



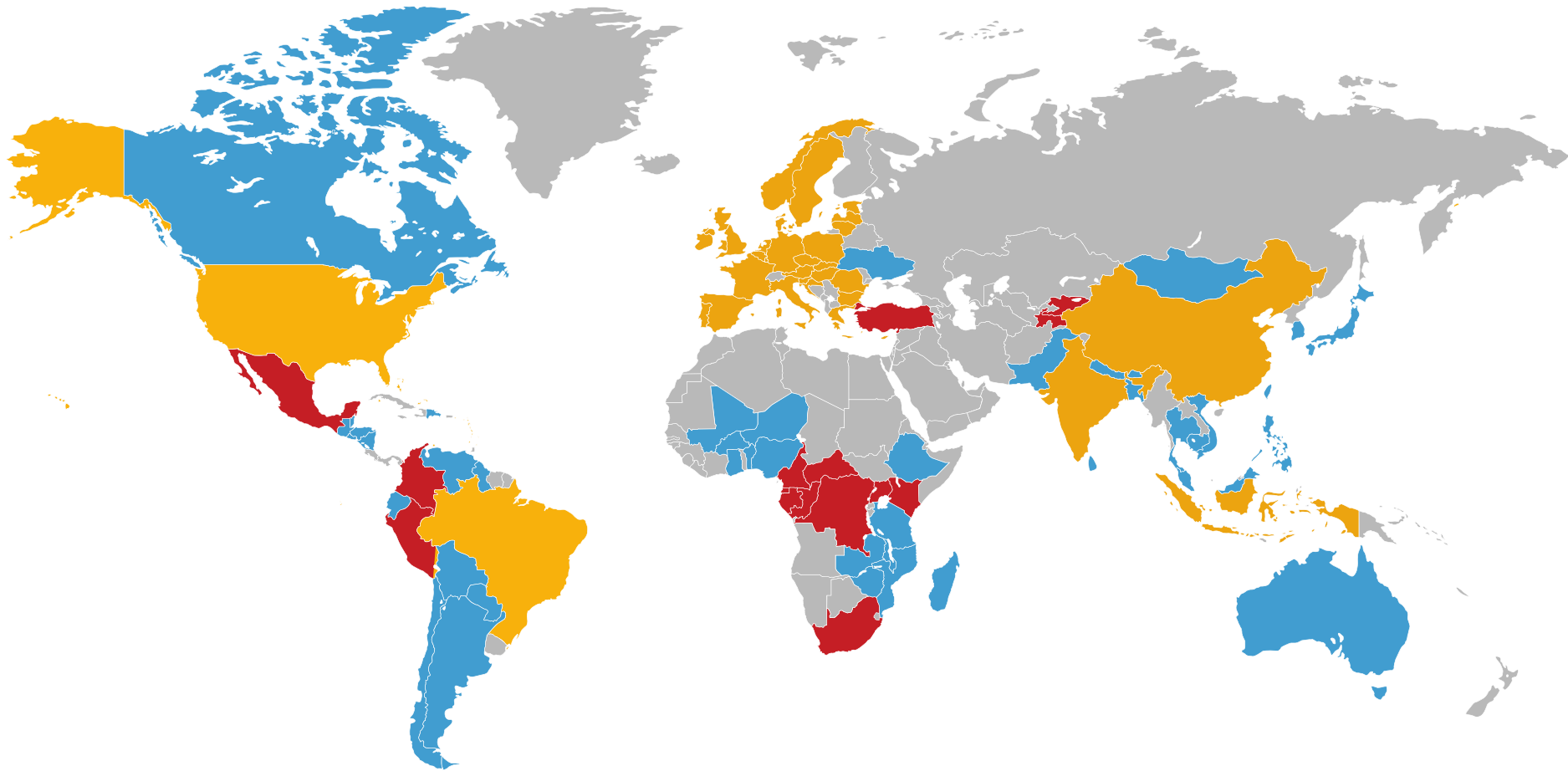
WORLD
RESOURCES
INSTITUTE



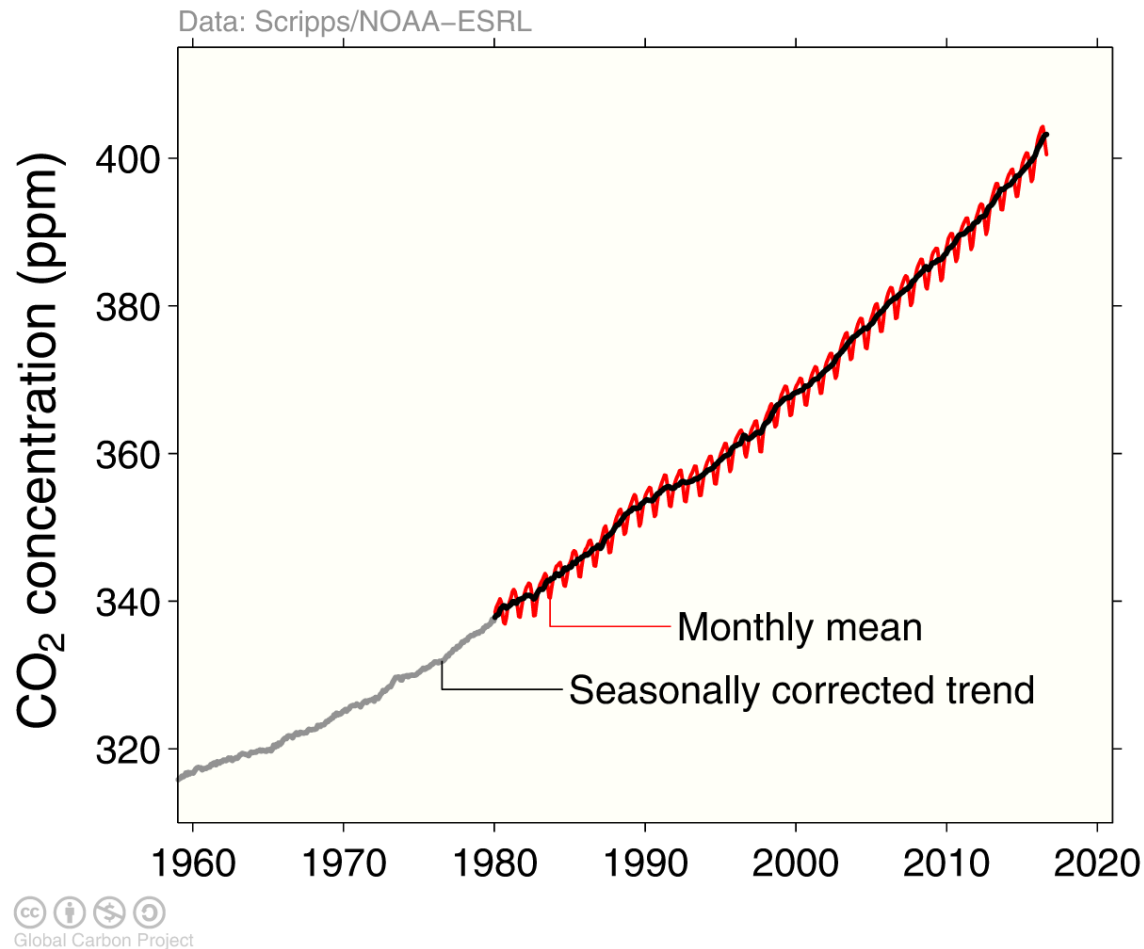
SIZING THINGS UP

NICHOLAS BIANCO

WRI's Global Network



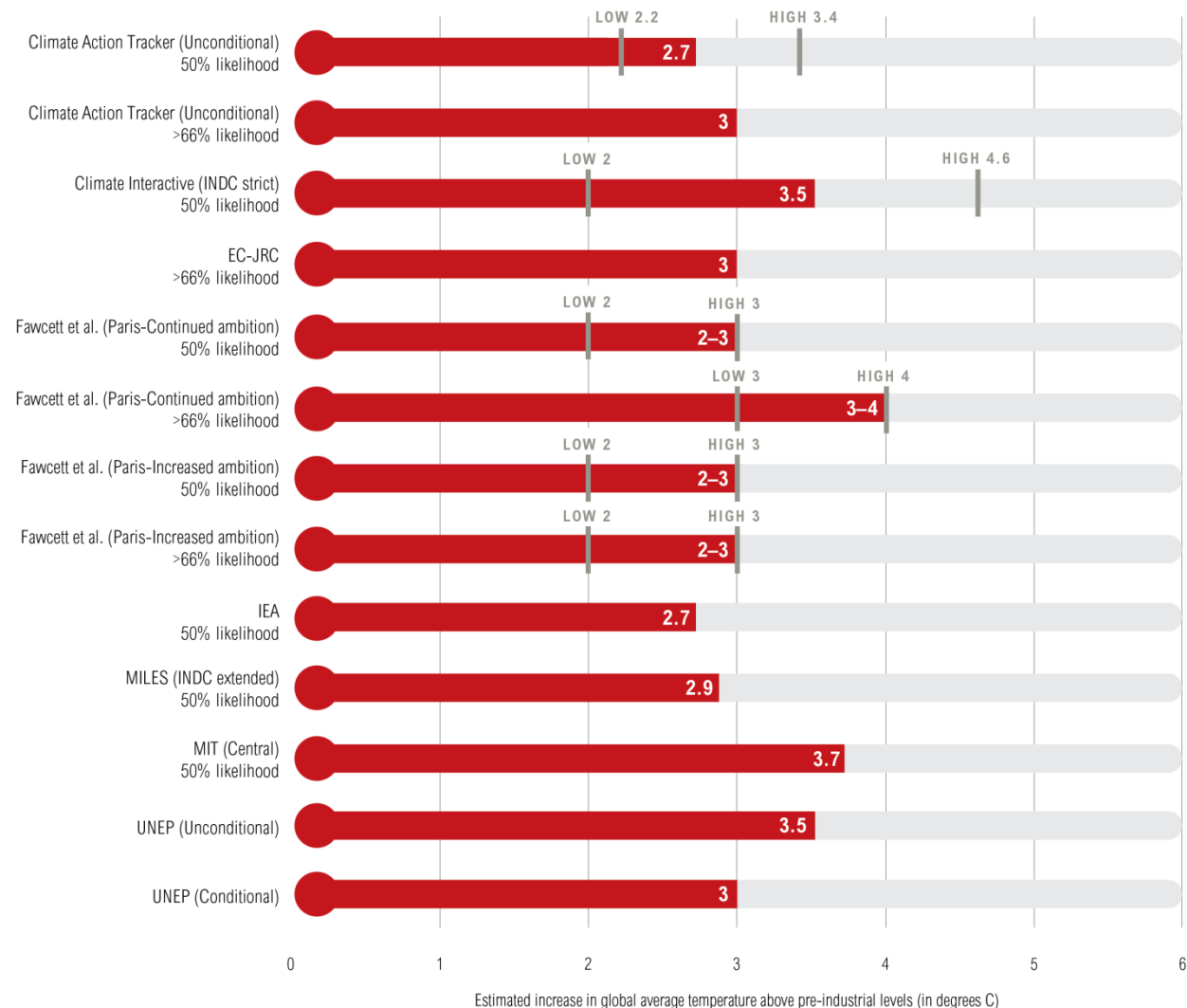
ATMOSPHERIC CONCENTRATIONS OF CARBON DIOXIDE



Globally averaged surface atmospheric CO₂ concentration. Data from: NOAA-ESRL after 1980; the Scripps Institution of Oceanography before 1980 (harmonised to recent data by adding 0.542ppm)
Source: [NOAA-ESRL](#); [Scripps Institution of Oceanography](#); [Le Quéré et al 2016](#); [Global Carbon Budget 2016](#)

WHERE ARE WE HEADED?

Estimates for Global Temperature Rise with INDCs



Note: "Likelihood" refers to the probability of limiting global warming to the specified temperature increase by 2100. For instance, 2.5°C at 50% likelihood provides a 50% chance that warming will not exceed 2.5°C. Likelihood for EC-JRC corresponds to middle of range defined by RCP4.5.

TIMING OF REDUCTIONS

LIMITING GLOBAL
WARMING TO

1.5°C REQUIRES

NET Ø CO₂

+

NET Ø GHG



2.0°C REQUIRES

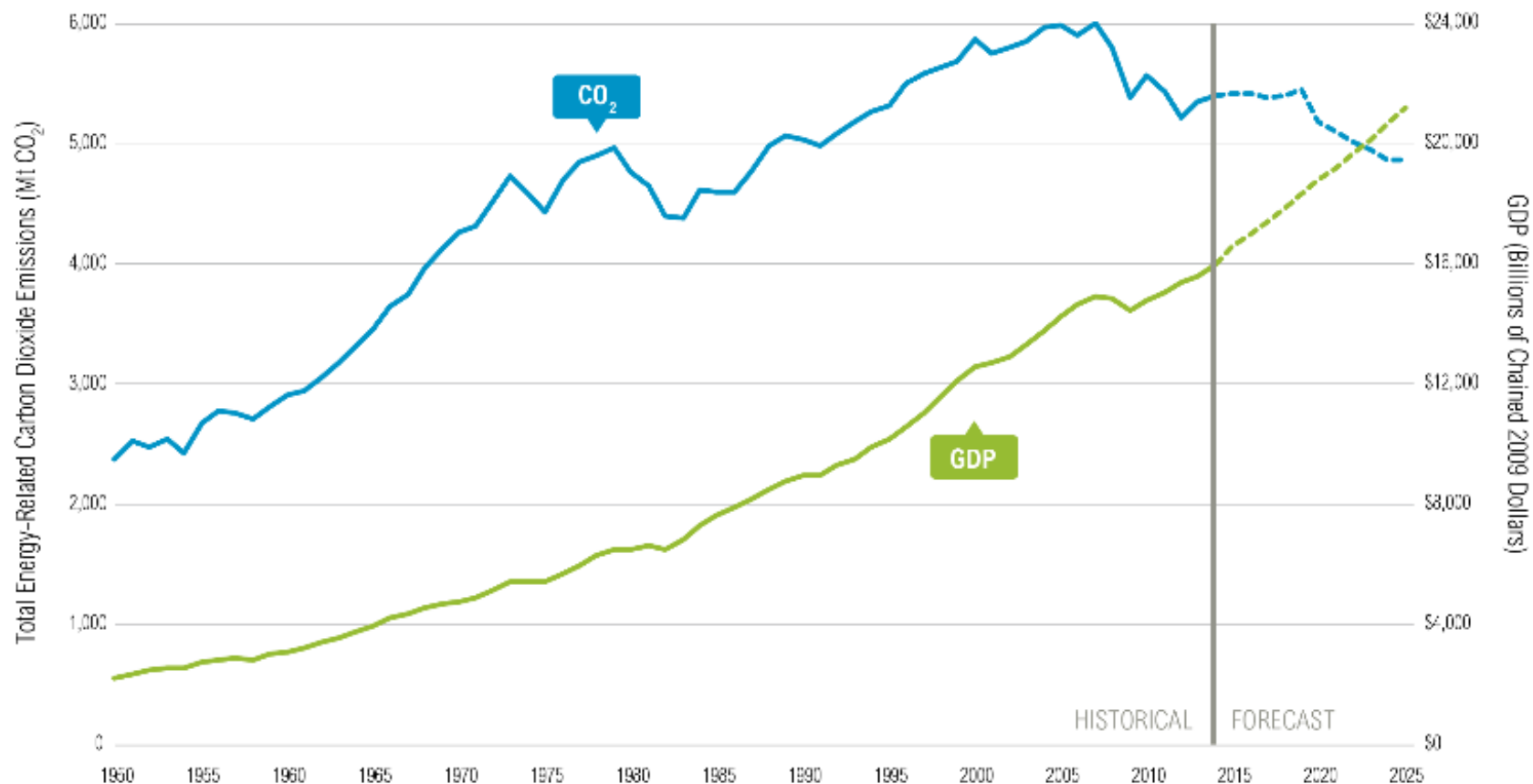
NET Ø CO₂

+

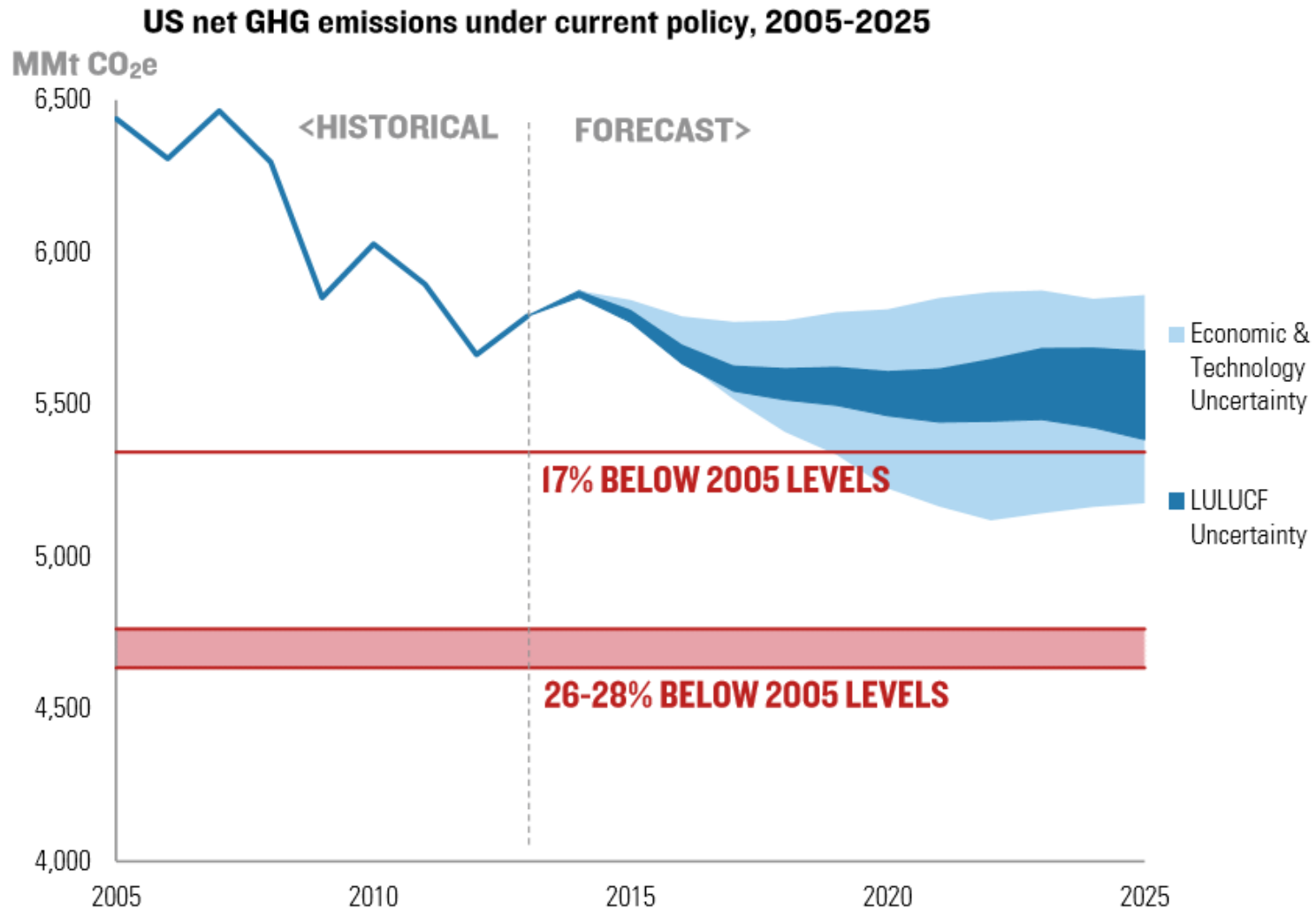
NET Ø GHG



U.S. CARBON DIOXIDE EMISSIONS HAVE FALLEN WHILE ECONOMIC GROWTH HAS CONTINUED



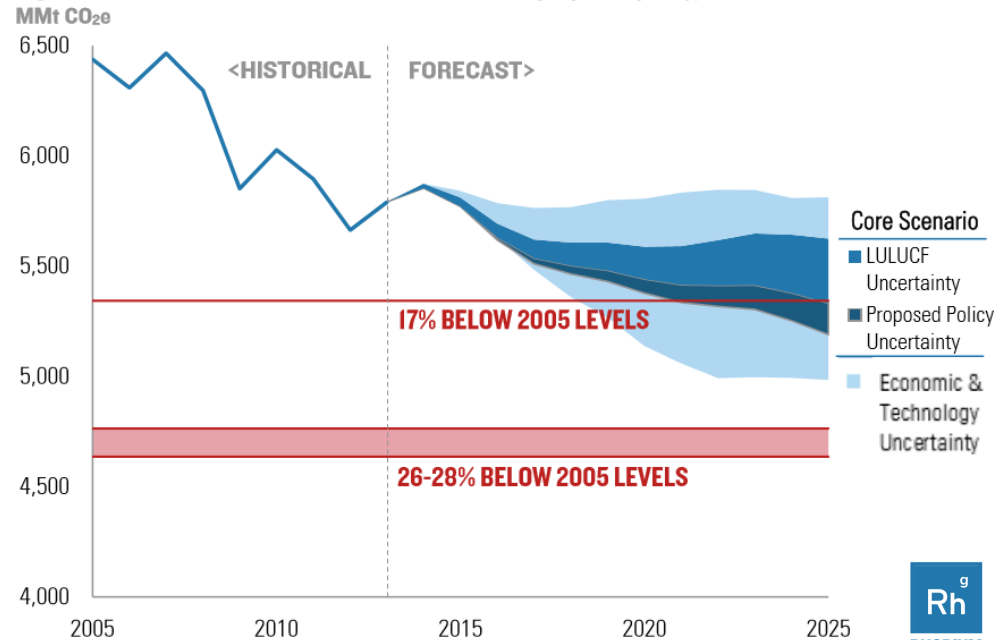
WHAT WILL IT TAKE?



Source: EPA, US Second Biennial Report, Rhodium Group analysis.

NUMEROUS STUDIES SHOW THAT IT IS POSSIBLE TO FURTHER REDUCE EMISSIONS AND TO MEET THE PARIS COMMITMENTS WITH ADDITIONAL POLICY MEASURES

Figure 10: US net GHG emissions under current and proposed policy, 2005-2025



Source: EPA, US Second Biennial Report, Rhodium Group analysis.



Figure 6 U.S. Emissions Projections—2016 Current Measures Compared with Potential Reductions from Additional Measures Consistent with the Climate Action Plan

Also shown are previous projections from the 2006, 2010, and 2014 U.S. Climate Action Reports, which demonstrate the dramatic ratcheting down of projected U.S. emissions over the past decade.

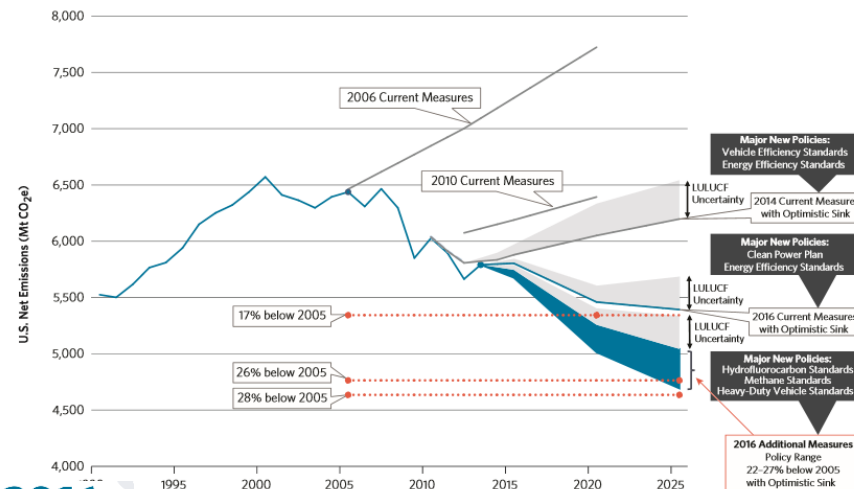
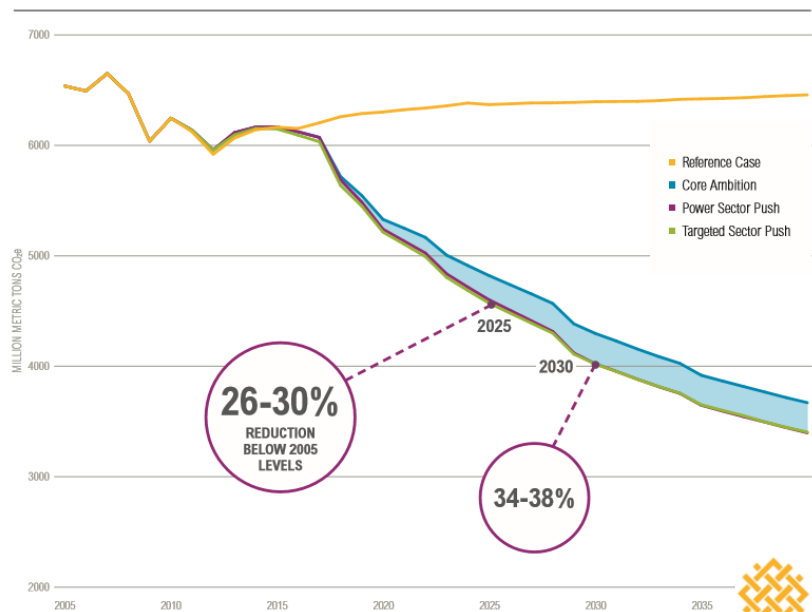


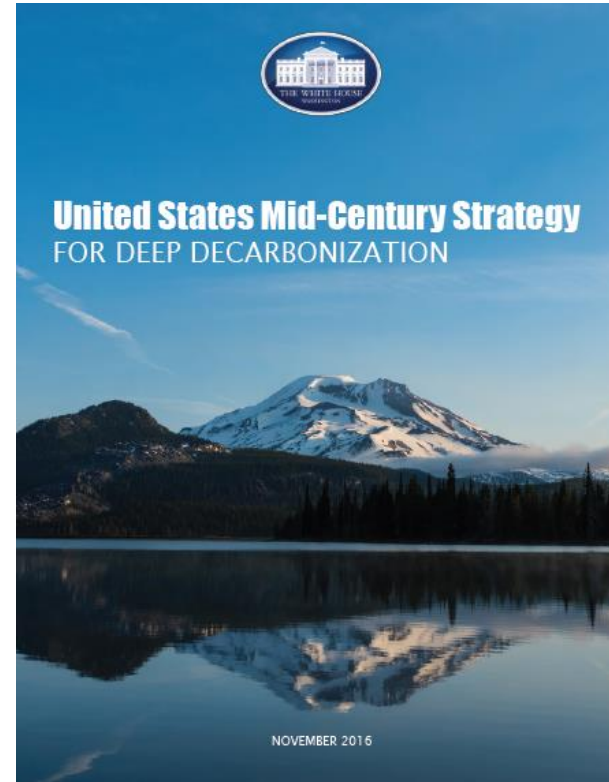
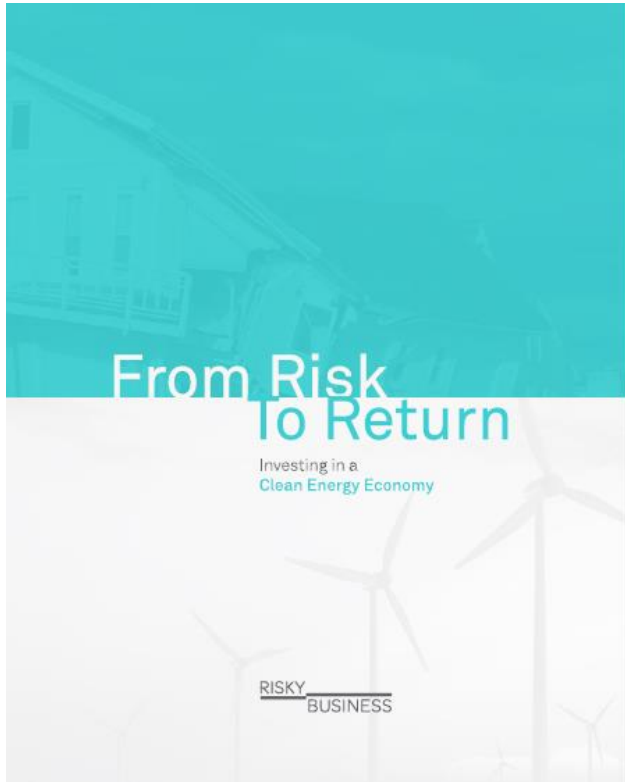
Figure ES-1 | Net U.S. Greenhouse Gas Emissions: Reference Case and Low-Carbon Pathways Using Existing Federal Authorities and Additional State Action



A SHIFTING POLICY ENVIRONMENT



WHAT ARE THE IMPLICATIONS OF ACHIEVING
DEEP EMISSIONS REDUCTIONS BY MID-CENTURY?



Three Pillars: Strategies and Metrics

STRATEGY

Decarbonization of electricity



Energy efficiency

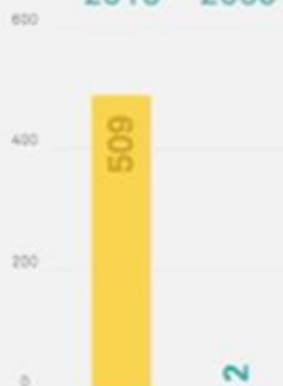


End use fuel switching to electric sources



KEY METRIC OF TRANSFORMATION

2015 2050



Electricity emissions intensity
(Kg of CO₂/MWh)

2015 2050



Final Energy Intensity of GDP
(MJ/\$2014 GDP)

2015

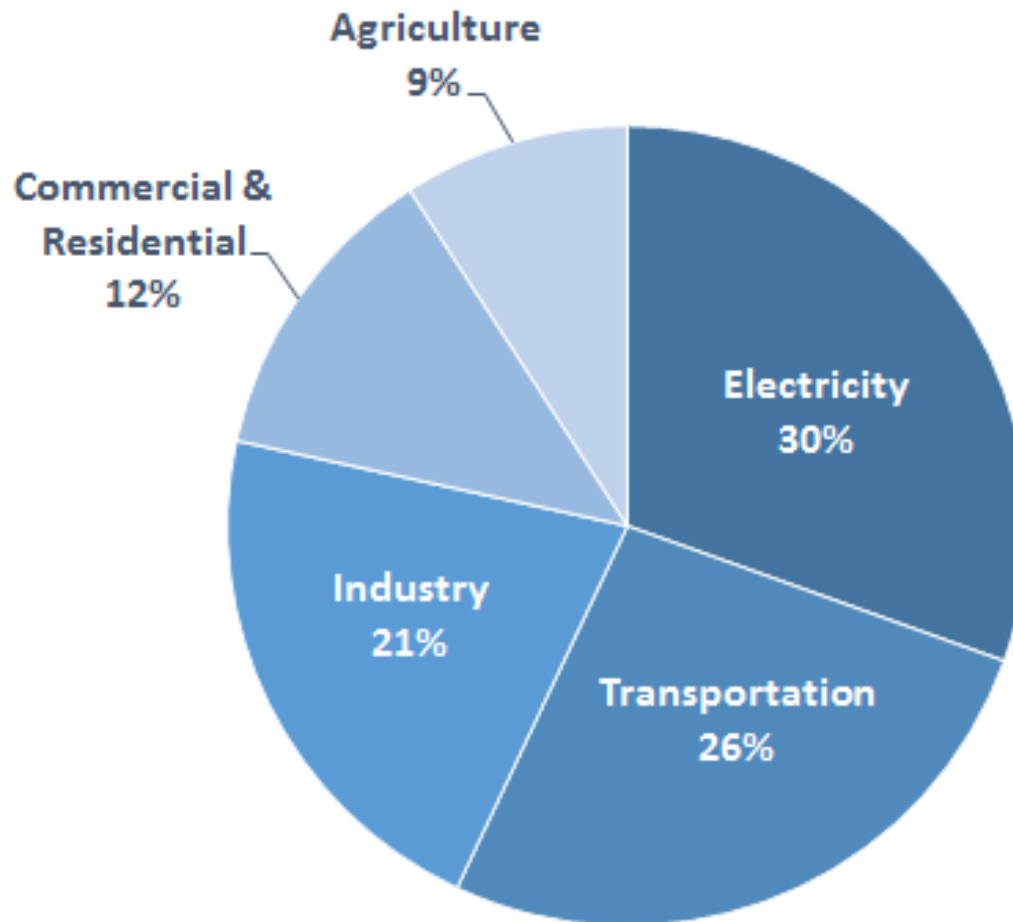
2050



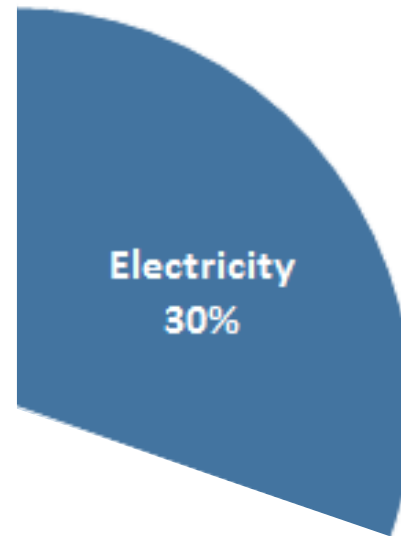
Share of electricity and electric
fuels in total Final Energy (%)

Mixed Resources Pathway

Total U.S. Greenhouse Gas Emissions by Economic Sector in 2014

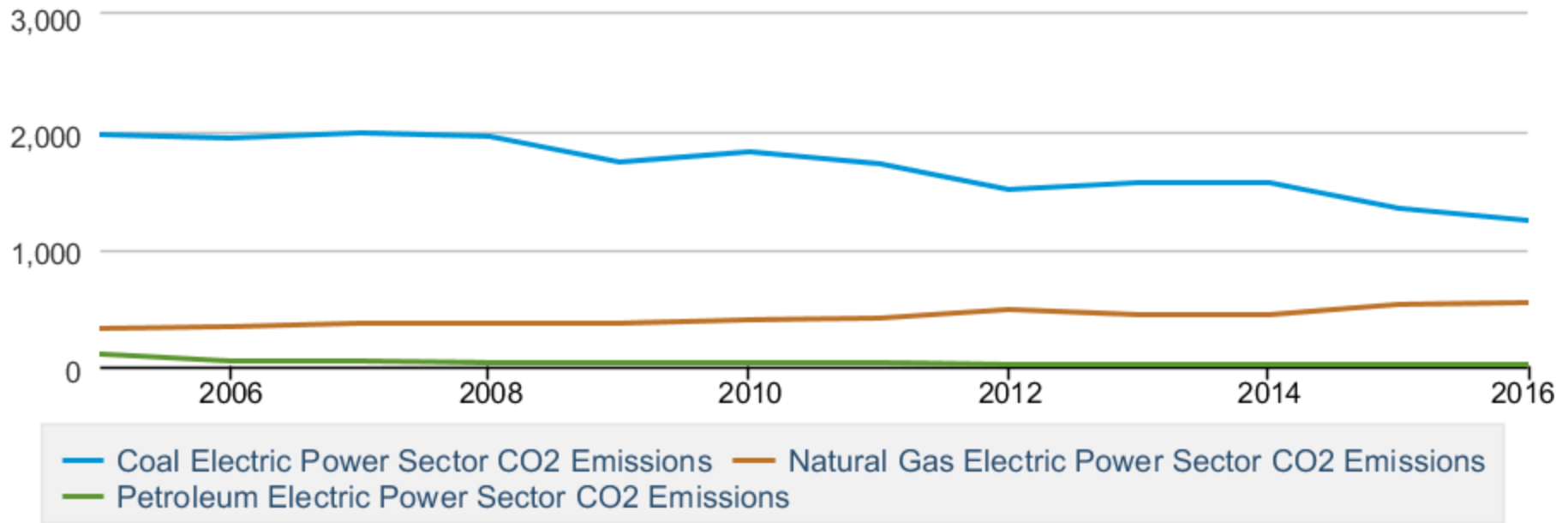


SOURCE: US EPA



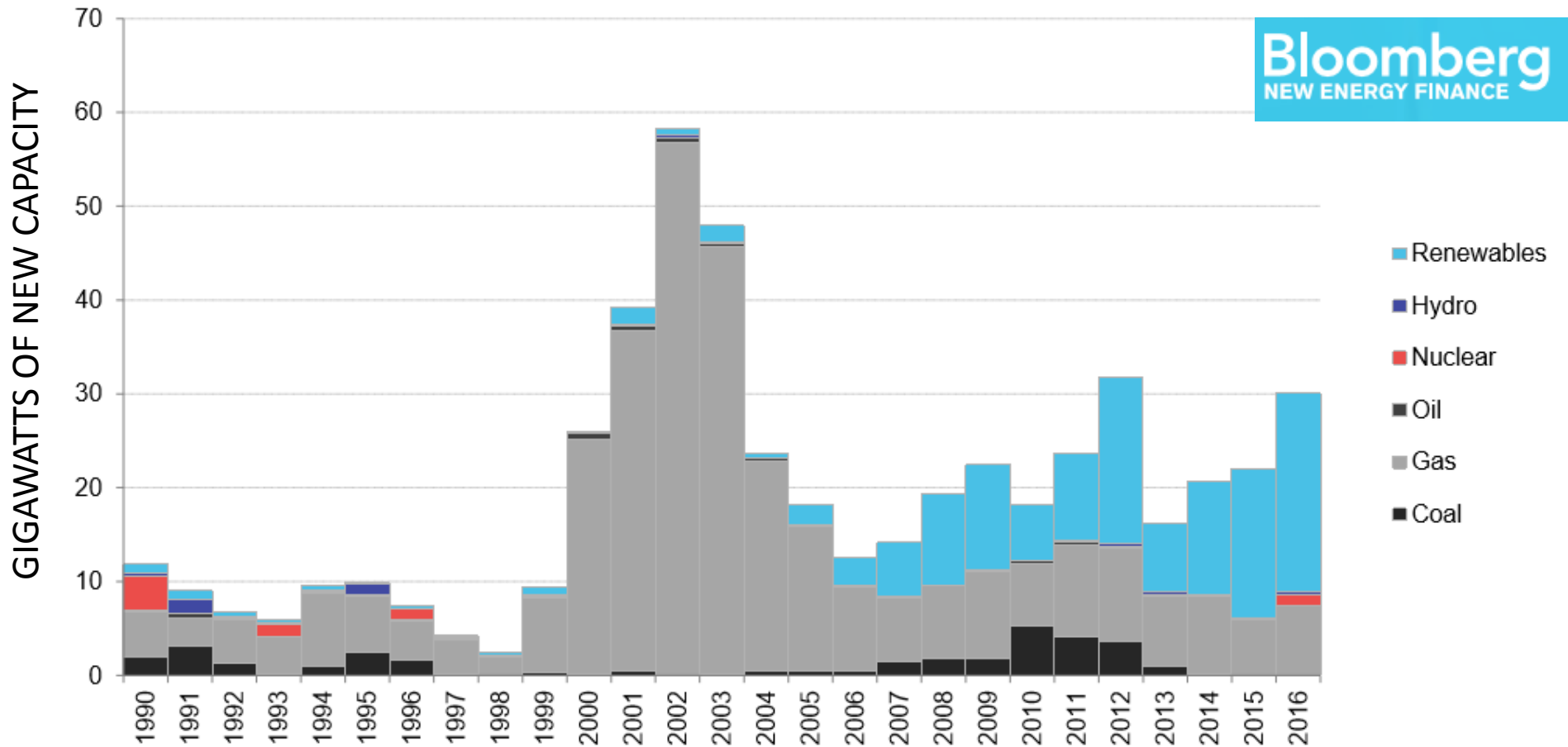
POWER SECTOR EMISSIONS **DOWN 25%** SINCE 2005

Million Metric Tons of Carbon Dioxide

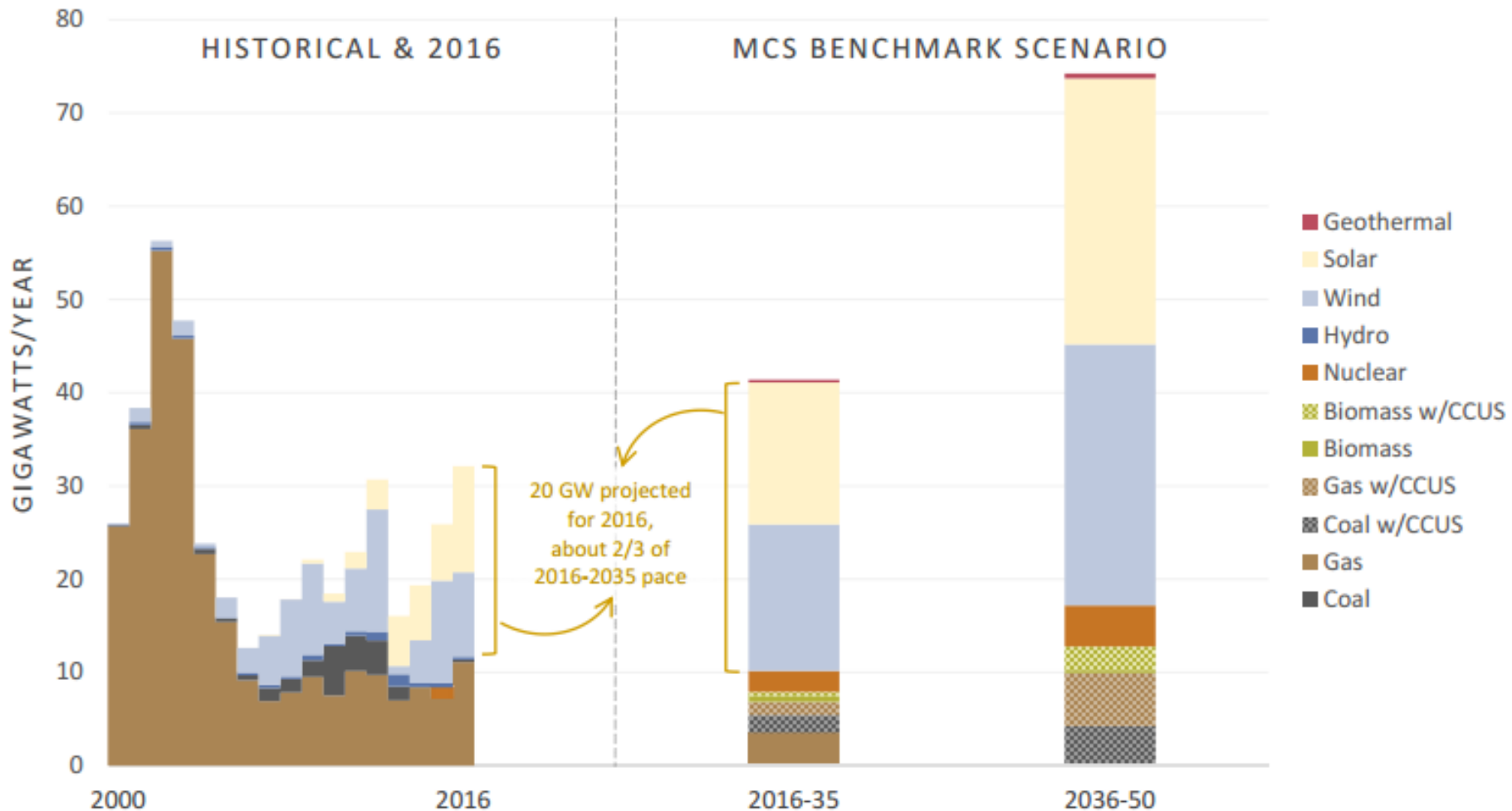


Source: U.S. Energy Information Administration

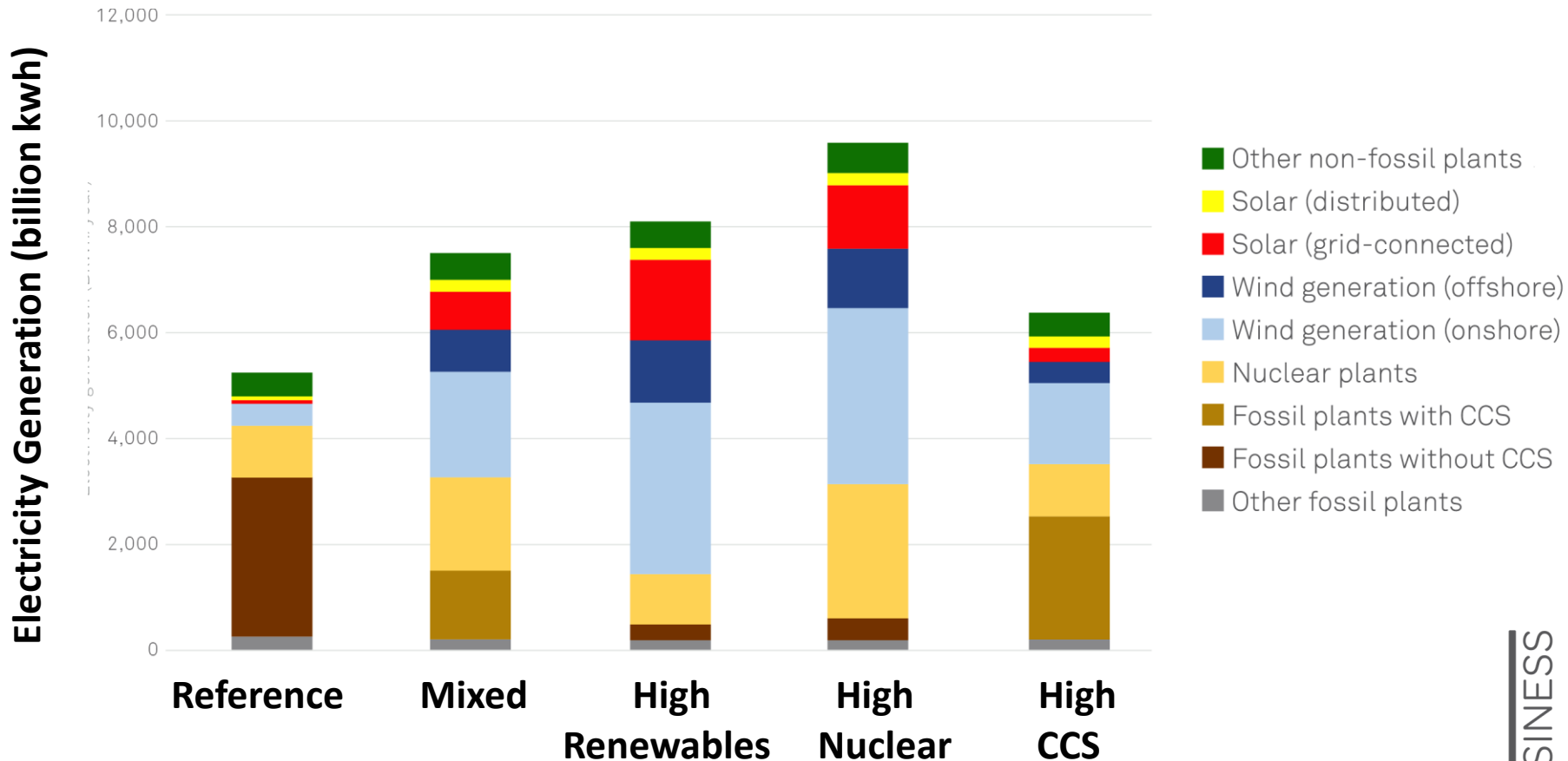
GAS AND RENEWABLES HAVE DOMINATED NEW BUILDS SINCE THE LATE 90s



DECARBONIZING THE POWER SECTOR REQUIRES AN ACCELERATION OF THIS RATE OF CHANGE

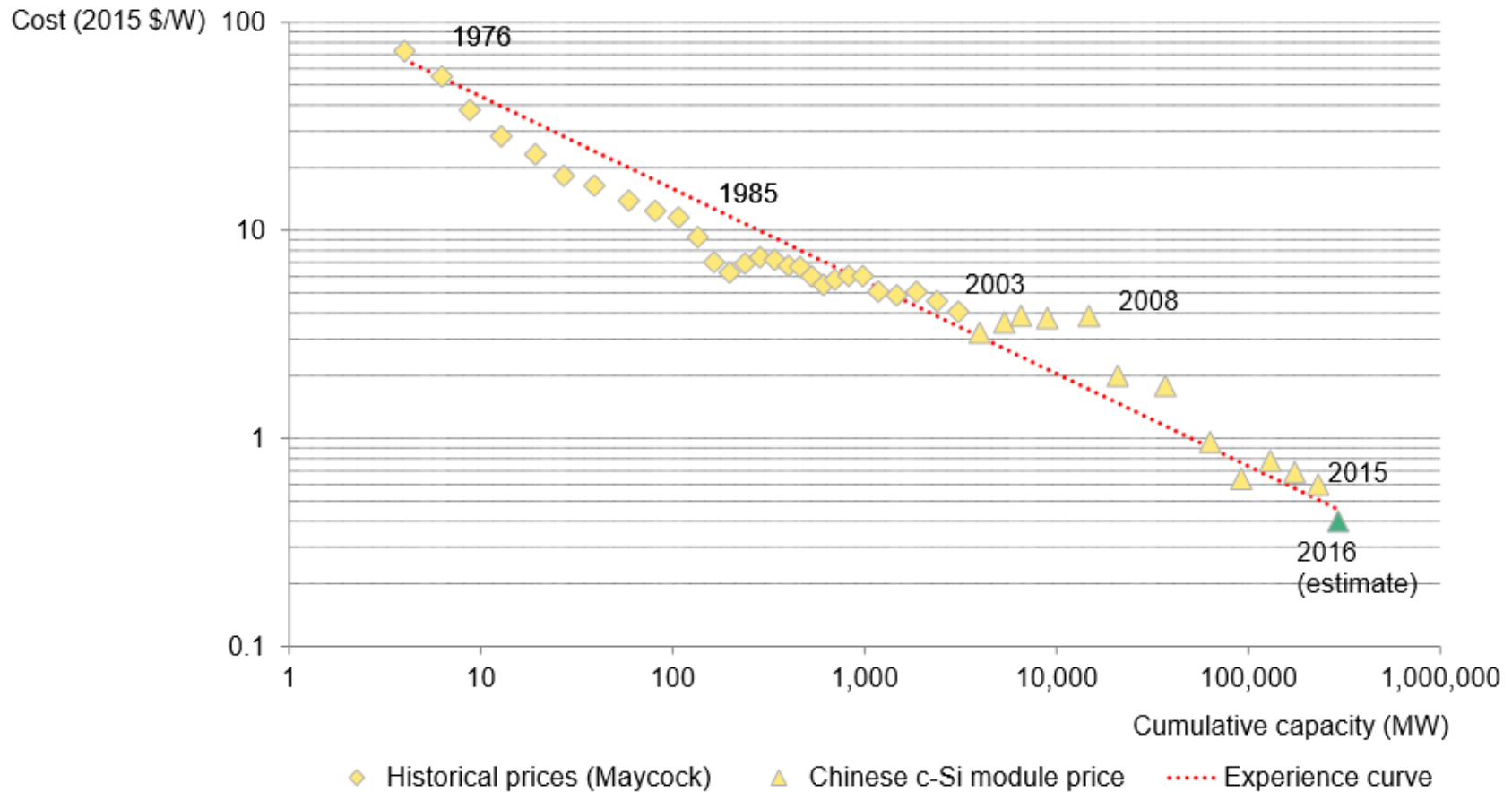


THERE ARE MANY PATHS TO A DECARBONIZED POWER SECTOR

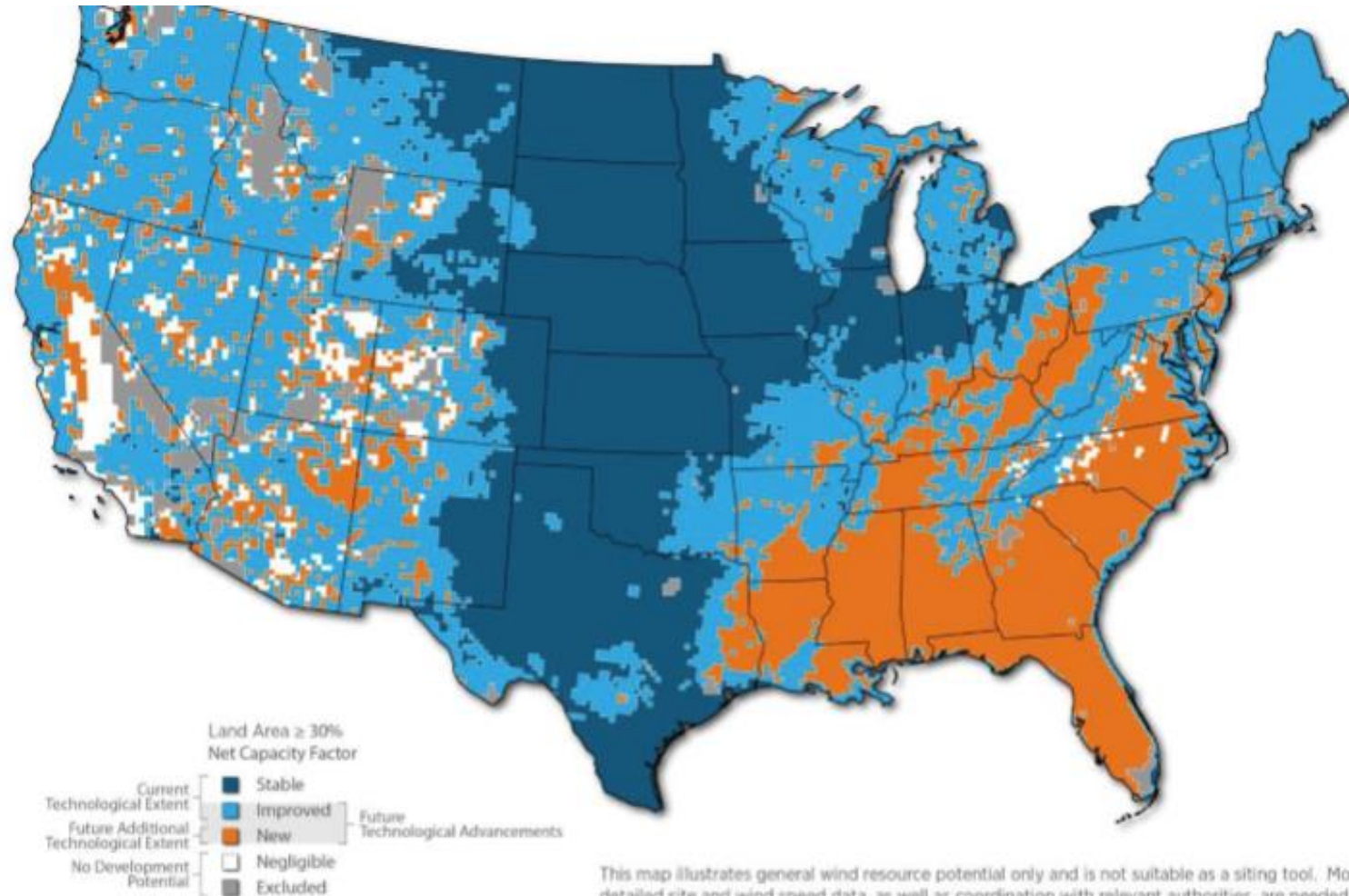


HOW REASONABLE IS THIS?

PRICES OF SOLAR CONTINUE TO DECLINE AS INSTALLED CAPACITY INCREASES



THE REGIONS OVER WHICH WIND IS VIABLE HAS INCREASED, AND IS POISED TO EXPAND FURTHER STILL



This map illustrates general wind resource potential only and is not suitable as a siting tool. More detailed site and wind speed data, as well as coordination with relevant authorities, are needed to thoroughly evaluate appropriate wind energy development at any given location.
Data sources: AWS Truepower, National Renewable Energy Laboratory

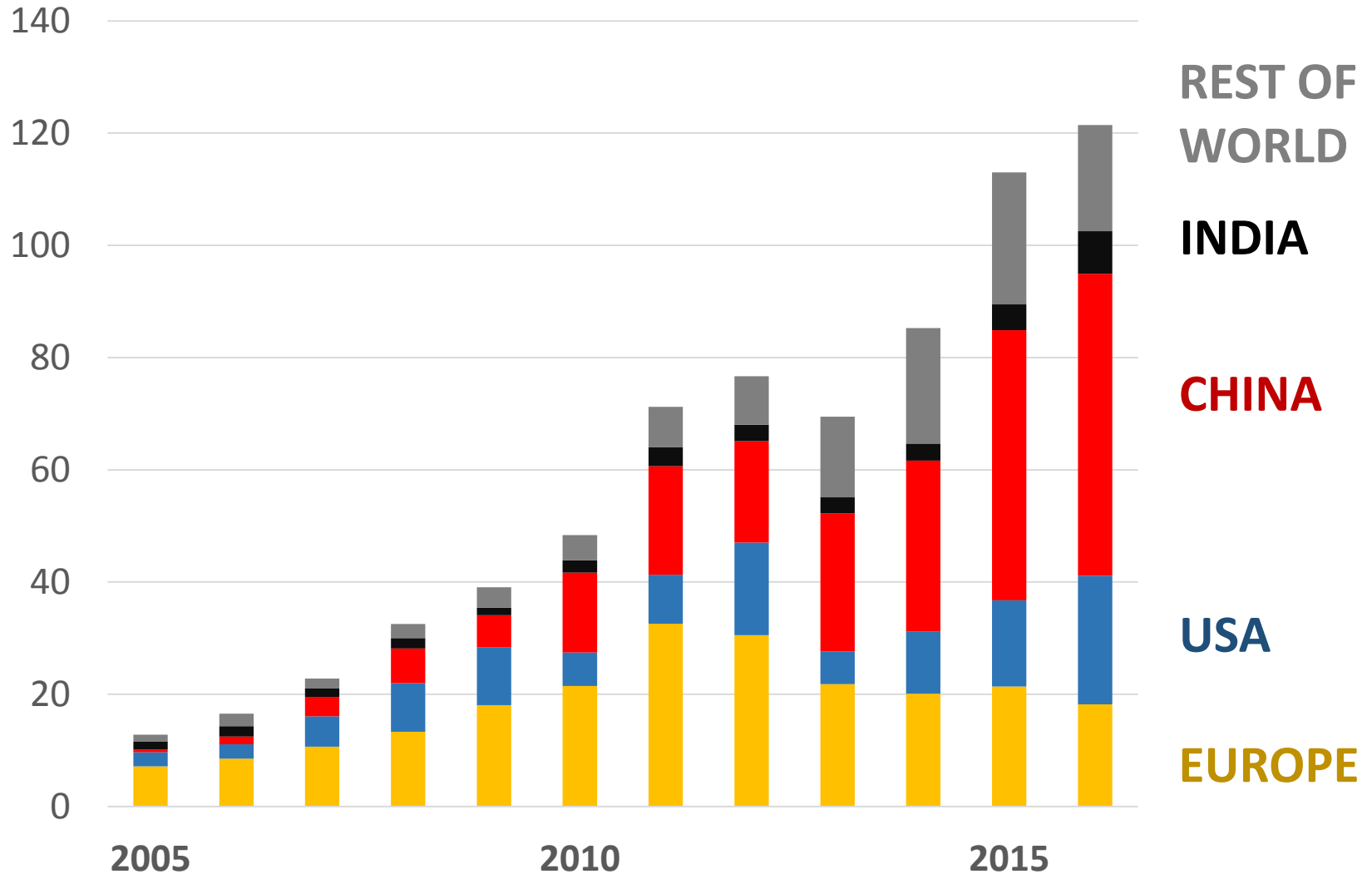
This map was produced by the
National Renewable Energy Laboratory
for the US Department of Energy.
March 2015

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

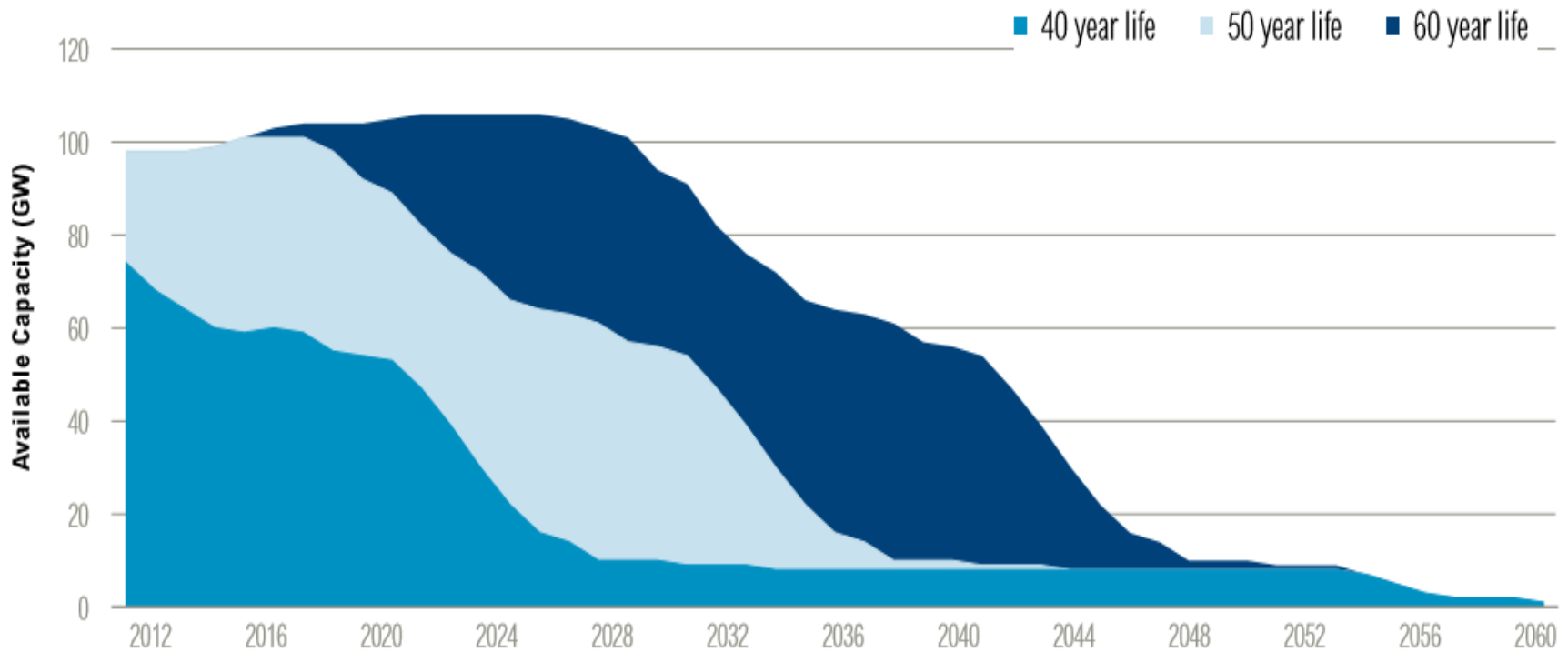
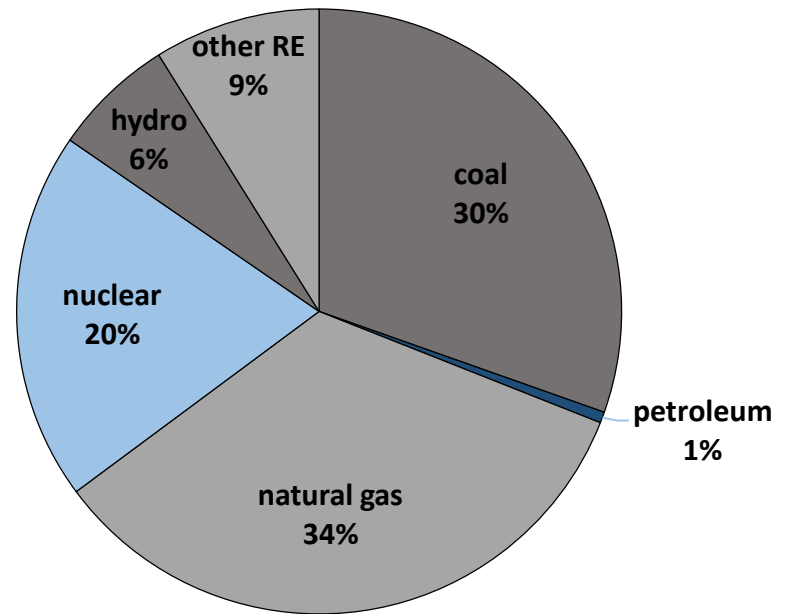
AWS Truepower

ANNUAL WIND AND SOLAR BUILDS

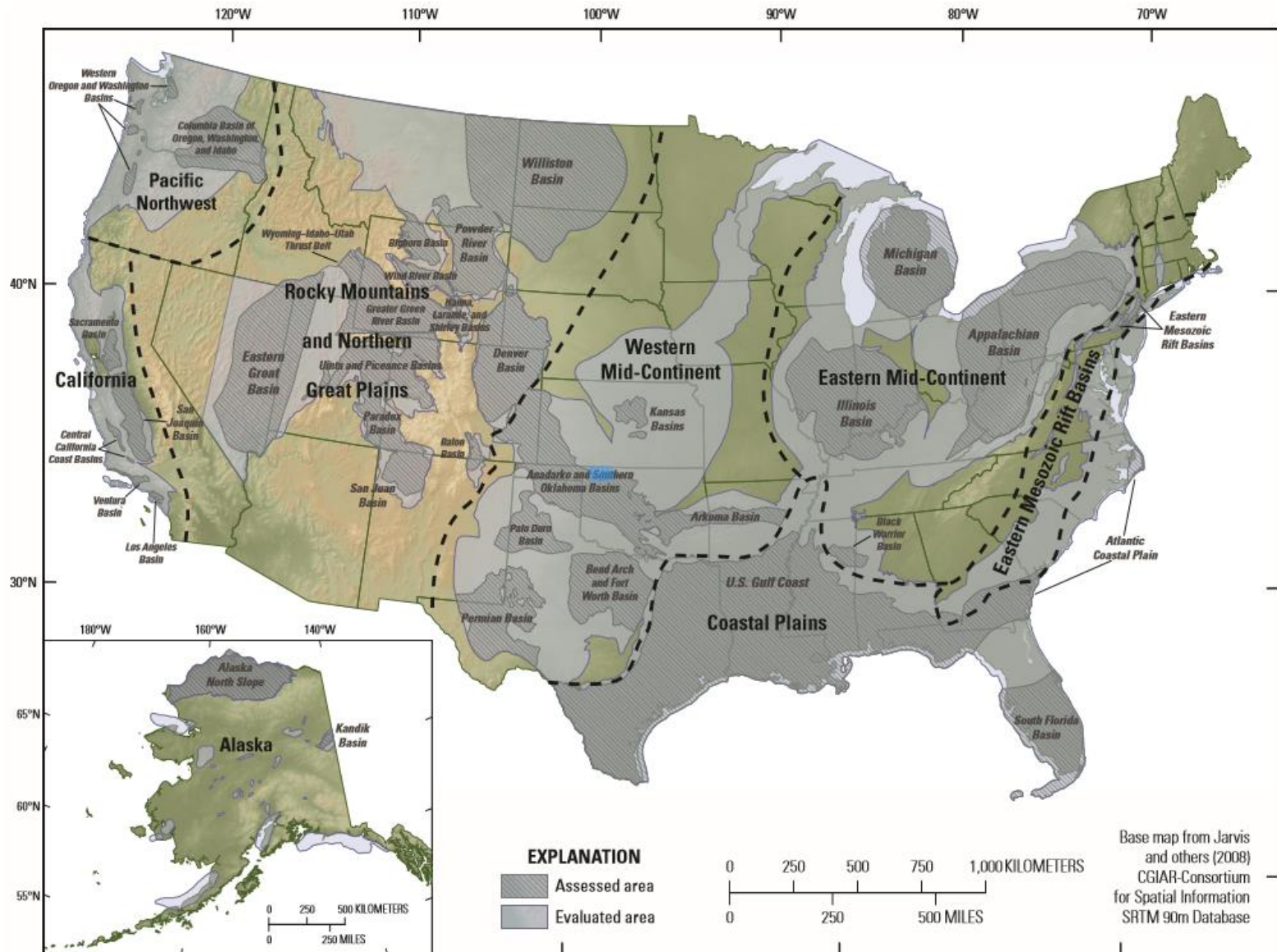
GIGAWATTS WIND AND SOLAR



NUCLEAR'S FUTURE COULD IMPACT GHG EMISSIONS



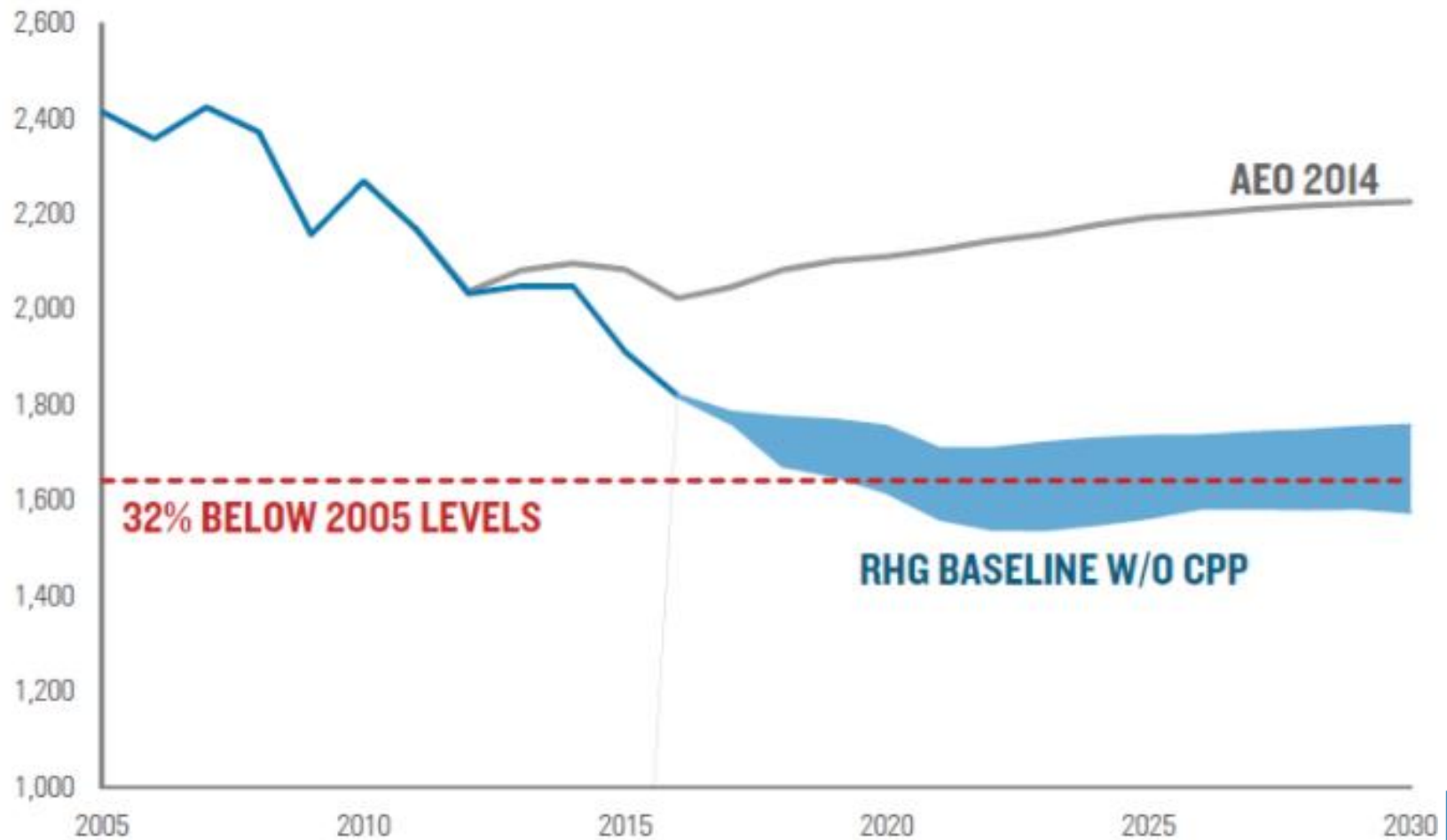
WHAT ROLE WILL CCS PLAY?



CLEAN POWER PLAN REPEAL EFFORTS

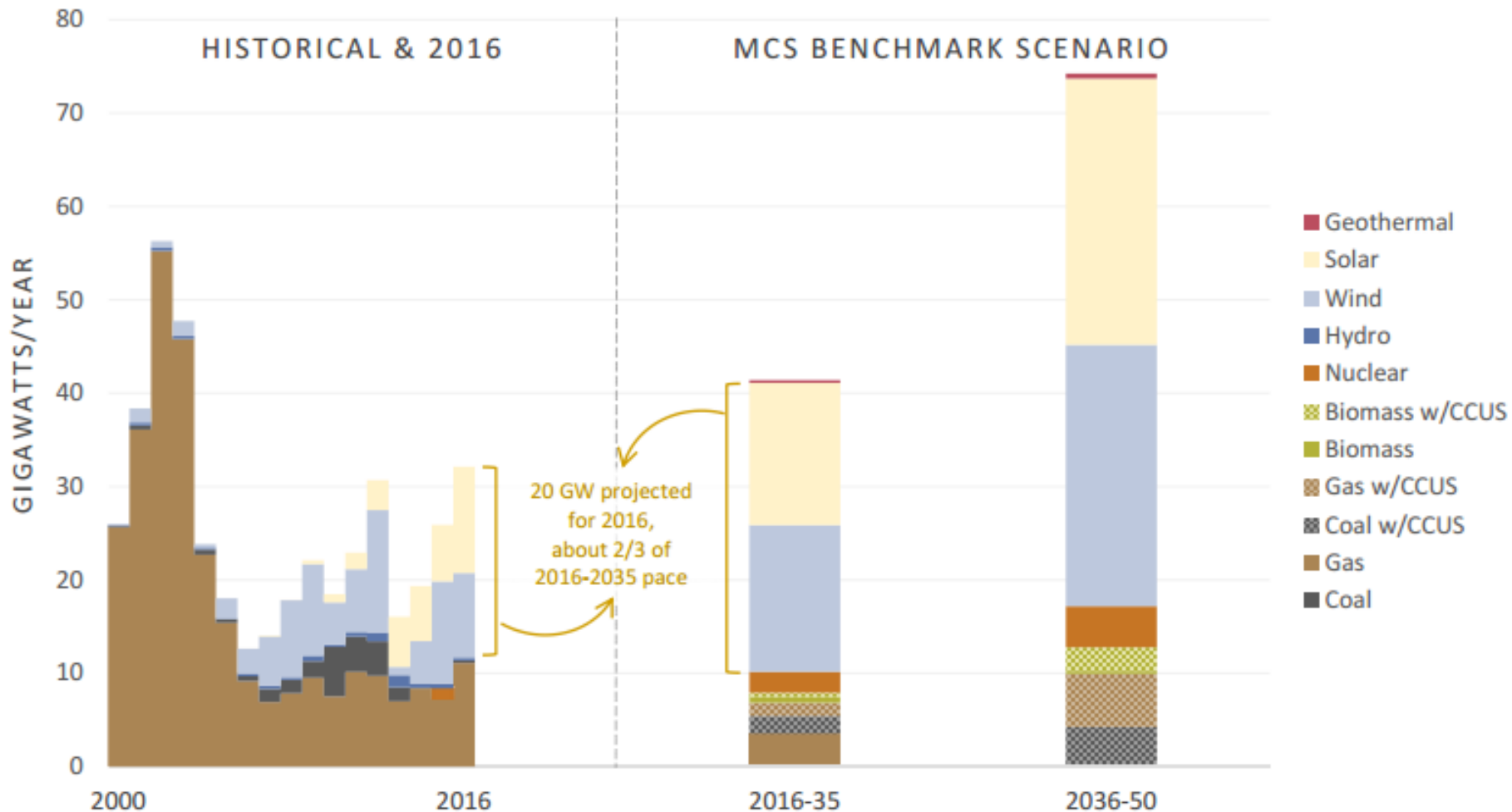


POWER SECTOR EMISSIONS MAY STILL FALL AT A RATE COMPARABLE TO THAT REQUIRED BY THE CLEAN POWER PLAN



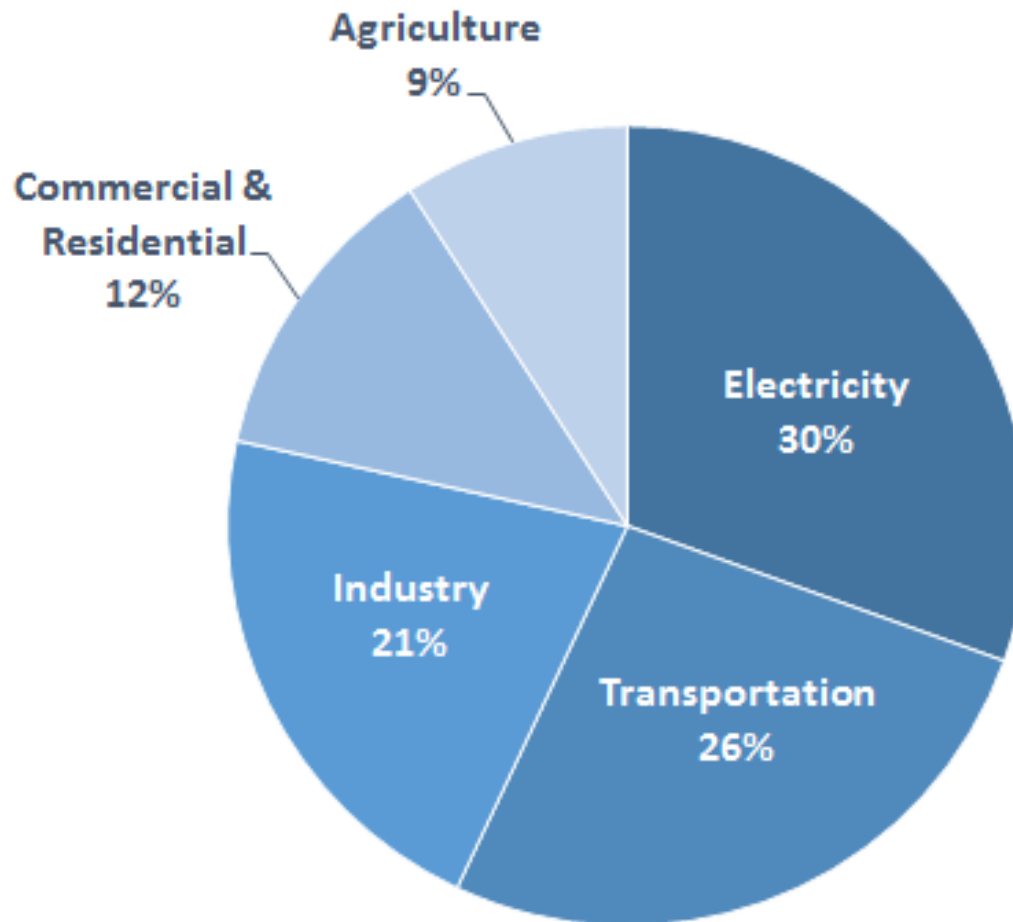
— Source: EPA, EIA and Rhodium Group analysis.

DEEP DECARBONIZATION REQUIRES AN **ACCELERATION** IN THE RATE OF CHANGE

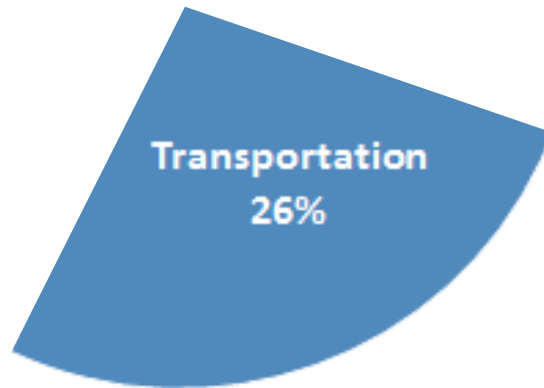


SOURCE: UNITED STATES MID-CENTURY STRATEGY FOR DEEP DECARBONIZATION

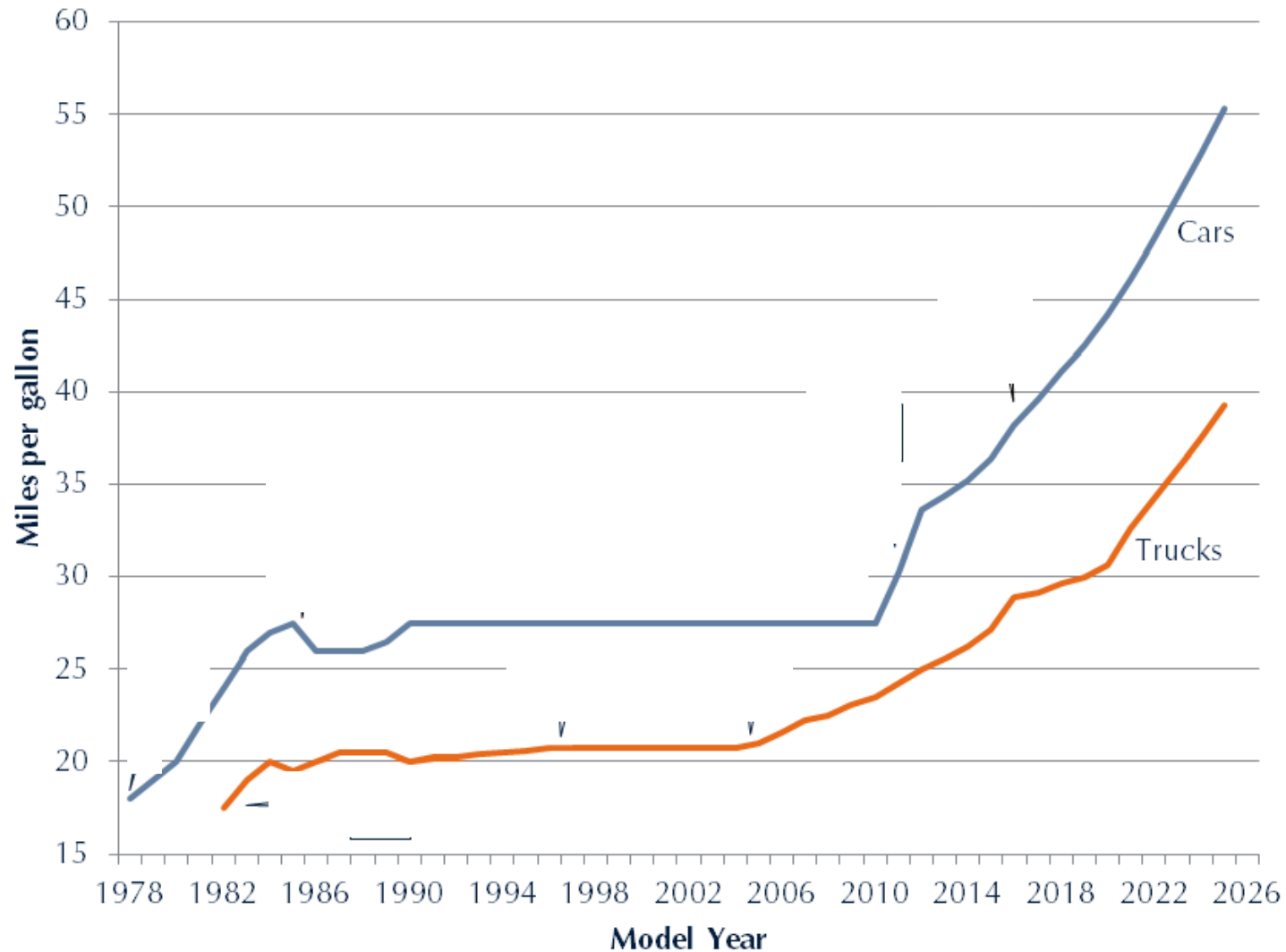
Total U.S. Greenhouse Gas Emissions by Economic Sector in 2014



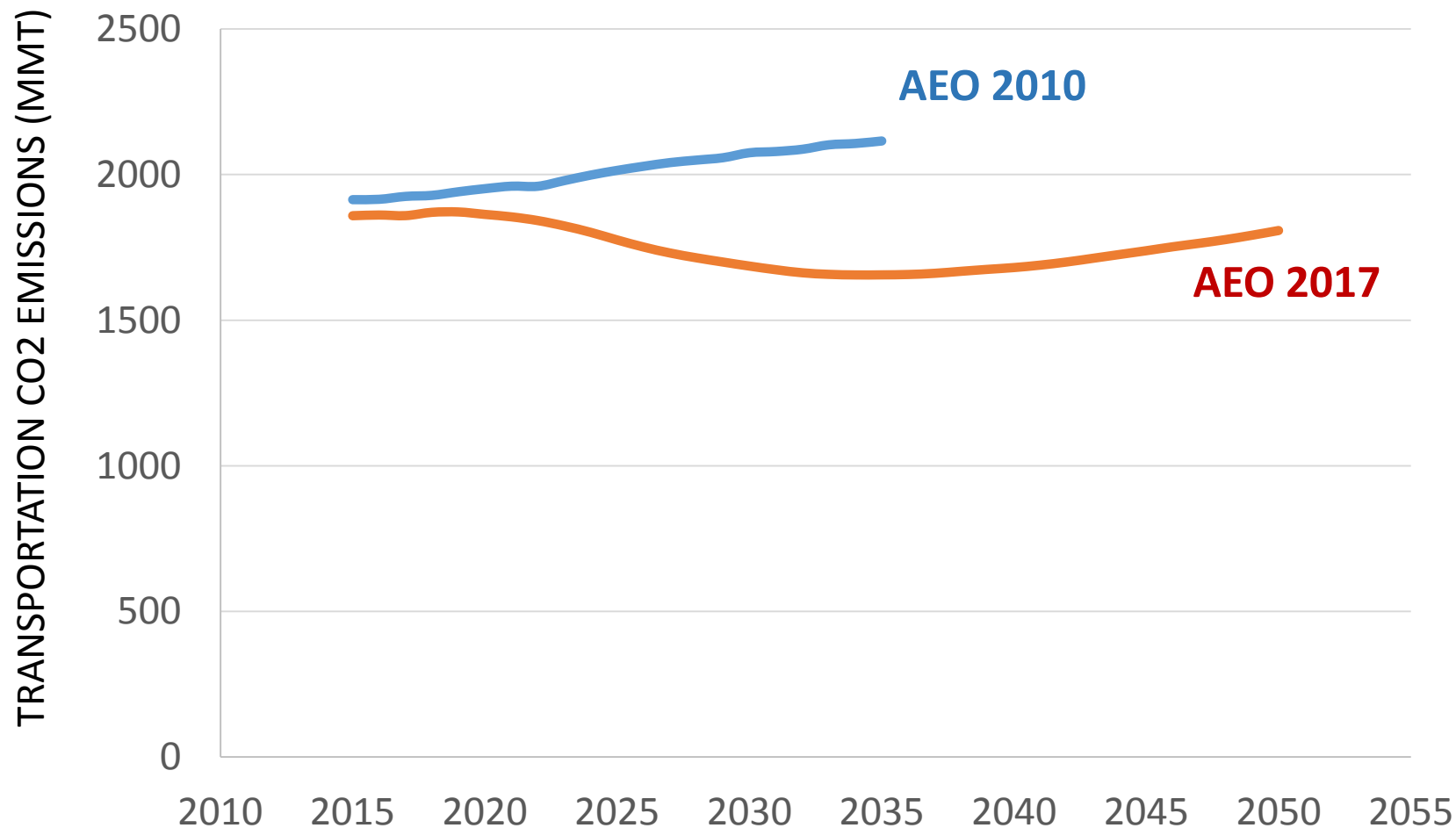
SOURCE: US EPA



FUEL ECONOMY STANDARDS

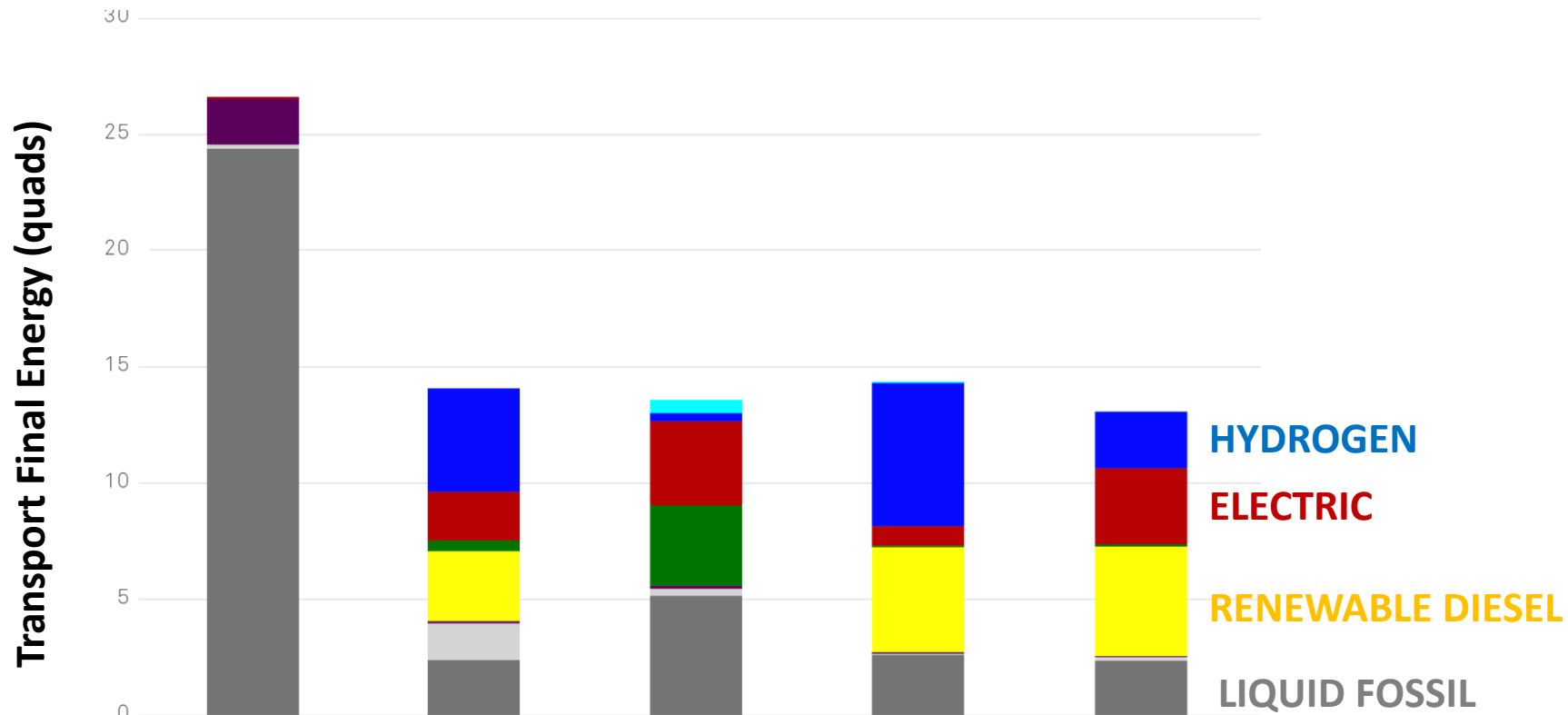


VEHICLE STANDARDS WILL SIGNIFICANTLY REDUCE GHG EMISSIONS, BUT MORE WOULD BE NEEDED TO MEET MID-CENTURY TARGETS



SOURCE: EIA

THIS LIKELY REQUIRES GREATER EFFICIENCY, LESS CARBON INTENSIVE FUELS, AND MODAL SHIFTS

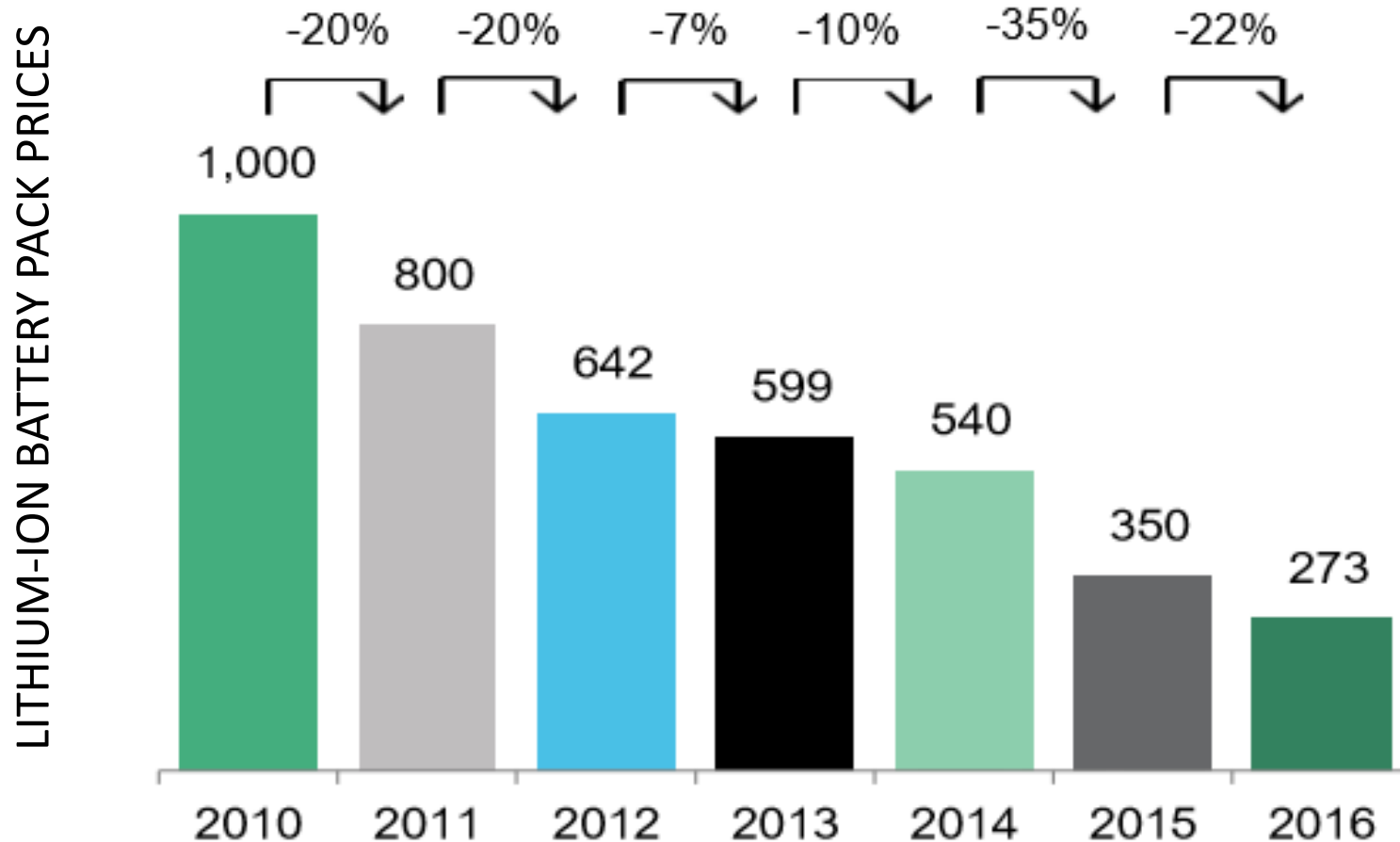


The bottom line on climate change

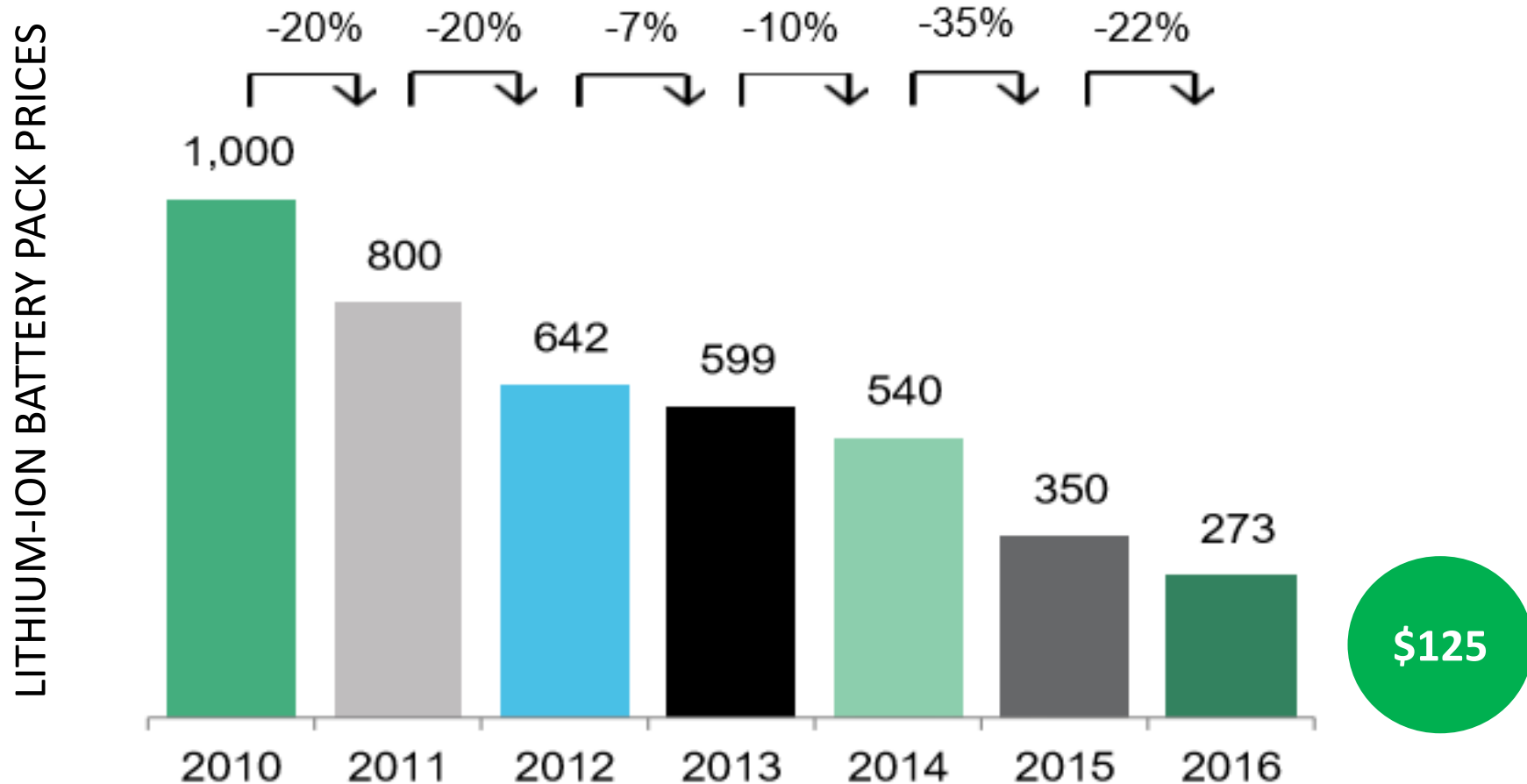
32



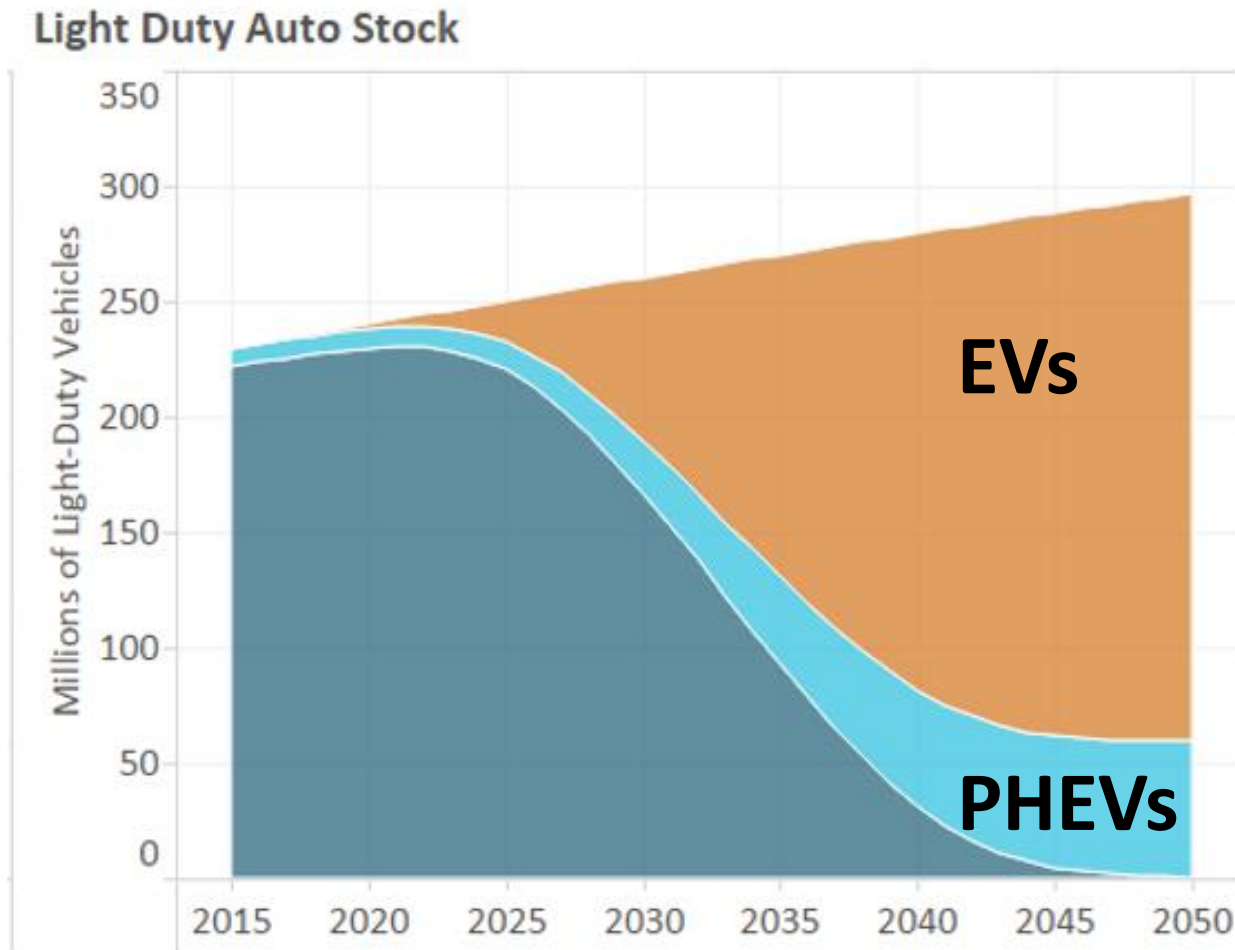
BATTERY PACK PRICES HAVE FALLEN 73% SINCE 2010



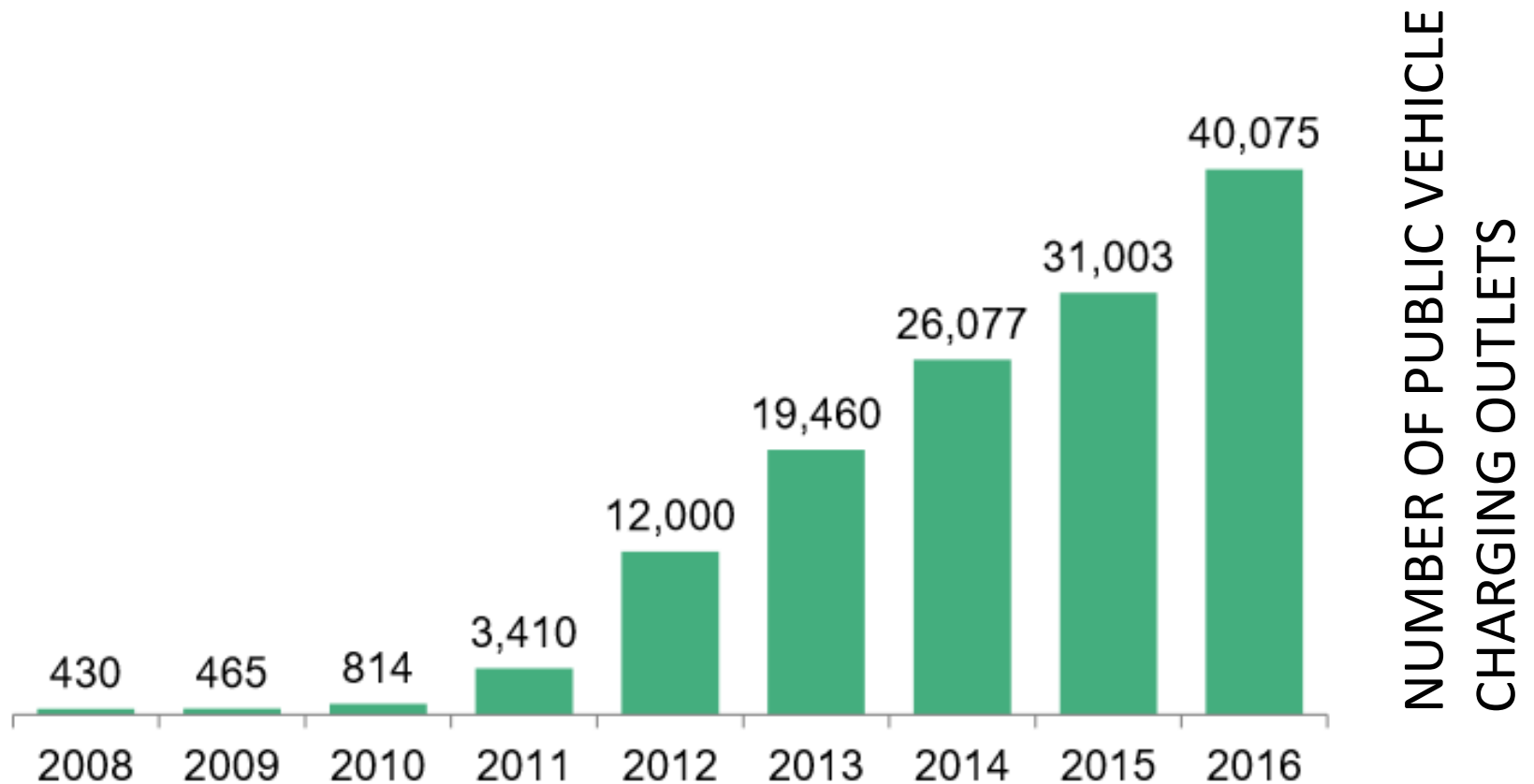
BATTERY PACK PRICES HAVE FALLEN 73% SINCE 2010



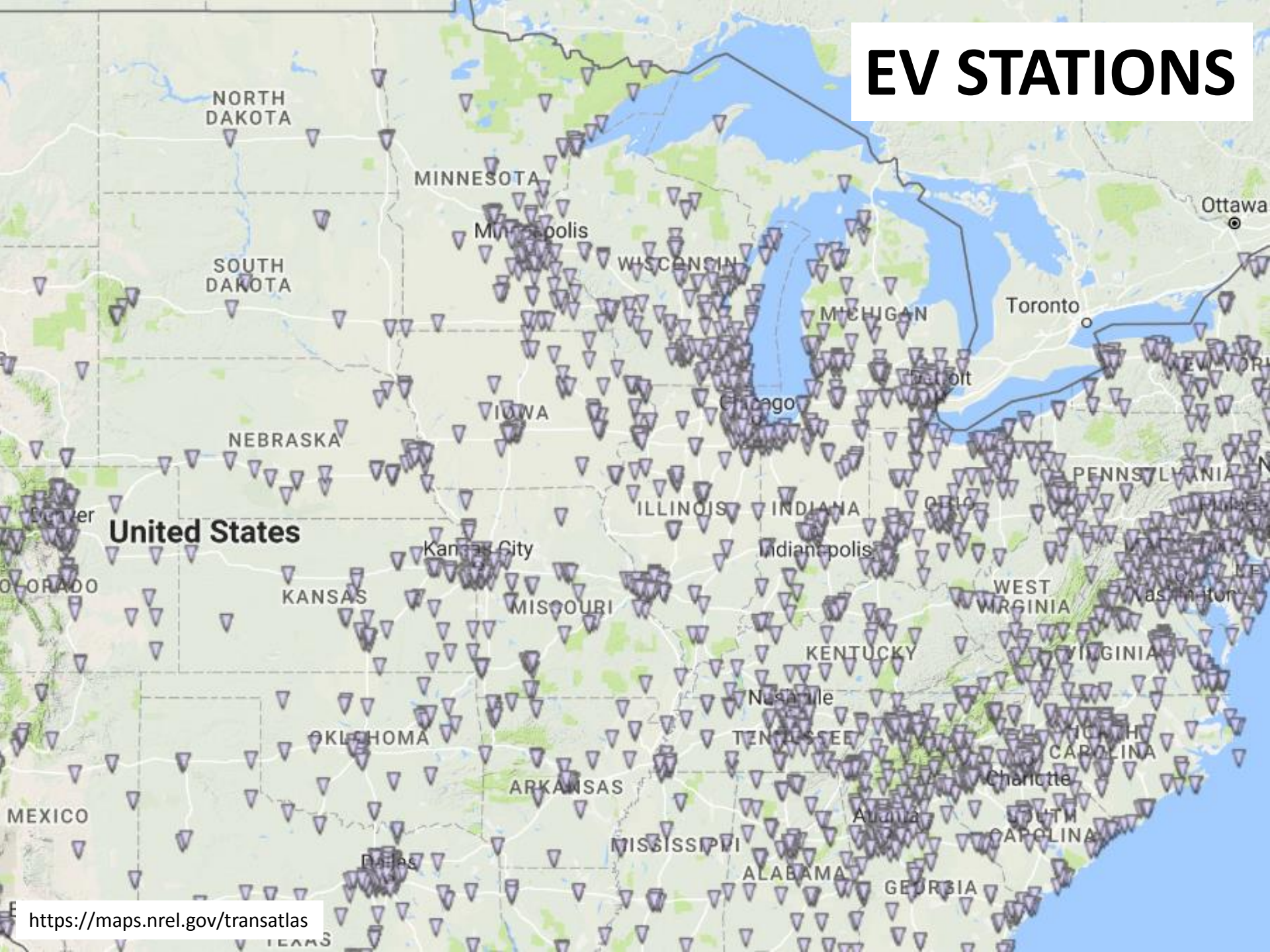
HOW QUICKLY WILL THIS TRANSFORMATION OCCUR AND WHAT ROLE WILL ELECTRIC VEHICLES MOVE INTO THE MARKETPLACE?



THE NUMBER OF CHARGING STATIONS CONTINUES TO GROW,
BUT MANY MORE ARE NEEDED TO SUPPORT DECARBONIZATION
OF THE FLEET

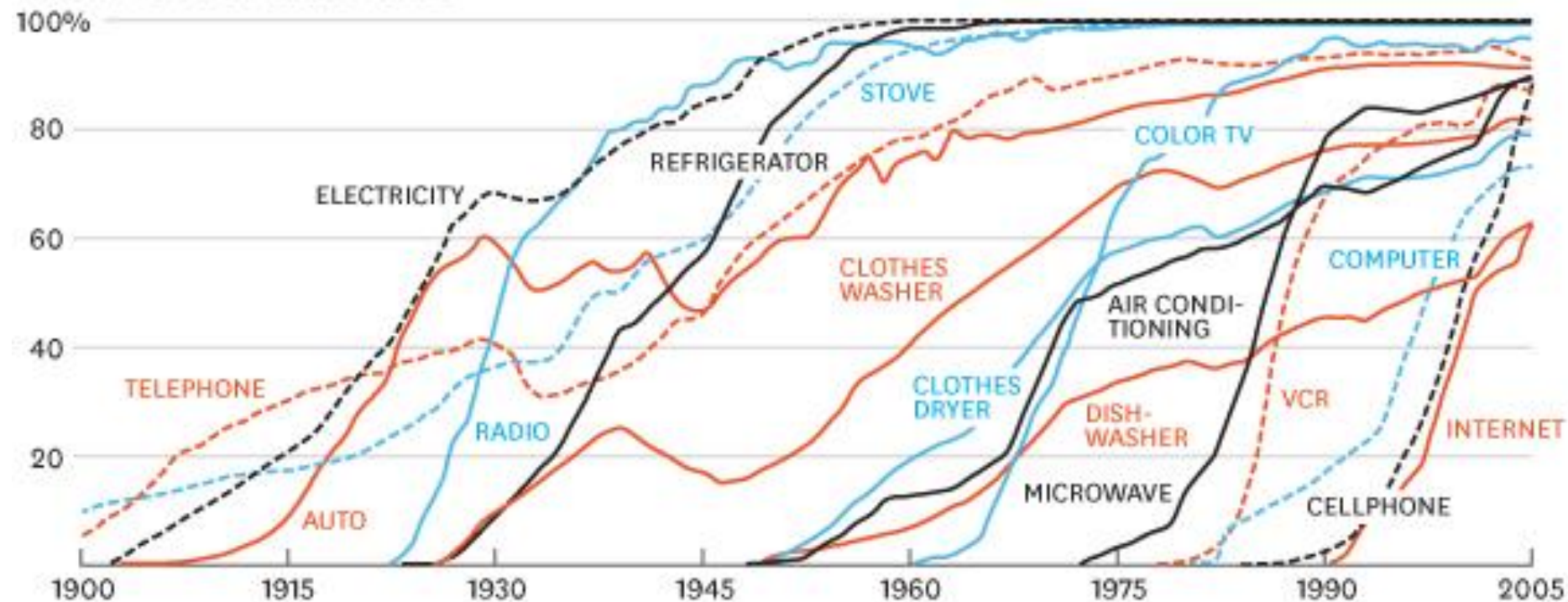


EV STATIONS



CONSUMPTION SPREADS FASTER TODAY

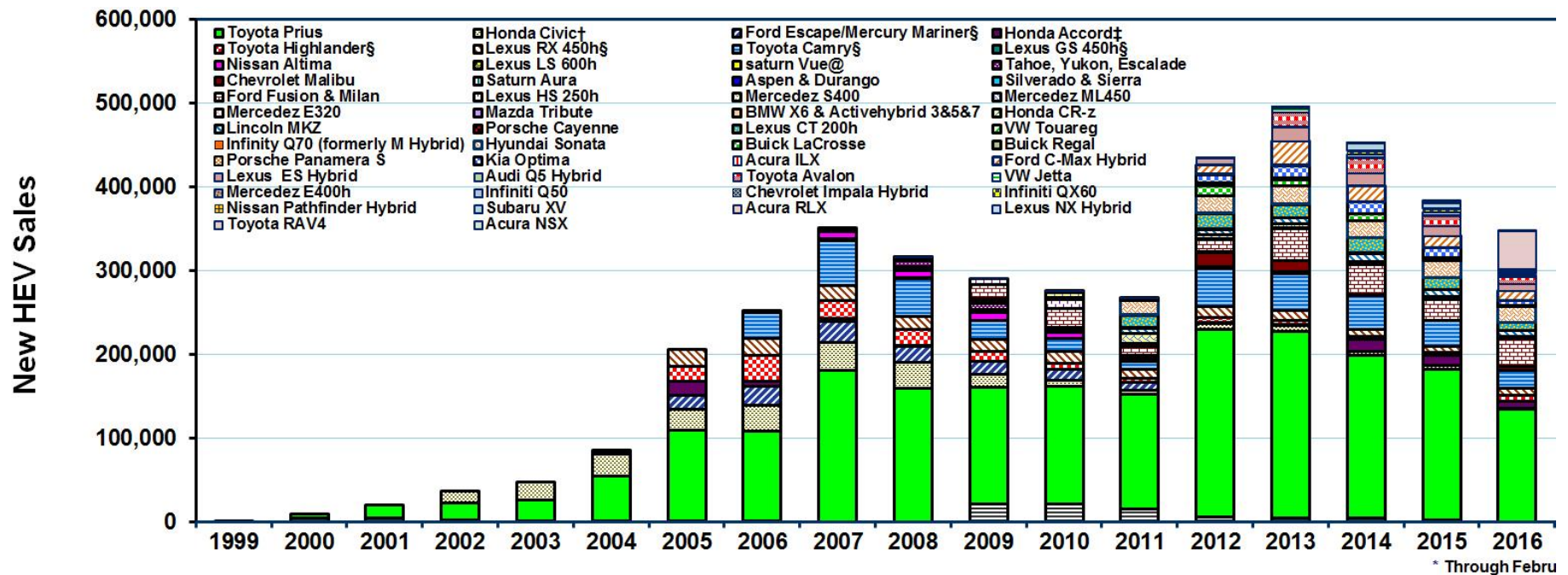
PERCENT OF U.S. HOUSEHOLDS



SOURCE MICHAEL FELTON, THE NEW YORK TIMES

HBR.ORG

HYBRID ELECTRIC SALES



Ford

EVs will overtake sales of gas-fueled vehicles within 15 years

Volkswagen

Committed to have EVs account for >25% global sales

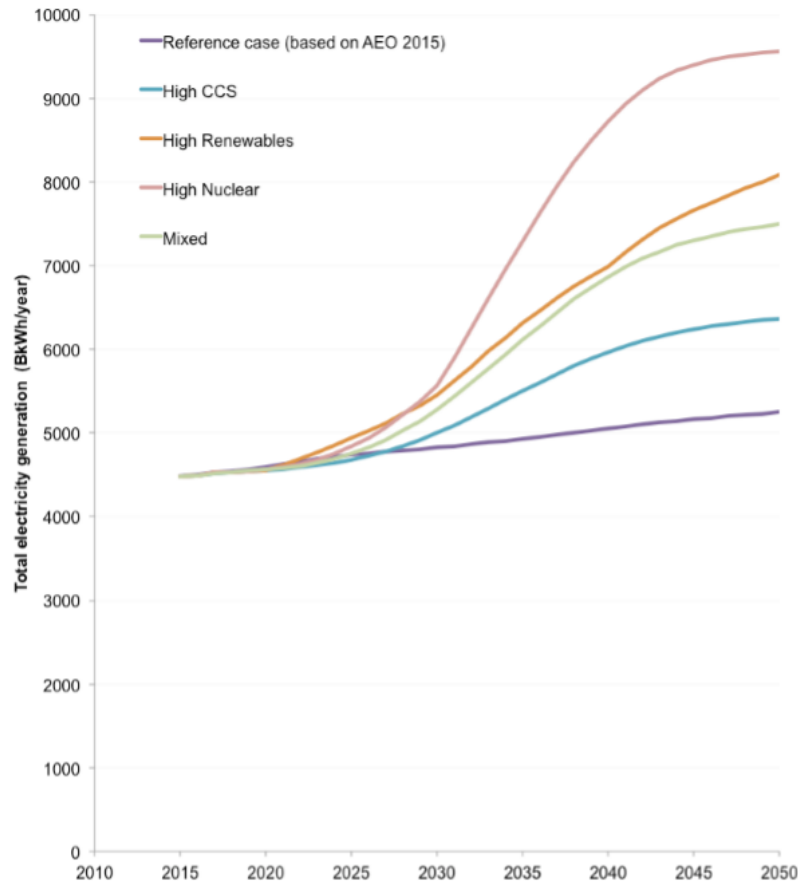
Mercedes

EVs expected to account for 25% of deliveries in 2025



SOME DECARBONIZATION SCENARIOS COULD RESULT IN CONSIDERABLE INCREASES IN ELECTRIC GENERATION

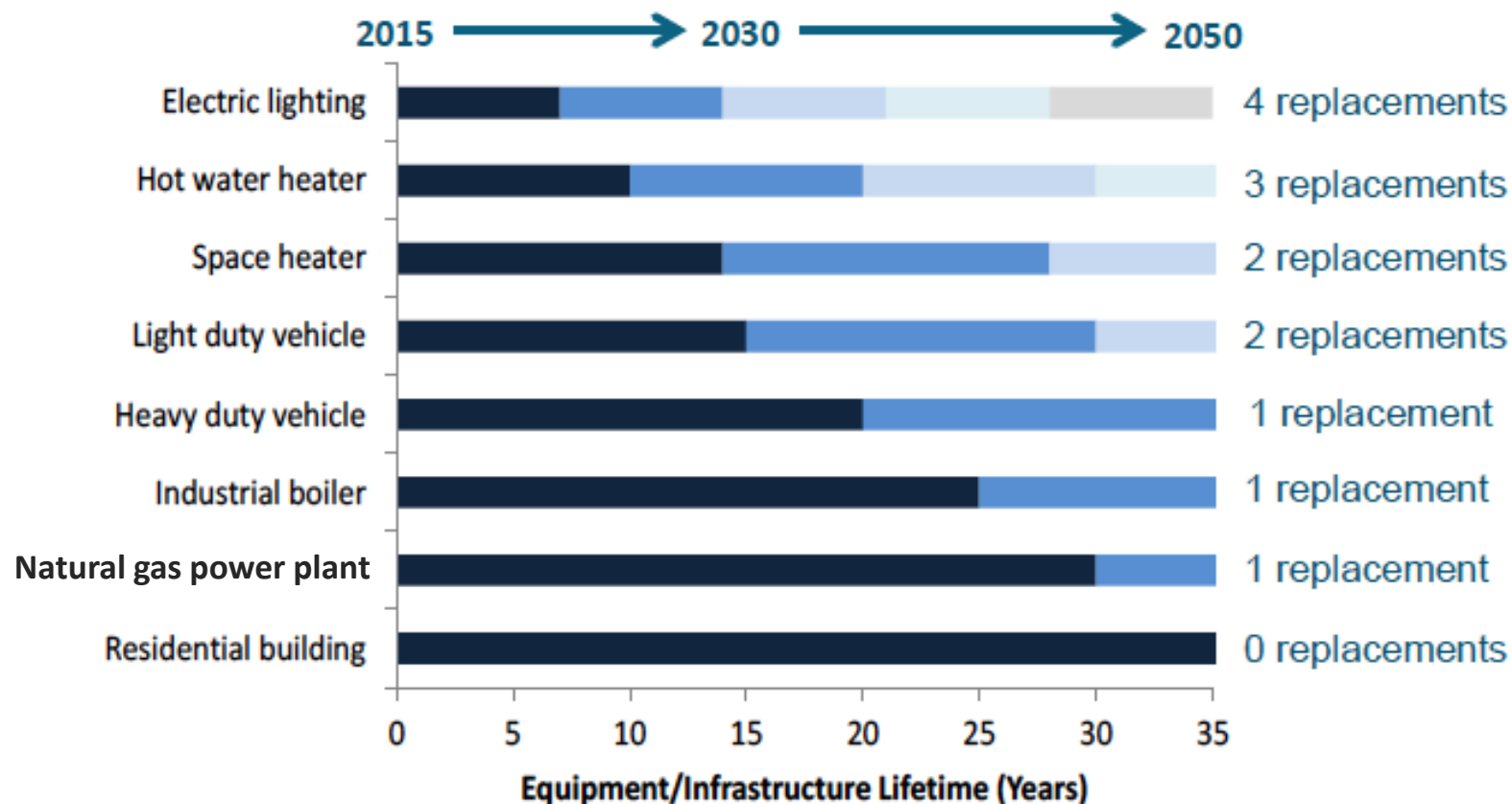
Figure A-1-18: Total electricity generation in High-Carbon Reference Case and clean energy pathways



ADDITIONAL INSIGHTS FROM LONG-TERM PLANNING

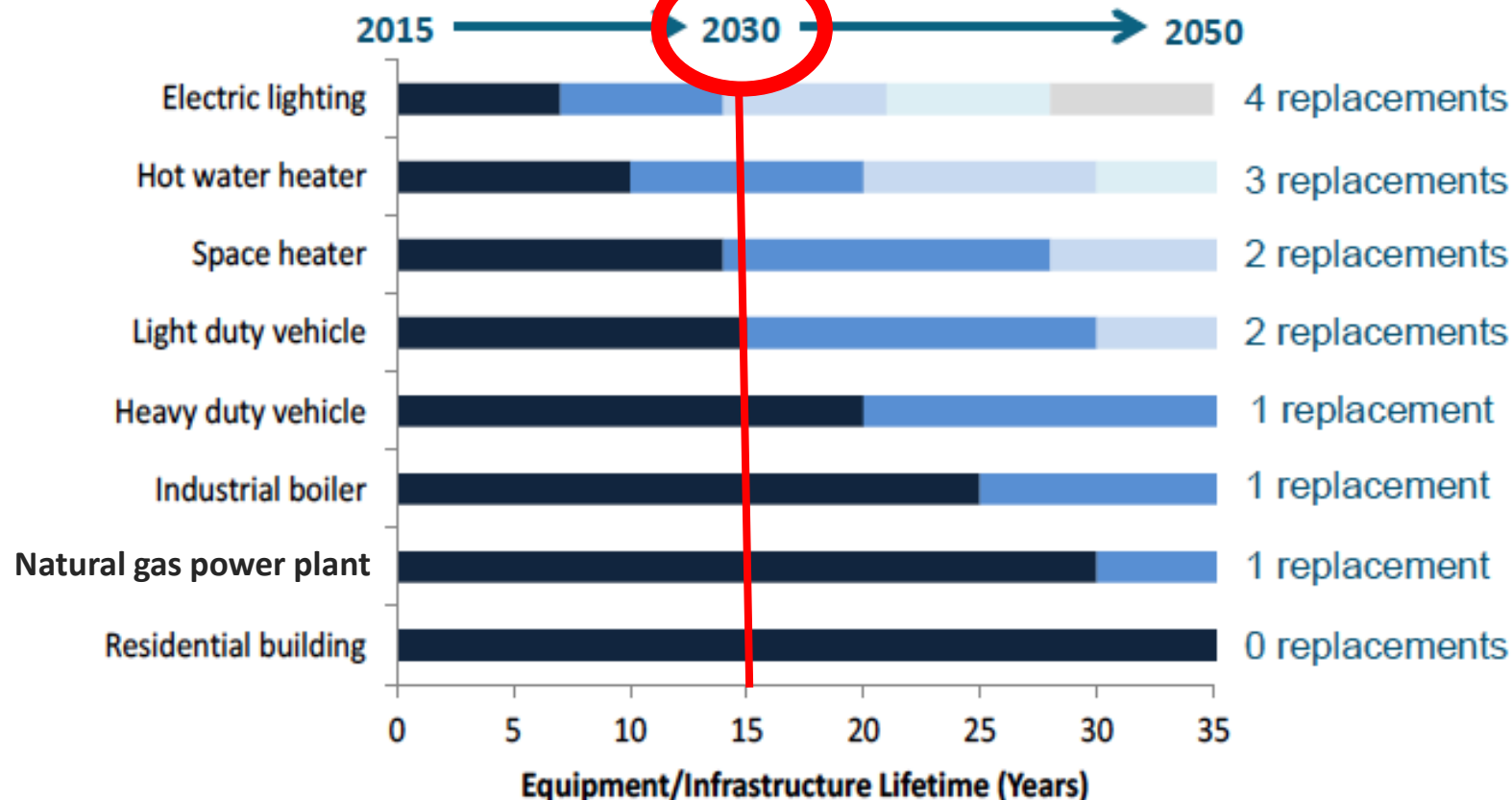
NEAR-TERM IMPLICATIONS ASSOCIATED WITH DIFFERENT DECARBONIZATION RATES

Figure ES 2. Stock Lifetimes and Replacement Opportunities



TO STAY ON TRACK TO MEET MID-CENTURY DECARBONIZATION TARGETS, EMISSIONS WOULD LIKELY NEED TO FALL BY 1/3

Figure ES 2. Stock Lifetimes and Replacement Opportunities

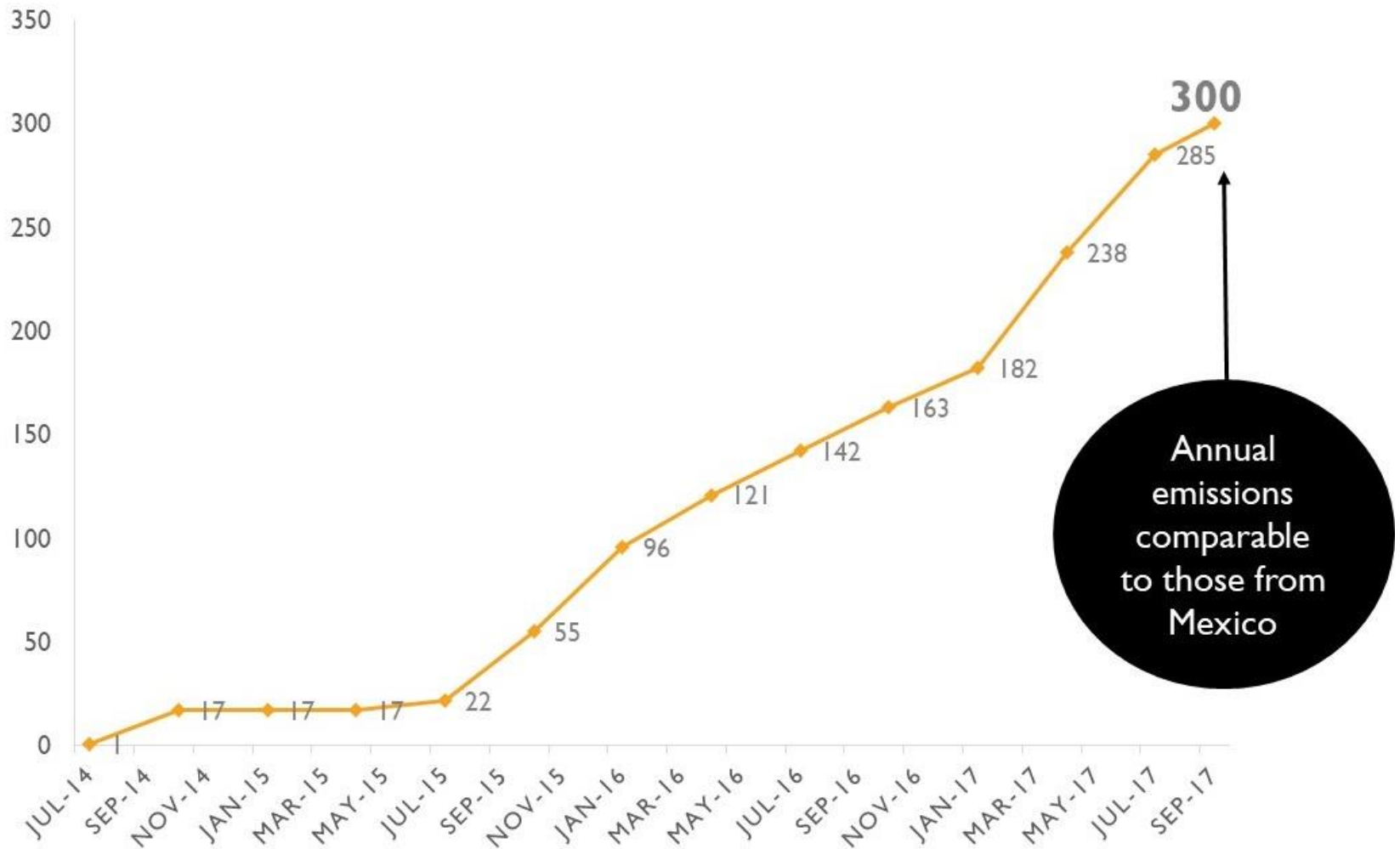


PLANNING FOR A LOW-CARBON FUTURE

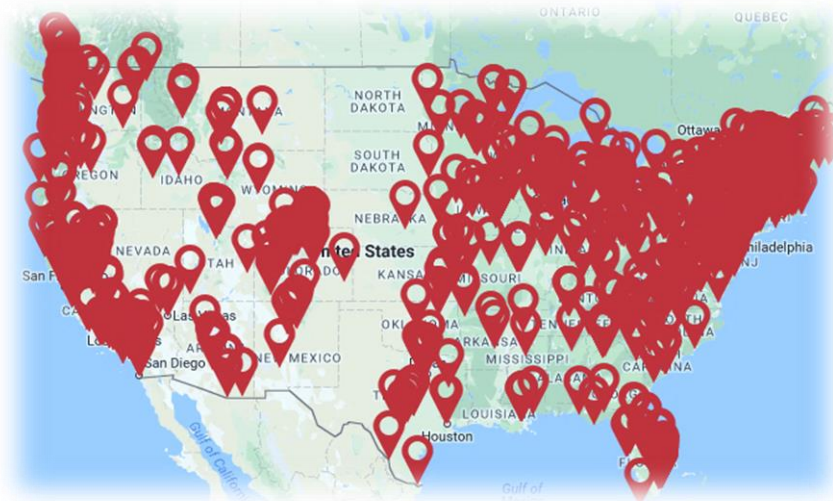


COMPANIES ARE INCREASINGLY PLANNING FOR A LOW-CARBON FUTURE

COMPANIES SETTING SCIENCE-BASED TARGETS



WE ARE STILL IN



- **2,300** cities, states, companies, & universities
- Represent more than **127 million Americans**
- **\$6.2 trillion** of the U.S. economy

A grayscale world map with numerous white location pins placed across all continents, indicating a global presence. The pins are most densely clustered in North America, Europe, and East Asia.

SUBNATIONAL ACTION GOES GLOBAL

7,477 cities
209 regions
2,138 companies

TIMING OF REDUCTIONS

LIMITING GLOBAL
WARMING TO

1.5°C REQUIRES

NET Ø CO₂

+

NET Ø GHG



2.0°C REQUIRES

NET Ø CO₂

+

NET Ø GHG



THANK YOU

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202-729-7870



WORLD
RESOURCES
INSTITUTE