#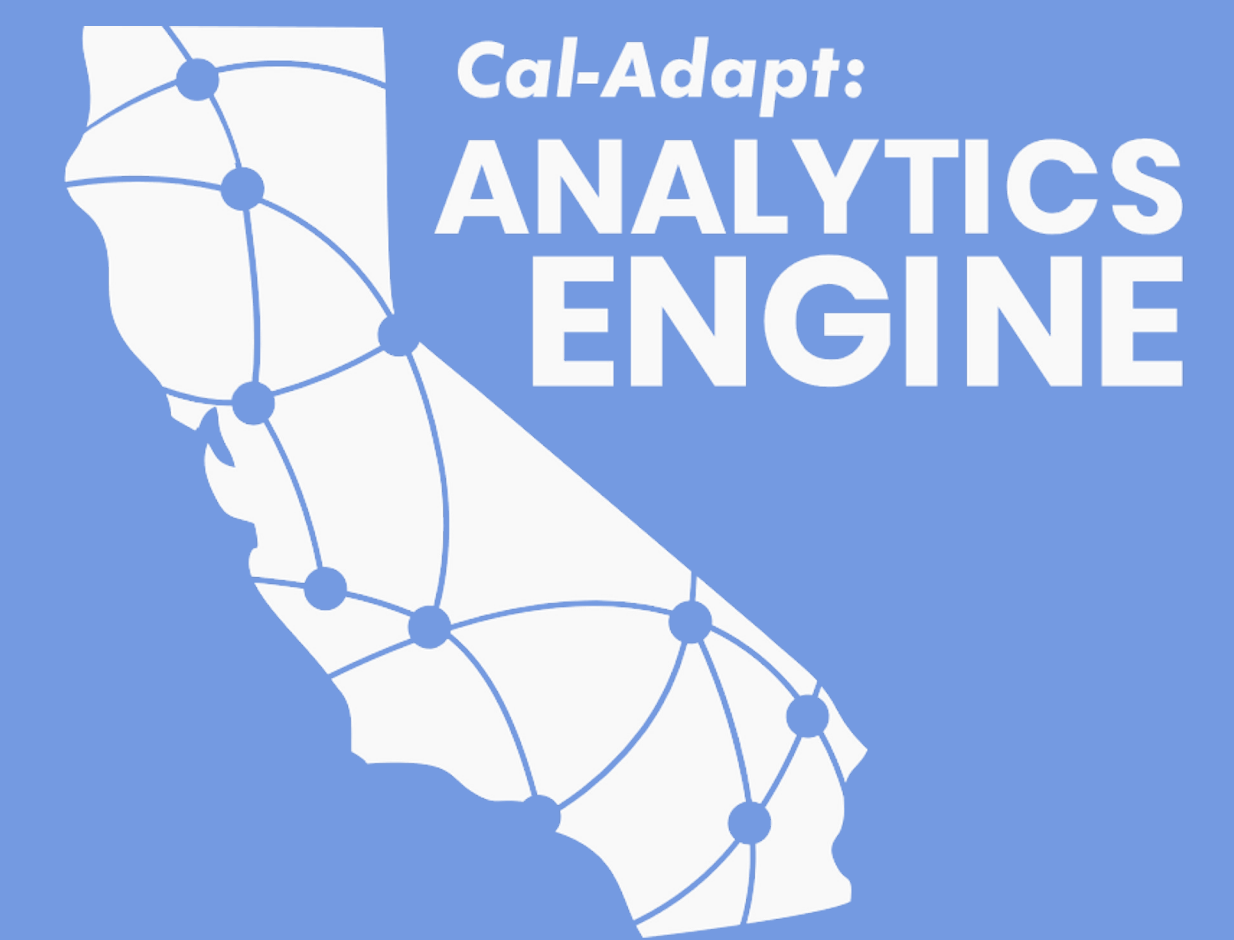 GC13L-0775: Building Climate-Informed Hourly Profiles for a Resilient Future via the Co-Produced Cal-Adapt: Analytics Engine

Cal-Adapt: ANALYTICS ENGINE

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Data Designed for Decisions

Many energy system modeling and other planning processes are designed to intake hourly information to capture short term weather fluctuations that affect power supply and demand[1].

An *annualized hourly climate profile* is a dataset that contains hourly weather conditions at a location for an entire year; commonly referred to as an "8760". Although climate profiles have previously been generated using historical observation-based datasets, **energy planners are increasingly calling for hourly climate profiles constructed with future climate models**.

User Requested Climate Profile Requirements

1. **Flexible**, customizable climate profiles that support diverse applications, *such as:* load forecasting, resiliency planning, risk analysis, extreme event evaluation, building simulation, and representative performance assessment.
2. Access to both **historical and future hourly climate profiles** derived from climate model output.
3. Clear pathways for next-generation model-based profiles, including **aggregation and down-sampling strategies** that reduce data volume while preserving key climate signals.
4. **Referenceable guidance** and methodologies aligned with established scientific standards and transparent intended-use documentation.
5. **Fully customizable extreme** climate profiles, allowing users to define the specific type and magnitude of extremes.
6. Methods **compliant with California regulatory requirement**s through the use of **global warming levels** (GWL).

> The Cal-Adapt: Analytics Engine delivers **policy-ready climate profiles** that empower energy practitioners with the data clarity and transparency needed to drive stronger compliance, smarter planning, and more effective climate solutions.

Developed For & With Users

Climate profile development on the Cal-Adapt: Analytics Engine is directly shaped by the climate data needs and operational grid expertise of energy-sector users, including **utilities** and **state agencies**. Together, we have identified scientific best practices, relevant data, methods, and workflows that both inform and utilize climate profiles, directly supporting energy-sector planning needs.
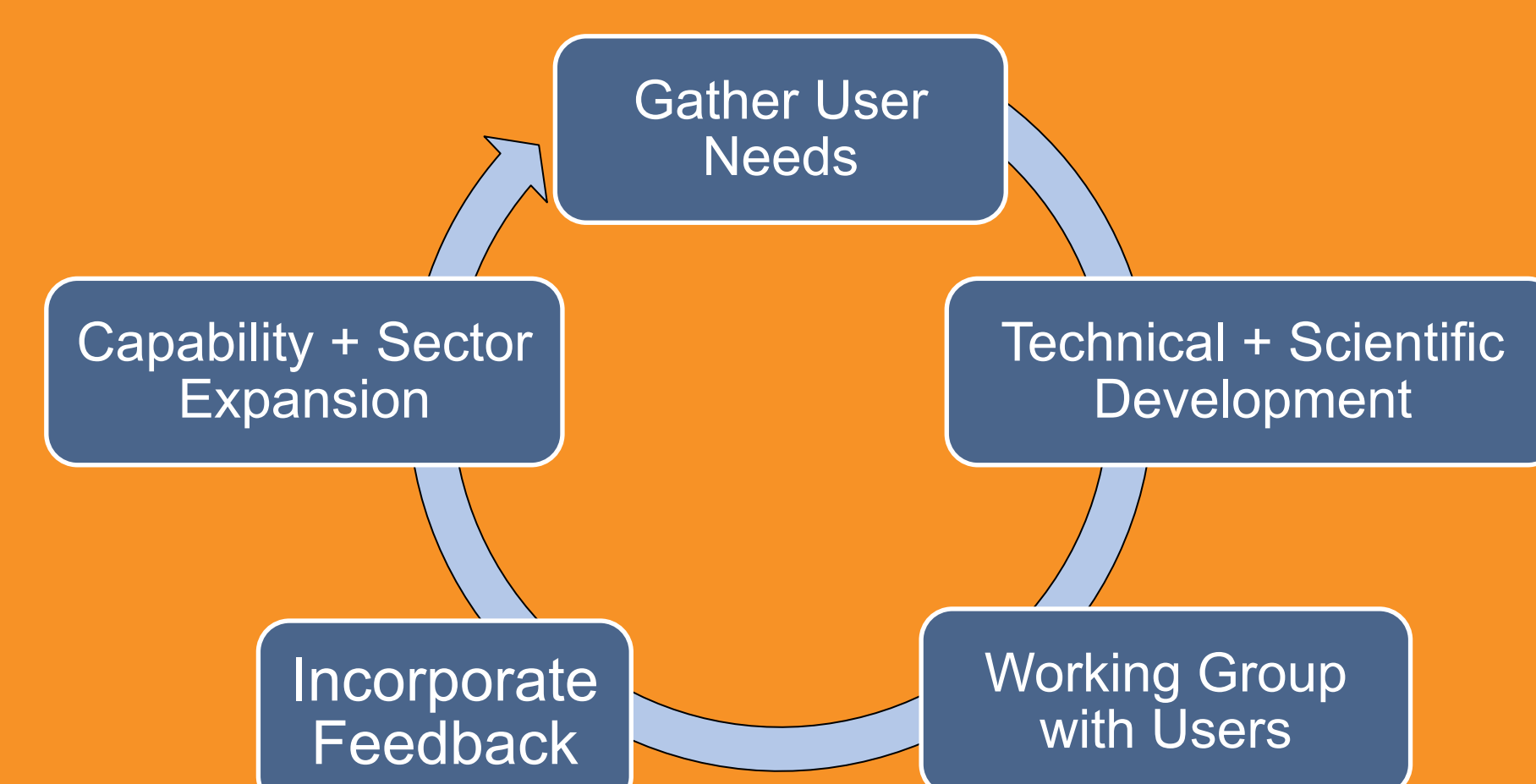

Figure 1. The production cycle to develop hourly climate profiles for the *Cal-Adapt: Analytics Engine*. This work is iterative and on-going.

Supported Data Products for Energy Sector Applications
What data gets you from problem to solution the fastest?

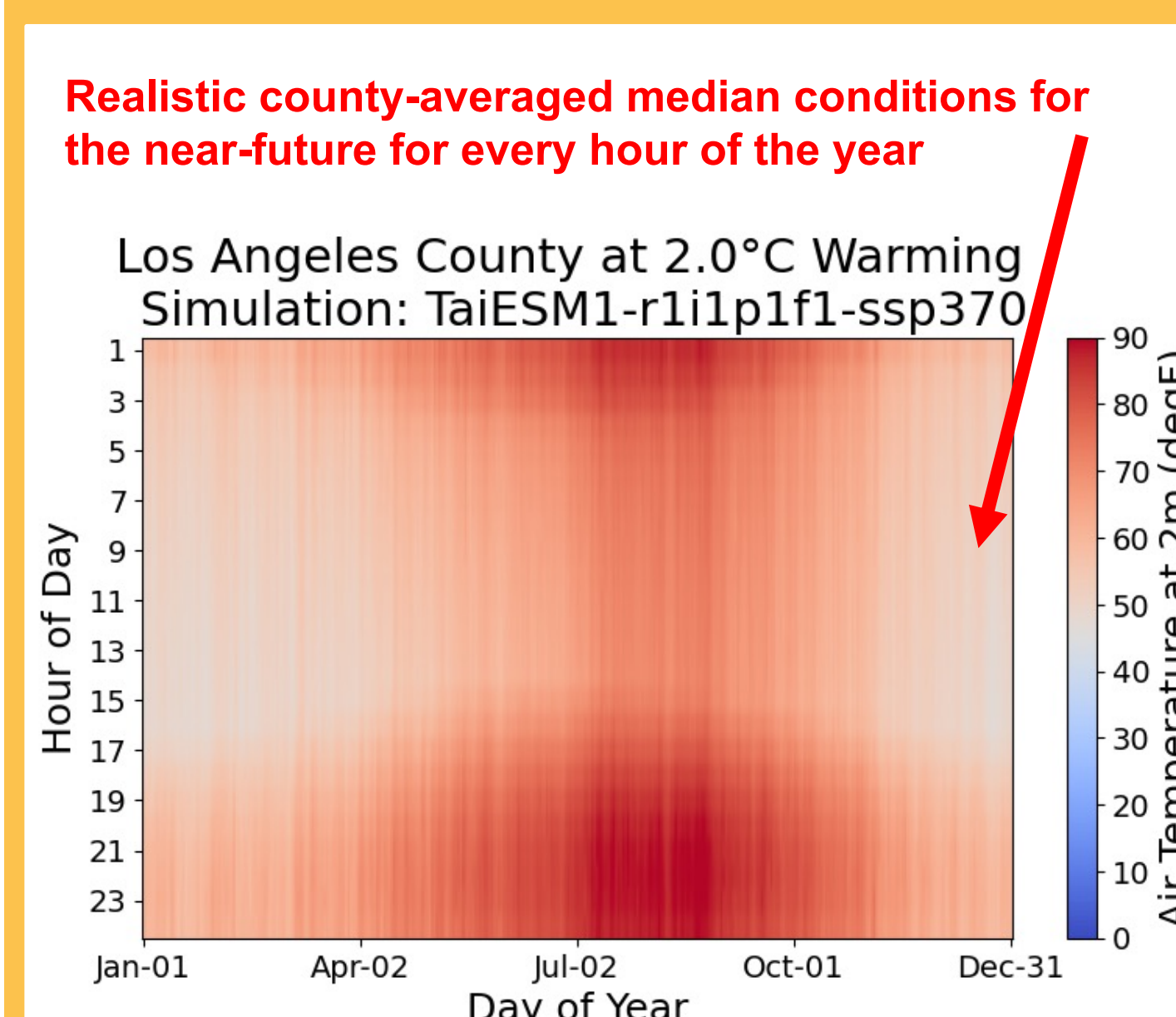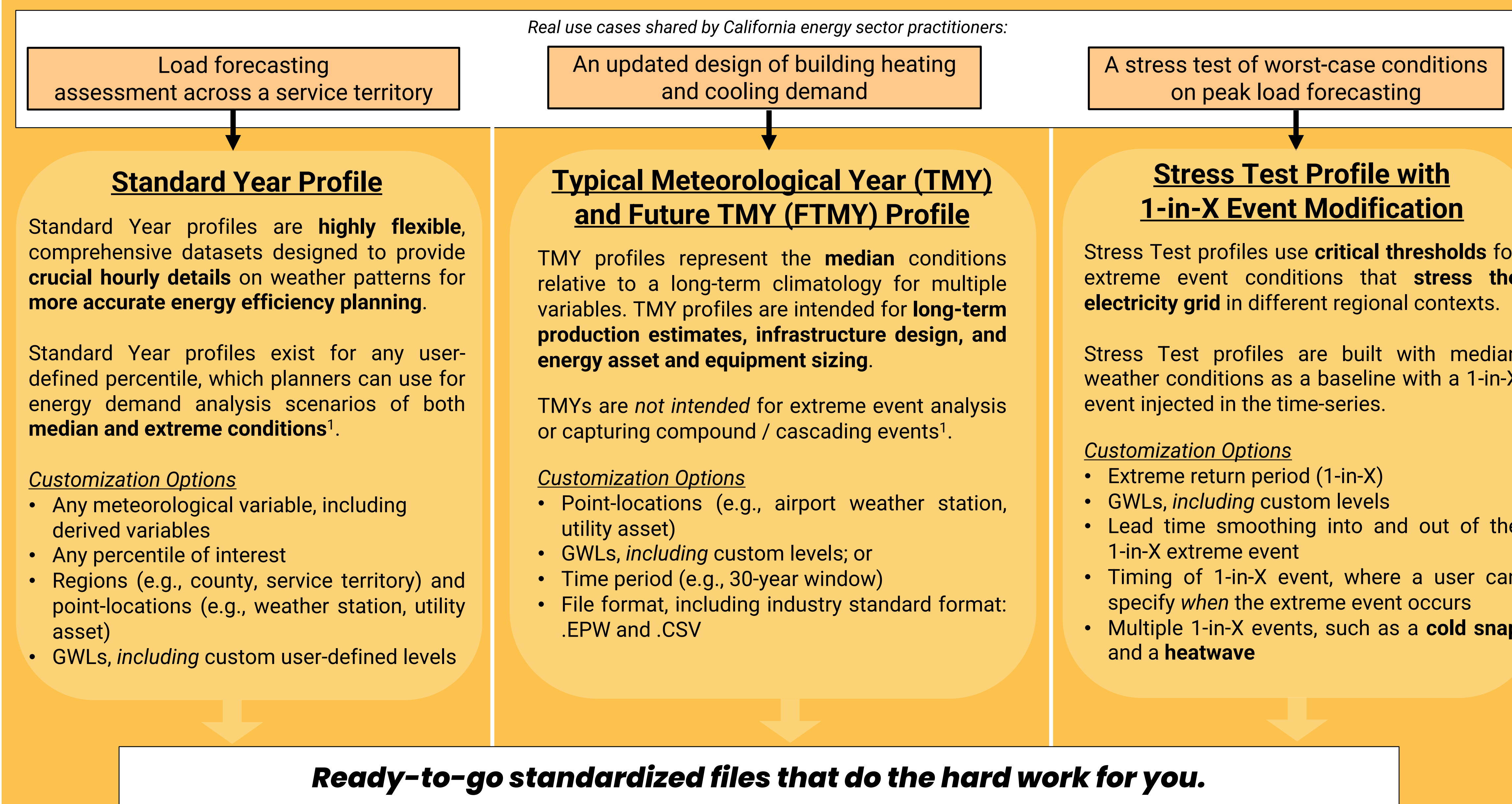*Real use cases shared by California energy sector practitioners:*

| Load forecasting assessment across a service territory | An updated design of building heating and cooling demand | A stress test of worst-case conditions on peak load forecasting |

Standard Year Profile

Standard Year profiles are **highly flexible**, comprehensive datasets designed to provide **crucial hourly details** on weather patterns for **more accurate energy efficiency planning**.

Standard Year profiles exist for any user-defined percentile, which planners can use for energy demand analysis scenarios of both **median and extreme conditions**[1].

Customization Options
- Any meteorological variable, including derived variables
- Any percentile of interest
- Regions (e.g., county, service territory) and point-locations (e.g., weather station, utility asset)
- GWLs, *including* custom user-defined levels

Typical Meteorological Year (TMY) and Future TMY (FTMY) Profile

TMY profiles represent the **median** conditions relative to a long-term climatology for multiple variables. TMY profiles are intended for **long-term production estimates, infrastructure design, and energy asset and equipment sizing**.

TMYs are *not intended* for extreme event analysis or capturing compound / cascading events[1].

Customization Options
- Point-locations (e.g., airport weather station, utility asset)
- GWLs, *including* custom levels; or
- Time period (e.g., 30-year window)
- File format, including industry standard format: .EPW and .CSV

Stress Test Profile with 1-in-X Event Modification

Stress Test profiles use **critical thresholds** for extreme event conditions that **stress the electricity grid** in different regional contexts.

Stress Test profiles are built with median weather conditions as a baseline with a 1-in-X event injected in the time-series.

Customization Options
- Extreme return period (1-in-X)
- GWLs, *including* custom levels
- Lead time smoothing into and out of the 1-in-X extreme event
- Timing of 1-in-X event, where a user can specify *when* the extreme event occurs
- Multiple 1-in-X events, such as a **cold snap** and a **heatwave**

> *Ready-to-go standardized files that do the hard work for you.*

Figure 2. Standard Year heatmap of absolute (no delta signal) median air temperature (p50) for LA County for the near-future 2°C GWL.
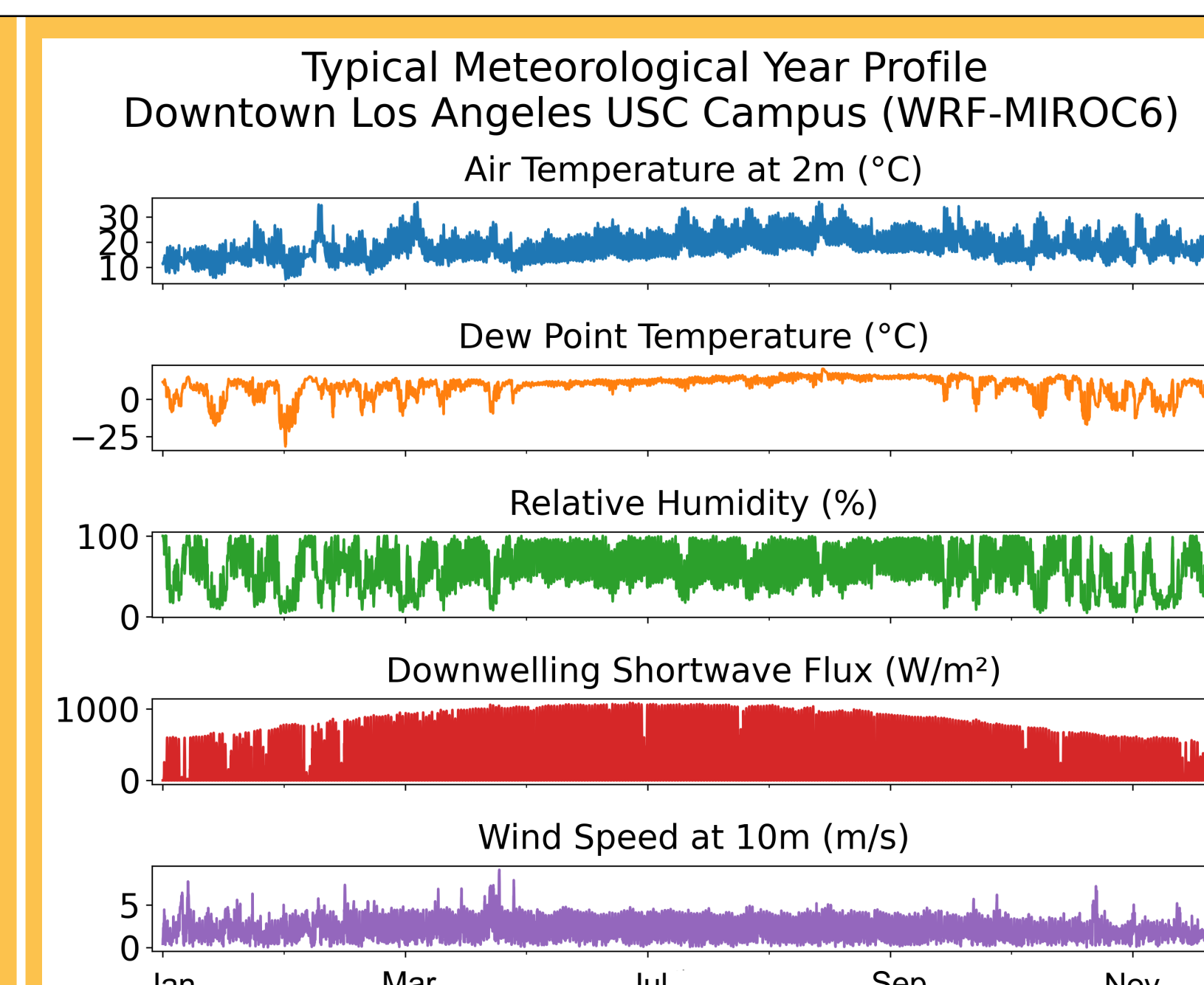

Figure 3. TMY profile for Downtown LA. TMYs include 10 meteorological variables (not shown: direct normal and diffuse radiation, longwave flux, wind direction, surface pressure).
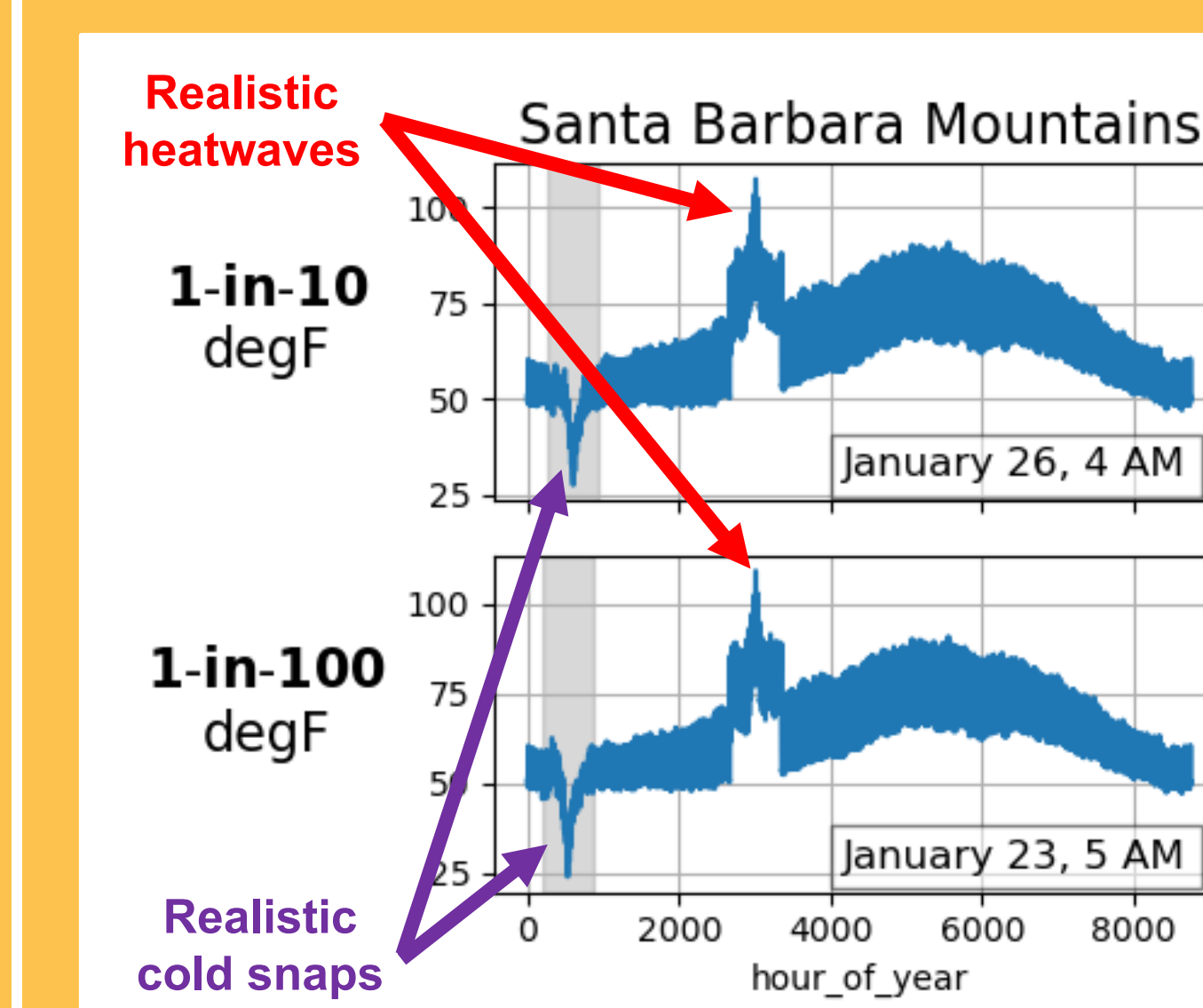

Figure 4. Stress Test profiles for with 1-in-X extremes under a 2.0°C GWL, with a 2-week lead in and out of each extreme event. Top: 1-in-10 year heatwave and cold snap. Bottom: 1-in-100 year heatwave and cold snap.
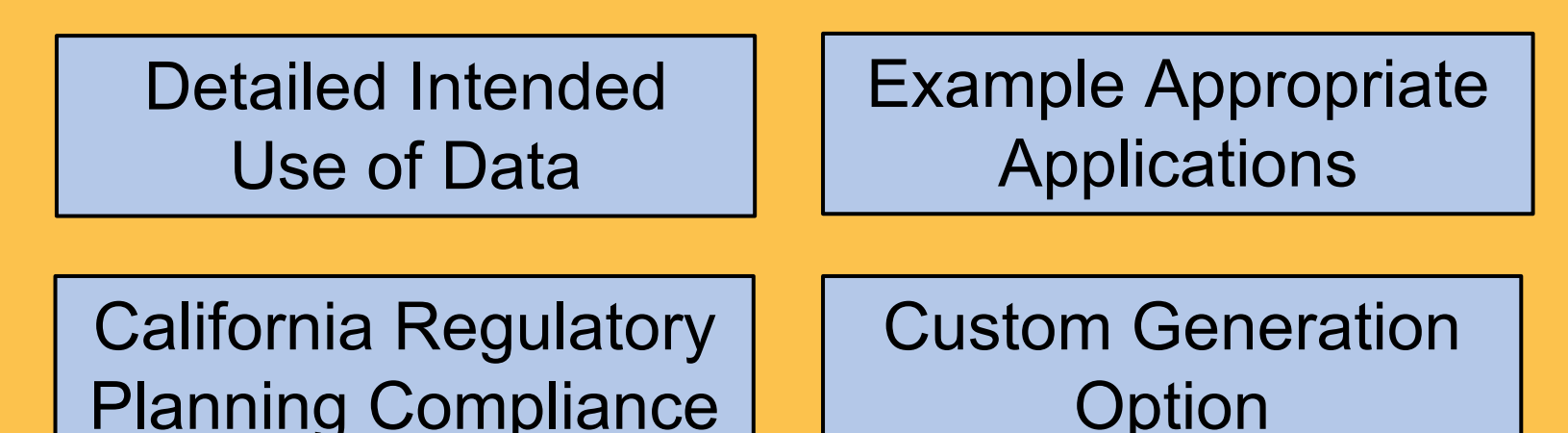
Scientifically-Informed Guidance for Applications

The Cal-Adapt: Analytics Engine provides access to high-resolution data fit for energy sector needs and scientifically rigorous guidance materials for best practices. For Climate Profiles, guidance centers on the common applications and questions facing users, to ensure information meets them where they are.

When seeking guidance on climate data use for their specific applications, energy sector practitioners often ask 2 critical questions:
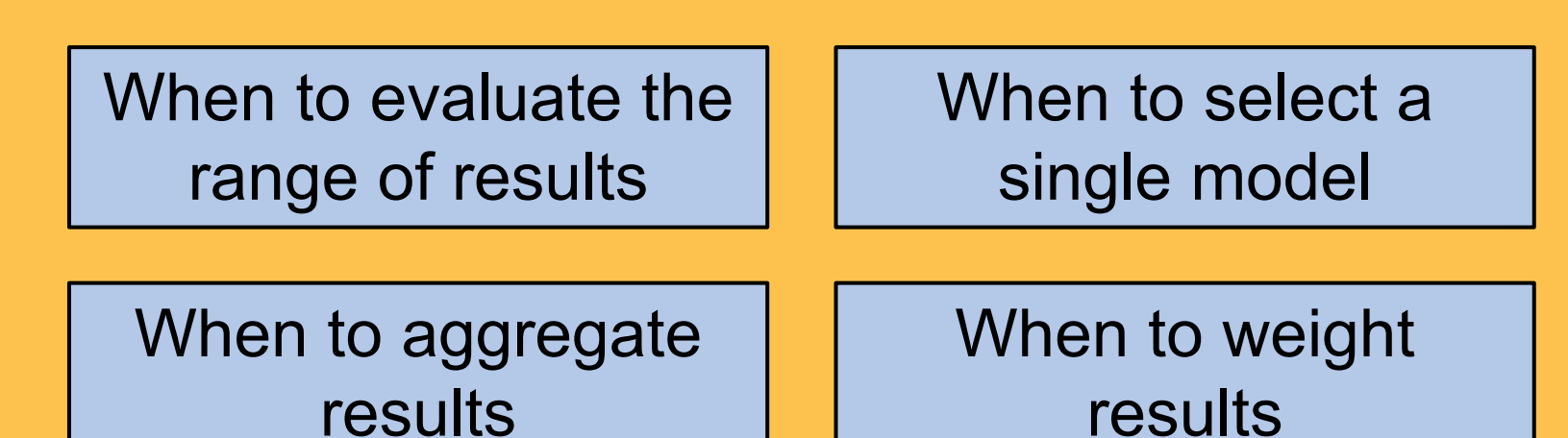
"Is this method appropriate for *my* use case?"

We provide detailed recommendations on:

| Detailed Intended Use of Data | Example Appropriate Applications |
| California Regulatory Planning Compliance | Custom Generation Option |

"This is a huge amount of climate model data. What methods can I use to synthesize it?"

We provide referenceable examples on:

| When to evaluate the range of results | When to select a single model |
| When to aggregate results | When to weight results |

Ready-to-Go Solutions

The Analytics Engine has **pre-generated an extensive set** of standardized climate profile files that you can use right now!

Standard Year Profiles
- Energy sector planning targets
- Energy sector common variables for regulatory requests
- Baseline conditions and extremes analysis

Typical Meteorological Year Profiles
- Energy sector planning targets
- Specific formats required for energy modelers

Climate Profile Expansion: More customizations are coming in 2026!

Download the Climate Profiles now!
DATA ACCESS   [1]GUIDANCE   CUSTOMIZE