

# Climate Change Impacts and Readiness Planning

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Powering forward. Together.



# Outline

- SMUD Overview
- Energy Resources
- Board Directives
- Background/Impacts of Climate Change
- Current Climate Readiness Strategy
- Summary Findings
- Plans

# SMUD Overview

- Publicly owned utility formed in 1946
- Governed by independent locally elected governing Board of 7 members
- Serves electricity to 1.3 million people in Sacramento region
- 2,100 Employees
- Peak Demand of 3,300 MW
- Annual Sales ~11,000,000 MWh





# SMUD Energy Resources



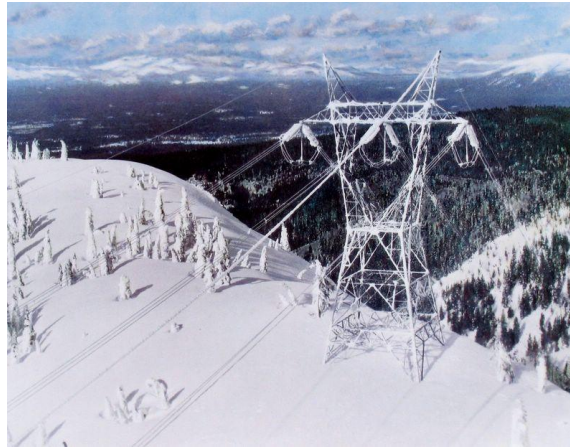
Distributed Solar – 50MW  
rooftop, 100 MW groundmount



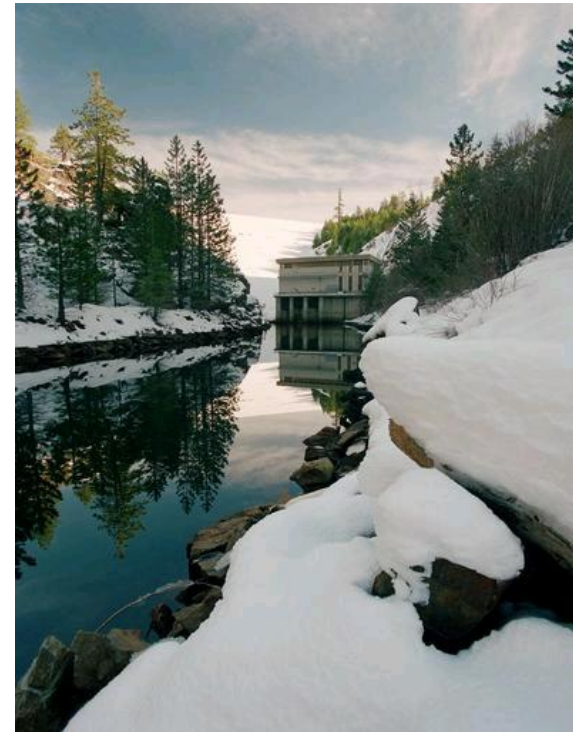
Biomass -203 MW



4 Solano Wind – 230 MW



COTP Transmission to NW  
– 1600 MW



Upper American River  
Hydro Project – 688 MW



Natural Gas Combined Cycle – 850 MW at  
4 locations, NG Peakers 150 MW at 3 loc's

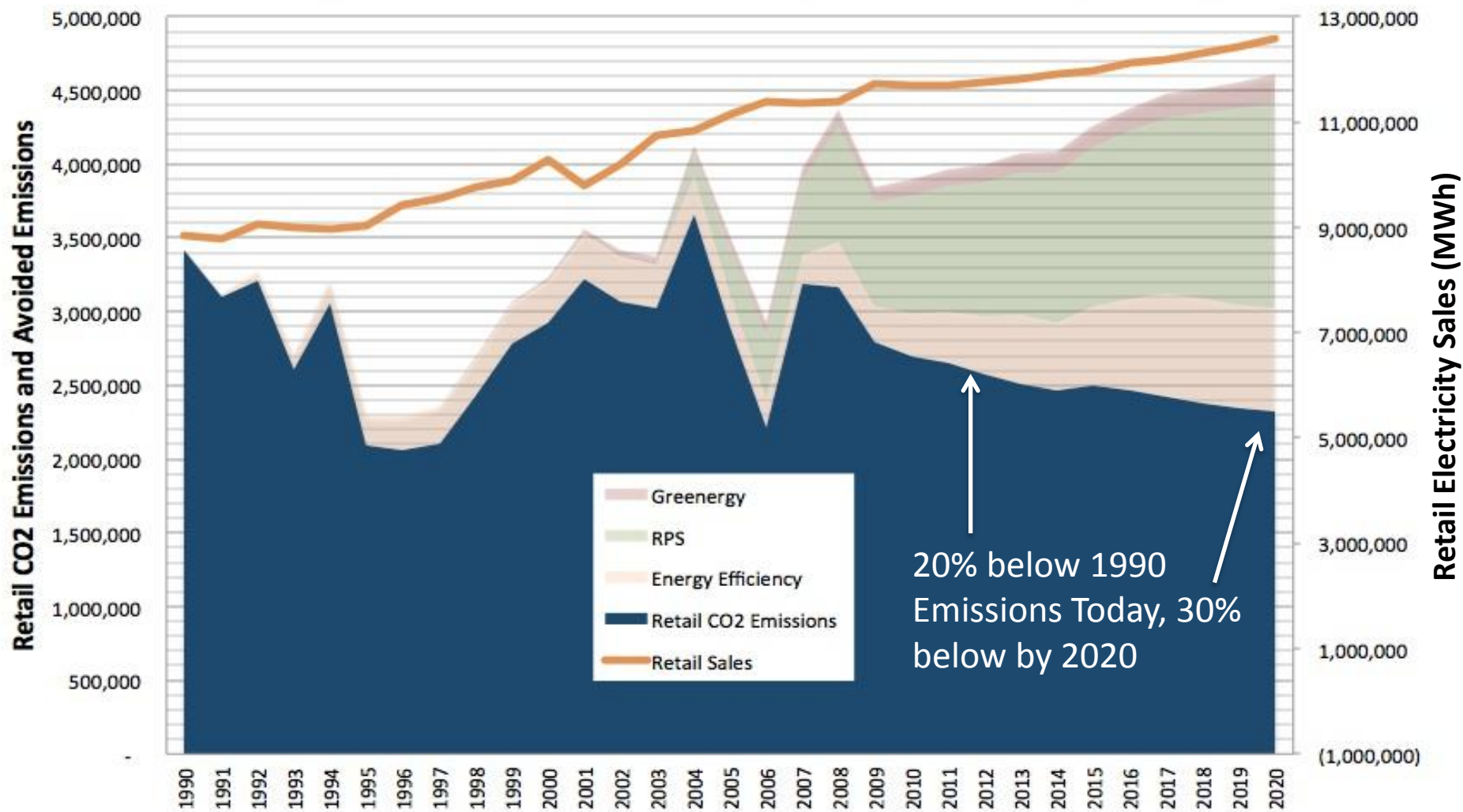
# SMUD's Board Strategic Direction on Resource Planning and Carbon Reduction

It is a core value of SMUD to provide its customer-owners with a sustainable power supply through the use of an integrated resource planning process. A sustainable power supply is defined as one that reduces SMUD's net long-term greenhouse gas (GHG) emissions to serve retail customer load to 350,000 tonnes (10% of its 1990 carbon dioxide emission levels) by 2050, while assuring reliability of the system, minimizing environmental impacts on land, habitat, water quality, and air quality, and maintaining a competitive position relative to other California electricity providers. In reducing its net GHG emissions, SMUD will utilize energy efficiency, renewable and net carbon free resources, including large hydroelectric resources and biogas. SMUD may also use offsets to support these goals to the extent their use is cost effective and beneficial to SMUD customers and the region.

To guide SMUD in its resource evaluation and investment, the Board sets the following interim goals:

<b>Year</b>	<b>Net Greenhouse Gas Emissions (metric tonnes)</b>
2012	2,608,000
2020	2,318,000
2050	350,000

## SMUD Retail CO2 Emissions, Avoided Emissions and Retail Sales



# SMUD's Current Climate Change Mitigation & Preparation Efforts

- Sustainable Power Supply Objective
- Renewable Energy Goals
- Energy Efficiency Programs
- Electric Transportation Programs
- Leadership in Smart Grid
- GHG Policy Initiatives
- Disaster Recovery & Emergency Response Coordination



# Concerns about Climate Impacts

- Initially examined climate impacts to SMUD and Sacramento in 2008/9 with SAIC
- Work focused on summarizing effects of temperature on peak demand, hydro impacts, flood risk, thermal limiting on powerplants
- Informed aggressive 2008 Board goals to address climate change
  - 90% reduction in 1990 emissions by 2050





# Current Approach

- Phase 1
  - Review 2009 summary of physical impacts
  - Investigate and summarize new findings
  - Review best science available for areas not addressed in 2009 (wind, wildfire)
  - Develop recommended next steps for consideration
- Subsequent Phases
  - Identify SMUD operations or processes that warrant closer discovery and data analysis
  - Pursue opportunities for collaborative research in targeted areas

# Why Prepare? Objectives of SMUD's Climate Readiness Strategy

- To assist SMUD's workforce and our community of customer owners to prepare for changes in climate and weather in our region, some of which are already happening.
- To enable SMUD to manage many of these changes and prepare for those beyond our control, helping to prevent unnecessary risks.

# Why “Readiness”?

- Adaptation not well understood among general public
- “Readiness” better conveys the desired end state

# Physical Impacts to California and Sacramento

	Statewide Projected Impacts by End of Century	Statewide Temperature Rise (degF)
Higher Emissions A1Fi (970 ppm)	<ul style="list-style-type: none"> <li>90% loss in Sierra snow pack</li> <li>3-4 times as many heat wave days in major urban centers</li> <li>4-6 times as many heat-related deaths projected for some urban centers</li> <li>2.5 times the number critically dry years</li> <li>20% increase in electricity demand</li> </ul>	4.4 – 5.8 °C (8-10.4 °F)
Medium-High Emissions A2 (830 ppm)	<ul style="list-style-type: none"> <li>70- 80% loss in Sierra snow pack</li> <li>2.5-4 times as many heat wave days in major urban centers</li> <li>2-6 times as many heat-related deaths projected for some urban centers</li> <li>2-2.5 times the number critically dry years</li> <li>11% increase in electricity demand</li> </ul>	3.1 -4.4 °C (5.5-7.9 °F)
Low Emissions B1 (550 ppm)	<ul style="list-style-type: none"> <li>30-60% loss in Sierra snow pack</li> <li>2-2.5 times as many heat wave days in major urban centers</li> <li>2-3 times as many heat-related deaths projected for some urban centers</li> <li>Up to 1-1.5 times the number critically dry years</li> <li>3- 6% increase in electricity demand</li> </ul>	1.7 -3.0 °C (3.0-5.4 °F)

Source: Excerpted from CEC White Paper CEC-500-2005-186-SF, Figure 17, 2006.

- Increased Temperatures
- Reduction in Sierra Snowpack
- Increased Risk of Flooding
- Reduced Air Quality



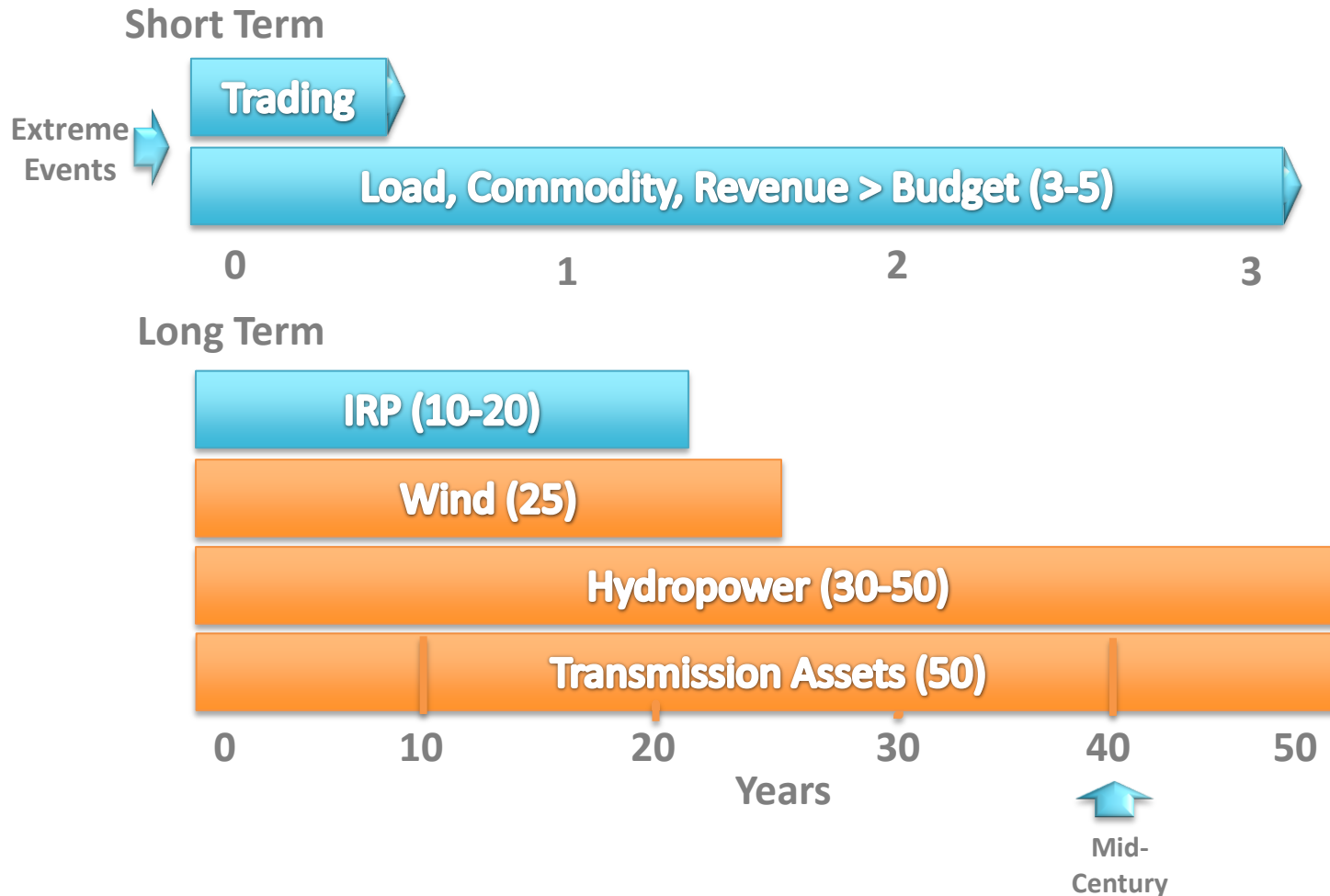
# Summary Projected Impacts: Middle & End of Century

	Mid-Century Projections	End of Century Projections
<b>Sacramento Area Average Temperatures</b>	0.7 to 2.2°C (1.3 to 4.0°F) increase by 2050	1.5 to 4.5°C (2.7 to 8.1°F) increase
<b>Sacramento Extreme Heat Days (&gt;101°F)</b>	Average of 44 days annually by 2050	Average of 85 days annually by 2099
<b>Sacramento Annual Precipitation</b>	2 to 19% decrease in overall precipitation	6 to 23% decrease in overall precipitation
<b>Northern Sierra Nevada Snowpack</b>	12 to 42% decrease in April 1 SWE	32 to 79% decrease in April SWE
<b>California Large Wildfire (&gt;500 acres) Occurrence</b>	11 to 55% increase by 2035-2064 period	25 to 128% increase by 2070-2099 period

# Potential Concerns for SMUD

- Changes in average, peak and nighttime temperatures
- Changes in frequency of extreme events
- Efficiency, reliability and life cycle of thermal power plants, transmission and distribution equipment
- Timing of snowmelt and volume of precipitation experienced in our hydropower system
- Localized and Bay Delta flood risk
- Wind patterns & speed: power generation and delta breeze cooling capacity
- Wildfire frequency and intensity impact to transmission assets and some sources of energy supply

# SMUD Planning Horizons & Asset Life Cycles



# SD-17 ERM Dashboard – Residual Business Critical Risk Exposure : May 1, 2013

## Financial Risks

### 1. Budget Planning & Rate Setting

#### 2. Financing

- 2a. Accounting/Financial Report
- 2b. Capital Availability/Cashflow
- 2c. Grants Administration

#### 3. Liquidity

#### 4. Price Volatility

- 4a. Commodity
- 4b. Interest Rate

#### 5. Project Execution

- 5a. Solano Phase 3
- 5b. East Campus Operations
- 5c. Enterprise Project Portfolio Process

#### 6. Legislative/Regulatory

- 6a. (Intentionally Left Blank)
- 6b. NERC/FERC Standards

#### 7. Revenue Collection/Write-offs:

#### Electric Sales, Loans & Theft

#### 8. Volumetric Weather

- 8a. Hydro Generation
- 8b. Retail Load

#### 9. Wholesale Credit Default

### Legend: by Risk Heat Zone

Extremely High Residual Risk

High Residual Risk

Medium Residual Risk

Low Residual Risk

Extremely Low Residual Risk

## Operational Risks

### OP: People

#### 10. Employee Safety

- 10a. Physical Work Environment
- 10b. Work Processes & Standards
- 10c. Employee Safety: Work Culture

#### 11. Ethics/Integrity

#### 12. Illegal Acts/Fraud

#### 13. Institutional Knowledge

#### 14. Performance Gap/Skilled Workforce

### OP: Systems and IT

#### 15. Applications / System Support

#### 16. Cyber Security

- 16a. Smart Grid
- 16b. Electronic Tagging System
- 16c. Energy Management System
- 16d. Outage Management System
- 16e. SAP

#### 17. Information Management

- 17a. Enterprise Content Management
- 17b. Enterprise-Wide Compliance Documentation
- 17c. Smart Grid

#### 18. Systems Development/Integration

#### 19. Systems Infrastructure: SAP Landscape

#### 20. System Relevance and Obsolescence

#### 21. Grid Operational Systems & Support

### OP: Process

- 22. Balancing Authority Operations: Business Disruption

#### 23. Bulk Power Op & Maintenance:

- 23a. Gas Pipeline Related Assets
- 23b. Power & Gas Contractual Assets

#### 23c. Power Generation Assets

#### 23d. Transmission Contractual Assets

#### 24. Communications

- 24a. External Communications
- 24b. Internal Communications/Alignment

#### 25. Customer Serv Ops: Business Disruption

#### 26. Grid Infrastructures: Business Disruption

- 26a. T&D Line Assets
- 26a.i. Underground Cables
- 26a.ii. Poles
- 26a.iii. Secondary Network

#### 26b. T&D Substation Assets

- 26b.i. North City Substation
- 26b.ii. Station A
- 26b.iii. Hurley Substation

#### 26c. Telecommunications Assets

#### 26d. New Services

#### 27. (Intentionally Left Blank)

#### 28. General Facilities Op & Maintenance

- 28a. Customer Service Center
- 28b. Energy Management Center
- 28c. Existing Corporation Yard
- 28d. Headquarter Building
- 28e. Physical Asset Security

#### 29. Labor: Business Disruption

#### 30. Litigation Liability

- 31. Nuclear Waste Disposal
- 32. Operational Efficiency/Effectiveness

#### 33. Payroll Disruption

#### 34. Pricing/Rate Design

#### 35. Public Safety

#### 36. Regulatory Compliance Practices

- 36a. Environmental Protection

#### 36b. OSHA/Safety

- 36c. NERC/FERC CIPS Standards 706
- 36d. NERC/FERC Reliability Standards 693
- 36e. Compliance - CPUC General Orders

#### 37. Revenue Collection Ops & Maintenance

#### 37a. Meter to Cash

#### 38. Supply chain: Business Disruption

## Strategic Risks

#### 39. Business Model

#### 39a. Technology/Competition Driven

- 39a.i. Distributed Generation/Storage
- 39a.ii. Electrification of Transportation Sector
- 39a.iii. Energy Efficiency/Demand Management System

#### 39b. Regulatory Driven

- 39b.i. Independent Balancing Authority
- 39c. Large Customer Retention
- 40. Competitive Workforce
- 40a. Health & Wellness Benefits
- 40b. Pension Reform
- 40c. Salary
- 40d. Strategic Workforce Agility

#### 41. Corporate Governance

- 41a. Board Driven
- 41b. GM Driven
- 42. (Intentionally Left Blank)

#### 43. Enterprise Grant Integration, Execution and Alignment

- 43a. Customer BU Related Grants
- 43b. R&D Related Grants
- 43c. Smart Sacramento (AMI+Grants)

## Strategic Risks

#### 44. Sustainable Energy

- 44a. Carbon Emission
- 44b. Load Serving Capability
- 44c. Renewable Portfolio Standard

#### 45. Product/Service Development

- 45a. Smart Grid Customer Interface and on-going integration

## External Risks

#### 46. Economy - Business Agility

#### 47. Employee/Labor Relations

#### 48. Legislative/Political Issues

- 48a. Federal
- 48a.i. Limits on Muni Bond Tax Exemption
- 48a.ii. Cyber Security
- 48b. Local Gov't
- 48c. State
- 49. Media & Community Relations
- 50. Natural / Other Hazards
- 50a. Earthquake
- 50b. Flood
- 50c. Global Pandemic
- 50d. Non-Cyber Terrorism
- 50e. Wildfire

#### 51. Regulatory Changes

- 51a. Federal
- 51a.i. DOE-PMA Initiative Related Issues
- 51a.ii. Dodd-Frank Implementation
- 51b. Regulatory Litigation
- 51b.i. FERC Order 1000
- 51c. State
- 51c.i. Bay Delta Flow Issues
- 51c.ii. RPS Eligibility Related Issues



# Additional Research Needs

- Wind
  - Impact on patterns and speed at our Solano Wind facility
  - Delta breeze patterns and speed
- Temperature granularity
  - Certainty of daytime peak vs. average annual temp projections
  - Increase in nighttime temp?
  - Relationship between extreme and normal peak demands
- Wildfire
  - Modeling of post-fire debris and sediment flows
- Improved downscaling for our climate zone “edge” location

# Proposed Readiness Next Steps



- Incorporate climate scenarios and readiness findings into long-term planning process (>5 yrs)
- Participate in new Sacramento regional adaptation collaborative and other regional efforts
- Support and help fund new research to help fill significant gaps in current knowledge
- Summarize new scientific conclusions and incorporate into Readiness Strategy every 4 years or as new methodologies warrant

Thank You!

