

# Decarbonization Action

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# Agenda

- Energiewende
- European Union
- China
- United States
  - ✓ California
  - ✓ New York
  - ✓ Massachusetts





# Energiewende History



- 1970's cheaper coal imports unsustainable for German government to subsidize the mines
- First appeared in 1980-means energy turnaround/revolution
- Anti nuclear movement in 1970s appetite for green energy. Chernobyl 1986.
- Ambitious goal: 80% of Germany's energy generated from RE by 2050
- Remaining two coal mines to shutter in 2018

# Energiewende Targets

- 2010: 80%-95% reductions relative to 1990 levels by 2050
- 2013: intermediate target introduced: 55–60% share of renewable energy in gross electricity consumption in 2035
- Achieved 27% decrease in emissions between 1990-2014
- Have to maintain 3.5% per year reductions to reach goal

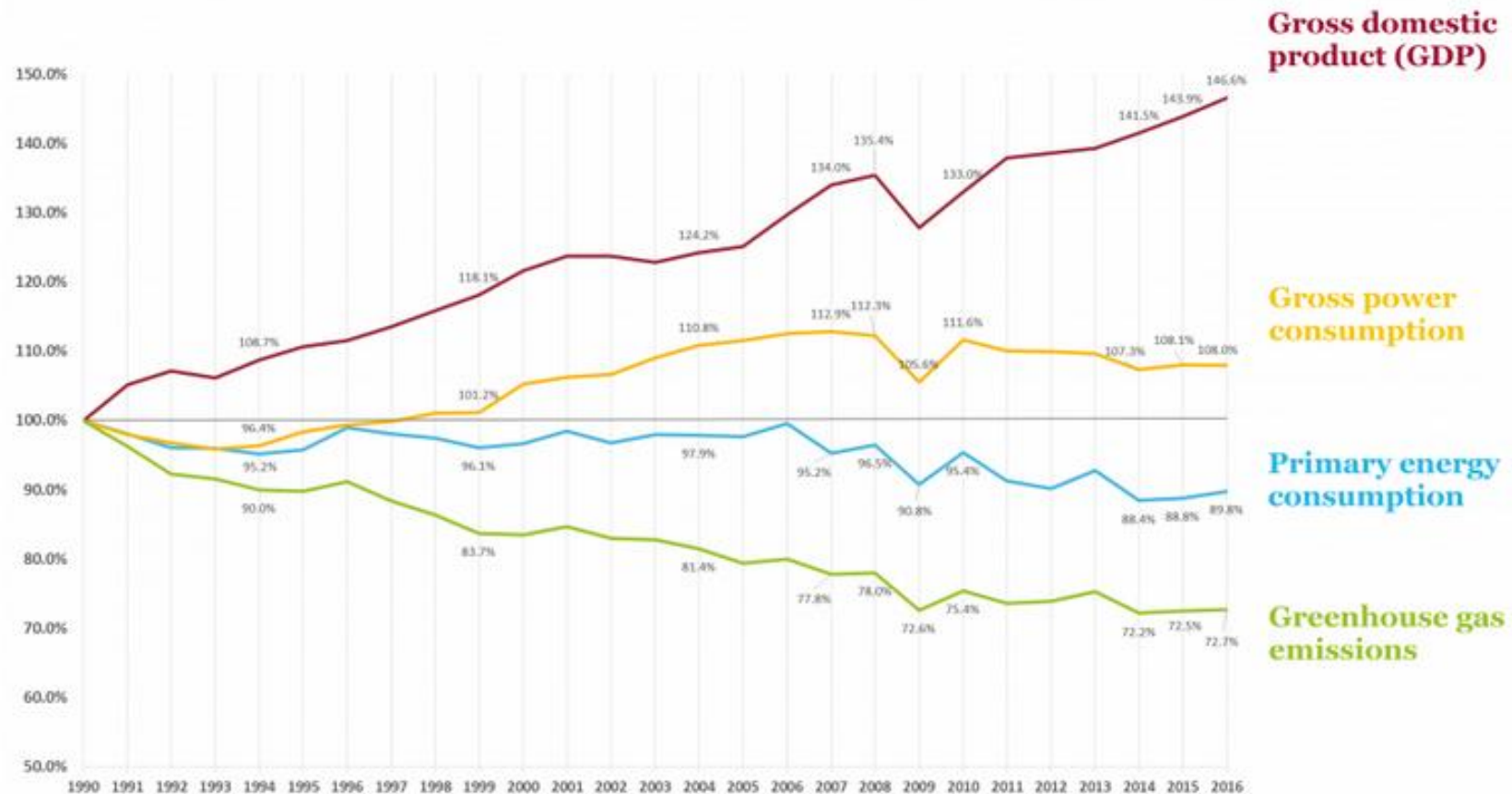


# GDP Decoupled from Growth

## Economic growth, power & energy consumption, GHG emissions 1990 - 2016.

Data: BMWi 2017, UBA 2018.

CLEAN  
ENERGY  
WIRE



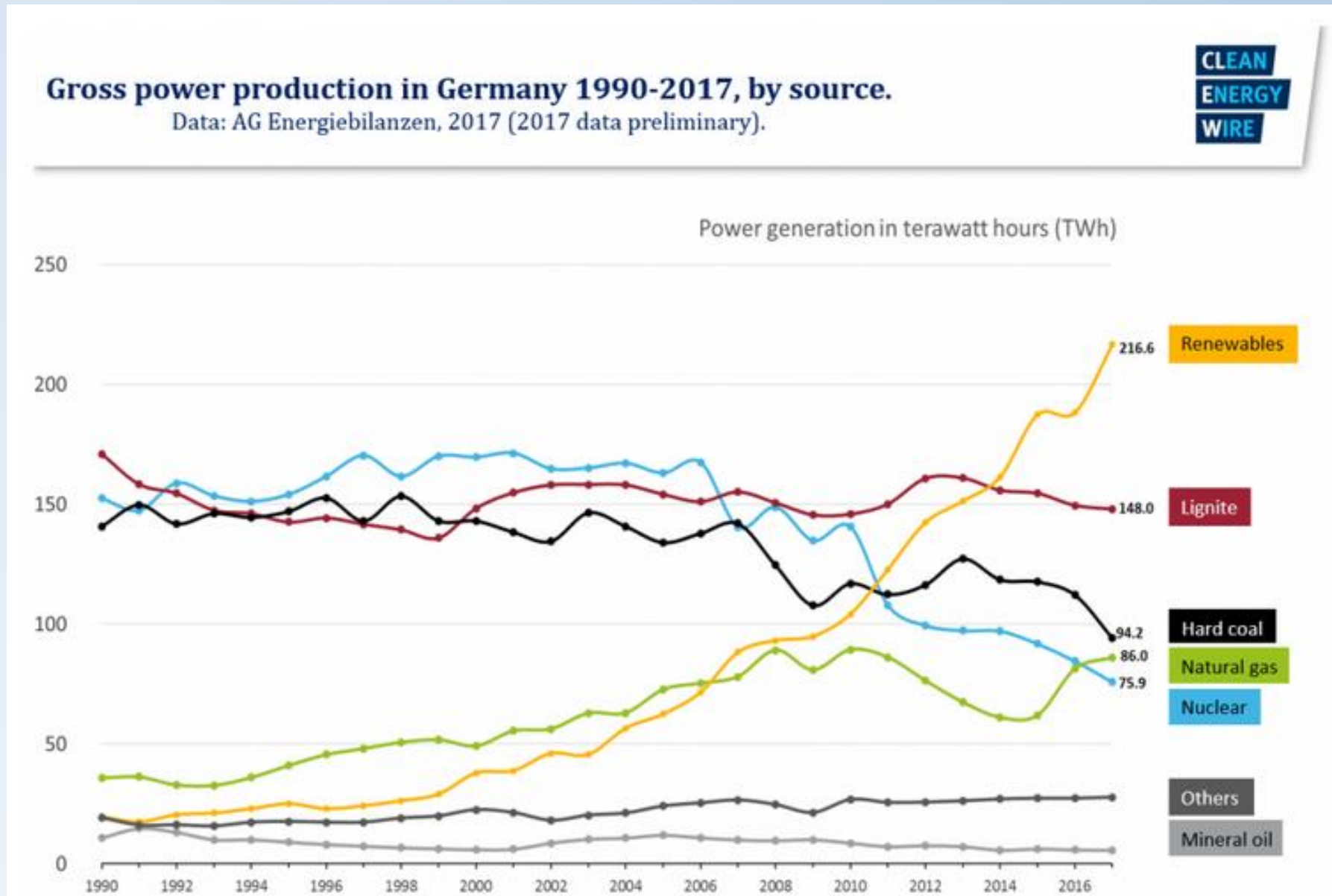
# Energiewende-Feed-in Tariff

- Renewables share had increased from 5% in 1999 to 22.9% in 2012
- Has spent \$200b over the past two decades and is spending 1.5B Euros per year
- Producers fixed feed-in tariff for 20 years, guaranteed fixed income





# German Power Production 1990-2017



# Energiewende Challenges

- Need investment in power infrastructure to bring the power to market
  - ✓ 8,300 km of power lines built or upgrades
- Rising electricity bills for consumers
- 2014 survey 1,015 respondents, 94% Germans support expanding renewable energy





# Energiewende, Nuclear & Coal

- Aug. 1, 2016 Renewable Energy Sources Act feed-in tariffs no longer fixed by the government; auction
- Dec. 3, 2014 National Action Plan on Energy Efficiency
- Dec. 2016 analysis: most likely miss the 40% by 2020 emissions cut



# European Union Emissions Trading System

- Was world's biggest scheme for trading greenhouse gas emissions allowances when launched in 2005
- 11,000 power stations and industrial plants in 30 countries
- Covers 50% of Europe's total emissions



# European Union Emissions Trading System

- Cap on total emissions; allowances adding up to the cap provided to companies regulated by the scheme
- Companies required to measure and report and hand in one allowance for each tonne they release. Can trade (incentive to reduce)
- Criticized for doling out allowances too generously; cos. Got 7% more allowances than needed in 1<sup>st</sup> phase
- 2008 economic downturn made things worse

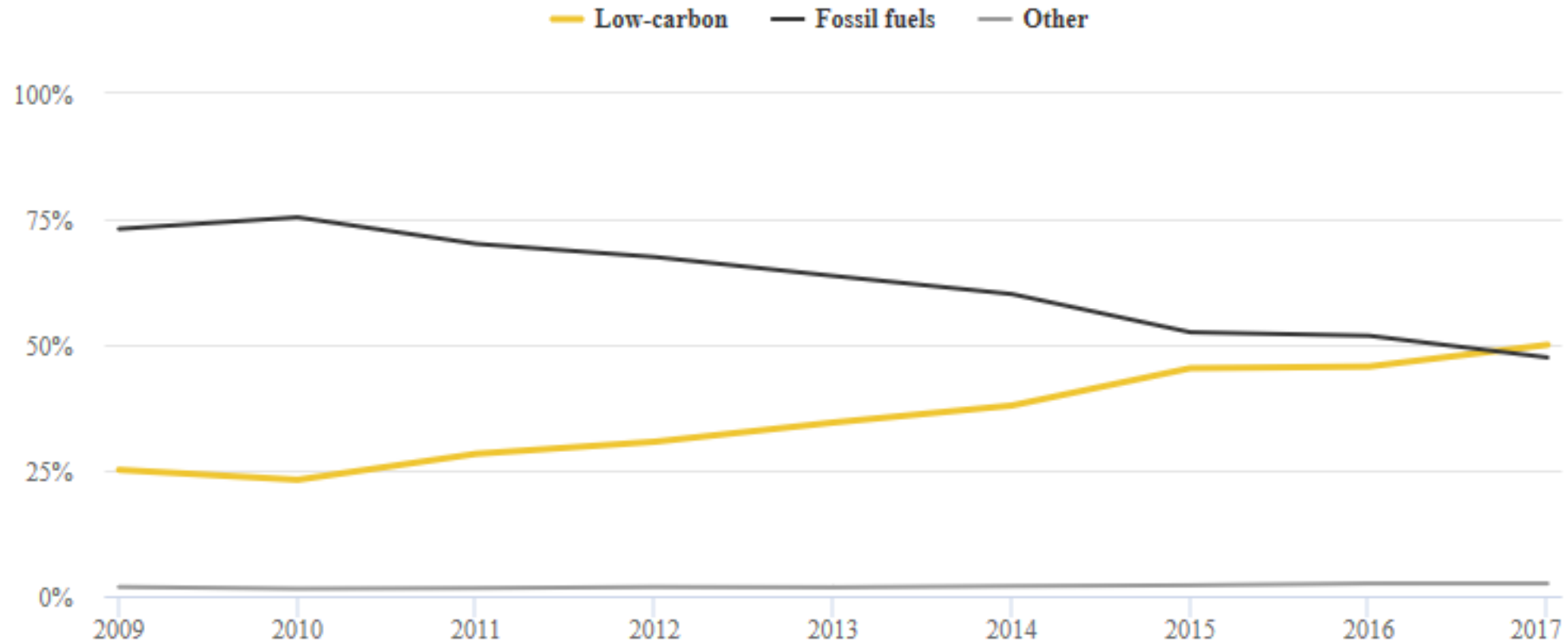


# European Union Emissions Trading System

- 2017 overhaul approved toughen up the regime; plug loopholes
- Number of allowances to be gradually reduced so cost more and provide more incentive
- Highest performing 10% of factories receive allowances for free
- But big polluters (cement industry) still getting free allowances

# United Kingdom Milestone

UK low-carbon electricity generated more than coal and gas in 2017



# China Center Stage



- China indisputable leader of RE energy expansion
- Betting heavily on energy efficiency, on wind, solar and other renewables, as well as other less carbon-intensive technologies
- Global consensus that the key to the energy transition will reside with decisions made in emerging economies



# Why China is Embracing CE

- Tackling country's problems with air water pollution, and socio-economic instability
- Dissatisfaction engenders unrest
- Ecological reason: world's largest emitter
- Strategic reason: country less reliant on oil and gas transport routes requires military protection
- "It has atrocious air pollution. It fears climate change. And it wants to be a "manufacturing monster" in renewables too."



# Made in China Initiative

- China world's largest polluter; remains dependent on coal
- But aims to bypass the United States and cement its dominant role in clean energy
- Made in China 2025 is major investment on clean energy to bolster the economy
- State-owned banks billions into solar, wind, EE, high-speed rail, subways



# China's Clean Energy Ambitions

- \$360B developing renewables and creating 13 million jobs by 2020 (US in 2016—less than 800,000 workers in renewables)
- 13<sup>th</sup> Five Year Plan for Electricity (2016-20) 35-39% non-fossil by 2020 for electricity production





# Clean Energy Dominance

- Produces 2/3ds of the world's solar panels 50% of world's solar panels
- Expanding nuclear reactors and leads the world in hydro
- Capturing sales in the fastest growing solar markets, India and Saudi Arabia



# Solar Panels on Buoys in Lake



# China “One Belt, One Road”

- \$1T to bankroll CE projects in Asia, the Mideast, East Africa, and Eastern Europe 60 countries
- \$6B-Chinese engineers drilling 100s of tunnels for 260-miles railway in Laos
- \$46B-Power plants in Pakistan
- Train lines from Budapest to Belgrade, Serbia
- Backbone of ambitious economic and geopolitical agenda



# One Belt, One Road

## China's Global Ambitions

Under the "One Belt, One Road" plan, President Xi Jinping is remaking global trade and nurturing geopolitical ties. The audacious plan, with little precedent, promises more than \$1 trillion in infrastructure investments that span 60-plus countries across Europe, Asia and Africa.

**Countries participating in the plan and selected African countries expected to receive the most investment from China from 2017 to 2021**

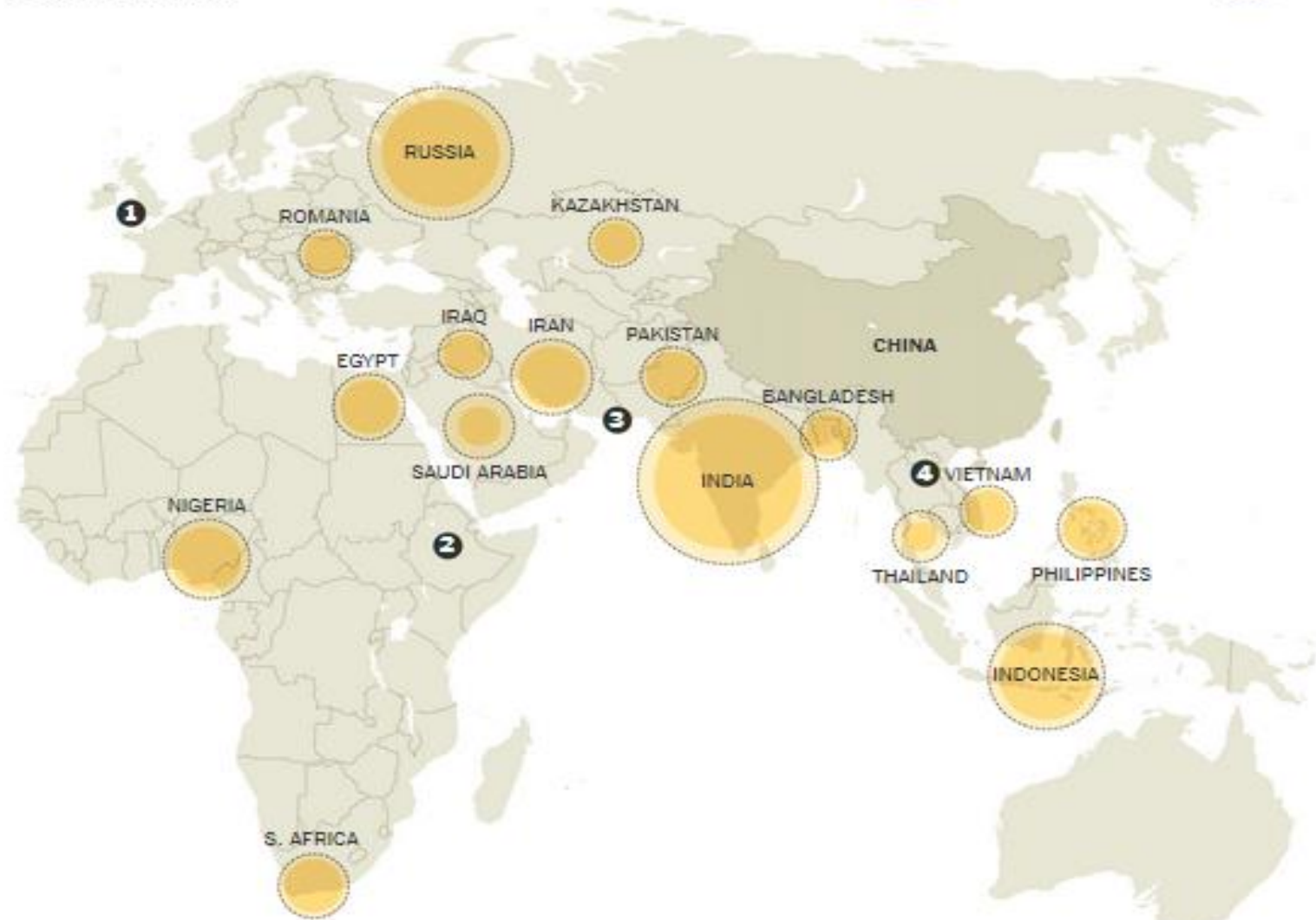
Forecast investment from China 2017 - 2021, in billions

\$50

Maximum

10

Minimum



Optic fibre cables, power plants, gas pipelines and highways are some of the projects planned along the busy corridor connecting China to the Gulf of Oman.

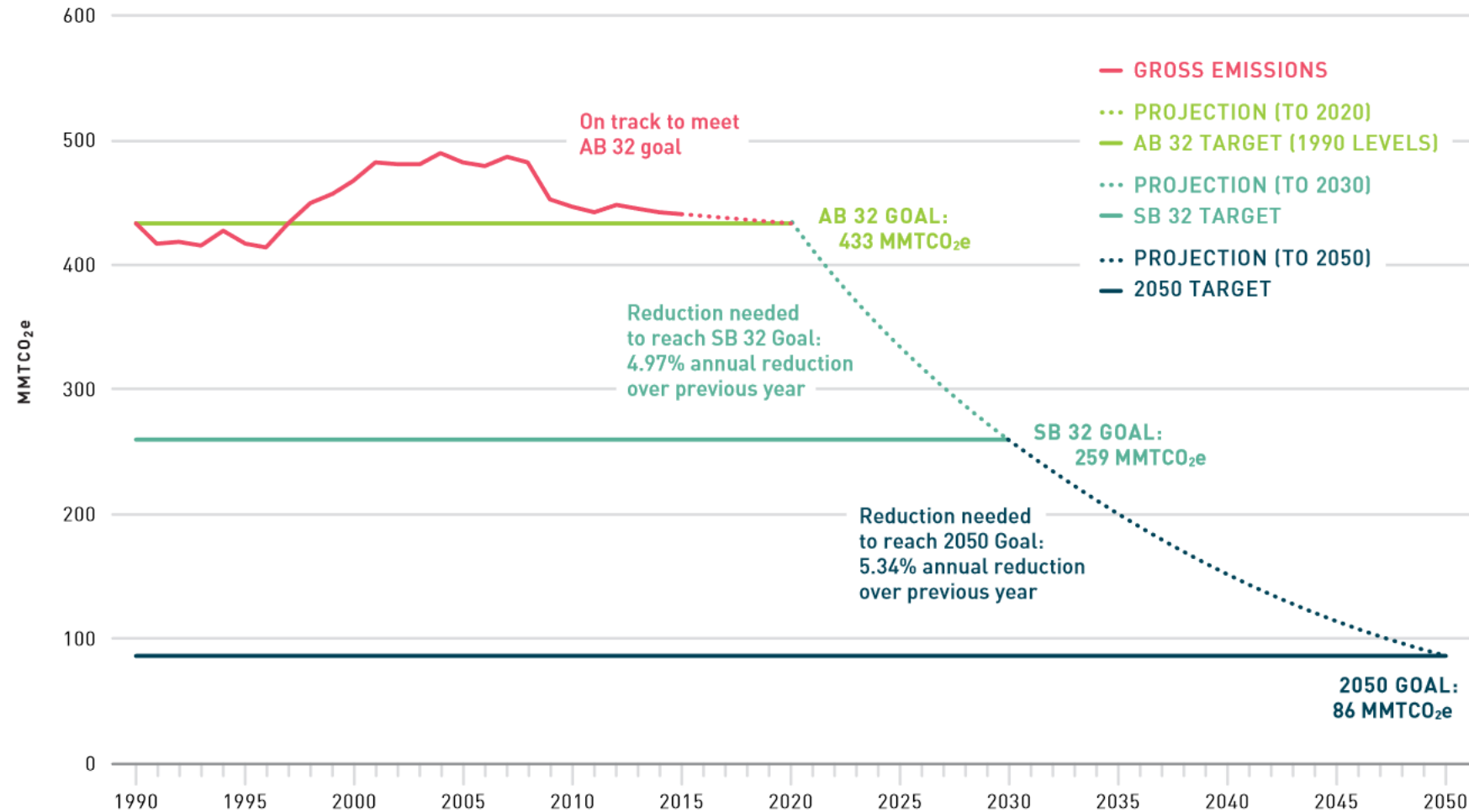


# China Clean Energy Prowess

- 2.5 million people work in solar power sector alone in China (260,000 in US)
- China closing coal mines and will cut 1.3 million coal-mining jobs
- Clean energy to meet 20% of China's energy by 2030
- Produces nearly half of the world's wind turbines-two every hour

# California's Goals

FIGURE 6. GHG EMISSIONS AND PROJECTED REDUCTION GOALS





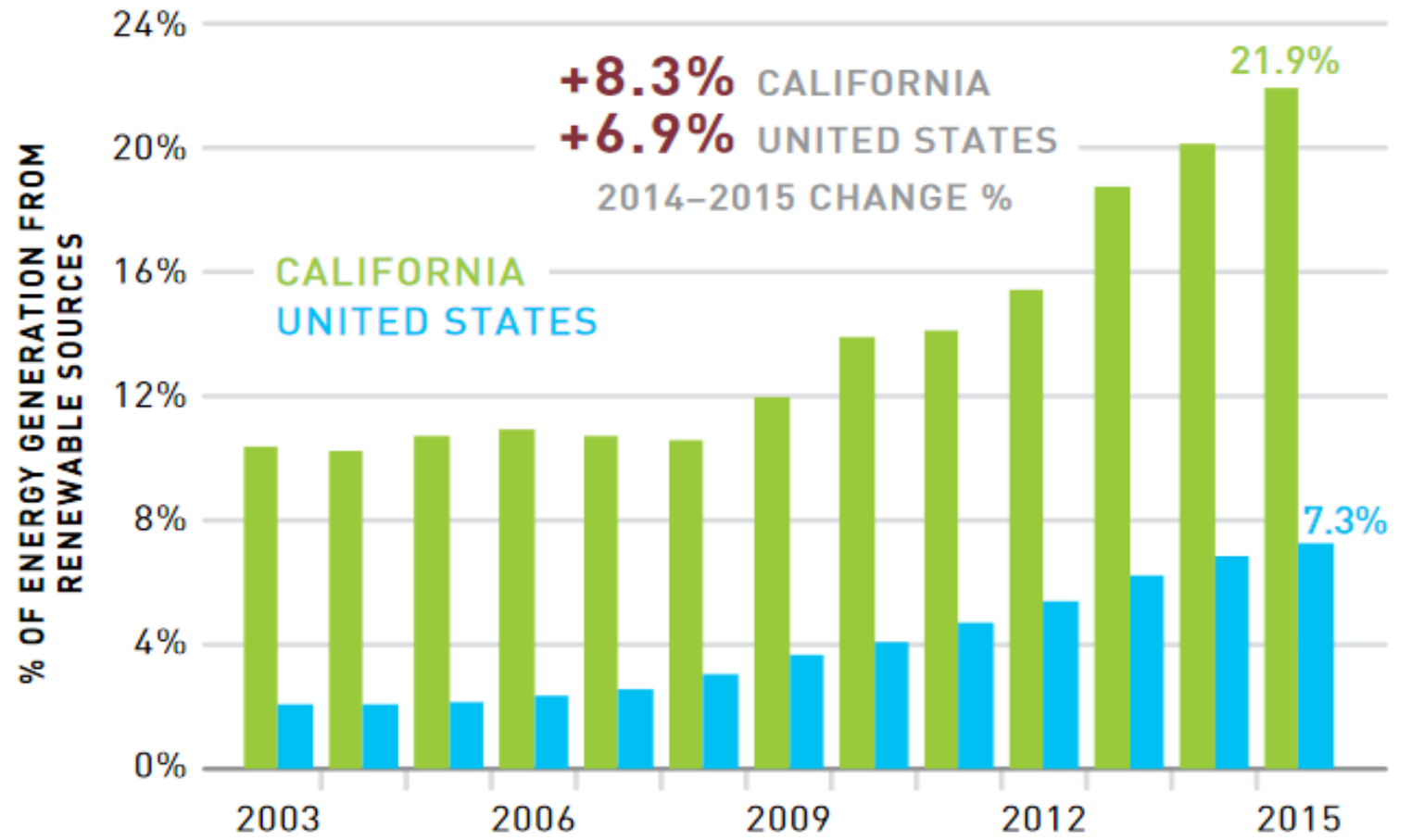
# Renewable Generation CA & US

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RENEWABLE ENERGY

## PERCENT OF TOTAL ENERGY GENERATION FROM RENEWABLE SOURCES

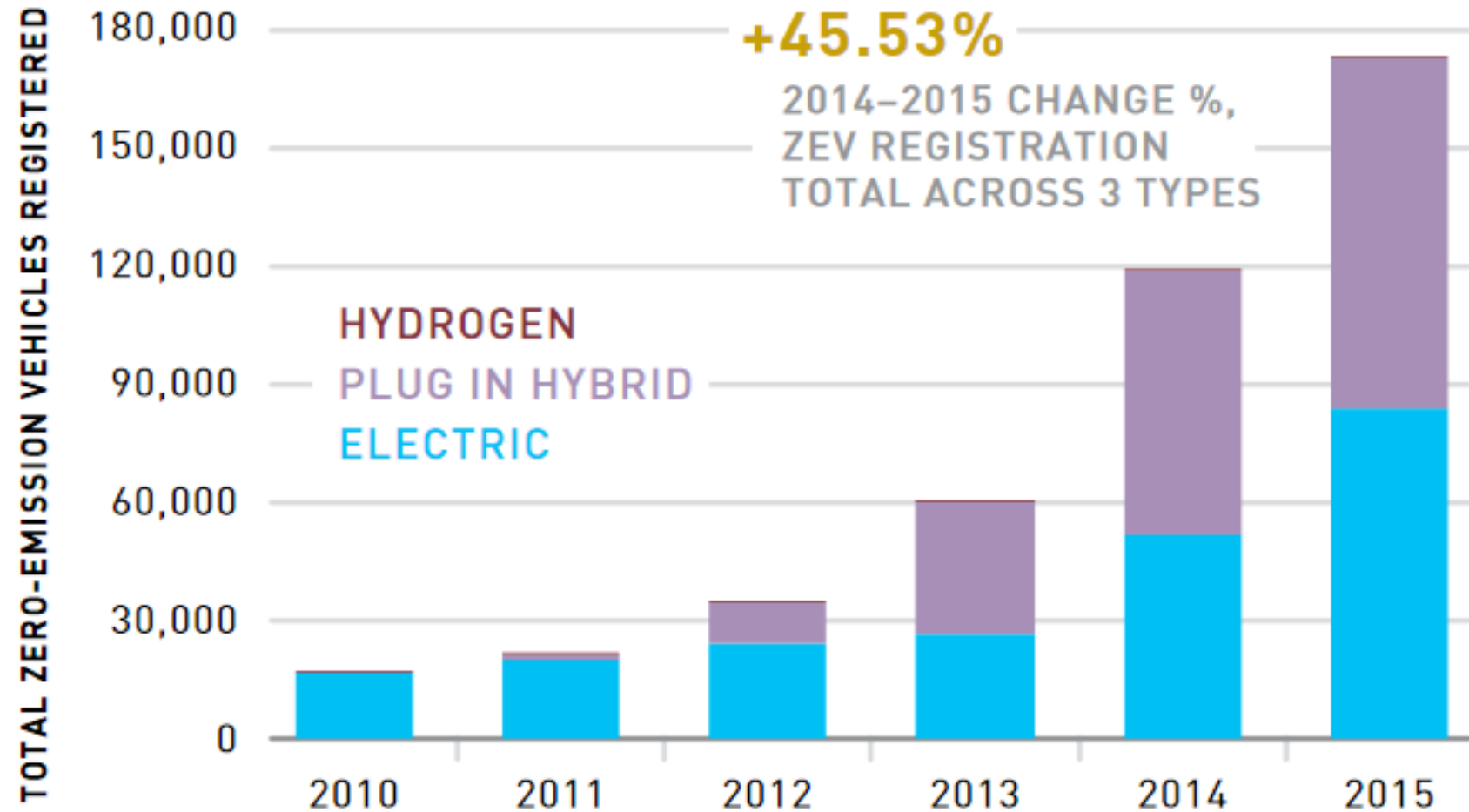
CALIFORNIA & U.S., 2003-2015



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission; U.S. Department of Energy, Energy Information Administration. NEXT 10 / SF · CA · USA

# ZEV Registration Trends

## TRENDS IN TOTAL ZERO-EMISSION VEHICLE REGISTRATION CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission.

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# California Clean Energy Jobs

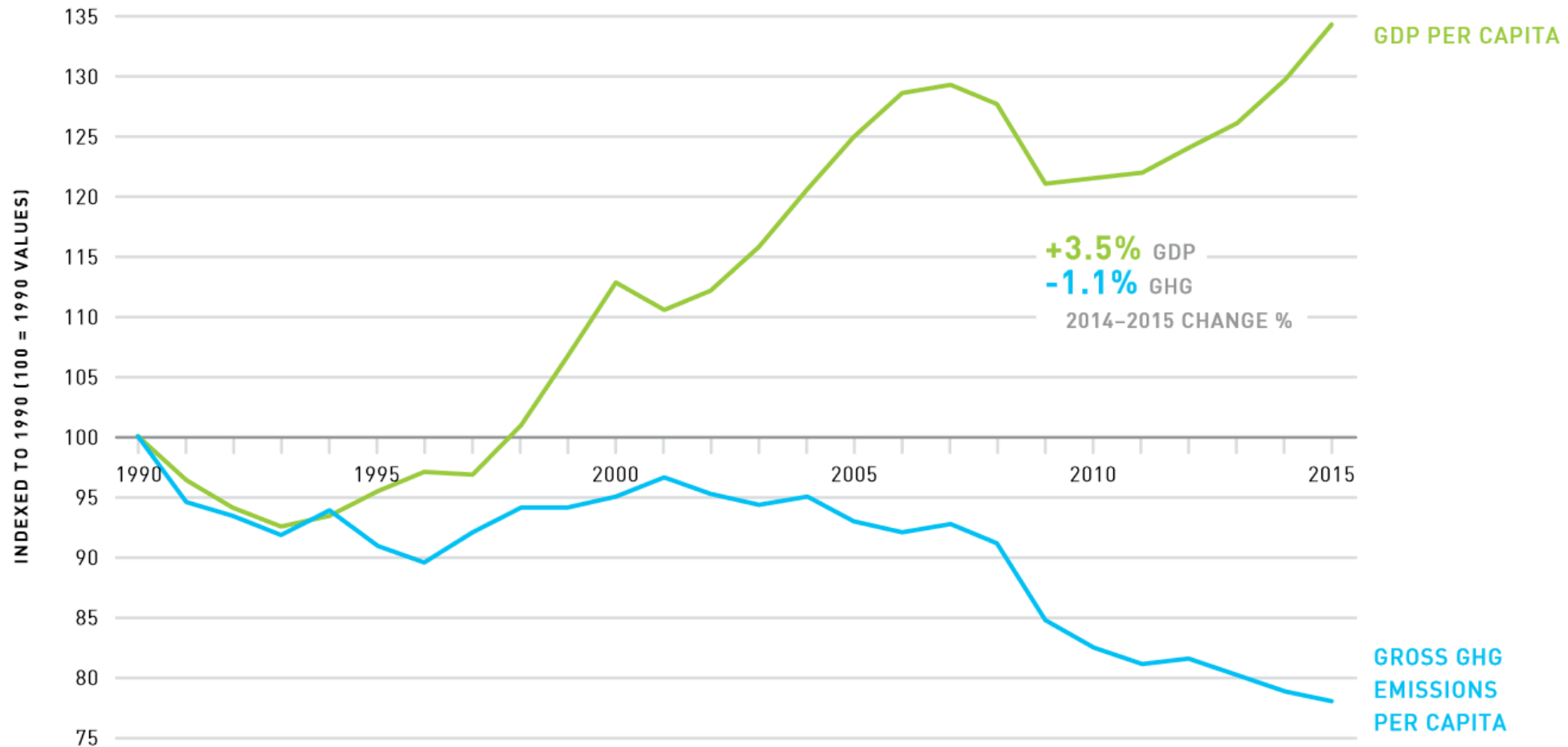


**Berkeley**  
UNIVERSITY OF CALIFORNIA

- 1/3 of state's RE comes from the San Joaquin Valley
  - ✓ 2002-2015, RE infra created 88,000 jobs
  - ✓ Berkeley report on climate policies and impacts on the valley "economic boon" net gain \$13B; more than 37,000 jobs
- 8.5 jobs in RE for every one fossil job in CA (US it's approx. 2.5 jobs in RE for every one in fossil)
- Energy storage 1 in every 6 jobs; US 1 in 14

# Decoupling GDP & Emissions

**FIGURE 3. GREENHOUSE GAS EMISSIONS AND GROSS DOMESTIC PRODUCT**  
CALIFORNIA RELATIVE TRENDS SINCE 1990: GREENHOUSE GAS EMISSIONS (MTCO<sub>2e</sub>) & GDP DOLLARS PER CAPITA





# Massachusetts

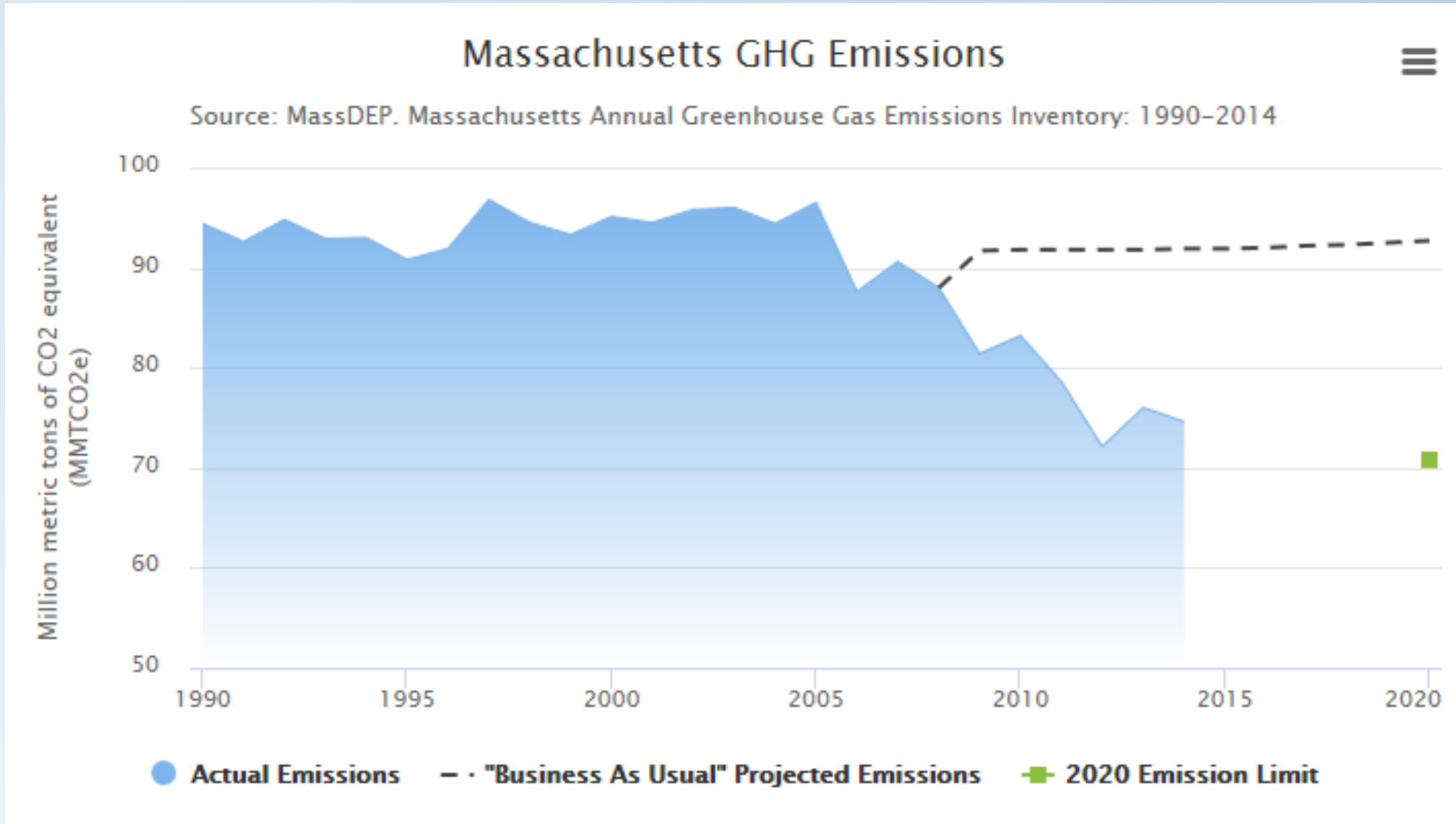
- Adopted California's low emission vehicle standard for cars in 1990
- Among first to create renewable energy standard in 1997
- 2001 first state in the nation to adopt enforceable limits on CO<sub>2</sub> pollution from power plants
- Top ranking for EE by the ACEEE

# Massachusetts

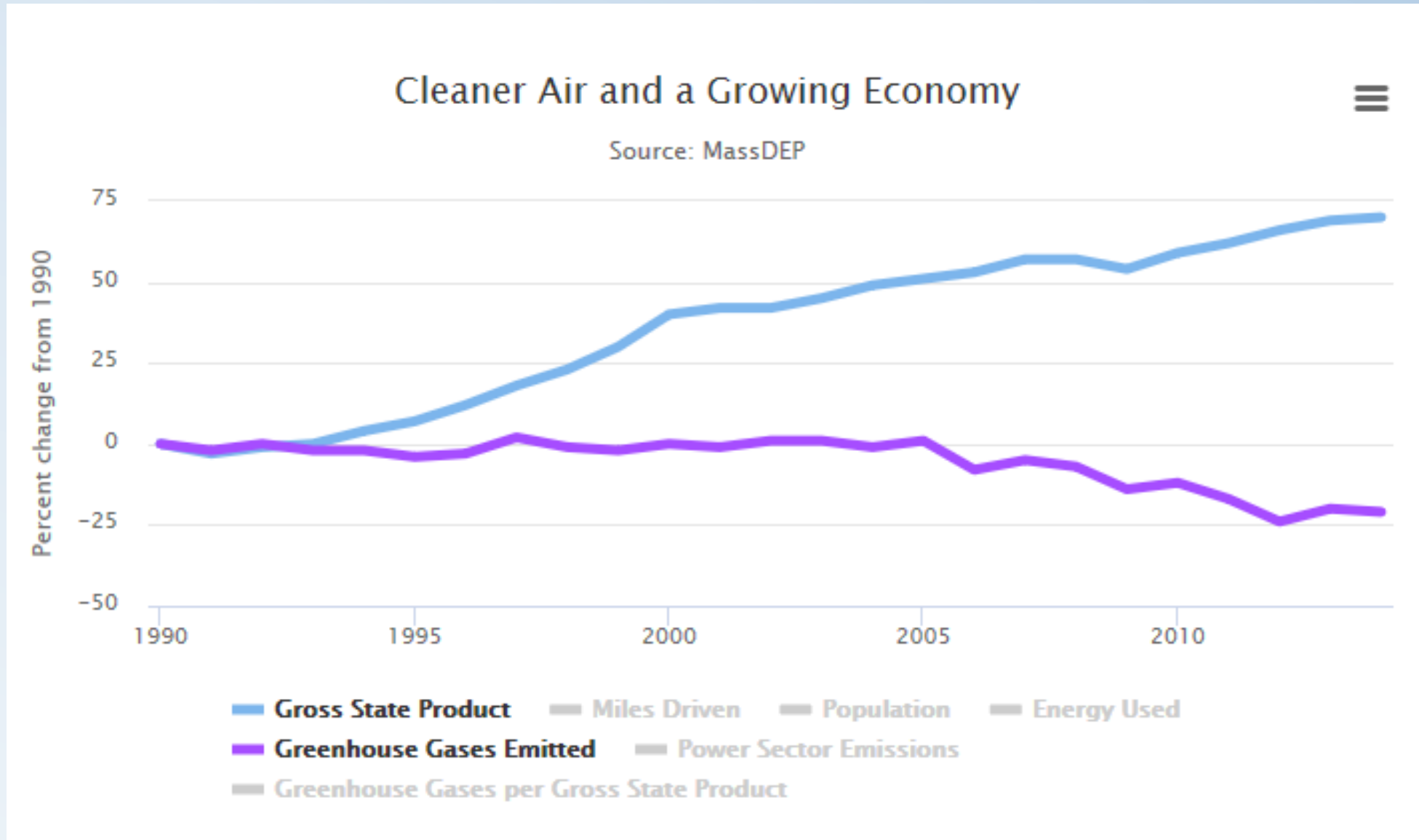
- 2008 Global Warming Solutions Act
- 2016 law requiring MA utilities to contract for 1,600 MW of offshore wind energy
  - ✓ Unprecedented: NY to top and NJ inclined to more than double
- Clean energy procurement requiring utilities to sign long-term contracts



# Massachusetts GHG Emissions



# Decoupling of Emissions & Growth





# New York



- Reforming the Energy Vision (REV) Gov. Cuomo's strategy to build clean resilient affordable energy system for all New Yorkers
- Clean Energy Standard: 50% RE by 2030
- Clean Energy Fund
  - ✓ 10-year, \$5 billion funding commitment
  - ✓ Reshape EE, RE, and energy innovation
  - ✓ Mobilize private investment in CE

# Cuomo's 2018 State of the State

- Expand RGGI to cover “peaking” plants
- Regulations to end use of coal in power by 2020
- 800 MW offshore wind
- \$200M investment in storage target of 1,500 MW by 2025
- Zero cost solar for 10,000 low-income New Yorkers



# NY-Sun Initiative

- Significantly expand installed solar capacity
- Attract private investment
- Enable sustainable development of a robust industry
- Create well-paying skilled jobs
- Improve the reliability of the electric grid
- Reduce air pollution
- Make solar available to all New Yorkers

Statewide Goal of 3 GW by 2023

Approx. \$1 Billion Total  
Budget

Self-  
Sustaining  
Market

Reduce  
Soft Costs

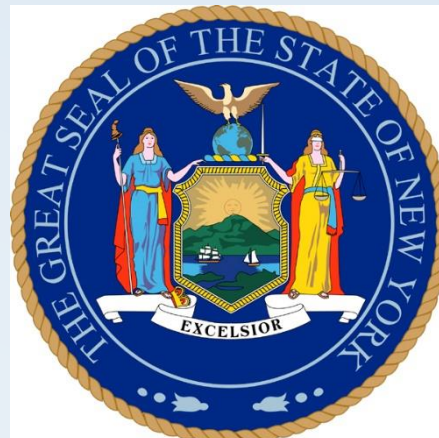
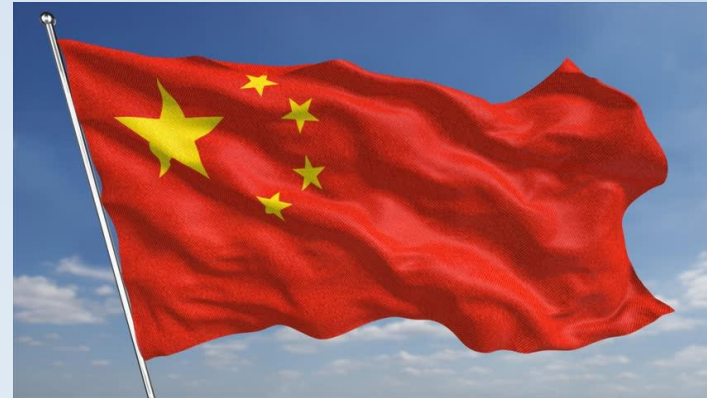
# New York's Solar Market

- Unprecedented growth – 575% growth in solar from 2012 to 2015
- 18,313 solar projects installed in 2015
- 525 MW installed by 2015 – enough to power nearly 85,000 homes
- Strong job growth – 8,250 employed in solar industry in 2015 – New York ranked 4<sup>th</sup> in the U.S. for number of solar workers



# Summary

- Intent
- Investment
- Decoupling
- Results



# Thank you

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Transitioning from Fossil Fuel to Clean Energy

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