SCIENCE-INFORMED ADAPTATION IN
CALIFORNIA’S ENERGY SYSTEM

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OUTLINE: THREE SIDES OF THE SAME COIN

Adaptation policies and adaptation planning are poised to become more prominent.

- California Policy Background

Adaptation success and needs are becoming more apparent, but demand more creative thinking.

- SLR, Groundwater, and HDD/CDD

Implementation is messy!

- Case study of forward-looking hydroelectric generation reservoir management
Executive Order B-30-15:

- Consider climate change impacts on infrastructure
- Update State’s climate adaptation policy every 3 years.
ADAPTATION POLICY IN CALIFORNIA

Sea Level Planning Database:

AB 2516

• Requires State creation of Sea-Level Rise Planning Database
• Entities required to provide planning information include:
  • Energy Commission
  • Utilities (publically owned and investor owned)

King tide in San Francisco, USA Today, 2014
ADAPTATION POLICY IN CALIFORNIA

- Multiple Adaptation Bills under consideration in the California Legislature

- Over 90% of General Plans in California have been or are being altered to take climate change into account (PPIC 2014).

- [California Climate Symposium, August 24th and 25th: www.californiascience.org]
MAJOR SUCCESS STORY OF ADAPTATION POLICY IN CALIFORNIA

CA Climate Assessments

AB 32

Better Adapted Energy Portfolio
(less thirsty)
LINKING SCIENCE AND POLICY

An Executive Order signed in 2005 mandates the generation of periodic “assessments”

2006 Assessment documented the severity of potential impacts

2006 Assessment helped support the passage of AB32

2009 Assessment concluded that adaptation is a necessary complementary approach to mitigation

2009 First California Adaptation Strategy

Third Assessment released in July 2012: regional and local studies, barriers to adaptation, etc.

Fourth Assessment currently under way.
ADAPTATION POLICY SUCCESS

Historical GHG Emissions

2020 Target
(1990 levels)
433.29

2030 Target
(40% below 1990 levels)
259.974

2050 Target
(80% below 1990 levels)
86.658

(S. Ziaja and M. Ching, 2015, Data From ARB GHG Inventory 2015)
ADAPTATION POLICY SUCCESS

Energy Sector Emissions

(S. Ziaja and M. Ching, 2015, Data From ARB GHG Inventory 2015)
Energy that's less thirsty.

Water Requirements by Plant Type

- Nuclear
- Coal
- Oil
- Gas
- Simple CT
- Comb. Cycle
- IGCC
- Solar thermal
- Solar PV
- Wind
- Biofuel

Water use, gal/MWh

- Hotel
- Fuel processing
- CT injection
- Inlet air cooling
- Ash handling
- Scrubbing
- Boiler make-up
- Cooling
NEEDS, CHANGES, AND GAPS

- Building off of prior adaptation successes:
  - SLR combined with large storm events
  - Groundwater pumping and energy
  - CDD and HDD
SEA-LEVEL RISE AND STORMS

• The Sacramento-San Joaquin Delta is protected by levees. Delta islands are below sea level.

• Energy Facilities:
  – Underground natural gas reservoirs
  – Transmission lines
  – Natural gas pipelines
  – Power plants on the west side of the Delta
SEA-LEVEL RISE & STORMS & SUBSIDENCE

• Nominally, “prepared” for an extreme storm (ca. 100-year event), provided that “prepared” is defined as no overtopping for a storm without SLR.

• But, if such a storm event were paired with a 1.4 m SLR—which is a possible, high-end 2100 estimate for California—then the storm would pose extensive risk to critical natural gas infrastructure as well as other energy-related and transportation infrastructure.

• And, these results have not accounted for subsidence which will exacerbate storm + SLR risks in the Delta.

Source: PPIC 2007
GROUNDWATER & ENERGY

- Approx. 65% of uses depended on groundwater during drought
- New and Deeper wells still being drilled
- What are the costs to energy supply and demand from increased groundwater dependence?

*Groundwater level change determined from water level measurements in wells. Map and chart based on available data from the DWR Water Data Library as of 04/28/2014. Document Name: 52014-52004_20140428 Updated: 04/28/2014 Data subject to change without notice.*
Estimated_Potential_Subsidence_20140

Legend

Summary_Ranking

- Insufficient Data
- Low
- Medium to Low
- Medium to High
- High

- Plugged/abandoned wells

Source: Stoms, Hou and Ziaja, 2015
COOLING AND HEATING DEGREE DAYS (CDD & HDD)

- CDD and HDD are very useful indicators for the energy system because energy demand is approximately proportional to CDD and HDD.
- However, data from NOAA lacks sufficient geographical resolution, or is at the station level, and uses 65° F as the baseline temperature.

Source: Franco and Pineda, 2014 using data from NOAA
60° F MAY BE A BETTER BASELINE TEMPERATURE FOR HDD FOR CA

The graph shows that 60 °F is a better baseline temperature for gas consumption by core customers.

Cal-Adapt will include CDD and HDD using grid resolutions of about 3.5 miles with different baseline temperatures including 60°F for HDD for the PG&E territory.

http://cal-adapt.org/
SUMMARY NEEDS

• How do multiple threats combine?
  • SLR, storm events, and subsidence

• What are the consequences of human responses to climate impacts across sectors?
  • Groundwater and energy

• Are the traditional baselines the correct ones at the local scale? Is the resolution appropriate for local needs?
  • CDD and HDD
IMPLEMENTATION HURDLES: WHEN SCIENCE INFORMATION AND BIG DATA ISN’T ENOUGH

INFORM = Integrated Forecast & Management Project

Source: K. Georgakakos et al., 2012

Compared to current practice, under future simulated climates INFORM gives a larger minimum water supply, more hydropower, and less salinity intrusion from the SF Bay.
INFORM

- Goal: improve reservoir management in Northern California using climate, hydrologic, and decision science

- Integrated forecast and reservoir management demonstrates significant capability for mitigating water resources impacts of climate and weather variability and uncertainty, particularly for extremes (droughts and floods)

Source: K. Georgakakos et al., 2012
• Administrative delays for State contracts; &
• Changing operating procedures may require an act of Congress.
• IWRSS caveat
2 MAJOR OPPORTUNITIES

• Potential for more required (rather than voluntary) adaptation planning in the energy sector.
• Sustainable Groundwater Management Act of 2014

1 TAKEAWAY

• Monitoring is the foundation of adaptation policy
  • Kundis-Craig’s 1st Principle of Climate Adaptation Law: “Monitor and Study Everything All of the Time”
  
THANK YOU!

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