California
Energy Commission
Research & Development

The Road to Electrification

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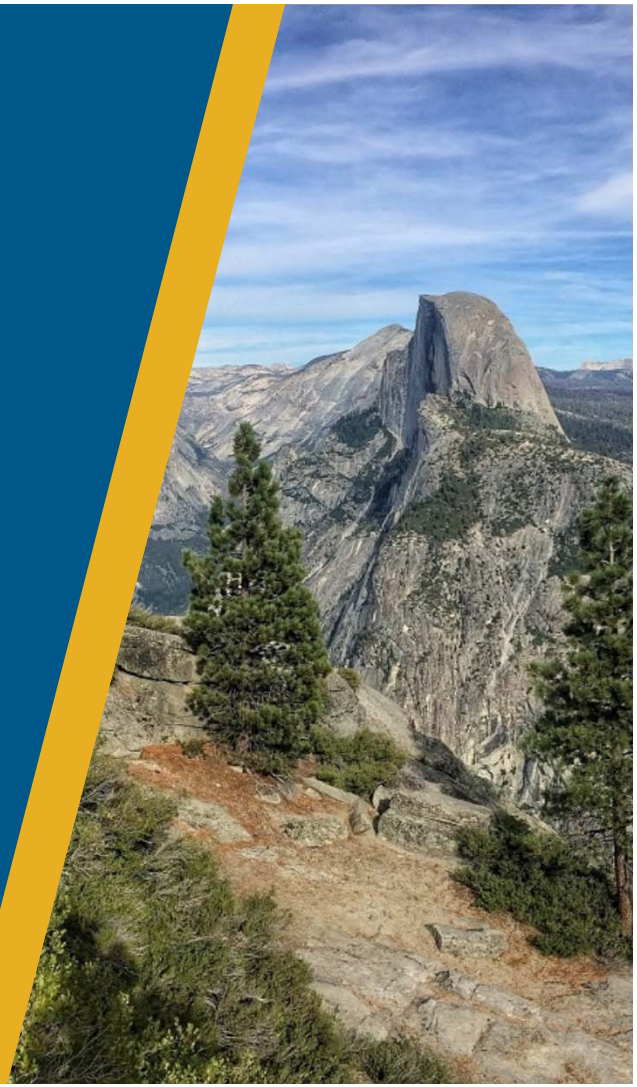
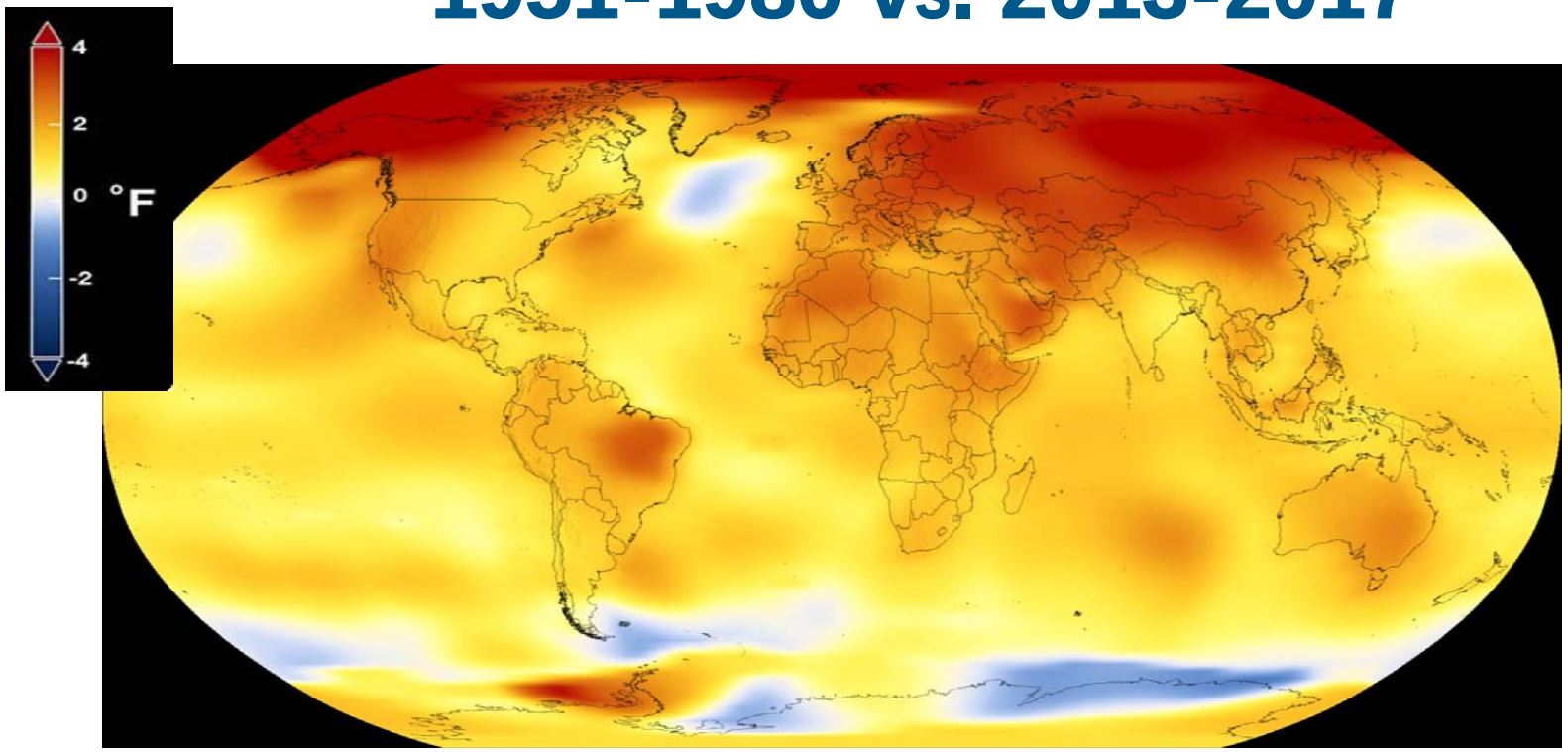


Climate Change and Green House Gases

Greenhouse gases from human activities are the most significant driver of observed climate change since the mid-20th century.[1]

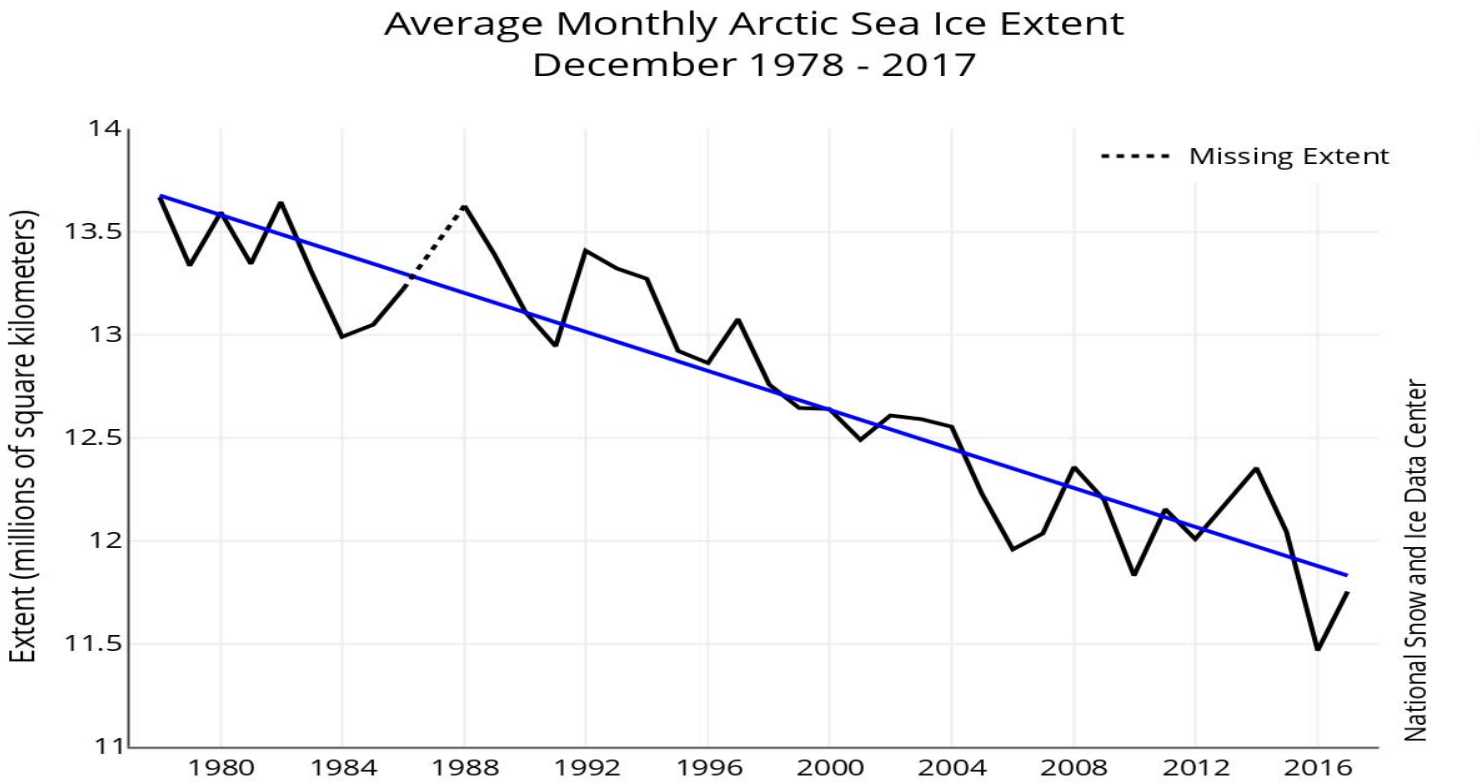
[1] IPCC (Intergovernmental Panel on Climate Change). 2013. Climate change 2013: The physical science basis. Working Group I contribution to the IPCC Fifth Assessment Report. Cambridge, United Kingdom: Cambridge University Press.

Global Temperature: 1951-1980 vs. 2013-2017



Source: NASA/GSFC/Scientific Visualization Studio

Arctic Sea Ice at Record Lows

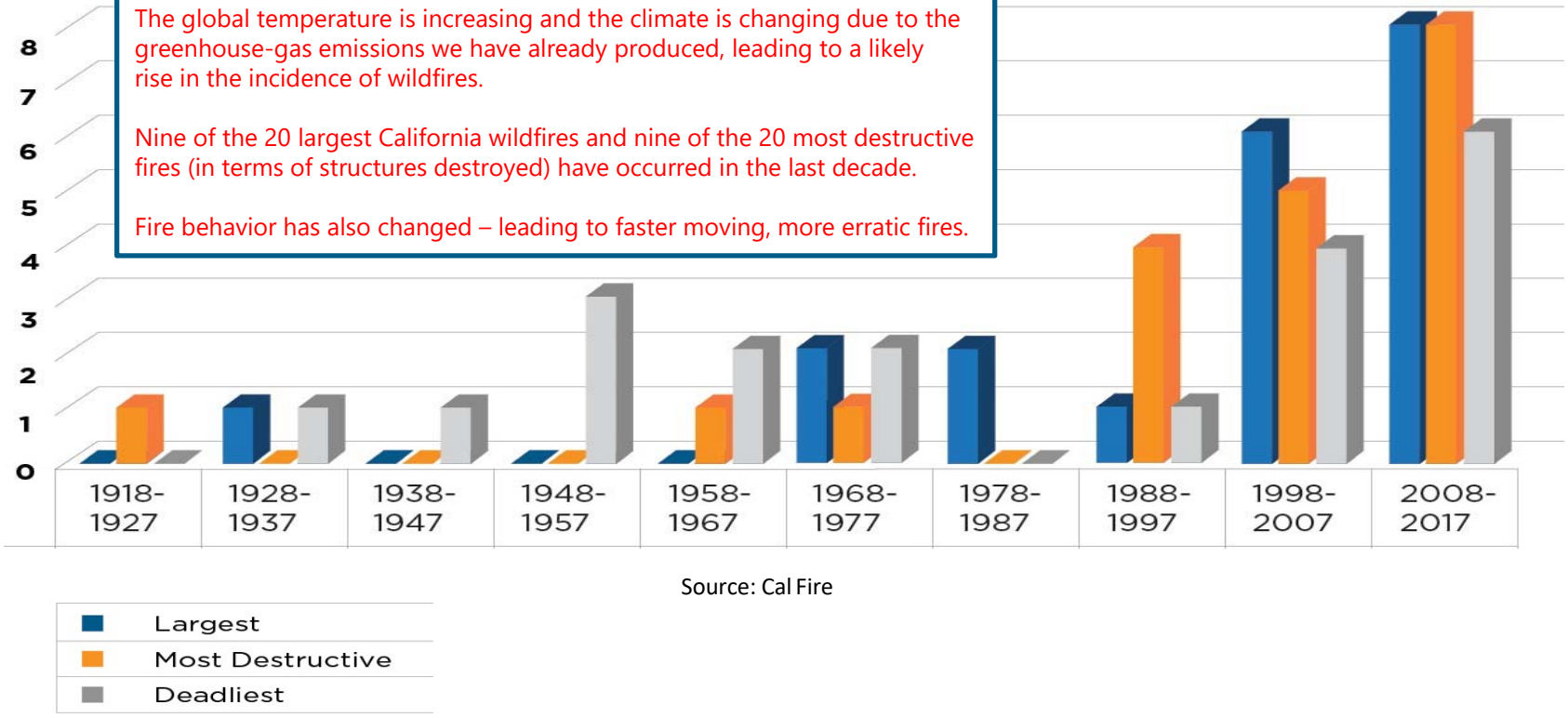


Climate Adaptation: Preparing for Future Forest Fires in California

The global temperature is increasing and the climate is changing due to the greenhouse-gas emissions we have already produced, leading to a likely rise in the incidence of wildfires.

Nine of the 20 largest California wildfires and nine of the 20 most destructive fires (in terms of structures destroyed) have occurred in the last decade.

Fire behavior has also changed – leading to faster moving, more erratic fires.



Source: Cal Fire

Decarbonization

Decarbonization denotes the declining average carbon intensity of energy (in various forms) over time.

Success Will Require an Integrated Approach

1. Efficiency & Conservation

-Higher efficiency & electric processes in buildings & industry
-Demand Response/Load Flexibility

2. Fuel Switching

-Greater reliance on electricity & biogas

3. Decarbonize electricity

-50% Renewable by 2030
-Increase in the flexibility of electric & efficiency of fossil gas generation

4. Decarbonize fuels (liquid & gas)

-Biofuels for transportation
-Biogas to replace fossil fuels

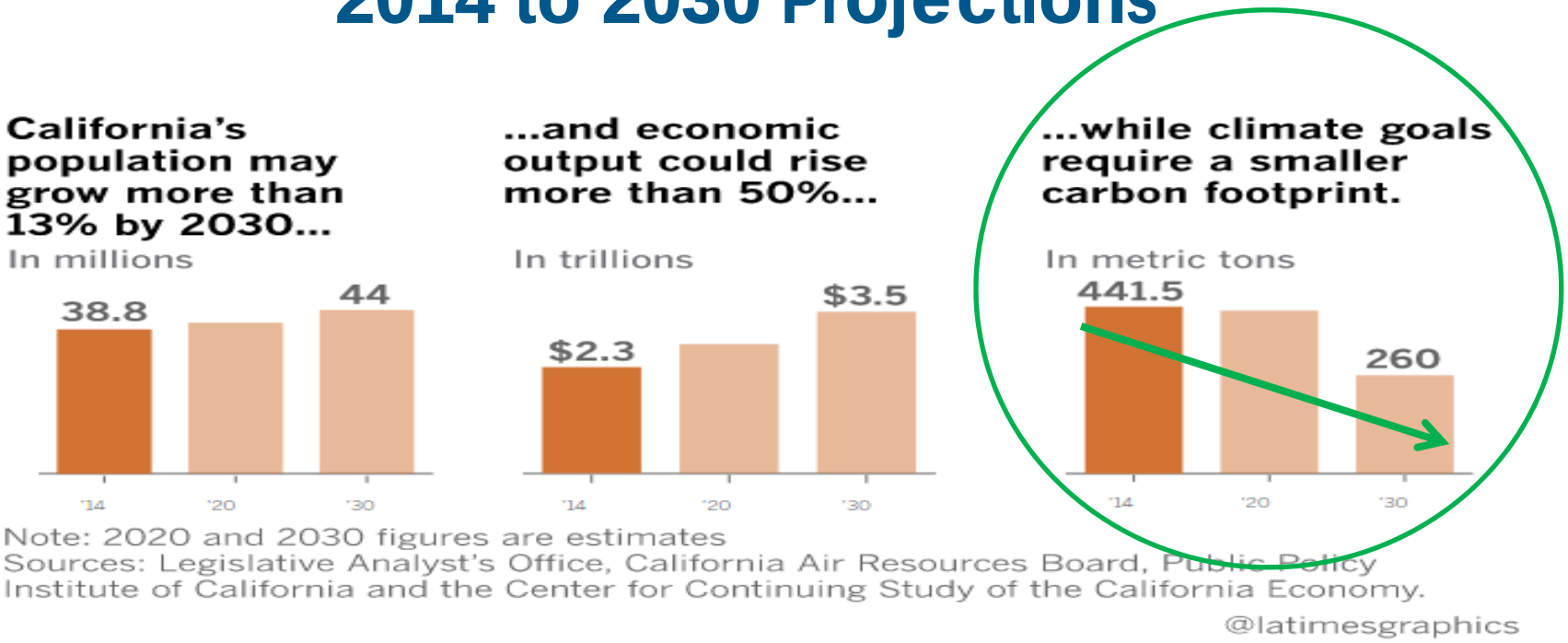
How Residential Homes May Change

Electrification of space and water heating, the two primary residential energy end uses + cooking (induction is one option)

Efficiency improvements in electric end uses, such as plug loads, clothes washers, dryers (heat pump), dishwashers, and lighting + Smart Controls

Improving residential building envelopes (e.g., windows, roofs, insulation) to reduce the demand for space heating and cooling + low GWP refrigerants

California Will Continue to Grow
2014 to 2030 Projections



Note: 2020 and 2030 figures are estimates
Sources: Legislative Analyst's Office, California Air Resources Board, Public Policy Institute of California and the Center for Continuing Study of the California Economy.

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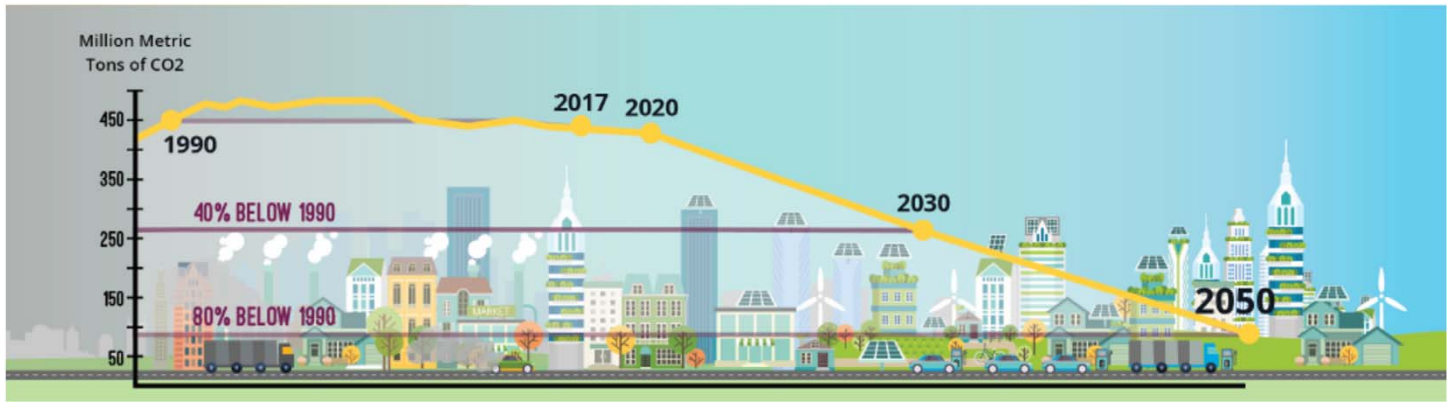
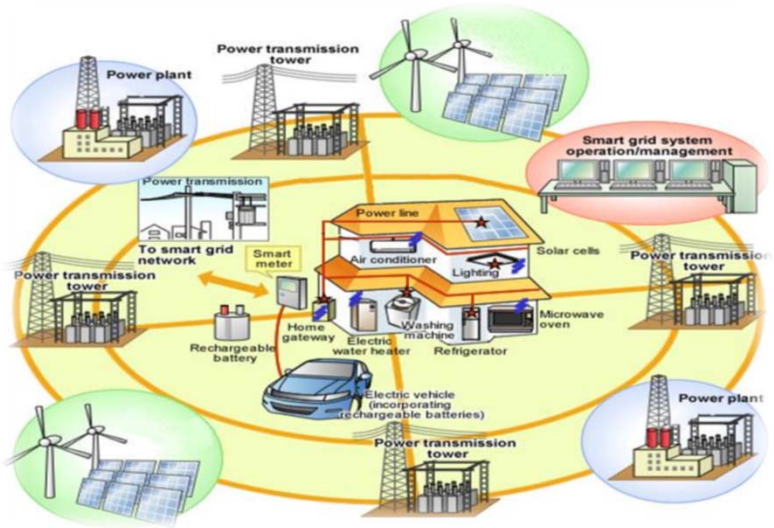
California's Energy Policy Goals

- California led the nation in 2006 with the passage of the Global Warming Solutions Act, or Assembly Bill (AB) 32, which established a comprehensive program to reduce greenhouse gas emissions.
- SB 350 (2015) requires a 50% energy efficiency increase for existing California buildings by 2030.
- Governor Brown's Executive Order B-30-15 established new GHG emission reduction goal to 40% below 1990 levels by 2030 and 80 percent reduction by 2050.
- **To reach these targets, <u>the pace of technology progress in the electricity sector will need to increase exponentially.</u>**



Policy Drives Innovation

- Increase RPS to 50% by 2030
- Reduce GHG to 40% below 1990 levels by 2030
- 1.3 GW of storage by 2020



- Double energy efficiency savings by 50%
- 1.5 million ZEVs by 2025
- Increase access to clean energy in disadvantaged communities