

2016 ACEEE Energy Efficiency Finance Forum



EE Overview

Accelerating EE and Slowing Climate change

Greg Kats

President Capital E

Managing Director ARENA Investments

Globally, all future net population growth and construction will be in cities

In US cities, 2/3 of CO2 is from buildings

In the US 2/3 of electricity use is in buildings

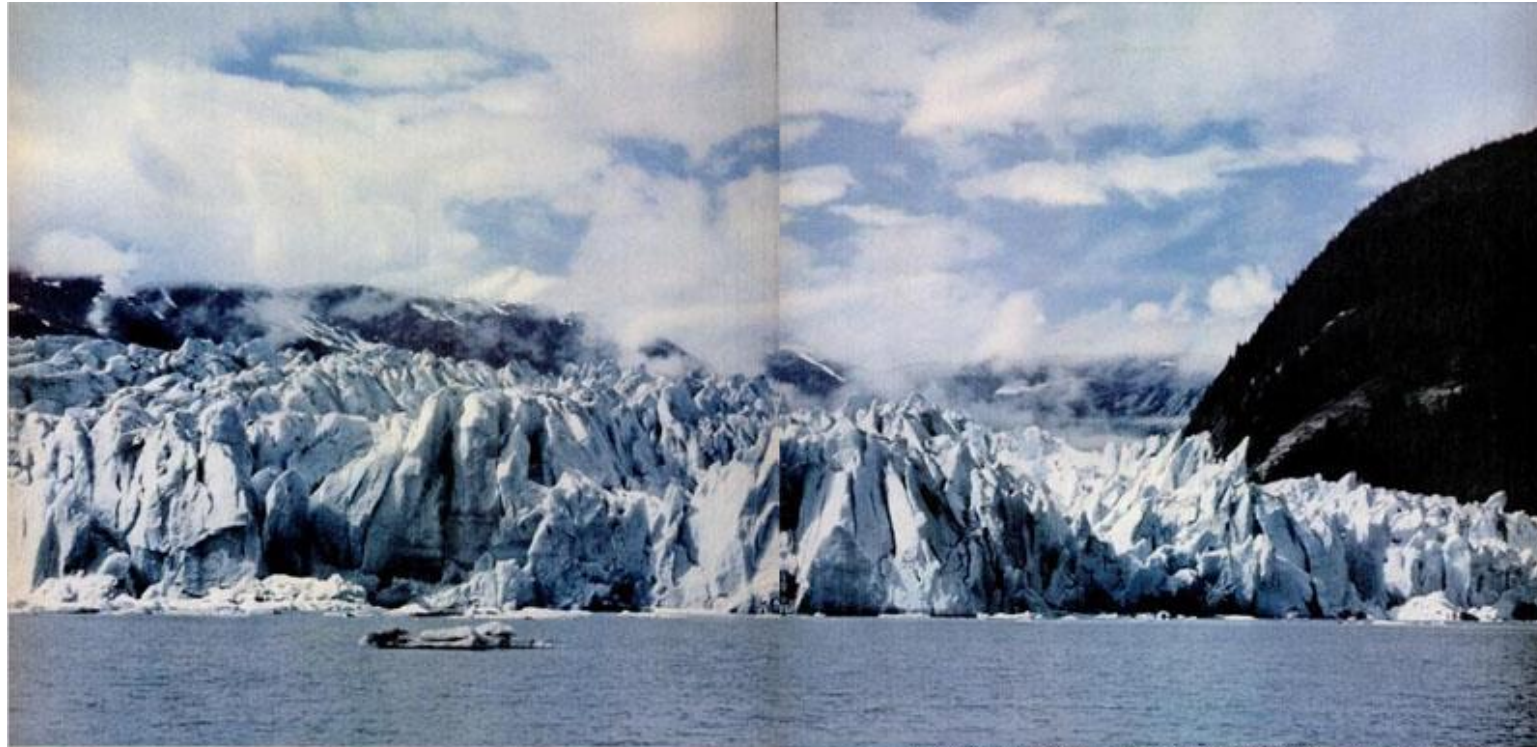


Climate Change Concern (should) Dominate Everything

Hurricane Sandy: NY Metro



Exxon Boasting in 1962 Life Magazine



THIS GLACIER, ALASKA, IS A PIONEER OF ICE SWATHING 270 SQUARE MILES. YET THE PETROLEUM ENERGY HUMBLE SUPPLIES AMERICA TODAY MELTS IT AT THE RATE OF 7 MILLION TONS A DAY!

EACH DAY HUMBLE SUPPLIES ENOUGH ENERGY TO MELT 7 MILLION TONS OF GLACIER!

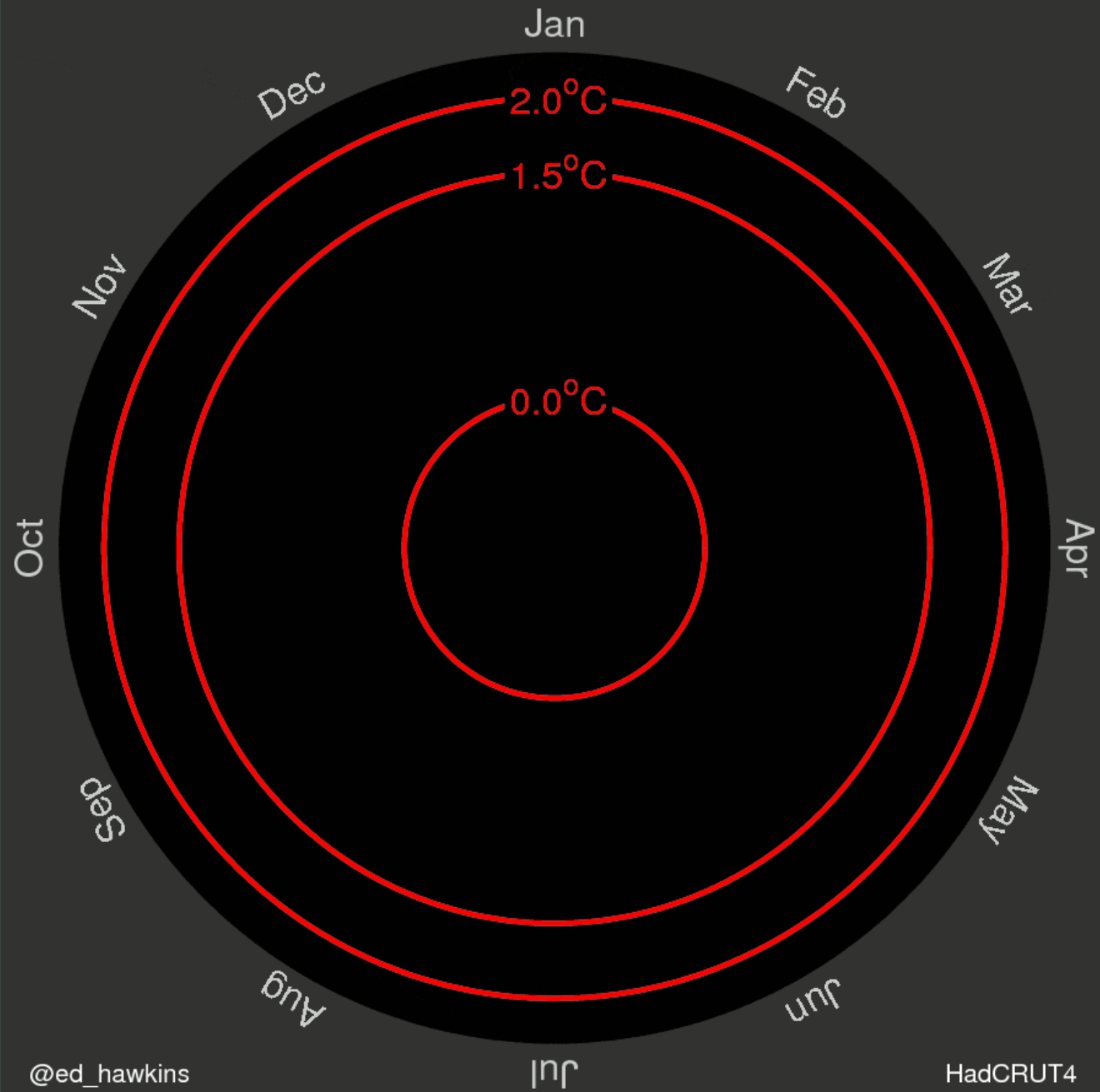
This giant glacier has remained unmelted for centuries. Yet, the petroleum energy Humble supplies—~~it~~ converted into heat—could melt it at the rate of 80 tons each second! To meet the nation's growing needs for energy, Humble has applied science to nature's resources to become America's Leading Energy Company. Working wonders with oil through research, Humble provides energy in many forms—to help heat our homes, power our transportation, and to furnish industry with a great variety of versatile chemicals. Stop at a Humble station for new Enco Extra gasoline, and see why the "Happy Motoring" Sign is the World's First Choice!

HUMBLE
OIL & REFINING COMPANY
America's Leading Energy company



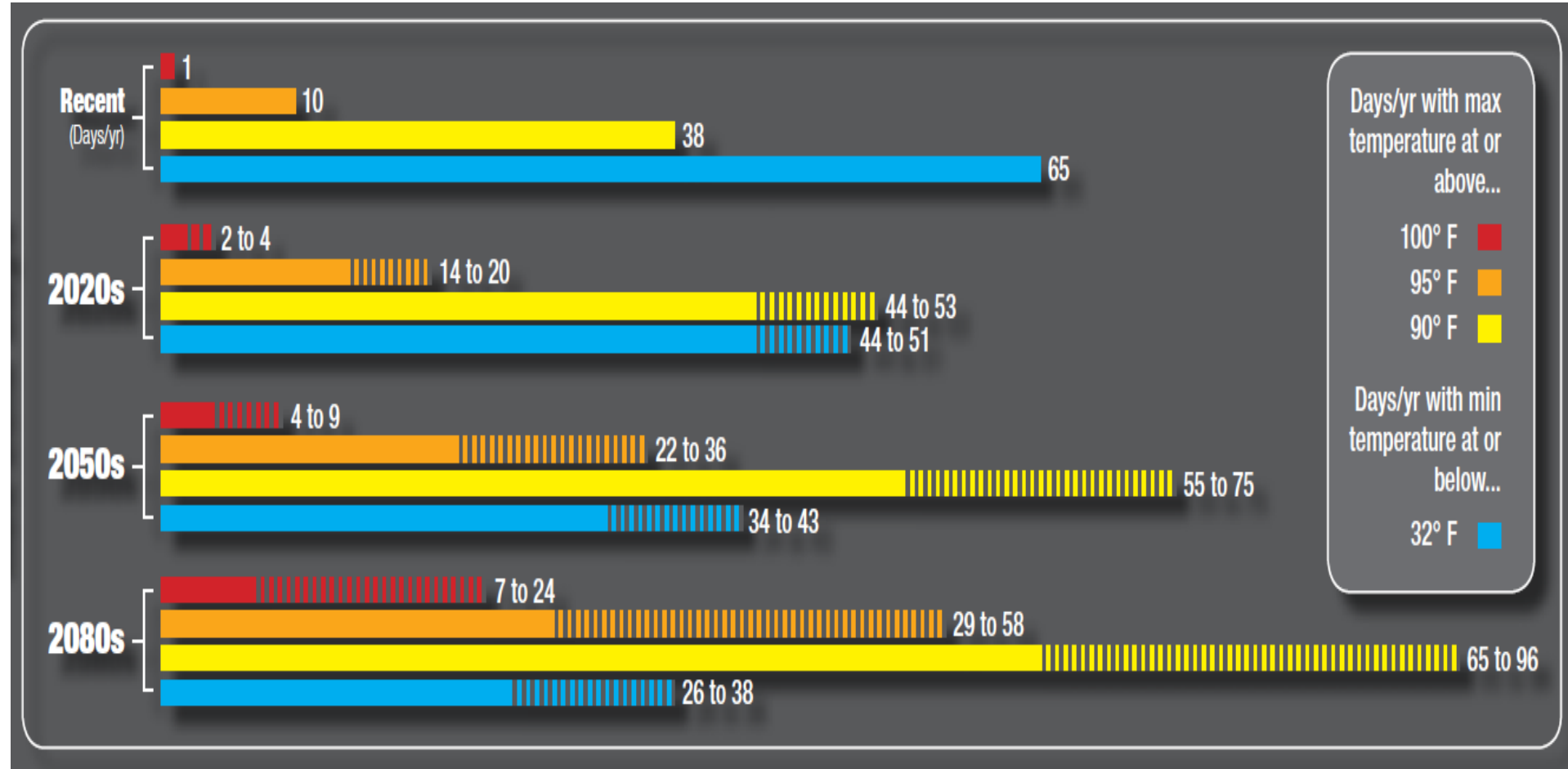
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Global temperature change (1850–2016)



Washington DC temperature future under current climate change pathway

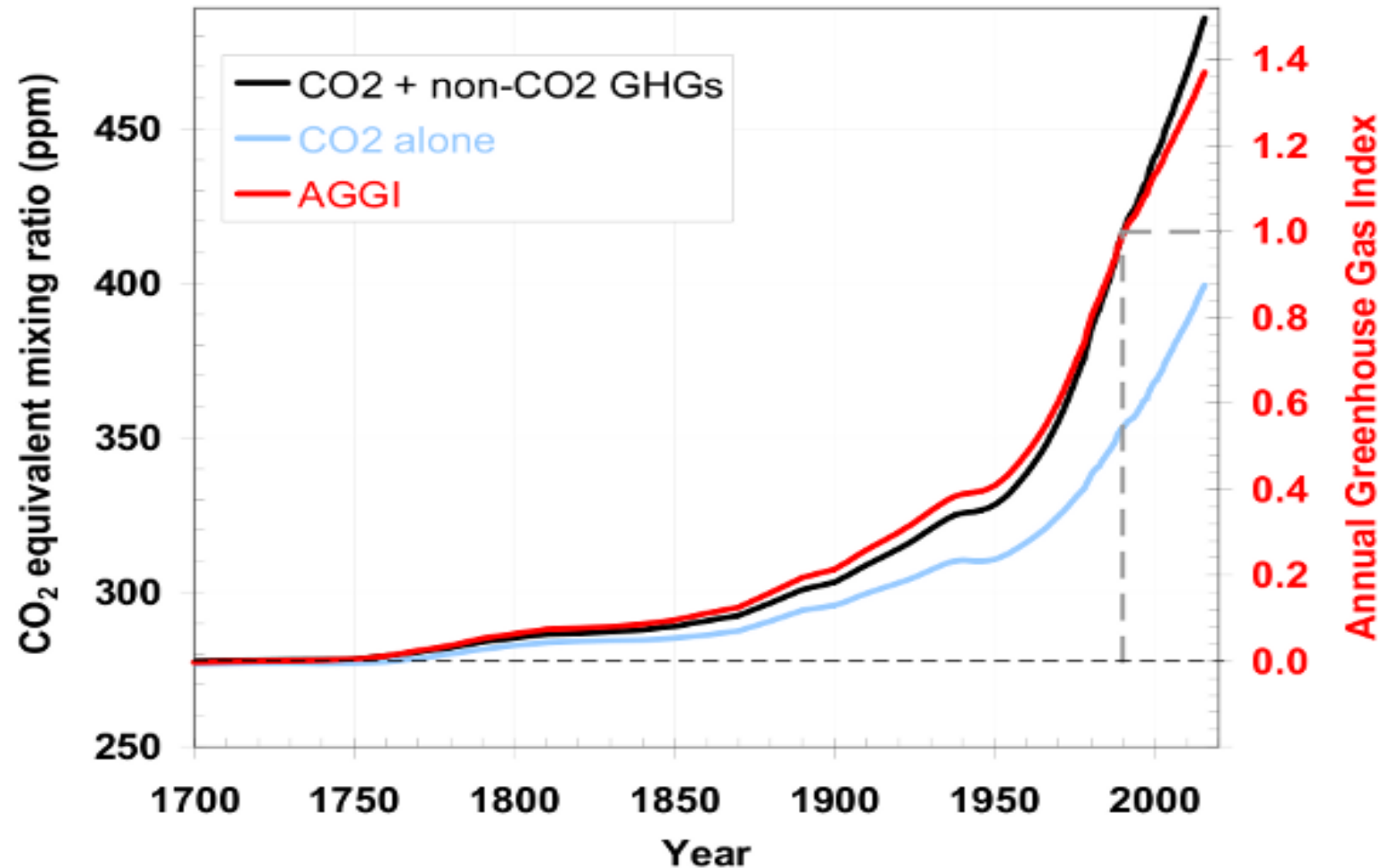
Source: NASA



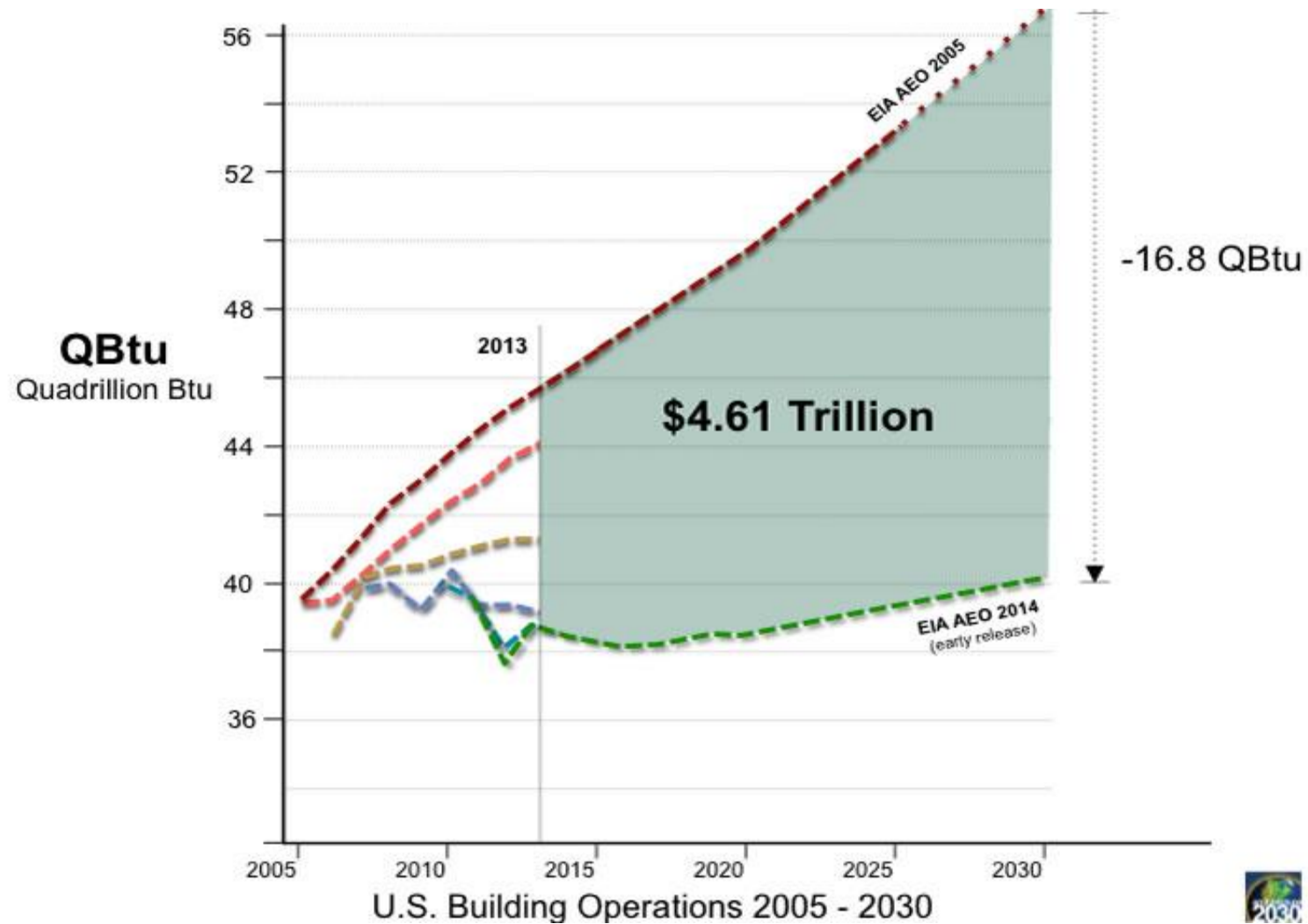
THE NOAA ANNUAL GREENHOUSE GAS INDEX

(Updated Spring 2016)

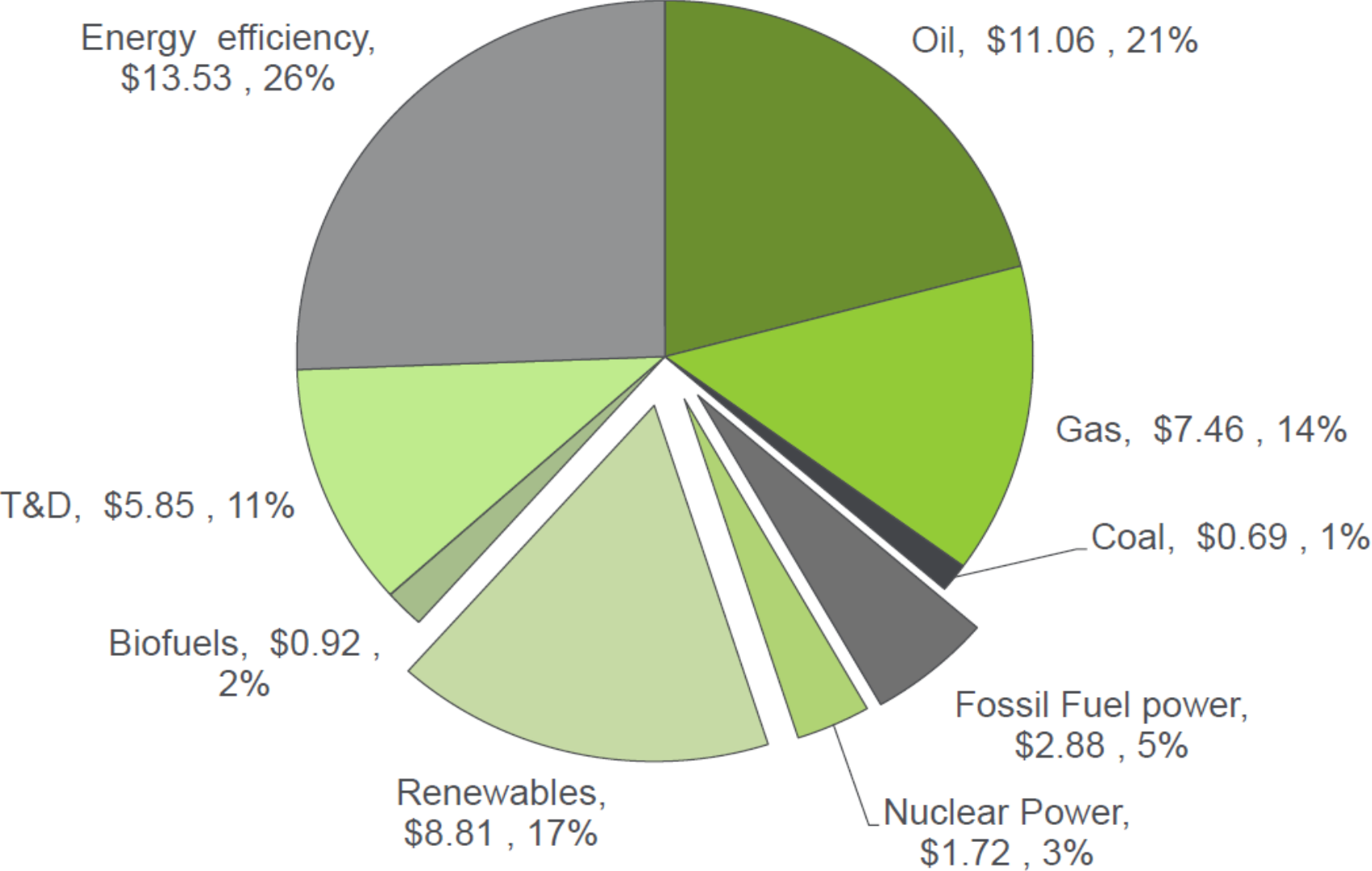
Global Warming/ climate change is **accelerating**, not slowing



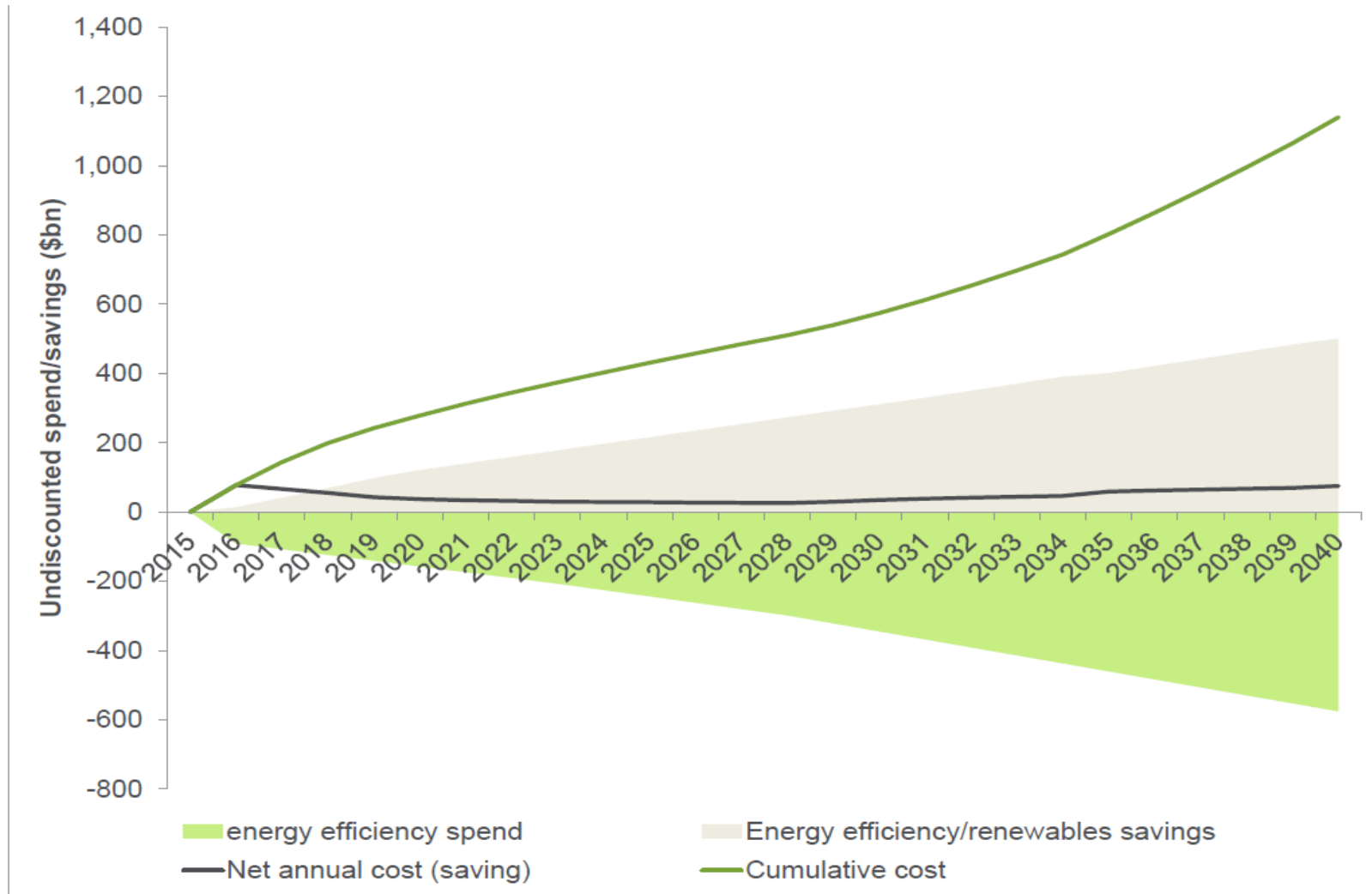
EIA Projections of Future US Building Energy Use: EE improvements save a lot of money



**EE is key to low carbon future:
Cumulative Investment (trillions \$) 2014-35 Under IEA's 450 Scenario: Citi 2015**

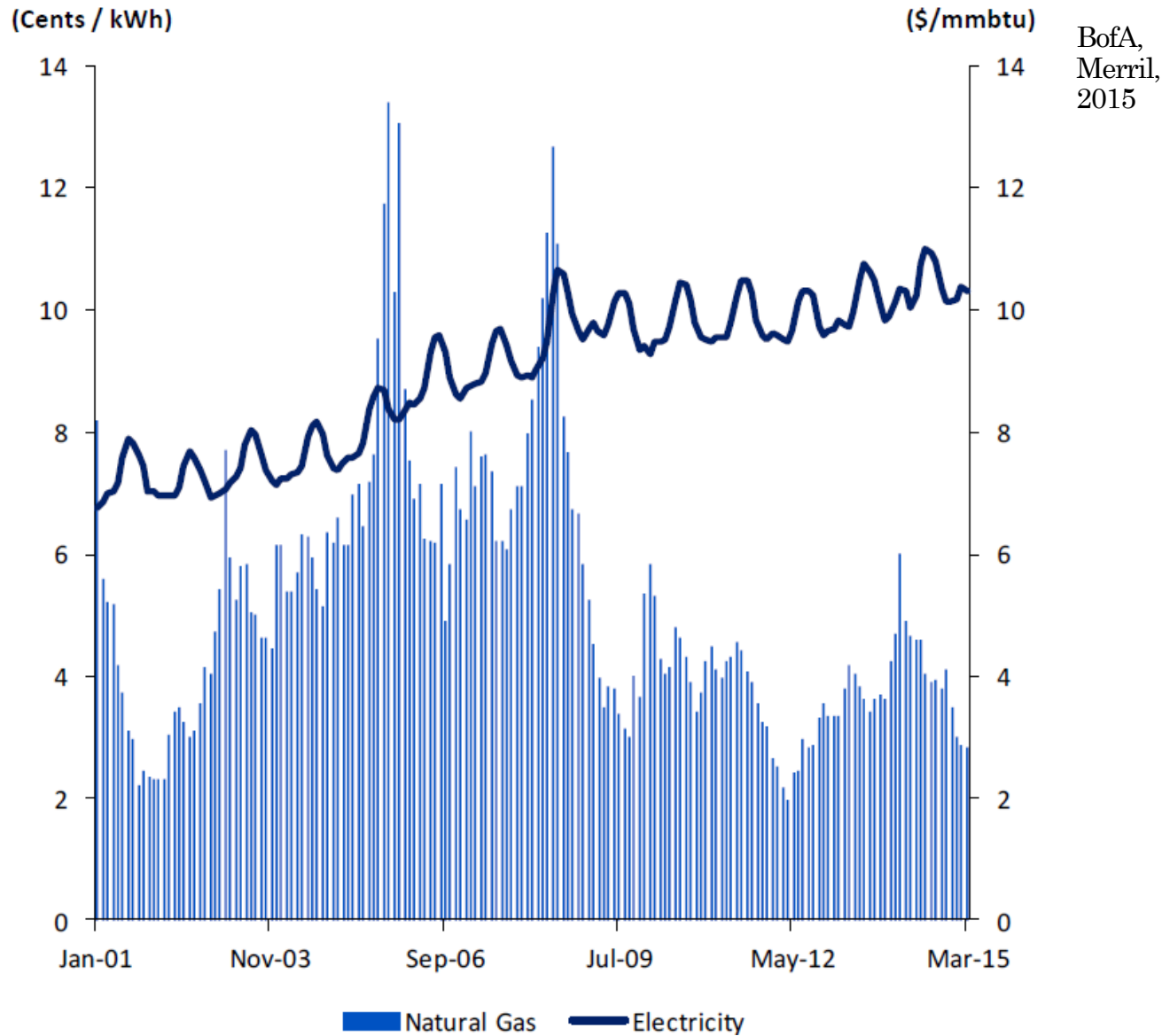


EE makes a low carbon transition very cost effective: Citi 2015: Net and incremental cost

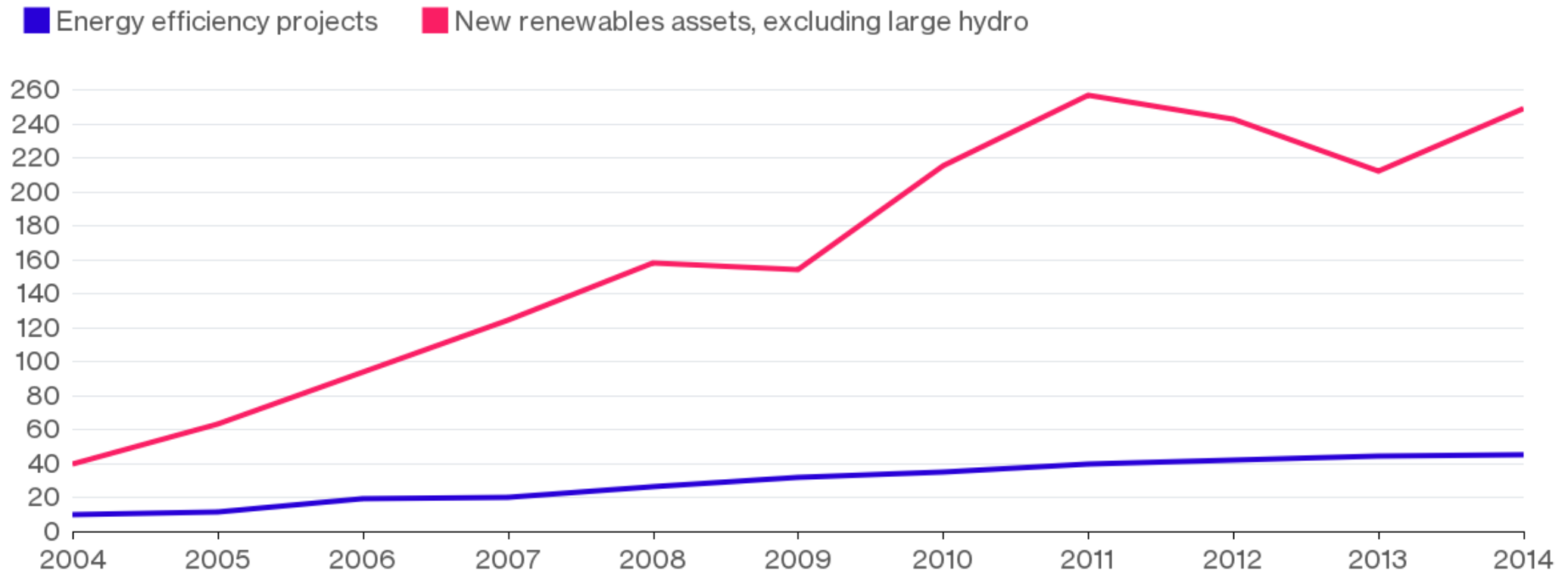


Source: IEA (2014), Citi Research

Electricity price generally rising despite v low nat gas prices



But EE investment rising slowly compared with RE investment (\$Billions)



Source: Bloomberg New Energy Finance

Bloomberg 

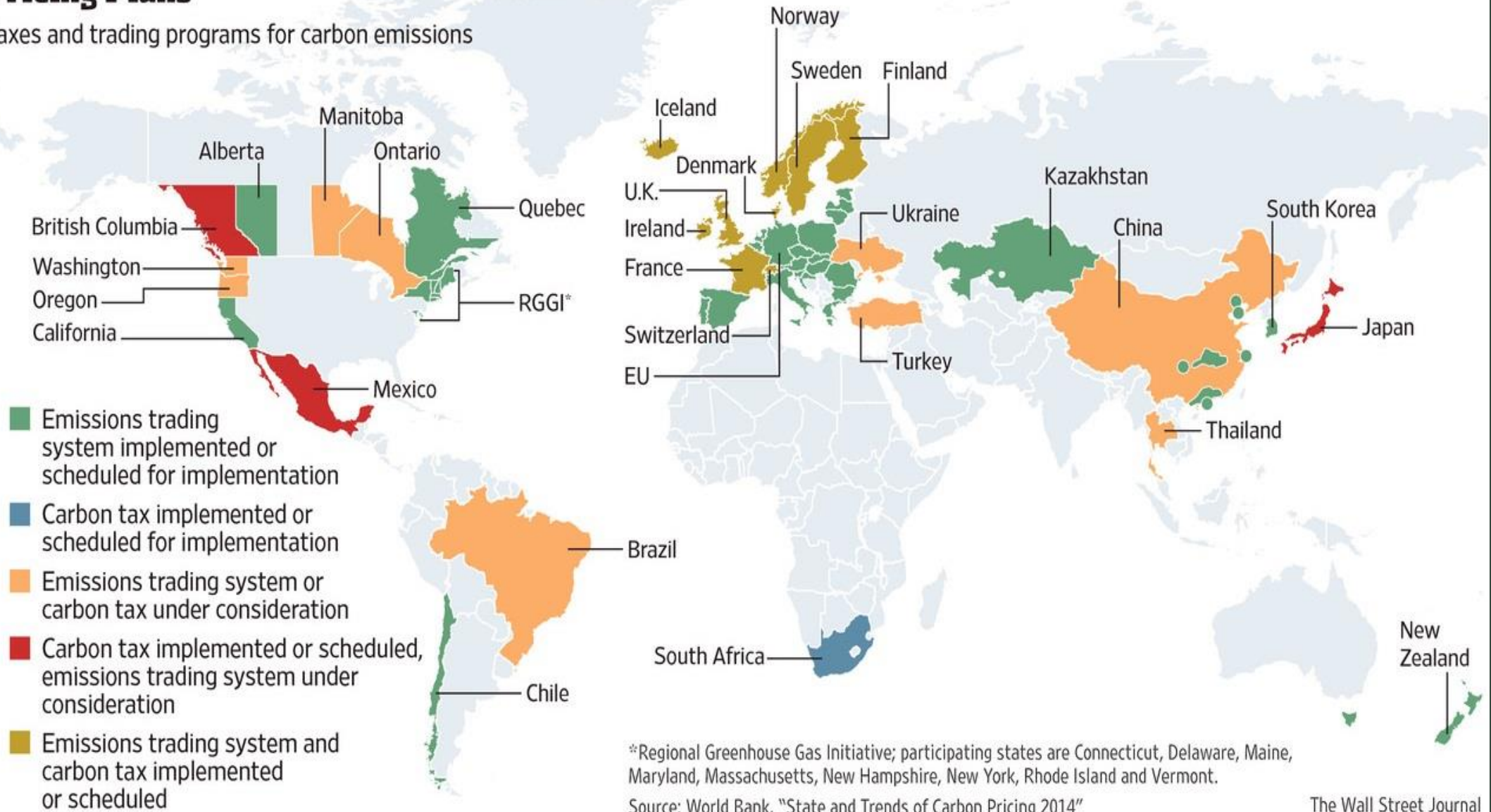
Valuing EE correctly:
Two pricing steps required now

Shift ownership of EE-driven CO₂ reductions to the building owners that make the EE Investments (Duh!!!)

Quantify and claim externalities for EE investments

Pricing Plans

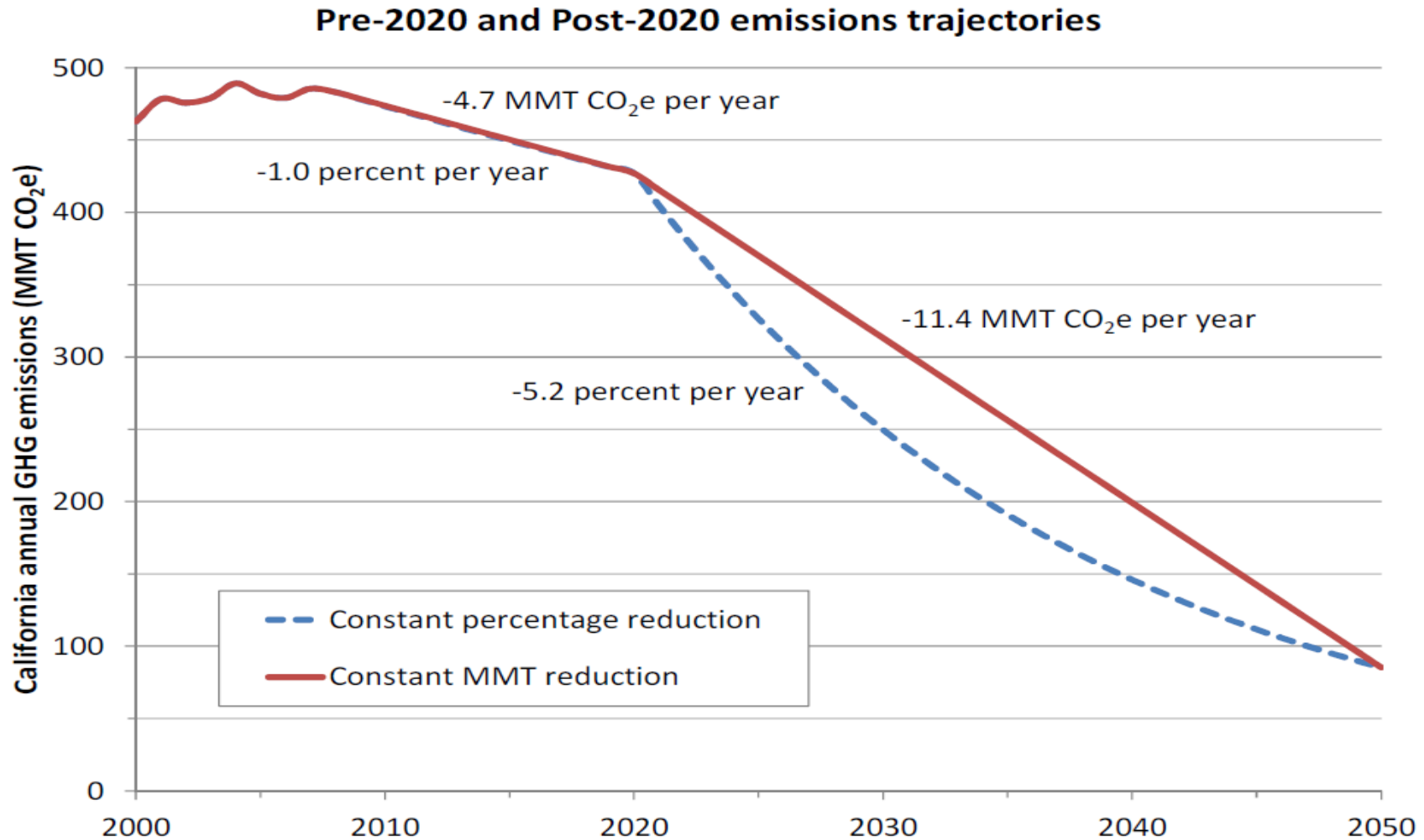
Taxes and trading programs for carbon emissions



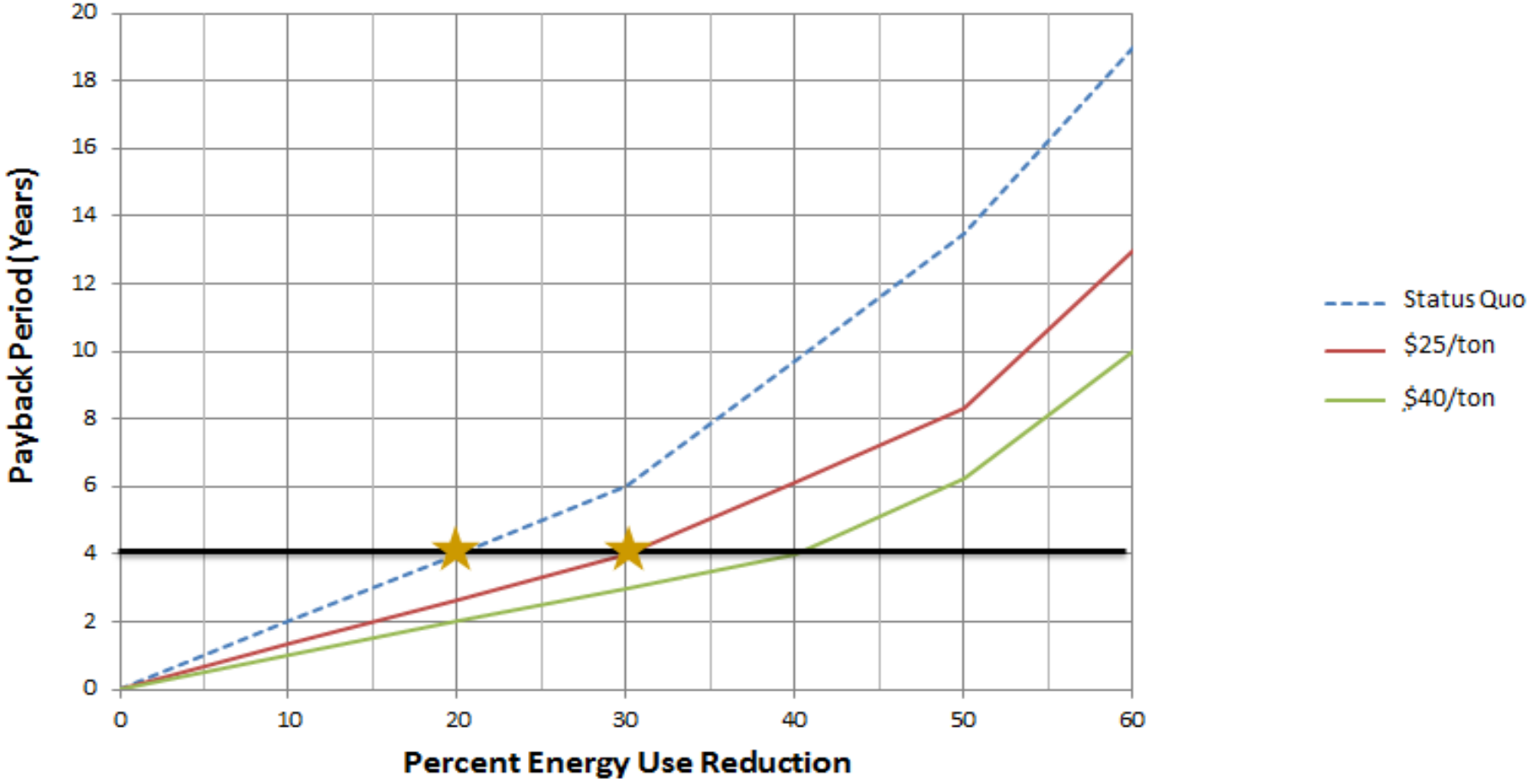
*Regional Greenhouse Gas Initiative; participating states are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.

Source: World Bank, "State and Trends of Carbon Pricing 2014"

CARB Projections: But existing building EE actually lags badly: Investors in EE don't own/get the value of the resulting CO2 reductions



Building owners (cities, REITs, schools) that invest in EE do not own or get the value of the CO2 reductions that result from their investments. This needs to change.. Join/advocate for CO2toEE

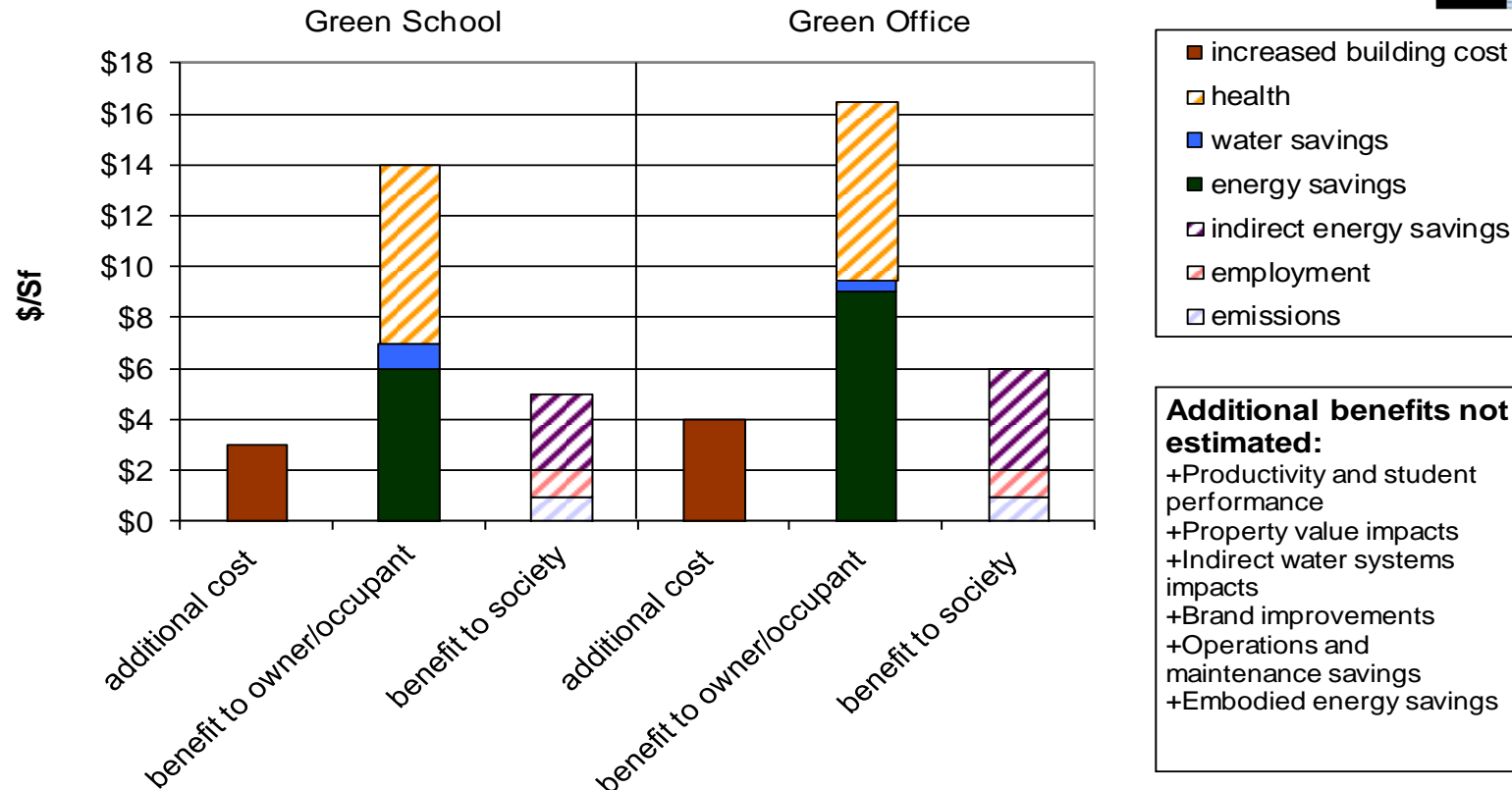
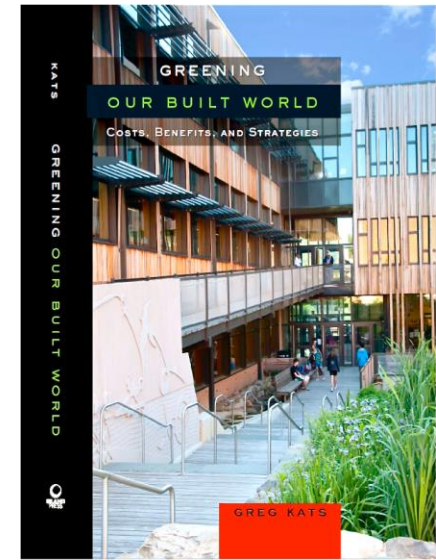


Assumes upfront payment from CO2toEE enables debt financing

Black line indicates 4-year payback period

Mapping and Claiming Benefits of Green Buildings, including EE

Costs and Benefits of Green Buildings: Present value of 20 years of estimated impacts based on study data set and synthesis of relevant research*



- increased building cost
- ▨ health
- water savings
- energy savings
- ▨ indirect energy savings
- ▨ employment
- ▨ emissions

Additional benefits not estimated:

- +Productivity and student performance
- +Property value impacts
- +Indirect water systems impacts
- +Brand improvements
- +Operations and maintenance savings
- +Embodied energy savings

Ongoing City-wide Cost Benefit Mapping (Health benefits are huge but ignored) Examples of Technologies:



Cool Roof



Green Roof



Reflective Pavement

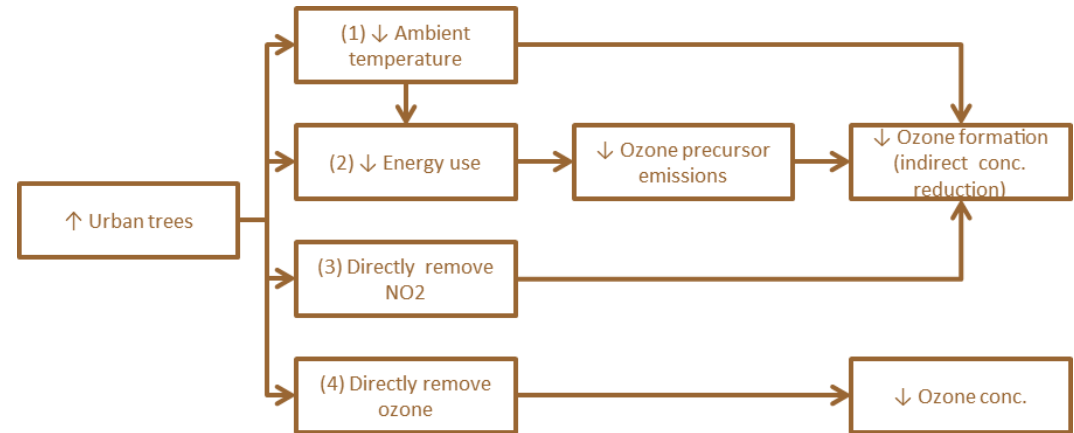
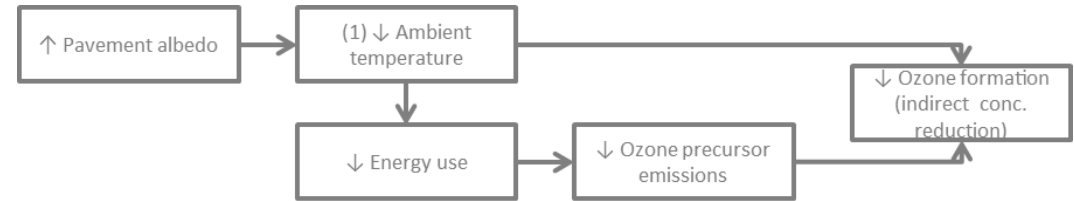
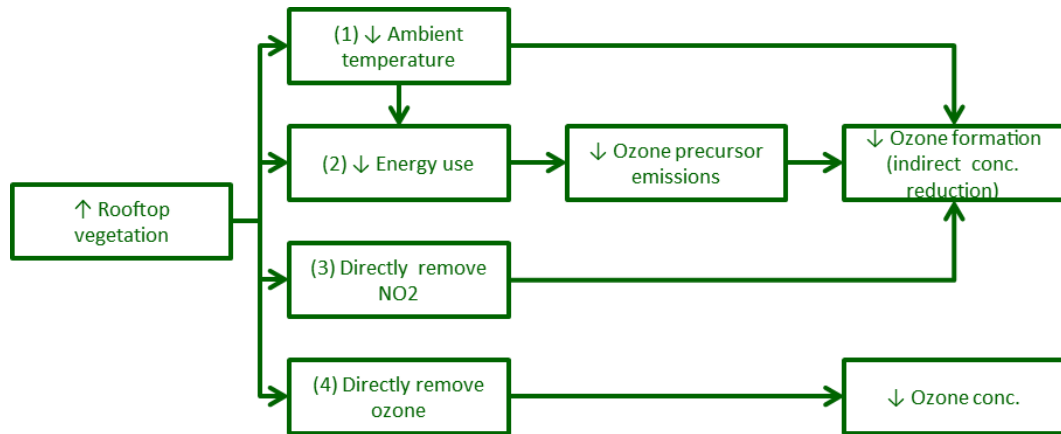
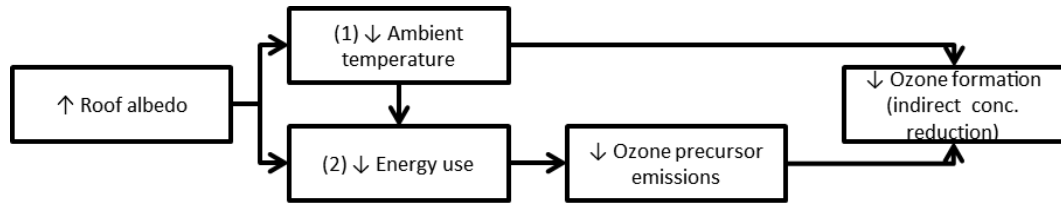


Solar PV

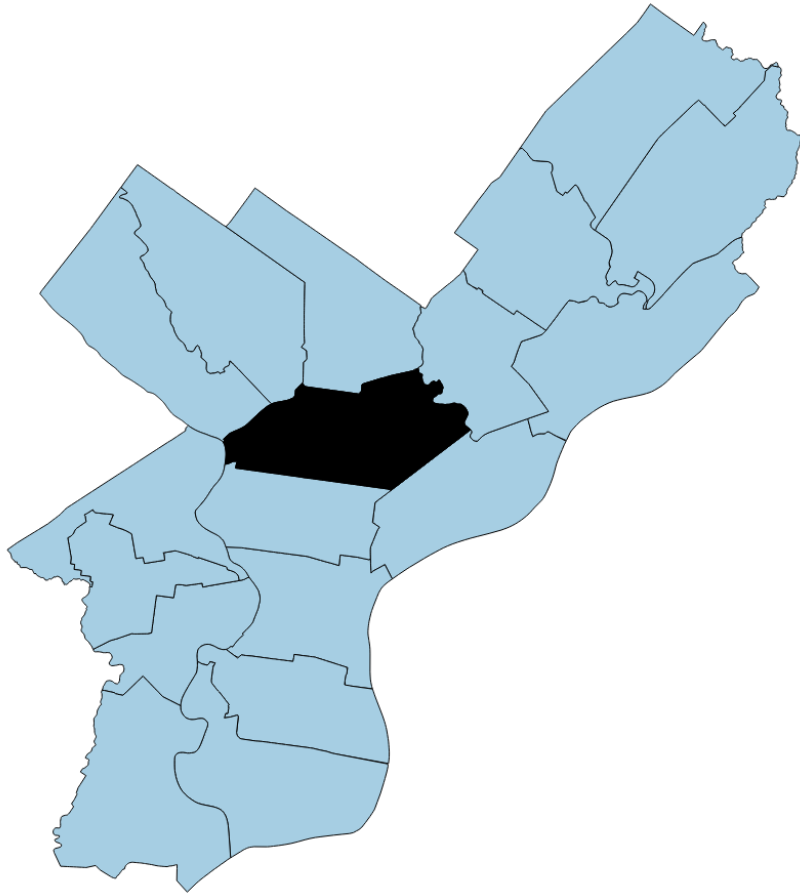


Urban Trees

Ozone Reduction Pathways



North Philadelphia



| Characteristic | Philadelphia | |
|--|------------------------------------|-----------|
| | North Philadelphia (2035 District) | City |
| Population (2010) | 137,849 | 1,526,006 |
| Income | | |
| <i>Median income</i> | \$23,115 | \$37,460 |
| <i>Percent of population below poverty line</i> | 45.2% | 26.7% |
| <i>Unemployment rate</i> | 24.8% | 14.9% |
| Land use | | |
| <i>Area (square miles)</i> | 8.6 | 134.1 |
| <i>Building footprint (% region)</i> | 27.6% | 18.7% |
| <i>Paved area (roads, parking, sidewalks) (% region)</i> | 32.9% | 26.6% |
| <i>Tree canopy (% region)</i> | 10.1% | 20.0% |

North Philadelphia



| TECHNOLOGY | Cool Roofs | Green Roofs | PV (Direct Purchase) | PV (PPA) | Reflective Pavements | Urban Trees | TOTAL |
|-----------------|--------------|---------------|----------------------|--------------|----------------------|--------------|---------------|
| COSTS | \$8,236,000 | \$100,076,000 | \$55,669,000 | \$25,000 | \$12,433,000 | \$14,136,000 | \$190,573,000 |
| BENEFITS | \$70,797,000 | \$115,154,000 | \$92,676,000 | \$95,456,000 | \$26,789,000 | \$31,113,000 | \$431,981,000 |
| NPV | \$62,561,000 | \$15,079,000 | \$37,007,000 | \$95,431,000 | \$14,356,000 | \$16,977,000 | \$241,408,000 |

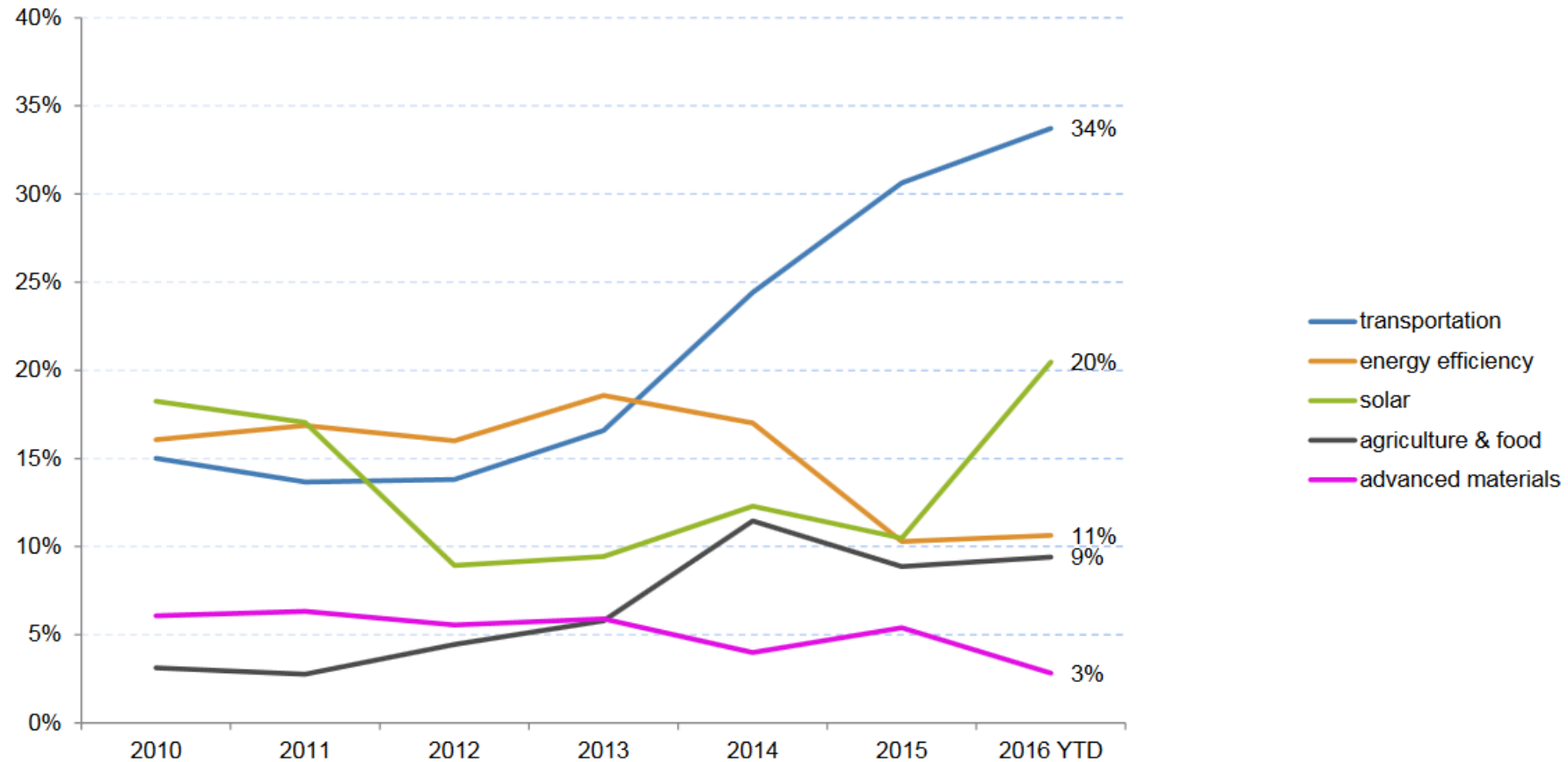
| TECHNOLOGY | Cool Roofs | Green Roofs | PV (Direct Purchase) | PV (PPA) | Reflective Pavements | Urban Trees |
|------------------------------|------------|-------------|----------------------|-----------|----------------------|-------------|
| Benefit-to-Cost Ratio | 8.60 | 1.15 | 1.66 | Very high | 2.15 | 2.20 |

Increase EE investing

- Allocate ownership of EE emissions to building owner who make the investments (Duh!) : CO₂toEE
- Address the critical project financing gap for small and mid sized growth clean energy firms
- Shape and capture capacity utilization value
- EE scope should broaden to include embedded energy/CO₂: CO₂ sequestration in buildings and roads
- Ride the solar wave

Sector shares of cleantech venture capital (dollars)

Percentage share of total dollars invested by sector over time*



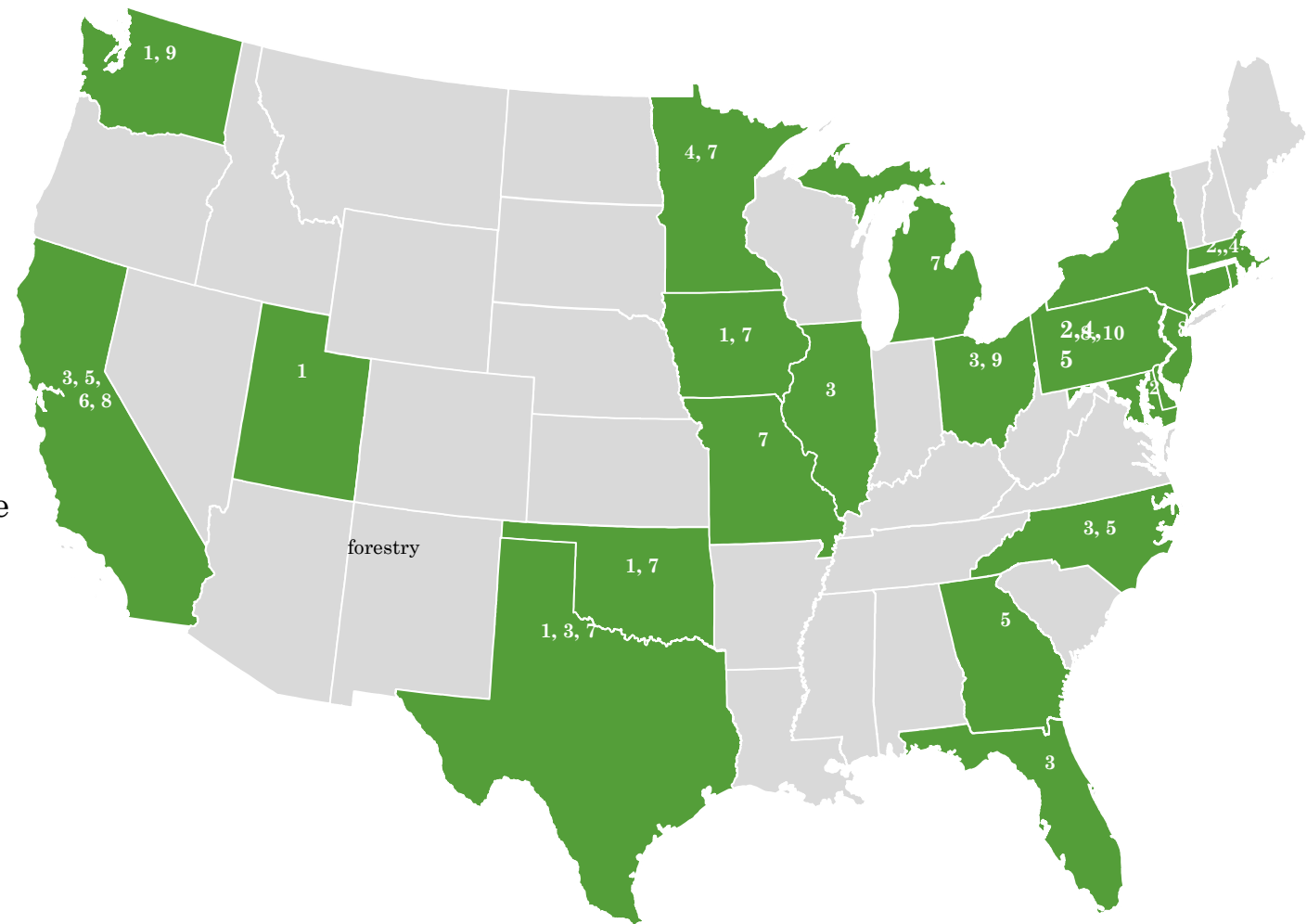
Critical lack of funding for growth stage clean energy firms

- Rapid improvement and cost reduction of sensors, software, LED lights, ground source heat pumps, storage, can allow urban transformation to low carbon
- But most growth clean energy firms cannot raise funding to bring these technologies to scale.
- Debt available for large firms but not for smaller (sub \$50 million) deals
- Growth capital for smaller, innovative firms is essential to rapidly bring proven technologies into new very fast growth markets to drive a rapid transition to a low carbon economy.
- SBA low cost debt enables debt financing for growth stage clean energy firms: First Clean Energy Impact Fund

Huge unfunded EE investment Opportunities: Pipeline of ARENA Investment Opportunities

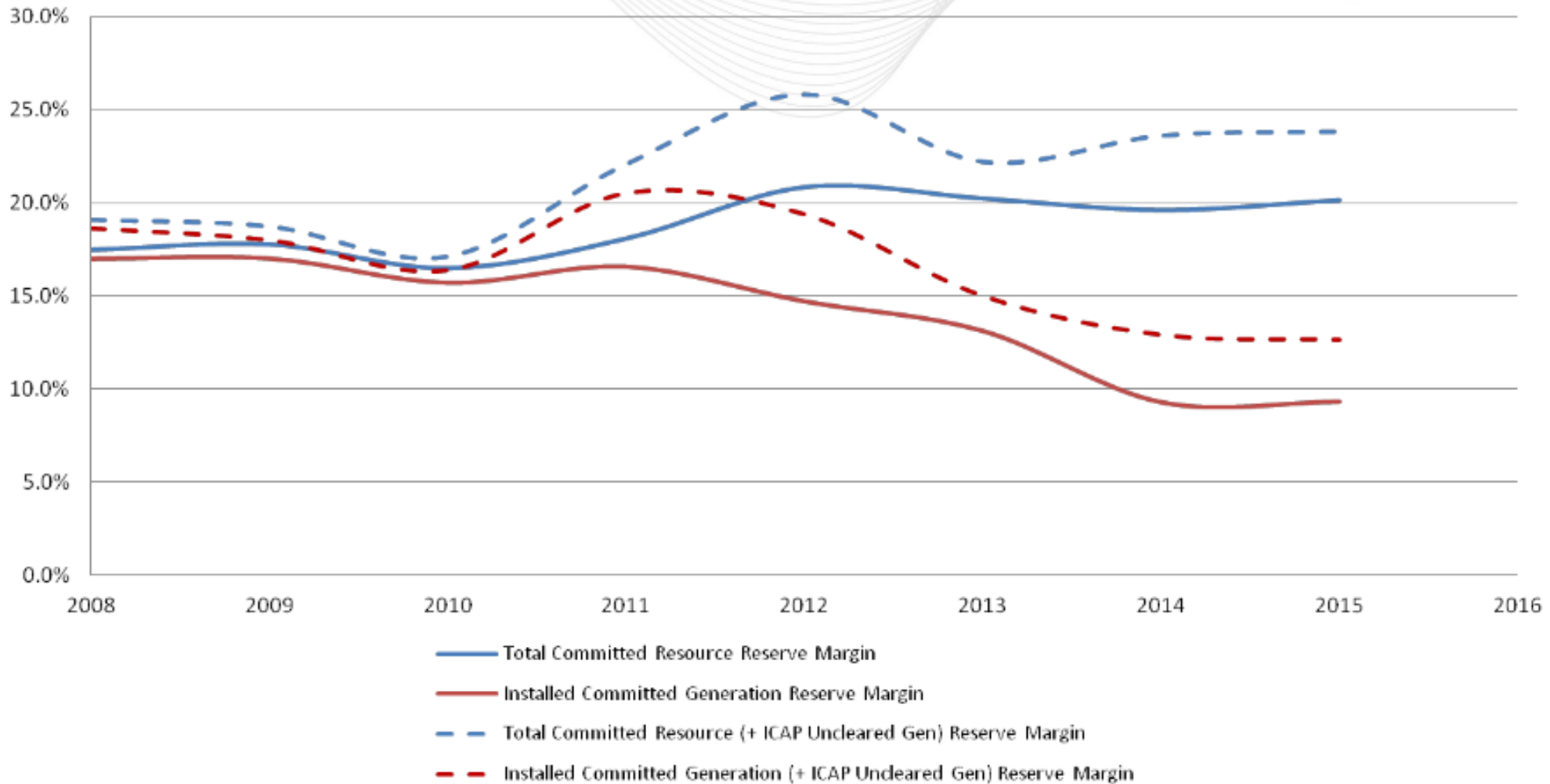
1. Apartment EE
2. Commercial Ground Source Heat Pumps
3. Commercial EE
4. Community Solar
5. Solar PV development
6. Carbon credits from
7. Community & utility scale wind
8. Storage
9. Municipal EE Services
10. Residential EE

EE = Energy Efficiency





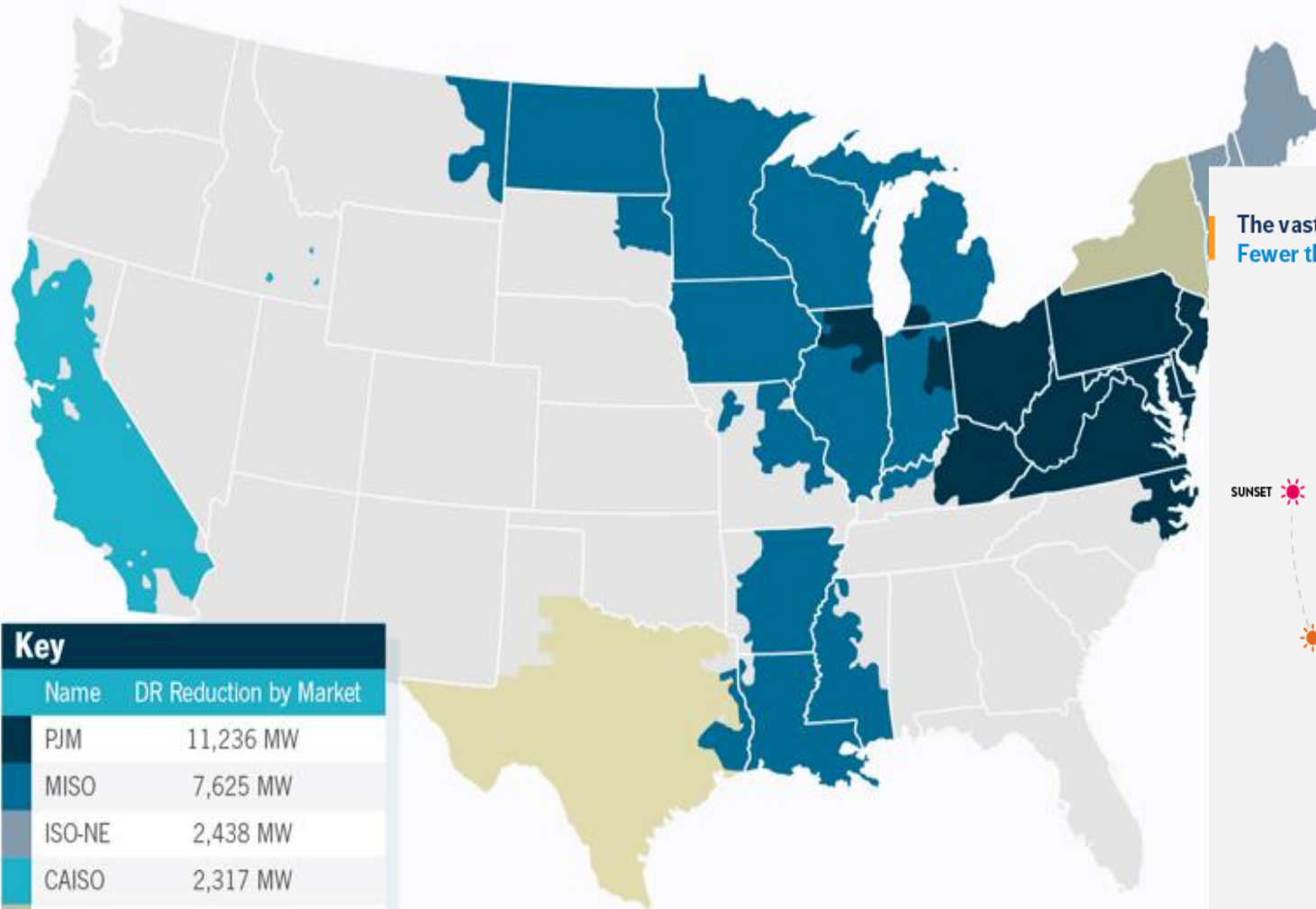
PJM Total Resource and Generation Reserve Margins



ICAP Uncleared Gen excludes Uncleared Planned Gen, Uncleared External Gen and Uncleared Retired Gen

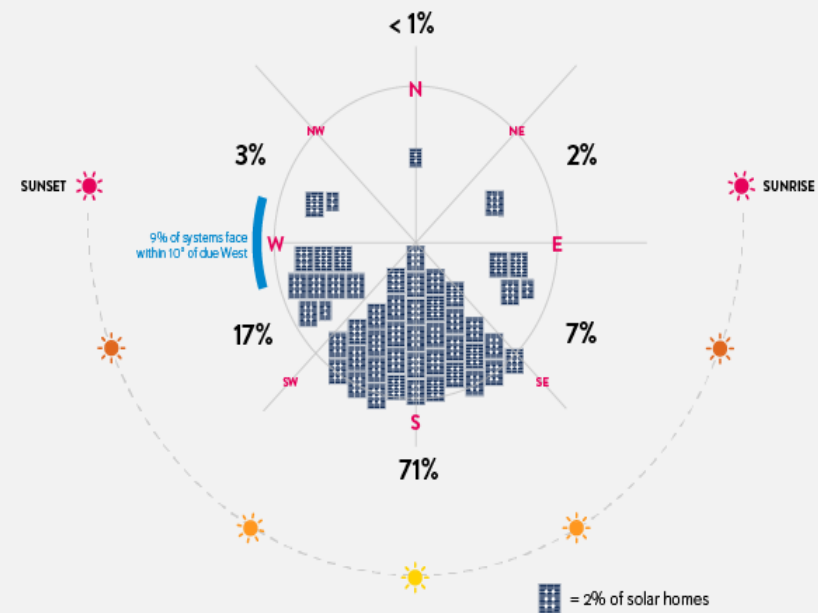
Major US DR Markets Source: GTM 2014

PV orientation: peaking implications for EE



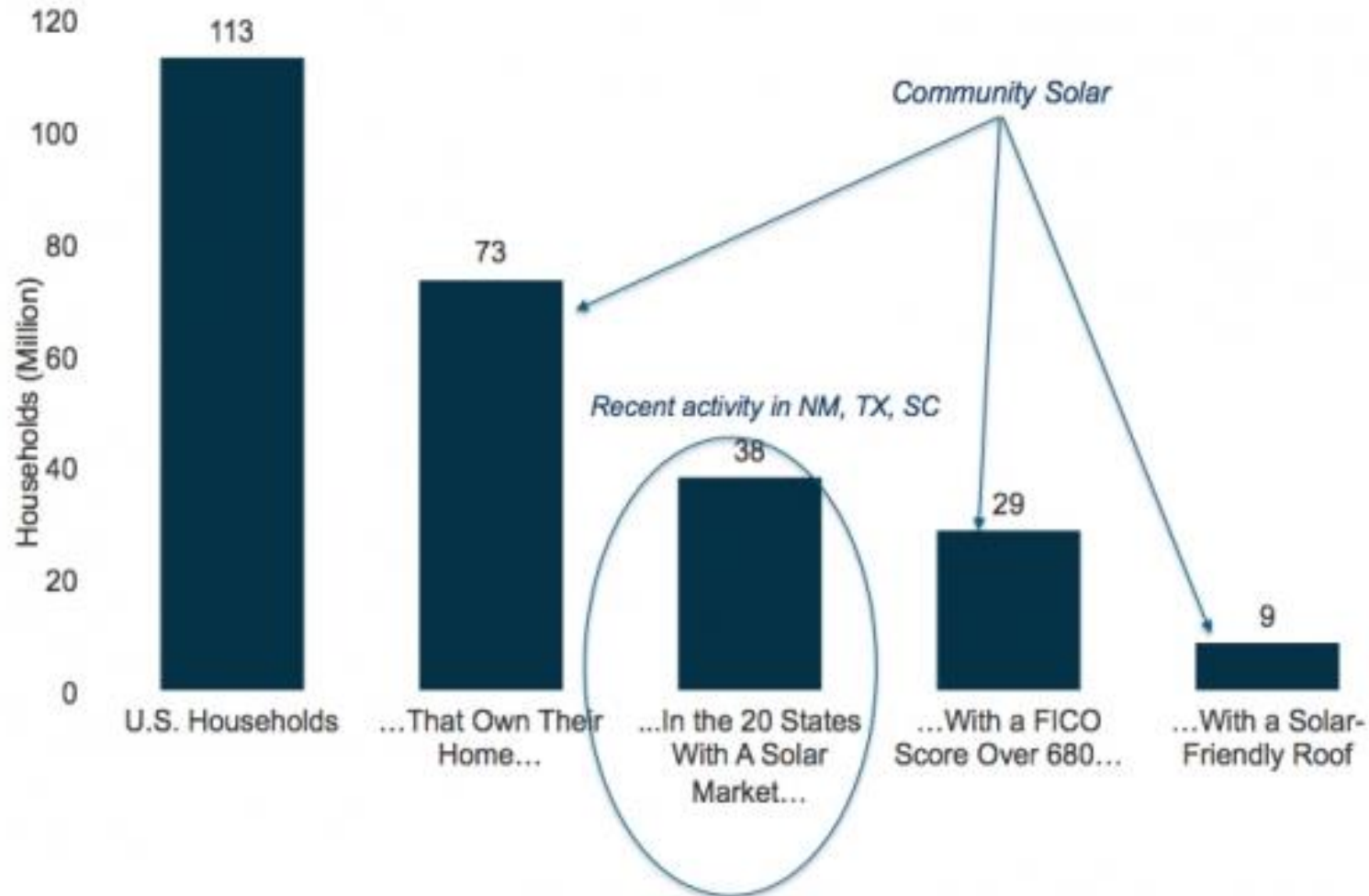
| Key | |
|--------|------------------------|
| Name | DR Reduction by Market |
| PJM | 11,236 MW |
| MISO | 7,625 MW |
| ISO-NE | 2,438 MW |
| CAISO | 2,317 MW |
| NYISO | 2,027 MW |
| ERCOT | 1,611 MW |

The vast majority of home solar panels in California are south-facing. Fewer than 10% of systems are oriented within 10 degrees of due west.

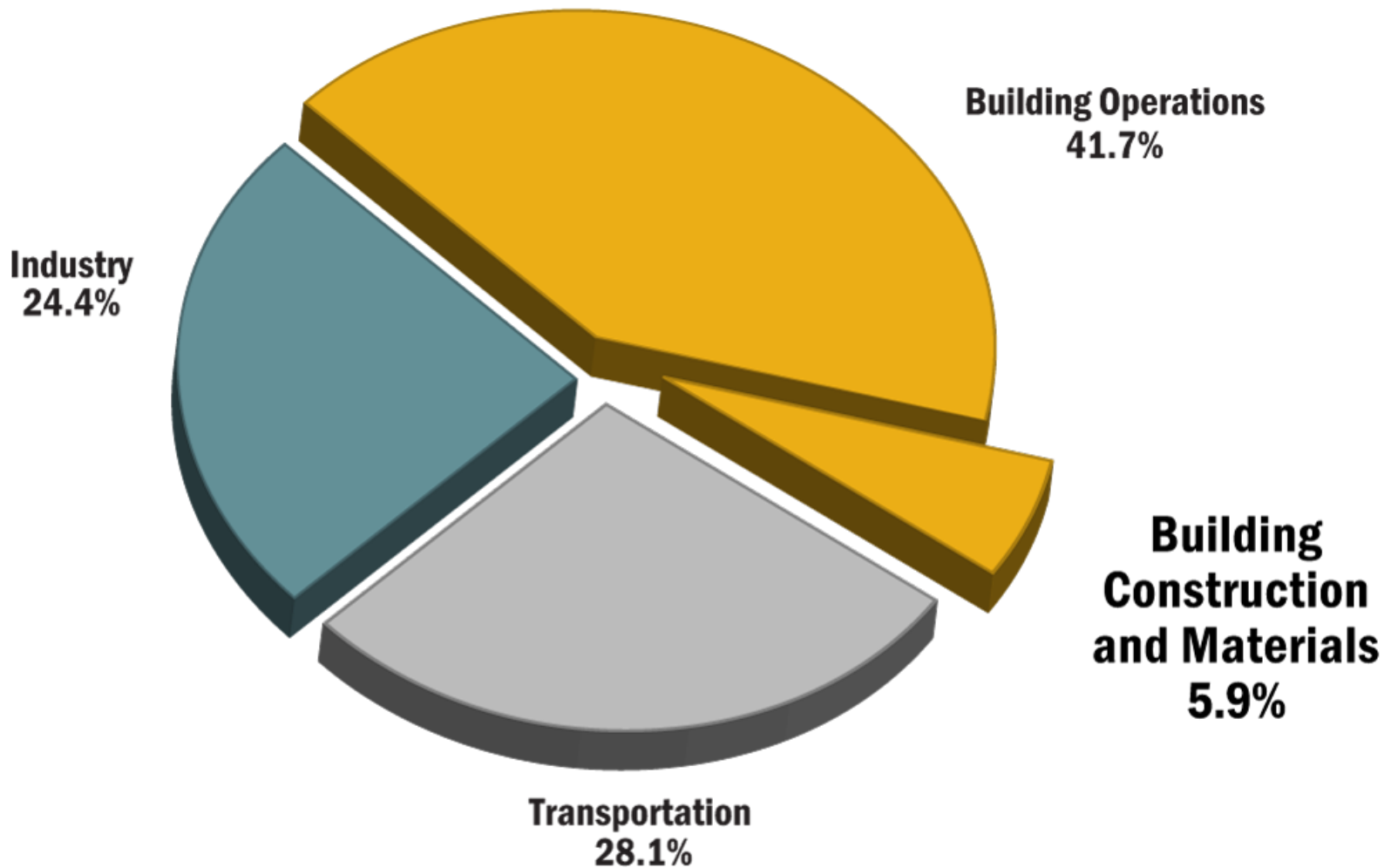


n = 111,764 solar homes with photovoltaic systems between 0-10 kilowatts
 (Data Source: California Solar Initiative, updated October 2014)

Community Solar will explode: EE should be part of this



Embedded energy and carbon gets larger as building become energy efficient: Cement = ~5% worlds CO2



U.S. Energy Consumption by Sector

How can buildings and cities sequester CO₂? Blue Planet: negative carbon roads and buildings



Economically captures carbon and criteria pollutants

Through a proprietary mineralization process

Creating high-value fine and heavy aggregates for green highway construction



Blue Planet
Carbon
sequestering
(carbon negative)
cement being
poured at SF
Airport
May 2016



Thank you



Greg Kats: gkats@cap-e.com

NOAA ANNUAL GREENHOUSE GAS INDEX: <https://www.co2.earth/annual-ghg-index-aggi>

www.blueplanet-ltd.com

www.cap-e.com (Inc for CO₂toEE)