PG&E: Building Climate Resilience

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June 26, 2017
Workshop on Extreme Weather-Related Flooding & Wildfires
and Mitigation Options for California's Transportation Fuel Sector

Together, Building
a Better California

About PG&E

PG&E is focused on providing safe, reliable, affordable and clean energy to nearly 16 million Californians.

23,000 employees	**5.3 million** electric customers	**69%** GHG-free energy
70,000 square mile service area	**4.4 million** gas distribution customers	**7,700** MW of owned electric generation capacity

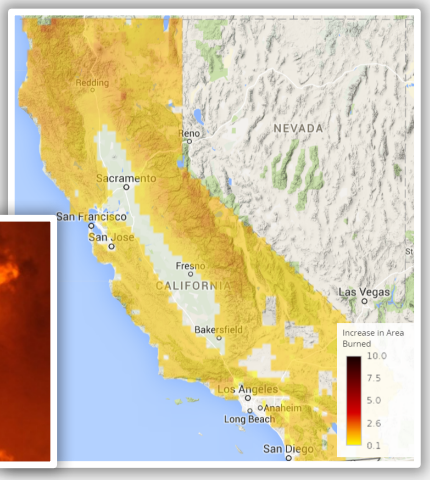
Forecasted threats from climate change

More hot summer days projected for Central Valley by 2050

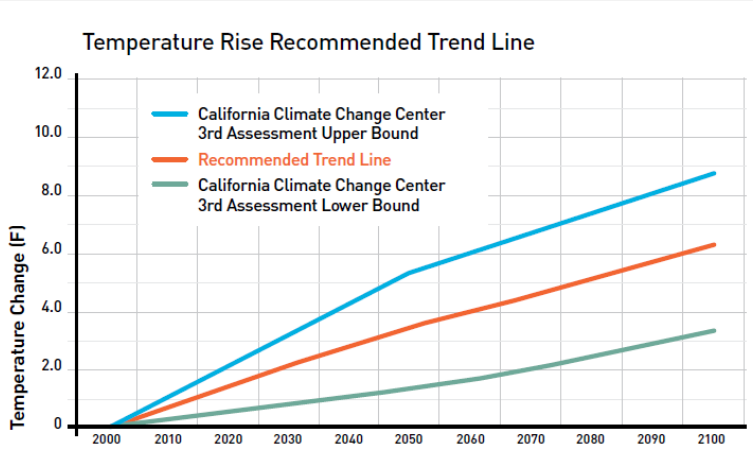
	HIgh Emission Scenario	Low Emission Scenario
Decade Ending	Modeled # Days ≥ 100°F	Modeled # Days ≥ 100°F
2020	12	13
2030	14	10
2040	18	19
2050	21	17
2060	24	18
2070	28	26
2080	37	20
2090	47	26
2100	57	27

Source: Cal-Adapt on-line database for Central Valley location with a 98% (4 days per year) maximum temperature of 100 degrees Fahrenheit relative to a 1961–1990 May–October baseline.

200% increase in non-urban areas burned by wildfire by 2050
vs. 1961-1990 average



Source: Scenarios to Evaluate Long-Term Wildfire Risk in California: New Methods for Considering Links Between Changing Demography, Land Use, and Climate. California Energy Commission. 2012.

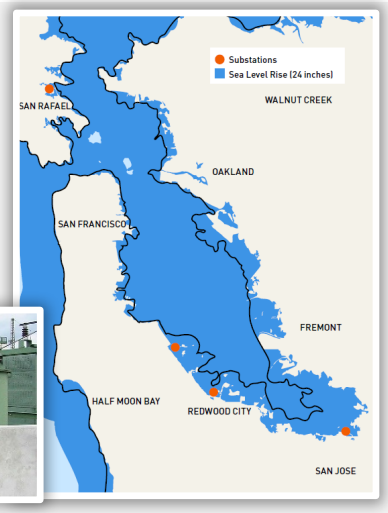


PG&E Science Team Guidance

Year	Temp Change (F)
2020	1.4
2030	2.2
2040	2.9
2050	3.6
2060	4.1
2070	4.7
2080	5.2
2090	5.8
2100	6.3

Source: Our Changing Climate 2012. CEC 500-2012-003.

5-24 inches of potential sea-level rise by 2050
24 inch increase shown with affected PG&E electric substations

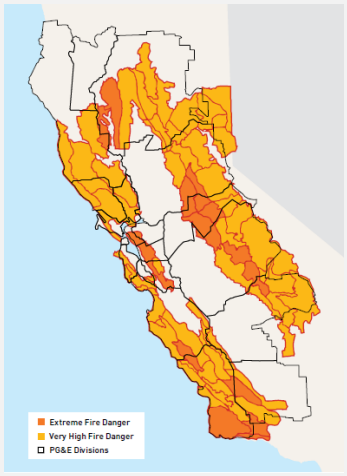


Source: Range values taken from California Coastal Commission Sea Level Rise Guidance, August, 2015.

As a California energy company, PG&E faces a variety of risks from a changing climate.

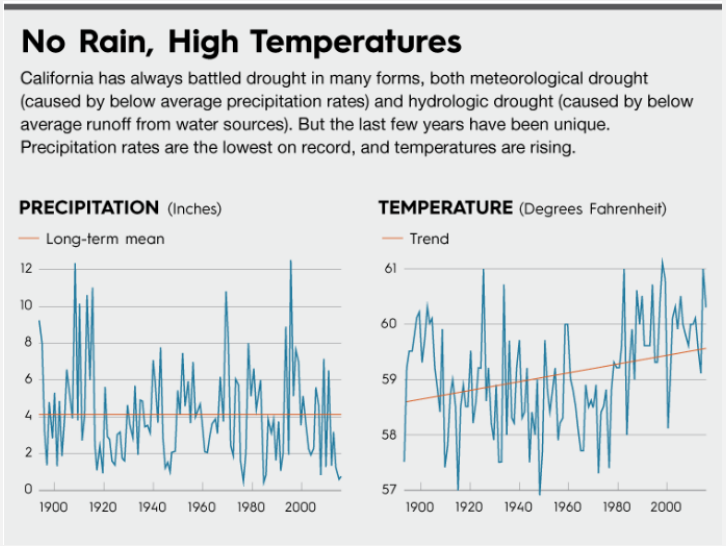
Impacts from drought and stronger storms

In 2015, California experienced one of the worst fire seasons in its history.

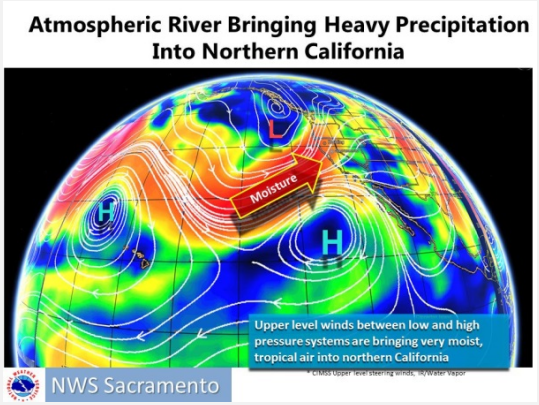


PG&E's daily map of fire index ratings

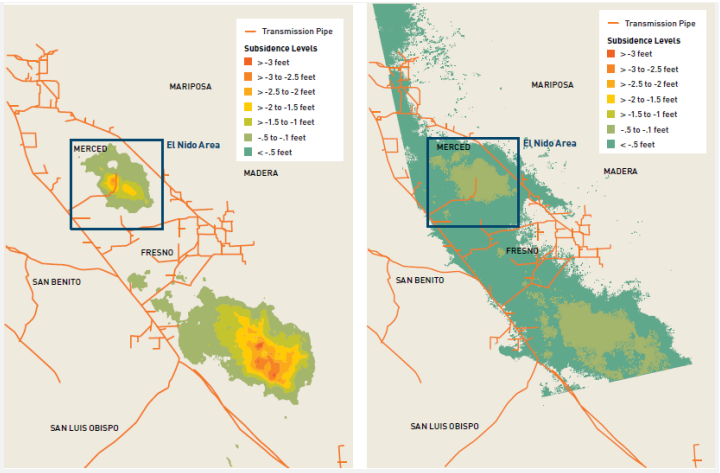
Reduced hydroelectric output from changing precipitation patterns and reduced snowpack



In 2017, California has received about 200% of normal precipitation.



Potential impacts to infrastructure from ground subsidence in Central Valley

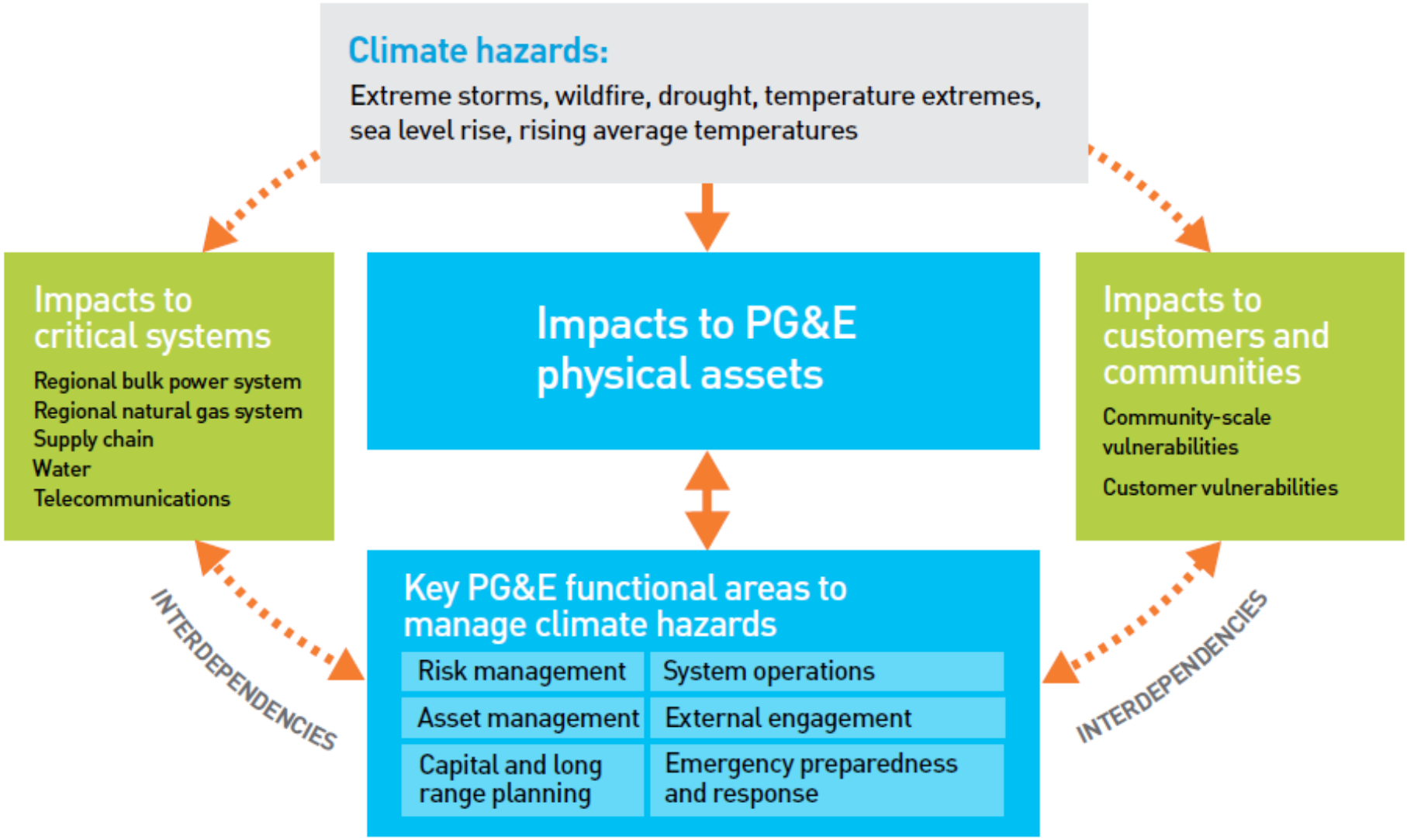


California faced severe drought conditions, followed by record-setting storms.

Building climate resilience

For PG&E, climate resilience means understanding the impacts of climate change on our business and being prepared to withstand and rapidly recover from major disruptions to service driven by changing climate conditions and weather events.

PG&E faces climate risks across value chain

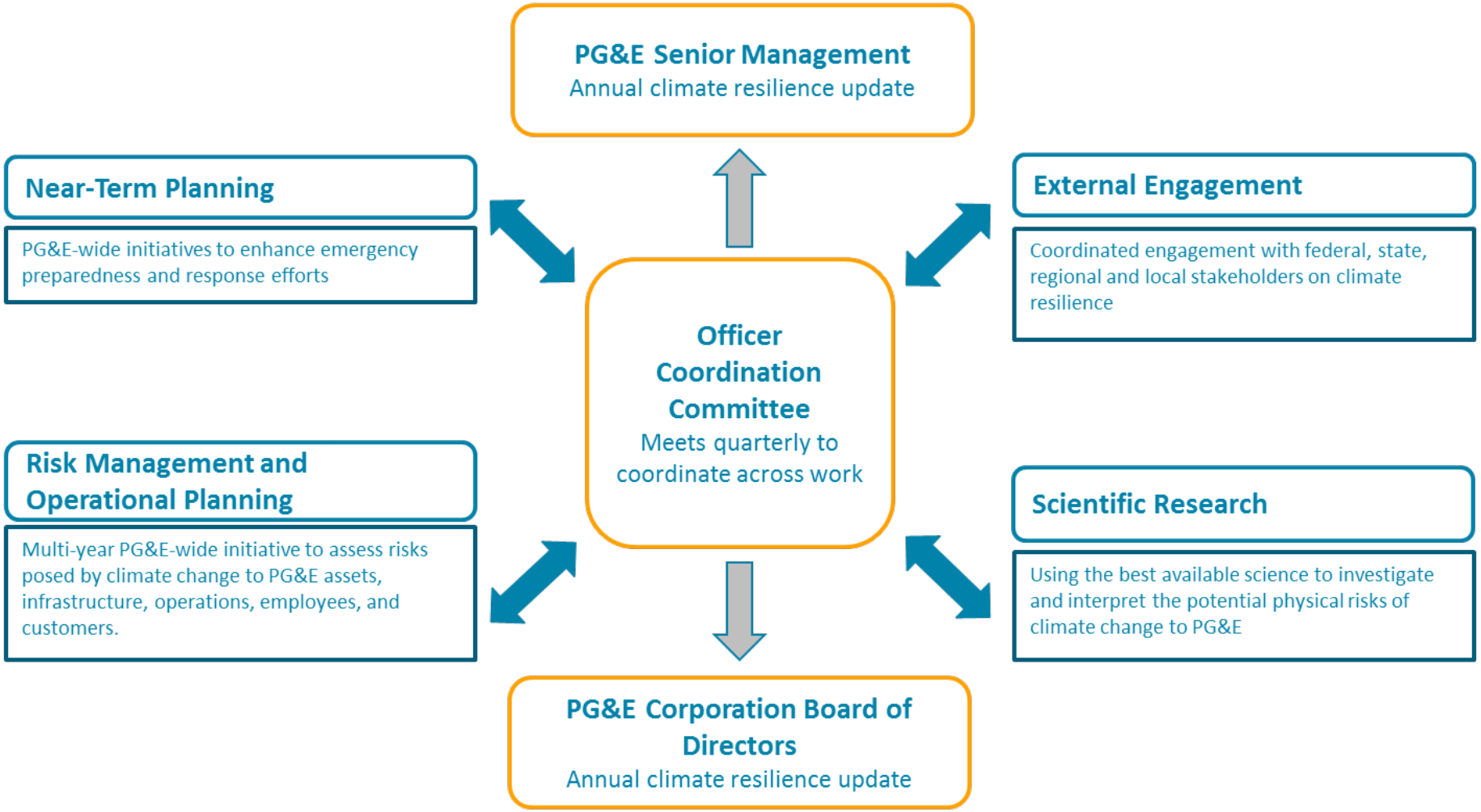


Beyond PG&E's assets, climate change impacts the critical systems and supply chains we depend on, as well as the customers and communities we serve.

Governance Structure to Enhance Coordination

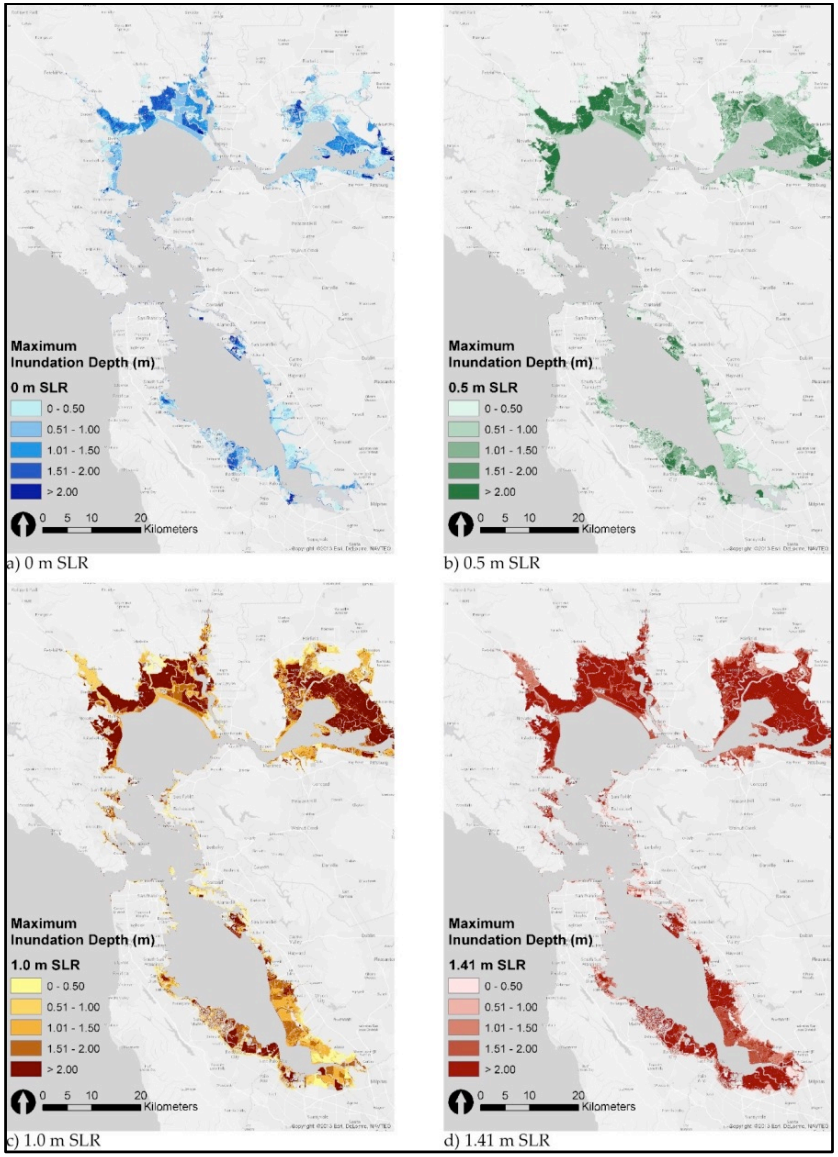
Climate Resilience Officer Coordination Committee:

- Meets quarterly to coordinate across four groups of climate resilience-related work
- Provides an annual update to senior management
- Supported by staff-level Climate Resilience Working Group
- Provides an annual update to the PG&E Corporation Board of Directors

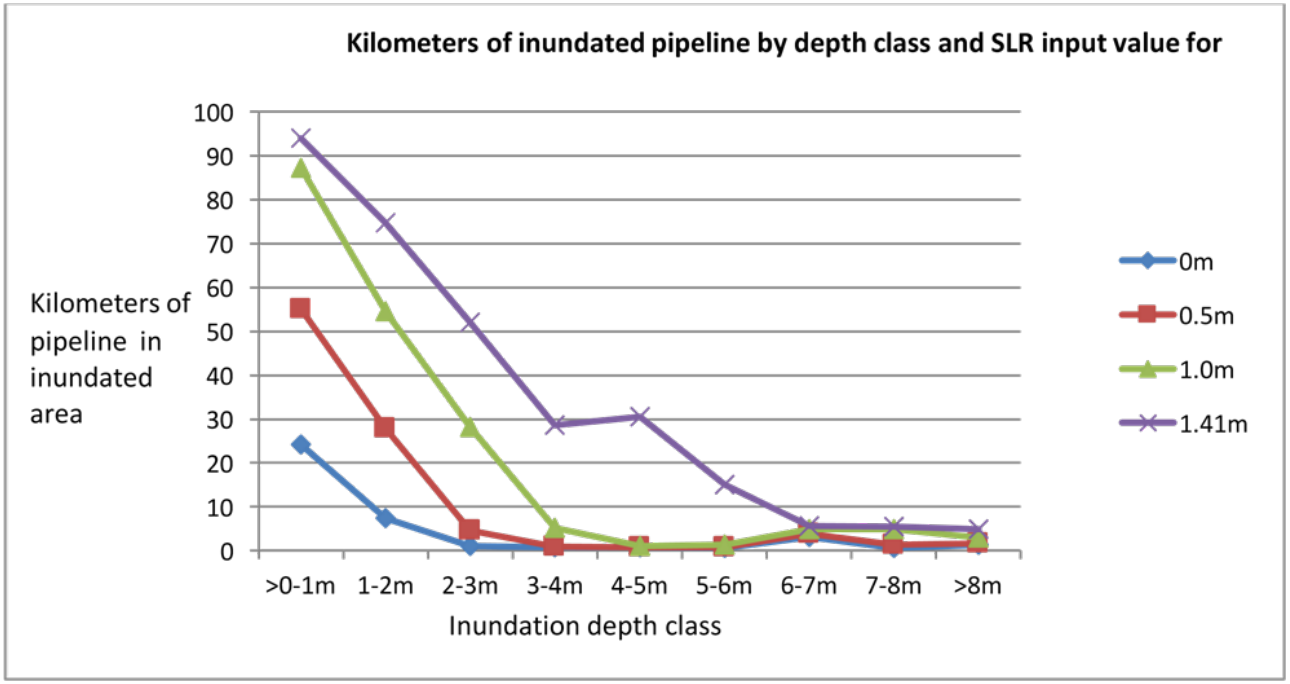


UC Berkeley Sea Level Rise Study: Background

- PG&E participated in a UC Berkeley-led sea level rise study funded through a grant from the California Energy Commission
- The final report was published in January 2017
- Scenario:
  - 1.41m (4.6 feet) sea level rise in San Francisco Bay and Delta region
  - Maximum storm surge experienced during 24-hour storm event (100 year storm event)
  - Scenario projected for the year 2100
- PG&E evaluated potential damage to its gas transmission asset base in the area and quantified a preliminary estimate of mitigation activities that would be required
  - Access issues
  - Buoyancy of pipelines



UC Berkeley Sea Level Rise Study: Results



Under the "worst cast" 1.41m scenario:

- **678 kilometers (421 miles) of transmission pipeline are within the inundation area**
- **Of this, 58 kilometers (36 miles), along with 97 stations and 477 valves, would be at levels of threat requiring specific interventions**
  - **58 kilometers is equivalent to 0.5% of PG&E's gas transmission system**
- **Today's cost of the mitigation efforts would be between $4 million and $7 million annually based on a preliminary estimate by PG&E**

UC Berkeley Sea Level Rise Study: Next Steps

- The risk associated with sea level rise is included in PG&E's weather-related and outside force threat for PG&E's transmission integrity management program (TIMP)
- Due to the extended timeframe of the analysis (year 2100), PG&E is ensuring that this longer-term threat is being monitored
- PG&E is also considering sea level rise as part of its overall climate resilience strategy

Significant Activity in Our State and Sector

National

- **U.S. Department of Energy**:
  2015: Launched Partnership for Energy Sector Climate Resilience
  2015: Published *Regional Vulnerabilities and Resilience Solutions*
  2016: Published *Guide for Climate Change Resilience Planning*

- **Electric Power Research Institute (EPRI):**
  2016: Launched research to assess resiliency metrics and frameworks

State

- **Governor**:
  2015: Signed Executive Order B-30-15, requiring energy sector adaptation plan
  2017: Convened ICARP Technical Advisory Committee, created by SB 246 (2015)

- **State Energy Adaptation Plan**:
  2016: State issued *Safeguarding California: Implementation Action Plans* with commitments for the state to:
  — Establish Interagency Energy Adaptation Working Group (CPUC, CEC, Office of Planning and Research, California Natural Resources Agency, Governor's Office of Emergency Services)
  — Work with DOE, IOUs, and publicly-owned utilities to establish resilience program for natural gas similar to DOE program for electric utilities
  — Collaborate on research needs, led by CPUC and CEC
  2017: *Safeguarding California* Workshops and Update

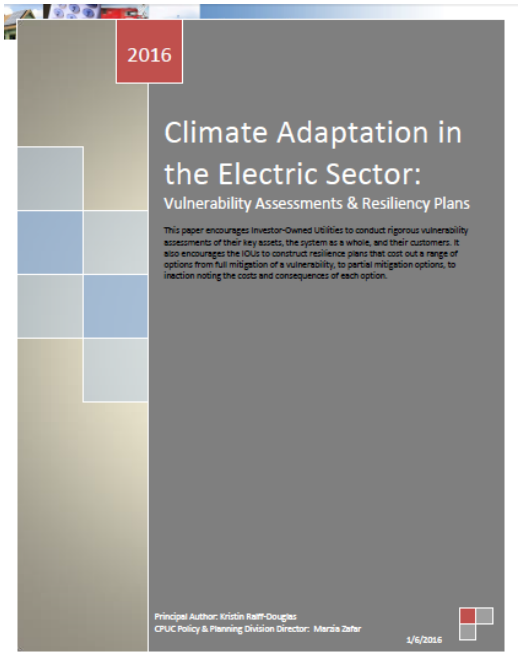
- **CPUC**:
  2016: Published comprehensive Guidance for IOUs – *Climate Adaptation in the Electric Sector: Vulnerability Assessments and Resiliency Plans*

- **CEC**:
  Since 2015: EPIC funding to study climate impacts on energy infrastructure; increasing engagement with utilities on climate resilience research needs

Local

- **Local Governments**:
  Since 2013: Vulnerability assessments, resilience planning and programs
  2015: SB 379 requires local hazard mitigation plans to address climate adaptation

- **Measure AA for a Clean and Healthy San Francisco Bay**
  2016: Provides $500M over 20 years, including for natural flood protection



"Rigorous vulnerability assessments and resilience plans are the first steps towards ensuring that California's [energy] sector can withstand the challenges that climate change will bring."

Resilient Communities grant program

In 2017, PG&E is supporting projects that will help communities **prevent and prepare for increasing wildfire risk**.

$1 million over five years in grants to support local initiatives to build greater climate resilience

Grant proposal evaluation criteria:

- Replicability
- Partnerships
- Focus on disadvantaged communities
- Impact

Will feature a different climate risk each year

All applicants must have local government partner within PG&E's service area

Advisory panel of community and sustainability leaders