# DOCKETED

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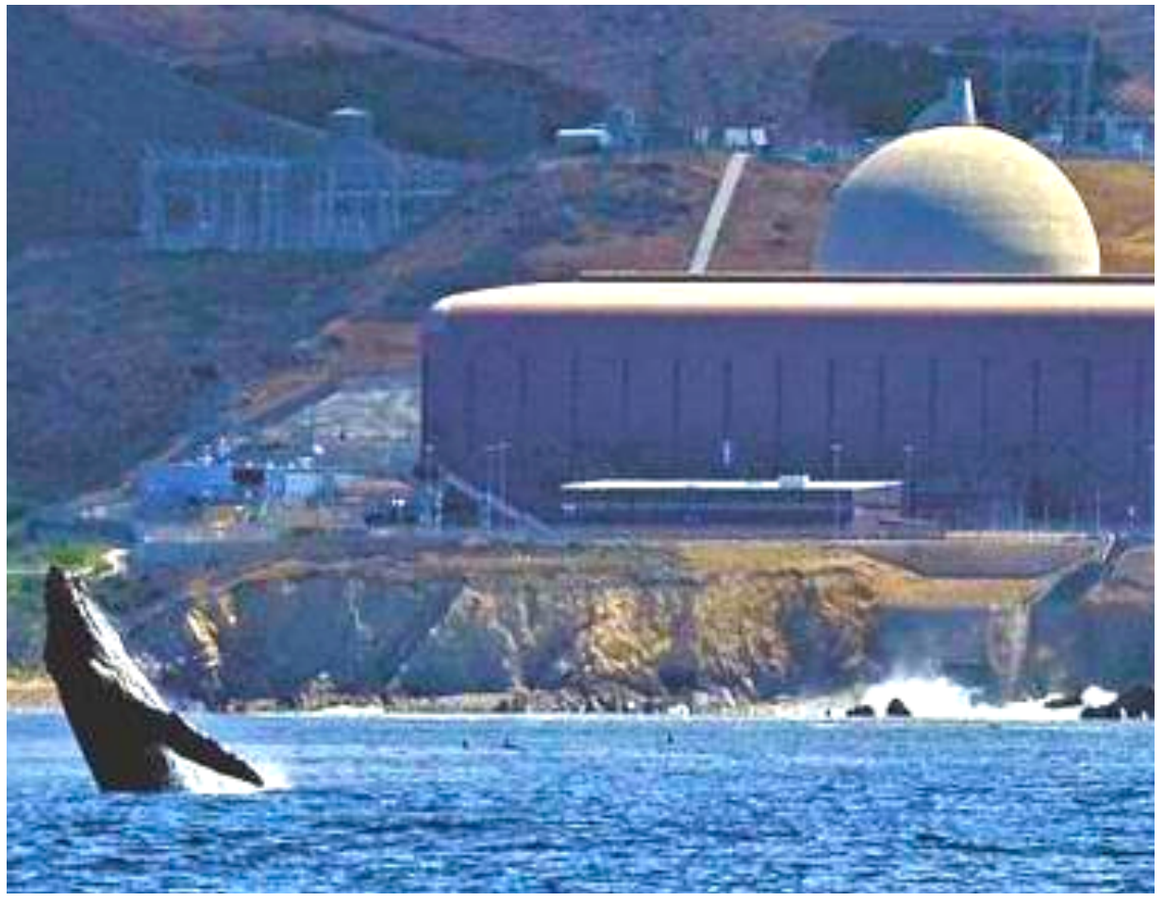
| **TN #:** | 210140 |
| **Document Title:** | Energy & Environmental Implications of a Diablo Canyon Closure |
| **Description:** | Research & analysis by Michael Shellenberger (michaelshellenberger@gmail.com) for SaveDiabloCanyon.org |
| **Filer:** | Raquel Kravitz |
| **Organization:** | California Energy Commission |
| **Submitter Role:** | Commission Staff |
| **Submission Date:** | 2/3/2016 11:21:19 AM |
| **Docketed Date:** | 2/3/2016 |



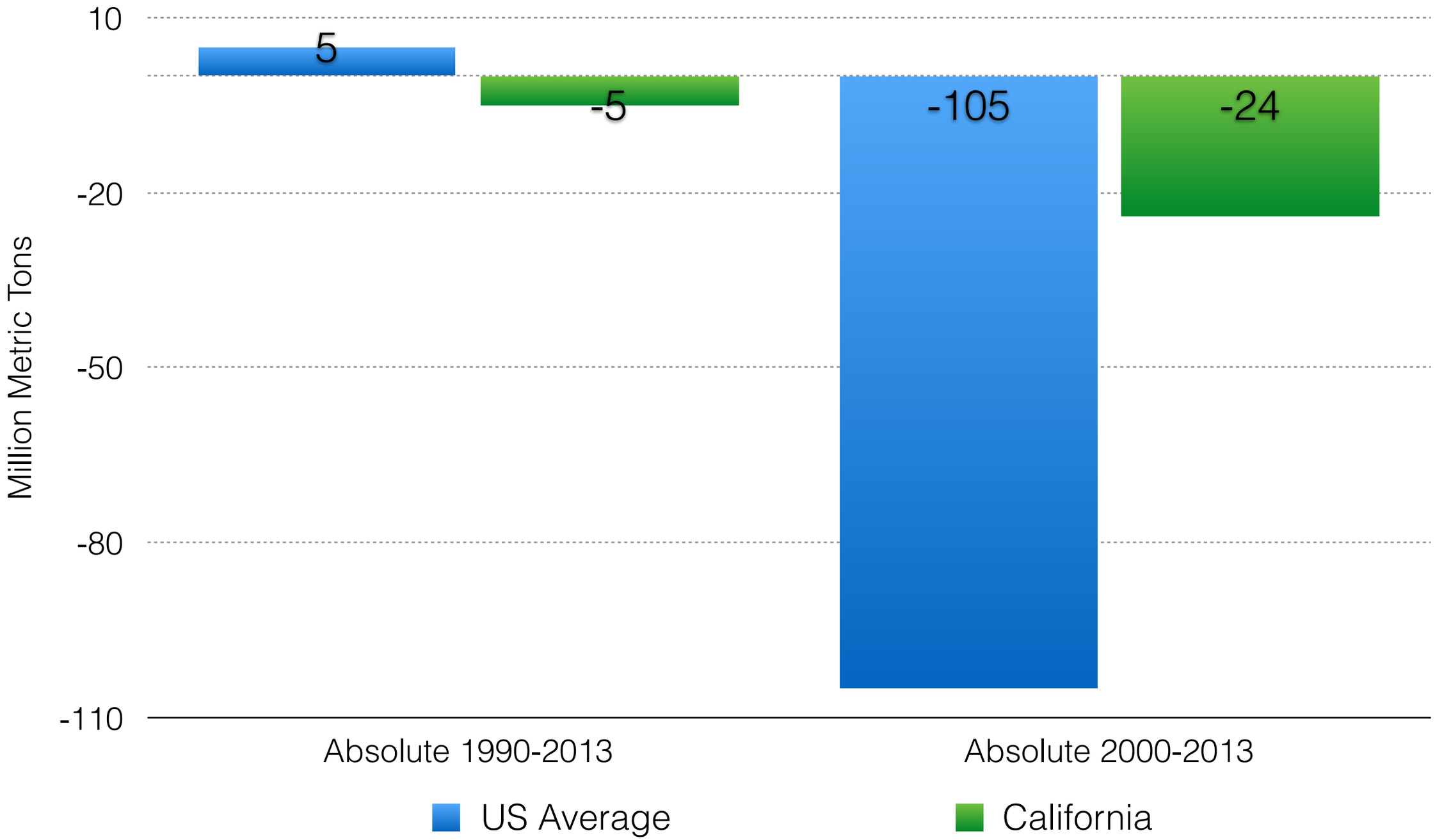
# Energy & Environmental Implications of a Diablo Canyon Closure

Research & analysis by Michael Shellenberger
(michaelshellenberger@gmail.com) for SaveDiabloCanyon.org
January 29, 2016

# California Emissions Overview
# US Energy Information Administration data

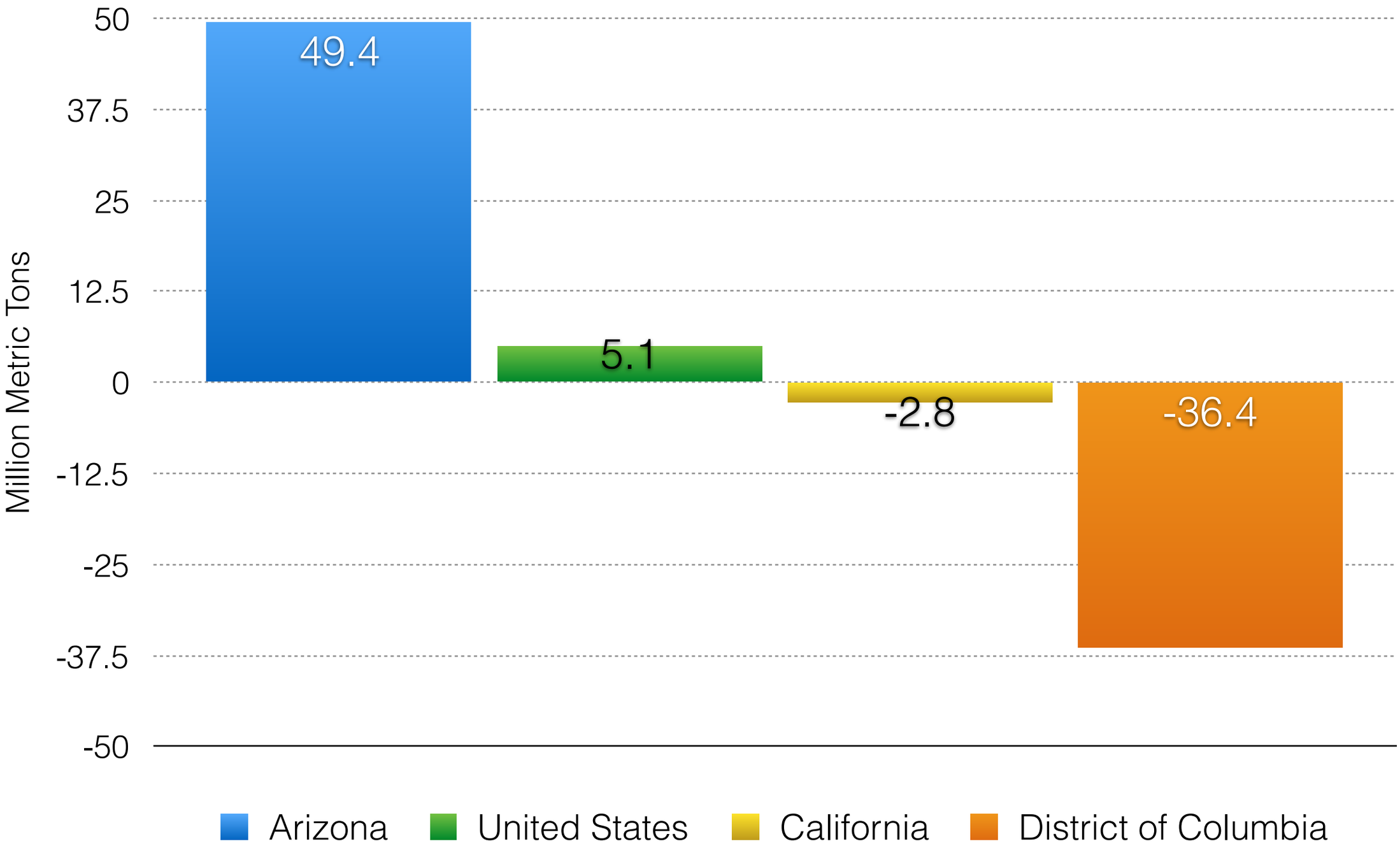
## Includes emissions from in-state electricity only

# Absolute Change in California vs average US state CO2 emissions,1990 - 2013 vs. 2000 - 2013 (in-state only)



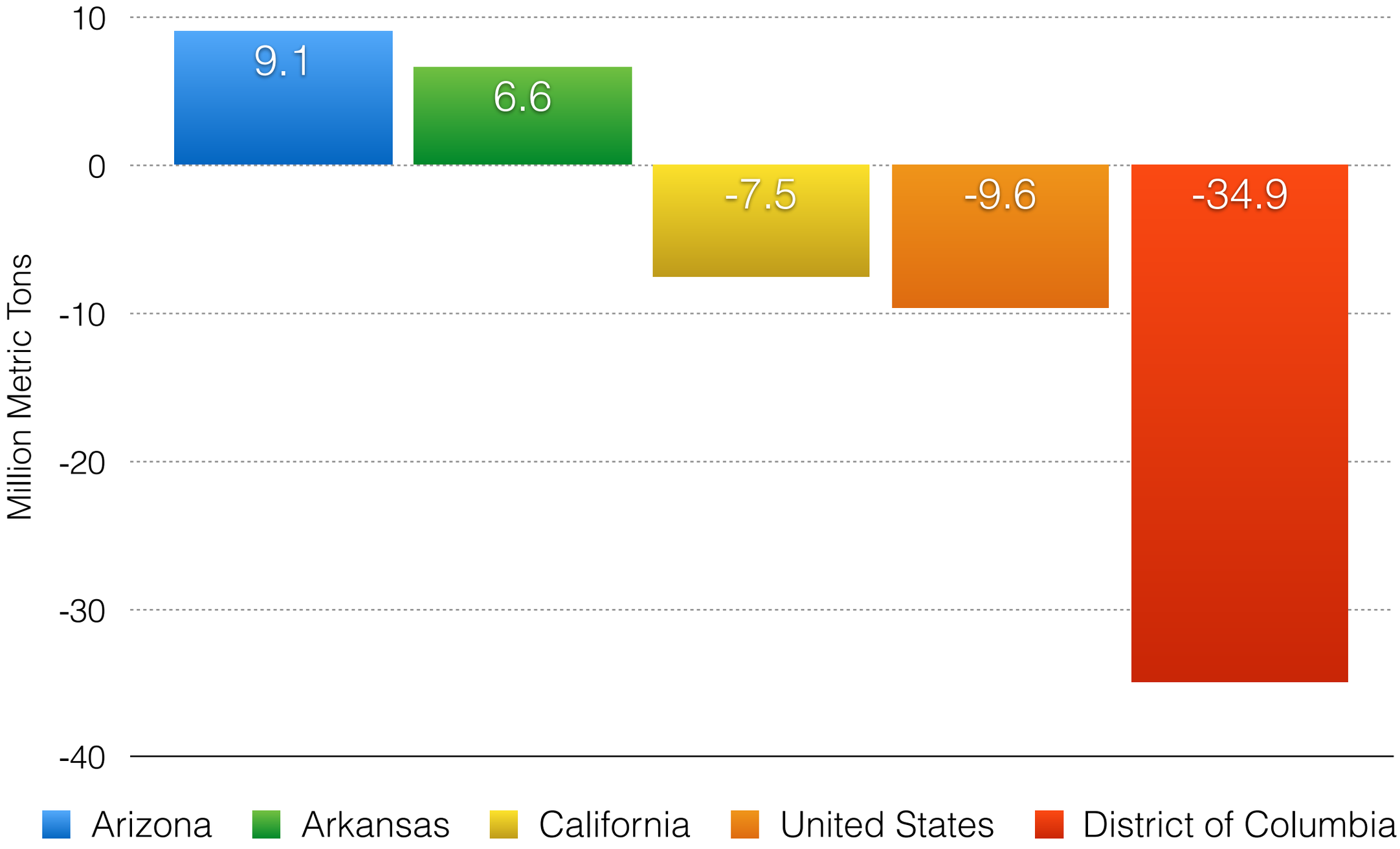

**Source**: US Energy Information Agency, "State Carbon Dioxide Emissions," October 2015

# Percent Change in CO2 emissions 1990-2013 (in-state only)




**Source**: US Energy Information Agency, "State Carbon Dioxide Emissions," October 2015

# Percent Change in CO2 emissions 2000-2013
## (In-state only)

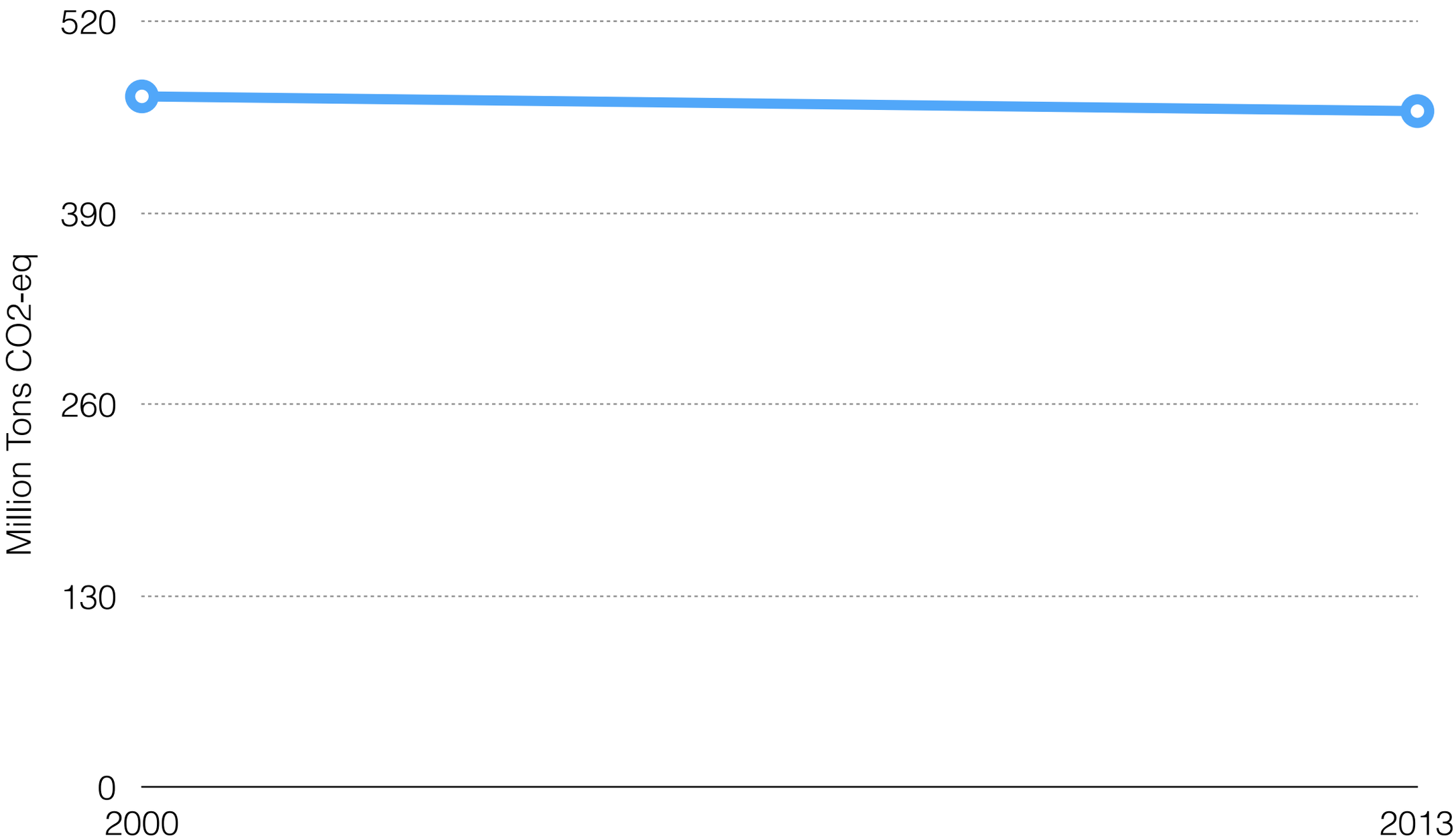



**Source**: US Energy Information Agency, “State Carbon Dioxide Emissions,” October 2015

California Emissions
California Almanac (state) data

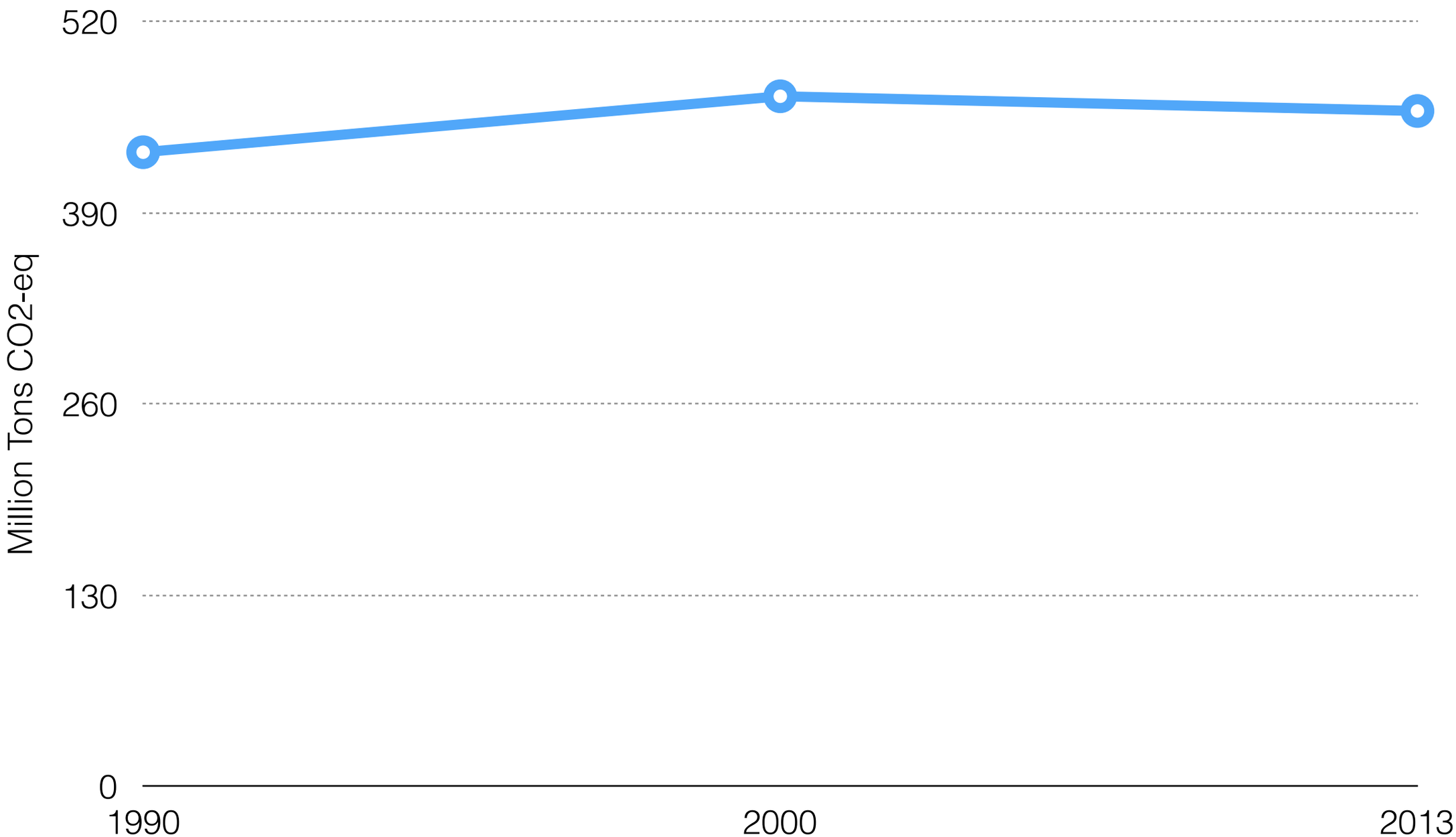
Includes emissions from both in-state electricity and out-of-state electricity

# California Emissions Fell 2% Between 2000-2013…



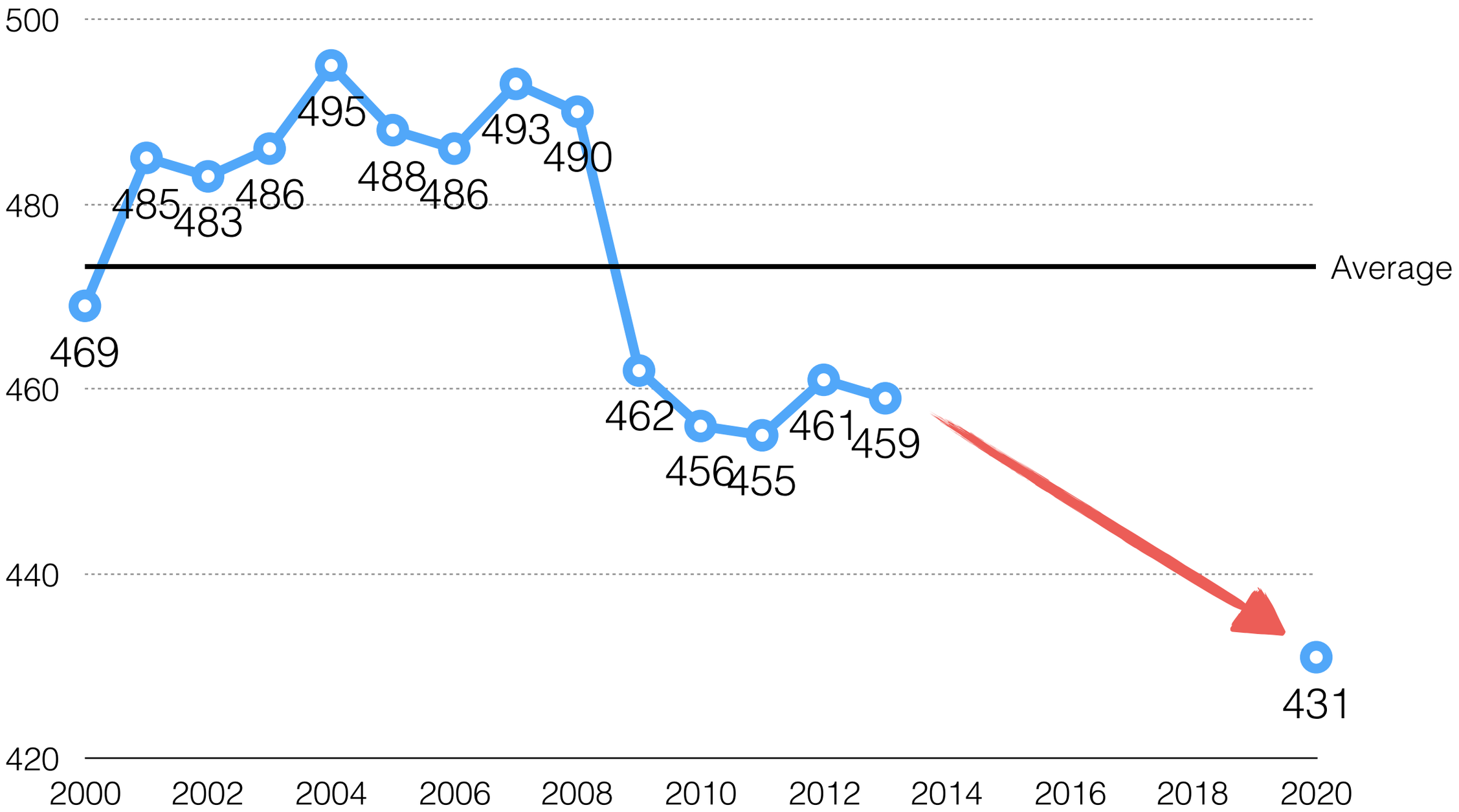

**Source**: “Greenhouse Gas Inventory,” California Air Resources Board, 2015

# California Emissions Rose 8.8% between 1990-2013

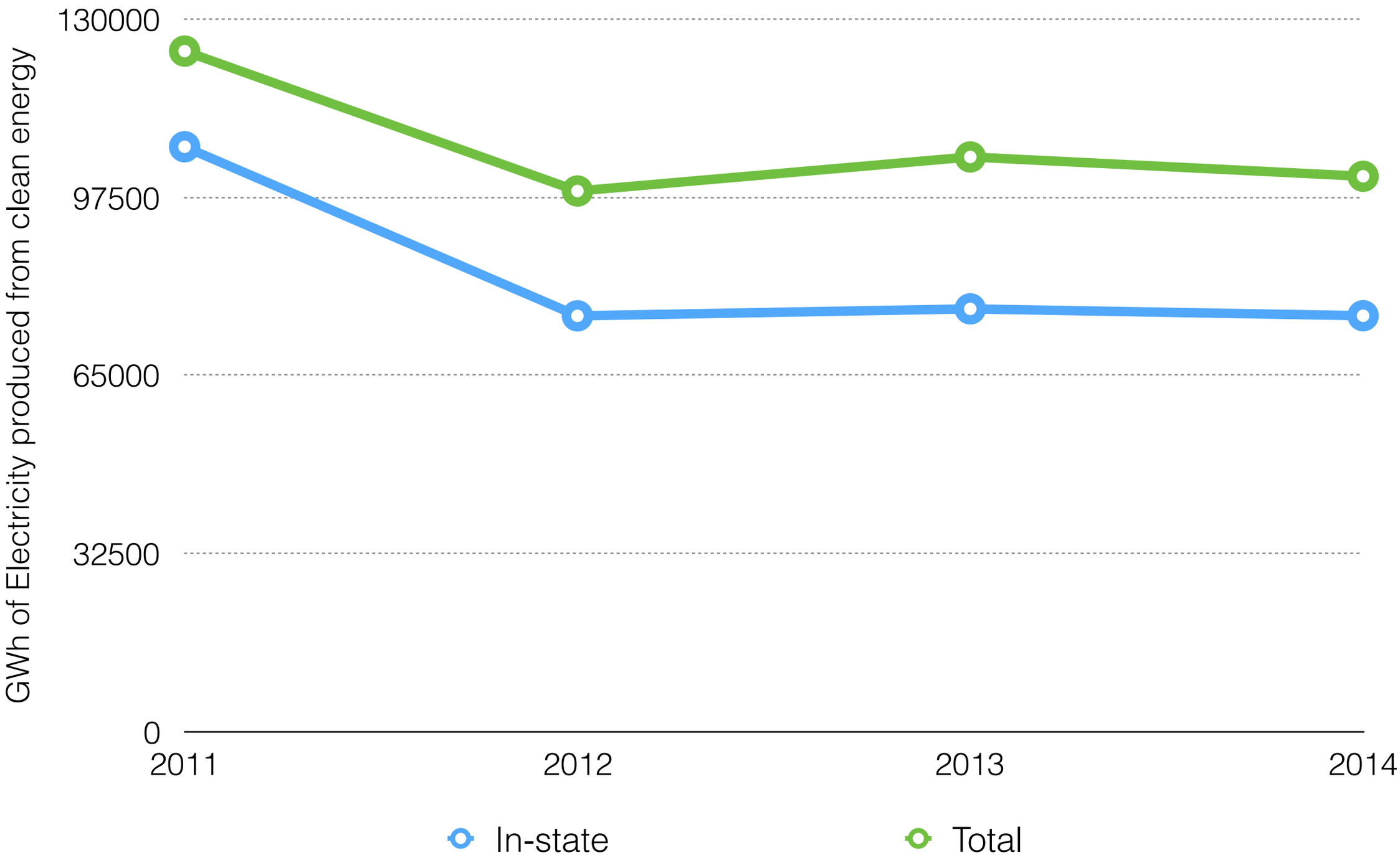



**Source**: “Greenhouse Gas Inventory,” California Air Resources Board, 2015

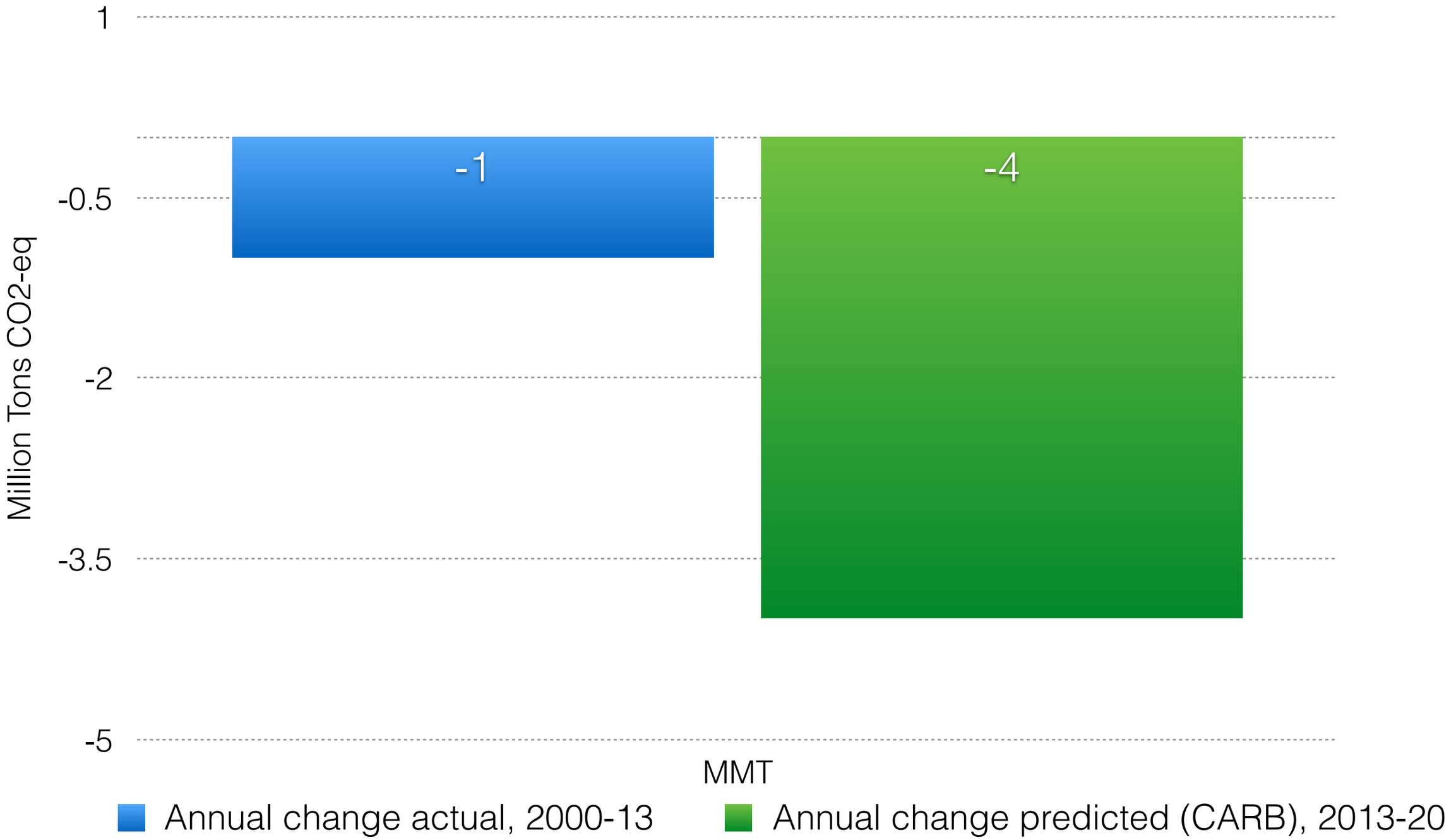
# California actual emissions & 2020 target



# CO2 data from 2014 isn't yet available but emissions were likely flat or higher in 2014 given energy trends

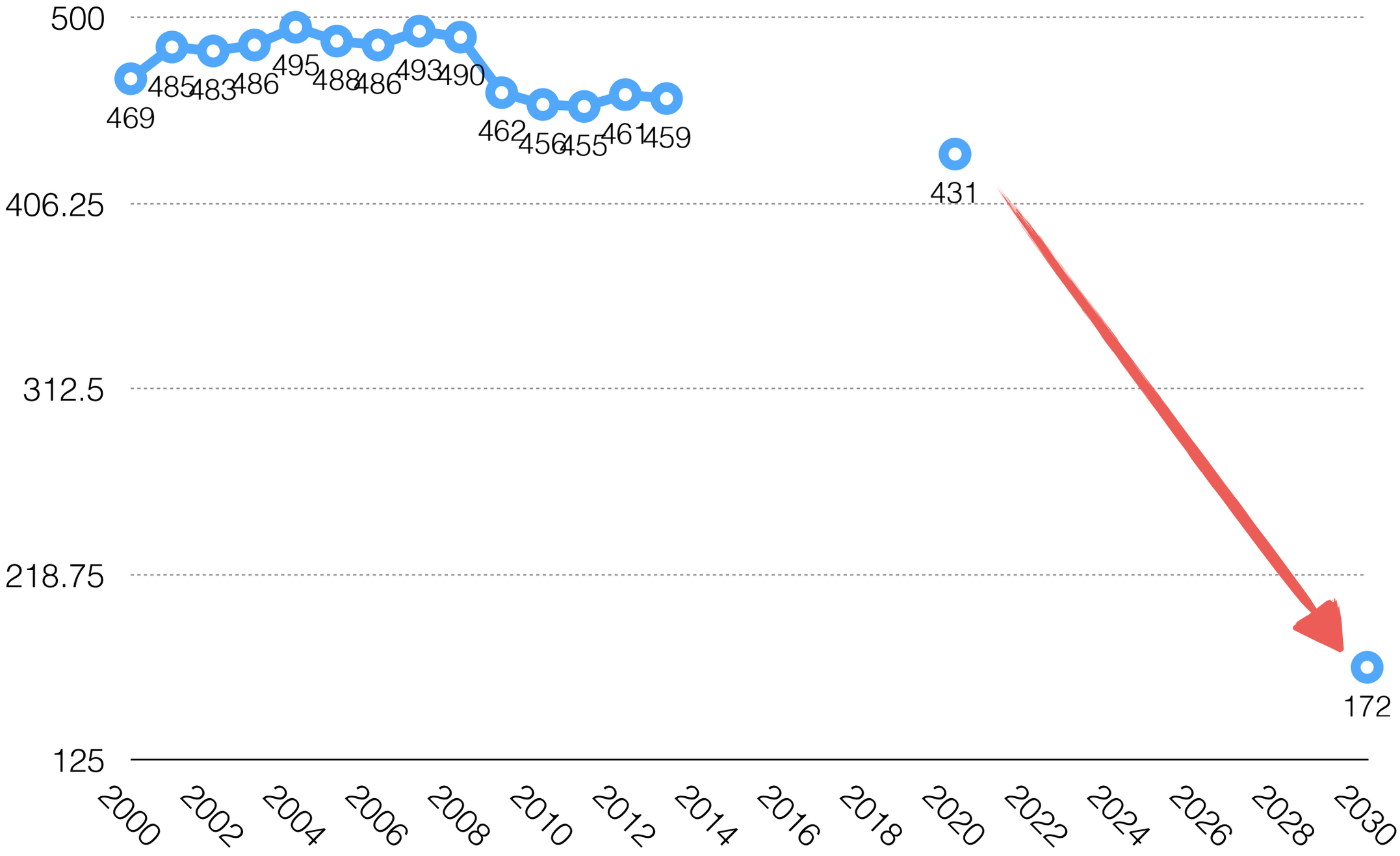


# CA Air Resources Board predicts emissions will fall 4x faster from 2016 - 20 than 2000-13



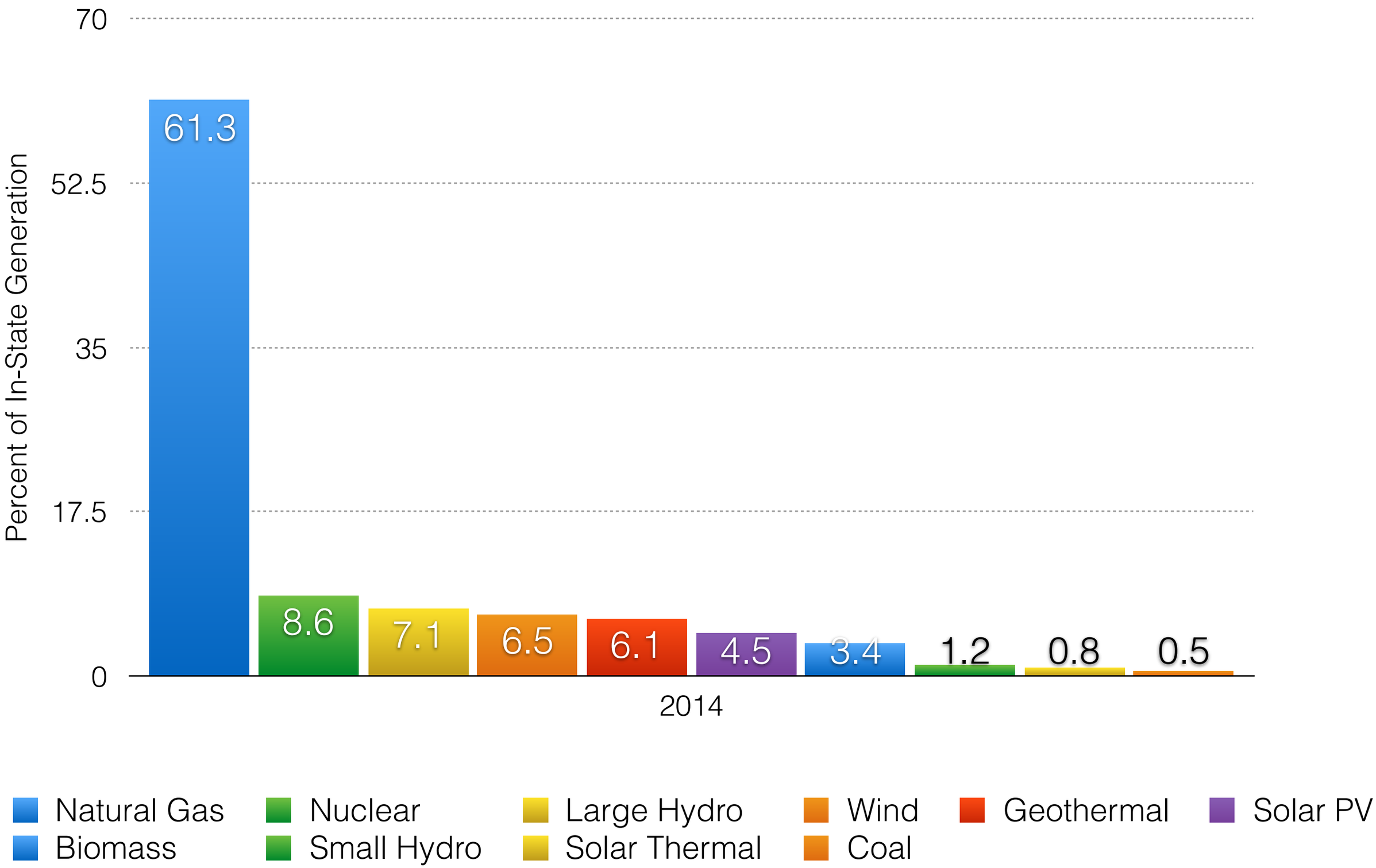

**Source**: “Greenhouse Gas Inventory,” California Air Resources Board, 2015

# California actual emissions & 2030 target



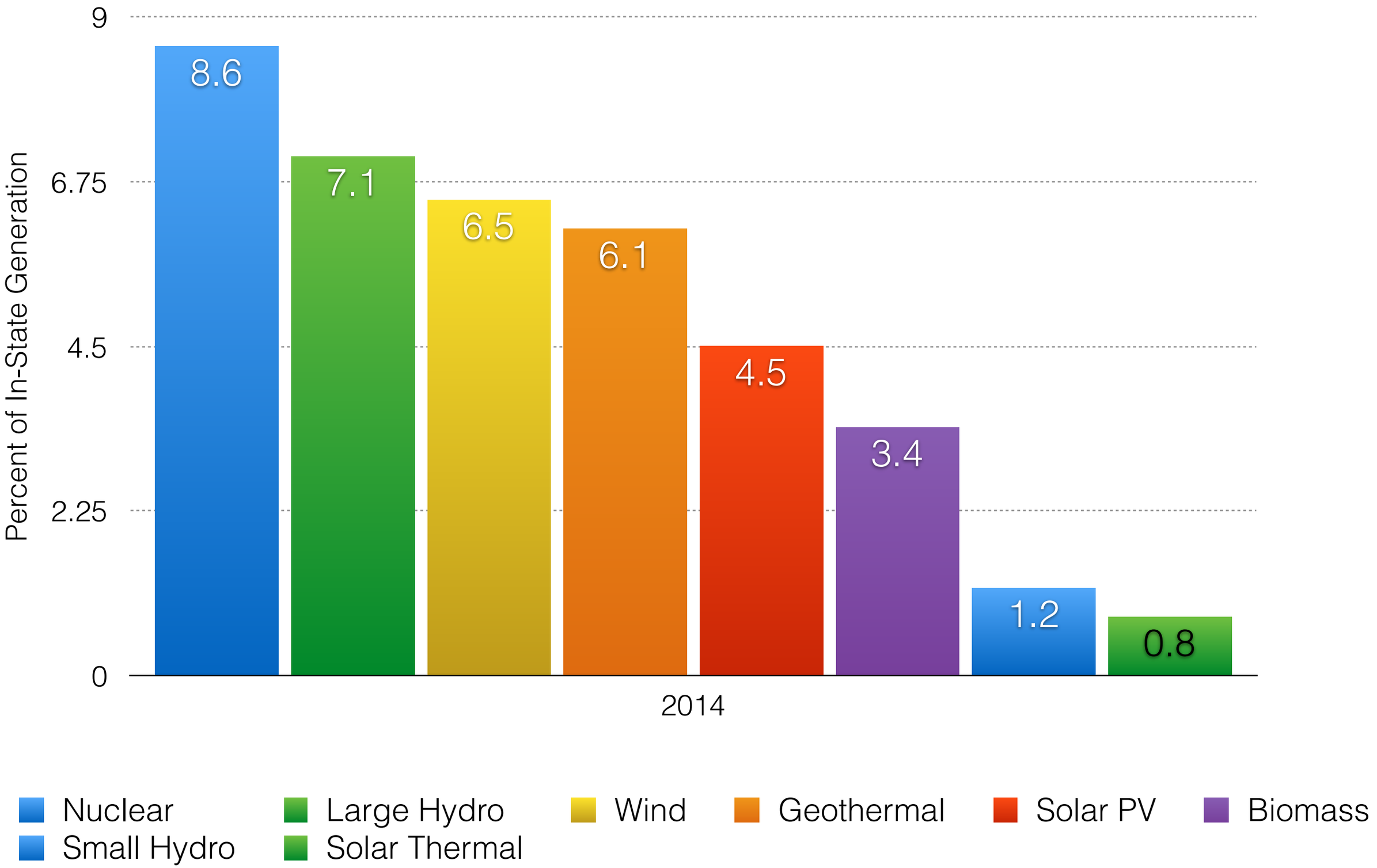
# California Energy Overview

# California In-State Generation, by percent, 2014




California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California Clean Electricity, by percent, 2014




California Almanac, “In-State Generation by Fuel Type”
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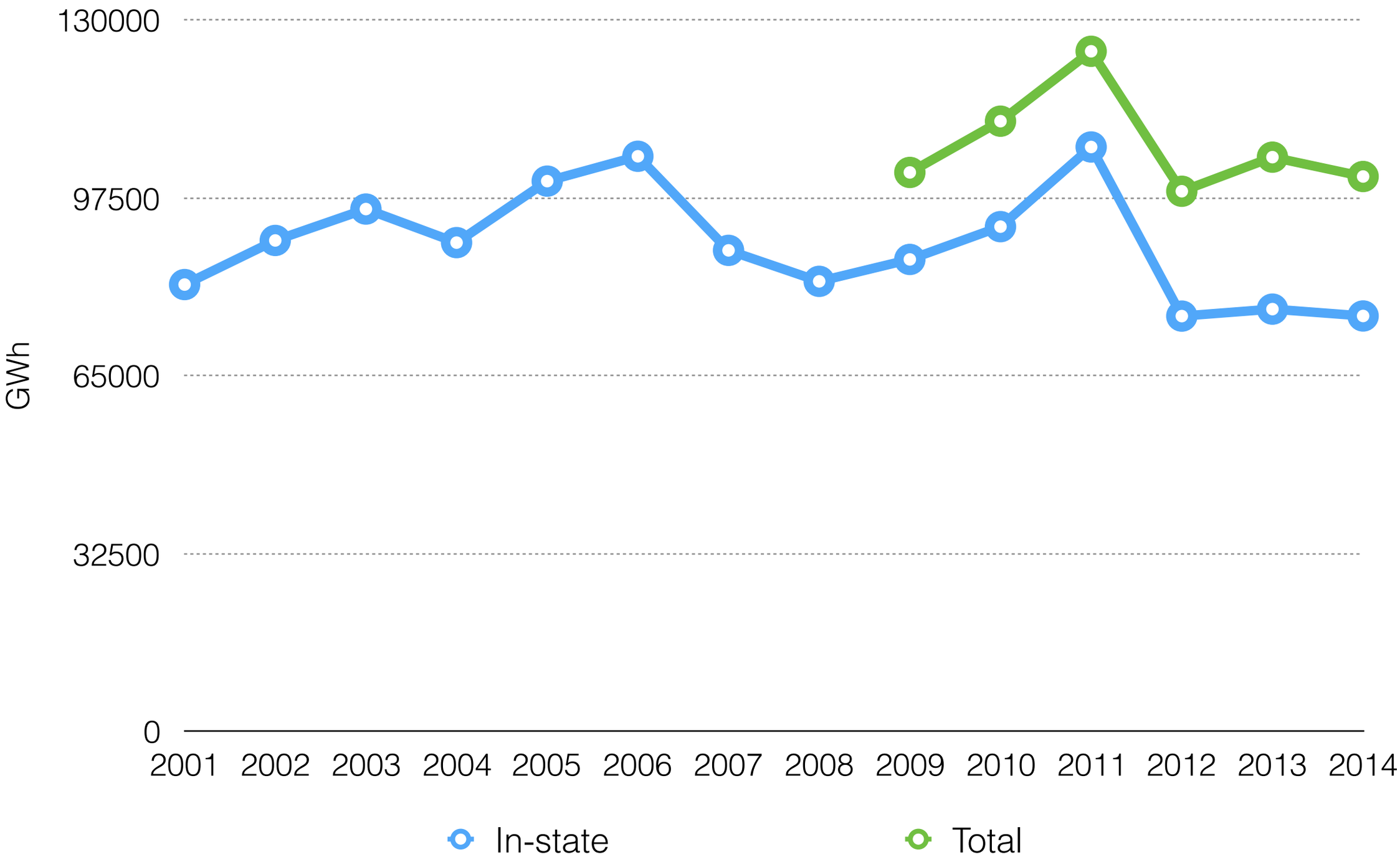
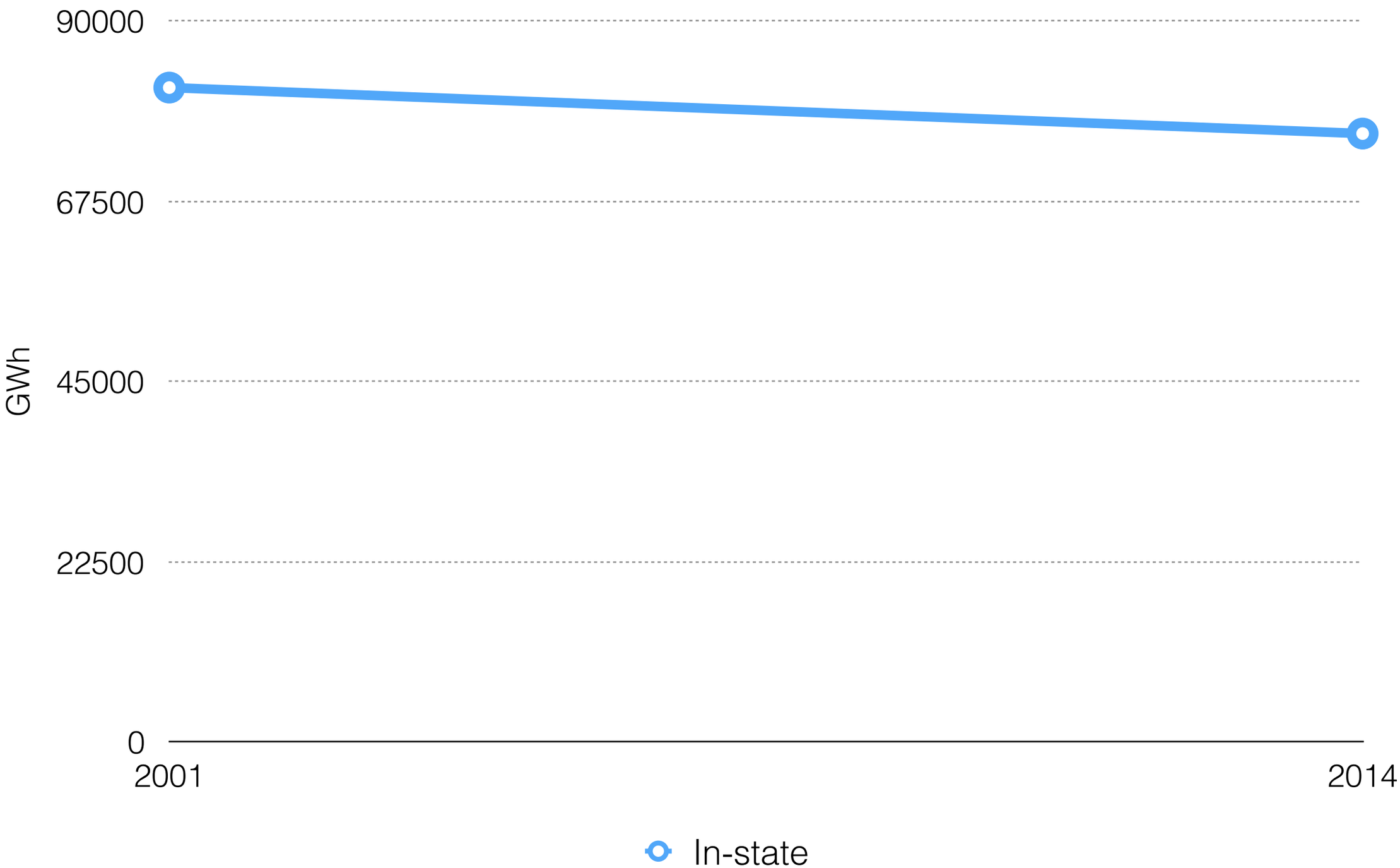
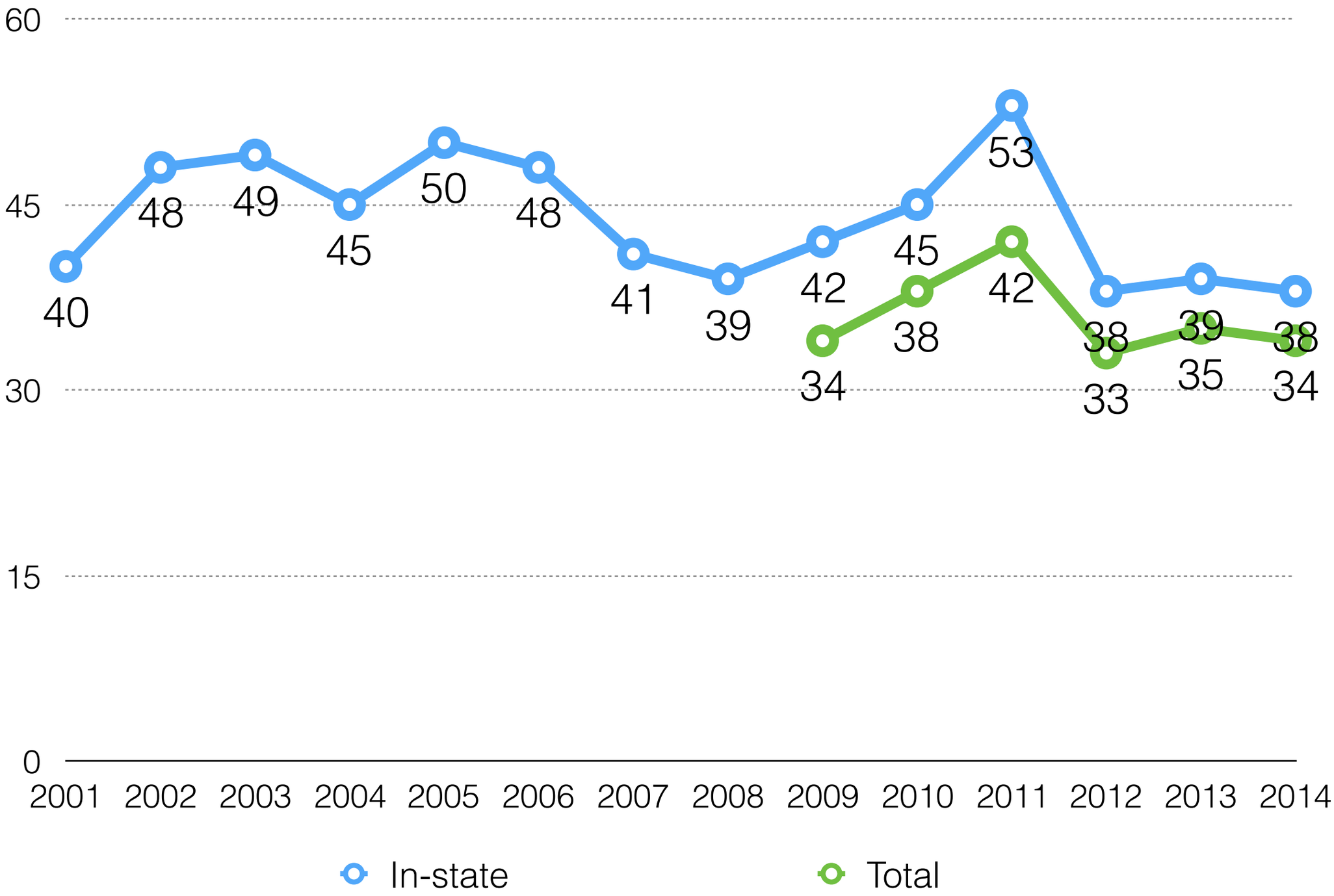
# California clean electricity (in-state & total)



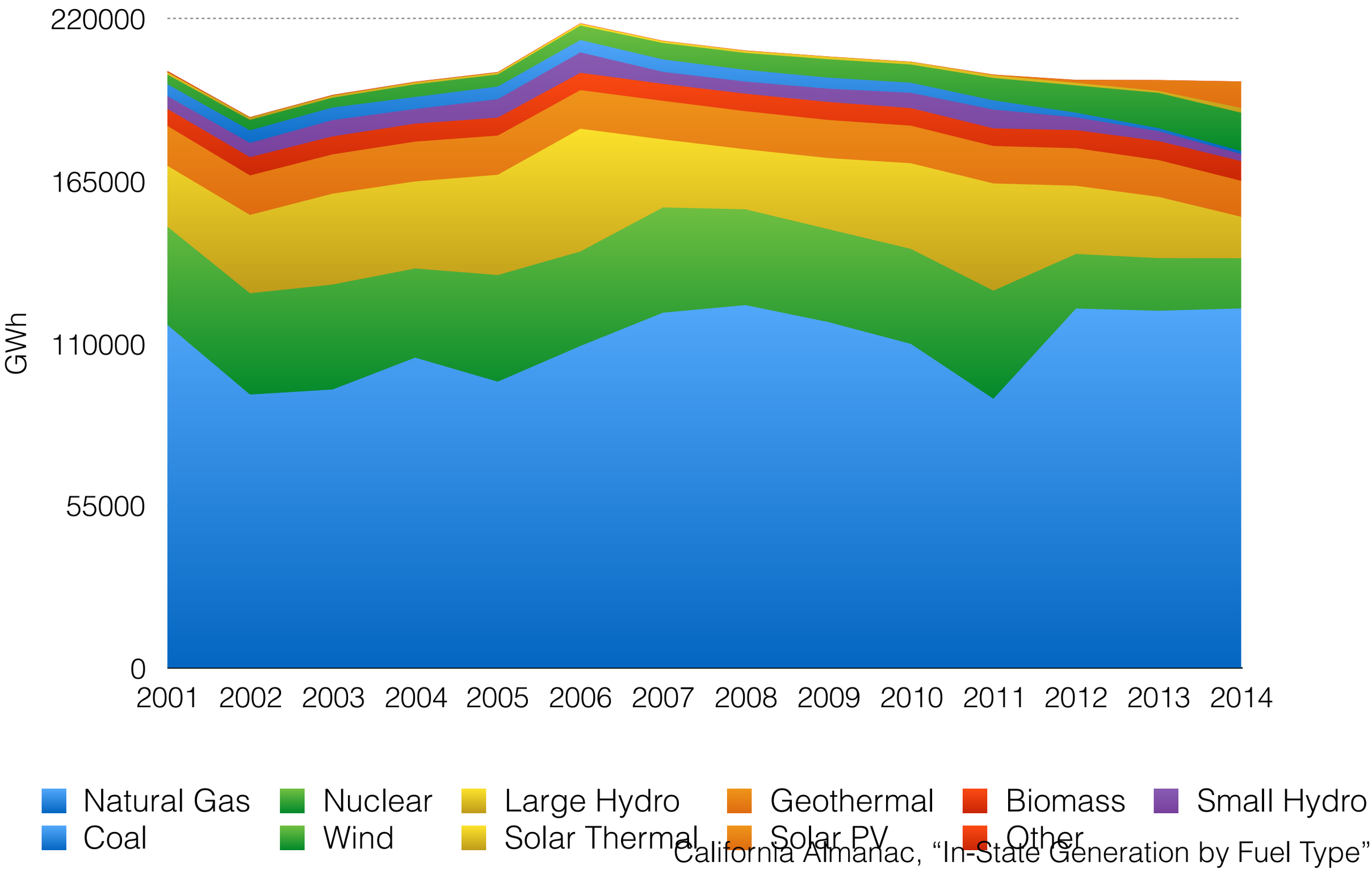
# California clean electricity in-state



# California clean electricity as percent of total

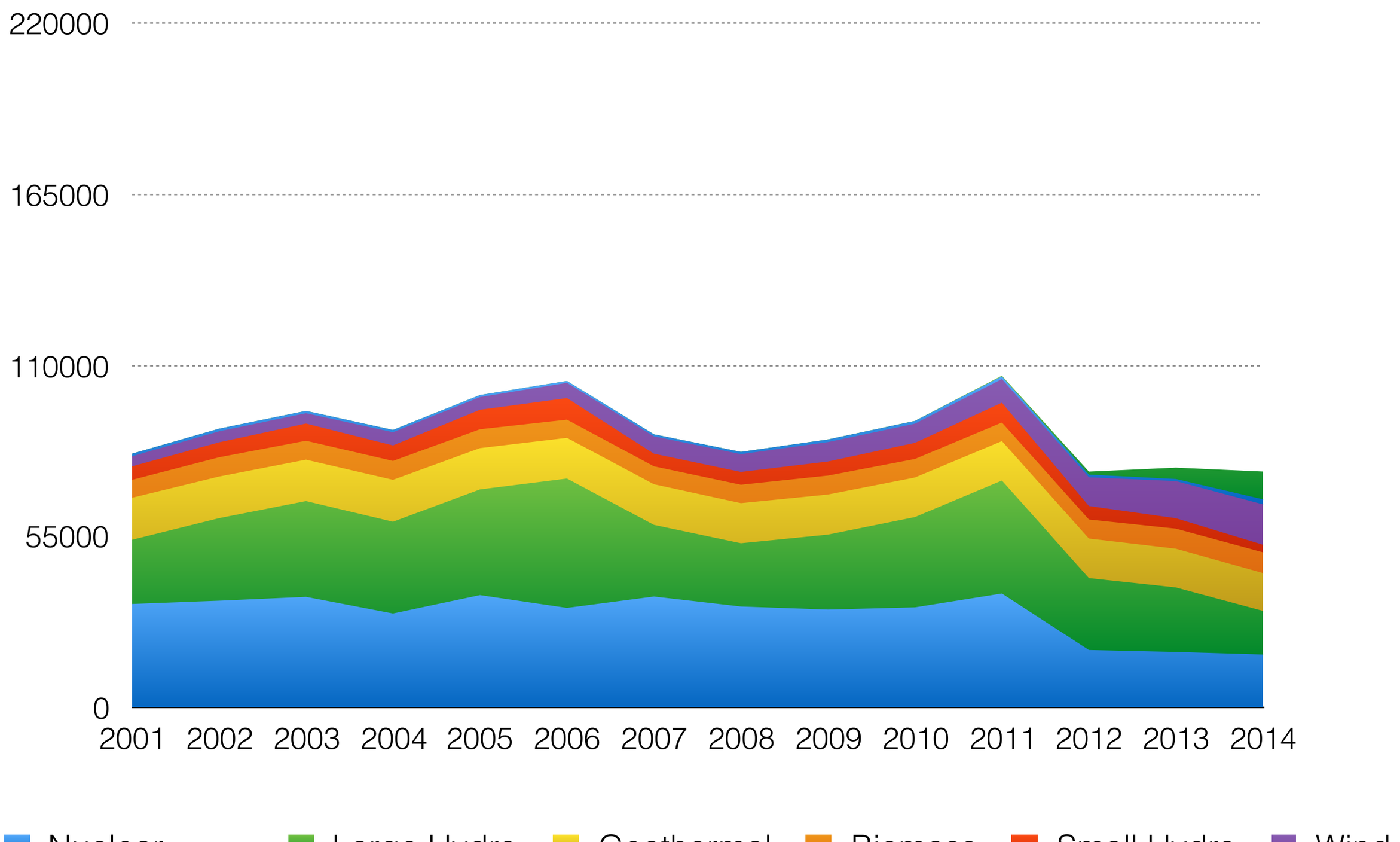


# California In-State Electricity, 2001 - 2014



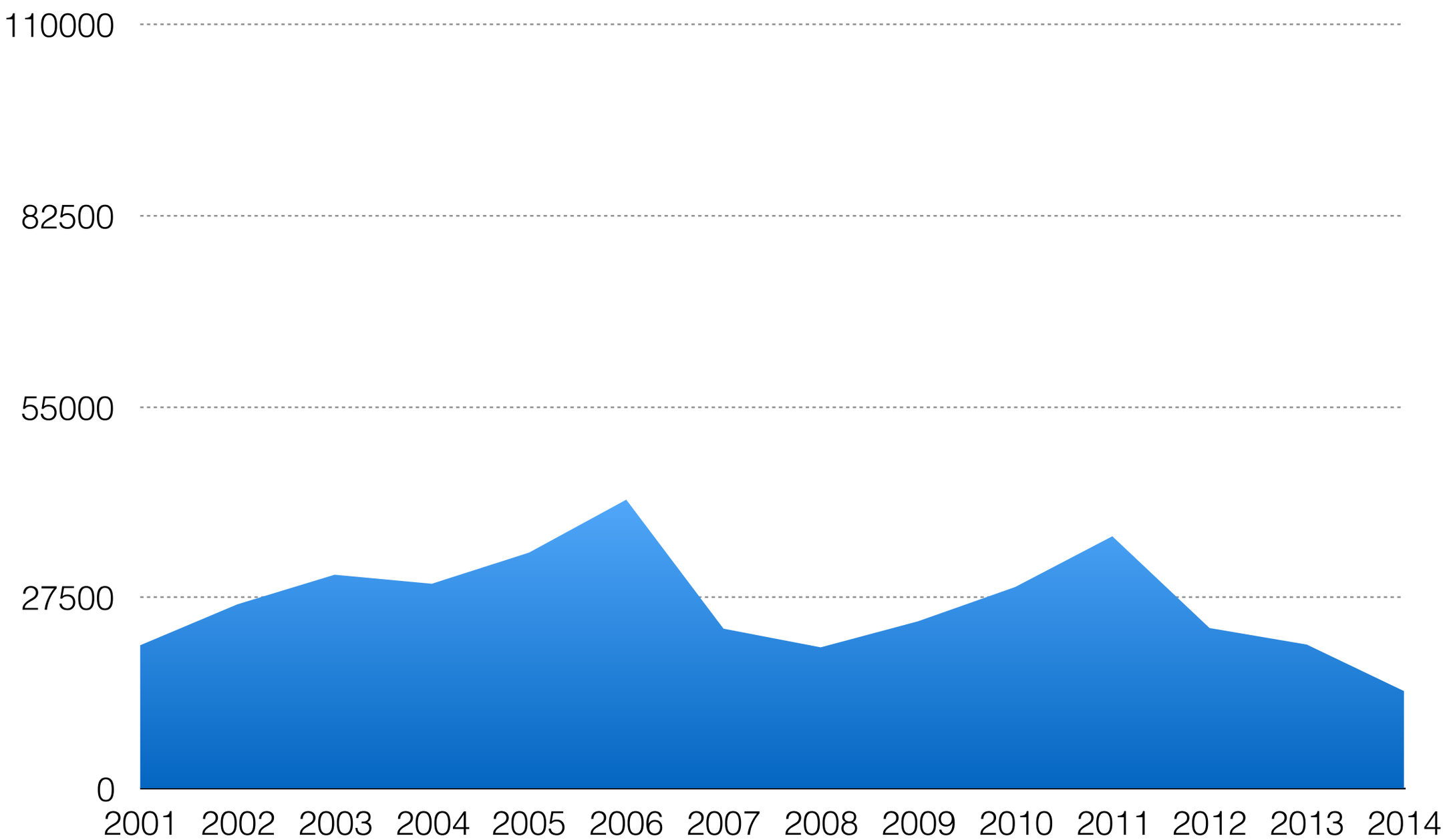

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California Clean Electricity In-State Generation, 2001 - 2014



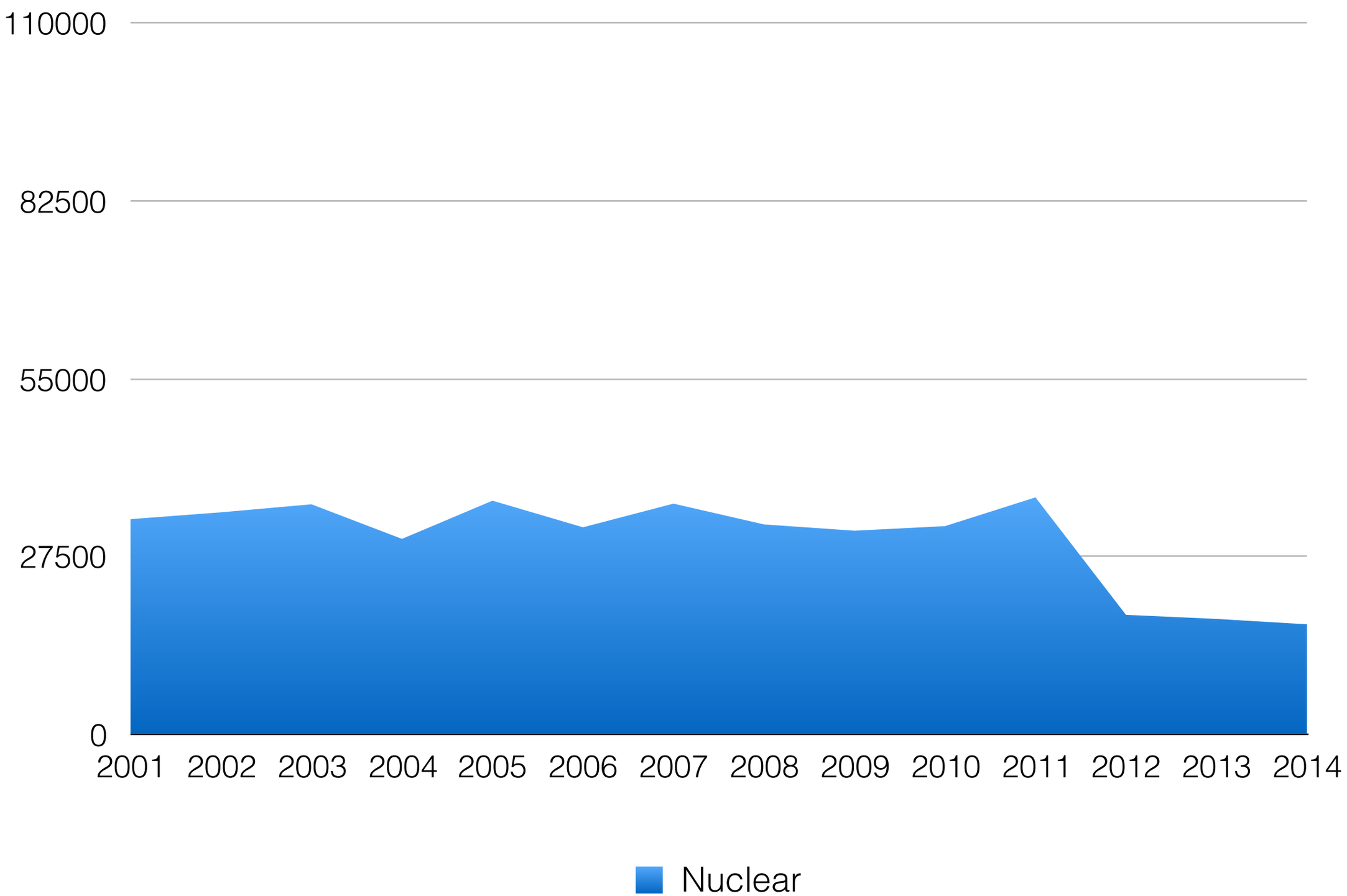

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California In-State Hydro, 2001 - 2014



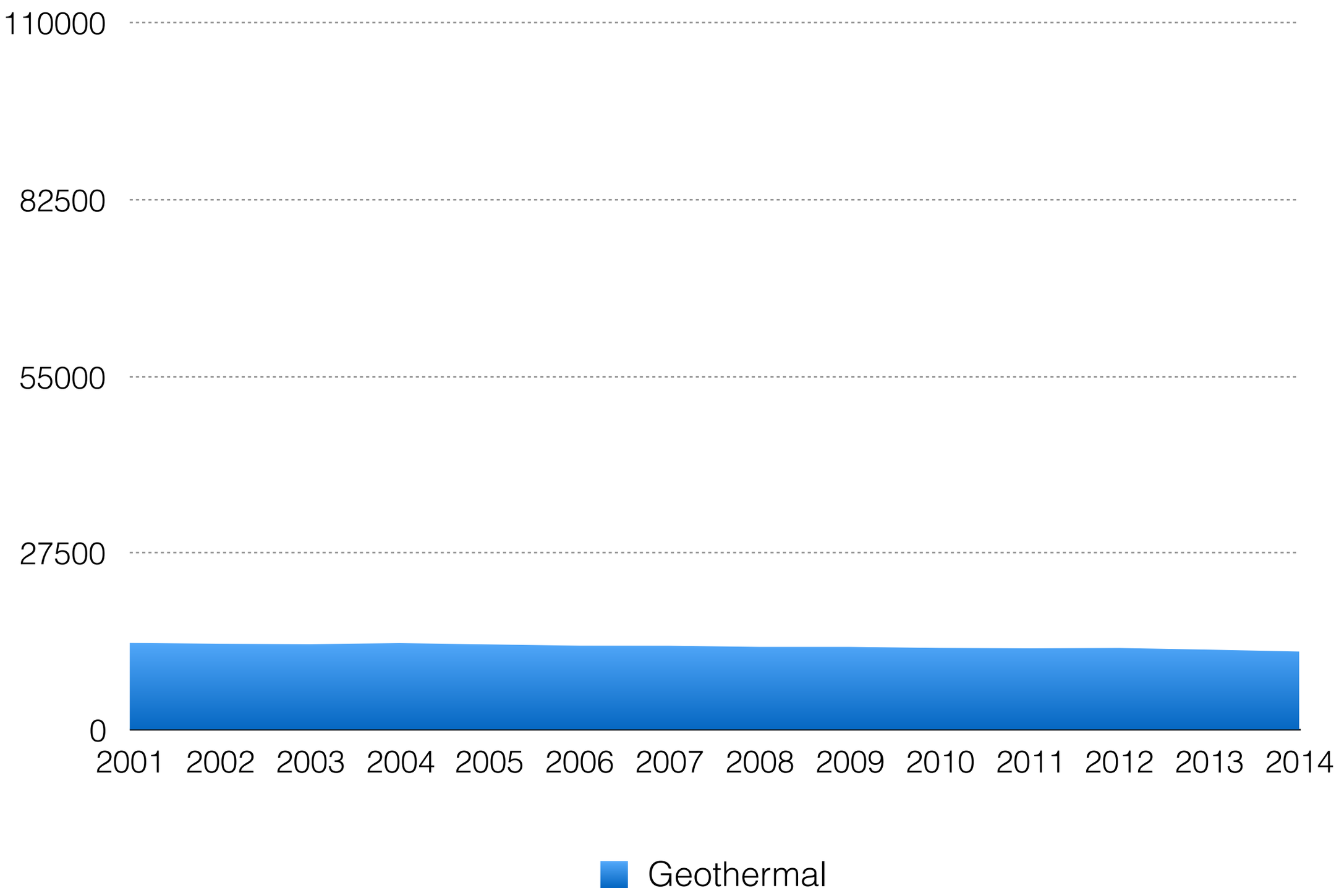

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California In-State Nuclear, 2001 - 2014



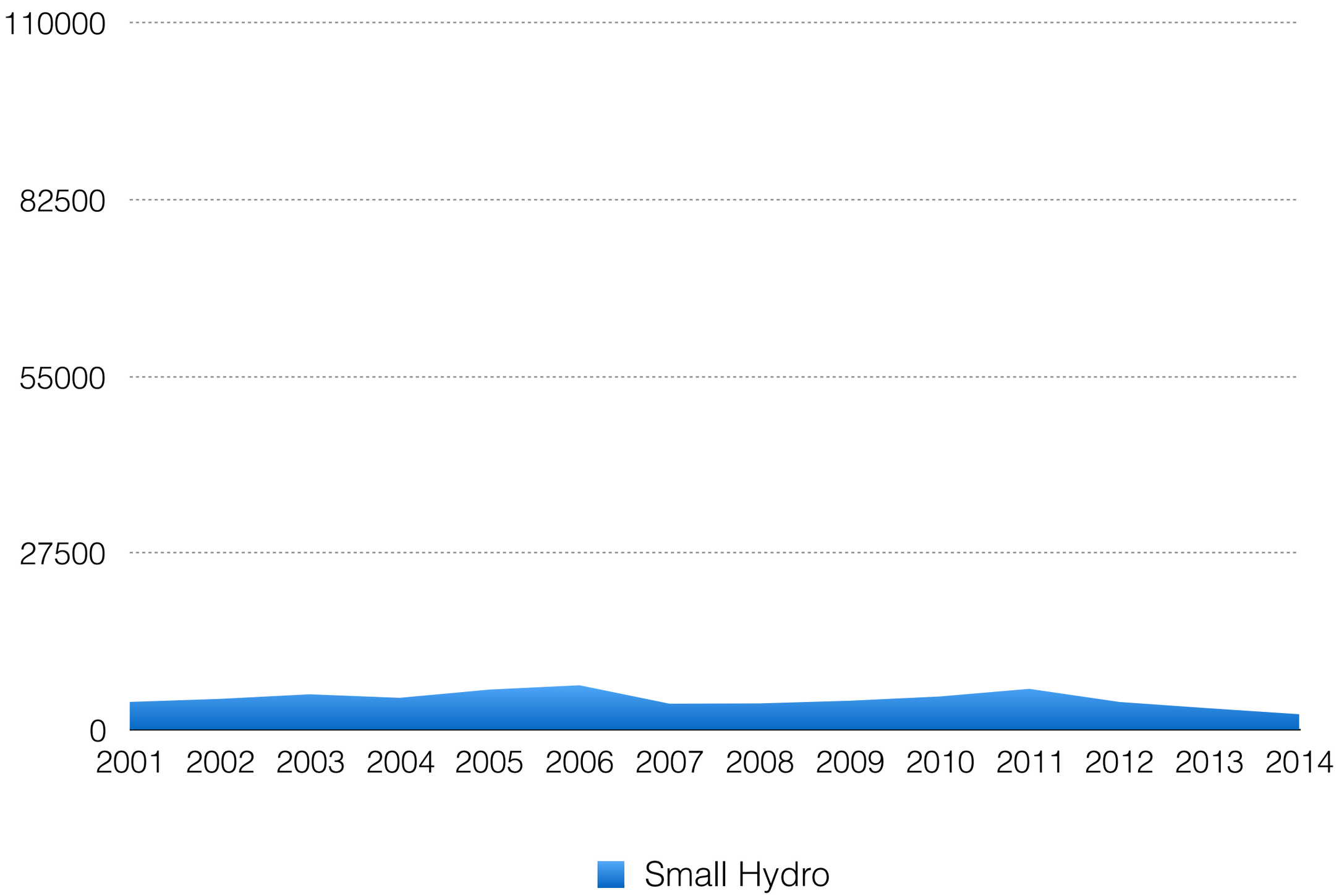

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California In-State Geothermal, 2001 - 2014



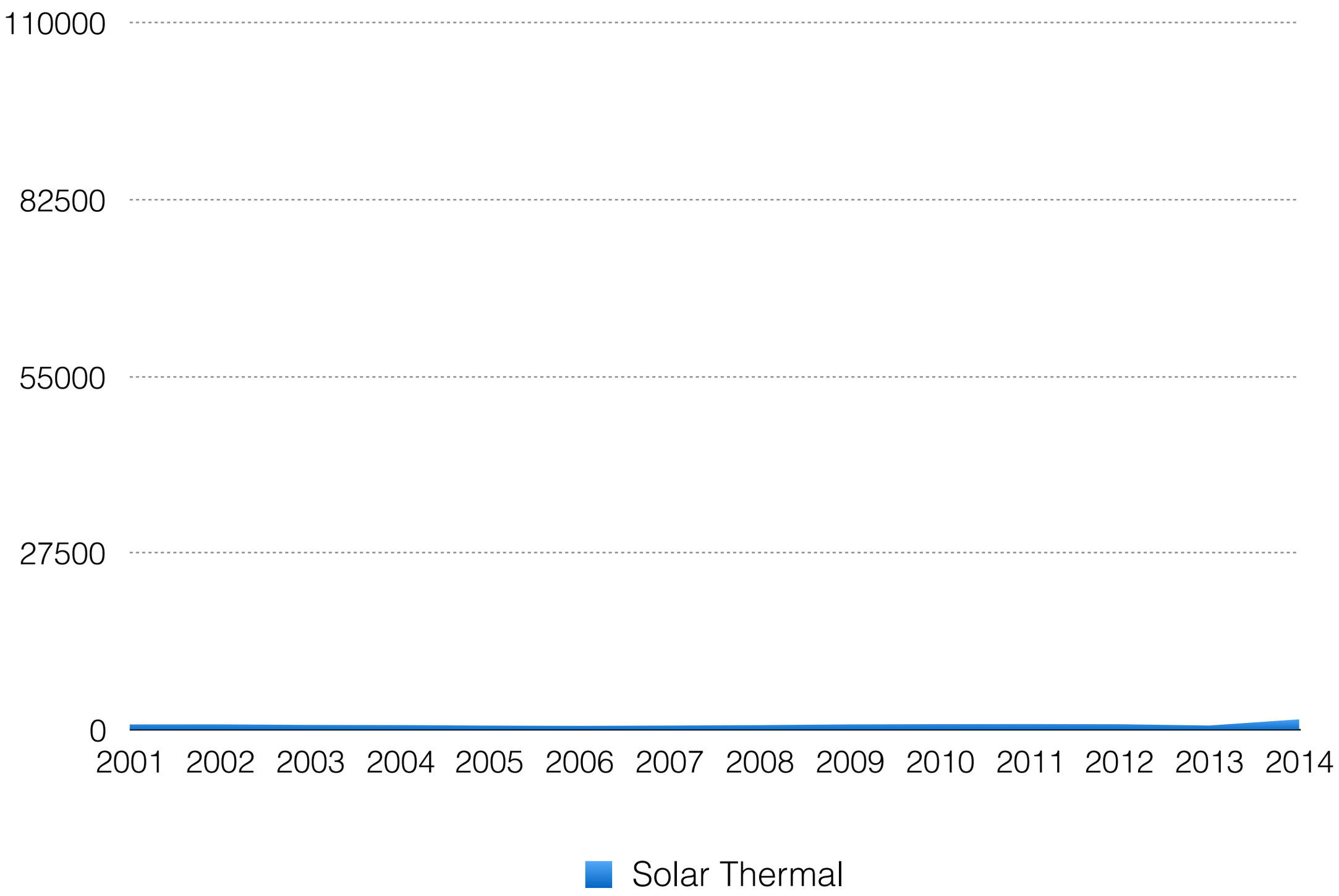

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California In-State Small Hydro, 2001 - 2014



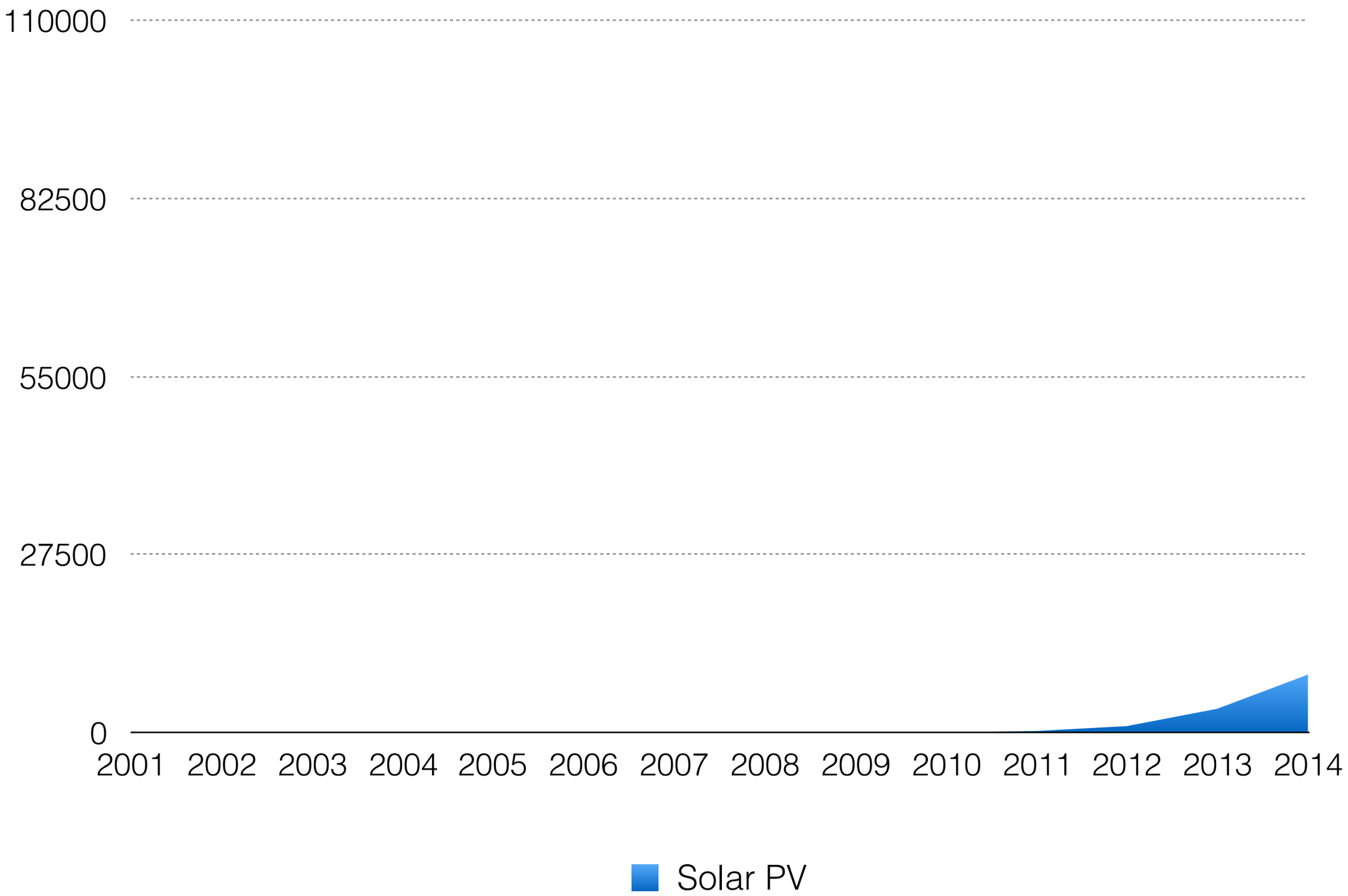

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California In-State Solar Thermal, 2001 - 2014




California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# California In-State Solar PV, 2001 - 2014




California Almanac, “In-State Generation by Fuel Type”
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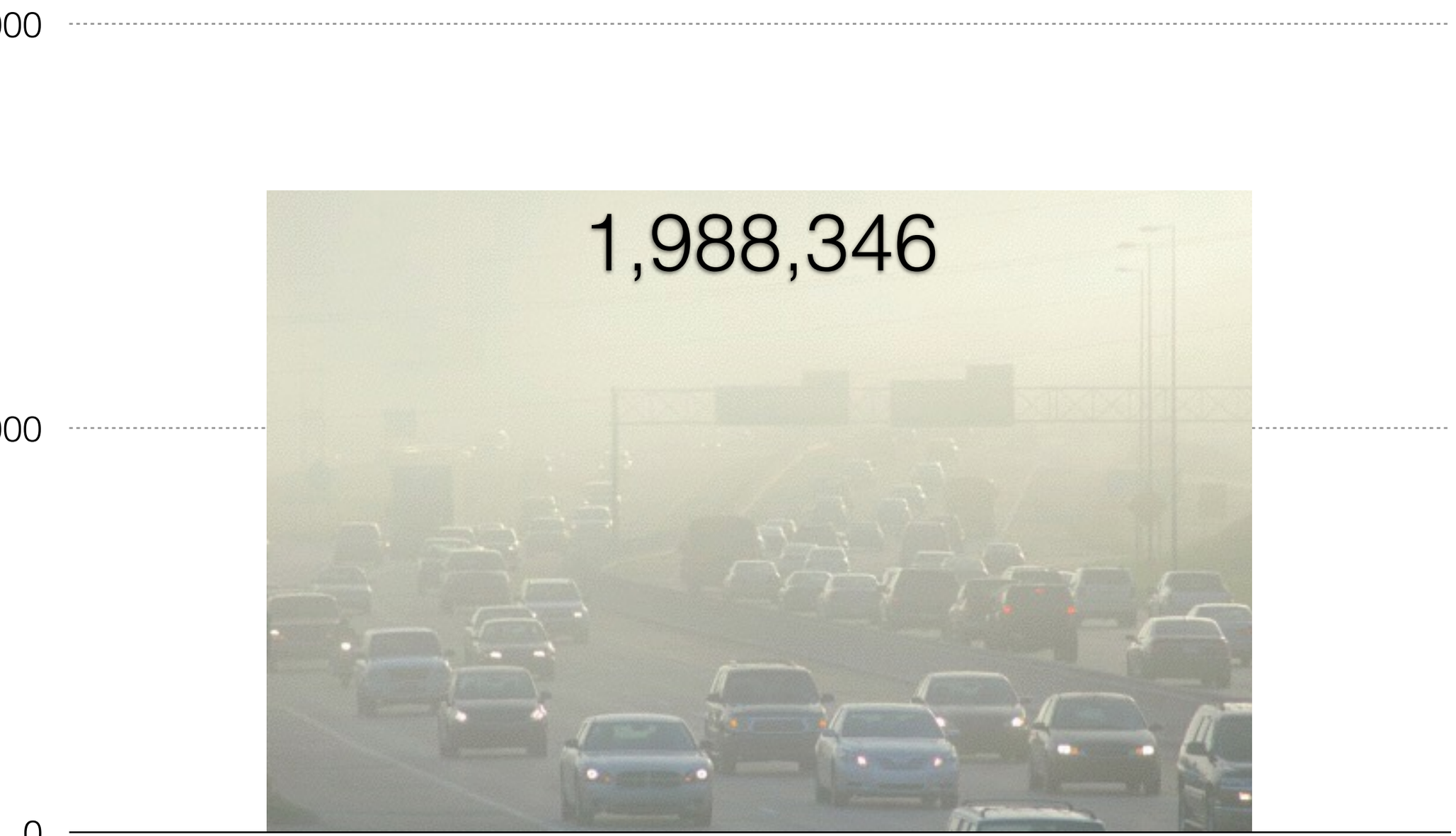
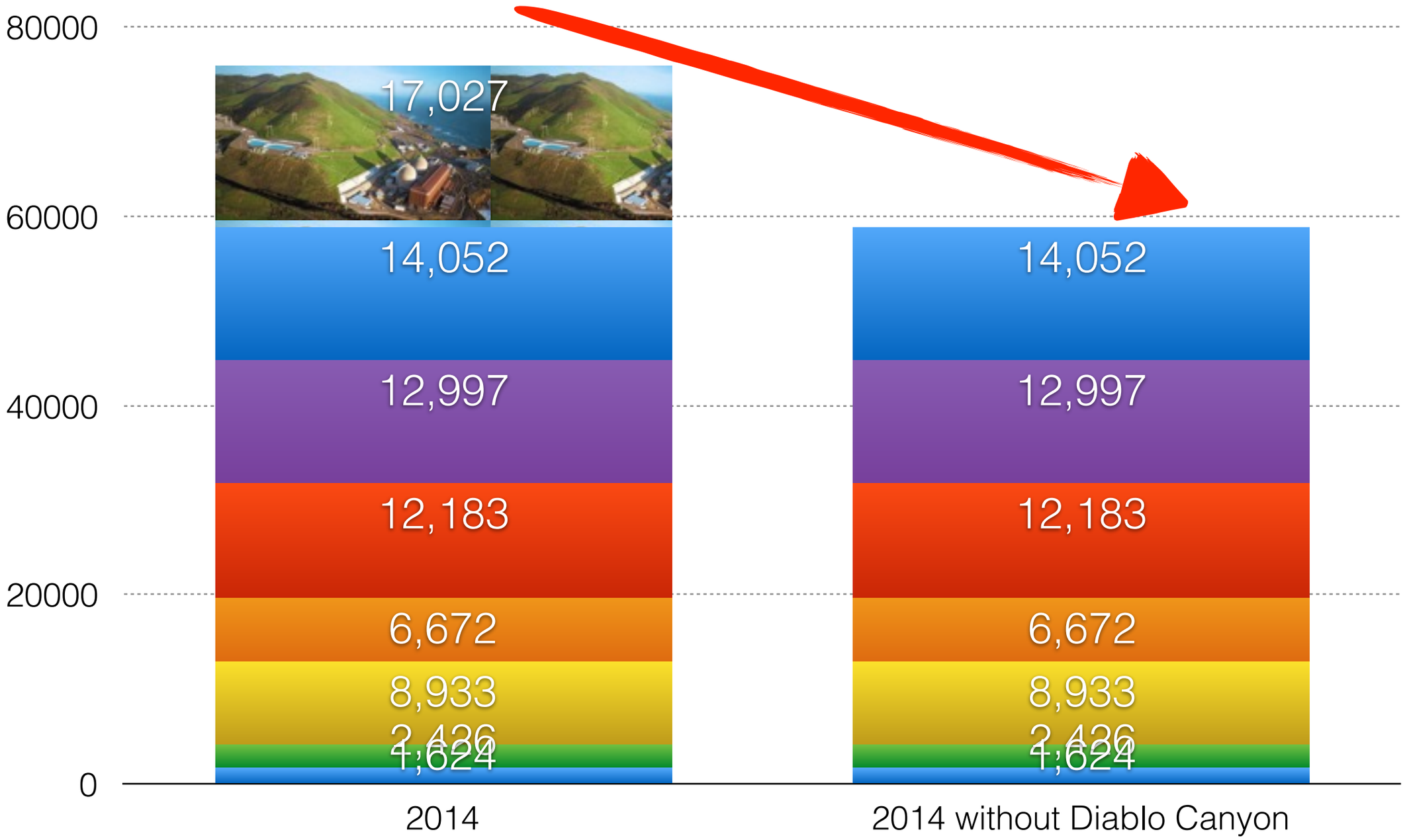
# Environmental Consequences of Diablo Closure

# Replacing Diablo with Natural Gas Would Be Equivalent of Adding ~2 Million Cars to the Road



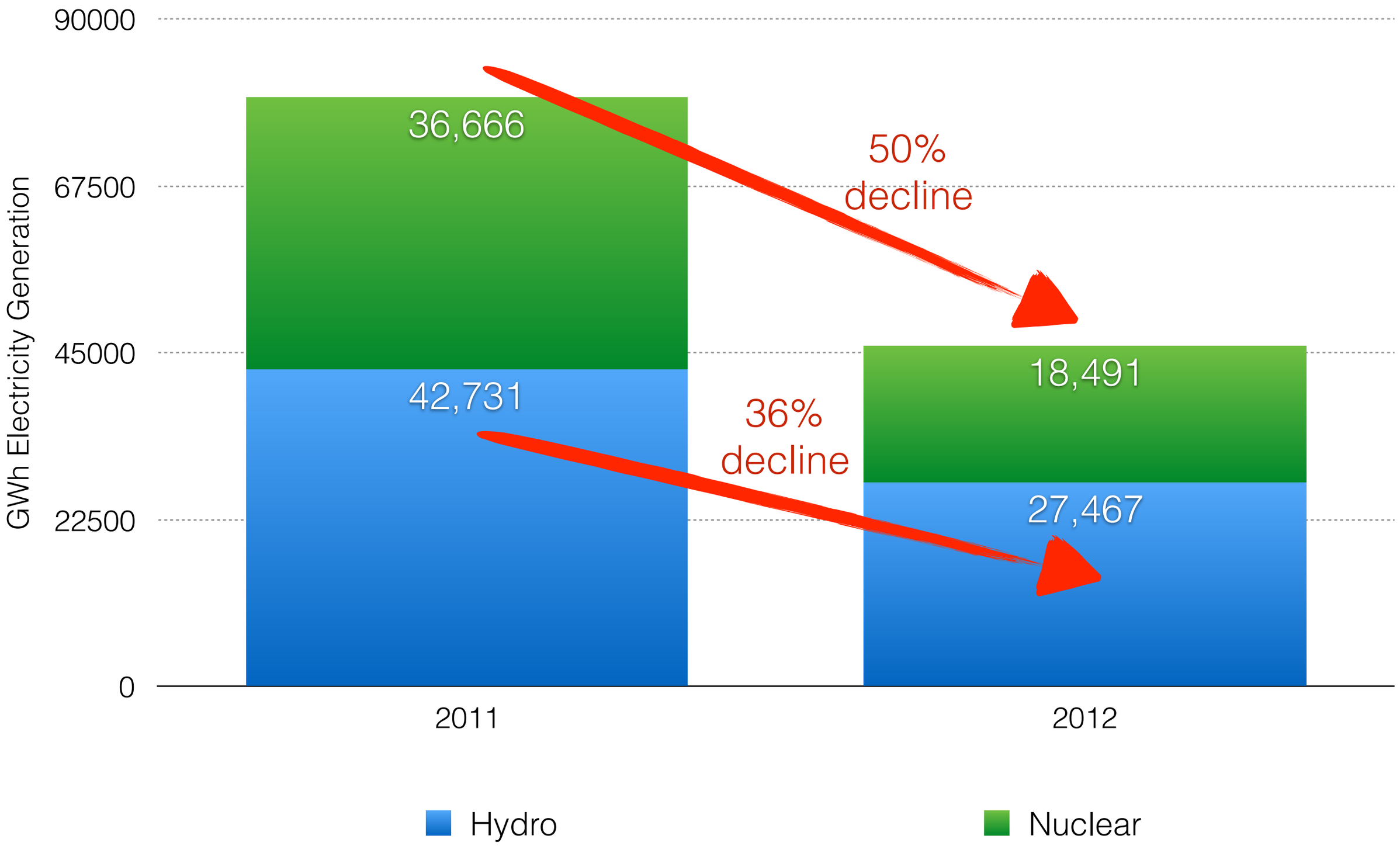

**Source**: EIA carbon emissions from natural gas; California (State Government Energy) Almanac, 2016

# If Diablo closes, 22% of California's clean electricity would be lost



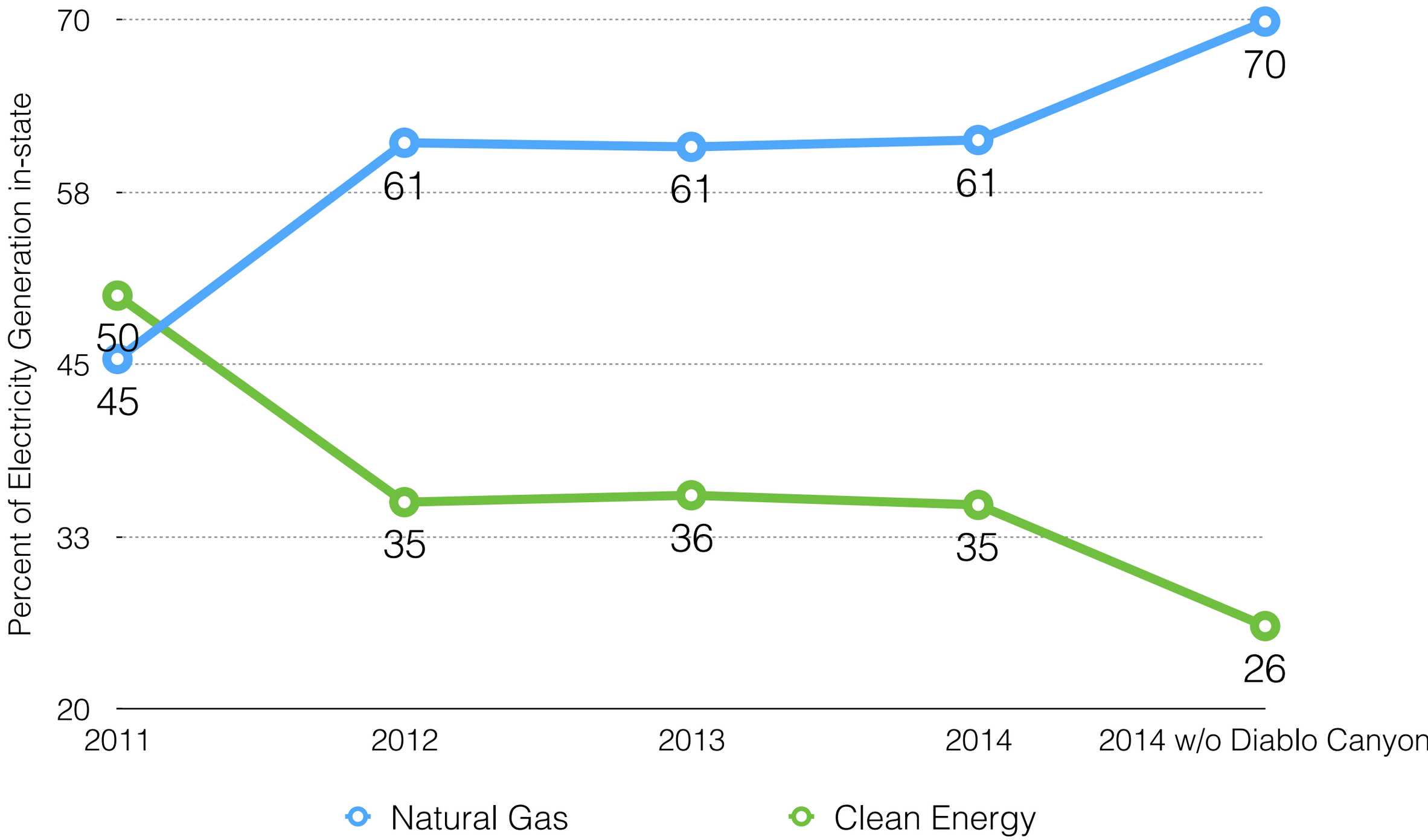

California Almanac, "In-State Generation by Fuel Type"
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# San Onfore closure reduced clean electricity by 50%, drought reduced it by 36%, 2011-2012



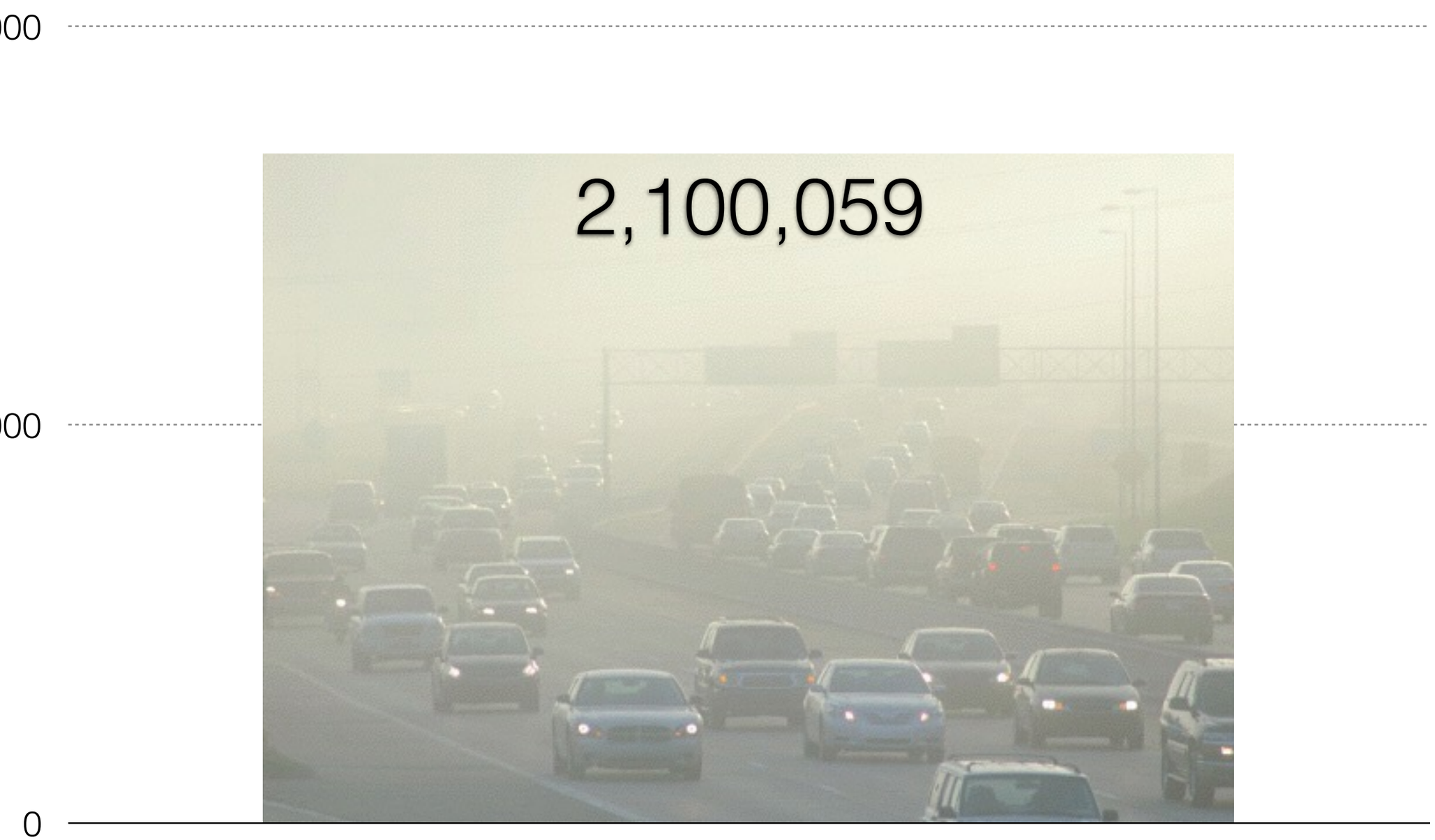

California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# Replacing Diablo Closure with natural gas would cut clean electricity to 26% & increase natural gas to 70%



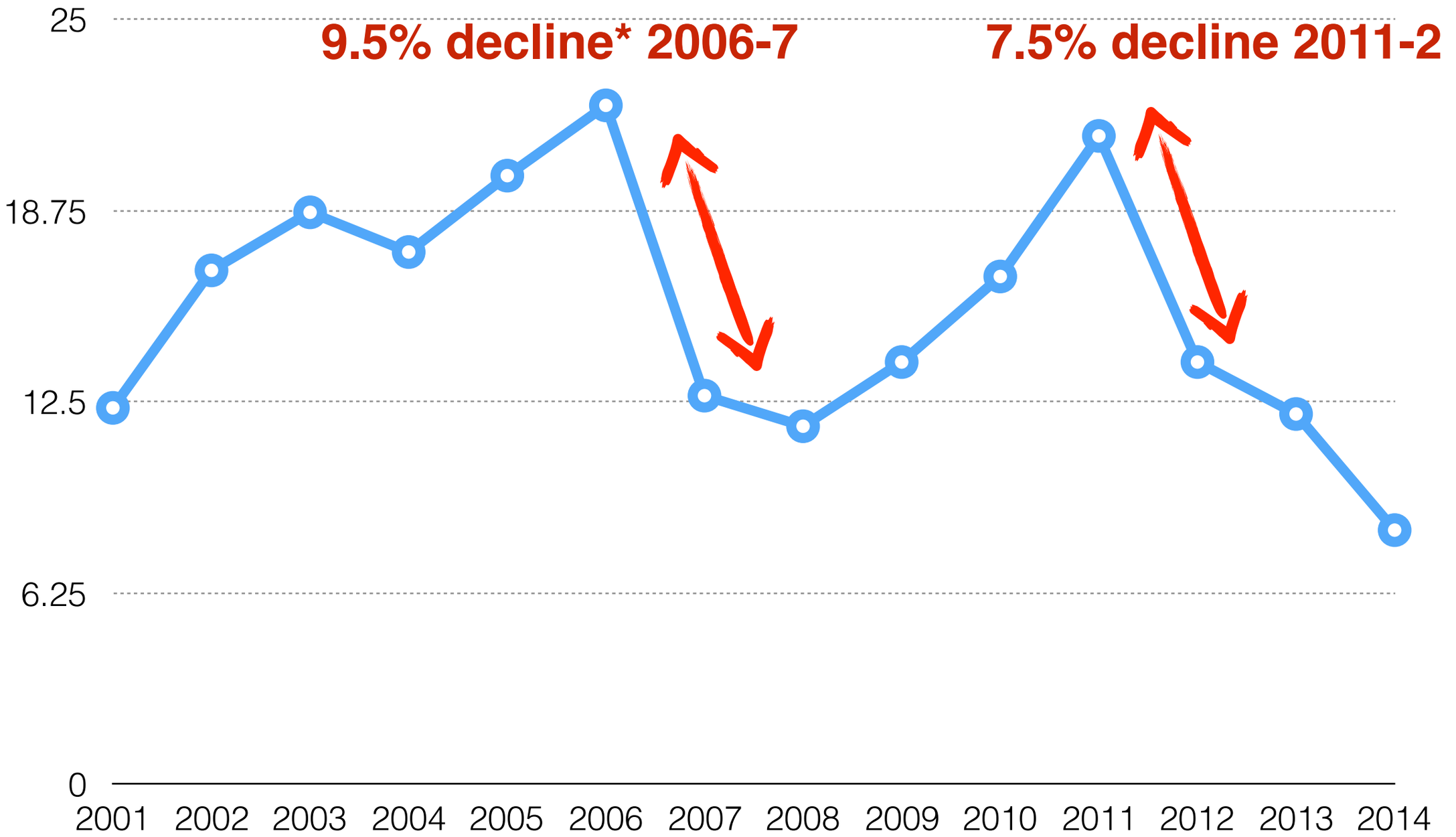

**Source**: California Almanac, “In-State Generation by Fuel Type”
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

# Carbon equivalent of 2.1 million cars added to road after San Onofre nuclear plant was replaced by natural gas




**Source**: California Almanac. In 2011, San Onofre Generating Station 18,175,000,000 KWh of power. It was replaced by natural gas, which according to US EIA generates 1.2 pounds of CO2 per KWh, or 9,975,282 metric tons of CO2. Average US vehicle emits 4.7 metric tons of CO2 per year. 9,975,282 divided by 4.7 = 2,100,059 cars

# Hydro-electricity fluctuates significantly




California Almanac, “In-State Generation by Fuel Type”
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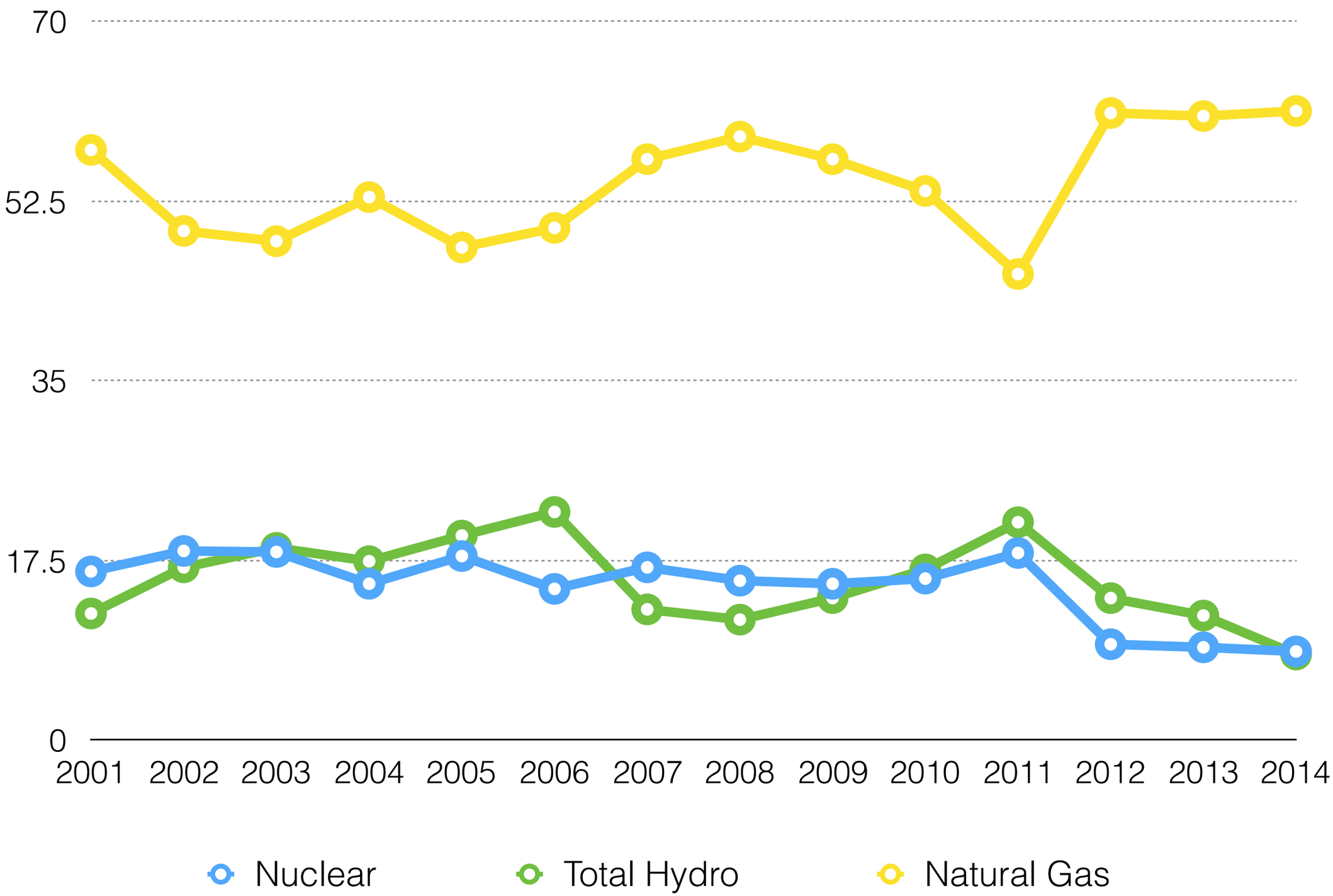
# Natural Gas Substitutes for Hydro & Nuclear




California Almanac, “In-State Generation by Fuel Type”
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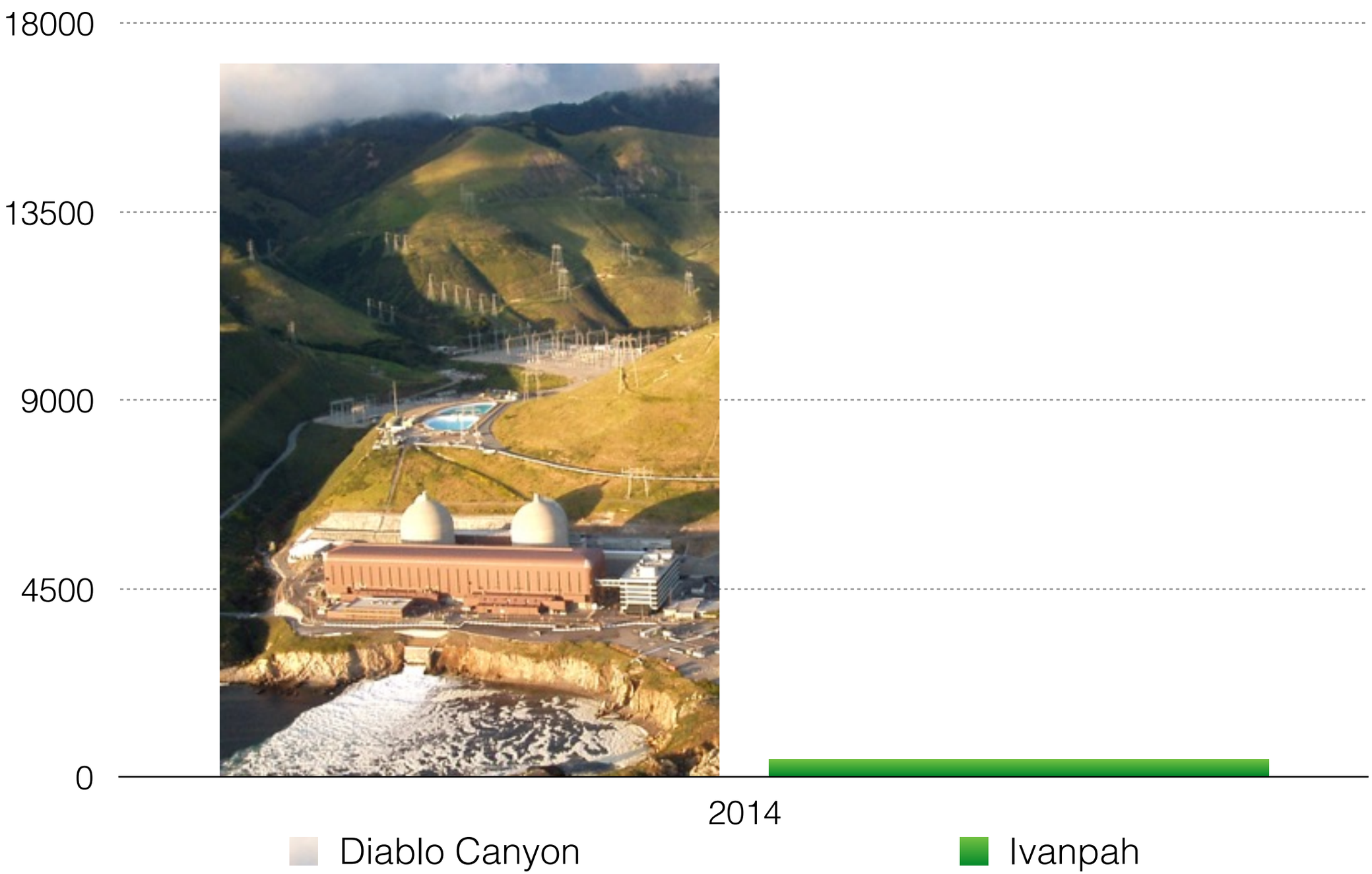
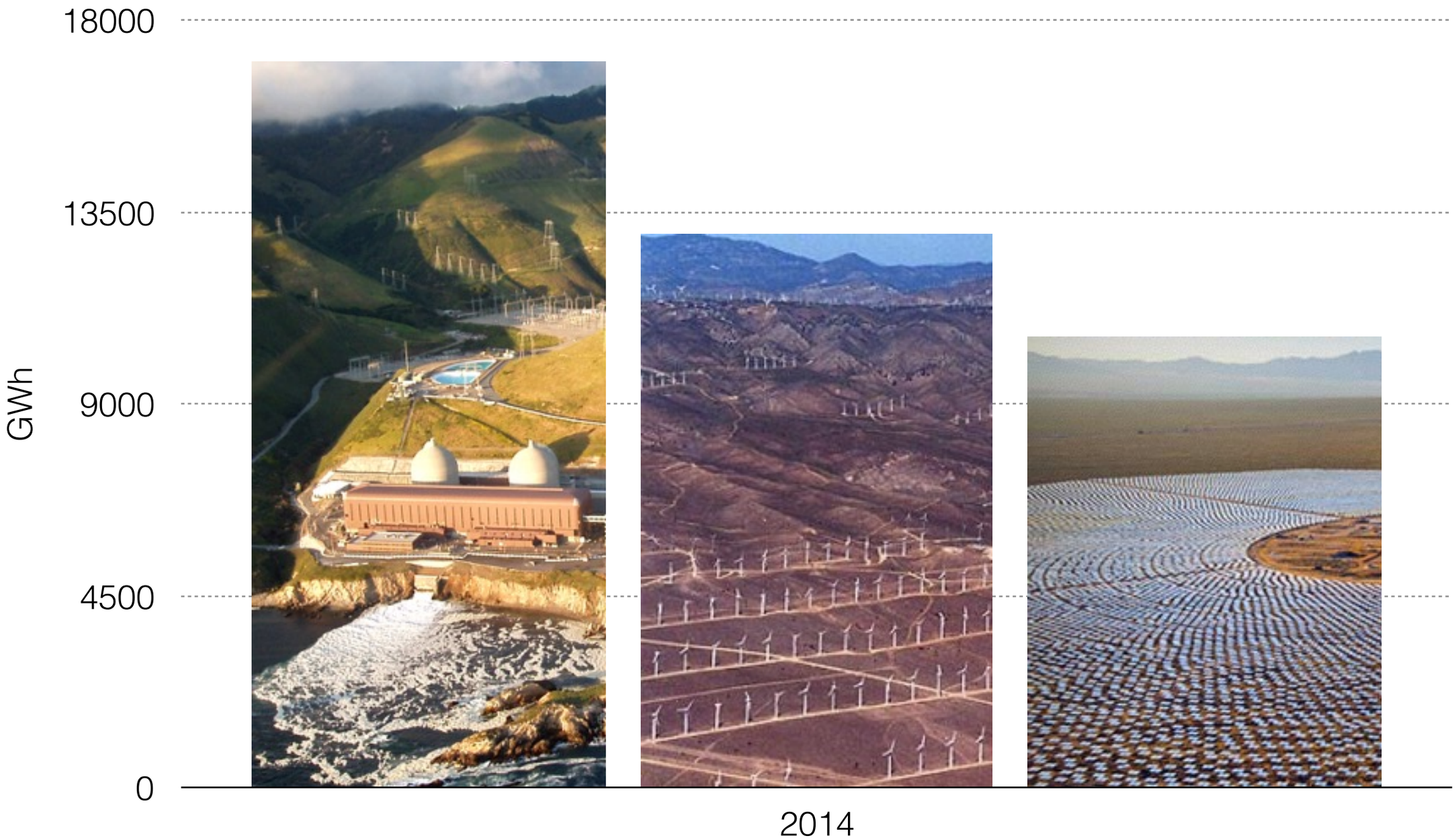
# Diablo Canyon produced 41 times more electricity than Ivanpah, California's largest solar plant




California Almanac, "In-State Generation by Fuel Type"
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

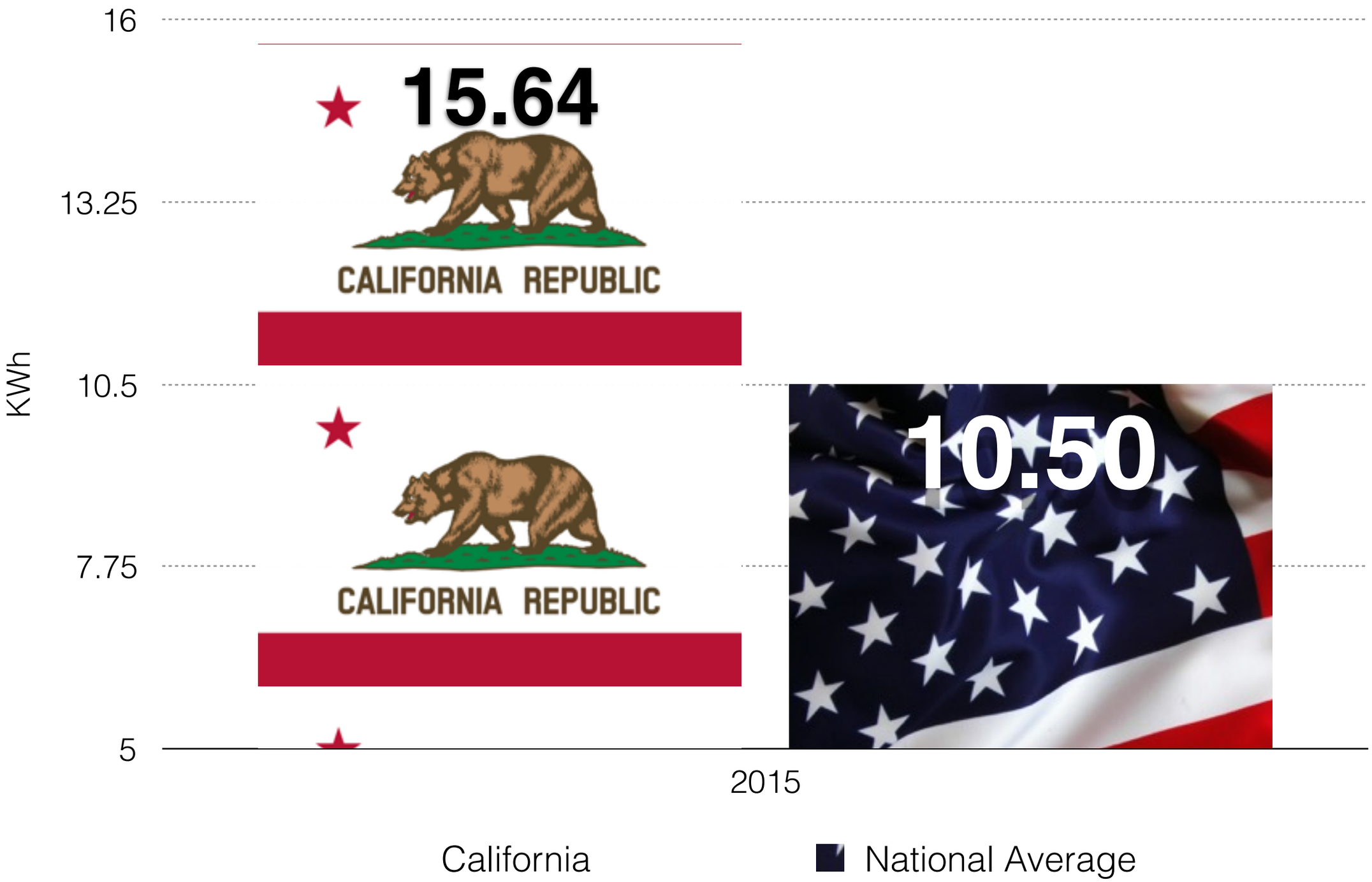
# Diablo Canyon produced 24% percent more electricity than all of California's wind, and 33% more than all of its solar




California Almanac, "In-State Generation by Fuel Type"
http://energyalmanac.ca.gov/electricity/electric_generation_capacity.html

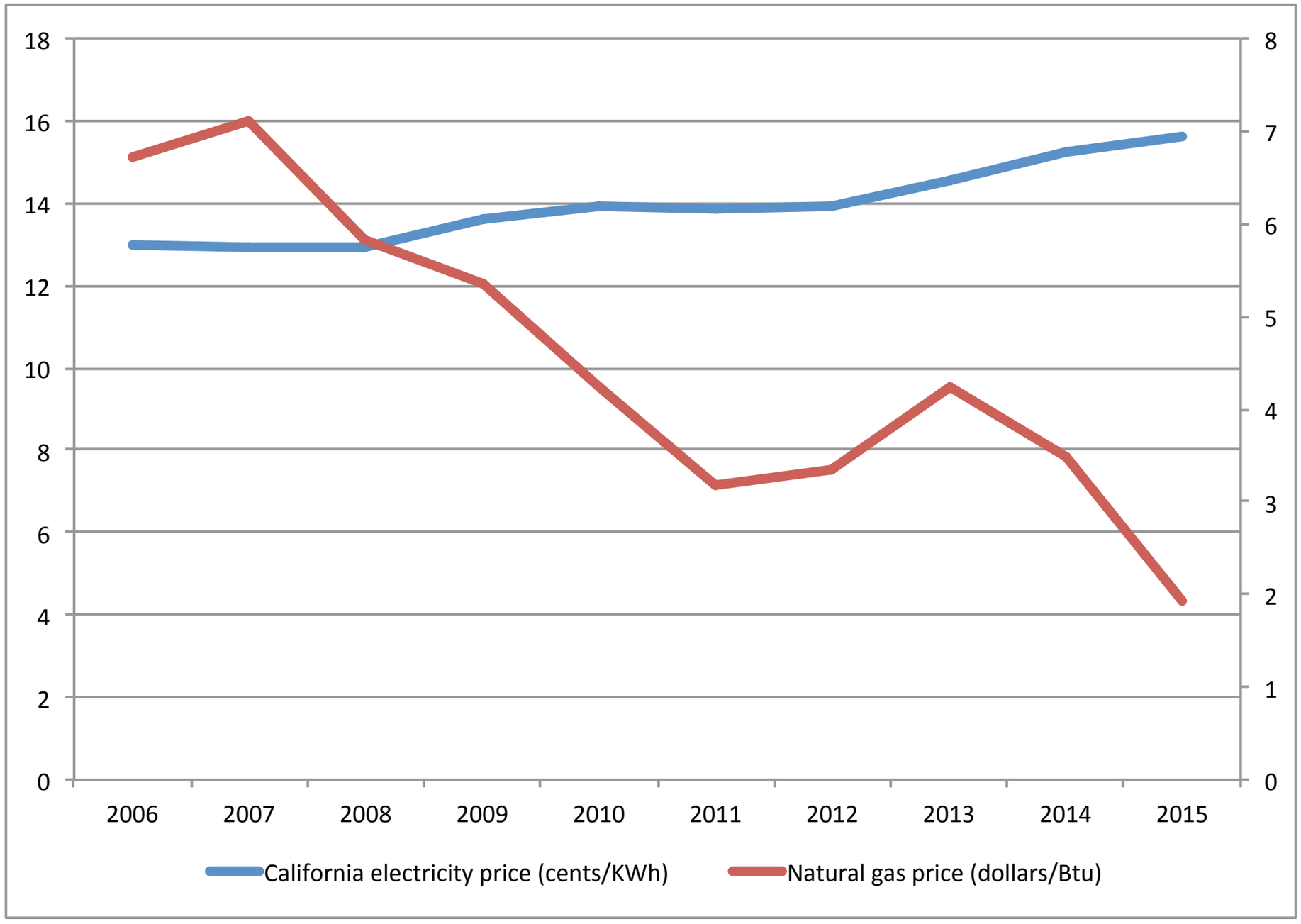
# Economic Consequences

# California has 6th most expensive retail (all sectors) electricity in continental United States




**Source**: US EIA, All in Year-to-date, Electric Power Monthly, 2011-2015

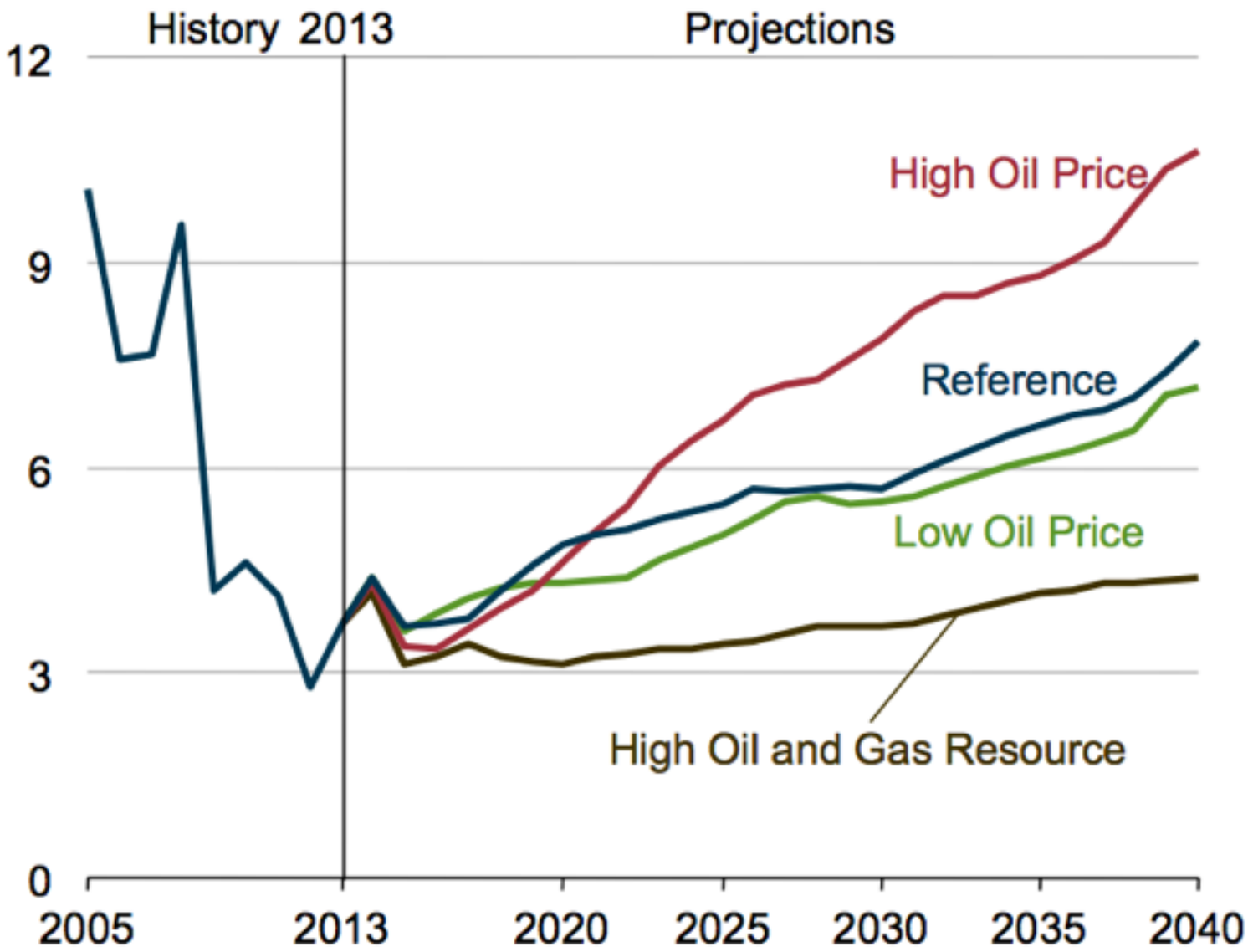
# Cheap natural gas has masked significant electricity cost increases from deploying (non-large hydro) renewables




**Source**: US Energy Information Administration,

# Natural Gas Prices Predicted to Double by 2025

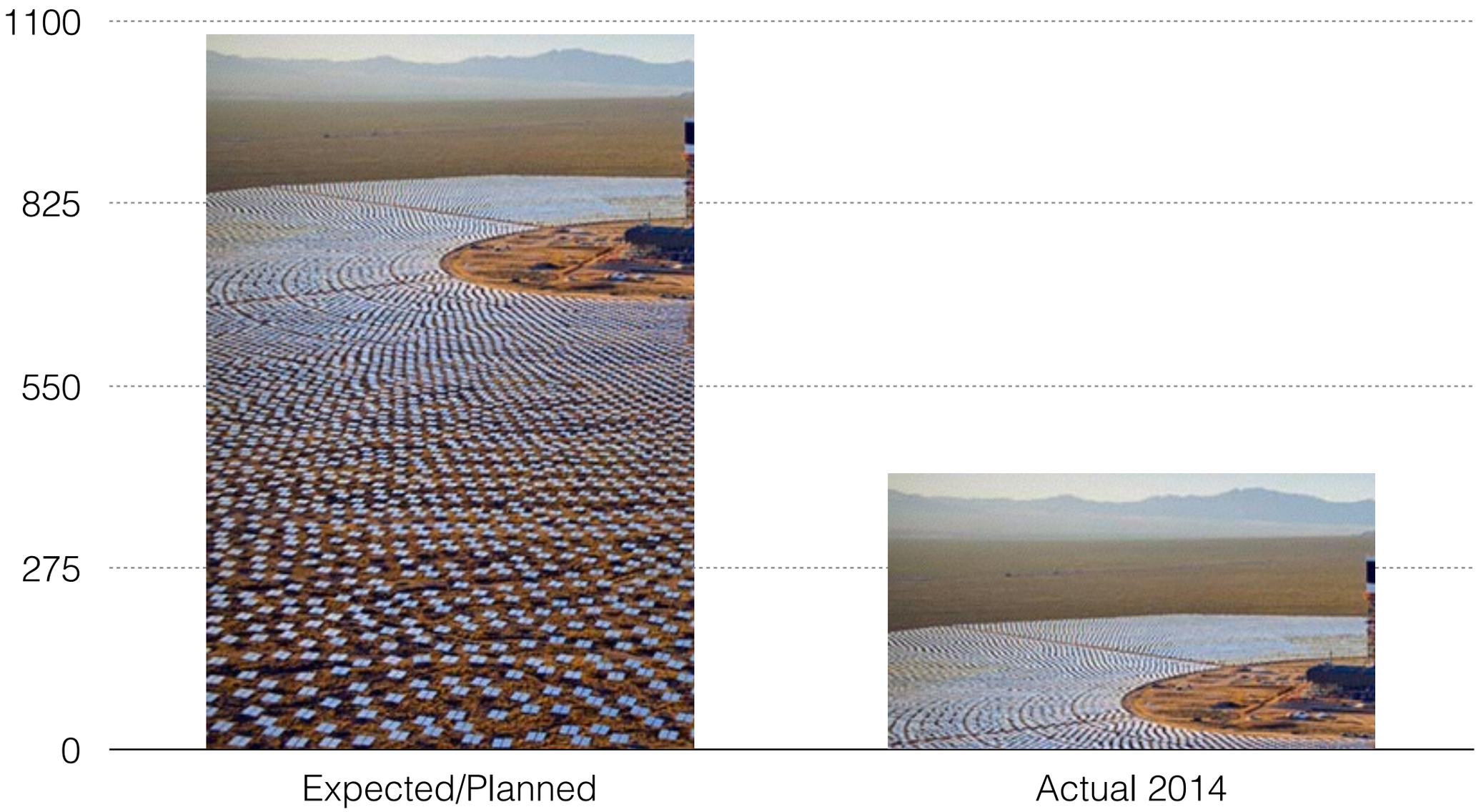
**Figure ES2. Average Henry Hub spot prices for natural gas in four cases, 2005-40 (2013 dollars per million Btu)**




on | Annual Energy Outlook 2015

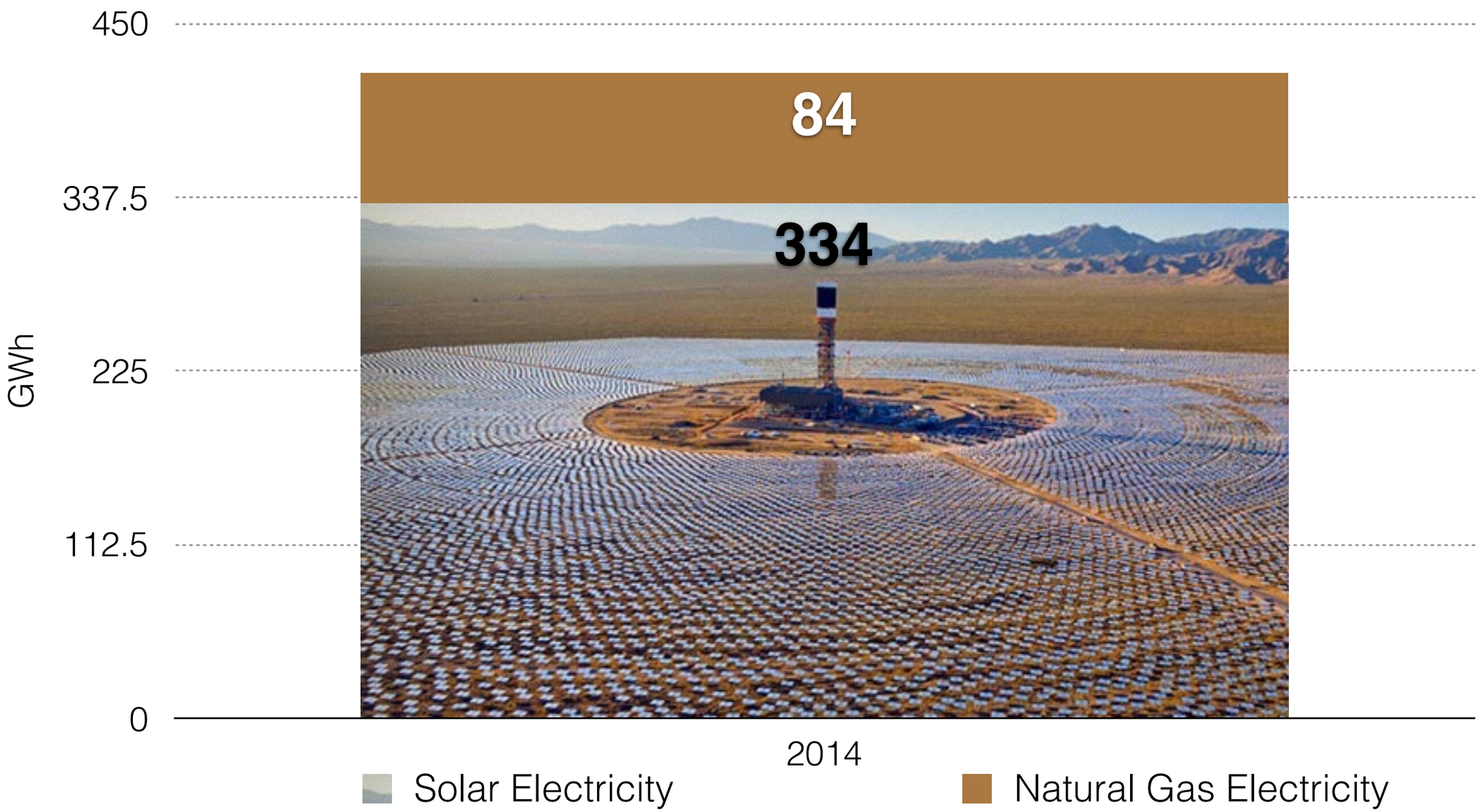
**Source**: US Energy Information Administration,

# Ivanpah produced 60% less electricity than was expected and planned



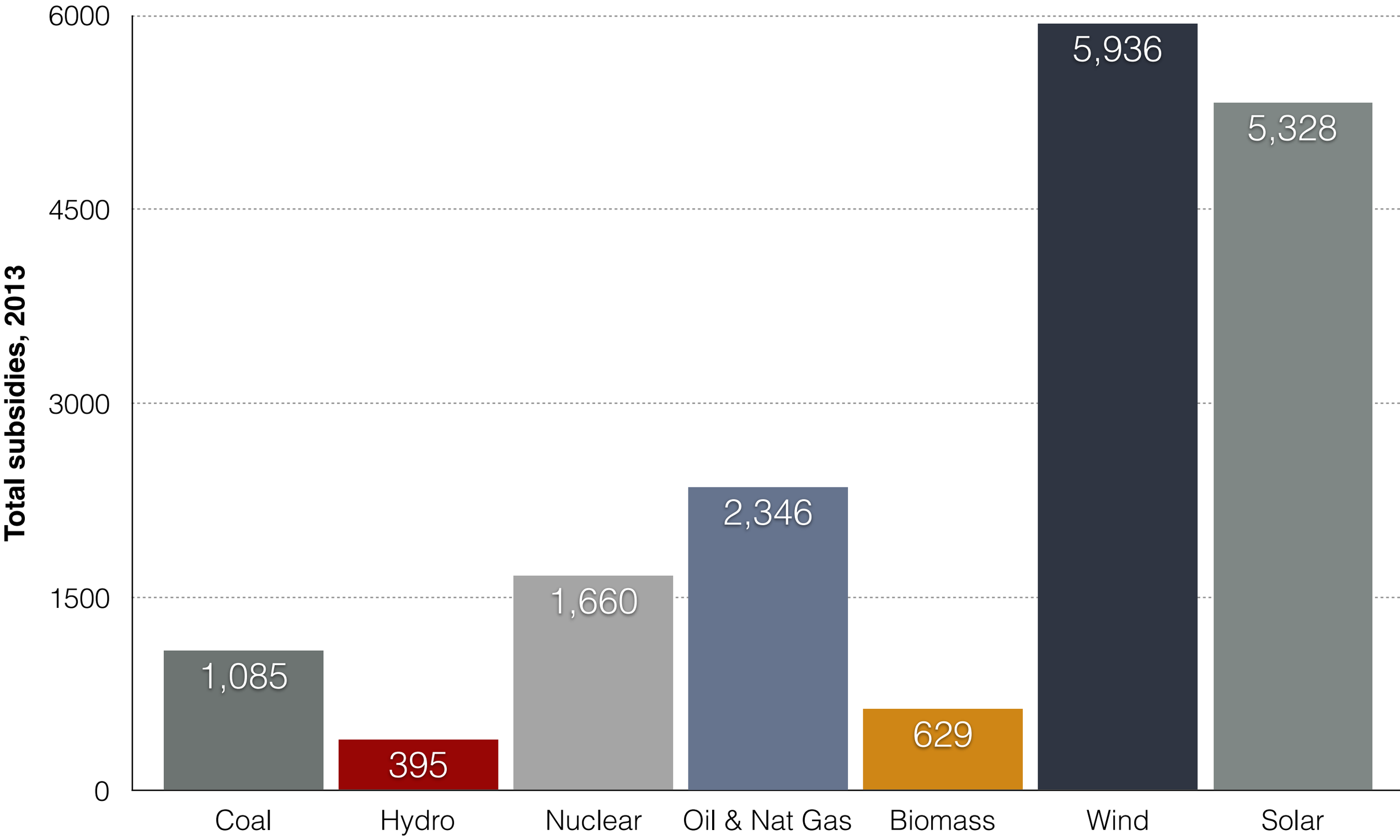

**Sources**: Expected: NREL, “Concentrating Solar Power Projects,” http://www.nrel.gov/csp/solarpaces/project_detail.cfm/projectID=62
Actual: California Almanac, “Annual Generation Plant,” http://energyalmanac.ca.gov/electricity/web_qfer/Annual_Generation-Plant_Unit.php

# 20% of Ivanpah's power was produced with natural gas — 4x more than State allows for projects to count as renewable



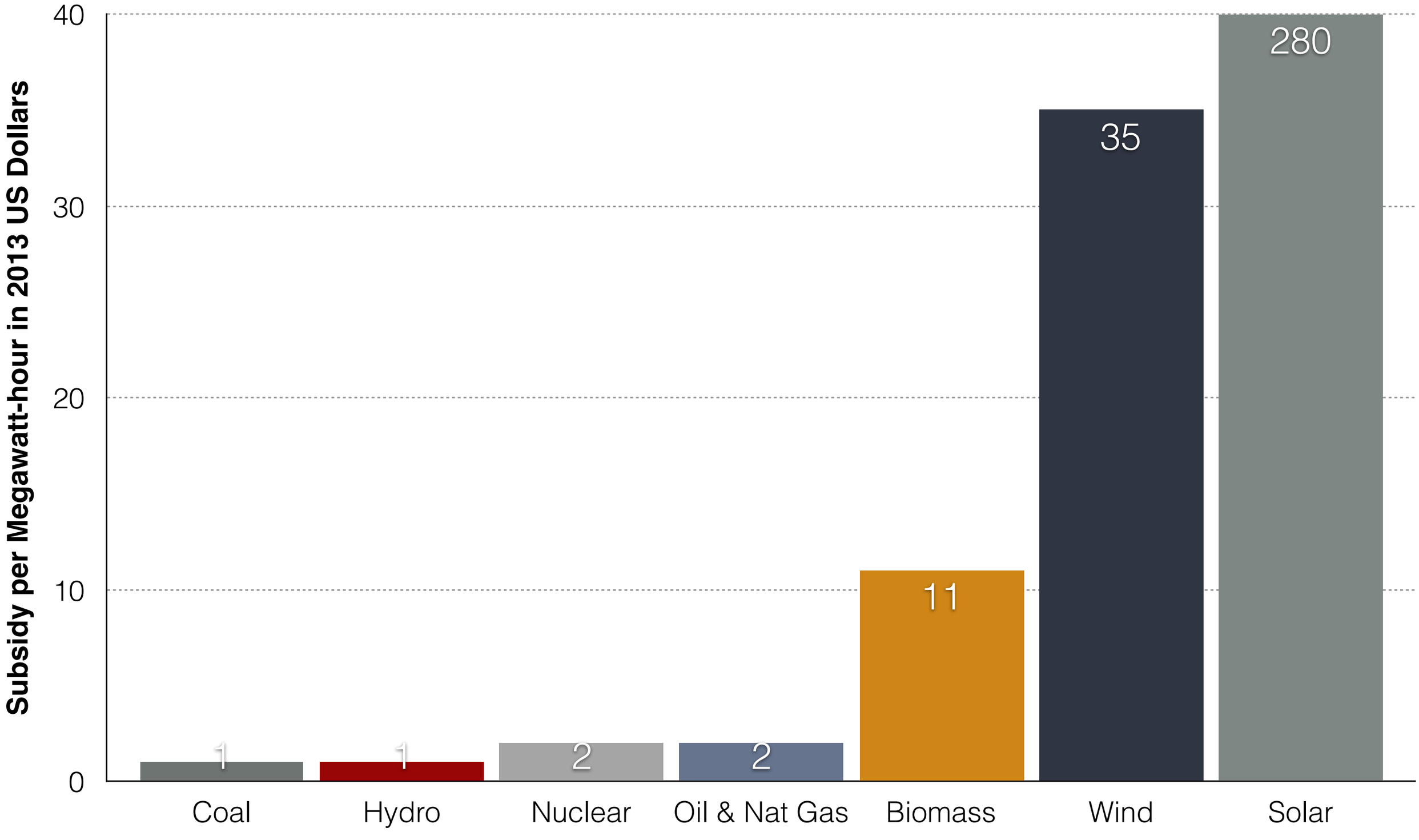

**Sources**: California Almanac, "Annual Generation Plant," http://energyalmanac.ca.gov/electricity/web_qfer/Annual_Generation-Plant_Unit.php

# US subsidizes renewables the most in absolute terms…




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

# US Subsidizes Solar & Wind 140x & 17x more than Nuclear




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