before



Source: CARB, 2016 Edition California Greenhouse Gas Inventory for 2000-2014 — by Sector and Activity, 2016

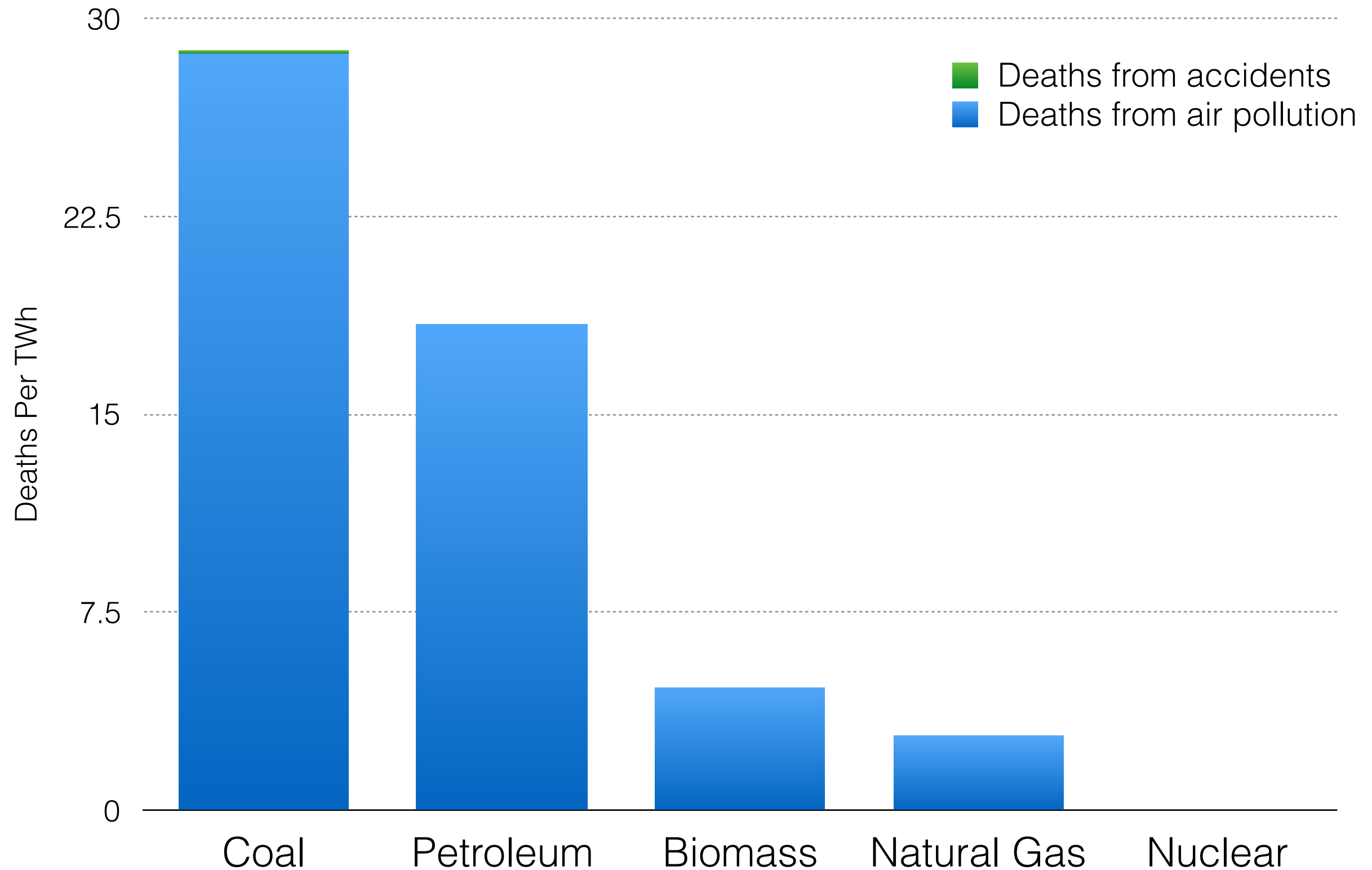
Why is this happening?

Public fears nuclear...



Source: Ipsos, December 2014

...even though it is the safest way to make reliable power



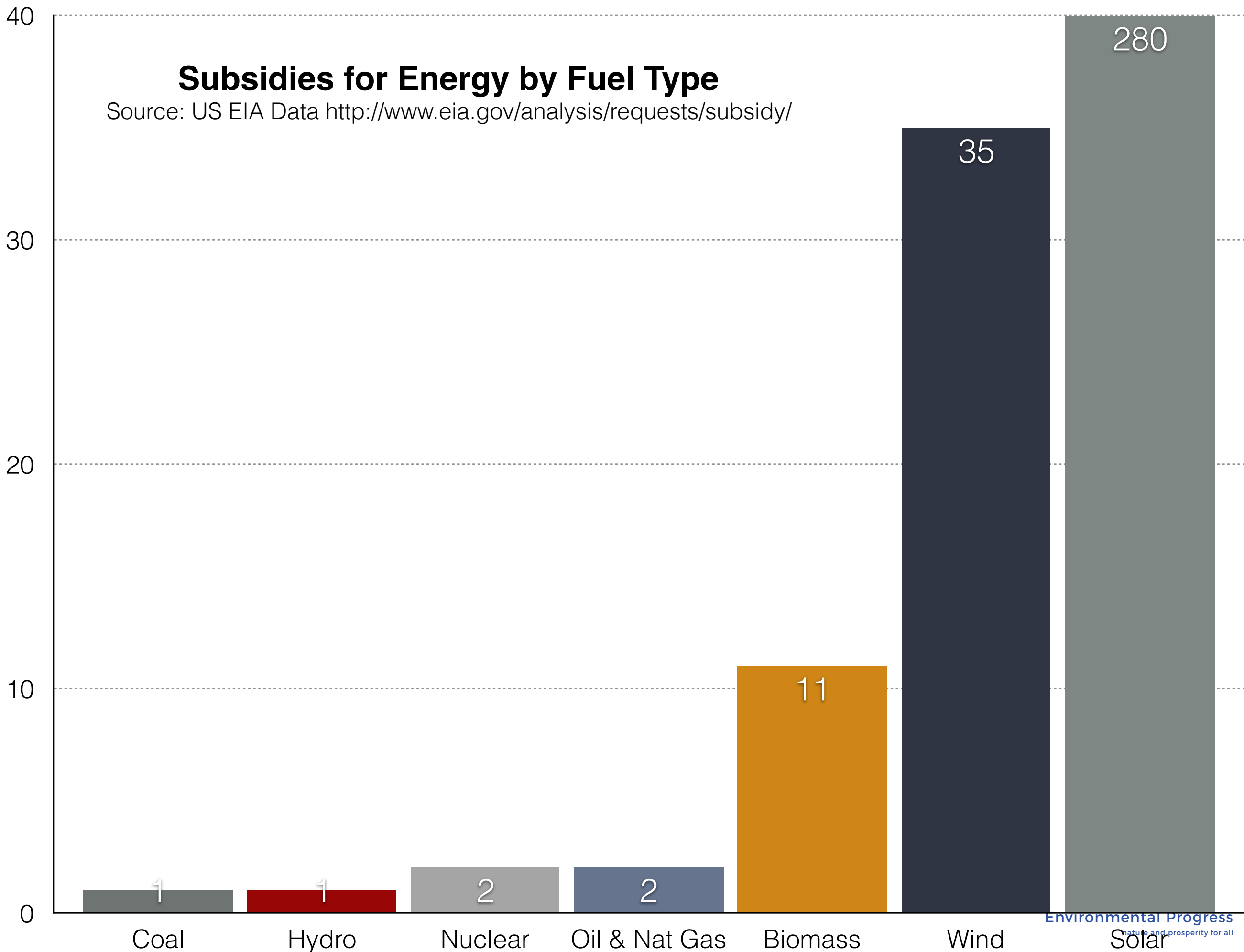
Health effects of electricity generation in Europe by primary energy source

Source: Markandya, A. & Wilkinson, Electricity generation and health. Lancet 2007; 370:970-90

Subsidies for Energy by Fuel Type

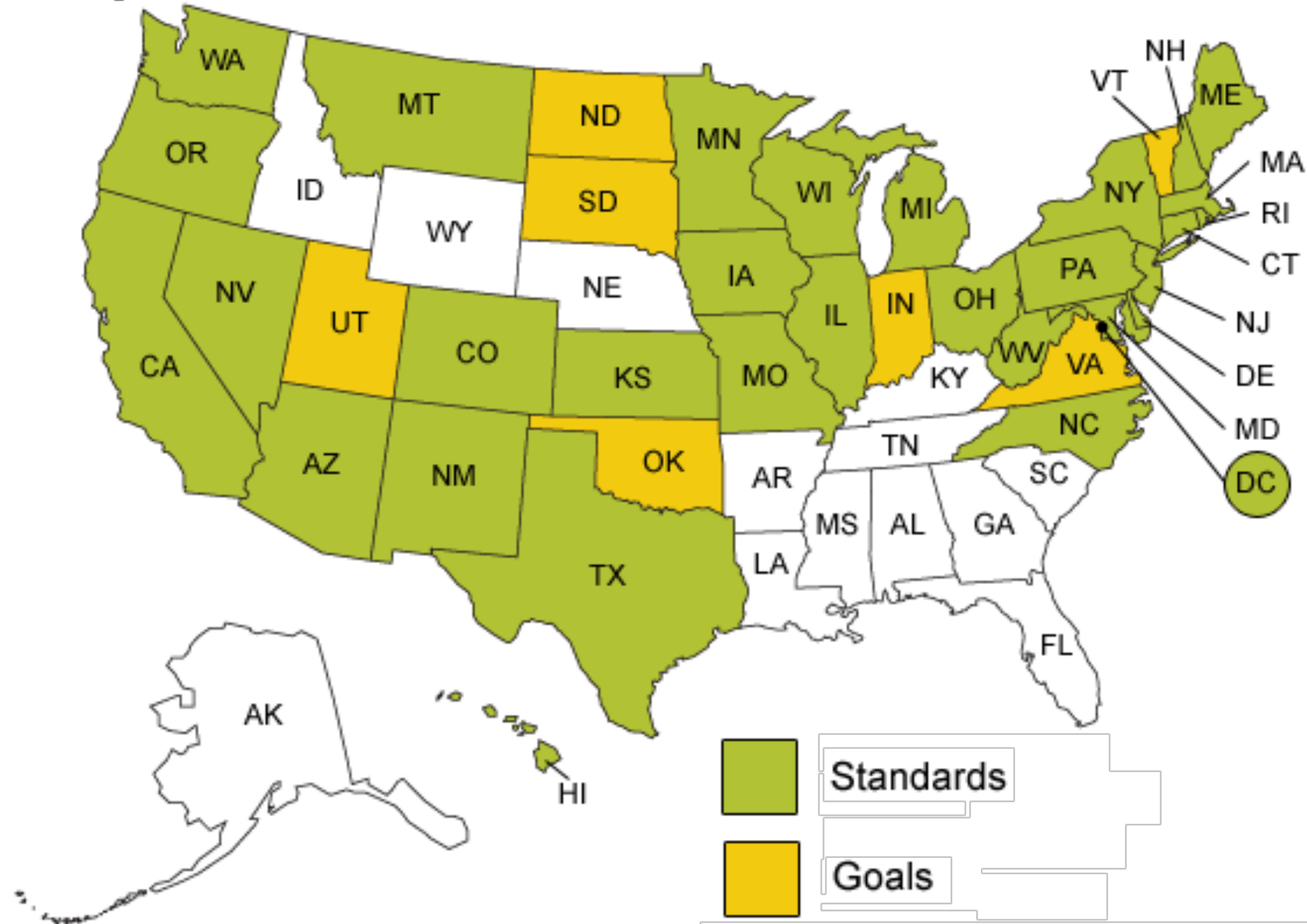
Source: US EIA Data <http://www.eia.gov/analysis/requests/subsidy/>

Subsidy per Megawatt-hour in 2013 US Dollars

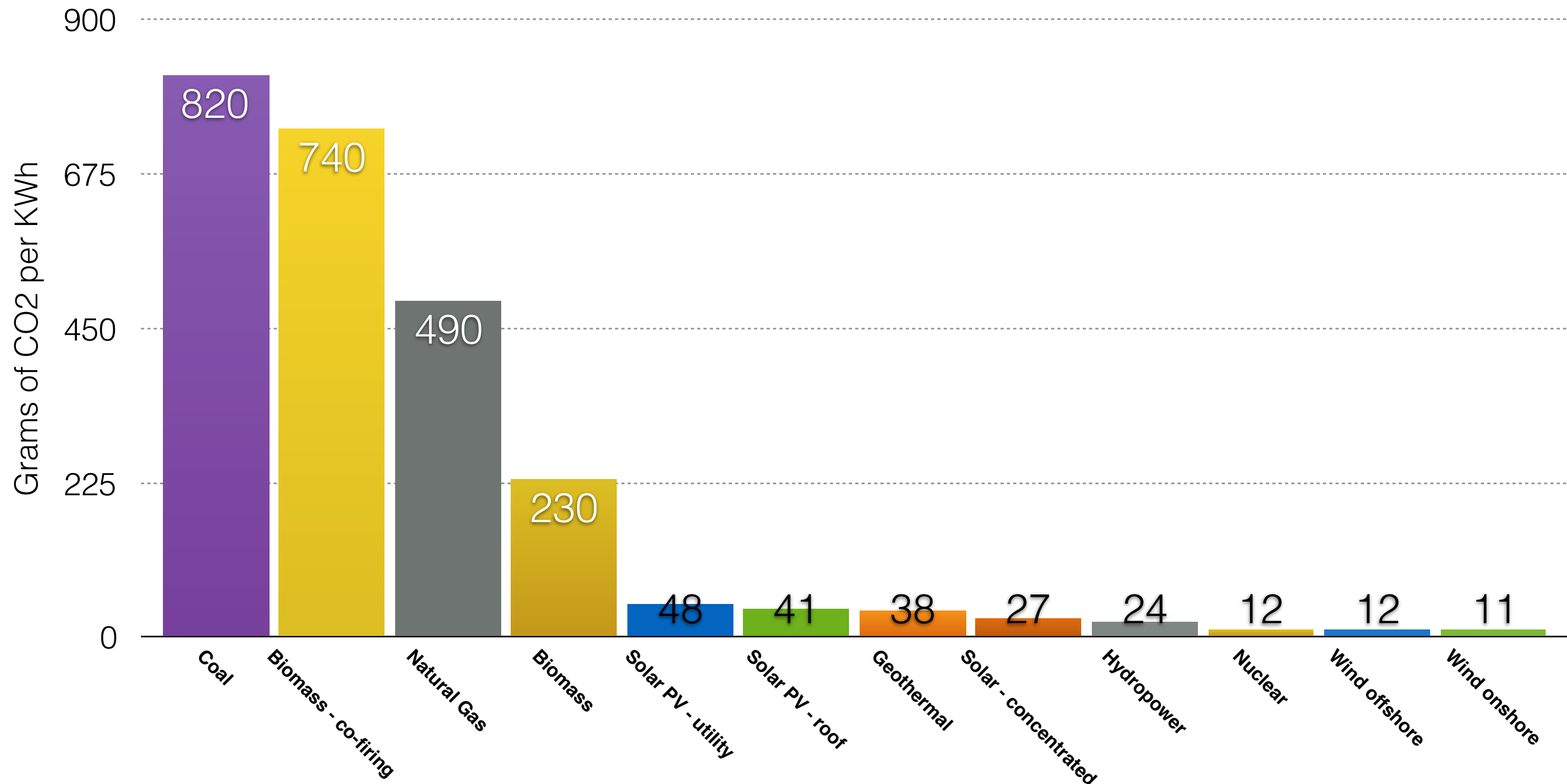


State clean energy standards exclude nuclear...

States with Renewable Portfolio Standards (mandatory) or Goals (voluntary),
January 2012



...even though is lower-carbon than solar



Source: IPCC 2014, Annex III Table A III.2

Schlömer S., T. Bruckner, L. Fulton, E. Hertwich, A. McKinnon, D. Perczyk, J. Roy, R. Schaeffer, R. Sims, P. Smith, and R. Wiser, 2014: Annex III: Technology-specific cost and performance parameters. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.



The New York Times

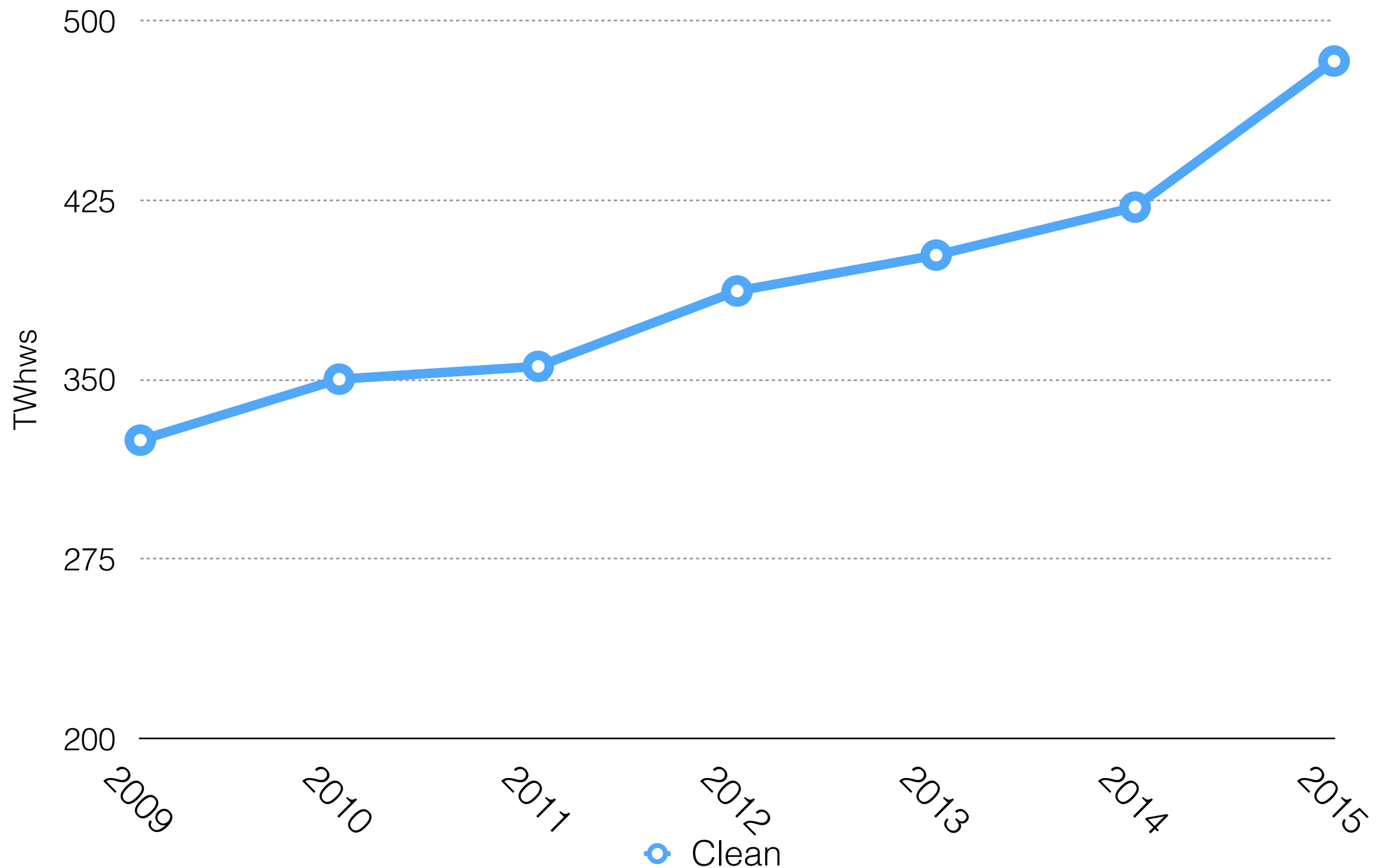
Chinese Protesters Accuse Solar Panel Plant of Pollution

By SHARON LaFRANIERE SEPT. 18, 2011



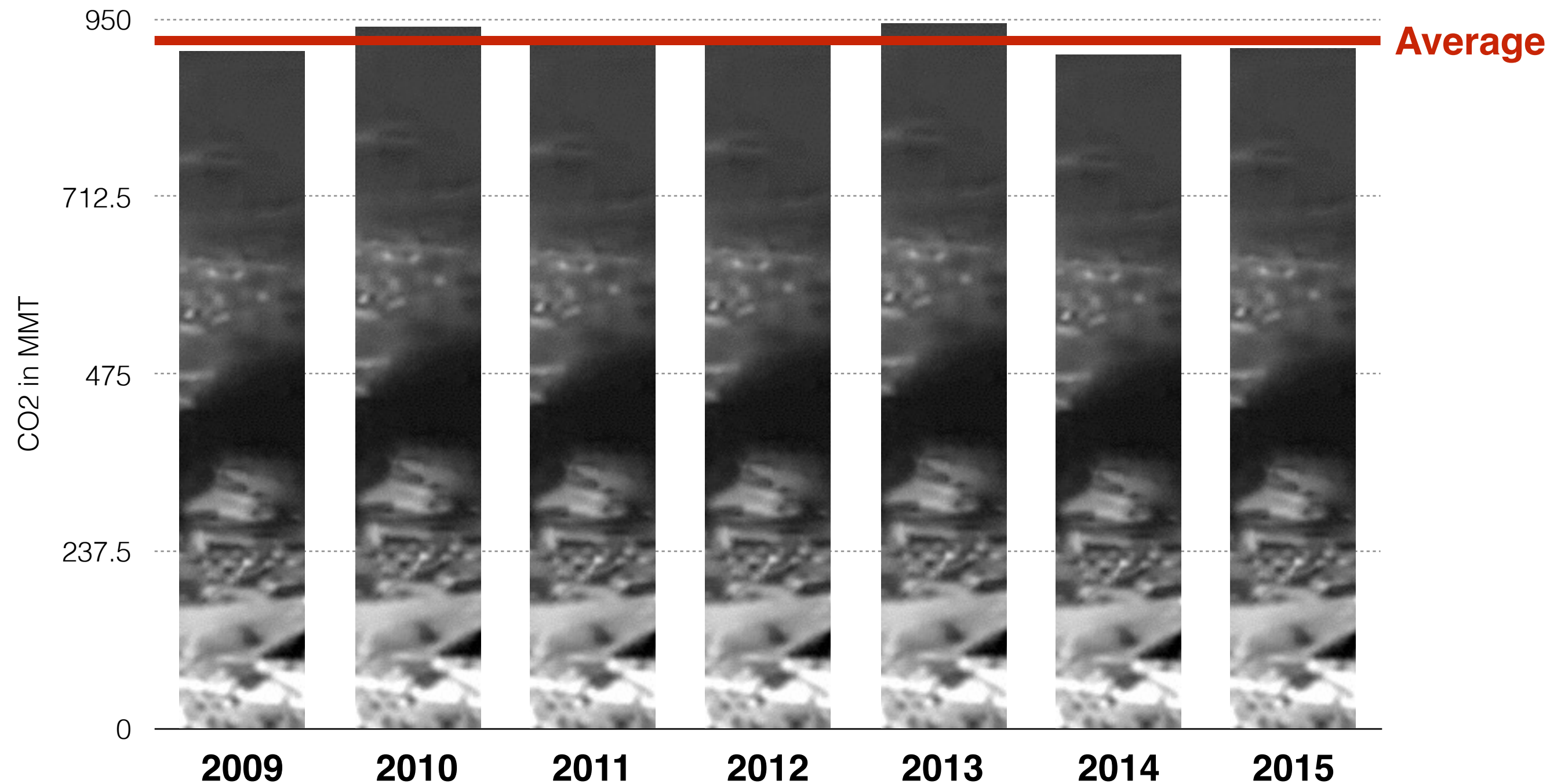
Germany

German electricity from clean energy *is* rising....

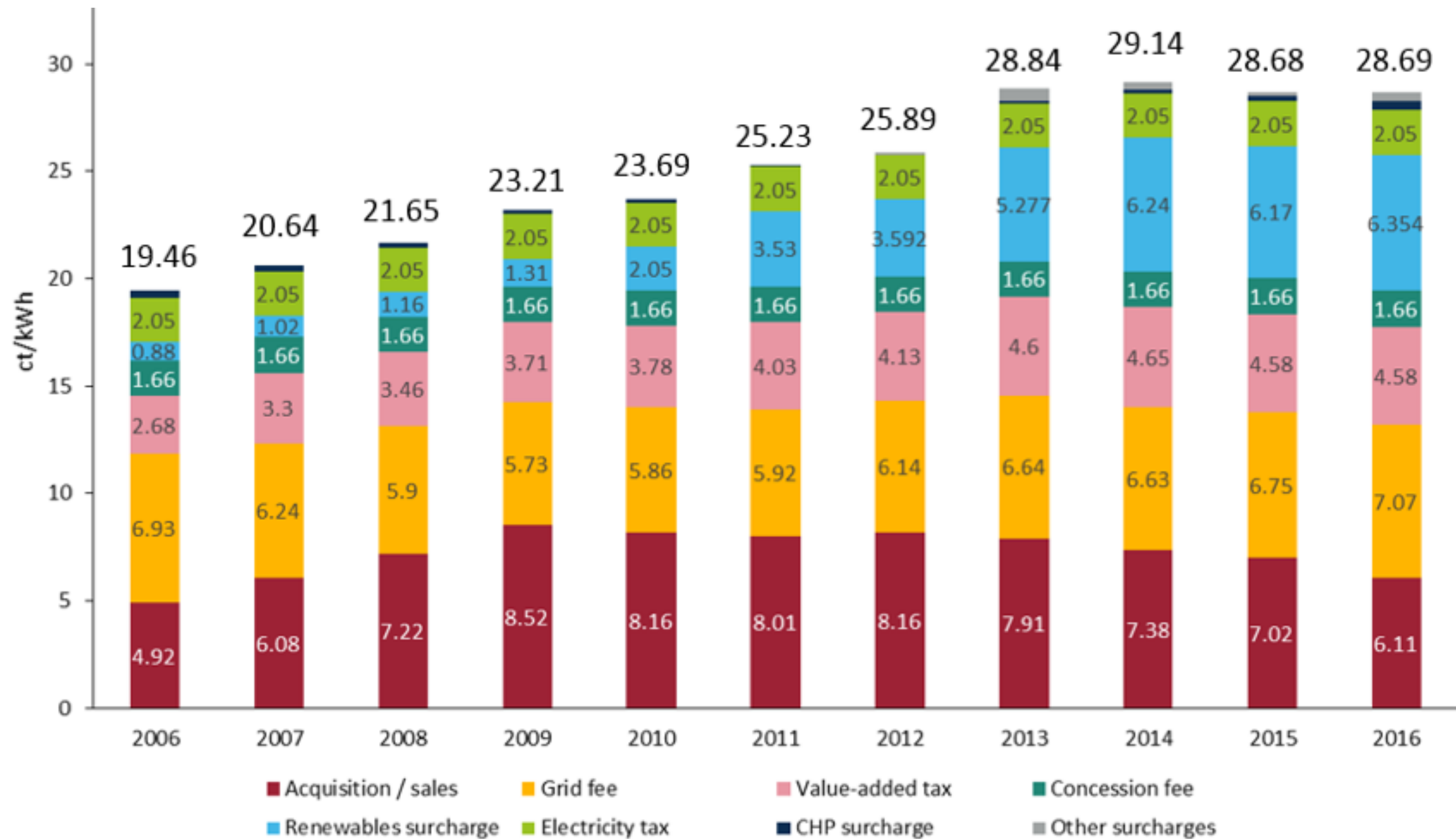


Source: BP Global Outlook 2016

...but Germany's emissions *aren't* declining.

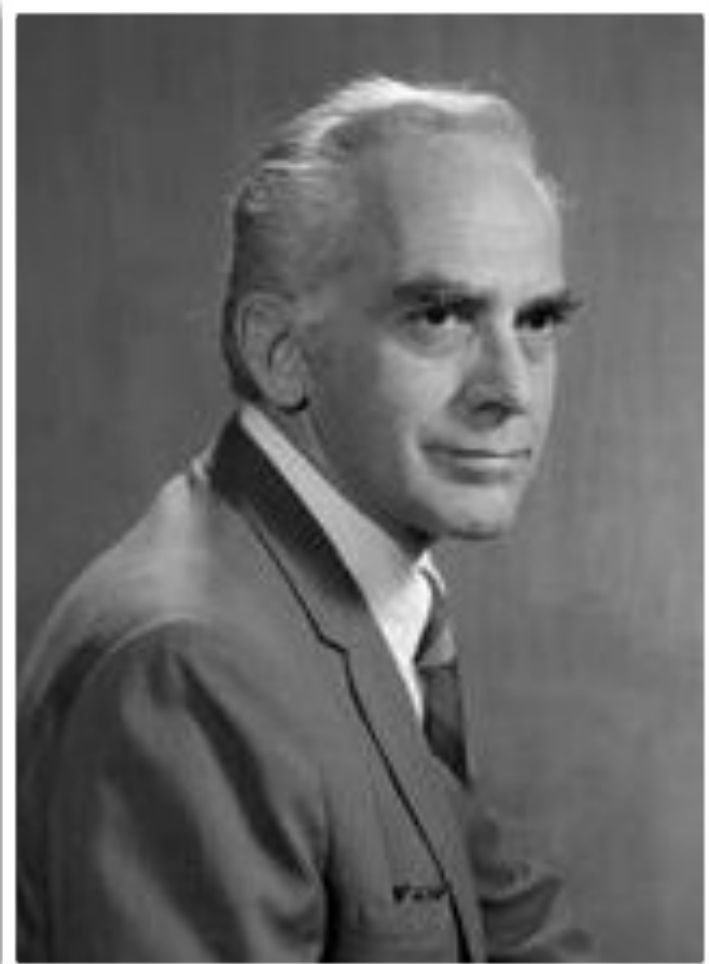


German Electricity Costs Rose 47 Percent, 2006 - 2016



Composition of average power price in ct/kWh for an average household (3,500 kWh per year). Data: BDEW, 2016.

Deeper causes



“Nuclear power is one of the chief long-term hopes for conservation.”

— David Siri, Sierra Club Director, 1966



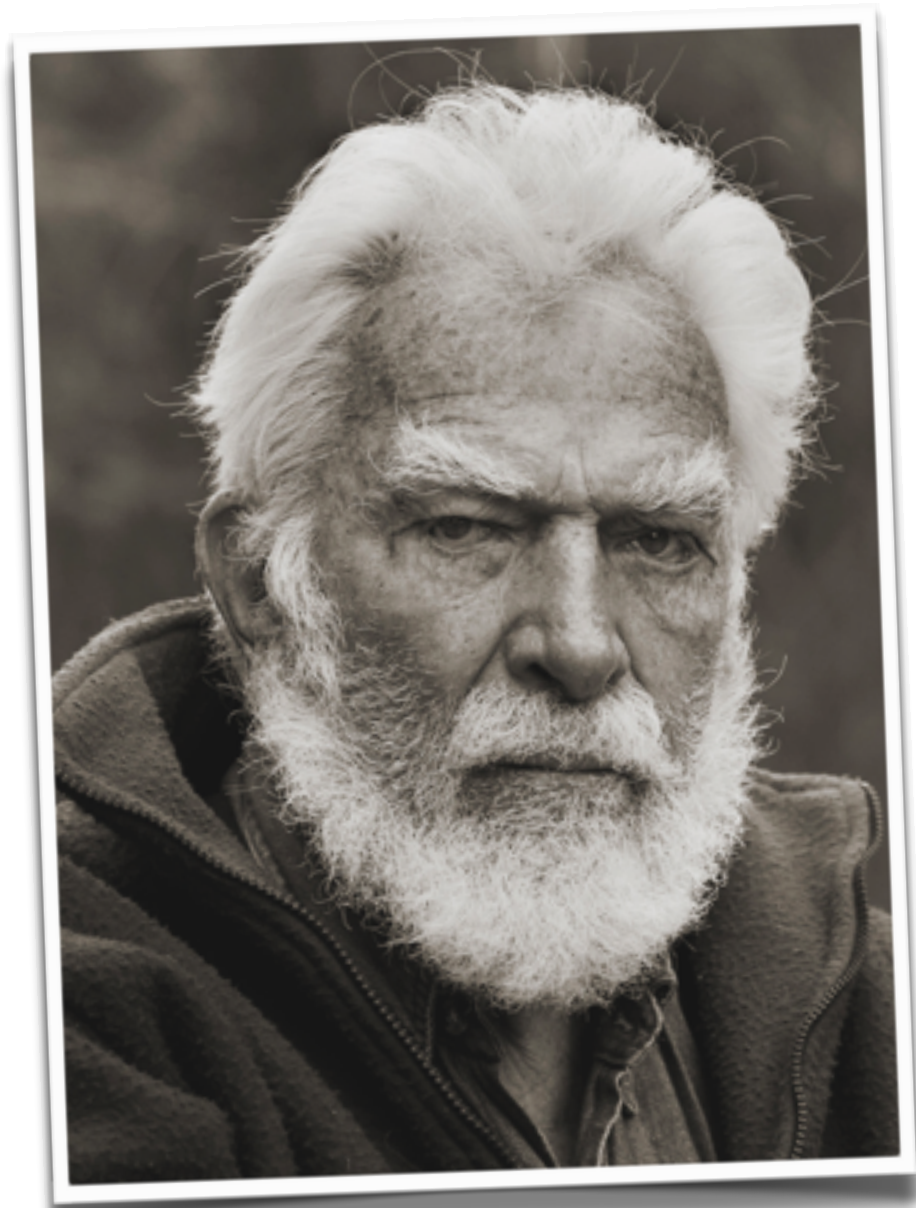
"It'd be little short
of disastrous for us
to discover a source
of clean, cheap,
abundant energy
because of what we
would do with it."

— Amory Lovins



"Our campaign stressing the hazards of nuclear power will supply a rationale for increasing regulation... and add to the cost of the industry.."

— Sierra Club Executive Director, Michael McCloskey, 1974



"I really didn't care
[about possible
nuclear accidents]
because there are too
many people anyway... I
think that playing
dirty if you have a
noble end is fine."

— Martin Litton,
Sierra Club Board
Member

The China Syndrome



— NO NUKES —

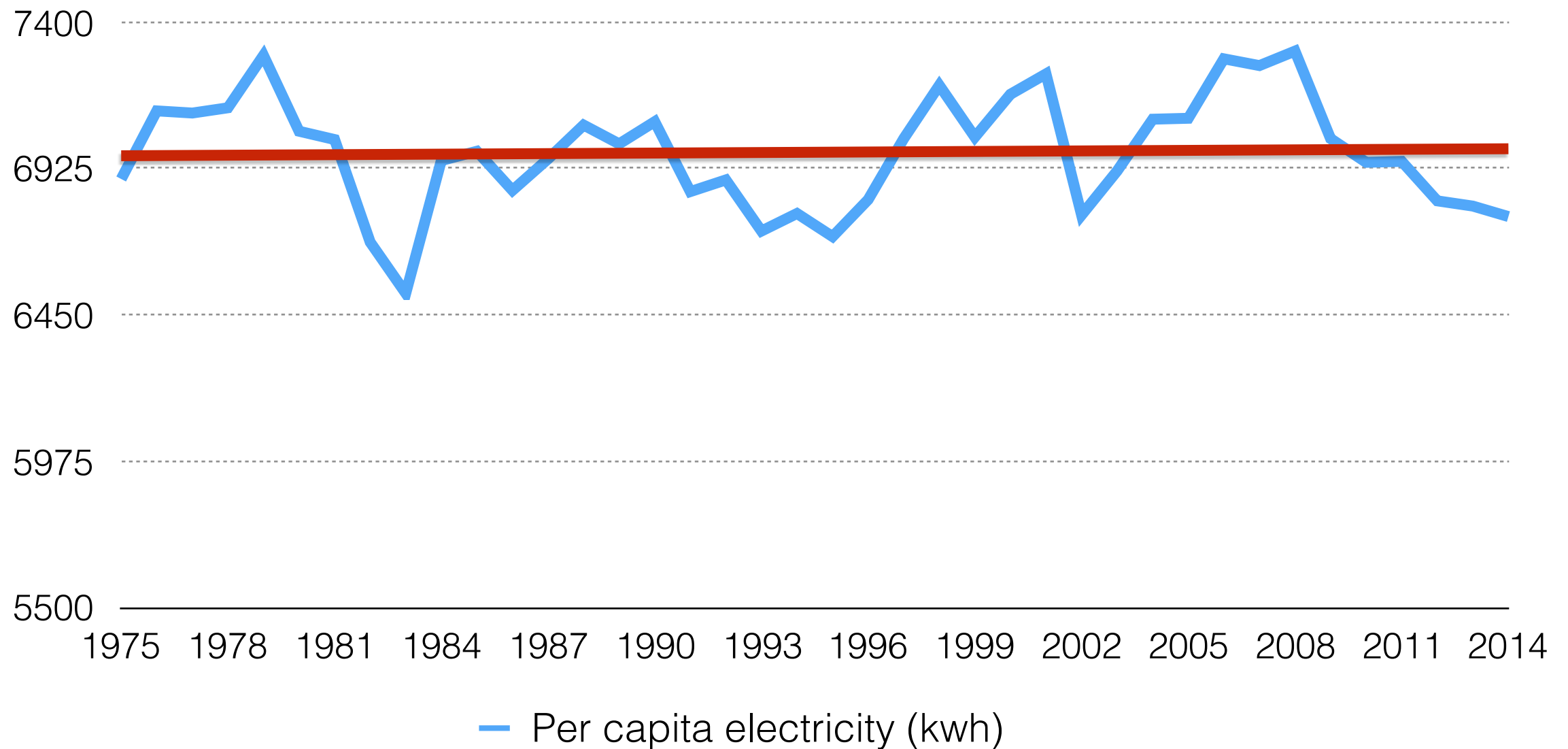




"The governor [Jerry Brown] said, 'I want the Department of Water Resources to build a coal plant.' So we embarked on the planning of a coal plant... a dreadful prospect."

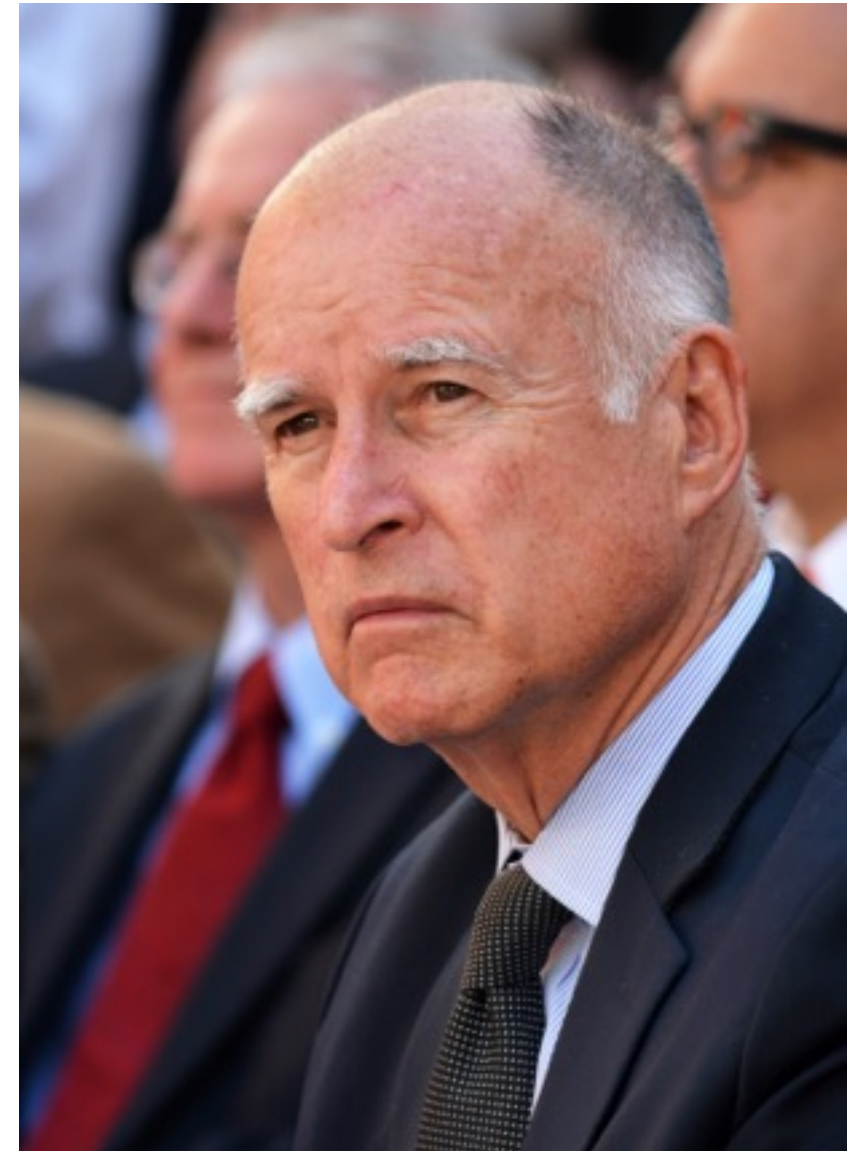
**— Ron Robie, California
Department of Water
Resources**

No long-term trend in California *per capita* electricity consumption

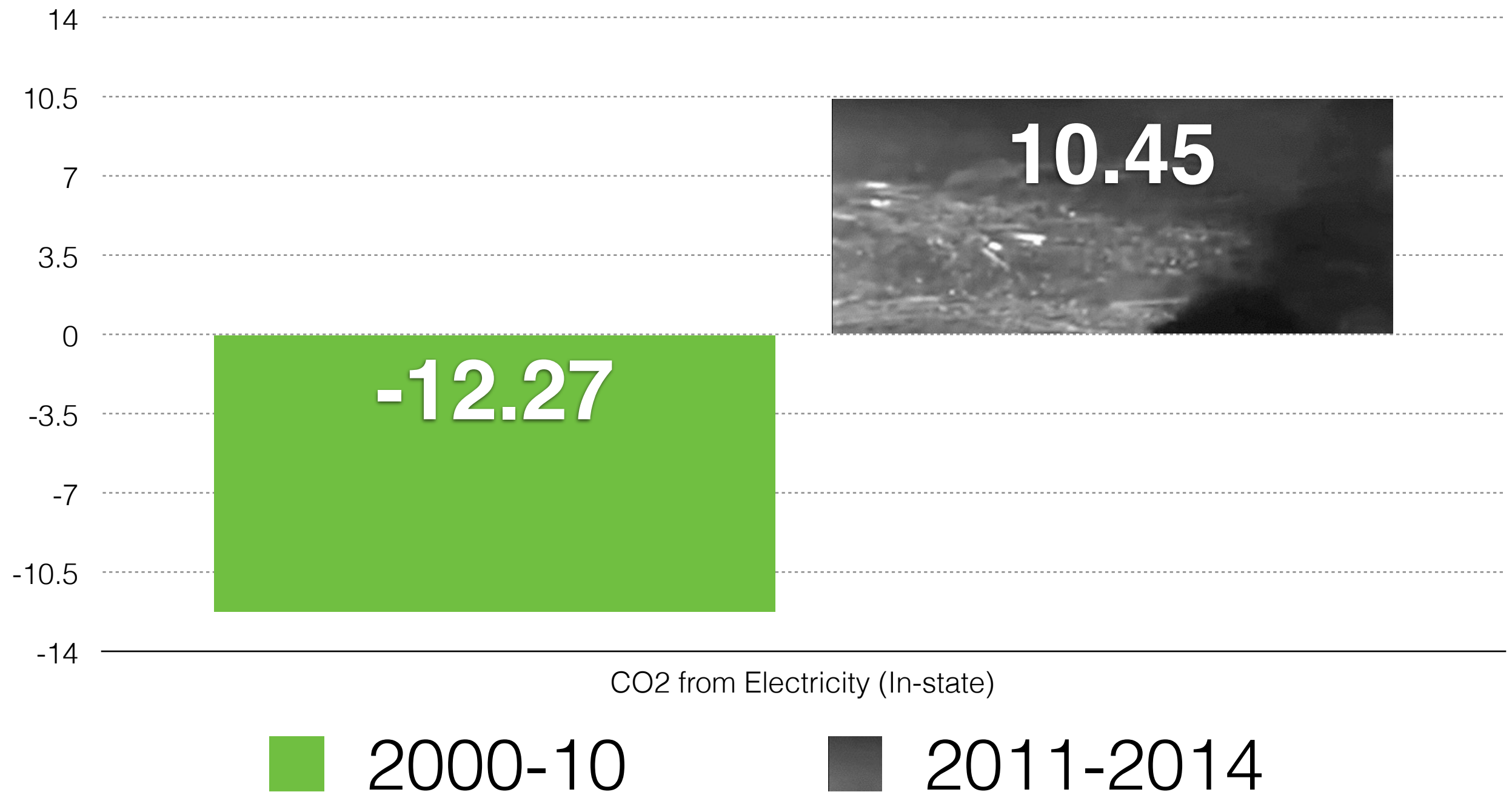


Source: EIA, 2016

NRDC in charge of California energy policy for 40 years

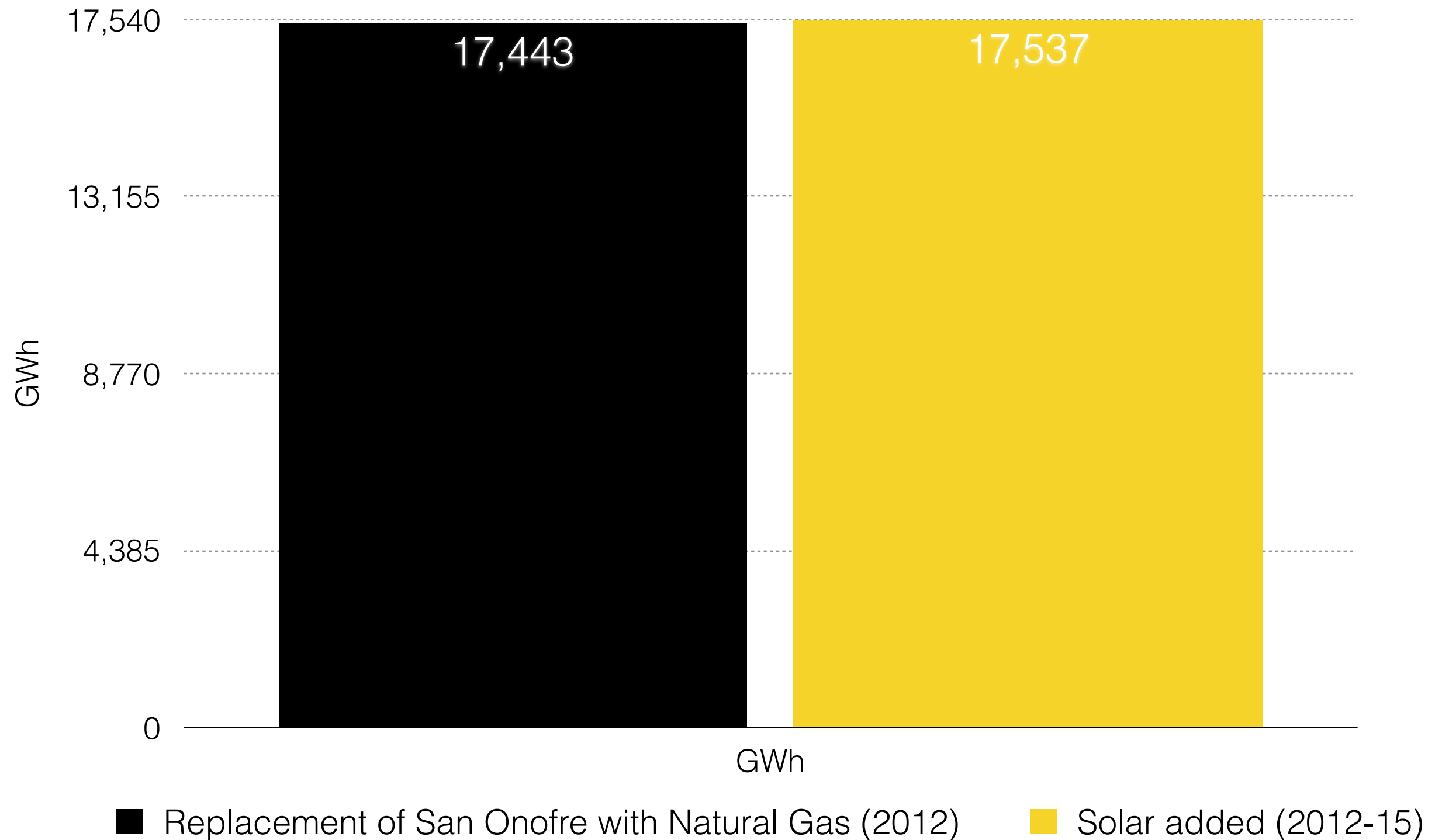


California Power Emissions Rose Dramatically After Closure of San Onofre Nuclear Plant

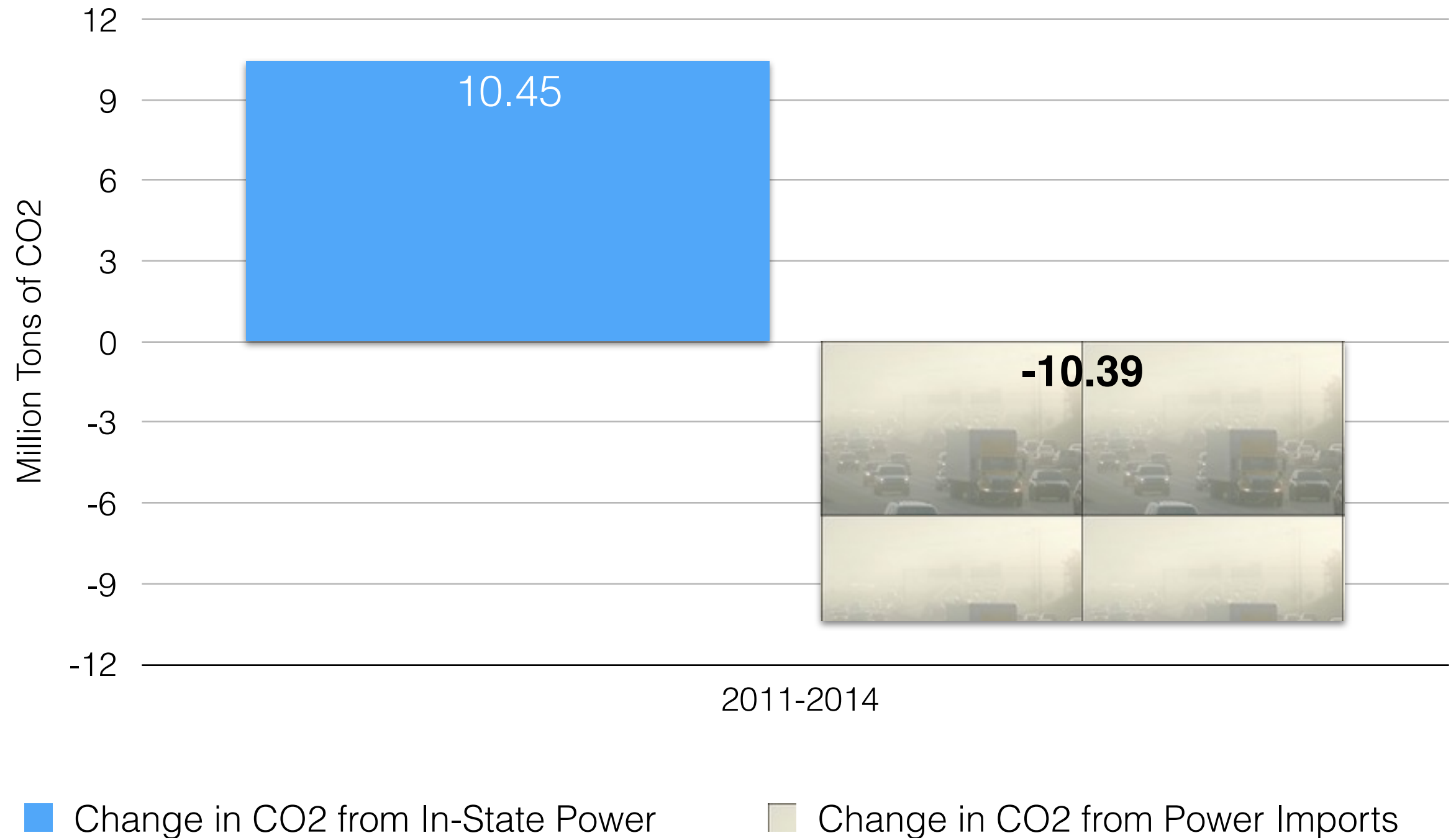


Source: CARB, 2016 Edition California Greenhouse Gas Inventory for 2000-2014 — by Sector and Activity, 2016

Loss of San Onofre Cancelled Out Solar Gains

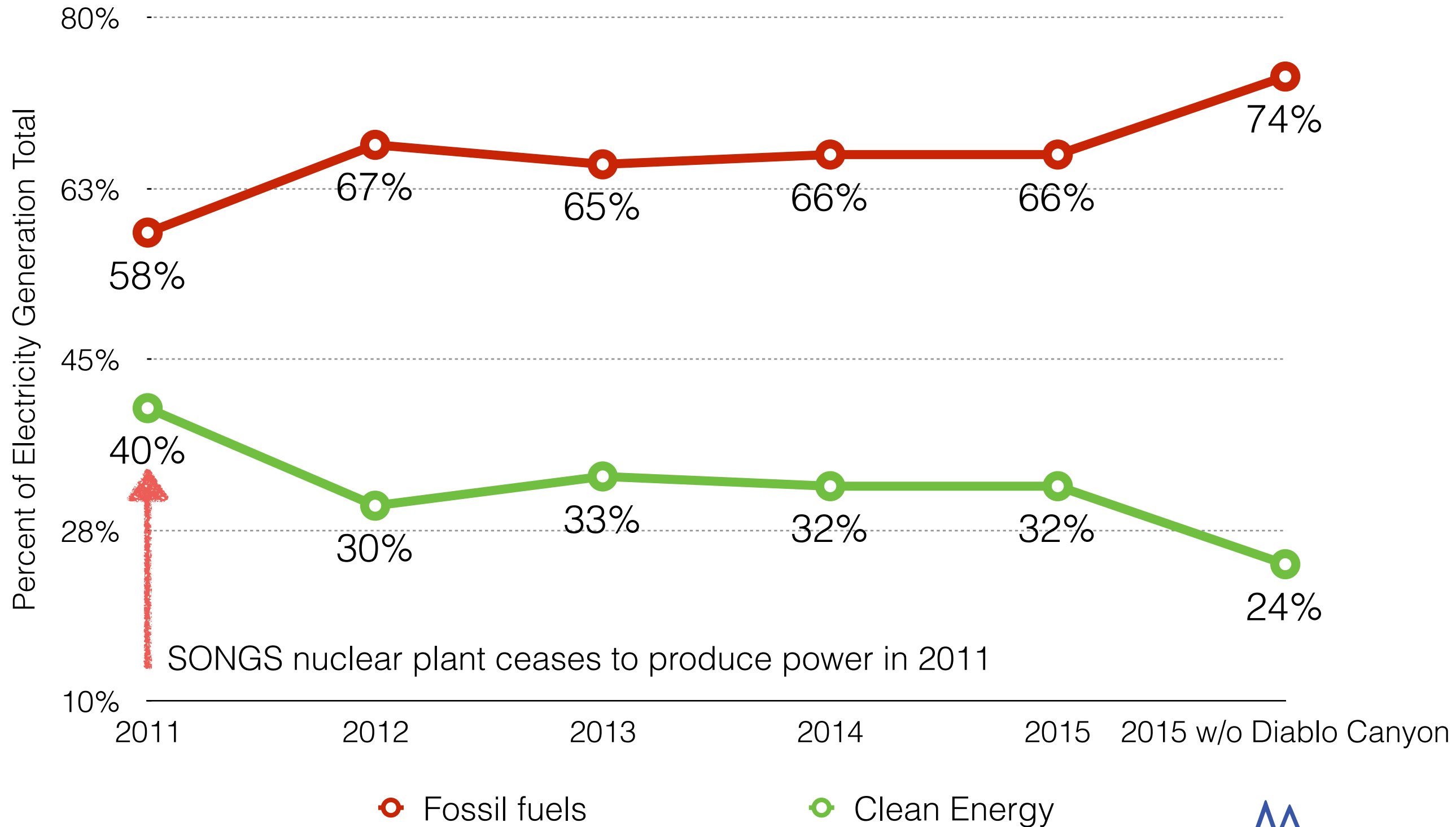


Decline in Emissions from Out-of-State Power Canceled Out by Rise of In-State Power Emissions



Source: CARB, 2016 Edition California Greenhouse Gas Inventory for 2000-2014 — by Sector and Activity, 2016

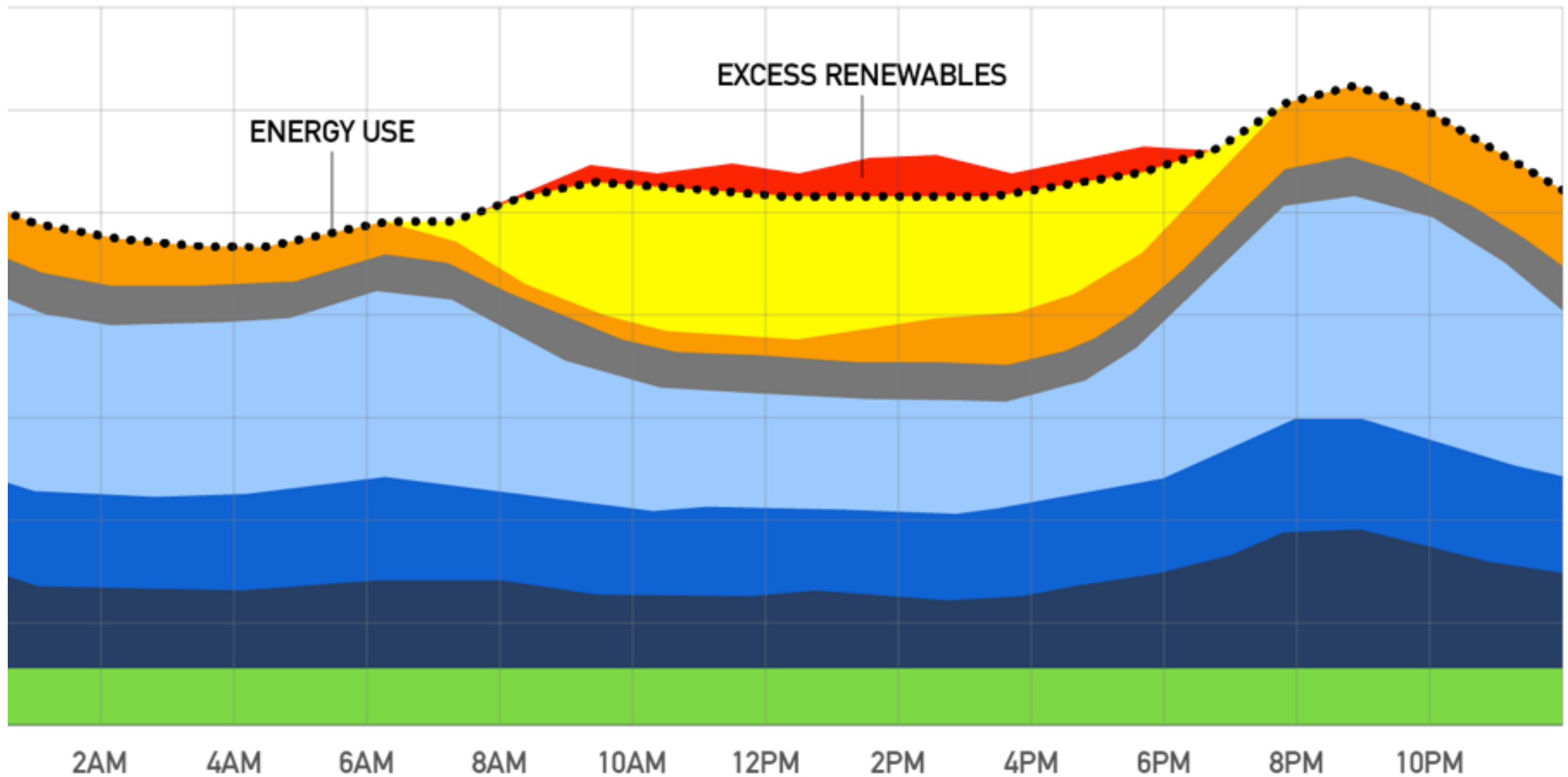
Total Nat Gas Rises with Nuclear Closures



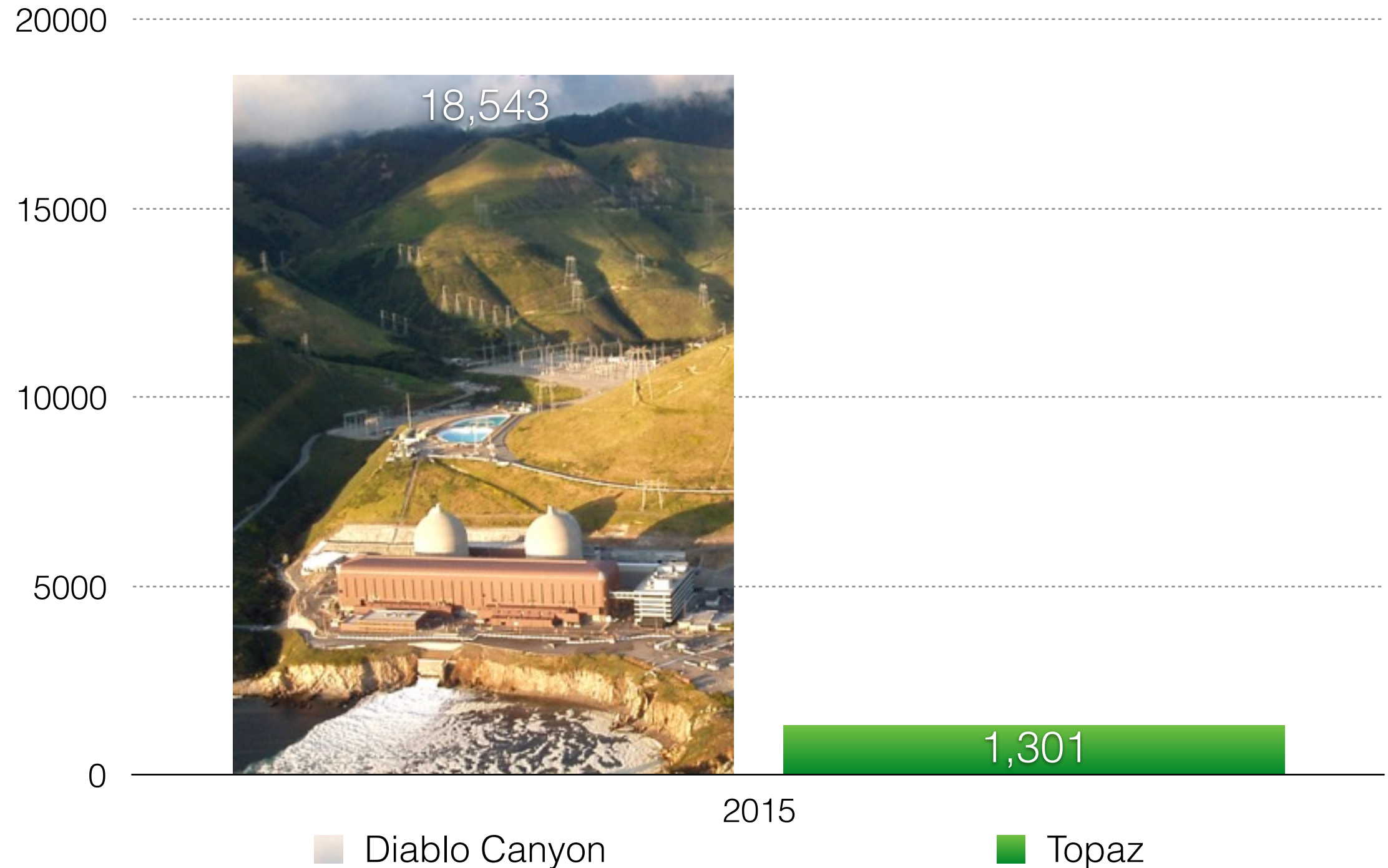
Because solar and wind produce power just 10 - 30% of the time they *almost always* require fossil fuel back-up



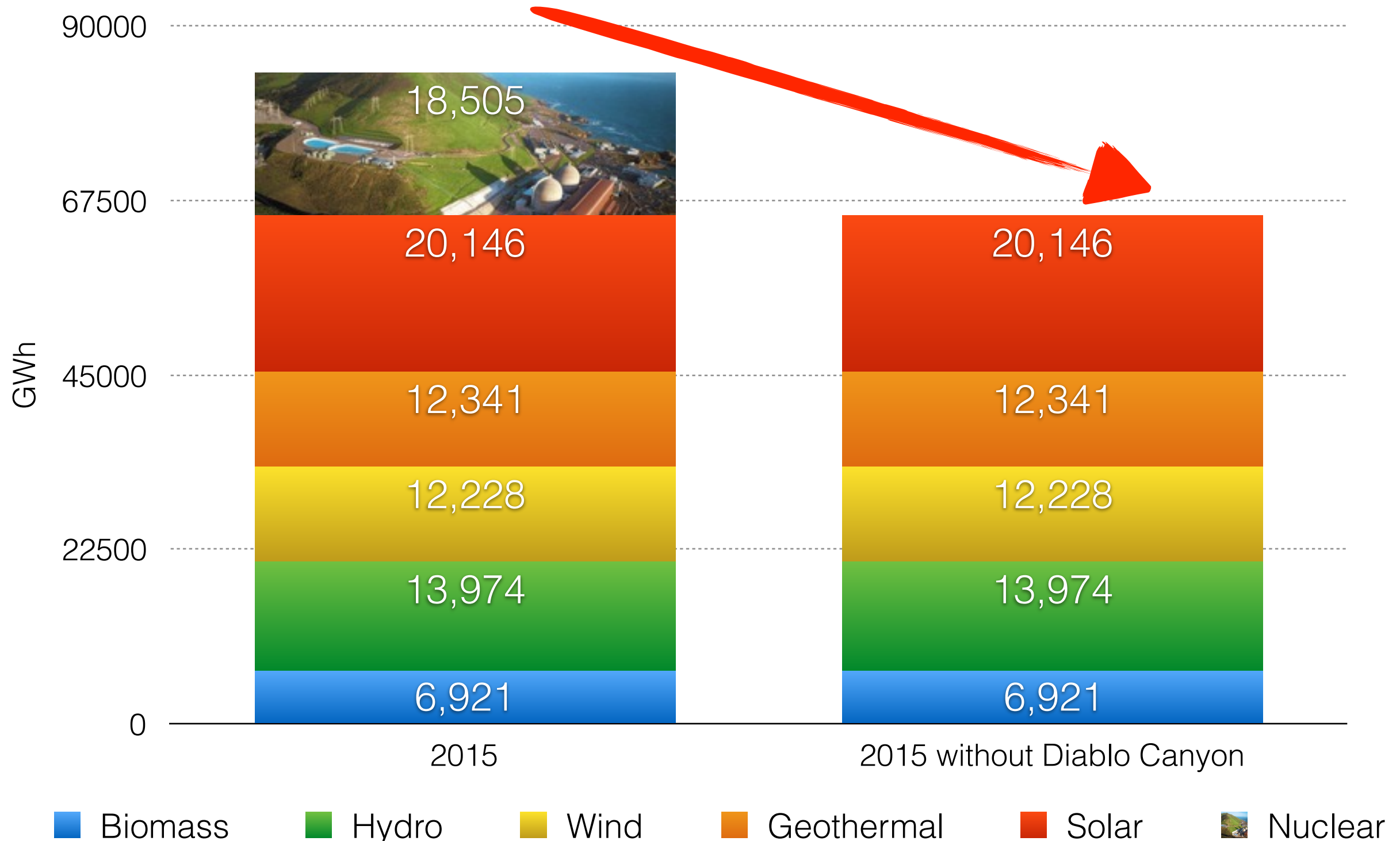
Methane gas leaking from Aliso Canyon, California, where it was stored to provide rapid back-up power to solar & wind. Source: Environmental Defense Fund



Diablo Canyon produced 14 times more electricity than Topaz, one of world's largest solar farms



If Diablo closes, 21% of California's clean electricity would be lost

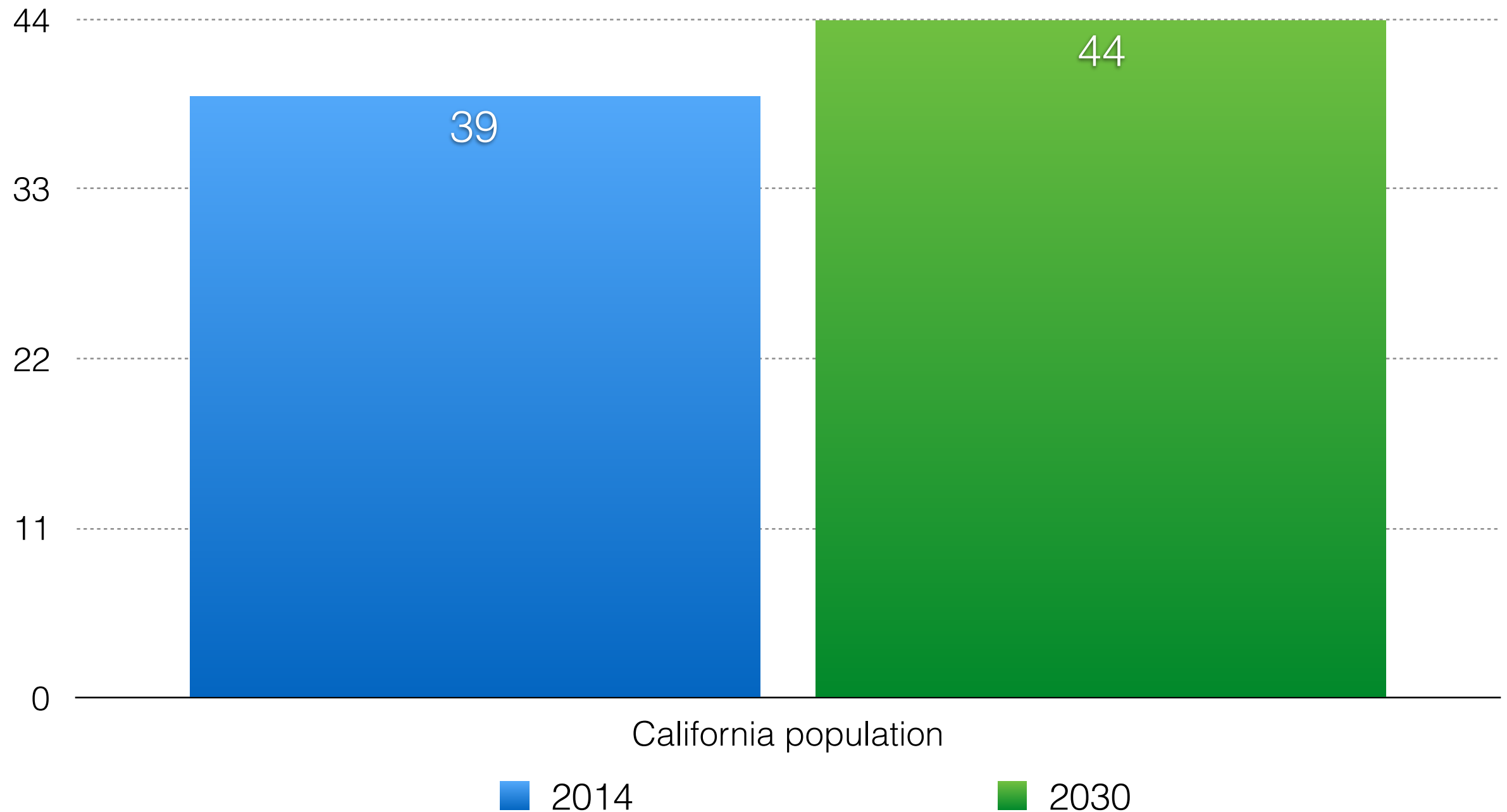


Includes distributed solar

Source: US Energy Information Administration

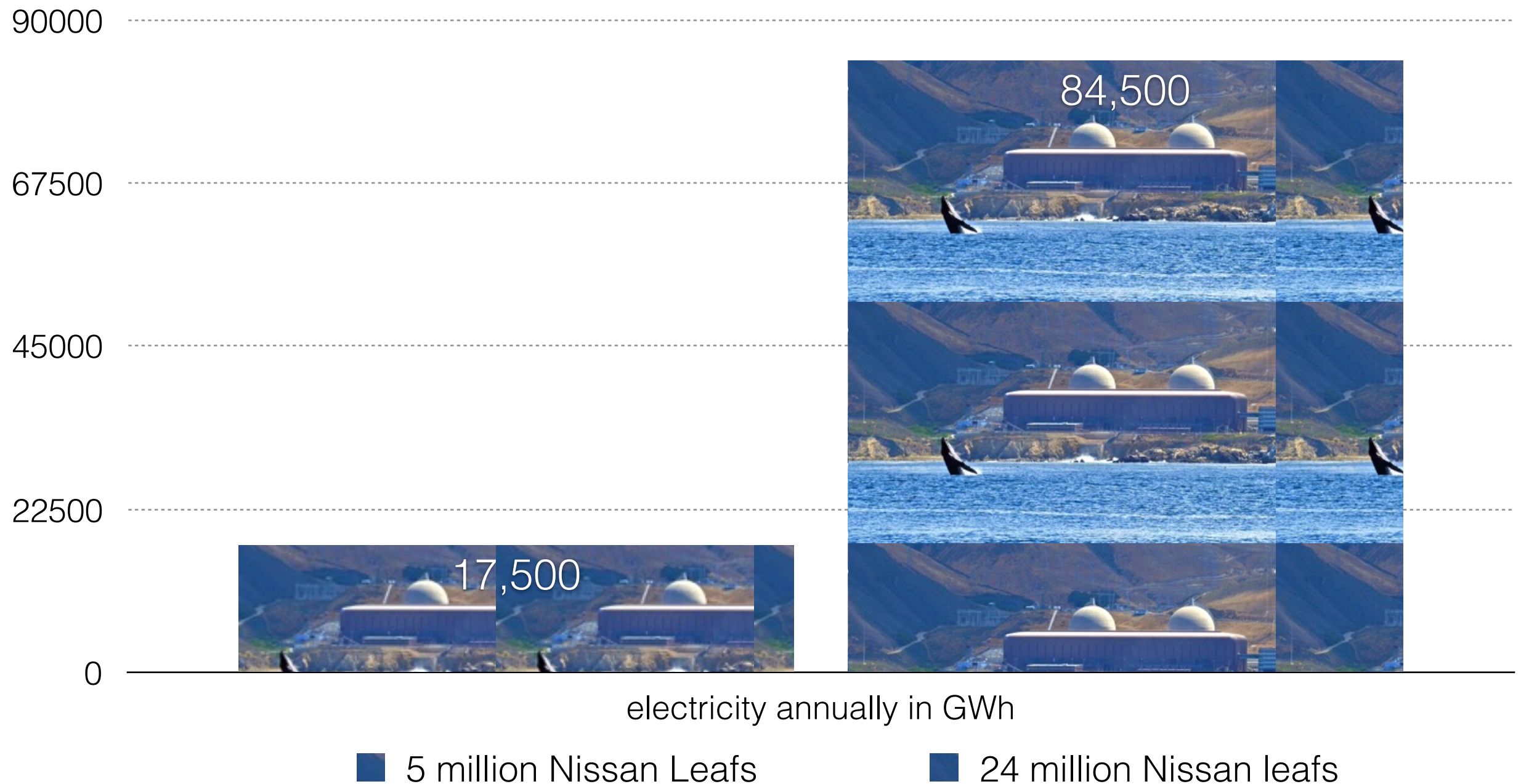
If Diablo Canyon is closed early, it could result in over 5,000 premature deaths from air pollution.

California Population Expected to Rise 13% by 2030



Source: California Department of Finance, "Projections: Population" 2016,
<http://www.dof.ca.gov/Forecasting/Demographics/projections/>

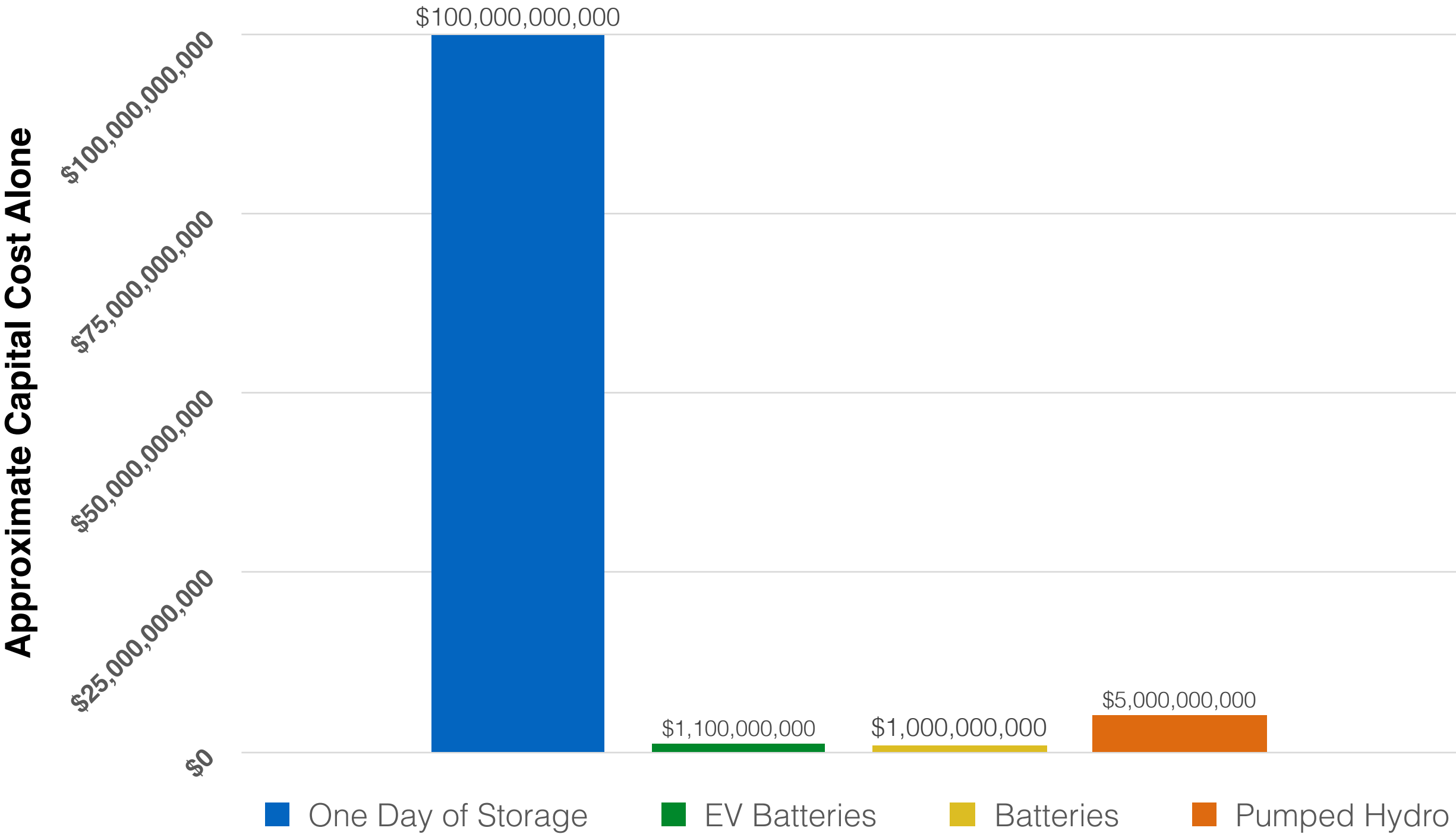
Electric vehicles will require 1 - 5x clean power currently provided by Diablo Canyon



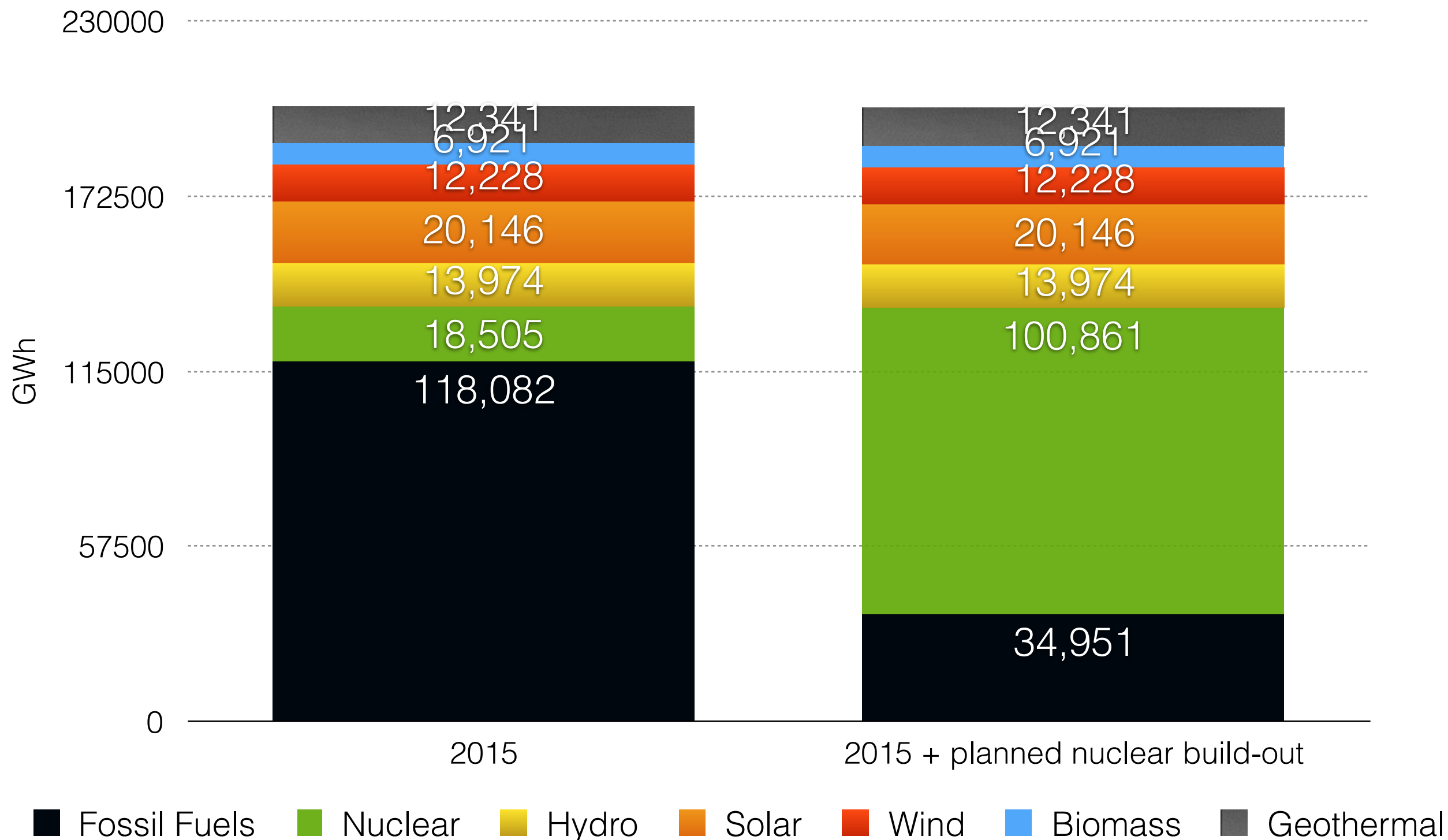
Sources and Calculation: Nissan Leaf needs 30 kWh of electricity to travel 100 miles, or .3 kWh per miles. Department of Energy, 2016. <http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=37066>. 5,000,000 Nissan Leafs at 0.3kWh per mile, multiplied by 12,000 miles (California average)

California has 23 minutes of electricity storage — if you used every car and truck in the state along with existing storage.

One day of back-up power as batteries and pumped storage would cost \$100 billion



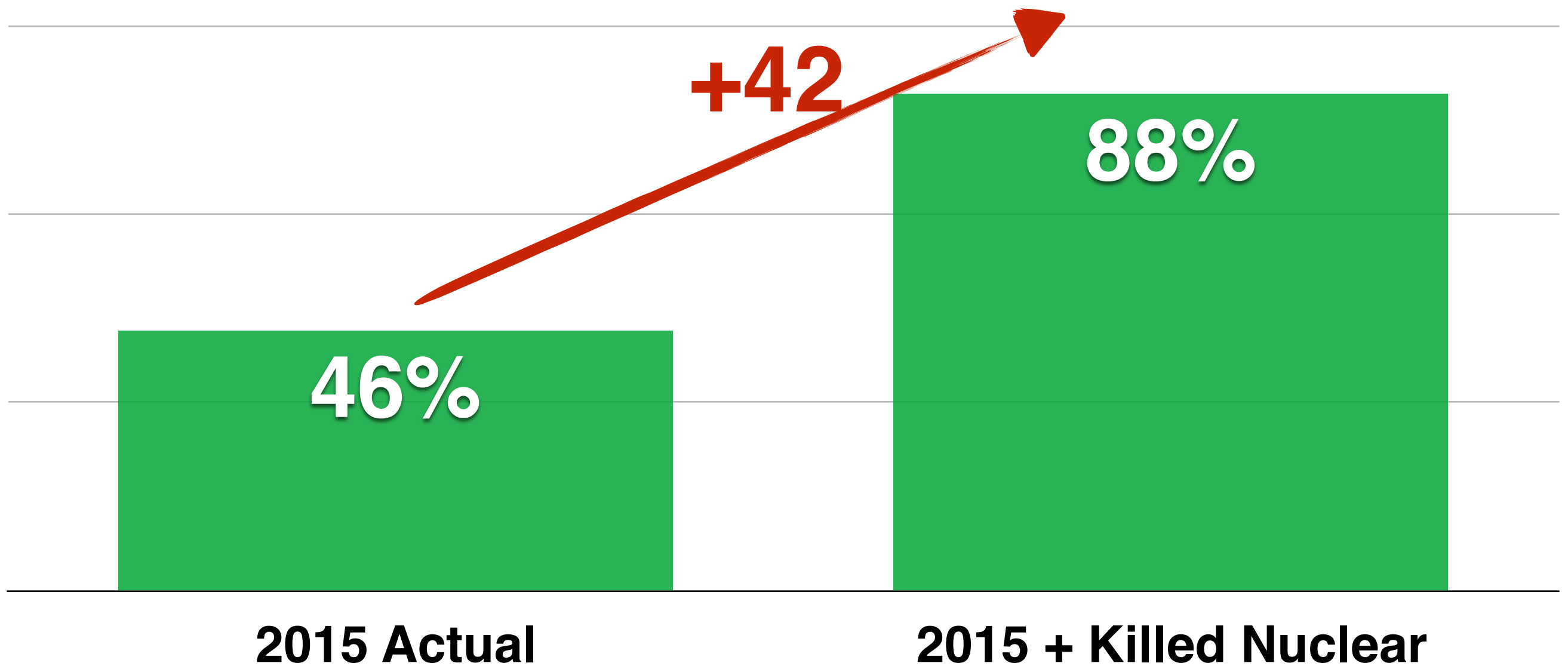
Nuclear Abandonments Locked in Fossil



Includes distributed solar

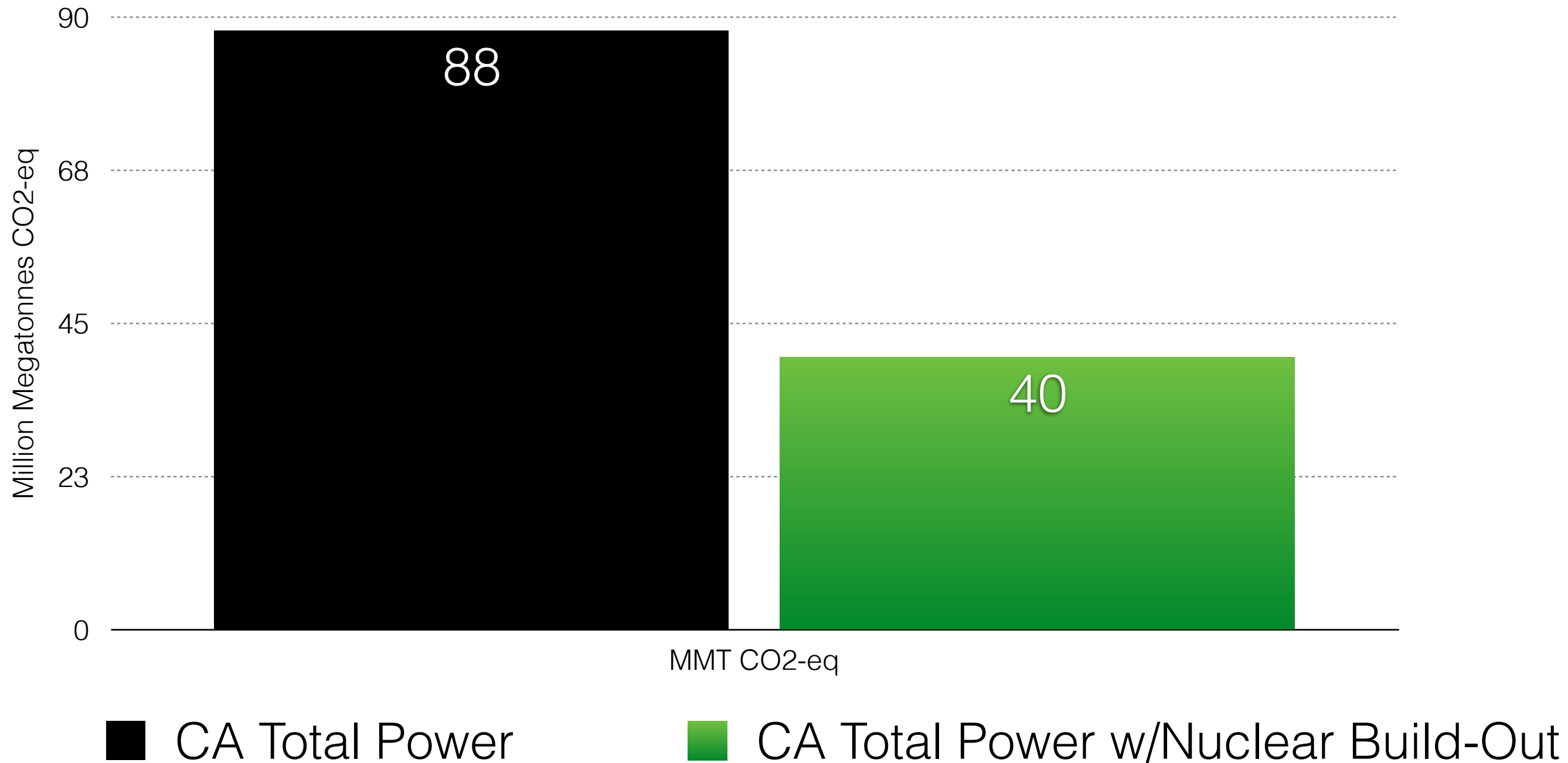
Source: US Energy Information Administration

California Clean Power 42% Less Without California Nuclear



Source: California Almanac, "In-State Power," 2016; Rooftop Solar Added;
https://docs.google.com/spreadsheets/d/1uXuqaE-BBvdNLnmuUic5mmhCkqOoU0VTunn3meS_dAU/edit?usp=sharing

California Emissions Are 2x Higher Without Nuclear



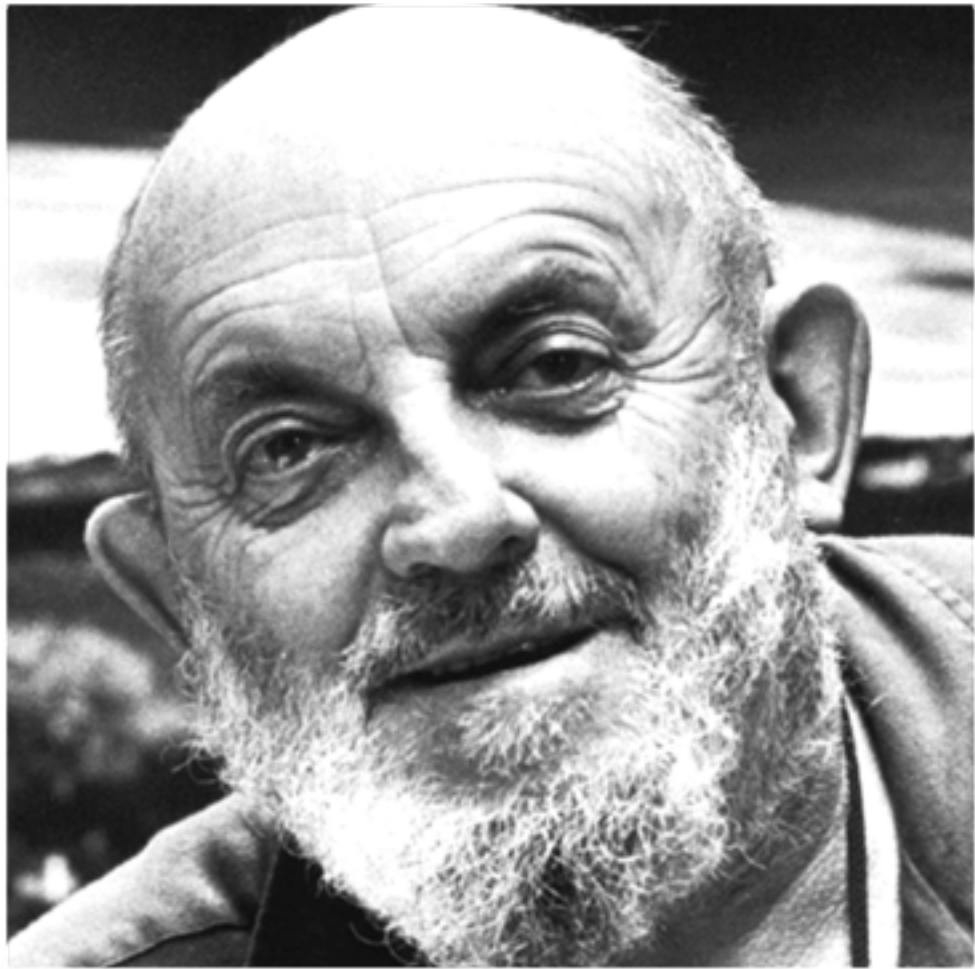
Source: California Almanac, "In-State Generation by Fuel Type", 2016





"It's like half the people who were saying 'No nukes!' are now realizing nuclear is the best way to go for energy for the future. "I think it's natural to reexamine your beliefs as you age up."

— Robert Downey, Jr., April 15, 2016



“Nuclear energy is the only practical alternative that we have to destroying the environment with oil and coal.”

— Ansel Adams, 1983