Climate Change Impacts and Readiness Planning

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Powering forward. Together.

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Outline

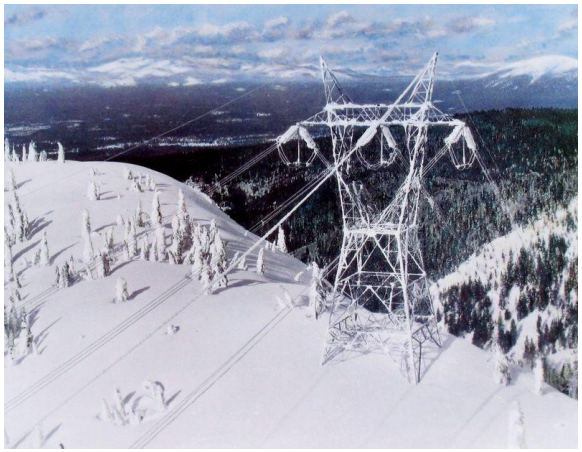
- SMUD Overview
- Energy Resources
- Board Directives
- Background/Impacts of Climate Change
- Current Climate Readiness Strategy
- Summary Findings
- Plans

SMUD Overview

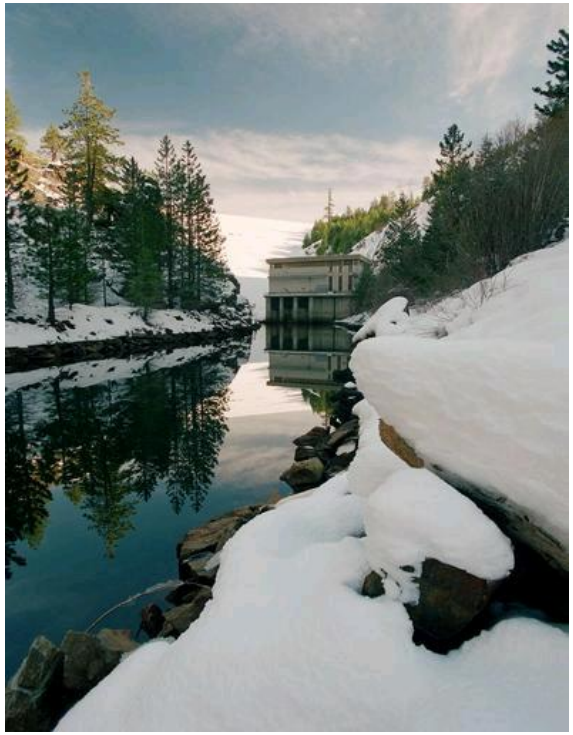
- Publicly owned utility formed in 1946
- Governed by independent locally elected governing Board of 7 members
- Serves electricity to 1.3 million people in Sacramento region
- 2,100 Employees
- Peak Demand of 3,300 MW
- Annual Sales ~11,000,000 MWh

SMUD Energy Resources

Distributed Solar – 50MW rooftop, 100 MW groundmount



COTP Transmission to NW – 1600 MW



Upper American River Hydro Project – 688 MW

Biomass -203 MW

Solano Wind – 230 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:

Year	**Net Greenhouse Gas Emissions (metric tonnes)**
2012	2,608,000
2020	2,318,000
2050	350,000

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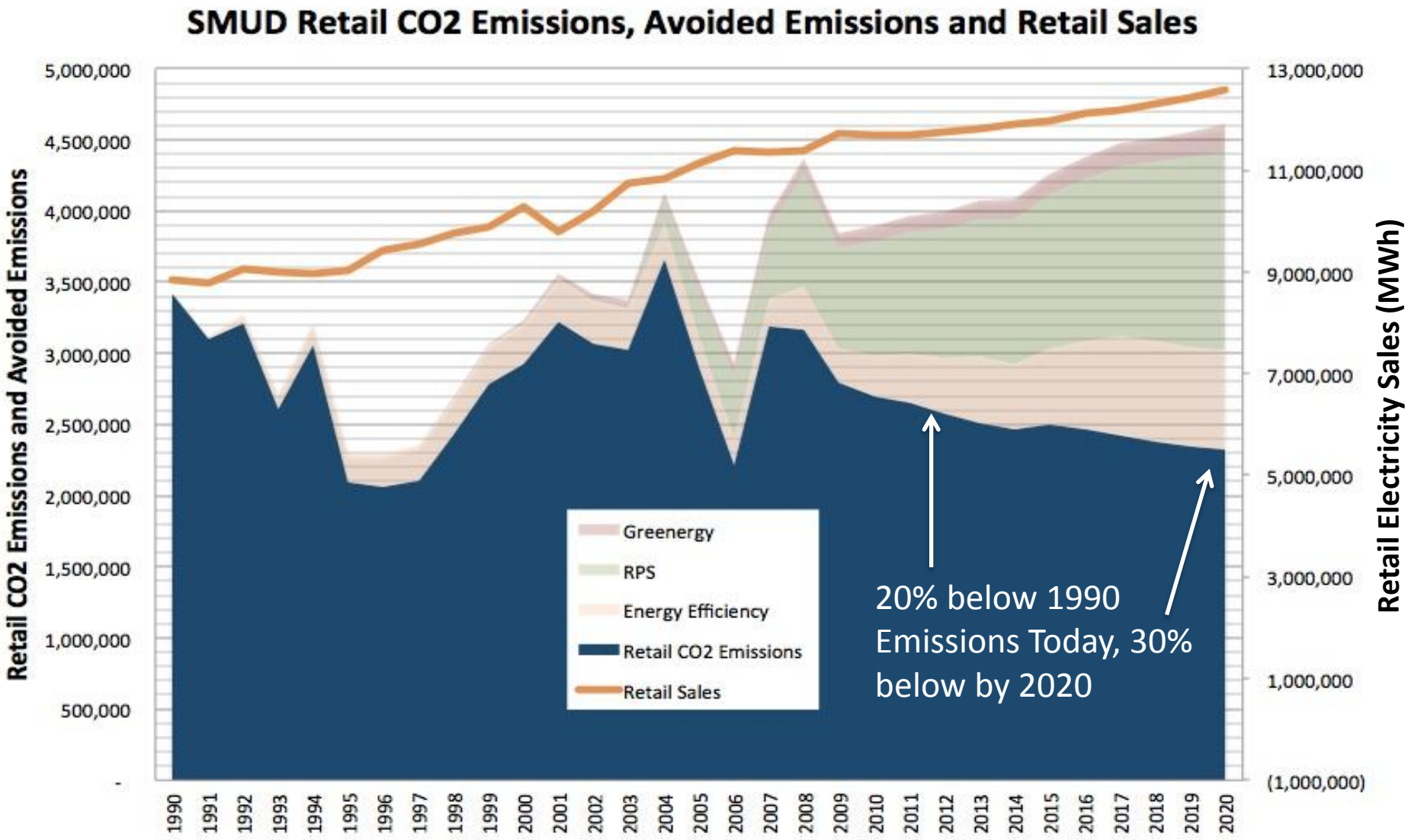
SMUD Retail CO2 Emissions, Avoided Emissions and Retail Sales
Retail CO2 Emissions and Avoided Emissions
Retail Electricity Sales (MWh)
5,000,000
4,500,000
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
-
13,000,000
11,000,000
9,000,000
7,000,000
5,000,000
3,000,000
1,000,000
(1,000,000)
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2016
2017
2018
2019
2020
Greenergy
RPS
Energy Efficiency
Retail CO2 Emissions
Retail Sales
20% below 1990 Emissions Today, 30% below by 2020

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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

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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

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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)	• 90% loss in Sierra snow pack • 3-4 times as many heat wave days in major urban centers • 4-6 times as many heat-related deaths projected for some urban centers • 2.5 times the number critically dry years • 20% increase in electricity demand	**4.4 – 5.8 °C (8-10.4 °F)**
Medium-High Emissions A2 (830 ppm)	• 70- 80% loss in Sierra snow pack • 2.5-4 times as many heat wave days in major urban centers • 2-6 times as many heat-related deaths projected for some urban centers • 2-2.5 times the number critically dry years • 11% increase in electricity demand	**3.1 -4.4 °C (5.5-7.9 °F)**
Low Emissions B1 (550 ppm)	• 30-60% loss in Sierra snow pack • 2-2.5 times as many heat wave days in major urban centers • 2-3 times as many heat-related deaths projected for some urban centers • Up to 1-1.5 times the number critically dry years • 3- 6% increase in electricity demand	**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

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Summary Projected Impacts: Middle & End of Century

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

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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

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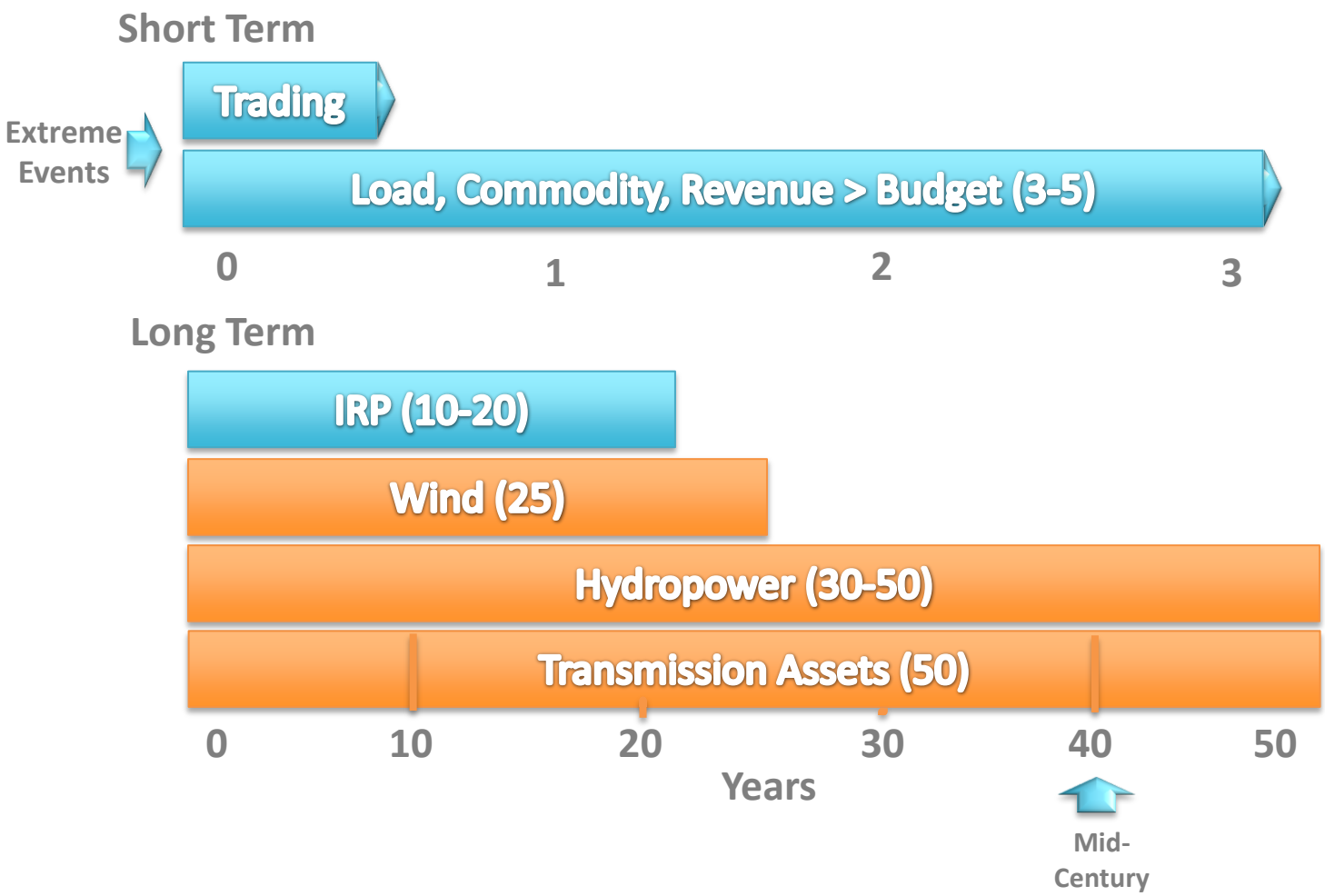
SMUD Planning Horizons & Asset Life Cycles



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. Stratgeic 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.SmartSacramento (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

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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

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Thank You!