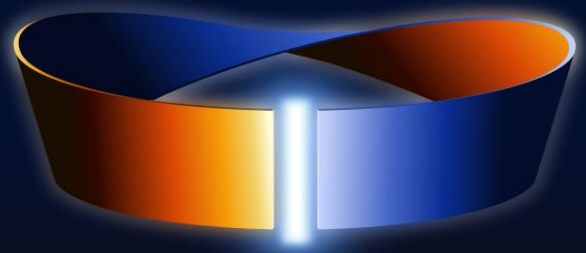


WARP to Resilience

Weather-Adapted Resource Planning

EPC-22-001
Advancing California's Electricity Resource Planning Tools to Assess and Improve Climate Resilience

KICKOFF MEETING

September 21, 2022

Lumen ENERGY STRATEGY

Meeting purpose and agenda

Purpose: (a) Introduce our study vision and objectives, (b) collect initial reactions to our timeline and milestones relative to CEC/CPUC planning study timelines and needs

TIME	TOPIC	LEAD
10:00 a.m. (10 min)	**Welcome**	**Mithra Moezzi** (CEC)
10:10 a.m. (25 min)	**Project overview** • Project goals and objectives • Key tasks and work products • Stakeholder engagement	**Mariko Geronimo Aydin, Onur Aydin** (Lumen)
10:35 a.m. (10 min)	**Project schedule** • Timeline and key milestones • Coordination with planning processes	
10:45 a.m. (15 min)	**Q&A**	All participants
11:00 a.m.	**Adjourn**	

Lumen ENERGY STRATEGY

Study motivation and mission

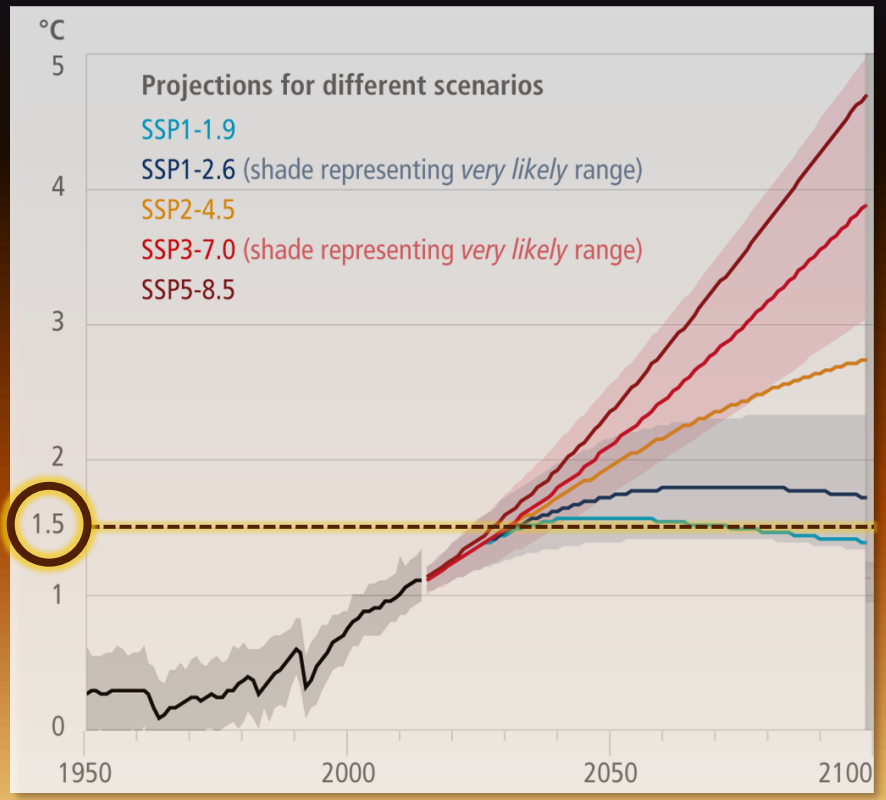
Impacts from exceeding 1.5°C warming threshold appear unavoidable—but energy systems can adapt

Excerpts from the IPCC Sixth Assessment Report:

Risks

"Global warming, reaching 1.5°C in the near-term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (*very high confidence*)…"
[Conclusion B.3]

"Beyond 2040 and depending on the level of global warming, climate change will lead to numerous risks to natural and human systems (*high confidence*)…"
[Conclusion B.4]

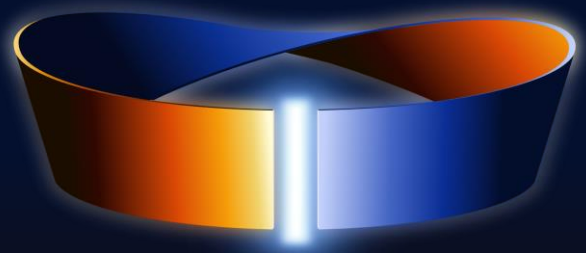


Energy System Transition

"… Climate responsive energy markets, updated design standards on energy assets according to current and projected climate change, smart-grid technologies, robust transmission systems and improved capacity to respond to supply deficits have high feasibility [as adaptation options] in the medium- to long-term, with mitigation co-benefits (*very high confidence*)."
[Conclusion C.2.10]

Institutional dimension identified as a limiting factor
[Figure SPM.4]

Source: Intergovernmental Panel on Climate Change (2022), annotated by Lumen.



WARP to Resilience

Weather-Adapted Resource Planning

Institutional Barrier	Advancement
No common definition of resilience or specific resilience evaluation metrics	**Build a resilience framework** that includes a definition of resilience and resilience evaluation metrics
Planning models have several concerning disconnects from climate projections and climate-driven risks	**Re-parameterize inputs and assumptions** to the state's resource planning models to account for climate-driven risks and extremes
Planning models are not structured to explicitly evaluate resilience	**Develop a resilience evaluation model** that is open-source and evaluates input resource portfolios and plans
Planners and stakeholders have no in-hand assessment of the resilience of alternative optimal resource portfolios	**Conduct a resilience assessment** of the state's resource portfolios and plans (e.g., Preferred System Plan)

Build a resilience framework

Goal: Develop a definition of resilience and corresponding metrics that can be used to evaluate resilience of California's electric system

- Currently no common definition of resilience or specific resilience evaluation metrics to support planning
- Will engage the CEC and key stakeholders to reflect on this and brainstorm on a common definition, refine it as appropriate, and accordingly develop resilience metrics
  - Start with literature review to establish a baseline conceptual framework
  - Conduct stakeholder workshop to discuss and incorporate different perspectives to refine the framework
- Final framework will serve as a basis for developing our resilience evaluation model, and can be integrated into stakeholders' existing planning efforts
- Product: A definition of resilience as a fundamental assumption to our analysis and a recommendation that the CPUC adopt our definition or something similar.

Re-parameterize inputs and assumptions

Goal: Re-parameterize inputs and assumptions to the state's existing planning models to capture the impacts of climate change on electricity supply and demand

- Use with existing planning models to the extent their architectures allow
- Bridge the knowledge gap between climate scientists and the various resource plan development teams; work with Group 2, Group 3, and stakeholders to translate historical and projected climate data into existing resource planning processes and input tables
- Product: set of input tables and parameters, tools and knowledge-sharing for the state's resource planners

Develop a resilience evaluation model

Goal: Construct a model that can be synergized with existing resource planning models to evaluate climate resilience of future resource portfolios

- Hourly stochastic model incorporating climate projections and weather-driven resilience events and shocks to load and supply (like extreme heat waves, drought, wildfire risk)
- Distinguish low-impact (e.g., short duration, limited geography) versus high-impact customer outages (e.g., long duration, extended geography, disadvantaged or low-income communities)
- LOLE-like output metrics using resilience framework defined earlier in study
- Customer-sited and distribution-connected resources modeled dynamically
- Spatial and resource granularity to be defined; represent load and supply resources by most useful geographic approximation of distribution sections (e.g., zip codes, census tracts)
- Calibrate and benchmark model against a historical year with resilience challenges (like 2020)
- Product: an open source "off the shelf" state-of-the art electricity portfolio resilience evaluation model that includes granular climate projection data and parameters for future climate impacts on electricity demand and supply—available to all stakeholders for download and their own use

Conduct a resilience assessment

Goal: Evaluate the resilience of the state's resource planning output portfolios

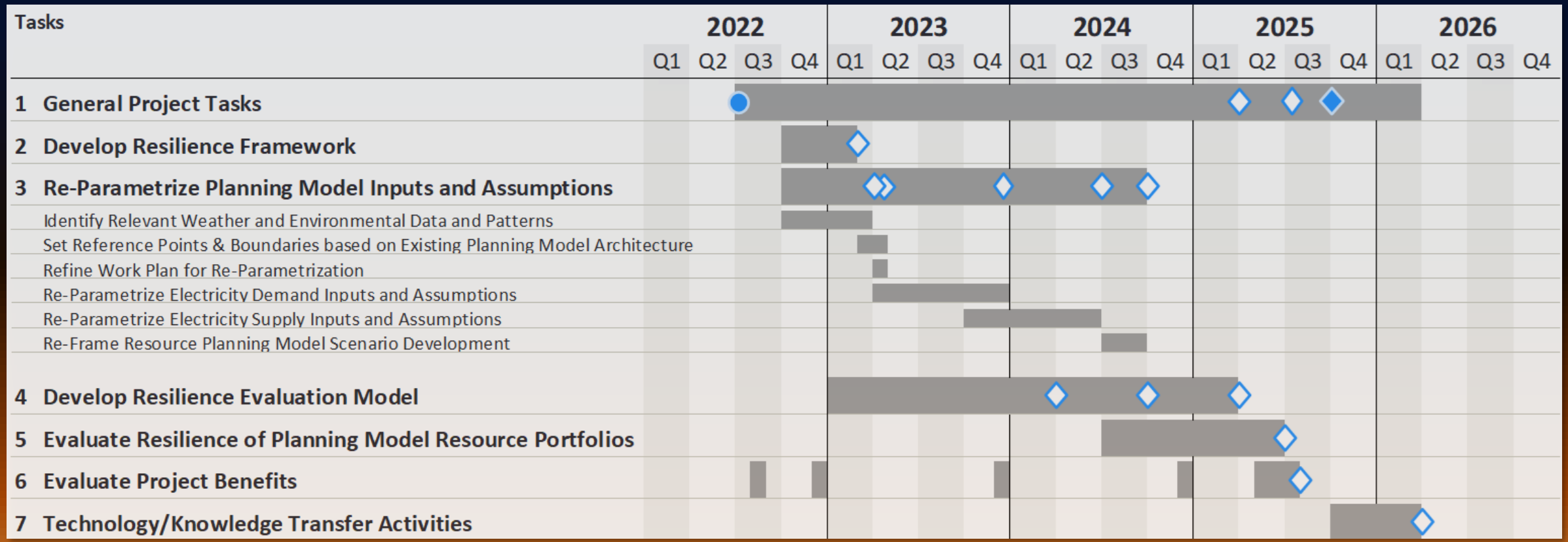
- Built upon the resilience framework and using the resilience evaluation model
- 8,760 hourly analysis of 2025, 2035, and 2045
- Focus on portfolios selected by the CPUC's Integrated Resource Planning group and portfolios highlighted in the California Joint Agencies' SB 100 studies
- Product: Evaluation results that include resilience impact metrics and identification of policy and investment strategies for enhancing portfolio resilience

Stakeholder engagement

- Target audience and users of our research and work products: California's state (primary) and LSE (secondary) electricity resource planners facing major technological shifts, an increasing threat of extreme environmental stresses on the grid, and heightened concerns over the resilience and safety of ratepayer investments

- Engagement in our Technical Advisory Committee (TAC) can provide:
  - Targeted and time-efficient knowledge exchange and coordination; sub-teams focused on a particular planning effort (e.g., IEPR CED) or analytical area (e.g., demand forecast)
  - High-level coordination and overview of study progress; presentations to core TAC members 2–4 times/year
  - In-depth workshops on key cross-cutting issues (e.g., brainstorming on climate data, definition of resilience)

Study tasks and timeline



Milestones
- **Project start**
- Key deliverable to CEC
- **FINAL REPORT delivered**

Audience Q&A

Please help us refine our timeline to better fit with your planning cycle and system/resource modeling efforts:

1. 2023 IEPR cycle: when do you expect to start modeling demand and DER forecasts? (Early 2023?)
2. 2024–2025 IRP cycle: when is the target for completing the current cycle, and when is the earliest we could expect modeling for RSP to start? (Early 2024?)
3. SB 100 forecasts: what is the timing and scope of modeling efforts?
4. Other planning efforts: what other planning efforts are you engaged with and what is the timing of their key modeling milestones?

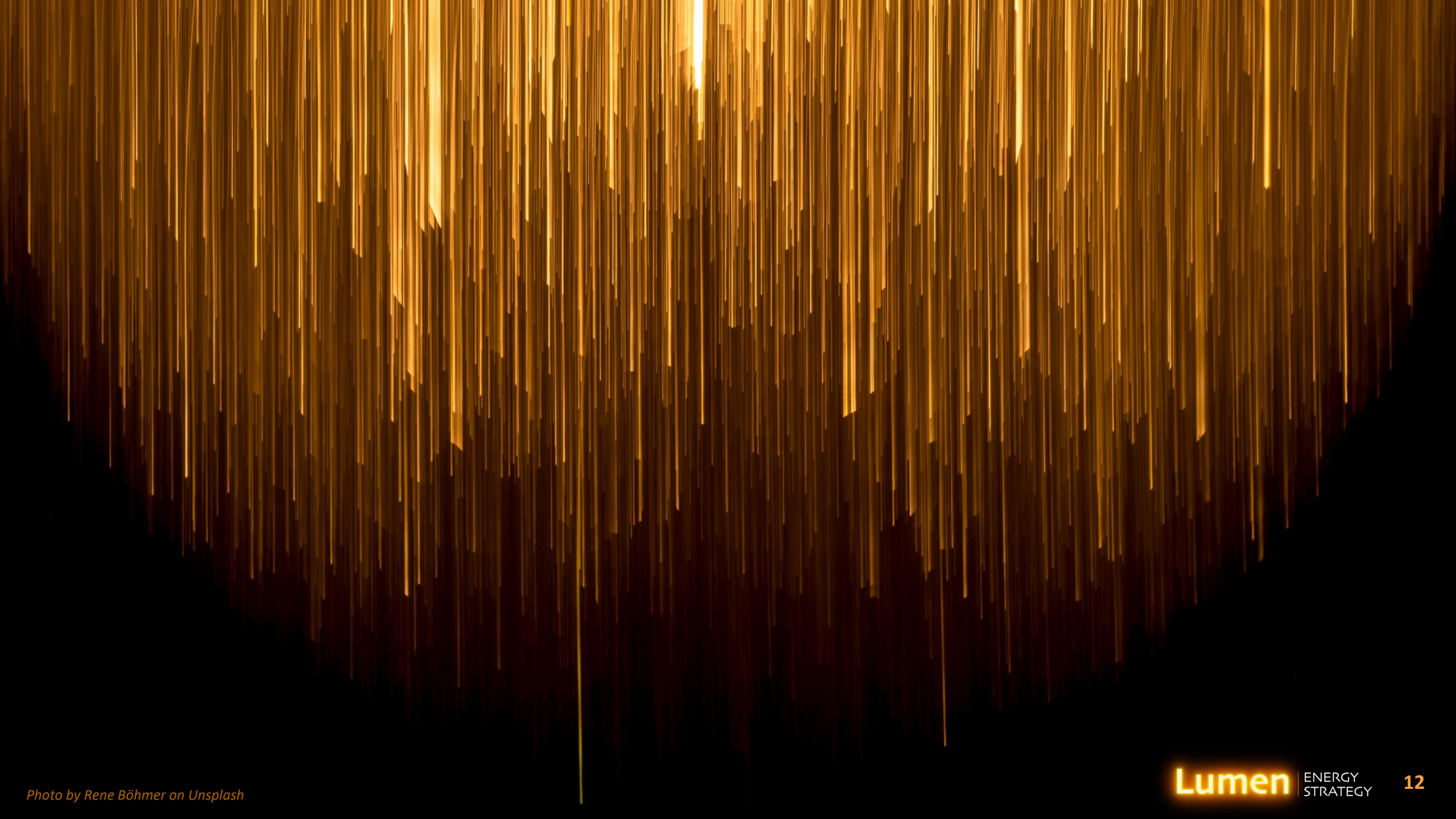


Photo by Rene Böhmer on Unsplash