Potential Impacts of Climate Change on California's Energy System

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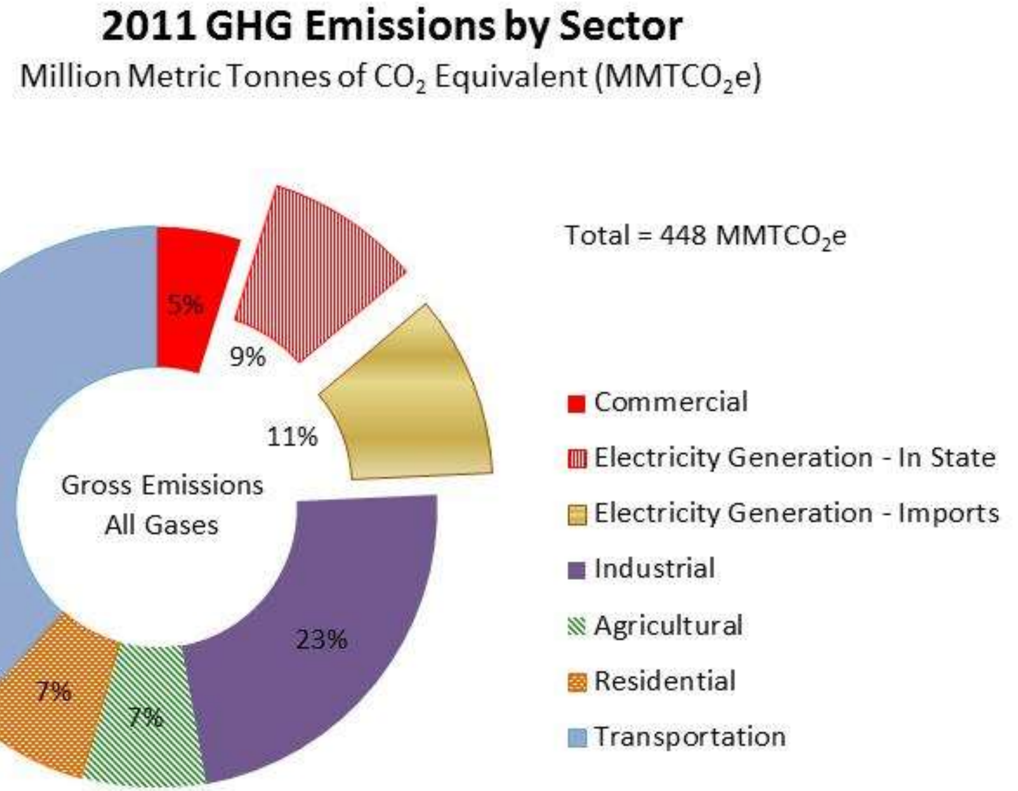
Outline

- Contribution of GHG emissions from the energy sector
- Vulnerability of the energy sector to climate impacts
- Energy scenarios for California
- Integrating mitigation and adaptation for the energy sector

Contribution of GHG Emissions from Energy Sector

Contribution by Sector



Source: Franco, Oliver, 2013
ARB data. 2013 IEPR

Vulnerability of the energy sector to climate impacts: some examples

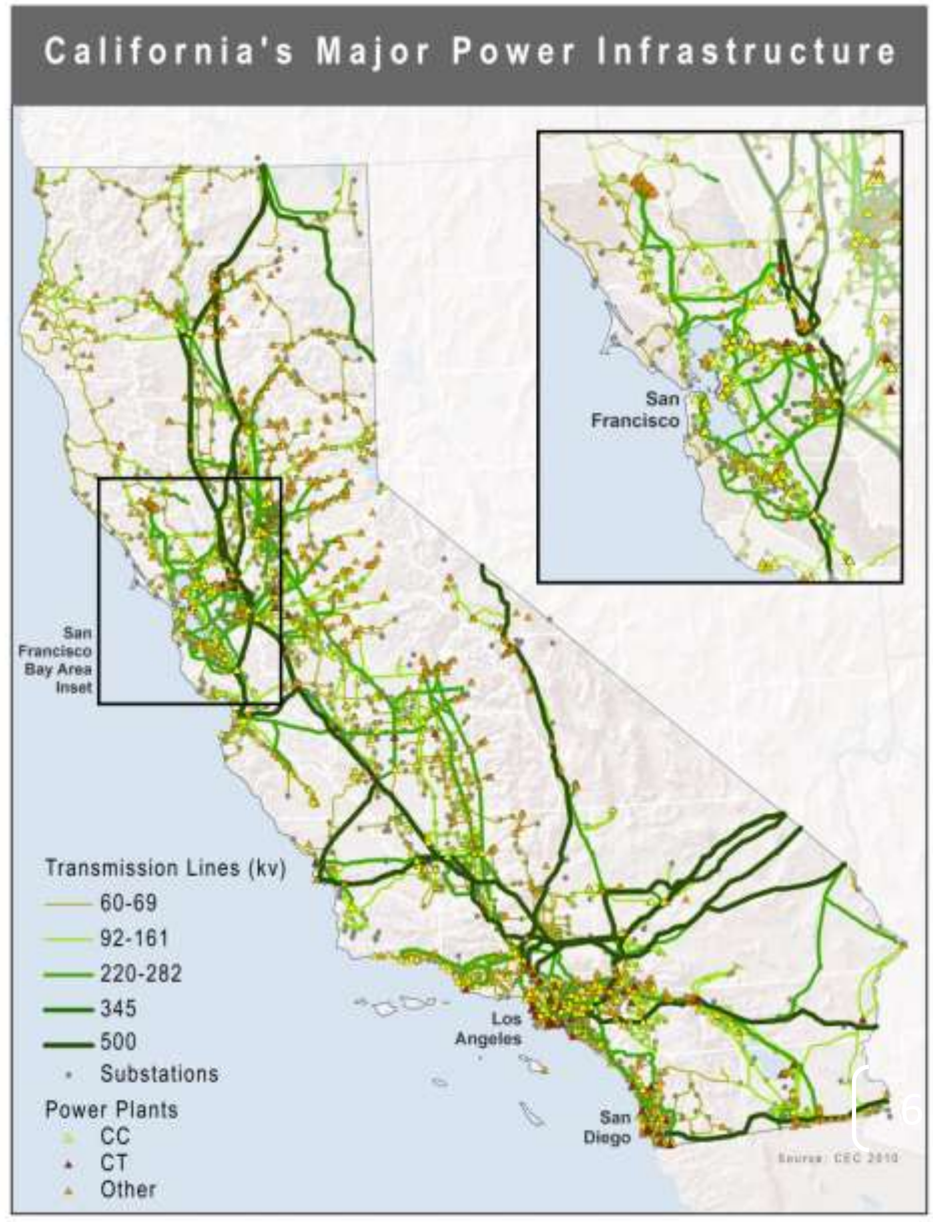
Electricity

LONG-TERM IMPACS
•**Need for More Generation on Hottest Days**
- •Decreased Gas Plant Generation Efficiency
  - • Need additional GW (8%)
- •Peak Period Demand (90%tile)
  - •21% higher cooling demand
  - •Need additional GW (27%)
- •Substation Loss
  - •2.7% higher losses
  - •Need more GW (3.6%)

•**Total Required Generation Capacity**:
  - •Need 39% more capacity GW

•**Need for More Transmission Capacity**
- •Transmission lines
  - • 7% - 8% loss of peak period capacity (static rating)
  - •Need up to 31% additional transmission capacity

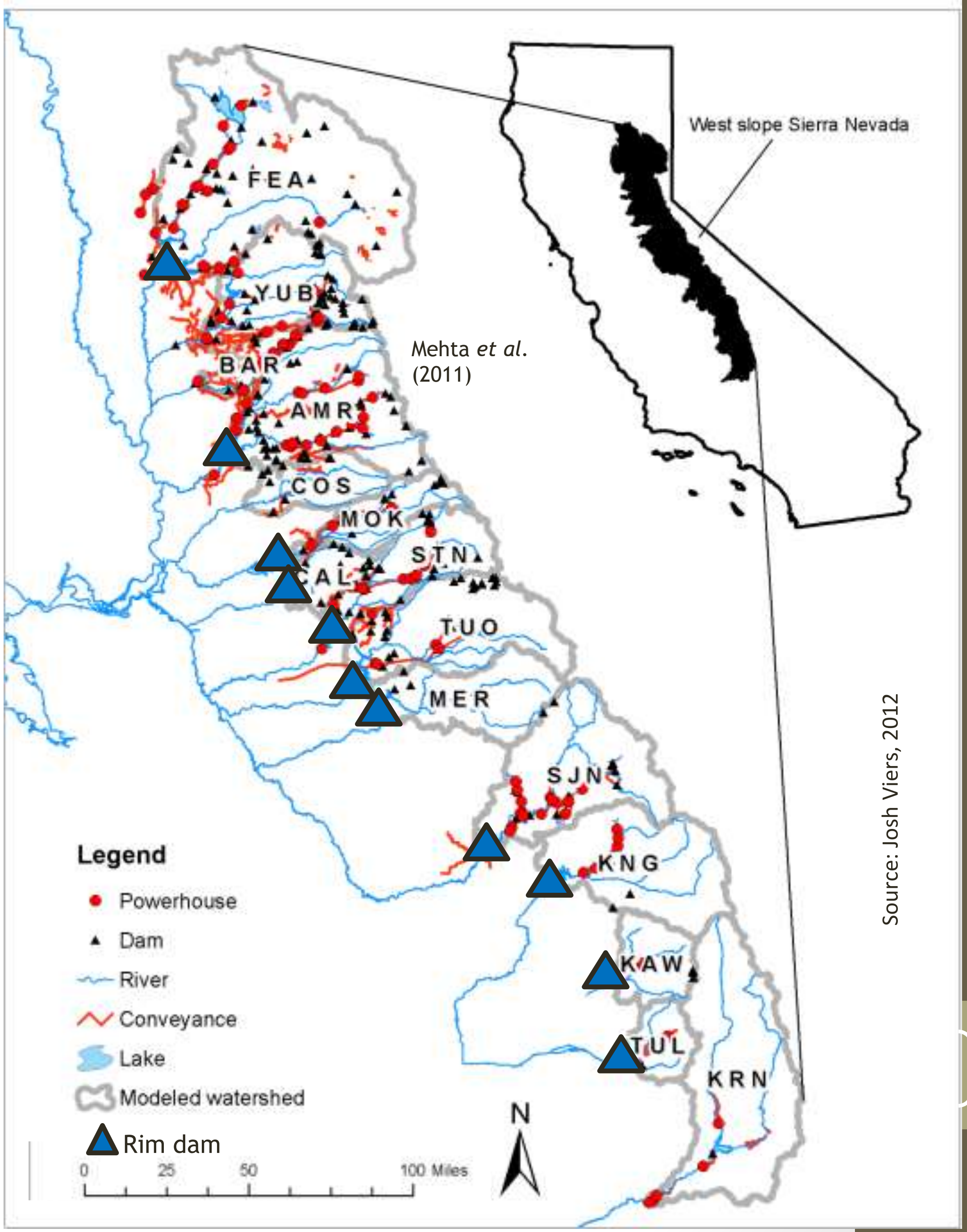
NEAR-TERM IMPACTS
• **Same as long-term but at a lesser degree. For example:**
- • Additional capacity of 1.6 GW in the next 10 years (IEPR)



Source: Sathaye et al., 2013

Hydropower

- **Multiple studies** (low and high elevation units)
- **Figure illustrates modeling work by UC Davis** (high elevation ~75% MWh)
  - 56 reservoirs
  - 85 run-of-river hydropower plants
  - 16 variable head hydropower plants
  - 125 diversion channels
  - 106 instream flow requirement points
  - Weekly time step
- **General results:**
  - Overall reductions in generation
  - Less generation available in the summer. Shift to generation in the winter



Source: Josh Viers, 2012

Energy Penalty

- Energy Demand for cooling is proportional to CDD
- Some of the gains from energy efficiency programs will be undermined by increased demand for cooling

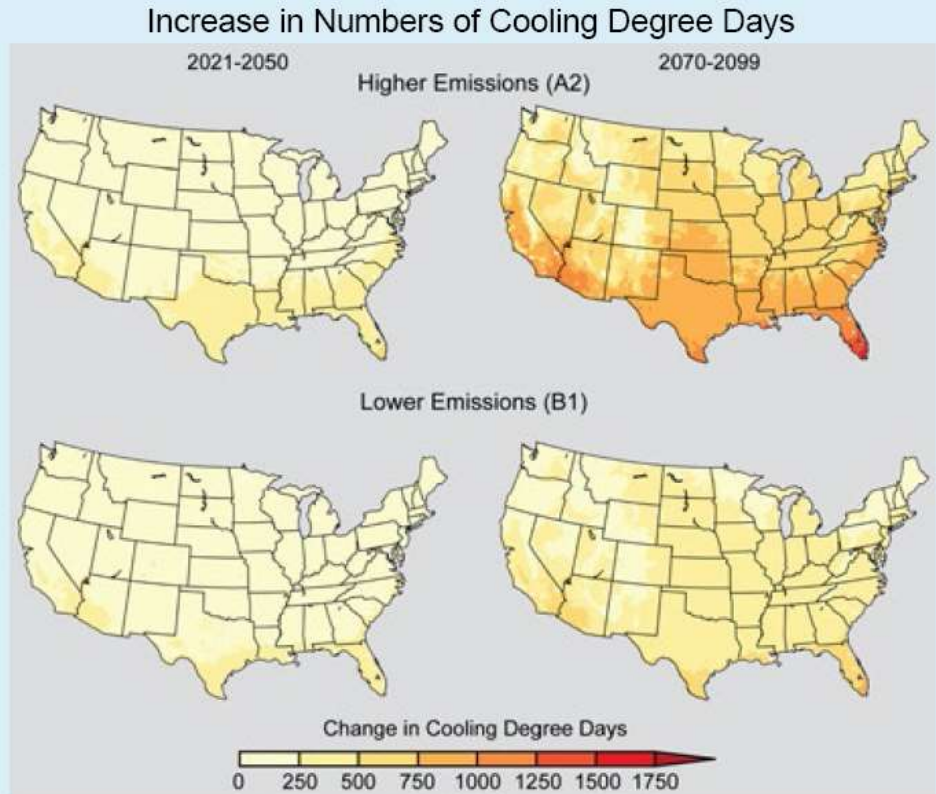


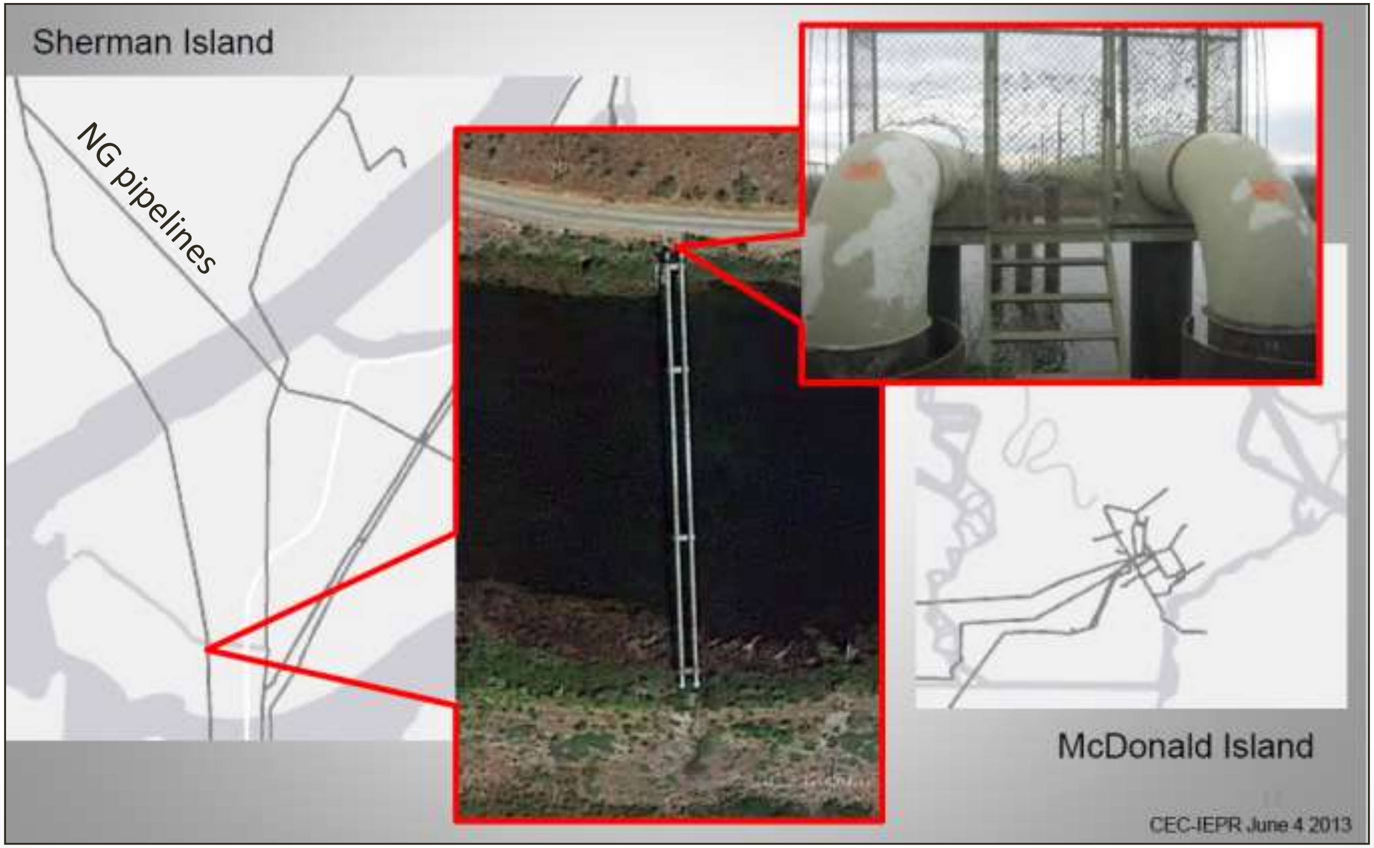
Figure 4.3. These maps show projected average changes in cooling degree days for two future time periods: 2021-2050 and 2070-2099 (as compared to the period 1971-2000). The top panel assumes climate change associated with continued increases in emissions of heat-trapping gases (A2), while the bottom panel assumes significant reductions (B1). The projections show significant regional variations, with the greatest increases in the southern United States by the end of this century under the higher emissions scenario. Furthermore, population projections suggest continued shifts toward areas that require air conditioning in the summer, thereby increasing the impact of temperature changes on increased energy demand.[18] (Figure source: NOAA NCDC / CICS-NC).

Source: National Climate Assessment. Energy Chapter. 2014

Energy Infrastructure in the Sac/SJ Delta

- **Catastrophic Failure of the levees in the Delta to impact energy infrastructure**
  - Natural gas pipelines
  - Underground storage facilities
  - Electrical transmission lines

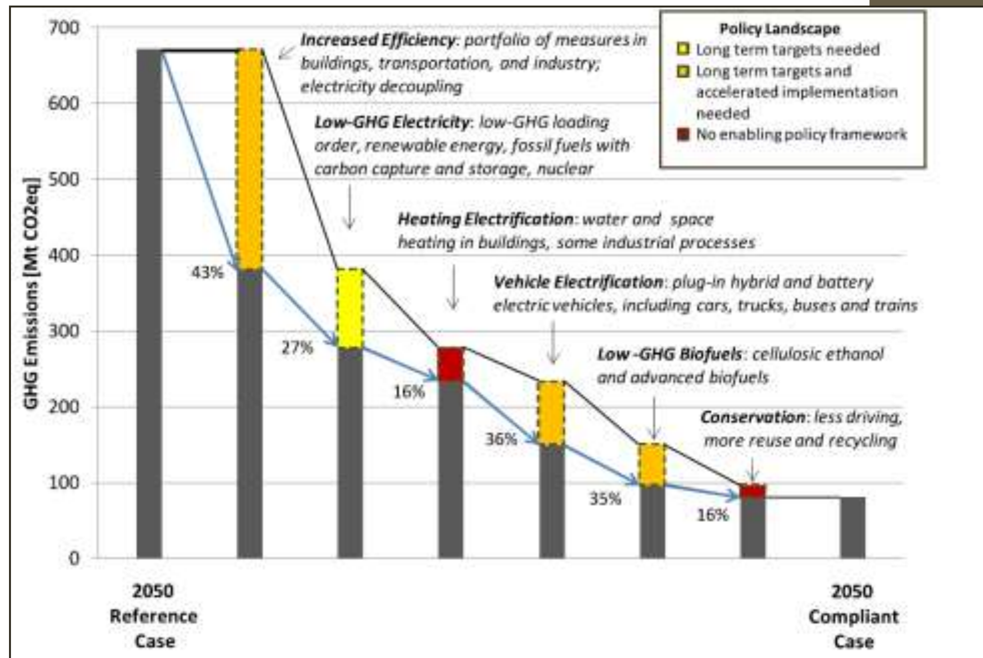
Source: Radke et al., 2013

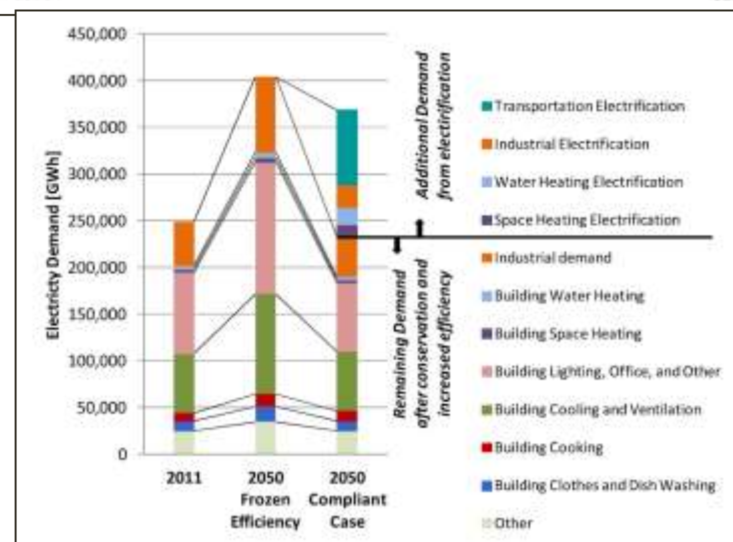


Future energy scenarios for California

A rapid transformation of our energy system is required

- Reducing GHG emissions by 80% in the next 36 years has huge implications for the energy system
- The electricity generating system has multiple options to reduce GHG emissions. It must be decarbonized
- Energy efficiency programs become even more important than before
- Most energy services would be electrified (e.g., EVs, space heating)
- Net effect is an increase of electricity demand even with strongly enhanced energy efficiency programs





Wei et al., 2013

Integration of Mitigation and Adaptation

The need for integration

- Main "problems" with past studies:
  - Past impact studies assume that the current energy system remains in place for the rest of this century
  - Energy pathways do not consider climate change such as demand increases with temperatures or changes in the availability of hydropower
- In practice, as required by the IEPR, the energy system should be designed in a way that results in drastic GHG reductions by 2050 while deploying an energy system that is less vulnerable to climate impacts
  - Microgrids that protect important services/areas
  - Smart grid
  - Distributed generation
  - Other features

Power Outage
September 2011

The Geisel Library at night, lit by locally-sourced microgrid energy | Photo: Nathan Rupert/Flickr/Creative Commons License

Climate Policy Mandates in the 2013 IEPR

- Sponsor research on regional climate projections, energy sector vulnerability, and strategies to reduce climate risks
- Fund research, development, and demonstration for technologies that reduce GHG emissions
- Support actions that provide both reductions in GHG emissions and preparation for climate risks
- Expand the support for Cal-Adapt and CaLEAP tools that assist local planning
- Assess the vulnerability of transportation fuels infrastructure (e.g., oil refineries) to climate change
- Continue to coordinate climate research by California agencies
- Support development of GHG reduction targets for 2030 and metrics to track progress

Source: 2013 IPER. Chapter 9

Thank you !

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Disclaimer: The views and opinions in this presentation do not necessarily represent the views and opinions of the Energy Commission or the State of California.