

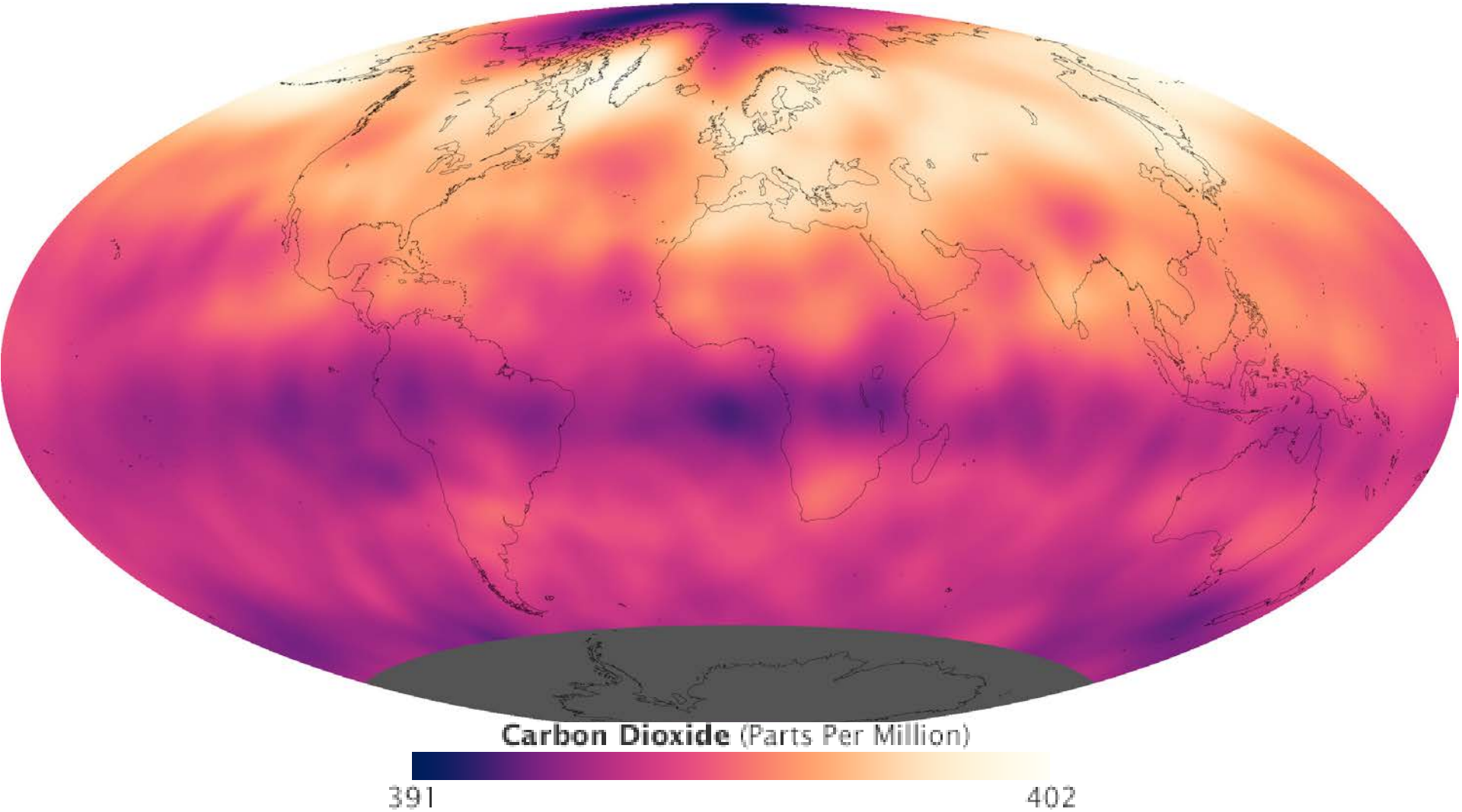
Carbon Dioxide: A Global Problem in Search of a Rational Global Solution

Kimery C. Vories

E-Ternion: Energy, Environment, & Economy



Global Carbon Dioxide Concentrations from NASA

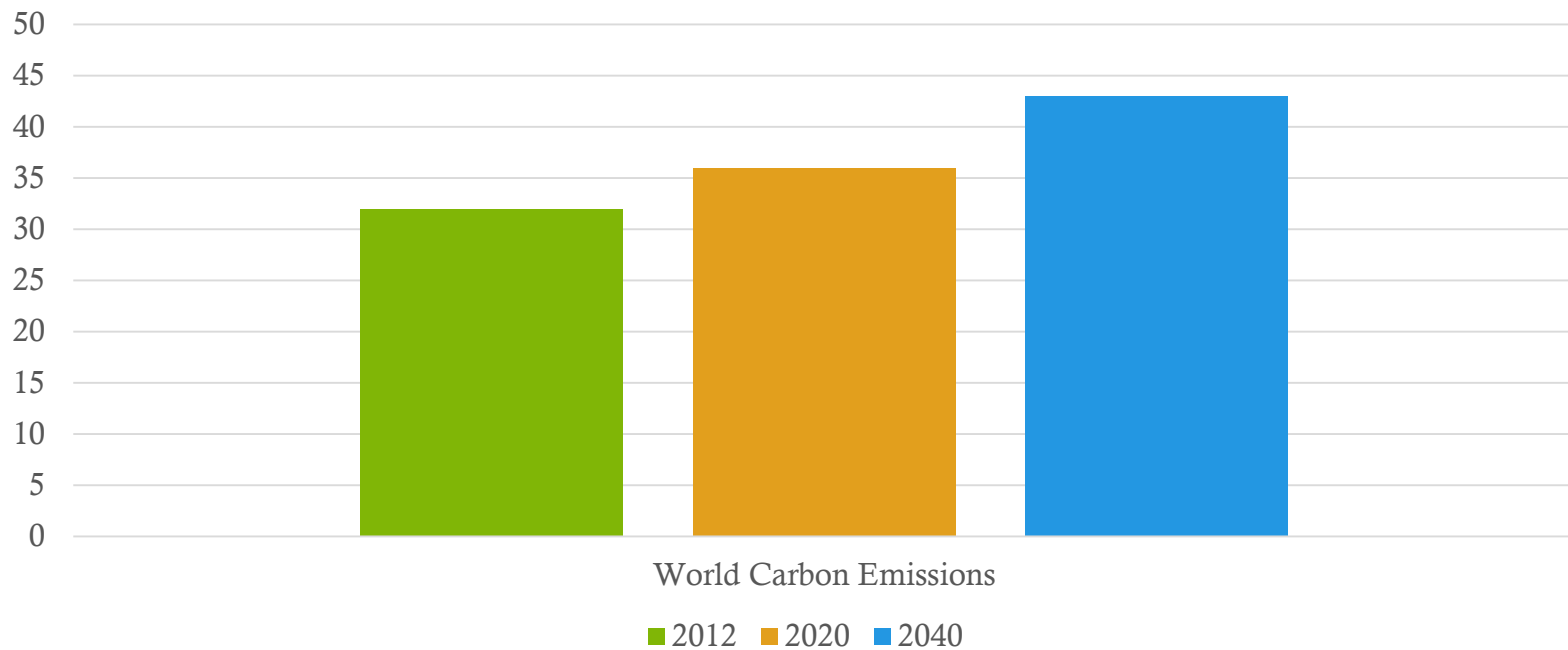


China Cancels Construction of 103 Coal Fired Power Plants

- ◆ China is on track for meeting its goal of 1100 gigawatts of coal fired capacity by 2020 (3 times the capability of the US) “*China National Energy Administration*”
- ◆ The US retired 13 gigawatts of coal fired capacity in 2015 and only plans to build 4 new plants in 2017 with less than 1 gigawatt of capacity
- ◆ EIA reports that global CO2 emissions have been flat for the last 3 years.
- ◆ USEPA Reports that US Greenhouse gas emissions have fallen below the levels reported for 1994.

2016 EIA Projected Increase for Global Carbon Emissions

(0.94%/year through 2040 – down from 2.4% 5 years earlier)



Popular Notions on Global Warming

- ◆ Increasing Global Carbon Dioxide Levels (**currently 0.94%/year down from historic 2.4%**) Contributes to Global Warming, Ocean level rise and Acidification
- ◆ This is a Result, at least in part, to the Increased Use of Fossil Fuels
- ◆ Popular opinions advanced in the Media:
 - ◆ Global Environmental Disaster will ultimately Result???
 - ◆ Fossil Fuels are “**evil**” and their use must be prohibited as an energy source beginning with Coal????
 - ◆ The world must Replace Fossil Fuels with Renewables resulting in a Renewables Only World ?????

Facts about Renewable Energy Limitations

- ◆ **Hydropower** – Few places left on the planet for placement of additional dams
- ◆ **Wind and Solar power** – Current technology results in unpredictable, unreliable power source with an inability to store energy for use based on demand. Can not be used as a baseload power generator. Requires redundant backup power generation capacity.
- ◆ **Energy Efficiency programs** are more likely to have substantially greater impact on retail electricity prices than distributed solar at a national level (Lawrence Berkley National Lab Report 2017)
- ◆ **Increased utilization of Solar and Wind** energy in the electric power grid **decreases** the efficiency of the entire system and **increases** the cost.
- ◆ March 2017, Aquion Energy, manufacturing state of the art **batteries to store solar power** filed for bankruptcy 7 years after receiving over \$20 million in state and federal funds.

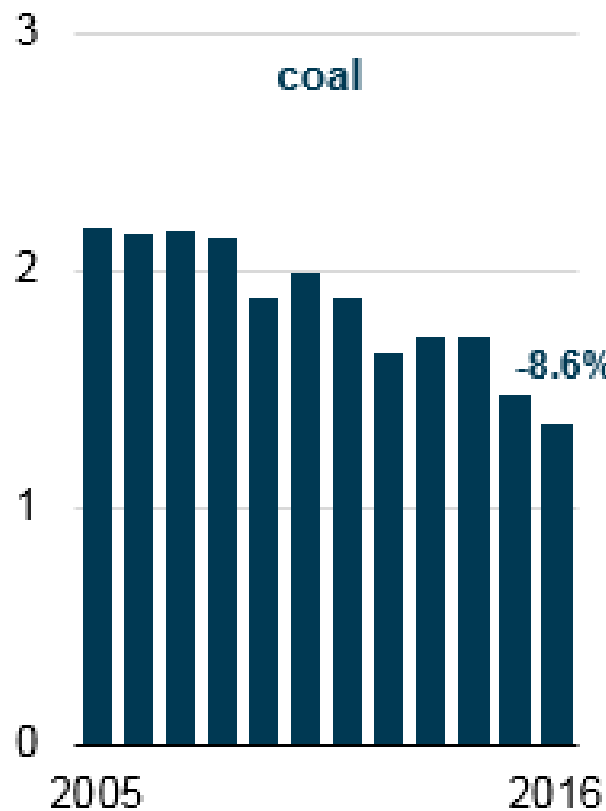
Factors Requiring Rational Consideration

- ◆ **Global Carbon Emissions** must be reduced
- ◆ **Global Fuel Consumption** is essential to drive a modern civilization
- ◆ **Global Electricity Supply** is determined by Available Fuel Type
- ◆ **Lengthy Time Span necessary to reduce dependence on fossil fuels** (not decades but centuries) and Uncertainty for Conversion to Renewables
- ◆ **Actual Potential** for Renewables to reduce CO₂ Emissions
- ◆ **World Population Impacts** due to Conversion to Renewables

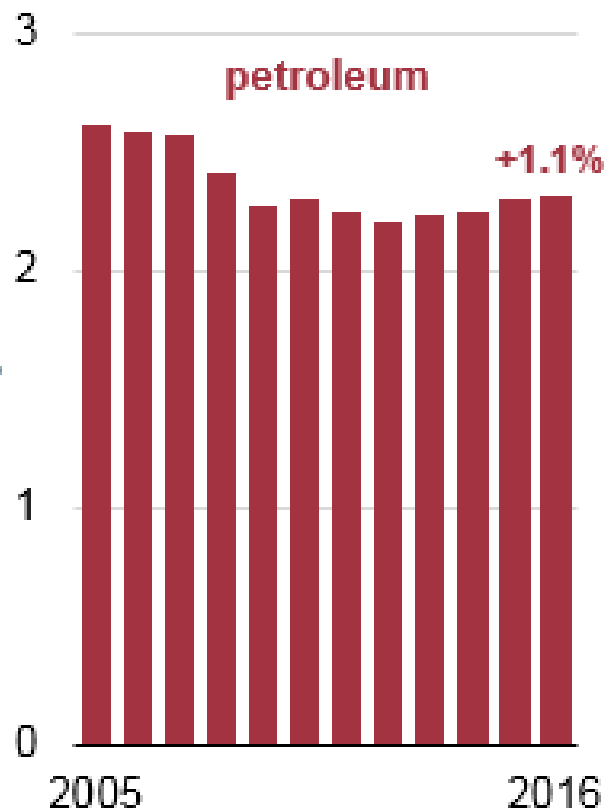
ANNUAL US CARBON DIOXIDE EMISSIONS

U.S. carbon dioxide emissions by fuel (2005-16)

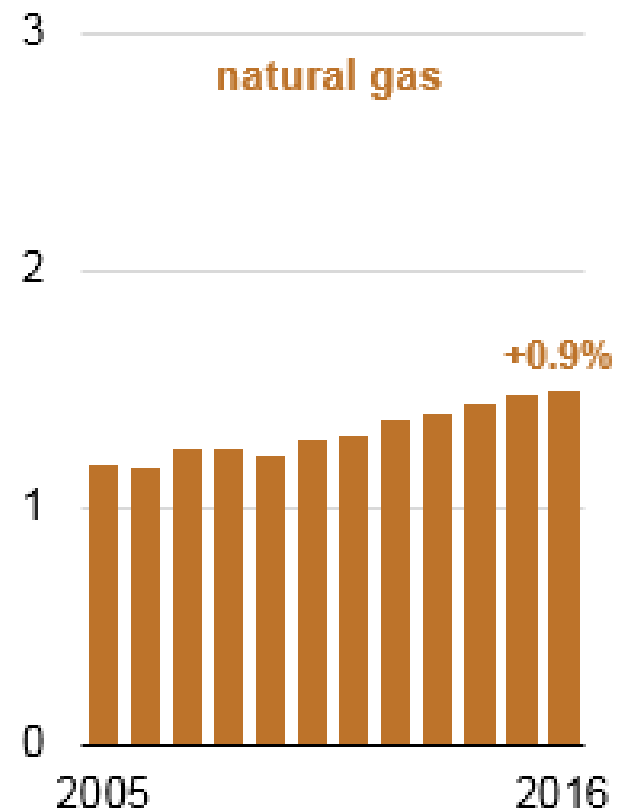
billion metric tons



billion metric tons

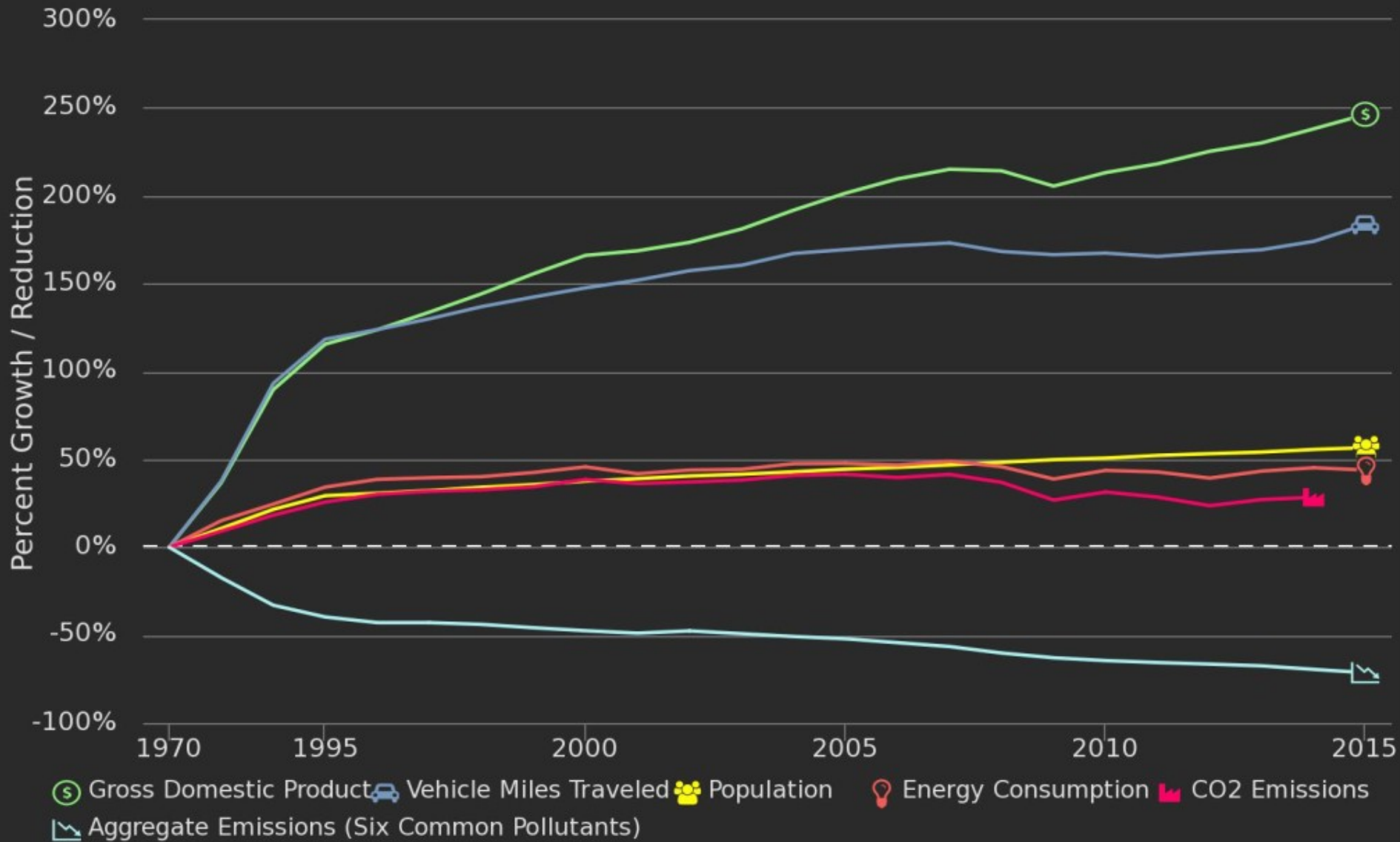


billion metric tons



COMPARISON OF GROWTH AREAS AND EMISSIONS

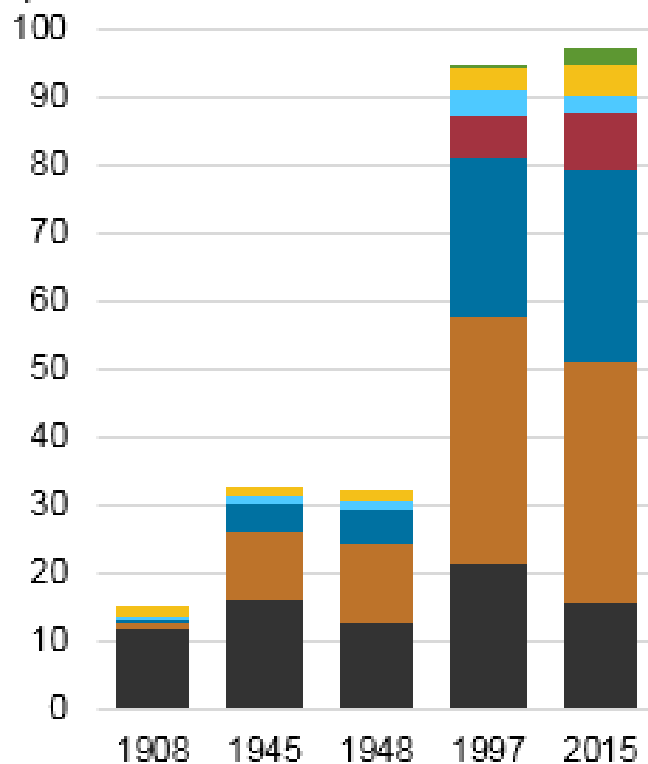
1970-2015



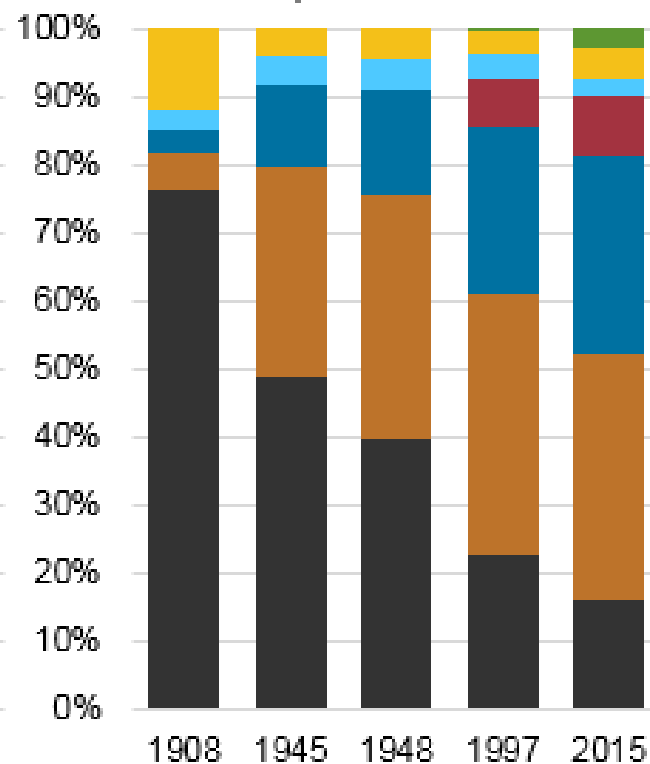
US Historic Energy Consumption

Energy consumption in the United States

quadrillion Btu



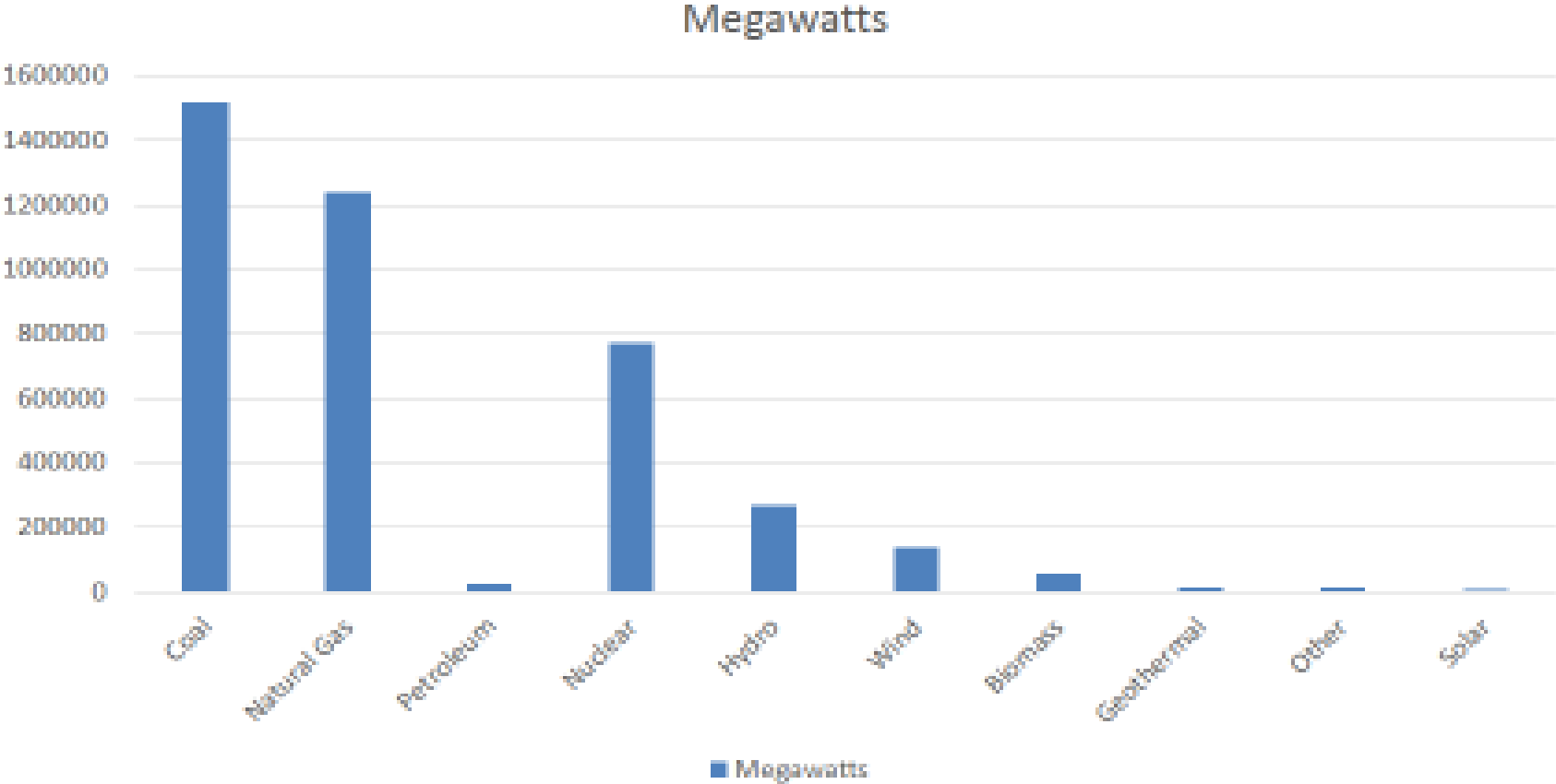
share of consumption



other renewables
biomass
hydroelectric
nuclear
natural gas
petroleum
coal



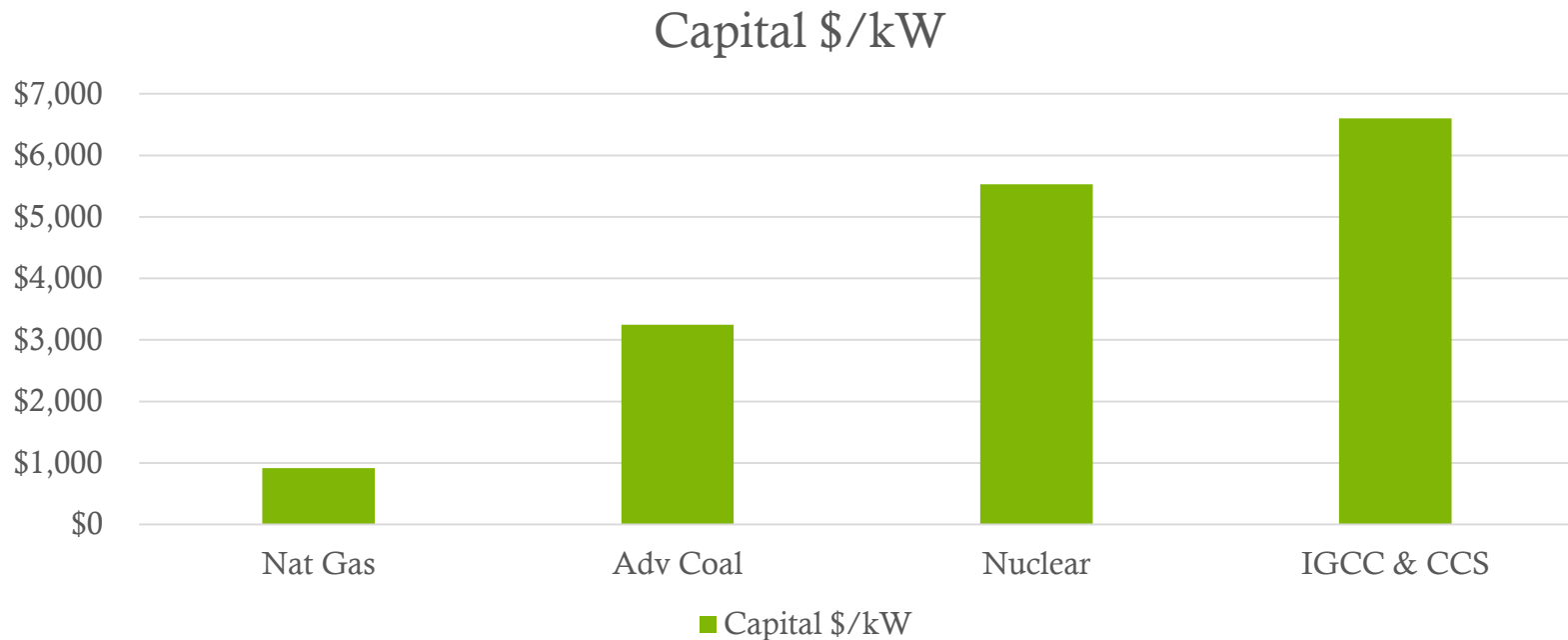
2012 U.S. Electric Generation by Fuel Source (thousand megawatts)



USEPA Current Coal Prohibition

- ◆ On January 8, 2014, the USEPA proposed a new standard for new source coal fired power plants to a new standard of 1,100 lbs. of CO² per megawatt hour (499 grams/kilowatt hour). USEPA makes the assertion that this is “**achievable**” with IGCC boiler technology and at least a 25% sequestration of CO² emissions.

Prohibitive Cost of IGCC with CCS



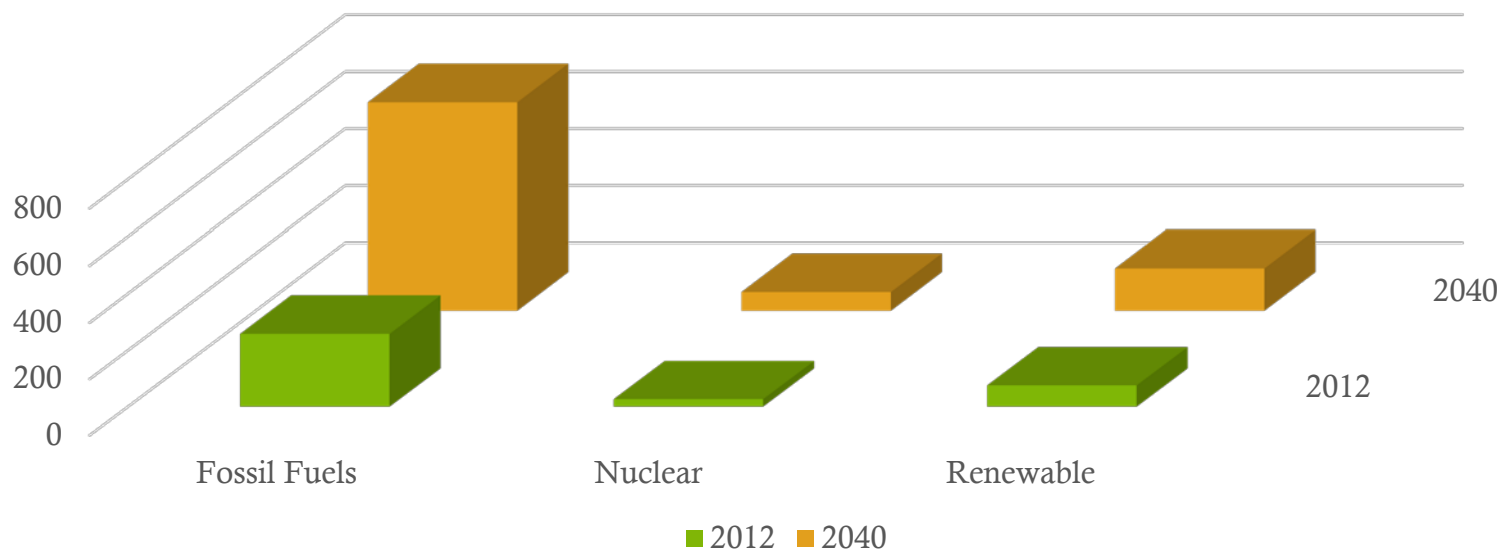
TIME Required for Renewables to Replace Coal Electric Power in the U.S.

- ◆ 2013
 - ◆ Coal 39% of total fuels used
 - ◆ Natural Gas 27%
 - ◆ Renewables 13%
- ◆ 2040 (30 years = apx one generation)
 - ◆ Coal 34% of total fuels used (*A reduction of 4% in a generation*)
 - ◆ Natural Gas 31% (*An increase of 4 % in a generation*)
 - ◆ Renewables 18% of total fuels used

No significant reduction in fossil fuels used for electric power in a generation.

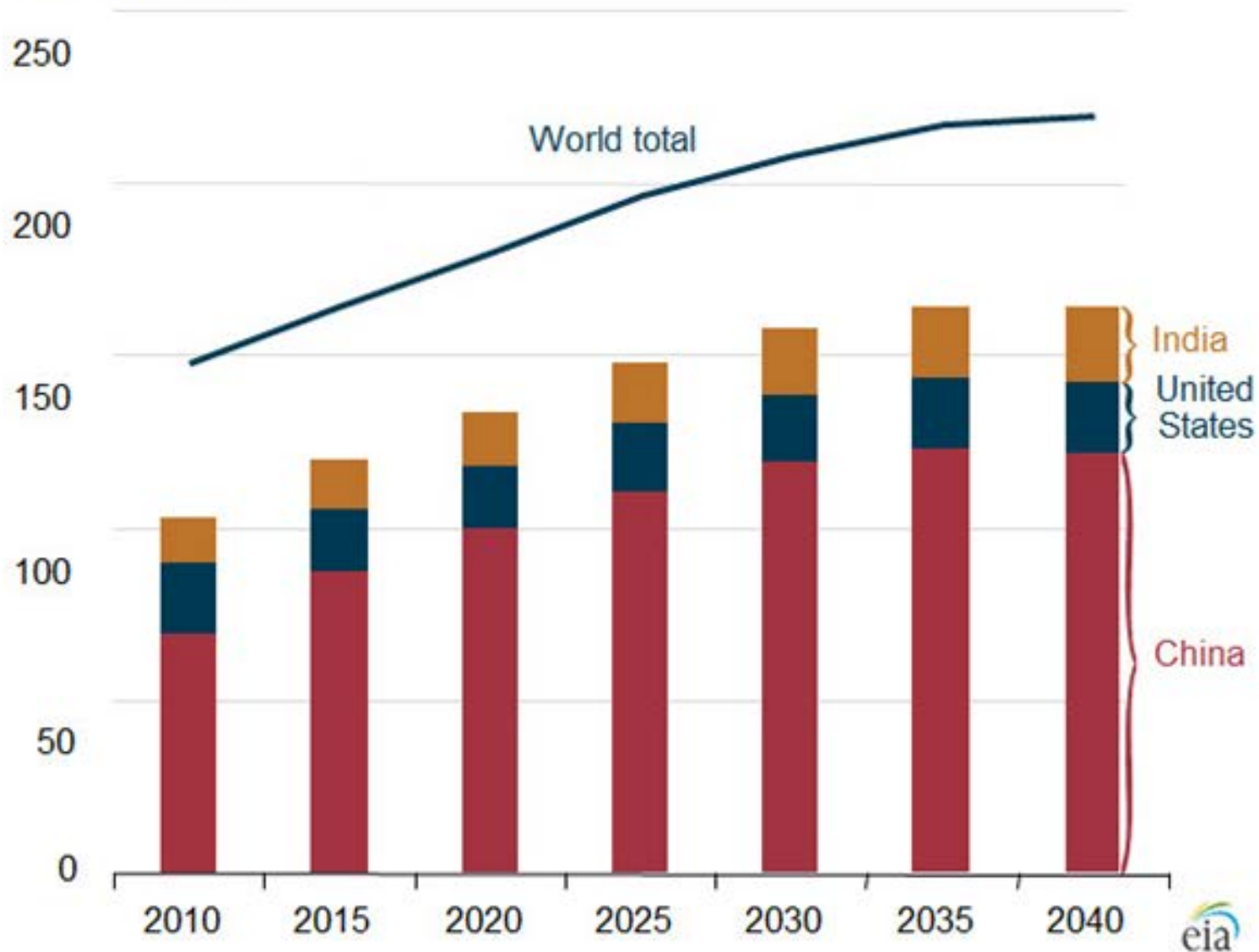
World Total Energy Consumption by Fuel Source from 2012 to 2040

World Projection in Fuel Use in Quadrillion Btu

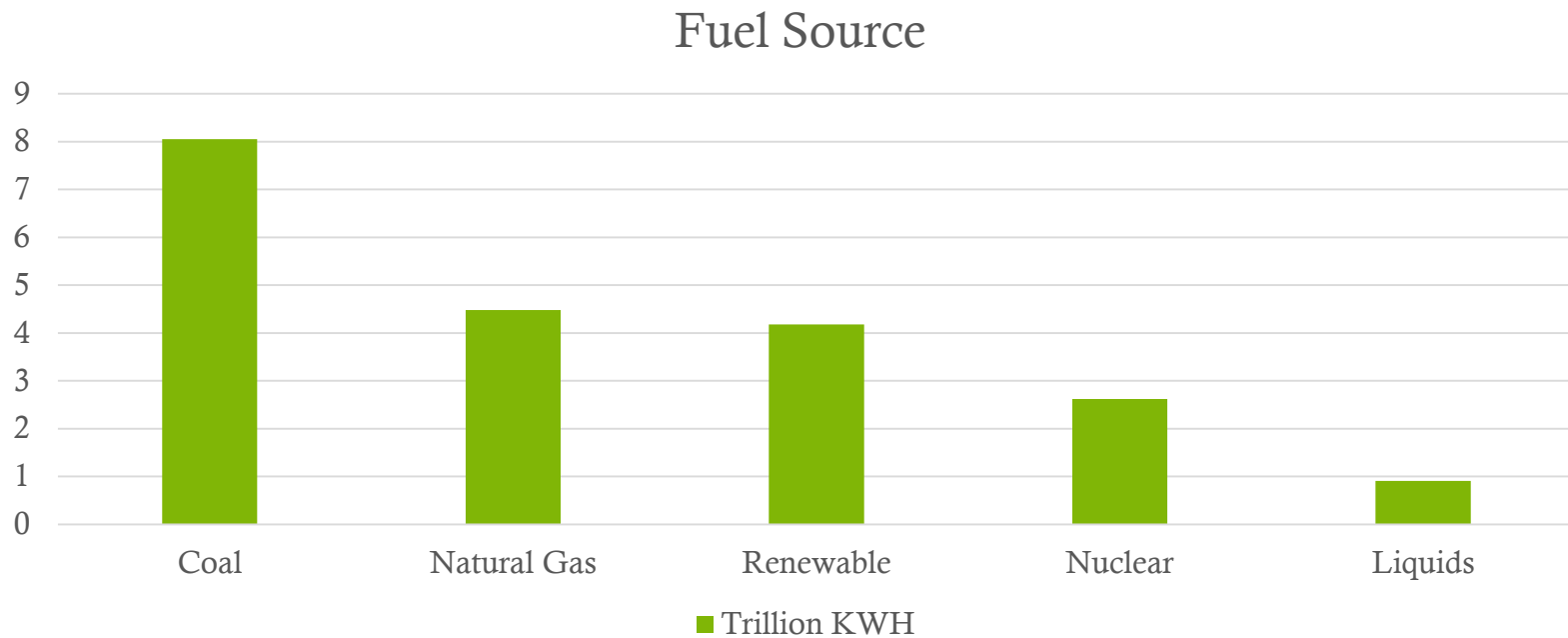


World coal consumption by leading countries, 2010-2040

quadrillion Btu



2010 Global Electricity Production by Fuel Source

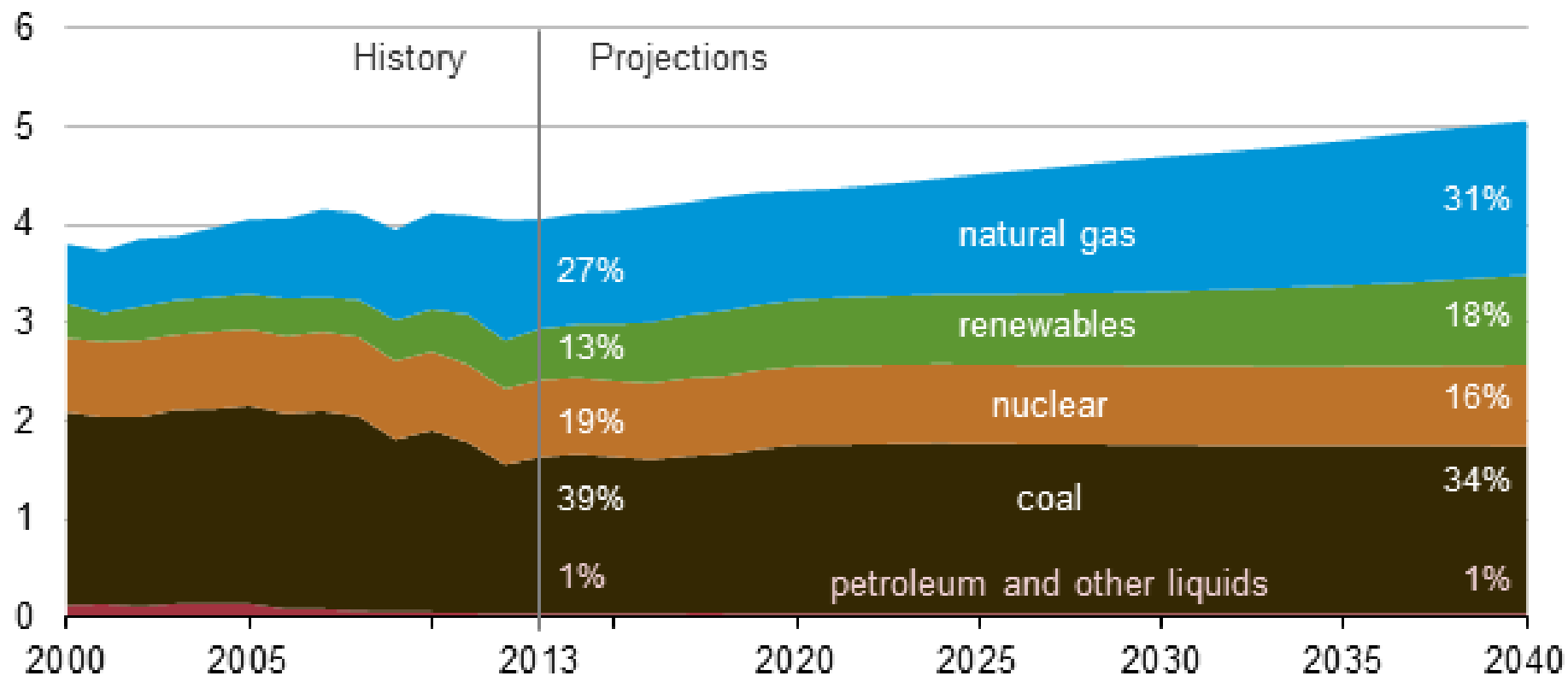


Electricity generation by fuel, 1990-2040

Electricity generation by fuel type in the AEO2015 Reference case, 2000-2040



trillion kilowatthours



2017 WORLD POPULATION

7.372 billion with Fossil Fuels or 1.098 billion without

Population



- Fossil Fuels
- No Fossil Fuels

Impacts on Social Justice

- ◆ Currently, about 85% of the world population depends upon fossil fuel as an energy source
- ◆ A “renewables only world” is improbable in any foreseeable future and if pursued it would result in a level of social injustice of “catastrophic” proportions
- ◆ Advocating that the world halt progress on “clean and efficient” fossil fuel production and use is likely to delay reductions in CO₂ emissions because the world is not prepared to do without current levels of energy consumption.

A Relevant Lesson from History

U.S. Alcohol Prohibition 1920-1933

- ◆ **Total Alcohol Consumption Levels was reduced by 50%**
- ◆ **ORGANIZED CRIME** under Al Capone came to control the supply of beer from Canada to Florida bringing in \$60 million a year in profits at his 10,000 speakeasies.
- ◆ The repeal of prohibition championed by Franklin Roosevelt and others emphasized the need to raise tax revenue and weaken the base of **ORGANIZED CRIME!**

The Goal of Prohibition



The Result of Prohibition

PUBLIC ENEMIES



AL "SCARFACE" CAPONE



"BUGSY" SIEGEL



"PRETTY BOY" FLOYD



FRANK COSTELLO



"MACHINE GUN" KELLY



JOHN DILLINGER



"BABY FACE" NELSON



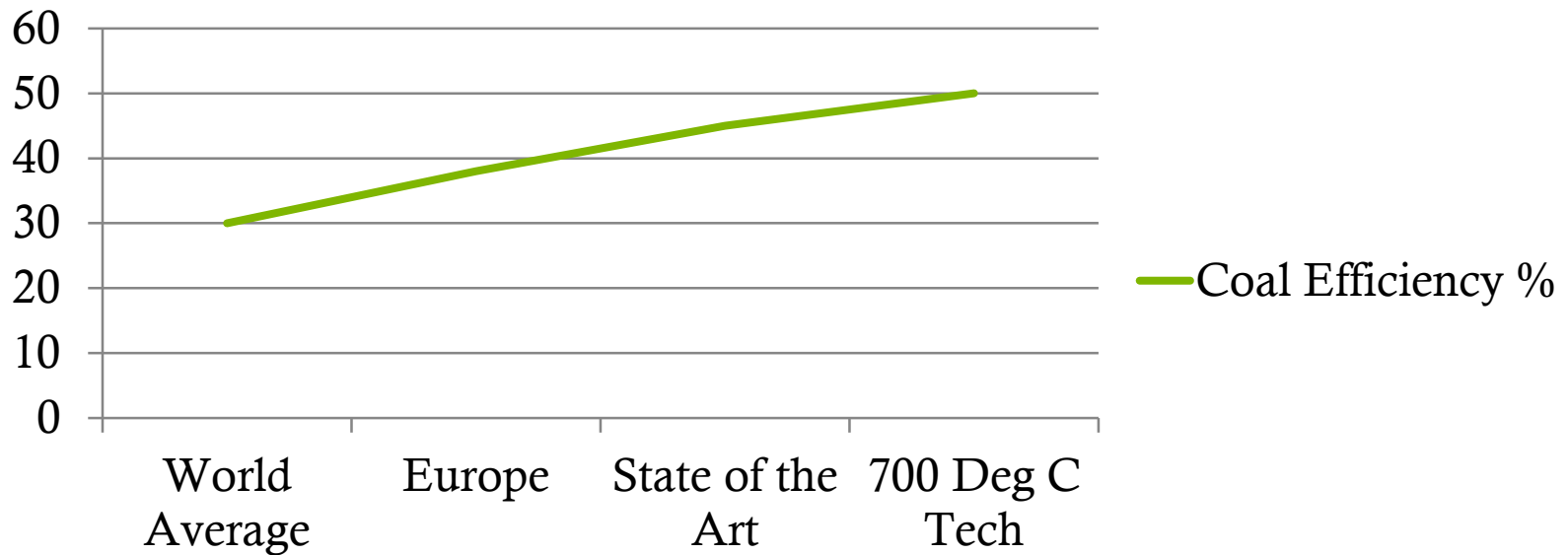
"LUCKY" LUCIANO

Impacts of Fossil Fuel Prohibition

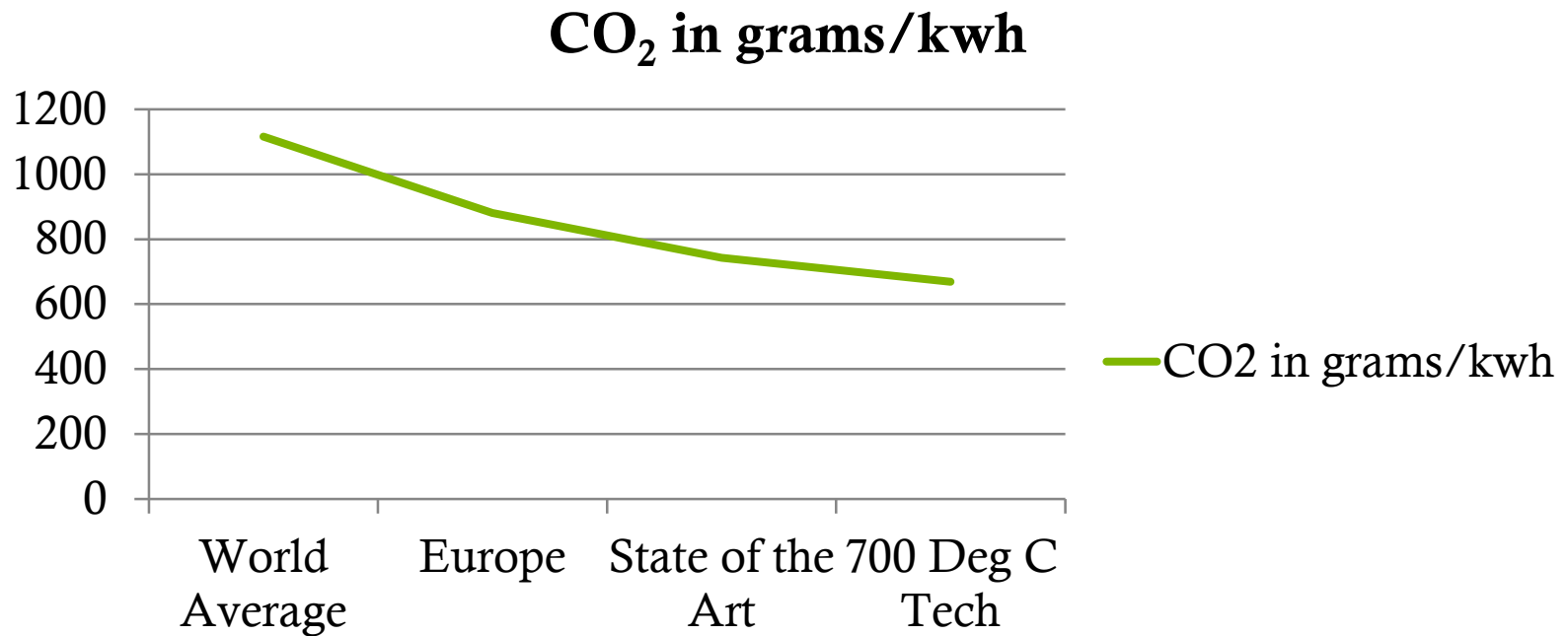
- ◆ US Prohibitions on Fossil Fuels beginning with coal by establishing legal barriers to construction of State of the Art, High Efficiency Coal Fired Power Plants sends a message to the world that efforts to implement clean coal technology are useless or counterproductive. The result is that **the world is discouraged from building more efficient less polluting technologies leading to greater levels of global CO₂ not less.**

Efficiency of Coal Conversion Related to Current Technologies

Coal Efficiency %



Carbon Dioxide Produced Related to Coal Fired Power Technologies



Conclusions

- ◆ Solutions must be **globally applicable and socially acceptable** to be effective.
- ◆ Solutions that **negatively impact the global economy and human population quality of life will not be adopted.**
- ◆ Quantitative US fossil fuel reductions by themselves will have very little impact globally. **Only affordable and achievable technologies that increase fuel efficiency and environmental performance will be adopted globally and actually make a difference.**
- ◆ The **unmanageable TIME FRAME** for replacement of fossil fuels with renewables **makes mandates for RENWEABLES ONLY unacceptable and unachievable.**
- ◆ **Prohibitions of fuel specific BACT solutions will have a negative rather than positive impact** on reductions in global Carbon Emissions because they will inhibit the technological improvements needed to actually reduce emissions.
- ◆ The very **ideological** people who have identified a **technological** problem with global carbon emissions are not the people who will find **rational solutions** to this technological problem.

Sources of Data

- ◆ Energy data is from the **U.S. Energy Information Administration** at: www.eia.gov
- ◆ Global Human Population figures based on **U.S. Census Bureau** data found at: <http://www.census.gov/popclock>
- ◆ Best Available Control Technologies for Coal Fired Power Plants at: www.worldcoal.org/coal-the-environment/coal-use-the-environment/improving-efficiencies
- ◆ U.S. Environmental Protection Agency (**USEPA**): www.epa.gov
- ◆ **Lawrence Berkeley National Lab**
https://emp.lbl.gov/sites/all/files/lbnl-1007060_0.pdf

Questions?