Climate Change and Advanced Energy Generation

Staff IEPR Workshop

August 10, 2009

Sacramento, CA

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Public Interest Energy Research (PIER) Program

California Energy Commission

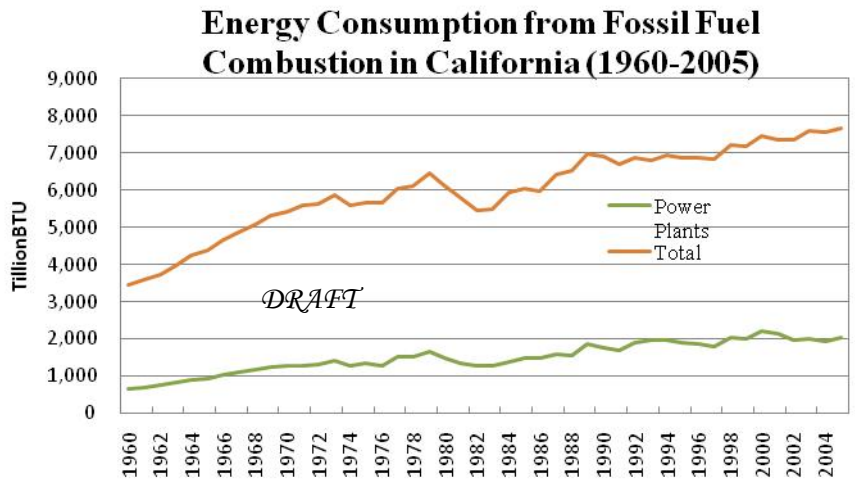
Outline

- Background Information
- Implications of Climate Change to Advanced Electricity Generation Systems
- Related PIER-Climate Change Projects
- Final Remarks

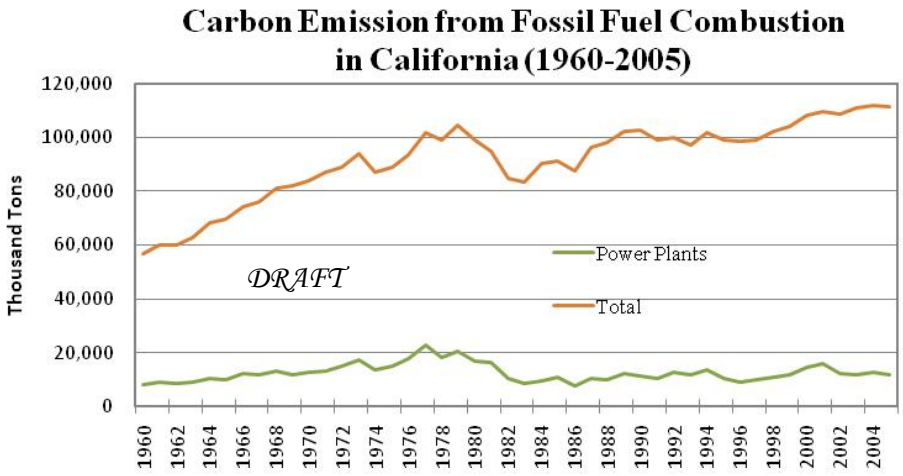
Background Information

Historical CO_2 Emissions

- Energy consumption from the combustion of fossil fuels has almost doubled in the last 40+ years
- CO_2 emissions from in-state generation had a peak in the late 1970s (residual oil combustion)
- What are the CO_2 emissions associated with electricity imports?

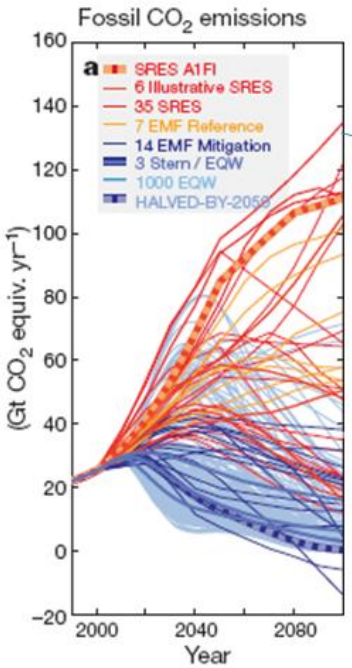


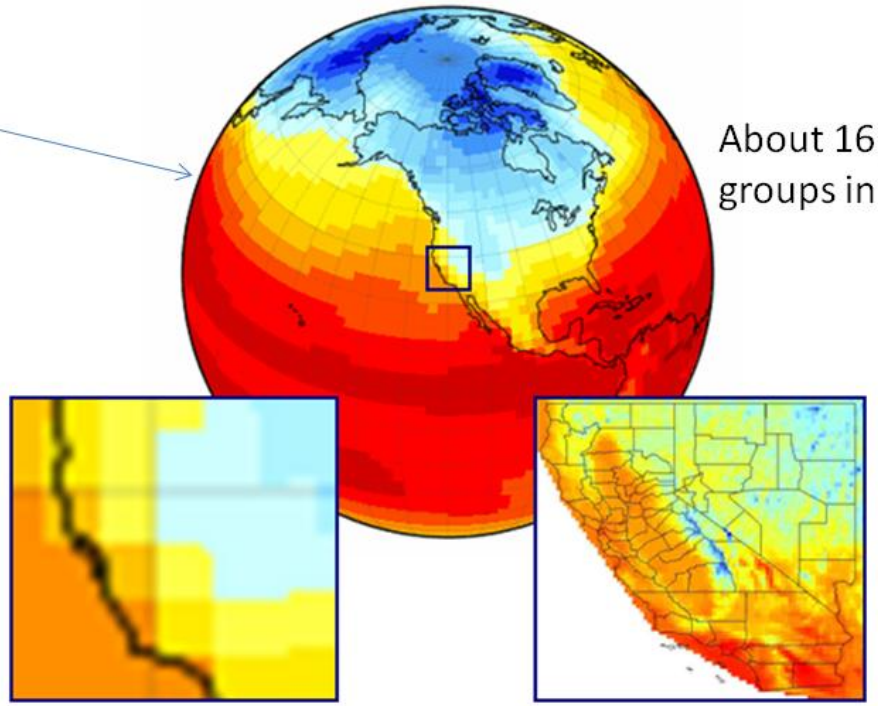
Data Source: EIA



Shen and Franco, 2009

Climate Projections for California





About 16 global modeling groups in the world

7 x 7 miles

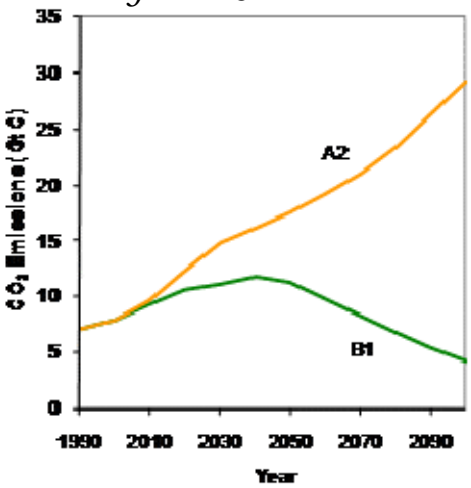
Statistical Downscaling

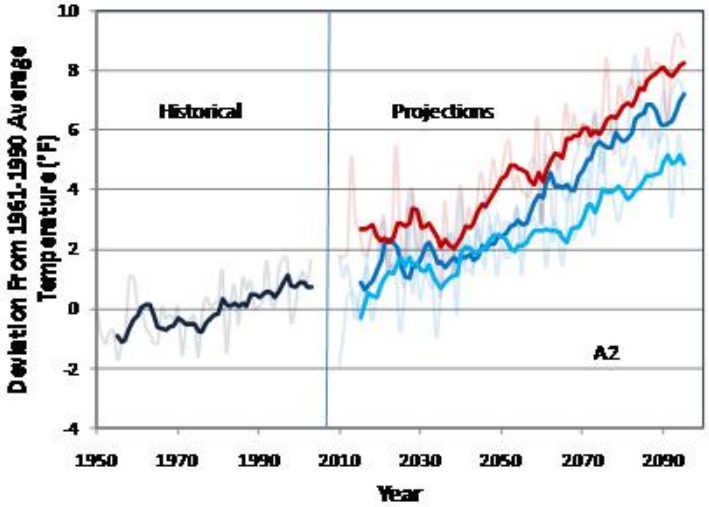
Source: Franco and Pittiglio, 2008.
Data provided by Scripps

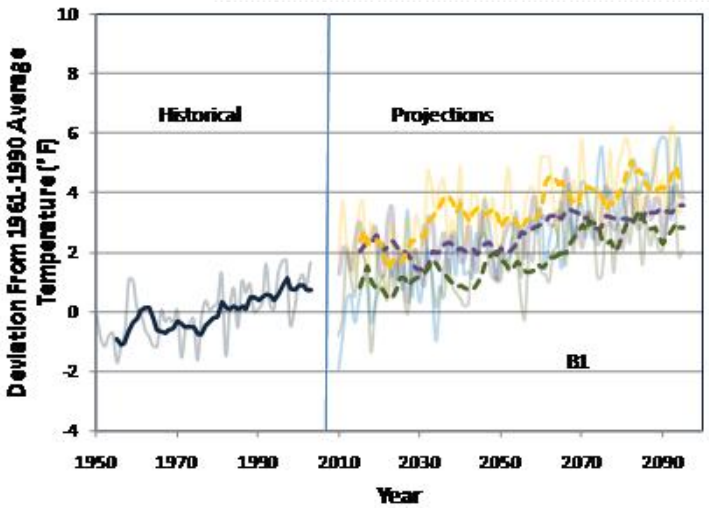
Historical and Projected Average Temperatures for California

- Average Temperatures will go up in California as a function of global GHG emissions

Global C Emissions







Source: Moser, Franco ,Pittiglio, Chou, 2008

Warming will not be uniform

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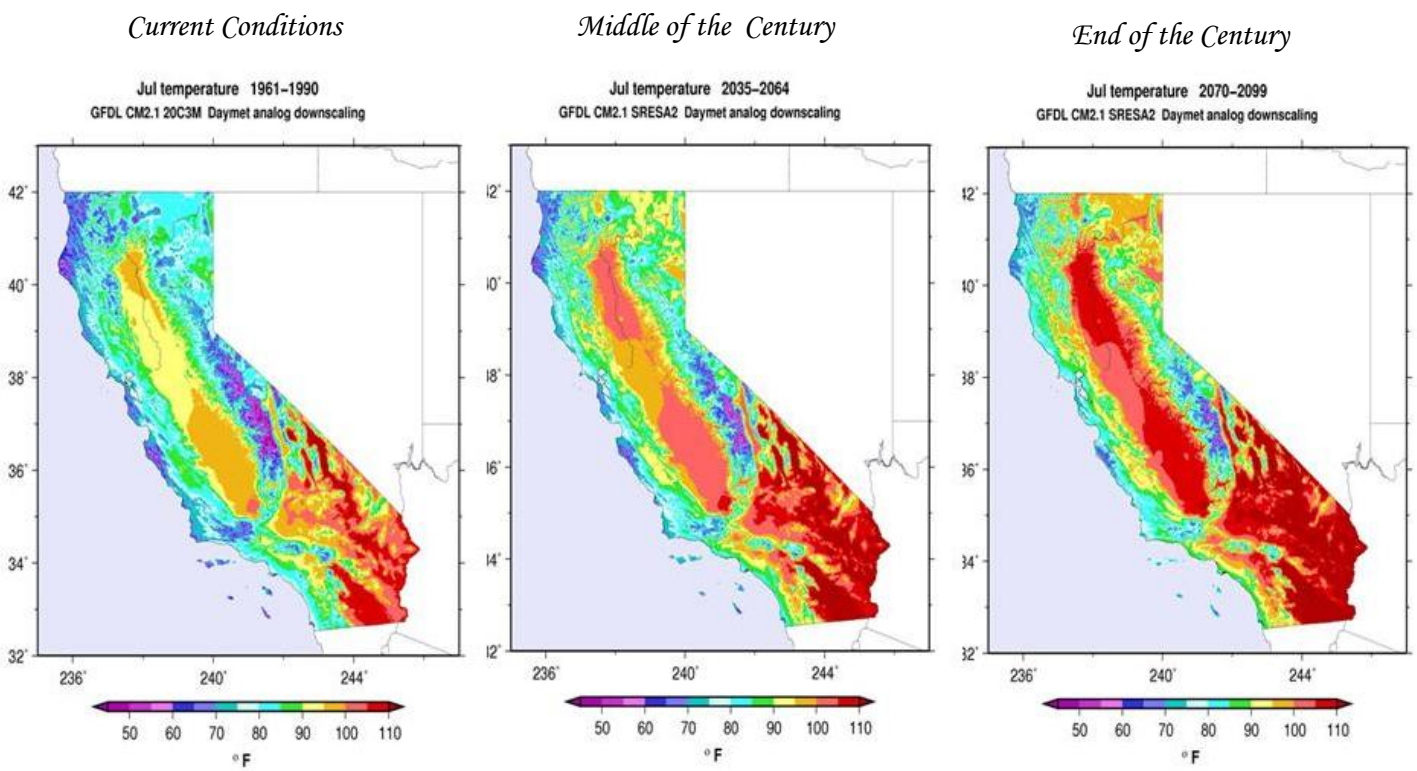
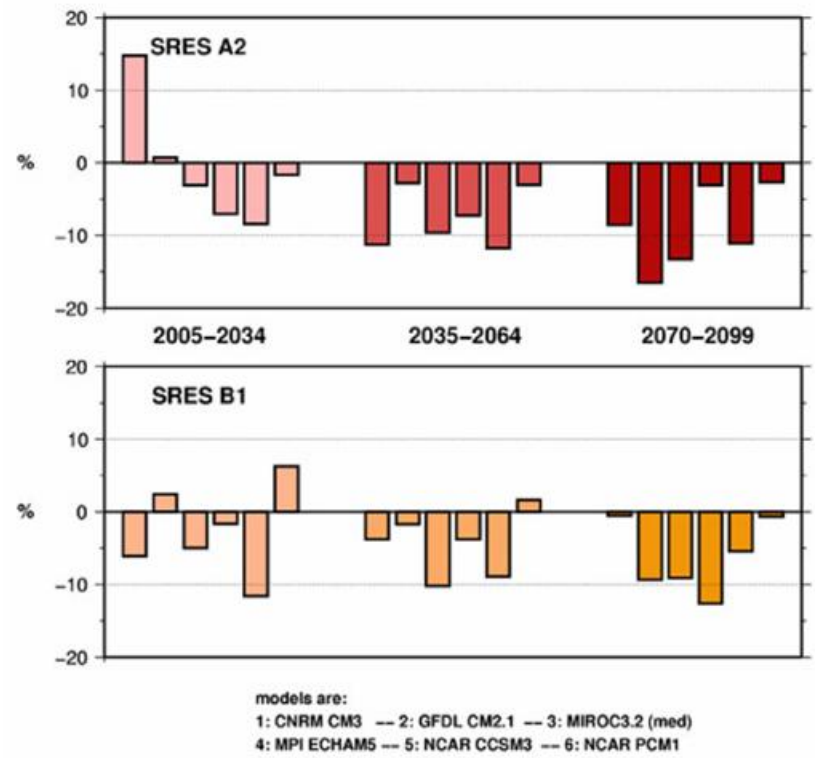


Source: Cayan et al., 2009. PIER Report

Drying Trend?

- Most of the global climate models suggest a drying trend for the Southwest and for California in particular

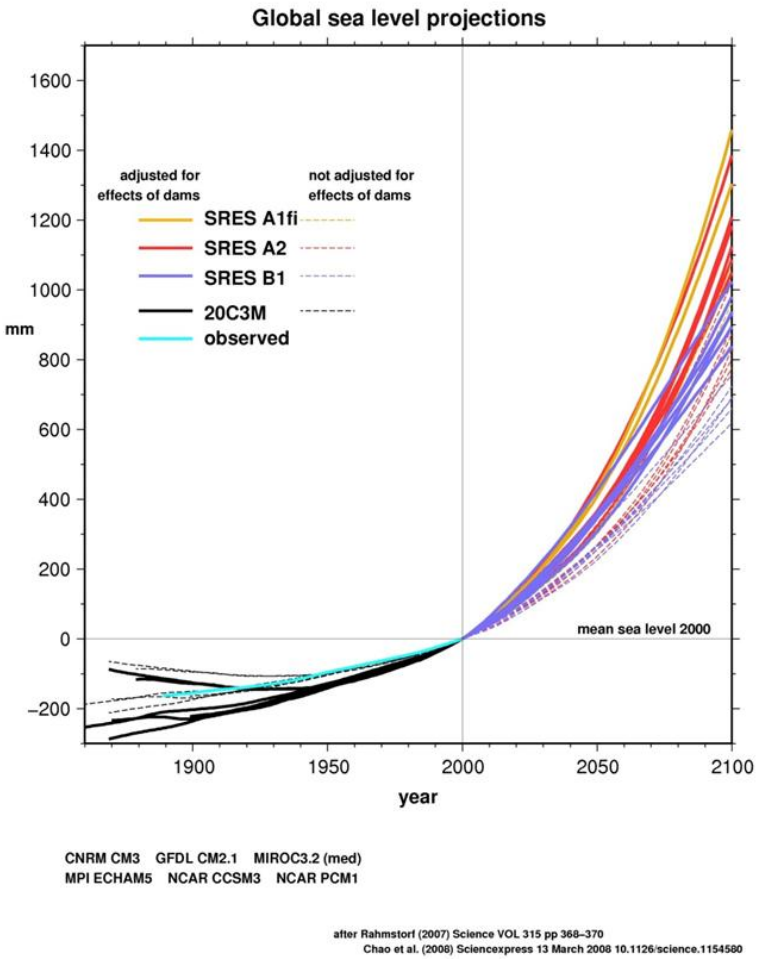
Percent Change in Precipitation Levels in Northern California in Relation to the 1961-1990 Water Year Average Precipitation



Source: Cayan et al., 2009

Sea Level Projections

- In the "worst" case scenario sea levels will go up by ~ 1.4 meters (55") by the end of this century
- Even if global emissions are reduced drastically sea levels will go up and will continue this trend for centuries



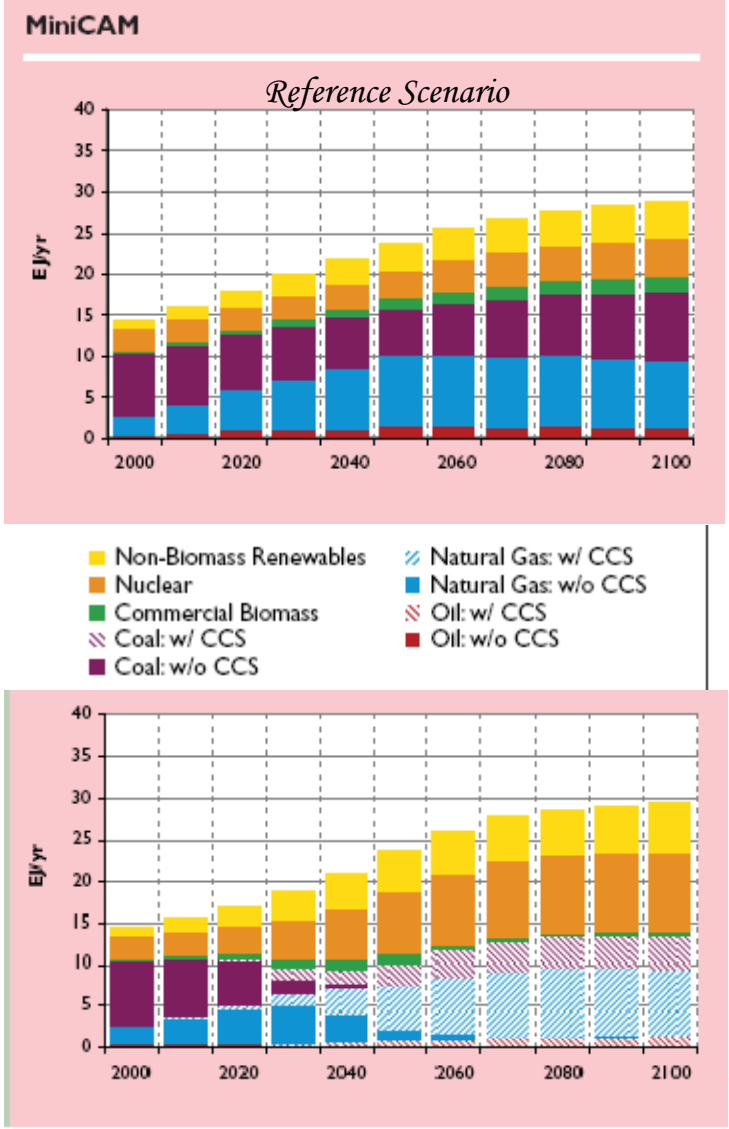
Source: Cayan et al., 2009

Implications of Climate Change to Advanced Energy (Electricity) Technologies

Results from Integrated Assessment Models

- Rapid electrification of the energy system under a carbon constrained world
- By 2050 an 80% reduction from "developed" countries requires the deployment of zero or close-to-zero GHG emitting technologies. Remember the CA 2050 target
- Be cautious with "silver bullets" (CCS?)

US Electricity – Reference case and one stabilization scenario



Source: US Climate Change Science Program. Synthesis and Assessment Product 2.1a. 2007

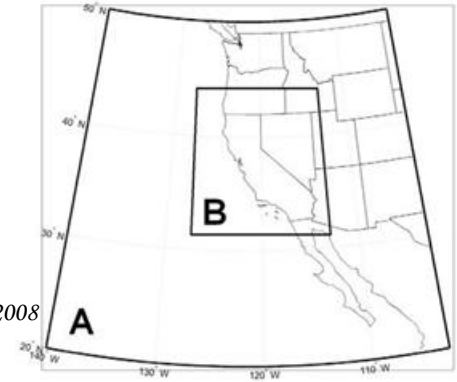
Related PIER-Climate Change Projects

Potential Energy Pathways for California through2050

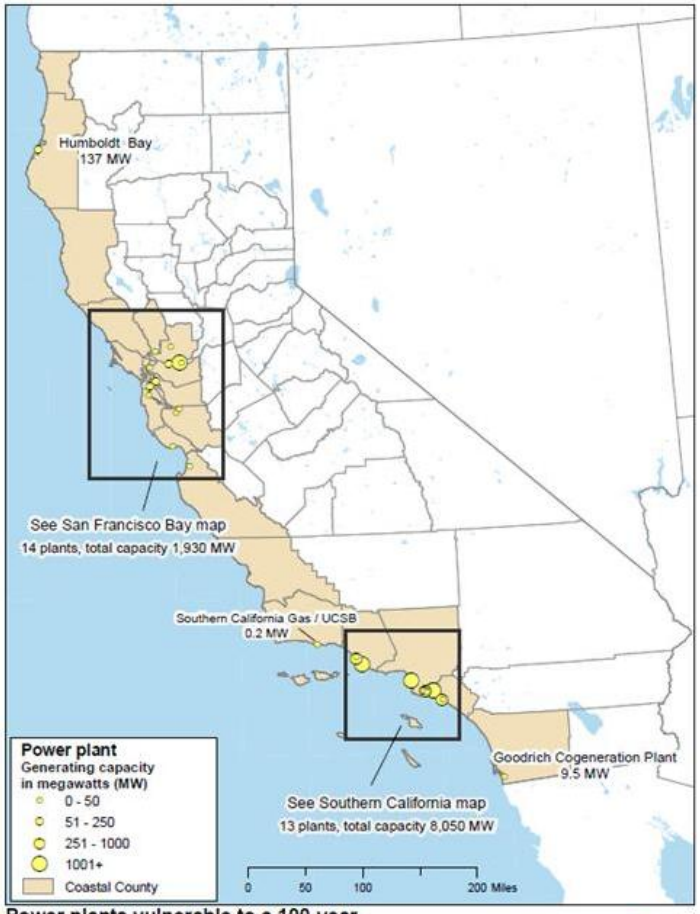
- LBNL, UC Berkeley, UC Davis are studying potential energy pathways for California integrating what we know about the potential for energy efficiency, renewables, etc.
- PNNL is developing a version of the MiniCAM model for California embedded into the US/Global model

Climate Change and the Energy Infrastructure and Renewable Sources of Energy

- Study of the potential effect of climate change on energy infrastructure in CA (LBNL)
- Study of the potential effect of climate change on renewable sources of energy



Source: Millet et al., 2008



Power plants vulnerable to a 100-year coastal flood with a 1.4 meter sea-level rise

Data sources: USGS/Scripps Institution of Oceanography,California Energy Commission, CaSIL, ESRI.
http://www.pacinst.org/reports/sea_level_rise

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Final Remarks

Advanced energy generation technologies are technologies with zero or near-zero net greenhouse gas emission profiles