ATTACHMENT B

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R.18-04-019 Phase II Procedural Workshop on Modeling, Investment, and Procedural Linkages for Climate Adaptation

Tasks 1 and 3

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Energy Division, California Public Utilities Commission (CPUC)
October 2, 2023

California Public Utilities Commission

WebEx Logistics

- All attendees are muted on entry by default.
- Questions can be asked verbally during Q&A segments using the "raise hand" function.
- The host will unmute you during Q&A portions [and you will have a maximum of 2 minutes to ask your question].
- Please lower your hand after you've asked your question by clicking on the "raise hand" again.
- If you have another question, please "re-raise your hand" by clicking on the "raise hand" button twice.
- Questions can also be written in the Q&A box and will be answered verbally during Q&A segments.

Workshop Agenda

Time	Activity
9:00	Introductions, Overview of Day, and Procedural Background
9:30	SCE Presentation on the Global Warming Level Framework
10:30	20 Minute Q&A
10:50	5 Minute Break
10:55	Energy Division Presentation on Climate-Informed Forecasting in the IRP
11:25	Q&A/Global Warming Level Framework Discussion Questions
12:00	Lunch
1:00	Energy Division Staff Presentation on Tasks 1 and 3, Q&A
2:15	15 Minute Break
2:30	PG&E Presentation on Tasks 1 and 3
3:00	15 Minute Q&A
3:15	SCE Presentation on Tasks 1 and 3
3:30	15 Minute Q&A
3:45	Commissioner Closing Remarks, Wrap up and Next Steps

Acronyms

- **AR6**- 6th Assessment Report
- **CAVA** – Climate Adaptation and Vulnerability Assessment
- **CMIP6**- 6th Coupled Model Intercomparison Project
- **IEPR**- Integrated Energy Policy Report
- **IPCC**- Intergovernmental Panel on Climate Change
- **IRP**- Integrated Resource Planning
- **GCM**- Global Climate Model
- **GWL**- Global Warming Level
- **GRC**- General Rate Case
- **RAMP**- Risk-Assessment Mitigation Phase (Proceeding)
- **RCP**- Representative Concentration Pathway
- **SSP**- Shared Socioeconomic Pathway

Overview of Task 1 and 3 Issues: Modeling, Investment, and Procedural Linkages

Task 1 Issues: Refinements to CAVA Requirements and CAVA Linkages to RAMP and GRC Proceedings

- Emission Scenarios
- Global Warming Level Framework and Temperature Bias
- Sensitivity Analysis
- Data and Methodology Disclosure
- Inclusion of Near-Term Risk Analysis (<5 years)
- GRC Investment Guidance

Note that today's discussion will not focus on integration with the RAMP or the inclusion of near-term risk in the CAVAs given that the September 13 workshop was dedicated to discussion of that issue.

Task 3 Issues: Linkages Between R.18-04-019 and Other Commission Proceedings Beyond RAMP and GRC Proceedings

- Implementation of measures to integrate climate change considerations into other proceedings
  - Designation/Prioritization of proceedings
- Emissions scenario guidance for other proceedings
- Use of climate data and CAVA results within proceedings other than the RAMP and GRC
- Role of R.18-04-019 in influencing system and resource planning, including third-party contractors
- Need for feedback loops from other proceedings

Task 1 Issues: Global Warming Level Framework

- Should the Commission require the IOUs to derive consensus Global Warming Levels (GWLs) by year from the climate models that inform the Intergovernmental Panel on Climate Change (IPCC's) Sixth Assessment Report (AR6) when conducting CAVA analyses?
- Should the IOUs, collectively or individually, be accorded flexibility in deriving consensus GWLs, specifically in regard to weighting methods?
- If yes, how should the Commission bound this work or ensure it is transparent?
- Should the Commission authorize the IOUs to cure temperature bias within their modeling results in other ways? If so, which ways, and how should this be reported?

Task 1 Background: Global Warming Level Framework

- Energy Division published a Staff Paper introducing the potential for a Global Warming Level (GWL) approach to the CAVAs in May 2023
- This analytical approach for utilizing Global Climate Models (GCMs) provides two benefits:
  - It is a way of curing a temperature bias that is inherent to the GCMs in CMIP6 while maintaining the sample size of the full set
  - Allows for sensitivity analysis across time vs. emission trajectory
- Concerns voiced by stakeholders regarding the GWL approach were related to:
  - Reproducibility of approach for other utilities/planning agencies
  - Ease of integration into other planning proceedings

Southern California Edison Presentation on the Global Warming Level Framework

Overview of Global Warming Levels

October 2, 2023

SOUTHERN CALIFORNIA EDISON®

Cal-Adapt: ANALYTICS ENGINE

Purpose of this presentation

Background

- The Cal-Adapt Analytics Engine team and an advisory group of IOU stakeholders have been working together to co-develop a set of python tools to process 1-2 PB of data from California's forthcoming 5th Climate Change Assessment
- The IPCC and National Climate Assessment have adopted a Global Warming Level (GWL) framework in place of planning to target years
- California needs to decide on an approach for future climate analysis

Objectives

- Provide motivation for use of the IPCC's Global Warming Levels framework
- Describe how this approach can fit into current planning activities
- Demonstrate that the technical capacity to curate warming level data exists for energy sector

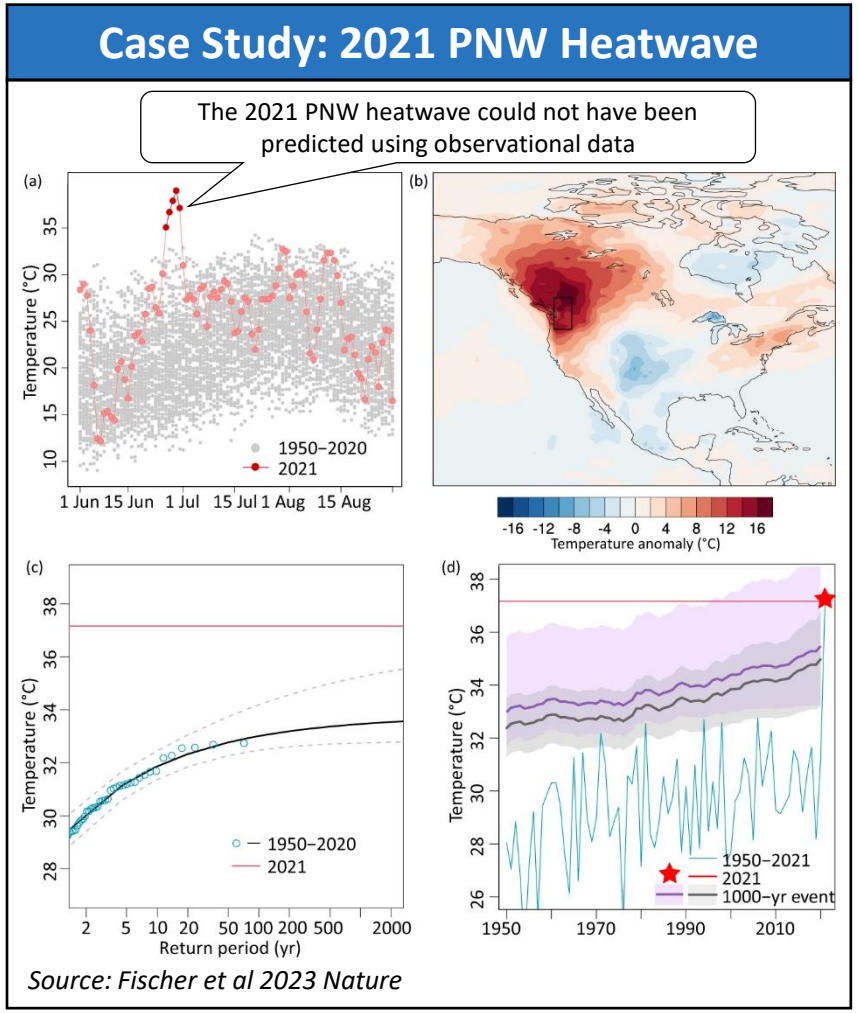
Comparing and contrasting IPCC Assessments

	IPCC AR5 (2014)	IPCC AR6 (2021)
Data	CMIP5 Ensemble	CMIP6 Ensemble
Characterization of Climate Change	**Representative Concentration Pathways (RCPs):** • Emissions pathways that do not consider socioeconomic outcomes **Target years:** • Climate outcomes characterized by timing of climate change	**Shared Socioeconomic Pathways (SSPs):** • Emissions pathways that account for economic development, energy, and land use narratives **Global Warming Levels (GWLs):** • Climate outcomes characterized by level of global warming

California Climate Assessments	**California 4th Climate Assessment:**
	• Statistically downscaled data
	  • 6x6 km resolution
	• 32 Global Climate Models (GCMs)
		California 5th Climate Assessment:
		• Statistically and dynamically downscaled data
		  • 3x3 km resolution
		• 119+ Global Climate Models (GCMs)

Global Climate Models (GCMs) allow us to more explicitly consider low probability, high impact events

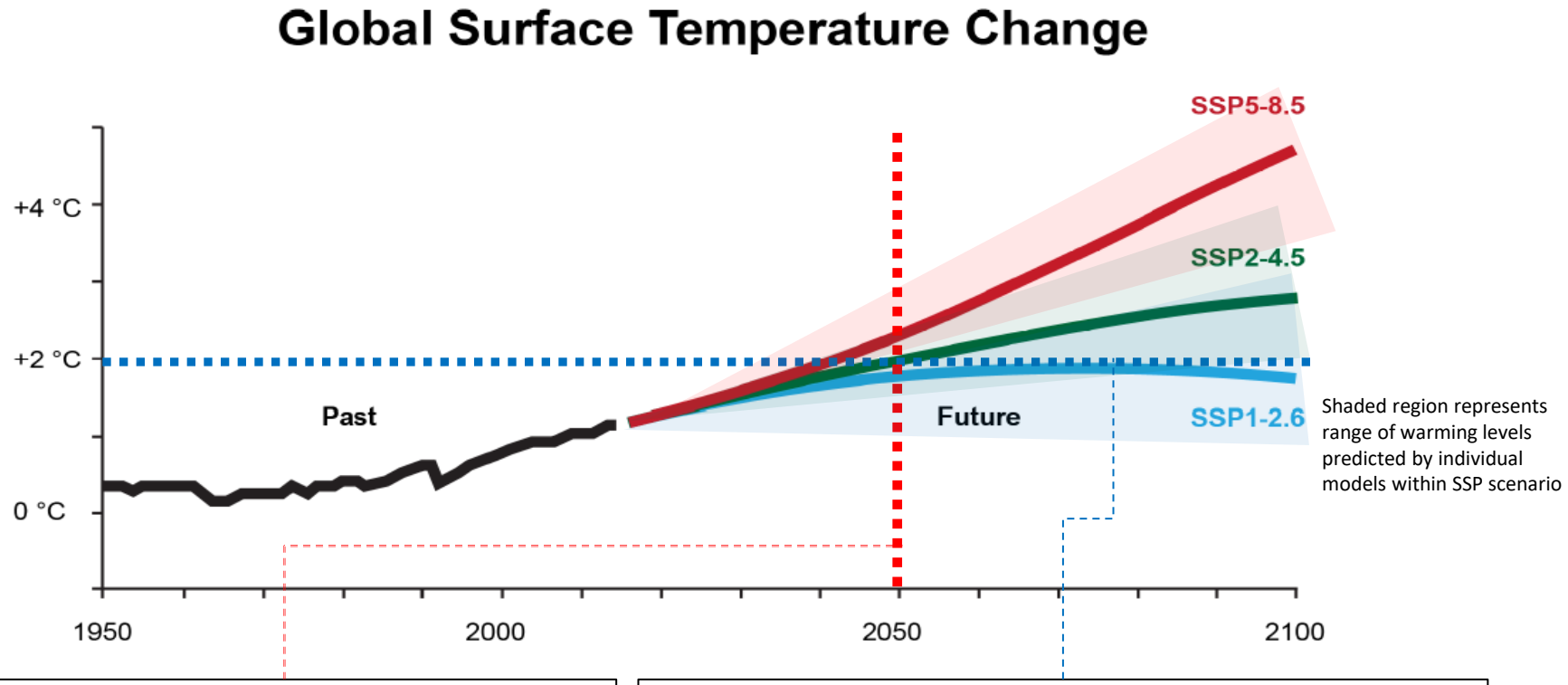
- Using a handful of models or solely relying on historical observations will cause us to miss future catastrophic events
- Relying solely on observational data is insufficient
- Luckily for California, we now have much richer dataset of climate futures to utilize for planning
  - The Cal-Adapt Analytics Engine enables users to process this data on a shared cloud server



Source: Fischer et al 2023 Nature

ILLUSTRATIVE

Explaining the difference between target years and GWLs



IPCC AR5 Approach (Target Year): Assess different climate models across the same year (ex. 2050), which could be different warming levels

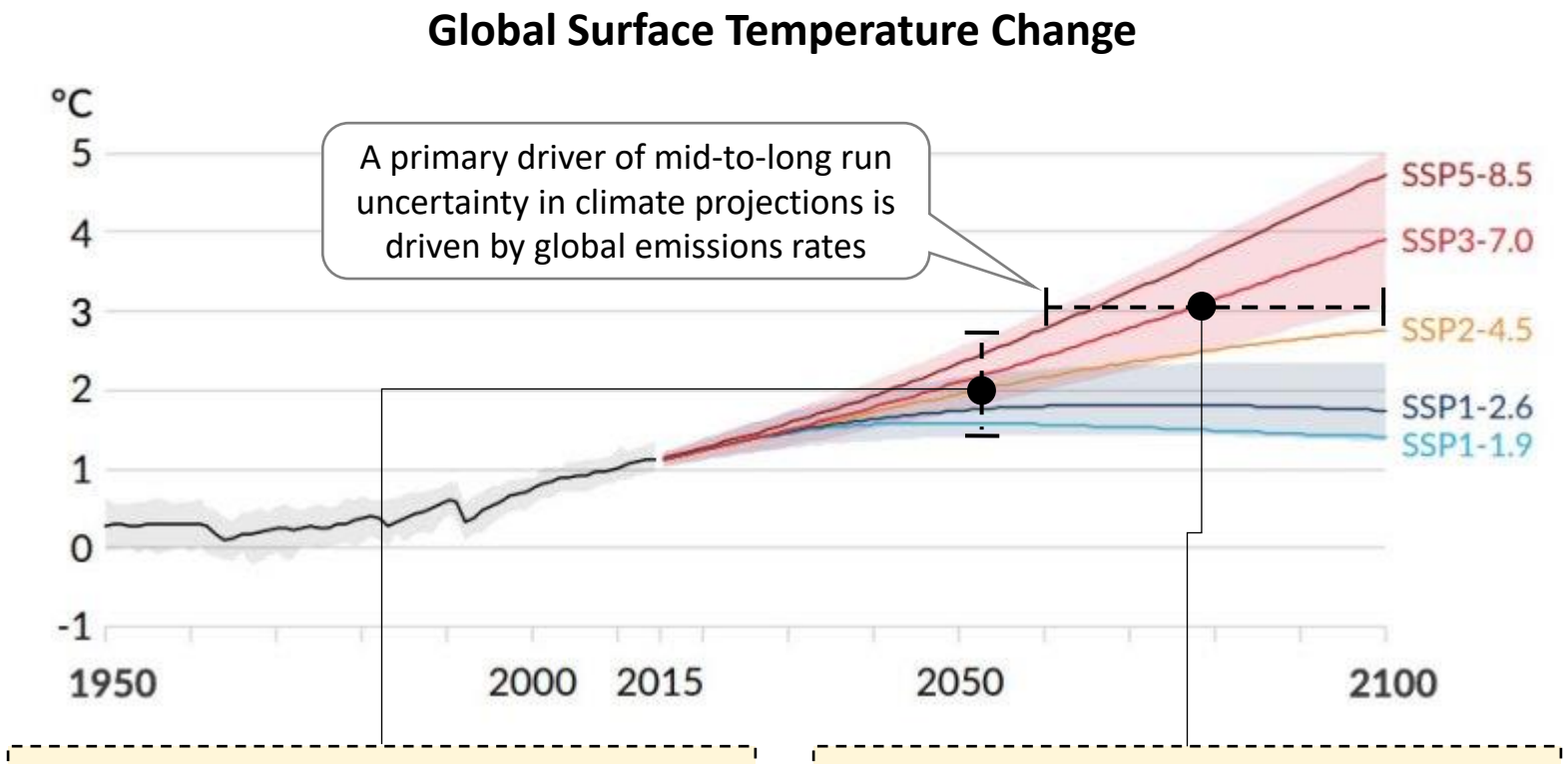
IPCC AR6 Approach (Global Warming Levels): Assess different climate models across the same warming level (physical response), which could be different years

IPCC AR6 Rationale[1]:

- "…robust projected geographical patterns of many variables can be identified at a given level of global warming, **common to all scenarios** considered and **independent of timing** when the global warming level is reached.[1]"

[1] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf, pg. 12

The challenges of planning based on target years



Planning to target years forces decisionmakers to pick a single emissions trajectory and reduces confidence in extremes that can affect reliability

There is less certainty around the rate (timing) of climate change than the range of temperature outcomes at a given level of warming

The benefits of a Global Warming Level (GWL) approach at a glance

Analytical benefits

- **Increased sample size** yields increased confidence in climate projections and allows for better resolution of extremes
- **Isolates uncertainty to physical response** independent of rate of climate change, which is much more dependent on GHG emissions trajectories
- **Allows for more streamlined characterization of probabilities**, because there is no initial selection of emissions trajectory

Planning benefits

- **Consistent with the best available science** and allows for consistent analysis with national and international climate assessments
- **GWLs allow for more confident decisionmaking** by reducing uncertainty
- **Allows for timing-based sensitivity analysis** and helps move policy closer to an adaptive planning approach

Implementation challenges and proposed solutions

	Challenge	Description	Proposed solution
1	**Temporal uncertainty of impacts**	GCMs often characterize physical response better than event timing, which adds additional complexity for infrastructure planning	Tie GWLs to the timing of a single SSP to identify planning horizons to mitigate planning challenges
2	**Consistency of inputs to planning processes**	Reframing GCM projections to warming levels should not impact downstream planning processes (i.e., data needs to be delivered in consistent format to existing processes)	Leverage Cal-Adapt Analytics Engine notebooks with pre-written query tools to parse data to a more manageable size
3	**Multi-year time series**	Some system planning processes rely on multi-year time series, which combine short-term and long-term views on climate change	• Utilize a starting point of 1 degree and draw time series **OR** • Rely on SSP series directly

There is broad agreement on the general rate of climate change to mid-century among SSPs

Goal: Provide climate data in same format to end users, so downstream planning processes do not have to fundamentally change to ingest inputs

Enablers:

- **A reference SSP** should define planning timeframes associated with key warming levels
- All **IOUs should plan to the same warming levels and timeframes** for consistency
- Should be **technically feasible** for all stakeholders

GWL Estimates by SSP:

IPCC estimate for current level of global warming[1]: 0.88°C to 1.21°C

	~1°C		1.5°C		2°C	
	Median	Range	Median	Range	Median	Range
SSP1-2.6	2023	-	2033	2026-2057	2054	2044-2065
SSP2-4.5	2023	-	2032	2026-2042	2052	2038-2072
SSP3-7.0	2023	-	2032	2026-2038	2048	2035-2058
SSP5-8.5	2023	-	2030	2026-2039	2043	2034-2052

Recommended planning scenarios

[1]https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_TS.pdf, pg 60
[2]https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf, pg. 12

ILLUSTRATIVE

A GWL-based approach does not require users to fundamentally change downstream vulnerability analysis

Scoping and Sensitivity

Thermal Resources identified for extreme heat analysis

- Ambient temperatures above 115°F may result in plants not being able to operate due to insufficient cooling, control equipment failure, SCADA equipment failure, etc.

Exposure Analysis

Plant exposed to temperatures that may make it unable to operate

- Temperatures are projected to exceed 115°F using 50th percentile temperature projections in 2030, 2050 and 2070

Primary area affected by GWLs

At-Risk Analysis

Plant outage consequences could have significant reliability and financial impacts

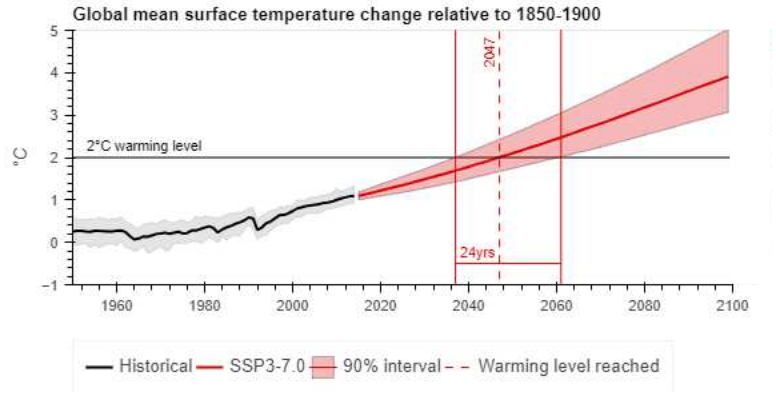
- Potential asset consequences include:
  - Operating damage
  - Lost market revenue
- Potential System Reliability Consequences

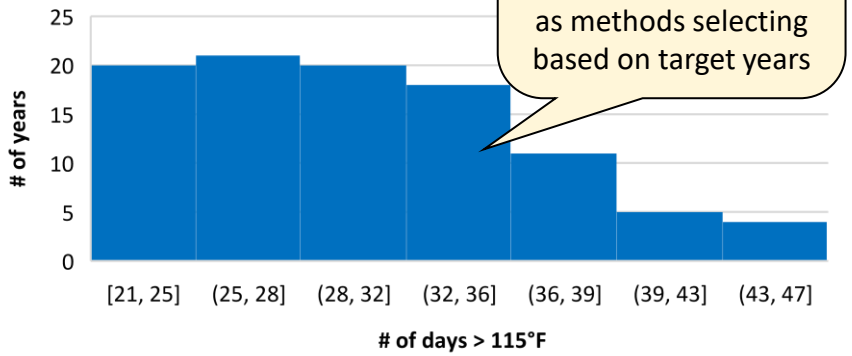
Adaptation Options

Exposure could be present by 2030, so cooling upgrades need to be considered

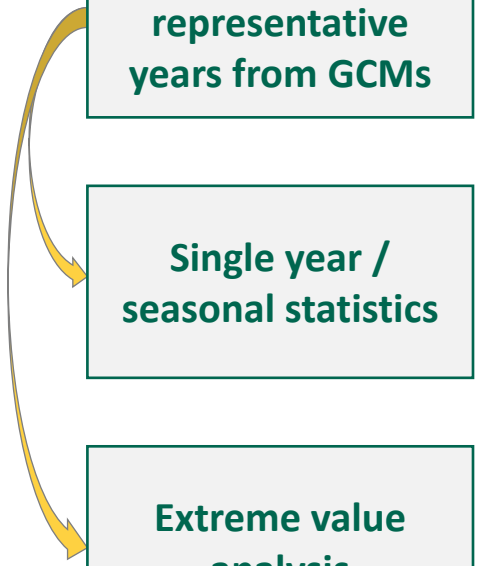
- In order to prevent potential shutdowns during critical periods, the plant should be considered for cooling upgrades or other options that reduce outage risk

GWL Sampling Process:





A GWL-based approach allows users to produce data in the same formats as target-year based methodologies



	Description	GWL Implementation
Select representative years from GCMs	• "Baseline" set of data for most calculations • Commonly the starting point for asset-level analyses	• Identify representative years using GWLs • Anchor timing assumptions to a single SSP
Single year / seasonal statistics	• Useful for determining frequency and magnitude of expected outcomes	• Derive seasonal statistics from representative years identified through GWLs
Extreme value analysis	• Useful for low probability, high impact events • Also frequently used for return period estimation	• Conduct extreme value analysis using representative years identified through GWLs
Multi-year time series	• Commonly used for system planning / IRP applications • Mostly uses projections starting at present day	• Utilize a starting point of 1 degree or rely on SSP time series data directly • Not a unique challenge to GWL-based approaches

Resolving the challenges of multi-year time series modeling

Challenges

- Many system planning processes (e.g., IEPR, IRP, etc.) require time series data that spans from present through mid-century
- GCMs are built to resolve multi-decadal trends and are *not* intended to serve as forecasts
  - This is a challenge regardless of policy framing (target year vs GWL)
- Multi-year time series built from GCM data often cross multiple warming levels

Potential Solutions

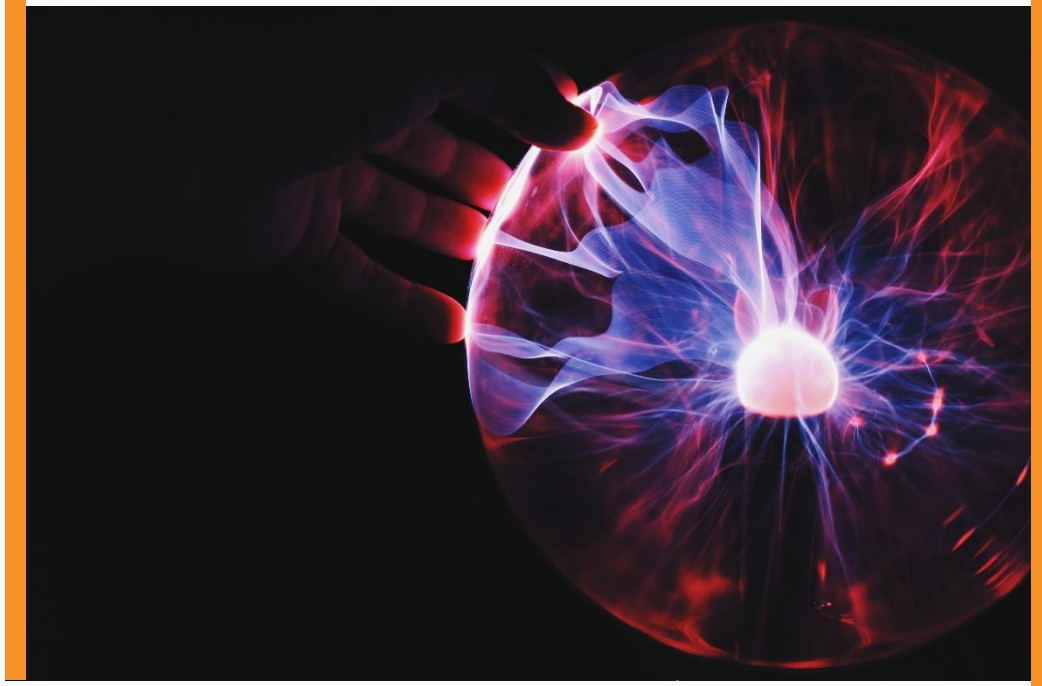
- Sample many time series using a 1-degree assumption for present day
  - Assures a similar starting point for possible climate change planning outcomes

OR

- Leverage time-series data from a single SSP
  - Approaches can be updated as ongoing research efforts begin to to resolve this issue

Multi-year time series will require further research and deliberation, given their prominence in ongoing system planning proceedings

Global Warming Levels Demonstration

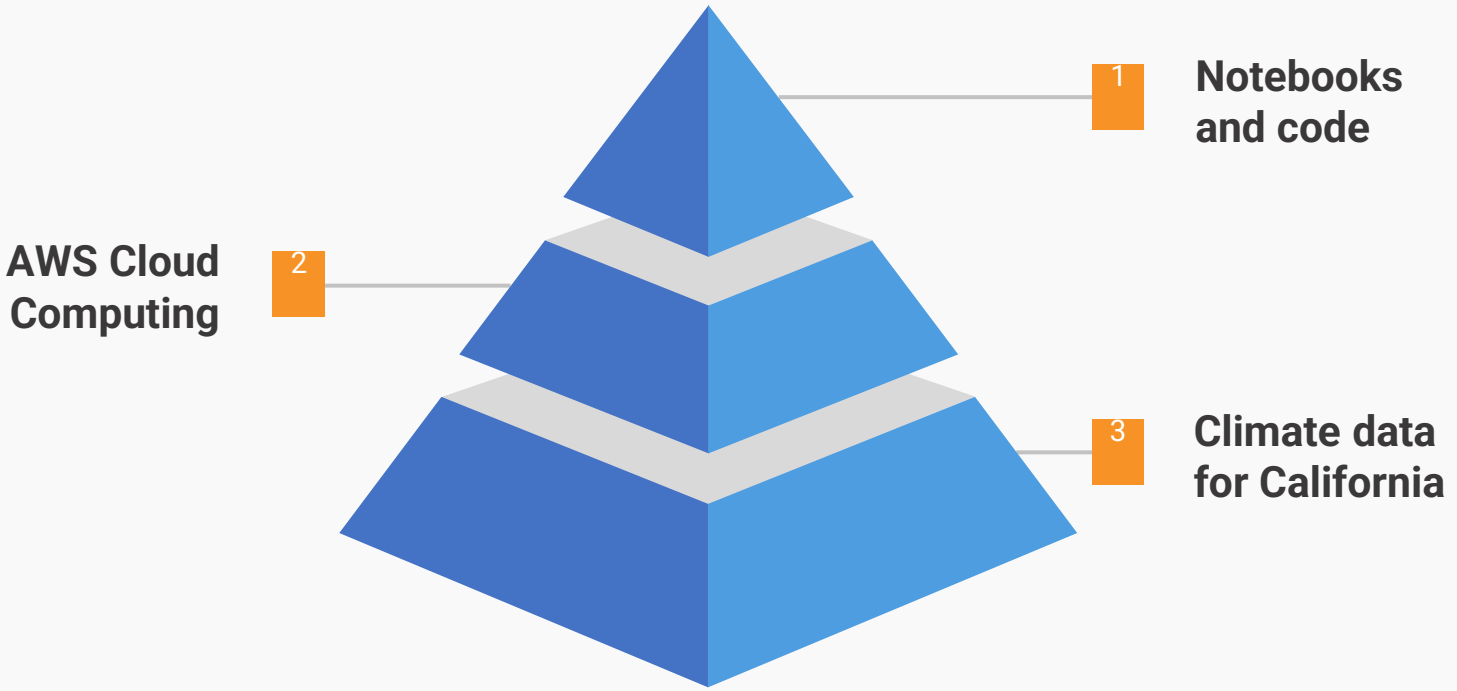


Cal-Adapt: ANALYTICS ENGINE

- What is the Analytics Engine?
- How can I access data & info
- Resources for GWL

What is the Analytics Engine

- Data portraying climate change in California is difficult to access and take action upon
- California has invested a lot in producing climate projections, but climate data can be difficult to access and utilize for many users
- The Analytics Engine will offer a cloud-based analytics platform to help transform the petabytes of data into useful and accessible data products



How can I access data and information

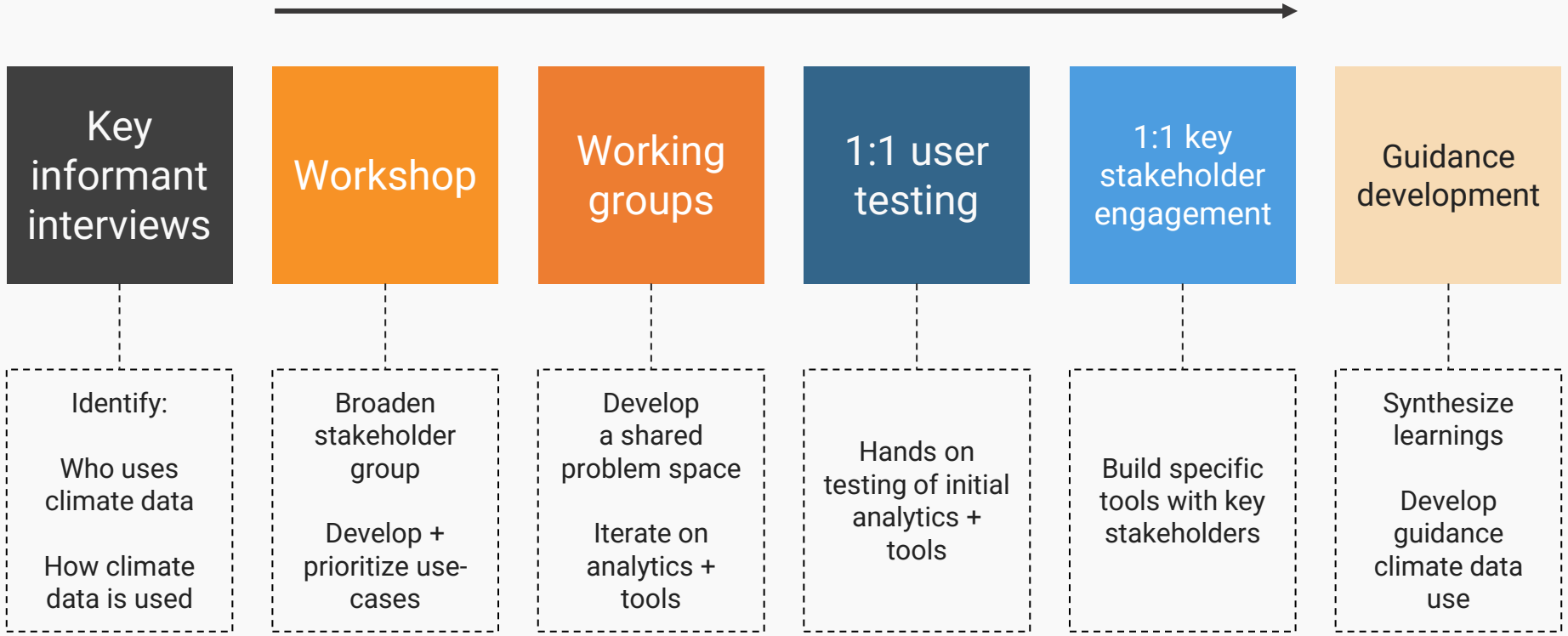
- Data and approaches are open, transparent and free

- All climate projections are freely available
    - Climate Data Catalogue
    - General Access Point
    - Data Download tool on Cal-Adapt (est: Dec 2023)

- All computer code developed to support applications is freely available
    - Climakitae (Python Library)
    - Example applications for energy (Jupyter Notebooks)

- Guidance on best practices and use of climate data

Co-production process and activities



Resources on Global Warming Levels

Resources Currently Available:

- Website includes guidance on use of GWL
- Two notebooks available that walk users through the concepts of GWL
- Today's demonstration notebook available

Cal-Adapt: ANALYTICS

The Analytics Engine is in beta at present, with multiple users at CPUC, CEC, PG&E, SCE, SDG&E and SMUD

Learn more by visiting our websites!

Analytics Engine: analytics.cal-adapt.org

We welcome feedback and additional energy sector stakeholders to test and use the Analytics Engine. Please email analytics@cal-adapt.org with your request.

Q&A

(Approximately 20 minutes)

5 minute break

Energy Division Presentation on Climate-Informed Forecasting for Integrated Resource Planning

Current and Proposed Approaches for Handling Climate and Climate Change within CPUC Electric Grid Reliability Forecasting Efforts

Presented to the Climate Adaptation and Vulnerability Assessment Workshop
California Public Utilities Commission
October 2, 2023

David Miller, PhD
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California Public Utilities Commission

Definitions

- **Climate Informed Forecasting (CIF)**
  - An approach that addresses limitations of using historical data to forecast electric grid reliability under climate change by incorporating climate projections
- **Coupled Model Intercomparison Project** (CMIP6)
  - Repository of historical and future Global Climate Model (GCM) weather simulations
  - Informs Intergovernmental Panel on Climate Change (IPCC) Assessment Reports (AR6)
  - Climate forcing reflects greenhouse gas emissions trajectory. Reference / Baseline Scenarios:
    - CMIP6: Shared Socioeconomic Pathway ssp370
    - CMIP5: Representative Concentration Pathway RCP8.5
  - CMIP provides climate information but at spatial resolutions insufficient for electric grid reliability forecasting
- **Ensemble**
  - Referring to collections of simulations across years and other climate parameter variations
- **Downscaled Projections**
  - Takes low spatial resolution CMIP climate projections and uses dynamical and/or statistical models to produce high resolution scenarios
    - High spatial resolution climate projections needed for electric grid reliability forecasting
  - CEC's EPIC and Gas R&D funds support development of high-resolution downscaled climate projections
- **Perturbation Theory**
  - Mathematical approach for approximating the value of a function using known value and differences of an estimator
    - For example, can be used to approximate temperature profiles under climate change by using existing historical temperatures adjusted / perturbed by information contained in CMIP6 climate simulation repository
  - Approach designed to provide a first-order approximation of impacts of climate change

Objectives

- Describe how historical weather data is currently used within CPUC electric grid reliability forecasting efforts
  - CPUC: Integrated Resource Planning (IRP) and Resource Adequacy (RA) proceedings
  - CEC: Integrated Energy Policy Report (IEPR)
- Describe two proposed approaches for incorporating climate change into electric grid reliability forecasting efforts
  - **Perturbation approach**
    - Perturb high spatial resolution historical weather data with low spatial resolution CMIP6 data
    - Uses IPPC recommended approach for solving 'hot model' problem which further reduces model bias
    - Currently being tested within CPUC IRP framework
  - **Downscale approach**
    - Uses Cal-Adapt Analytics Engine – in progress / data only recently available
- Both proposed approaches:
  - Use high resolution historical weather data plus low resolution CMIP6 data
  - Can use IPCC's recommended framework for addressing the "hot model" problem
- **CPUC proposes using perturbation approach in IRP modeling as interim approach**

Pros and Cons of Proposed Perturbation Approach

- **Pros**
  - Captures impacts of ALL available CMIP6 models (ssp370) in a simple yet justifiable manner
  - Provides a first order approach to capturing impacts of climate change on electric grid reliability forecasting
  - Completed development of stochastic weather dataset capturing climate change using this approach
    - Has been used to develop electric demand profiles under climate change
    - Currently being used to model electric grid reliability forecasting under climate change
- **Cons**
  - Proposed perturbation approach filters out any projected changes to climate variability in CMIP6 repository beyond averaged by month-of-year and hour-of-day impacts
    - Assumes variability of future climate is consistent with variability of current climate
      - "Large Ensemble" research beginning to study variability of climate variability: "Ubiquity of human-induced changes in climate variability," *Earth System Dynamics*, 2021
    - If future climate is more variable than current climate may underestimate peak demand
      - Downscaled CMIP6 projections will more realistically capture high variability future

How Does Climate Impact Electric Grid Reliability Forecasting?

- CPUC relies on a high spatial resolution hourly historical weather dataset (1997 – 2020) across WECC footprint (23 weather years)
  - Temperature and Dew Point impact electric demand
  - Solar, wind and precipitation impact renewable production
  - Historical correlations across time and space between various weather variables preserved
  - **Stochastic Dataset**: 23 weather years of hourly electric demand and renewable production profiles across WECC and offshore
- Electric demand profiles naturally separate into a magnitude and shape
  - CEC provides magnitude (peak and average annual) for CA via IEPR
  - CPUC develops normalized load shapes across WECC
- Stochastic dataset currently used in IRP is based on historical weather data
- CPUC has developed an interim stochastic dataset under climate change using the perturbation approach that will allow CPUC to include impacts of climate change on reliable operation of electric grid

Components of Current and Future Electric Grid Reliability Forecasting Framework

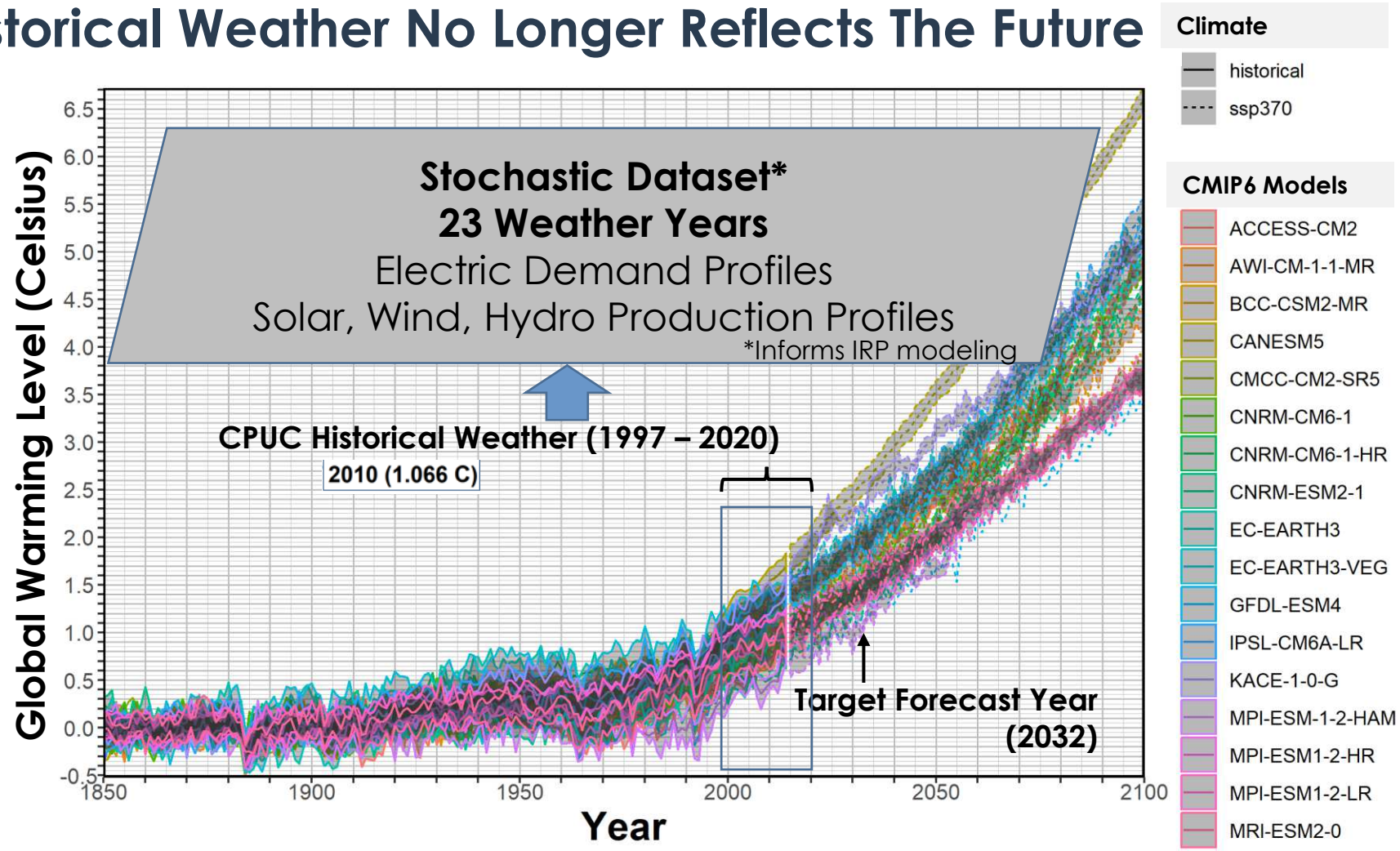
- CAVA and RAMP address risk management in energy sector
  - For IOUs, costs recovered under GRC
- CPUC modeling section runs Probabilistic Production Cost Model simulations for IRP and RA that determine LSE obligations and informs Transmission Planning
  - For IOUs, costs recovered under
    - Energy and Power Purchases: Energy Resource Recovery Account (ERRA)
    - Transmission: Transmission Access Charge (TAC)

Proposed CIF

			CPUC	CEC	WECC	CAISO	IOU/PTO
Electric Demand	Magnitude	In-State		IEPR			
		Out-Of-State			ADS		
	Shape	In-State	IRP(current)	IEPR(future)			
		Out-Of-State	IRP				
Renewable Production	Demand Side			IEPR			
	Supply Side		IRP				
Generator Efficiency			IRP				
Transmission	Substations		TPP			TP	CAVA, RAMP
	Wires		TPP			TP	CAVA, RAMP
	Transformers		TPP			TP	CAVA, RAMP
Sea Level Rise			CAVA, RAMP				CAVA, RAMP
Wildfire			CAVA, RAMP				CAVA, RAMP

TP: CAISO Transmission Plan
TPP: CPUC Transmission Planning Process

Historical Weather No Longer Reflects The Future



How can we develop stochastic dataset under climate change?

Interim CPUC Staff Proposal For Incorporating Climate Change Into Electric Grid Reliability Forecasting: Perturbation Approach

- Uses historical data perturbed by differences of ensemble averaged Global Climate Model (GCM) simulations corresponding to a target GWL relative to the current historical GWL
  - Uses averaged by-month and by-hour differences from CMIP6 data to perturb calibrated, high resolution historical data.
    - Assumes that variability of future synthetic climate consistent with historical
  - Follows IPCC recommended approach to addressing "hot model" issue
- $\boldsymbol{V}$ is the weather variable which can be
  - *Temperature*
  - *Dew Point*
  - *Solar radiation*
  - *Wind speed*
  - *Hydro*
  - $\boldsymbol{x}$ is location and $\boldsymbol{t}$ is hour of year

$$V^{GWL}(\boldsymbol{x}, t) = V^{Historical}(\boldsymbol{x}, t) + \Delta^{GWL}(\boldsymbol{x}, M, H)$$

Current CPUC Historical Weather Database

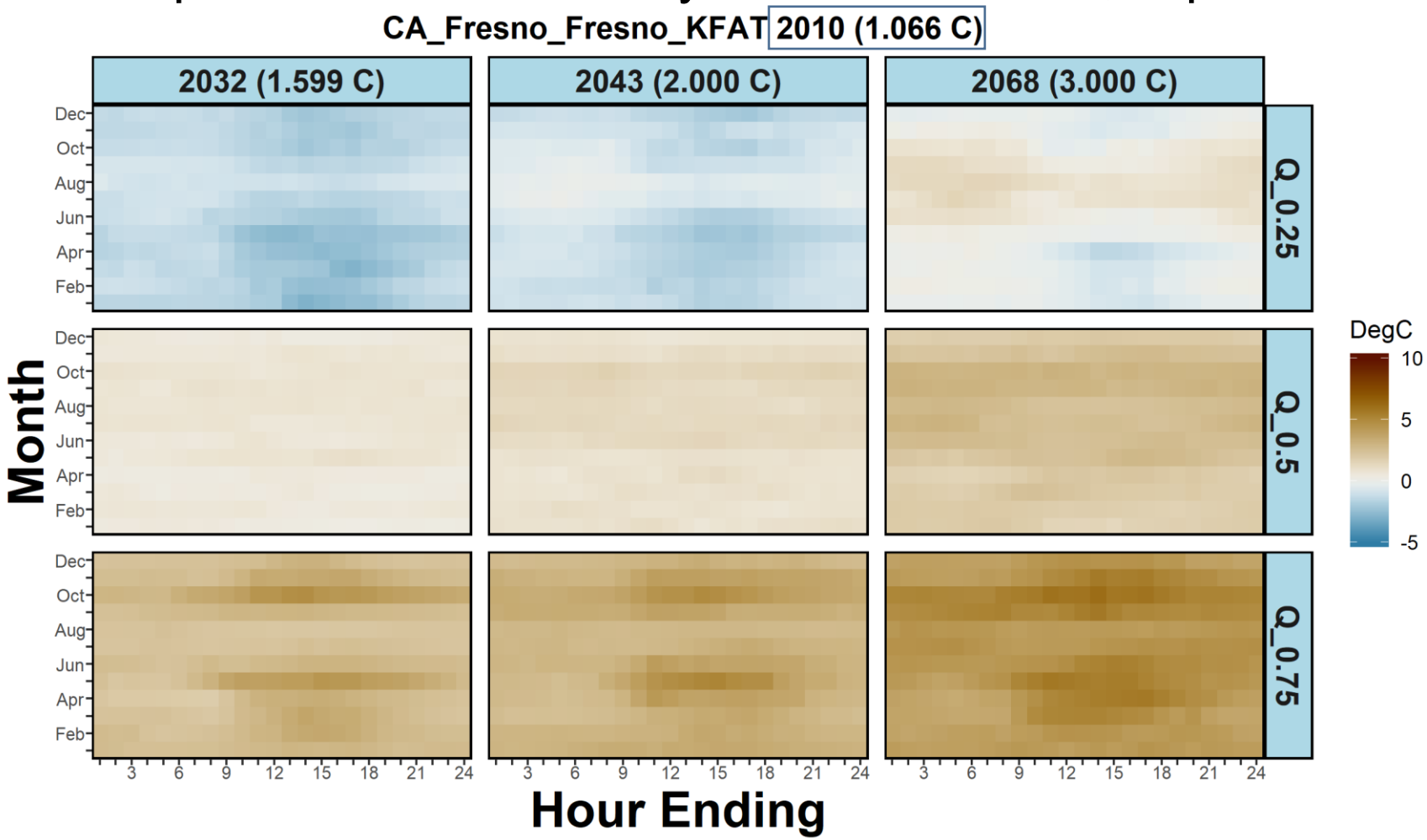
Ensemble Average Difference by Month and Hour
Captures CMIP6 climate change information

Ensemble Average Differences by Month and Hour

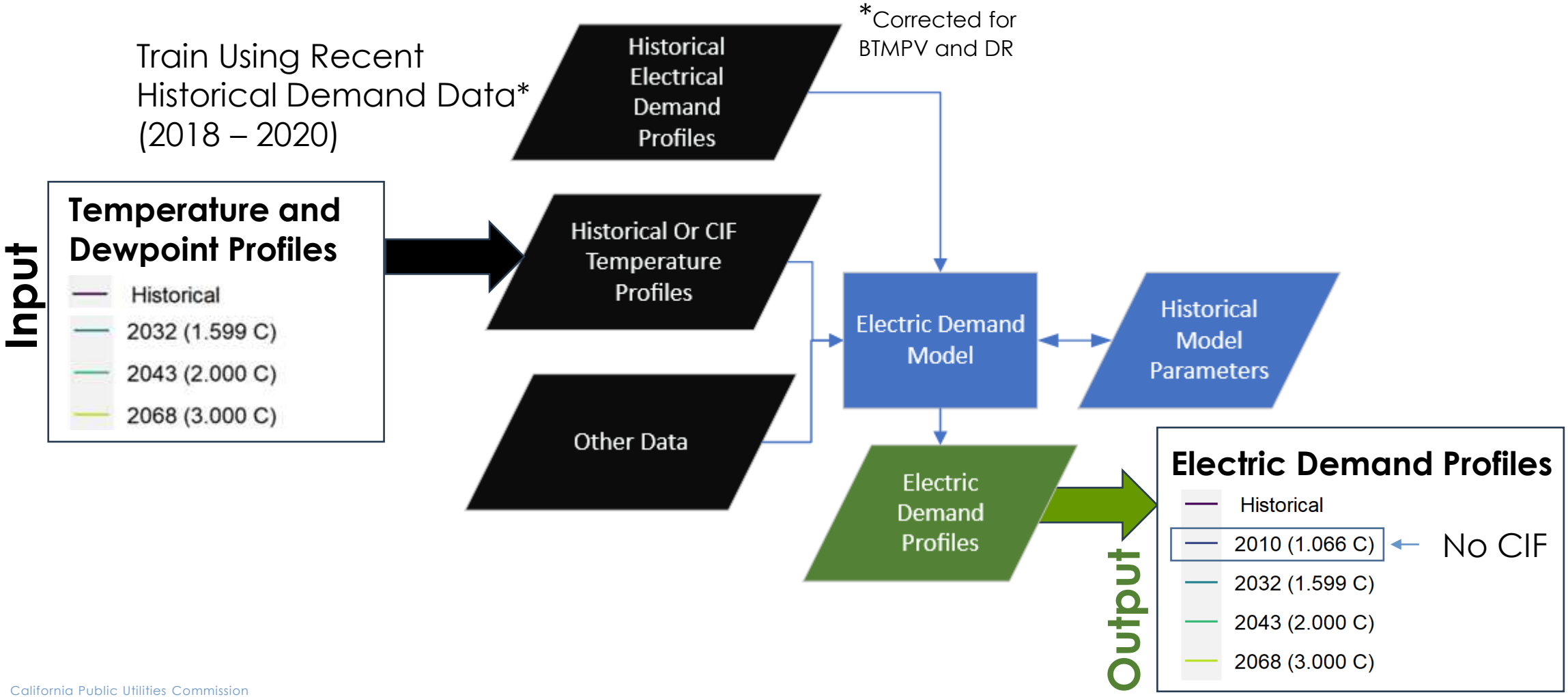
- Each weather station in our model is represented by a similar set of heat maps
- Heat maps are developed by taking differences of ensemble averages corresponding to the warmer and current climates
- All available CMIP6 models equally weighted
- **Convert by month and hour to hourly across entire 23-year record**

$$\Delta^{GWL}(\boldsymbol{x}, M, H)$$

Temperature Difference by Month and Hour, ssp370

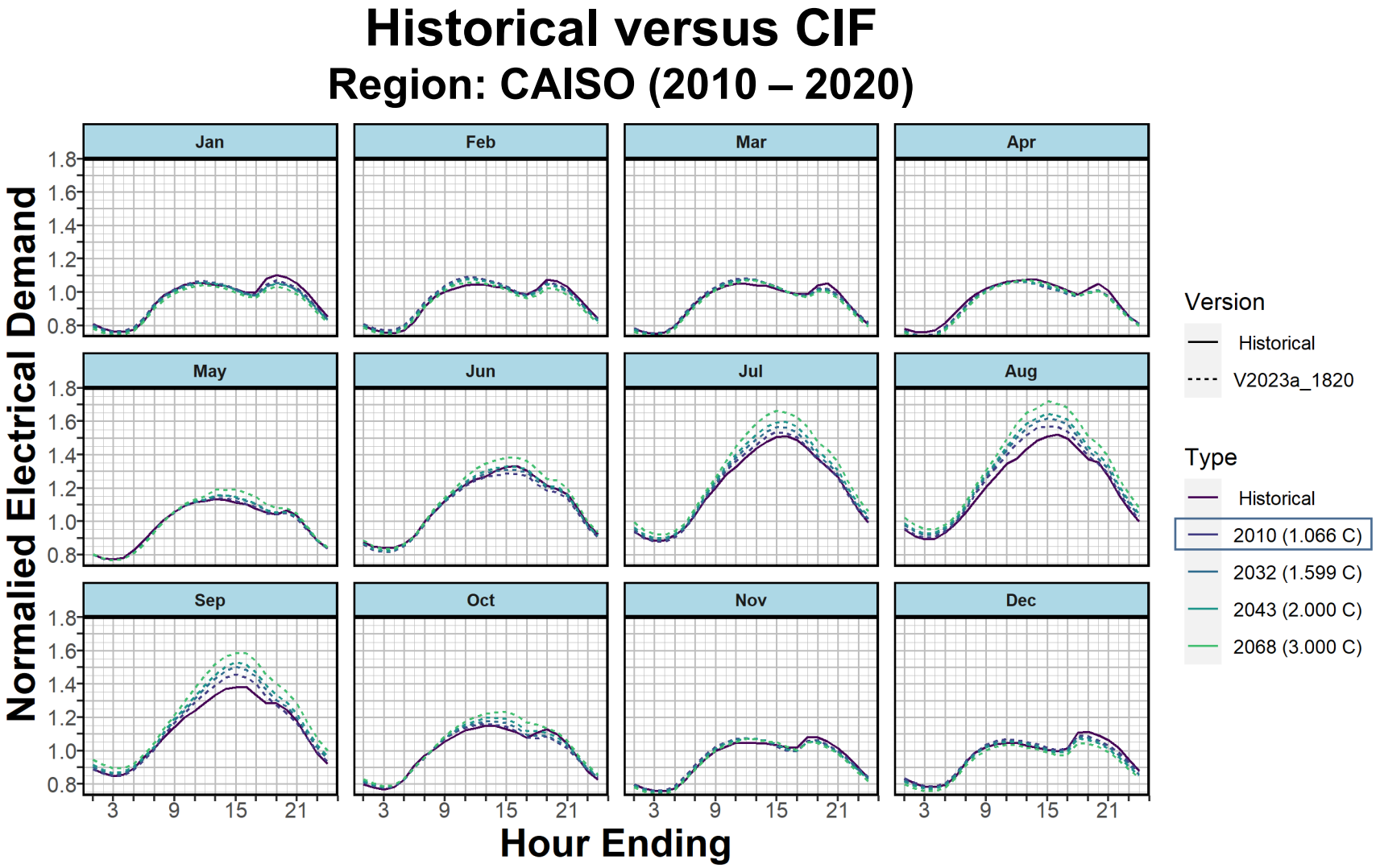


Developing Normalized Electric Demand Profiles from Historical Or Synthetic Climate Data



Normalized Electric Demand By Hour and Month

- Normalized Electrical Demand: Average = 1
- Aug / Sep discrepancies reduce when compared to historical 2018 – 2020
- Observations:
  - Increase load: Summer
  - Decreased Load: Winter
- Impact of climate change greatest during summer months and can be as large as 10%



Comparing IEPR Forecast to CPUC CIF Model

- IEPR and CPUC forecasts coming up w/relatively similar values for ratio of annual peak to median daily
- Chart also shows evolution of peak to median daily ratio under warming climates
- 2010 column is not that different then the IEPR Planning column
- Given that peak and energy are important metrics to compare, illustrates robustness of our MONASH method, and our approaches are comparable.
- Ratio gets larger as climate change escalates

	CEC (IEPR) and CPUC (CIF) Ratios of Annual Peak to Median Daily				
Region	IEPR_2022_Planning	2010 (1.066 C)	2035 (1.702 C)	2043 (2.000 C)	2068 (3.000 C)
CAISO		1.83	1.87	1.88	1.92
LADWP	2.06	2.15	2.20	2.22	2.31
PGE	1.90	1.70	1.73	1.75	1.78
SCE	2.13	2.07	2.11	2.13	2.20
SDGE	1.96	1.82	1.88	1.90	2.03
SMUD	2.27	2.59	2.69	2.77	2.92

Region	Delta (%)
CAISO	
LADWP	-4.1%
PGE	10.1%
SCE	2.7%
SDGE	7.0%
SMUD	-14.1%

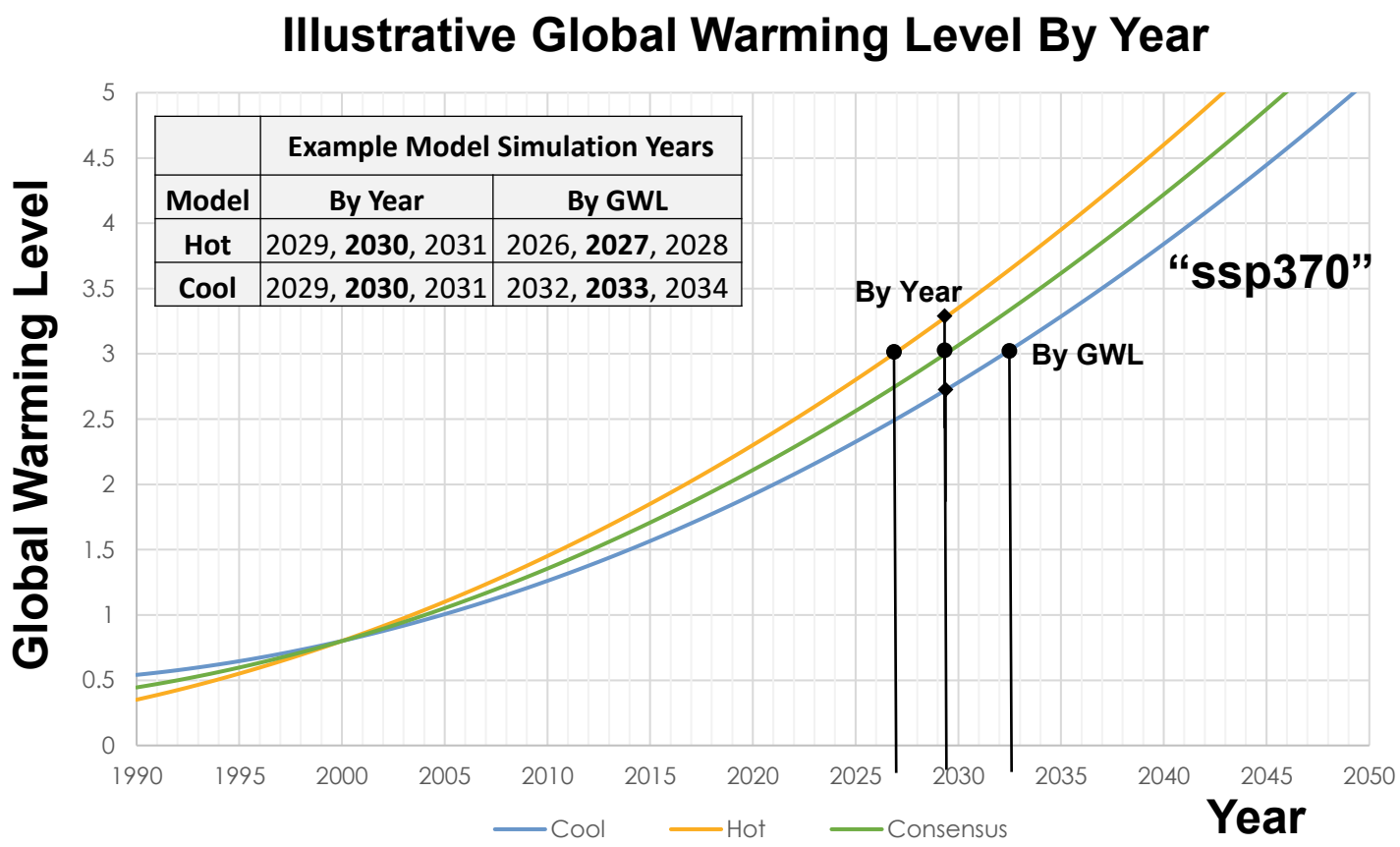
Region	2035 (1.702 C)	2043 (2.000 C)	2068 (3.000 C)
CAISO	1.8%	2.5%	4.9%
LADWP	2.4%	3.5%	7.7%
PGE	1.6%	2.4%	4.5%
SCE	2.1%	2.9%	6.2%
SDGE	3.0%	3.9%	11.0%
SMUD	4.2%	7.0%	12.8%

How to Combine / Weight Different CMIP6 Models?

- Under CA's Fourth Climate Change Assessment, Department of Water Resources Climate Change Technical Advisory Group limited set of preferred CMIP5 models
  - No limitations have been placed on use of CMIP6 models
- Different climate models will estimate varying levels of Global Warming Level by year
  - Some models will be 'hot'
- The recommended approach used in the latest IPCC assessment (AR6):
  - ***Simulation ensembles compared around GWL, not year, are found to reflect the most unbiased projections, consistent with 'assessed warming'***
- In this way ALL models may be considered in the development of the consensus for each climate variable being examined
- Climate simulations: recognize the 'hot model' problem
  - "The sixth and latest IPCC assessment weights climate models according to how well they reproduce other evidence. Now the rest of the community should do the same."
    - https://www.nature.com/articles/d41586-022-01192-2

IPCC Recommendation For Fixing the "Hot Model" Problem: Minimizing Model Bias

- Consensus GWL by year based on equal weighting of available models
- Each GCM simulation corresponds to one year
- Once target year-GWL combo is determined from consensus, ***use model simulations taken around GWL, not Year***
- Minimizes model bias



Next Steps

- Does proposed approach support policy objectives?
  - Integrate with evolving IEPR and IRP Processes
    - How does this process evolve when CEC develops stochastic dataset
- Normalized electric demand profiles ready for use in PCM studies
  - Preliminary estimates substituting CIF normalized electric demand forecast shapes showing significant impacts on reliability
- Develop additional synthetic production profiles to support IRP CIF efforts
  - solar, wind and hydro
- Add additional functionality to PCM efforts:
  - Synthetic temperature profiles allow us to model, under a warming climate:
    - Generator efficiency
- We continue to vet our approach and coordinate with CEC Planning and Forecasting Group
- Q4 2023: Currently implementing and testing this approach

Discussion Questions

- Are there any barriers to implementing the GWL approach?
  - Computational feasibility?
- Did the methodology and results reported by SCE make sense to stakeholders?
  - Is this approach risk analysis sufficiently interpretable and reproduceable for the purposes of the CAVA?
- Is there a preference for the Commission to mandate specific approaches to bias correction vs. allowing flexibility?

Lunch Break
12:00 pm-1:00 pm

Energy Division Presentation on Modeling, Investment, and Procedural Linkages for Climate Adaptation

Task 1 Issues: Emission Scenarios

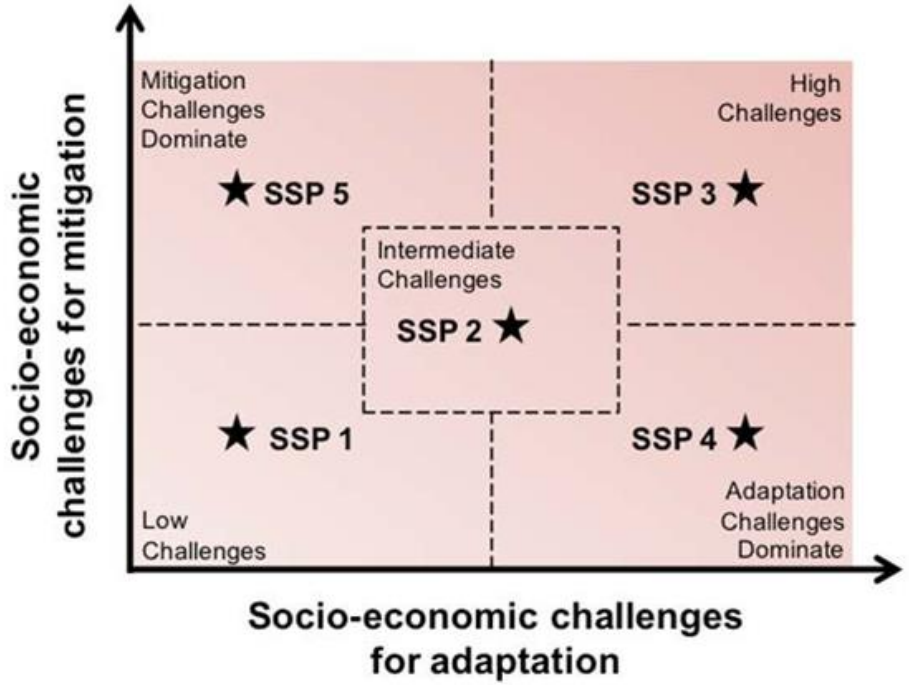
- Should the Commission refine the requirement that Representative Concentration Pathway (RCP) 8.5 be used for planning, investment, and operational purposes?
- If yes, should the Commission again specify use of one or more specific scenarios for preparation of the CAVAs and for planning, investment, and operational purposes?
- Should the Commission require the IOUs to conduct sensitivity analyses over one or more emission scenarios? If yes, which emission scenarios and what type of sensitivity analyses?

Procedural Background: Representative Concentration Pathway (RCP) 8.5

- D.19-10-054 adopted three specific requirements in relation to the use of RCP 8.5
  - **OP 3**: "**The energy utilities shall adhere to at least the same climate scenarios and projections used in the most recent California Statewide Climate Change Assessment when analyzing climate impacts**, climate risk, and climate vulnerability of utility systems, operations, and customers. Third party analyses or datasets used by the energy utilities should be derived from or based on the same climate scenarios and projections as the most recent Statewide Climate Change Assessment."
    - **OP3b:** "If the Fifth Assessment or future Assessment updates these climate scenarios and projections, the **energy utilities shall align their analyses with the newly adopted scenarios and projections**."
  - **OP 4: "Energy utilities are directed to use the business-as-usual Representative Concentration Pathways 8.5 for planning, investment and operational purposes."**
  - **OP 6**: "**If the Fifth Assessment or a future Assessment updates these models, representative concentration pathways, climate scenarios or projections, the energy utilities shall align their analyses with those updates** by filing a Tier 3 Advice Letter with Energy Division within six months of the new Assessment update."

Moving Away from Use of RCP 8.5

- Representative concentration pathway (RCP) 8.5 is one of several scenarios developed by climate experts to provide plausible descriptions of the future, based on socio-economic scenarios of how global society grows and develops.
- Each RCP represents a level of radiative forcing, which measures the combined effect of greenhouse-gas emissions and other factors (such as atmospheric aerosol levels) on climate warming.
  - RCP 8.5 = 8.5 W per square meter excess radiative loading in the year 2100 due to anthropogenic carbon emissions. Current baseline is 340 W/m2
- The RCPs were used for the IPCC 5th Assessment Report, but the IPCC has since transitioned to the use of Shared Socio-economic Pathways (SSPs).
- Cal-Adapt will be updated to include the latest IPCC data in 2023, **which will no longer include RCP baselines**. They will be replaced with SSPs.



Stakeholder Perspectives

- All parties were in consensus that:
  - The Commission should revise its guidance related to the use of RCP 8.5 and transition to the use of Shared Socio-economic Pathways (SSPs)
  - The Commission should again adopt a specific reference scenario or scenario(s) for the purposes of standardization
  - A workshop should be held to reach consensus on which emissions scenario should be adopted
- Parties disagreed on the need for sensitivity analysis across emission scenarios in the CAVAs
  - No IOUs supported a Commission requirement of this type, citing to concerns regarding usefulness of results

Energy Division Recommendation - Commission adoption of SSP3-7.0 in place of RCP 8.5

- Energy Division recommends that the Commission again adopt a single emissions pathway for planning, investment, and operational purposes. We recommend that the Commission adopt **SSP3-7.0**.
  - *Rationale*: Consistency
    - The California Climate Change assessment will utilize Shared Socioeconomic Pathways for the 5th Assessment.
    - The California Electricity Demand (CED) forecast that is adopted as part of the annual Integrated Energy Policy Report (IEPR) will be utilizing downscaled CMIP6 GCMs under SSP3-7.0 to make the forecast climate-informed
    - The Integrated Resource Planning (IRP) modeling team has developed their methodological approach for climate-informed forecasting under SSP3-7.0 as well.

Energy Division Recommendation: Sensitivity Analysis and Emission Scenarios

- Energy Division recommends **against** conducting sensitivity analysis across emission scenarios in the CAVAs. We find it reasonable to limit sensitivity analysis across emissions scenarios for investment proposals when warranted.
  - *Rationale*: Usefulness of results
    - Sensitivity analysis across scenarios provides the most useful information when looking far out into the future (>30 years). Near-term risk (10-20 years) will likely show marginal differences in risk results. If near-term risk is ultimately prioritized for investment, then marginal differences in results will not provide a large enough spectrum of risk to be useful to decision-makers.
    - Sensitivity analysis across scenarios is most beneficial for site or asset-specific analysis. As discussed later, ED proposes sensitivity analysis requirements for specific investments originating with the CAVA; such analysis should be preserved for those proposals instead of included in the CAVAs itself.

Discussion Questions

- Are there any concerns with ED's recommendations or rationales regarding either the adoption of SSP3-7.0 or the issue of sensitivity analysis?
- If, in the future, the IPCC issues or the California Climate Assessment uses different scenarios to those described here, what type of Commission review or approval would be necessary before the utilities could use a new scenario (that has been endorsed by a relevant external authority) in the CAVA?
- If SSP3-7.0 is ultimately adopted along with a GWL framework, is it sufficient to require the IOUs to plan to the median GWL/year produced under SSP3-7.0? Is more discussion needed?

Task 1 Issues: Linkages of the CAVA and the GRC

- Should the Commission provide additional guidance regarding the inclusion of climate adaptation projects in GRC applications or in freestanding climate adaption investment applications?
- Should such guidance identify criteria for prioritization of climate adaptation projects? If yes, what criteria should the IOUs use to prioritize climate adaptation investments?
- Should such guidance outline minimum information or other requirements regarding each adaptation investment?
- Should the Commission express a preference for the inclusion of climate adaptation investments in GRCs versus freestanding applications?

Energy Division Staff Proposal on Climate Adaptation Investment Guidance

- Clarify Commission guidance on what type of investments should be included in the CAVA chapter of the GRC or free-standing applications, and how investments should be presented
- Note potentially conflicting guidance in D.20-08-046:
  - **"We expect that any new infrastructure, operations, or services the utilities propose in their GRC to be informed by their analysis of climate change impacts to their territory**. The vulnerability assessment will be an intermediate step to identify the risks of climate change and mitigation options, leading to approval of alternatives and associated financing in the GRC or other project approval applications." (p. 84, emphasis added)
  - "[PG&E, SDG&E, and SCE] shall include in their [GRC] filings the main takeaways from the vulnerability assessments as a separate section or chapter that contains, at a minimum: 1) a list of vulnerabilities, 2) proposals addressing those vulnerabilities (with options), and 3) long-term goals for adapting to climate risks." (Ordering Paragraph 12). [Abbreviated for brevity]

ED Recommendations: General Requirements

1. *Incrementality*: CAVA Investment Proposals presented in the CAVA-dedicated chapter of a GRC or in a stand-alone application must be demonstrably incremental to investments approved for reliability, safety, and resiliency purposes in the utility's most recent GRC.

2. *Prioritization*: CAVA Investment Proposals should prioritize infrastructure that is classified in the CAVA as high-risk and low-adaptive capacity within the 10-20-year analytical timeframe. If infrastructure deemed as high-risk, low-adaptive capacity in the later analytical timeframes is proposed, the utility should justify why the investment is necessary to make in advance.

ED Recommendations: Information Requirements

1. When presenting CAVA Investment Proposals in either in the CAVA-dedicated chapter of the GRC or in free-standing applications, the IOUs should provide the following information:

   - *Cost-Effectiveness*: Comparative cost forecasts between the proposed CAVA Investment Proposal and alternative adaptation options identified in the CAVA for the purposes of demonstrating that the proposed investment is the least-cost, best-fit option.

   - *Justification of Investment*: Description of the constraints that prevent the CAVA Investment Proposal from being accounted for in the spending categories of, including but not limited to, wildfire mitigation and RAMP, along with a detailed description of the controls the utility will implement to ensure that costs related to CAVA Investment Proposals are not duplicative of any other costs presented for approval or already approved by the Commission.

ED Recommendations: Sensitivity Analysis Requirements

1. Energy Division recommends that the utilities provide sensitivity analysis for CAVA Investment Proposals that is supplemental to the analysis conducted in the CAVA.
2. Such supplemental analysis should be limited to investments that exceed the following cost thresholds:
    - For PG&E, SCE, and SoCalGas: cumulative $75 million over four years for capital programs, and $15 million in the test year for expense programs;
    - For SDG&E, cumulative $37.5 million over three years for capital programs and $7.5 million in the test year for expense programs.

ED Recommendation: Guiding Principles for CAVA Investment Proposal Sensitivity Analysis:

1. Consider multiple climate futures as a way to demonstrate both the likelihood of risk and the ability of the investment to perform reliably;

2. Consider key vulnerability thresholds, beyond which systems will have problems or cannot operate effectively; and

3. Help decision-makers understand where the deepest sources of uncertainty are in the analysis.

Discussion Questions

- Clarifying questions/general reactions to staff's proposal?
- Does Staff's proposal sufficiently implement cost controls while maintaining flexibility?
- Are the cost-thresholds for sensitivity analysis reasonable?
- Are the guiding principles for sensitivity analysis reasonable?
- Is enough and the right information required regarding CAVA Investment Proposals?

Task 3 Issues: Linkages Between the CAVA and Commission Proceedings Outside of RAMP and GRC

- Should the Commission implement measures to integrate climate change considerations into other proceedings so that the climate projections reflected in the IOUs' CAVAs are factored into related regulatory planning processes?
- If yes, how should the Commission identify proceedings that are addressing matters relevant to or impacted by climate resilience issues and climate-informed decision-making? What proceedings are most important for the Commission to focus on and why?
- How can R.18-04-019 drive consistent and additive treatment of physical climate risk considerations in Commission proceedings (beyond RAMP and GRC proceedings) to create a more resilient energy system for the benefit of customers?

Task 3 Issues: Linkages of the CAVA and Commission Proceedings Outside of RAMP and GRC (cont.)

- How should climate data and CAVA results be used within proceedings other than RAMP and GRC proceedings? What potential endpoints, information or outputs can be defined to be taken into other proceedings?
- What is the appropriate role of R.18-04-019 to influence system and resource planning, including but not limited to the CAVA survey requirements for third party contracts adopted in D.20-08-046?
- Are any feedback loops from other proceedings into R.18-04-019 needed (e.g., such as improved provision of incident data to inform CAVA processes)?

Task 3: Integration of Climate Change Considerations into Other Proceedings

Stakeholder Perspectives

- All but one party supported the integration of climate projections into other Commission proceedings
  - The utilities pointed to the major planning proceedings that utilize climate and weather data as the prioritized starting points: Integrated Resource Planning (IRP), Long-Term Procurement Planning (LTTP), High Distributed Energy Resources (DER) Proceeding, and CAISO's Transmission Planning Process (TPP).
  - Dissenting party did not support R.18-04-019 becoming an "umbrella proceeding"

Task 3: Integration of Climate Change Considerations into Other Proceedings

- Energy Division agrees with the IOUs that the Commission planning proceedings that maintain longer-term planning horizons and rely on load forecasting to inform grid needs should be the priority for integrating forward-looking climate data.
- The recent IEPR demand forecast developments are critical to this policy discussion:
  - The CEC will adopt its proposed climate-informed forecasting method into the California Electricity Demand (CED) forecast this IEPR cycle (2023).
  - This will produce a CED, Typical Meteorological Year (TMY) and associated 1-in-Ns that are informed by CMIP6 GCMs
  - **With these climate-informed planning inputs, which underpin the IRP, Resource Adequacy, TPP, and distribution planning forecasts, what additional planning gaps R.18-04-019 should address, if any?**

Discussion Questions

- With CEC's planned use of climate-informed planning inputs, which underpin the IRP, Resource Adequacy, TPP, and distribution planning, what additional planning gaps R.18-04-019 should address, if any?
- Should the Commission leave it to individual planning proceedings to decide how forward-looking climate data should be utilized? Or should the proposed methodologies be vetted in R.18-04-019?
- Are there additional energy-related planning gaps that need "climate-informing?"
  - Disaggregation process of IEPR demand forecast for distribution planning?

15-minute break

PG&E Presentation on Tasks 1 & 3

Climate Adaptation OIR Phase II

PG&E's Positions on Task 1 and Task 3

R.18-04-019 - Phase 2 Workshop October 2, 2023

Nathan Bengtsson, Lead - Climate Resilience
Eric Kuhle, Expert - Climate Resilience

Background, Purpose, Desired Outcomes

Background

- IOUs are still in beginning the process of completing their first ever Utility Climate Adaptation Vulnerability Assessments (CAVAs).

Purpose

- Utility CAVAs are one of several risk assessments that consider safety impacts to energy systems. There remains questions on the role of Utility CAVAs in informing Utility's larger investment plans.

Desired Outcomes

- A shared view of the role of CAVAs in how they can inform Utility efforts to develop a more climate resilience energy system, while considering customer needs and issues.

Overall Objective: Create a framework for Utility Climate Vulnerability Assessments (CAVA) that can inform larger utility efforts to develop a more climate resilient energy system.

PG&E's Task 1 Issue Questions:

- What type of changes to Utility CAVA's could help further integrate findings and results with Utility RAMP/GRC risk and planning requirements?
- Should climate adaptation investments be considered with the same framework as other Utility investments or does the scale and complexity of the problem warrant new decision criteria?

PG&E's Task 3 Issue Questions:

- What is the role of Climate Data and CAVA findings for informing larger utility planning efforts and what are the primary objectives of presenting a climate-informed outlook?
- What is needed for the creation of a more resilient energy system for the benefit of customers, and can just Utilities achieve the desired outcome alone?

Task 1, Question (a)

a. Should the Commission again specify use of one or more specific emissions scenarios to prepare their CAVA and for planning, investment, and operational purposes? Or, should the IOUs be given flexibility to determine what scenarios to use in CAVA modeling and whether to use one or more than one scenario?

- The complexity of climate hazard analysis requires flexibility in methodology given the evolution of climate science and a shared industry approach.
  - Guidance on a baseline climate risk scenario could provide a common denominator for planning and evaluation.
- Flexibility will help Utilities in maturing climate hazard analysis and management of this cross-cutting risk.
  - PG&E would ask any framework allow Utilities to evolve with the science and internal requirements.
- The ultimate scope and objective of the IOUs second CAVAs will determine the need for multiple SSPs or scenario analysis.

PG&E Responses to Phase II Scoping Memo & Ruling

"Yes. PG&E suggests the Commission refine the requirement that Utilities use RCP 8.5 for climate hazard analysis to align with the next generation of climate models from the Coupled Model Intercomparison Project Phase 6." *(PG&E response to Q1)*

"PG&E suggests that the Commissions specify a "reference" SSP to be used by all Utilities for climate vulnerability assessment purposes….The value of a reference SSP is that it establishes a shared vision of the future for planning purposes. " *(PG&E response to Q2)*

Task 1, Question (c)

c. Should the Commission provide additional guidance regarding the inclusion of climate adaptation projects in GRC applications or in freestanding climate adaption investment applications?

- An iterative process would be beneficial to spur action today, while Utilities formalize more structured responses to the impacts of climate change.
- Climate Resilience cannot live in a vacuum inside the utility and will require a whole-of-utility approach to address this issue systematically throughout a utility's investment planning and risk processes.
- Building climate resilience is a long-term process and will require a coordinated approach across many important planning, risk, and investment processes.

PG&E Responses to Phase II Scoping Memo & Ruling

"In this rulemaking the Commission and Parties should consider whether such guidance is needed….

Whatever structure is created or agreed upon to support Utility climate adaptation investments, it must provide the flexibility for Utilities to address investments in each of these categories. " *(PG&E response to Q11)*

"Climate hazards are by nature localized and variable, so it is important that interventions be designed to the specific needs revealed by CAVA analysis." *(PG&E response to Q22)*

Task 1, Question (d)

d. Should such guidance identify criteria for prioritization of climate adaptation projects?

- PG&E recognizes action is needed today to address climate change, yet it may be too early to consider a new prioritization criteria.
- Given the early stage of directed climate adaptations from Utility CAVAs, PG&E believes any guidance should emphasis flexibility and innovation.
- There is no silver-bullet climate adaptation plan or easy solution, strategy, or technology to make utilities resilient to the impacts of climate change.

PG&E Responses to Phase II Scoping Memo & Ruling

"No. Establishing criteria for prioritization of climate adaptation investments is premature given that three of four Utilities have not yet filed adaptation assessments and many questions remain regarding how to manage projects stemming from CAVAs.

PG&E expects that many of the same policy principles that guide prioritization of near-term utility investment will apply to climate resilience investment. " *(PG&E response to Q11 a)*

Task 1, Question (e) – Part 1

e. Should such guidance outline minimum information or other requirements regarding each adaptation investment?

- ***PG&E believes that guidance or other requirements for climate adaptation projects is currently premature.***
- Incentives to innovate with more flexibility in funding requests would be helpful to spur utility action today to develop a more climate resilient energy system.
- PG&E believes that building climate resilience, utilities will need to balance near-term adaptation investments with a longer-term, and more comprehensive, climate adaptation strategies.
  - PG&E is supportive of SoCal Edison approach that used its CAVA finding to request supplemental funding in their 2025 GRC Application.
- PG&E supports further consideration of this topic beyond this workshop.

PG&E Responses to Phase II Scoping Memo & Ruling

"PG&E expects that climate adaptation investments will likely fall into a few general categories:

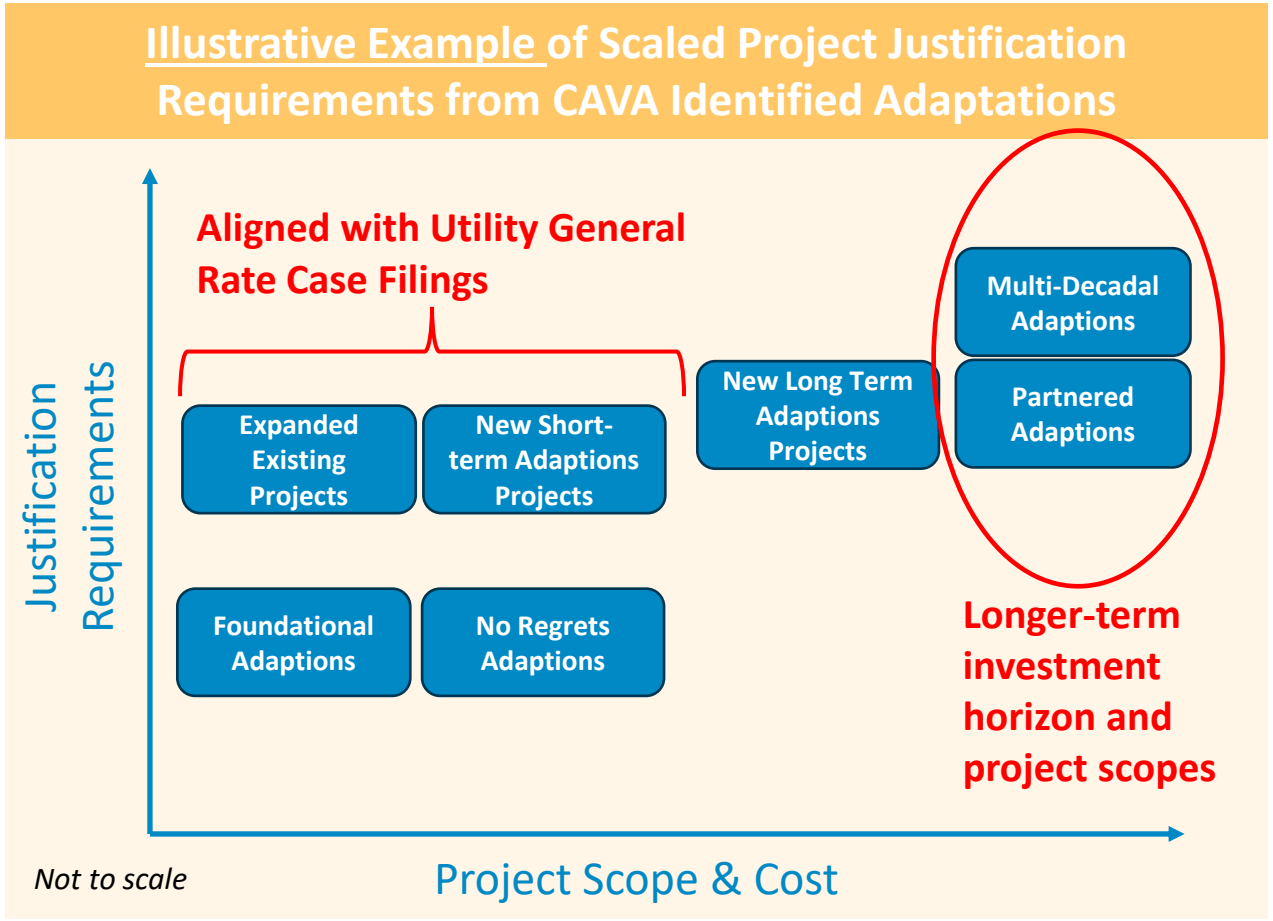
- "**No regrets**" / "**Proactive adaptation**" / "**Partnered adaptation**" *(PG&E response to Q11)*

PG&E Reply Comments to Phase II Scoping Memo

"PG&E sees value in recognizing a category of investments that are not justified via traditional cost-benefit analysis, but which are necessary and valuable based on future climate hazards." *(PG&E response page 7)*

Task 1, Question (e) – Part 2

e. Should such guidance outline minimum information or other requirements regarding each adaptation investment?



- ***PG&E believes that guidance or other requirements for climate adaptation projects is currently premature.***
- Climate Adaptation investment options identified through Utility CAVAs will come in many forms and should inform utility investment plans.
- Climate adaptation projections have some unique issues that warrant further conversation, but a defined approach may be premature.
  - Consider how utilities fund and justify projects where collaboration with other entities would be either beneficial or required (e.g., regional sea level rise partnerships).
  - Consider multi-decadal adaptation strategies that do not currently align well with shorter-term GRC/RAMP investment periods.

Task 1 Issues: Insights

Task 1 Issues: Refinements to CAVA Requirements for Large Investor-Owned Utilities (IOUs) and CAVA Linkages to RAMP and General Rate Case (GRC) Proceedings

1. The complexity of climate hazard analysis requires flexibility in methodology. A baseline climate risk scenario could provide a common planning vision.

2. Given the early stage of directed climate adaptations from Utility CAVAs, PG&E believes any guidance should emphasis flexibility and innovation.

3. There is no silver-bullet climate adaptation plan or easy solution, strategy, or technology to make utilities resilient to the impacts of climate change.

4. PG&E believes that building climate resilience, utilities will need to balance near-term and no-regrets options with longer-term and more comprehensive climate adaptation strategies that may or may not align well with the GRC investment time periods.

Overall Objective: Create a framework for Utility Climate Vulnerability Assessment (CAVA) that can inform larger utility efforts to develop a more climate resilient energy system.

PG&E's Task 1 Issue Questions:

- What type of changes to Utility CAVA's could help further integrate findings and results with Utility RAMP/GRC risk and planning requirements?

- Should climate adaptation investments be considered with the same framework as other Utility investments or does the scale and complexity of the problem warrant new decision criteria?

Task 3, Question (a)

a. Should the Commission implement measures to integrate climate change considerations into other proceedings so that the climate projections reflected in the IOUs' CAVAs are factored into related regulatory planning processes? Which proceedings should integrate CAVA data for consistency?

- A consistent climate framework across CPUC proceedings will provide further transparency for why certain investments (Capacity & safety) are required and supported by a shared view of the future in utility planning.
  - CAVA data is just a sub-set of the larger dataset needed for utilities to reflect the impacts of climate change for internal planning functions.
- Building climate resilience can be a larger issue than any IOU can achieve on its own and more active participation is needed with stakeholders and other regulatory bodies.

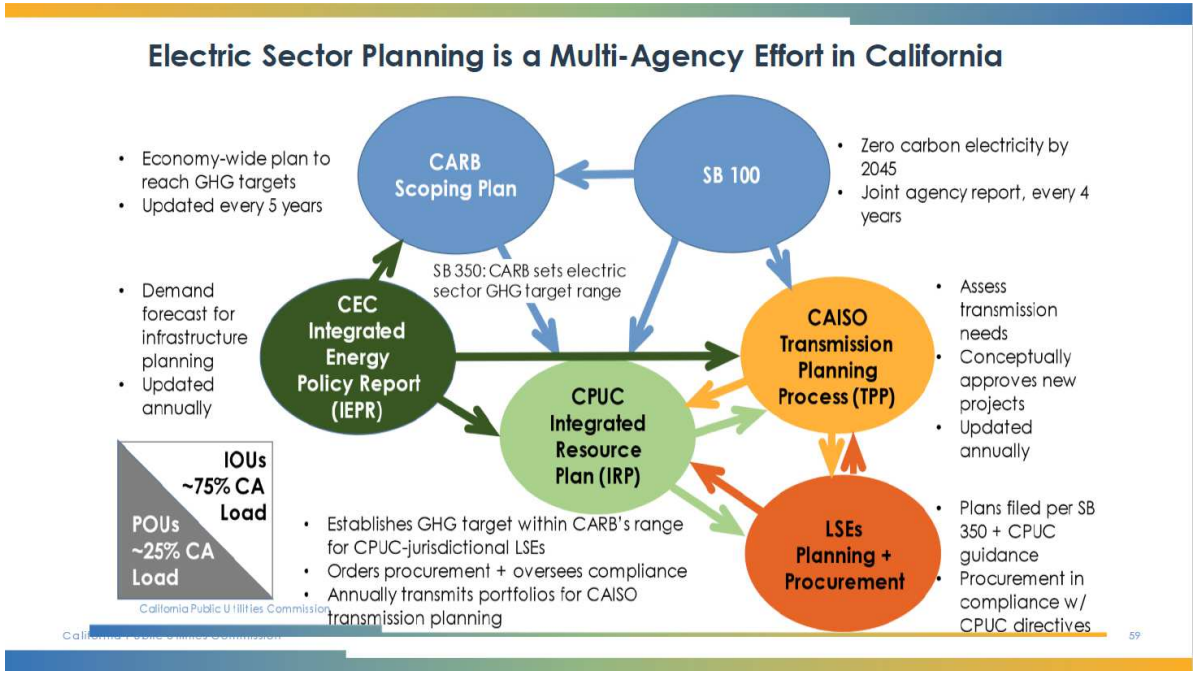
PG&E Responses to Phase II Scoping Memo & Ruling

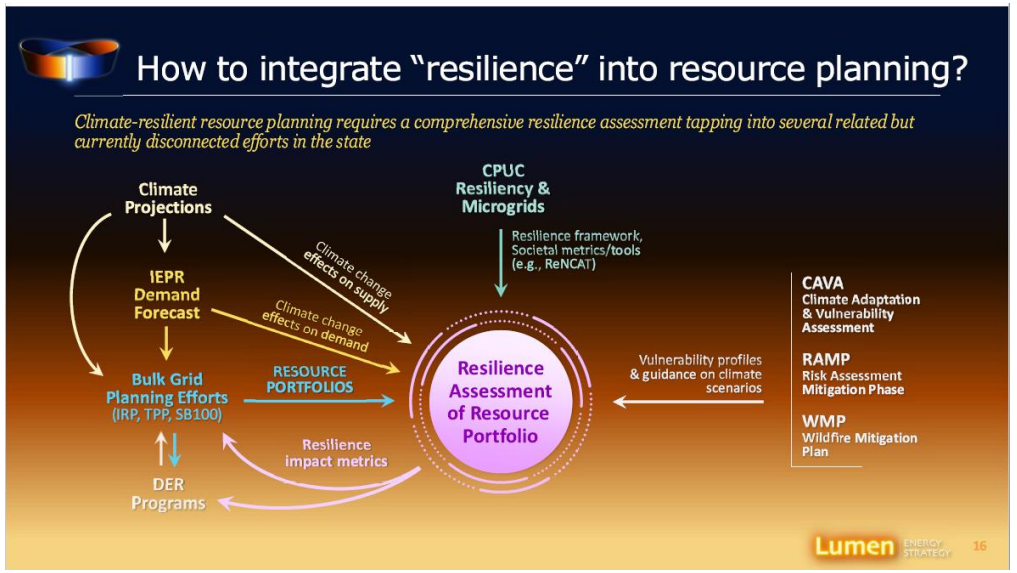
"PG&E supports the establishment of a shared reference scenario to be used consistently across energy planning proceedings, likely in the form of a preferred SSP with guidance regarding preferred model ensemble and probability thresholds." *(PG&E response to Q13)*

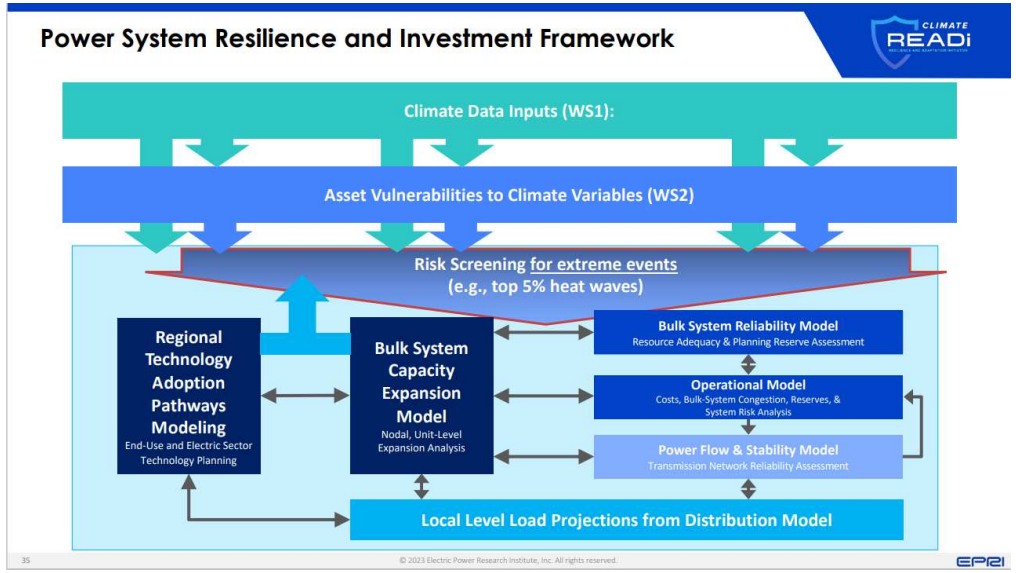
"PG&E suggests the Commission start by prioritizing proceedings that use climate and weather data for planning future electric grid requirements. This would include, but is not limited to, proceedings falling under Integrated Resource Plan and Long-Term Procurement Plan. An additional subset of Commission proceedings would be those with implications to electric and natural gas system planning that extend to ten years and beyond." *(PG&E response to Q14)*

Task 3, Question (f) – Part 1

f. How can R.18-04-019 drive consistent and additive treatment of physical climate risk considerations in Commission proceedings (beyond RAMP and GRC proceedings) to create a more resilient energy system for the benefit of customers?







- 'Resilience' and/or 'climate resilience' should be considered as part of larger trends as the State moves to a 21st Century Energy System that supports decarbonization goals and affordability.

Task 3, Question (f) – Part 2

f. How can R.18-04-019 drive consistent and additive treatment of physical climate risk considerations in Commission proceedings (beyond RAMP and GRC proceedings) to create a more resilient energy system for the benefit of customers?

- Energy-sector climate resilience can be accelerated via a coordinated and consistent policy framework and planning vision.
- Considering only safety and asset risks will provide a partial solution to climate resilience needs for Utilities.
  - Capacity needs and reliability impacts should also be considered as part of Utility investment strategies.
- Further consideration is warranted to determine what being resilient to different climate hazards means for utilities planning and investment decisions.

PG&E Responses to Phase II Scoping Memo & Ruling

"PG&E suggests that this proceeding could have a major role in maturing California's energy planning ecosystem by establishing a shared view of how to include future climate impacts and conditions across the CEC, CPUC, ARB, and the Utilities. This would be a critical first step to better climate-informed system planning, as out-of-date meteorological data still inform many energy planning assumptions." *(PG&E response to Q 19)*

"In PG&E's view, it is more critical that standards for use of climate data be propagated from this proceeding to other proceedings….The primary inputs for CAVA analysis are climate projections and asset data which are readily accessible for utilities through the State's ongoing Climate Assessments." *(PG&E response to Q20)*

Task 3 Issues: Insights

Task 3 Issues: Proceedings Beyond RAMP and GRC Proceedings

1. Energy-sector climate resilience can be accelerated via a coordinated and consistent policy framework.

2. Building climate resilience is a larger issue than any IOU can achieve on its own. Active participation with other stakeholders is needed.

3. Lack of transparency in assumptions and data sourcing can delay the development of a shared vision of the future to plan toward.

4. There is a difference in CAVA vs. Climate change data and impacts to other utility and planning functions.

Overall Objective: Create a framework for Utility Climate Vulnerability Assessment (CAVA) that can inform larger utility efforts to develop a more climate resilient energy system.

PG&E's Task 2 Questions:

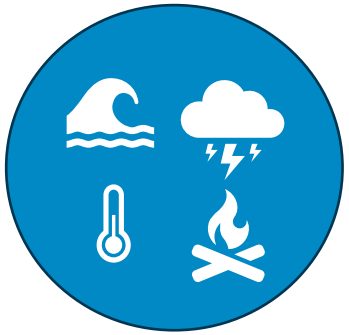
- What is the role of Climate Data (and CAVA findings) and types of climate data to be used to inform larger utility planning efforts?

- What is needed for the creation of a more resilient energy system for the benefit of customers, and can just Utilities achieve the desired outcome alone?

Climate Change Impacts Multiple Priorities of an Integrated Risk-Based Decision-Making Framework

There is a wide degree of maturity in understanding & quantifying the impacts of climate change to grid priorities. Doing so will take a concerted enterprise effort.

Climate Change



Reliability
Minimize downtime from planned and unplanned events

Capacity
Enable capacity requirements driven by building and transportation electrification

Equity
Provide equitable service and access to all customers

Integrated Risk-Based Decision-Making

Flexibility
Increase flexibility on the grid to accommodate DERs

Risk
Reduce the risk of wildfires and mitigate long-term impacts of climate change

Asset Health
Address routine asset needs such as age, degraded material, environment, etc.

Summary of Insights

Framing Issues for this Discussion
• Having a clearly defined goal of the Phase II outcome for future Utility CAVAs will help clarify answers to specific questions posed today. • Acknowledgement that Utility CAVAs are just an initial step in building climate resilience for the State's energy system and they alone will not achieve this objective. • Climate resilience must be considered in the context of other important goals and priorities. • Energy-sector climate resilience can be accelerated via a coordinated and consistent policy framework.

Task 1 Insights	Task 3 Insights
1. The complexity of climate hazard analysis requires flexibility in methodology. 2. Any guidance should emphasis flexibility and innovation. 3. There is no silver-bullet climate adaptation plan. 4. Utilities will need to balance near-term and no-regrets options with longer-term and more comprehensive climate adaptation strategies.	1. Energy-sector climate resilience can be accelerated via a coordinated and consistent policy framework. 2. Building a climate resilient energy system is a larger issue than any one Utility can solve by itself. 3. Lack of transparency in assumptions and data sourcing can delay the development of a shared vision of the future to plan toward. 4. CAVA's climate data is just a subset of the larger climate change data universe.

Thank You

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Discussion Questions (Provided by PG&E)

PG&E's Task 1 Issue Questions:

- What type of changes to Utility CAVA's could help further integrate findings and results with Utility RAMP/GRC risk and planning requirements?

- Should climate adaptation investments be considered with the same framework as other Utility investments or does the scale and complexity of the problem warrant new decision criteria?

PG&E's Task 3 Issue Questions:

- What is the role of Climate Data and CAVA findings for informing larger utility planning efforts and what are the primary objectives of presenting a climate-informed outlook?

- What is needed for the creation of a more resilient energy system for the benefit of customers, and can just Utilities achieve the desired outcome alone?

SCE Presentation on Tasks 1 & 3

SCE Discussion on Climate Phase 2 Tasks 1 and 3

2023-10-02

CPUC Task 1 Issues: Refinements to CAVA Requirements for Large Investor-Owned Utilities (IOUs) and CAVA

Should the Commission again specify use of one or more specific emissions scenarios to prepare their CAVA and for planning, investment, and operational purposes? Or, should the IOUs be given flexibility to determine what scenarios to use in CAVA modeling and whether to use one or more than one scenario?

- The Commission should select a single reference emissions scenario (SSP) to translate selected global warming levels (GWLs) to specific target years
  - Adopted GWLs, with flexibility for divergence to other GWLs with justification, are needed to drive consistency across electric sector's planning processes
- Either SSP3-7.0 or SSP2-4.5 could be used to assign time frames to chosen warming levels
  - Almost all SSPs project warming of 1.5°C above pre-industrial levels in the 2032 timeframe
  - Median estimates for SSP2-4.5 and SSP3-7.0 project warming of 2°C above preindustrial levels in the 2048-2052 timeframe

Should such guidance identify criteria for prioritization of climate adaptation projects? Should such guidance outline minimum information or other requirements regarding each adaptation investment?

- The CAVA is meant to identify vulnerabilities and risks and then develop a portfolio of potential adaptation options
- CAVA Adaptation options are meant to be refined post-CAVA filing as potential investment requests in the GRC or standalone funding requests
  - Additional risk reduction benefits of adaptation investments proposed and funded in previous GRCs can be accounted for in other proceedings
- It is premature for the Commission to define specific standards for investment justifications as any such requirements need to allow for flexibility in how investments are justified

CPUC Task 3 Issues: Linkages Between R.18-04-019 and Other Commission Proceedings Beyond RAMP and GRC

Should the Commission implement measures to integrate climate change considerations into other proceedings so that the climate projections reflected in the IOUs' CAVAs are factored into related regulatory planning processes? Which proceedings should integrate CAVA data for consistency?

- Relevant climate exposure needs to be consistently incorporated across key planning proceedings to "climate inform" outputs and address climate risks that could affect the broader electric system
- CPUC's Integrated Resource Plan (IRP) and High DER proceedings should be targeted for integration as these proceedings define investment needs and are impacted by climate driven load increases
- CAISO's Transmission Planning Process (TPP) should be targeted for integration as future climate projections should inform significant long-term planning approaches and investments

How can R.18-04-019 drive consistent and additive treatment of physical climate risk considerations in R.18-04-019 proceedings (beyond RAMP and GRC proceedings) to create a more resilient energy system for the benefit of customers?

- Adopt GWLs to guide climate exposure assessments, and a reference scenario (e.g., SSP3-7.0) to translate GWL to specific timeframes; identify climate variables (e.g., temperature) to be incorporated in other proceedings
- Allow flexibility in incorporating climate projections for those variables selected by proceeding owners as different planning processes and risk tolerances may create need for different application methodologies
- Develop a prioritization and sequencing for integration of climate projections into other CPUC proceedings beyond IRP based on expected impact, process maturity, and process timing

Commissioner Closing Remarks, Wrap Up & Next Steps

R.18-04-019 Next Steps

- Ruling with Task 1, 3 and 5 questions will be issued for party comment (October – November)
- **Proposed decision on Tasks 1, 3 (and 5) targeted for issuance in Q1 2024**
- Other
  - Ruling directing Small and Multi-Jurisdictional Utilities to file information regarding current climate adaptation efforts (Task 4)(Q1 2024)
  - Workshop and Ruling Questions regarding Task 2, Climate Engagement Plan and Disadvantaged and Vulnerable Community issues (TBD)
  - Exploration of General Orders needing updates to reflect climate adaptation (Task 6) (TBD)
- Questions/ suggestions?

Thank you!

For more Information contact:

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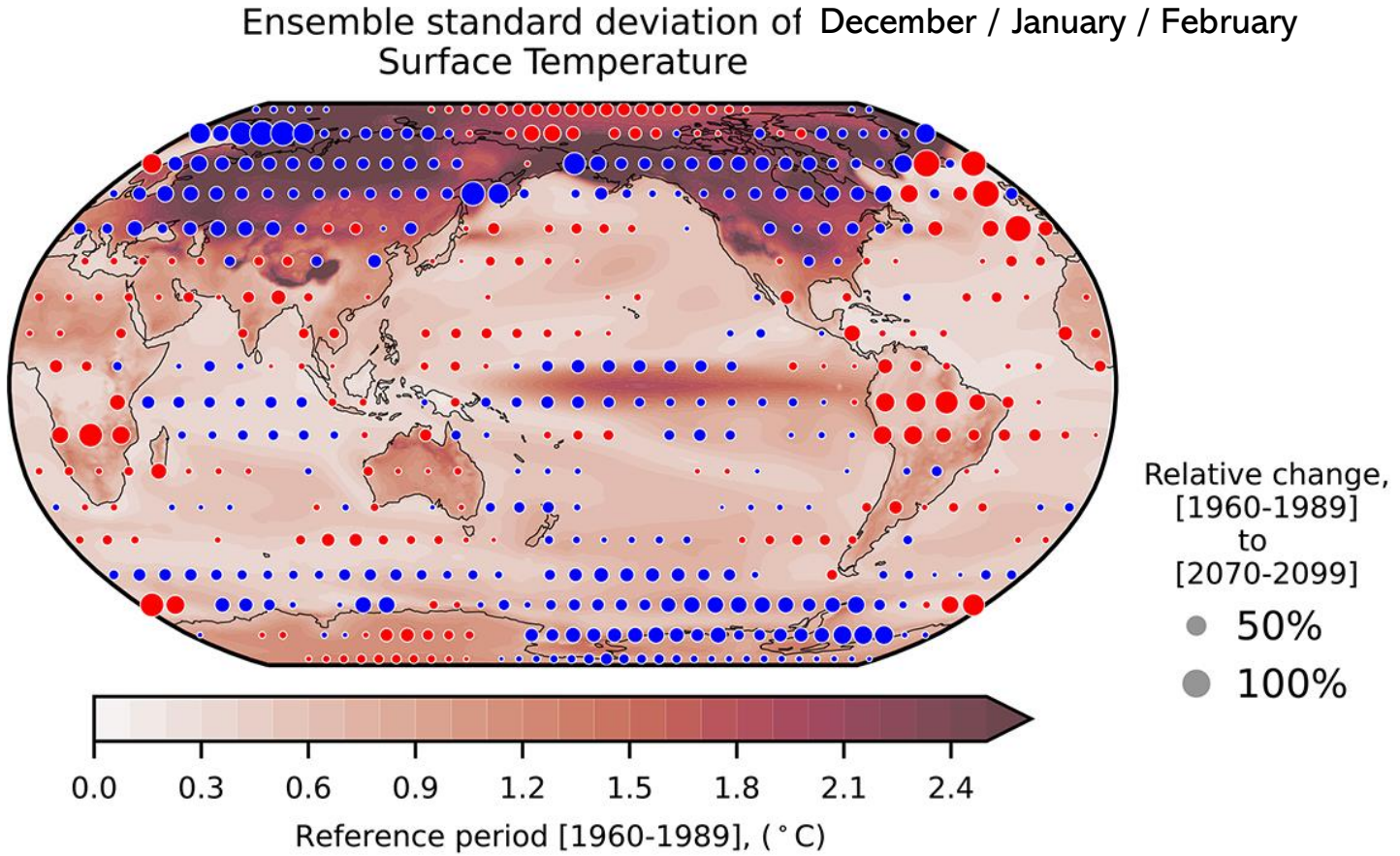
Appendix: IRP Methodology Slides

Climate Variability Examined by Large Ensembles



"Ubiquity of human-induced changes in climate variability," *Earth System Dynamics*, 2021

Electric Demand Forecasting Model

Monash Electric Forecasting Model

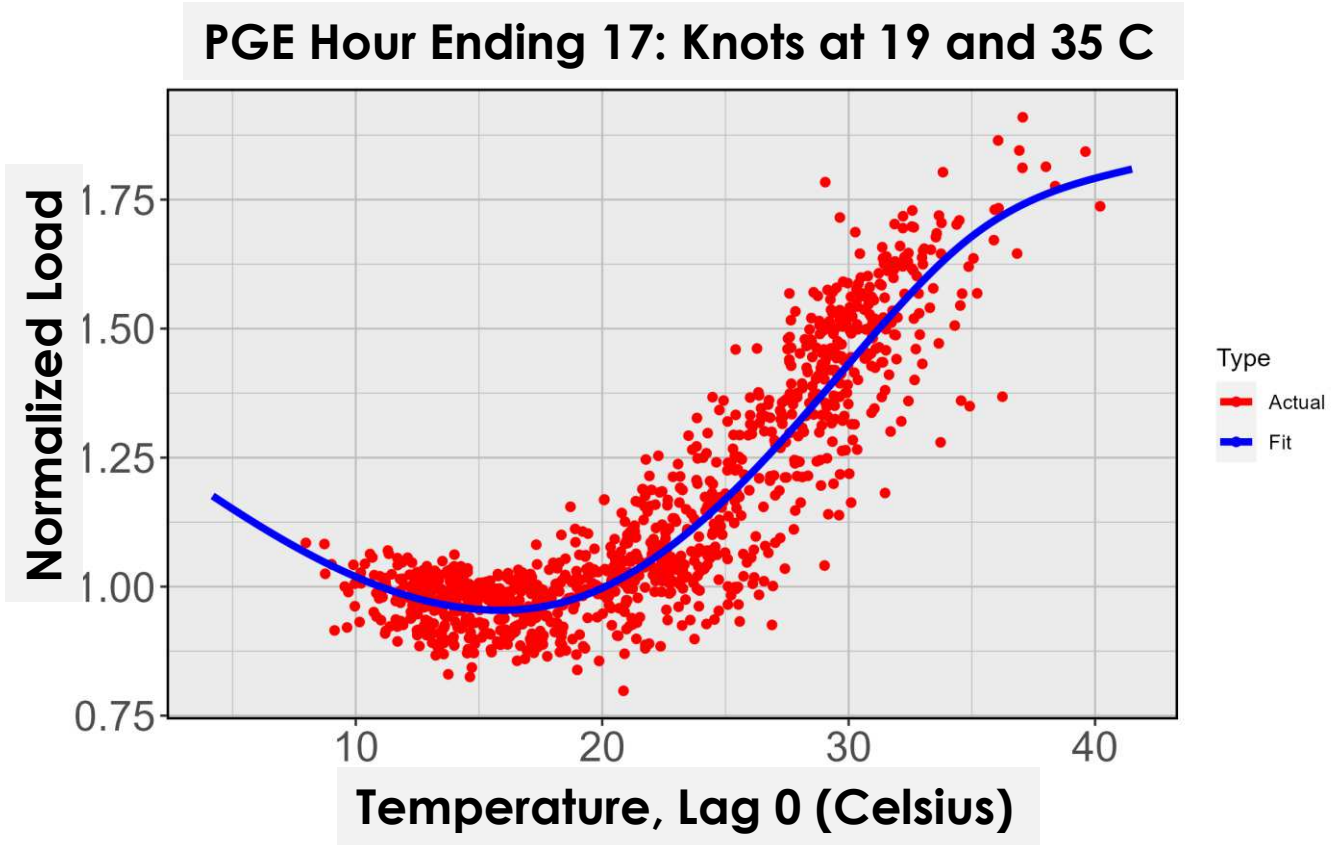
- Hourly Model
- Knot locations optimized for each non-linear variable and hour

Non-Linear Variables

- Temperature: Lag 0, 1, 2, 3
- Median temperature, previous day
- Minimum temperature, previous day

Linear Variables

- Holiday
- Day of week
- Month of year



Adjusting Normalized Load Profiles to IEPR Target: Load 'Stretching'

- IEPR Electric Demand Forecast defined in terms of target peak and average annual mean
- Use linear transformation: $Y_t = aX_t + b$
- Preserves distribution of historical peaks

Define Target Magnitude

$p = target\ mean$

$q = target\ peak$

From IEPR

$N = number\ of\ weather\ years$

$r = Median\{\text{mean}[X_t^n] | n = 1 \dots N\}$ (constant)

$s = Median\{\max[X_t^n] | n = 1 \dots N\}$ (peaks)

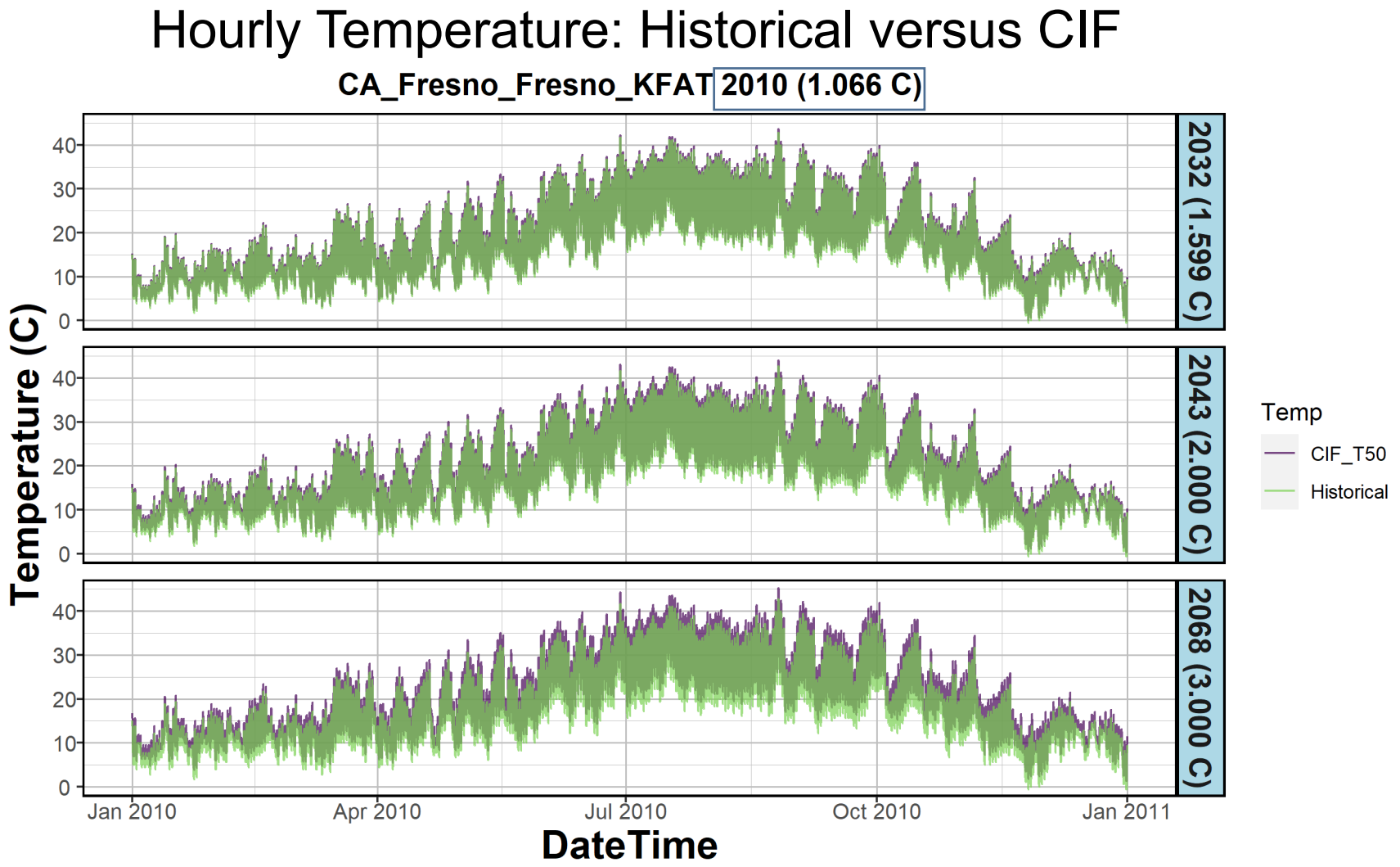
$then$

$$a = \frac{q - p}{s - r}$$

$$b = \frac{ps - qr}{s - r}$$

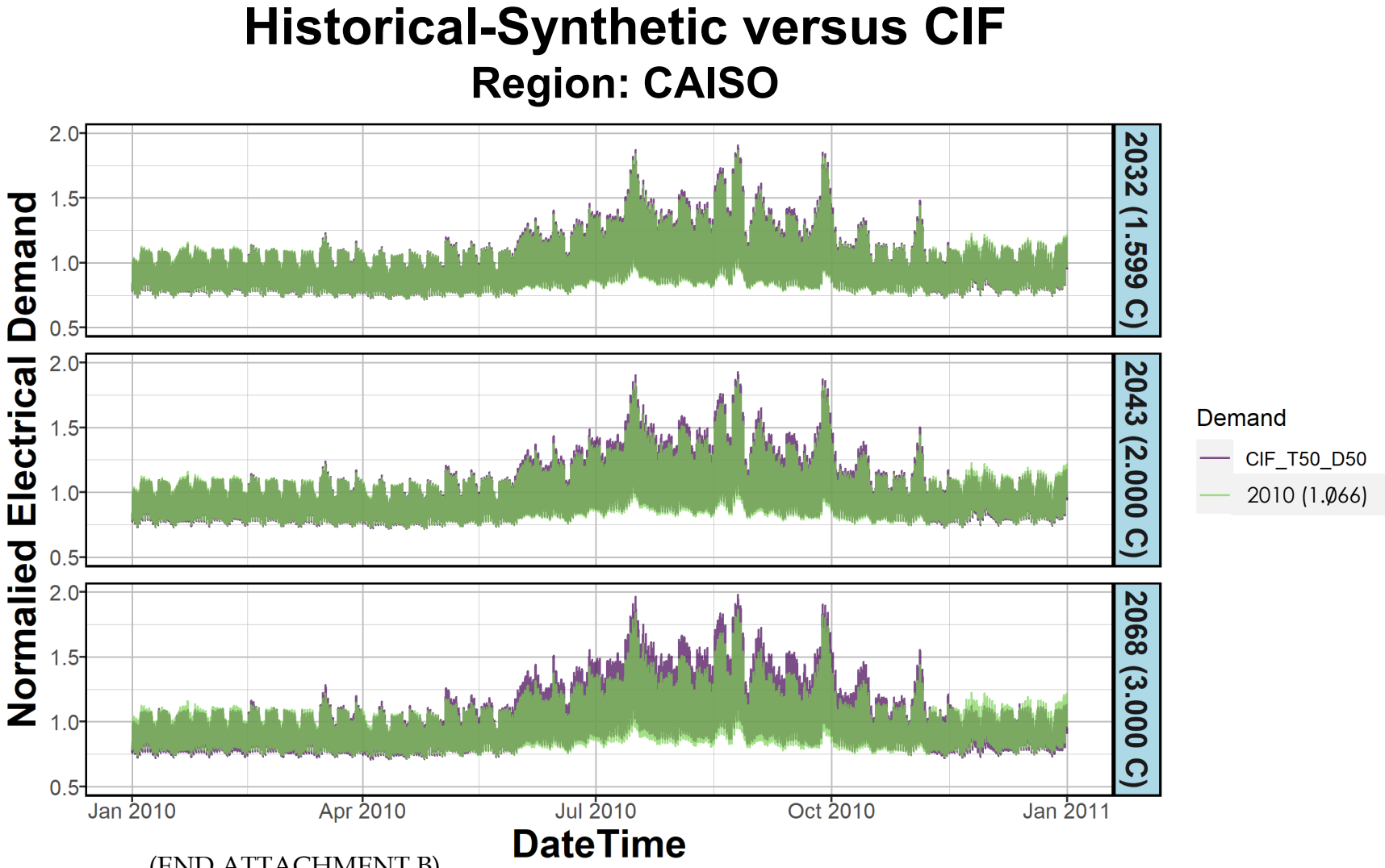
Synthetic Temperature Profiles Reflecting 3 Climate Scenarios

- Each weather station in our model is represented by a similar set of profiles.
- By month and hour heat maps are converted to 8760 strips which are then added to each yearly profile in the historical record.
- Each panel reflects one of three climate scenarios, with historical reproduced on each panel.
- CIF_T50 reflects the median heat map response for each climate.



CIF Normalized Electrical Demand Profiles

- Each panel reflects one of three climate scenarios, with historical reproduced on each panel.
- Observations:
  - Increase load: Summer
  - Decreased Load: Winter



(END ATTACHMENT B)