Google

# The Path to 24/7 Carbon-Free Energy

Allegra Reister, Data and Software Climate Solutions

# Agenda

01 24/7 CFE Inception and Traction

02 Data and Software Climate Solutions

- Measurement
- Optimization
- Procurement

03 Looking Ahead

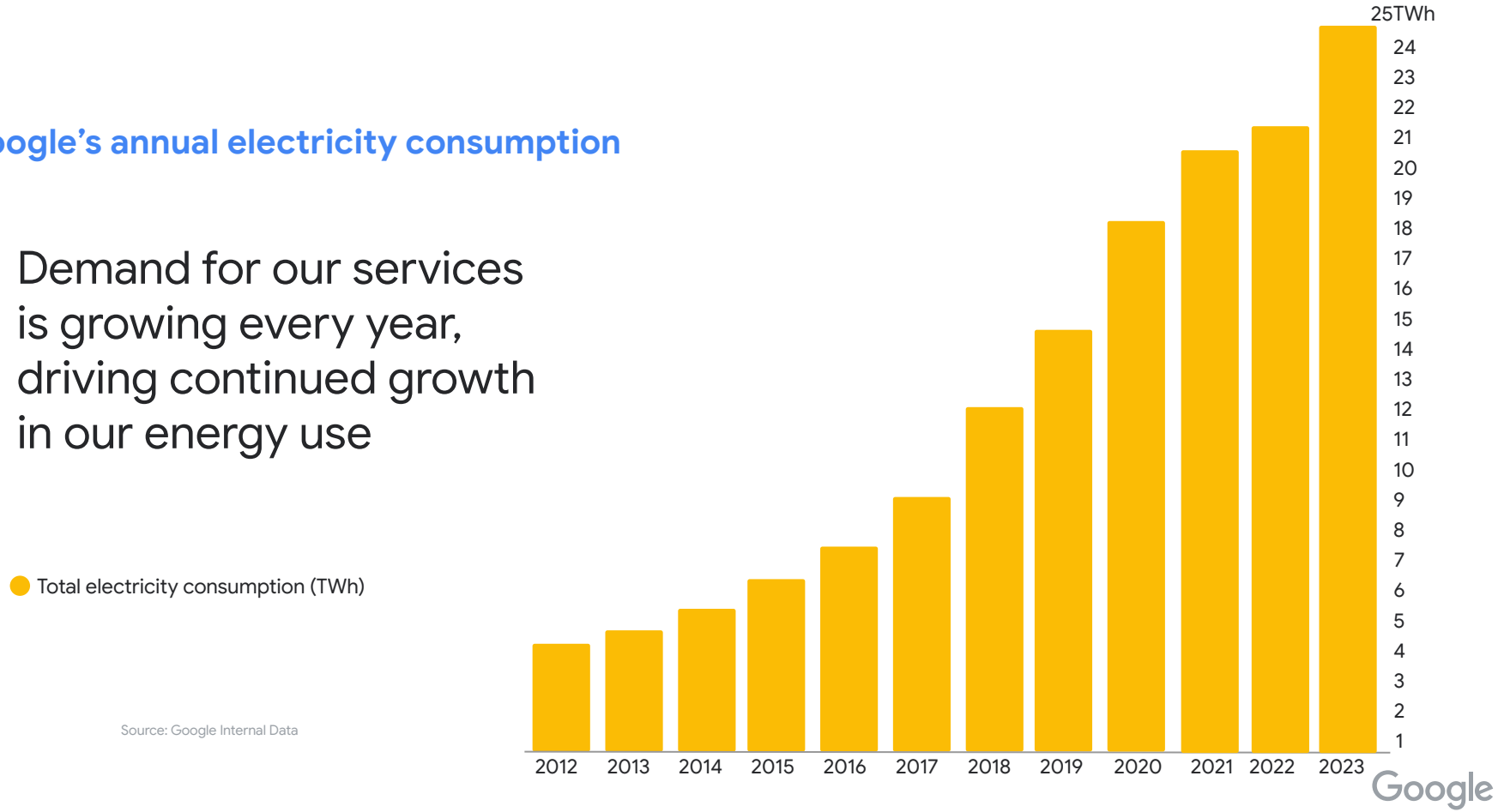
Google

01

# 24/7 CFE Inception and Traction

## Google's annual electricity consumption

Demand for our services is growing every year, driving continued growth in our energy use



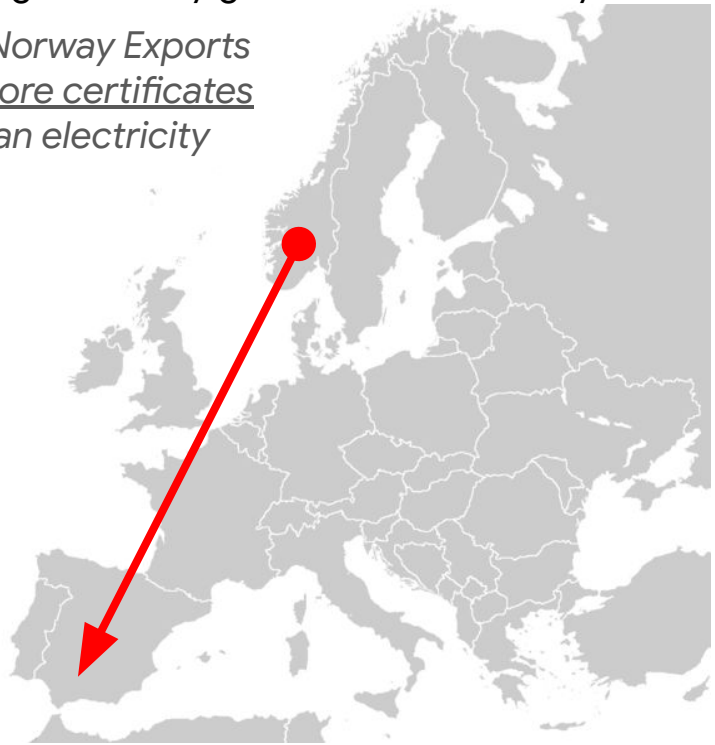

Source: Google Internal Data

Google

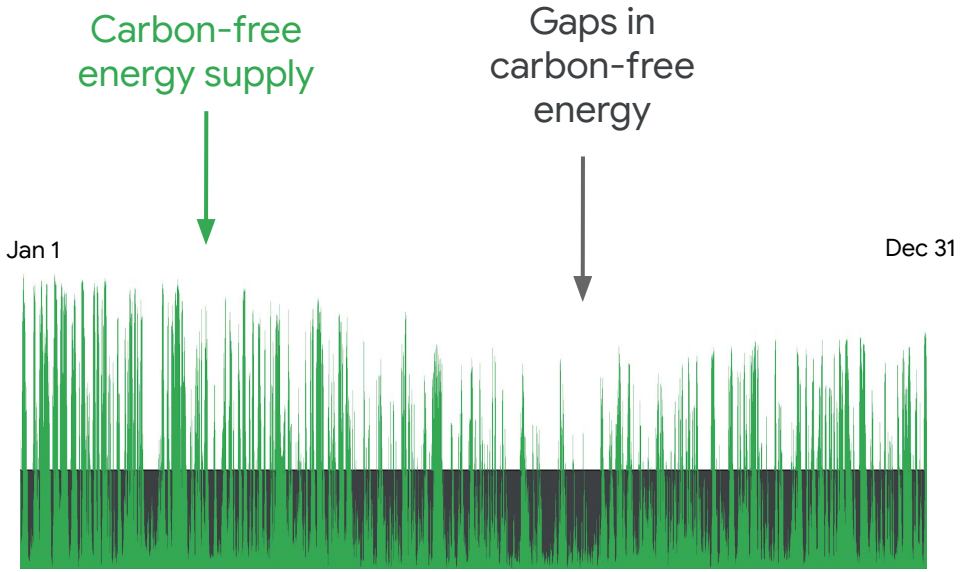
# Accounting Standards Don't Require Engagement with System Reality

**Location:** Companies can achieve "zero" emissions by buying RECs far from where they operate, ignoring electricity grids and deliverability

*e.g. Norway Exports*
***4x** more certificates*
*than electricity*

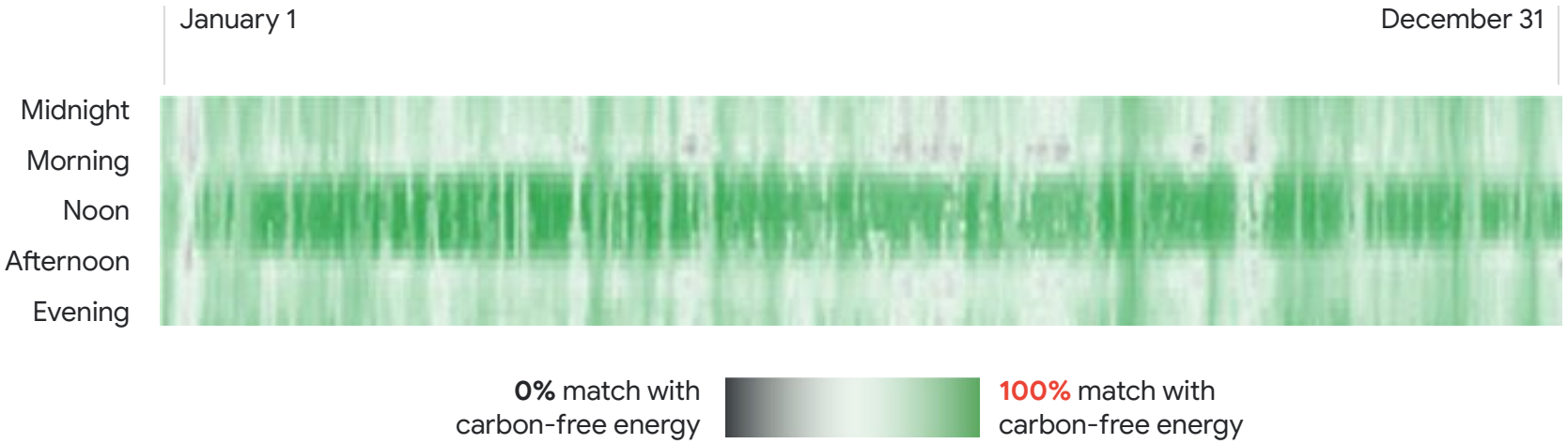


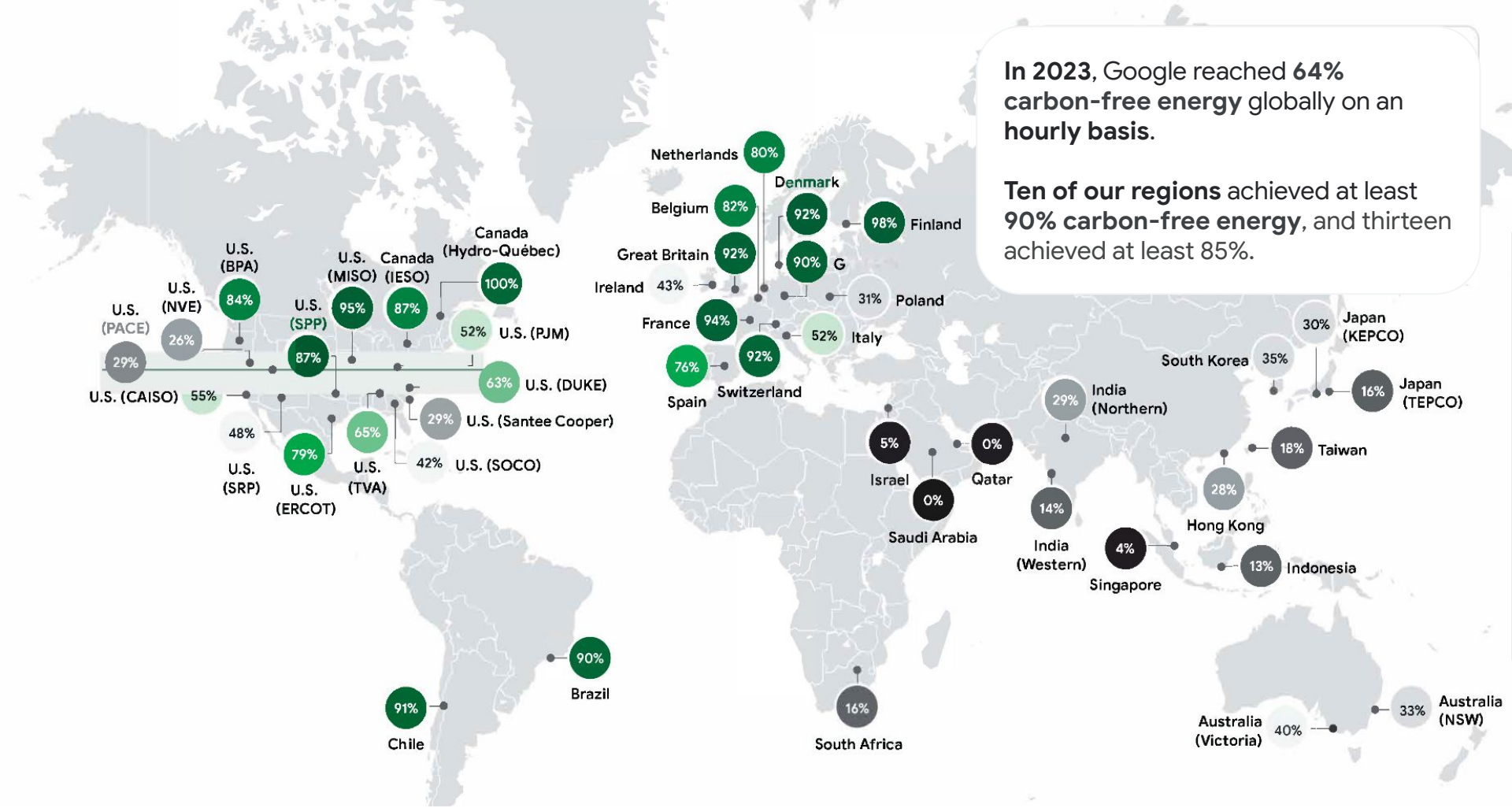
**Time:** Companies can achieve "zero" emissions by buying RECs to match *annual* demand, ignoring hourly variability and need for flexibility, storage.



# Google's 24/7 Carbon-free Energy Approach

- Local (same electricity grid)
- Hourly matched
- Additional




In 2023, Google reached 64% carbon-free energy globally on an hourly basis.
Ten of our regions achieved at least 90% carbon-free energy, and thirteen achieved at least 85%.
U.S. (BPA) 84%
U.S. (NVE) 26%
U.S. (PACE) 29%
U.S. (CAISO) 55%
U.S. (SRP) 48%
U.S. (ERCOT) 79%
U.S. (SPP) 87%
U.S. (MISO) 95%
U.S. (TVA) 65%
Canada (IESO) 87%
Canada (Hydro-Québec) 100%
U.S. (PJM) 52%
U.S. (DUKE) 63%
U.S. (Santee Cooper) 29%
U.S. (SOCO) 42%
Brazil 90%
Chile 91%
Netherlands 80%
Denmark 92%
Belgium 82%
Great Britain 92%
Ireland 43%
France 94%
Spain 76%
Switzerland 92%
Finland 98%
G 90%
Poland 31%
Italy 52%
Israel 5%
Qatar 0%
Saudi Arabia 0%
South Africa 16%
India (Northern) 29%
India (Western) 14%
Singapore 4%
South Korea 35%
Japan (KEPCO) 30%
Japan (TEPCO) 16%
Taiwan 18%
Hong Kong 28%
Indonesia 13%
Australia (Victoria) 40%
Australia (NSW) 33%
Google

Our Founding Partners – **Google, AstraZeneca, Iron Mountain Data Centers, Shree Cement, AirTrunk and Vodafone (UK)** – have joined the 24/7 Carbon-Free Coalition pilot to work with us to shape the campaign before we launch our full campaign in 2025.

CLIMATE GROUP
RE100

02

# Data and Software Climate Solutions

## Measure

Hourly consumption, production, REC, and emissions data

## Optimize

Demand response, load shifting, region picker

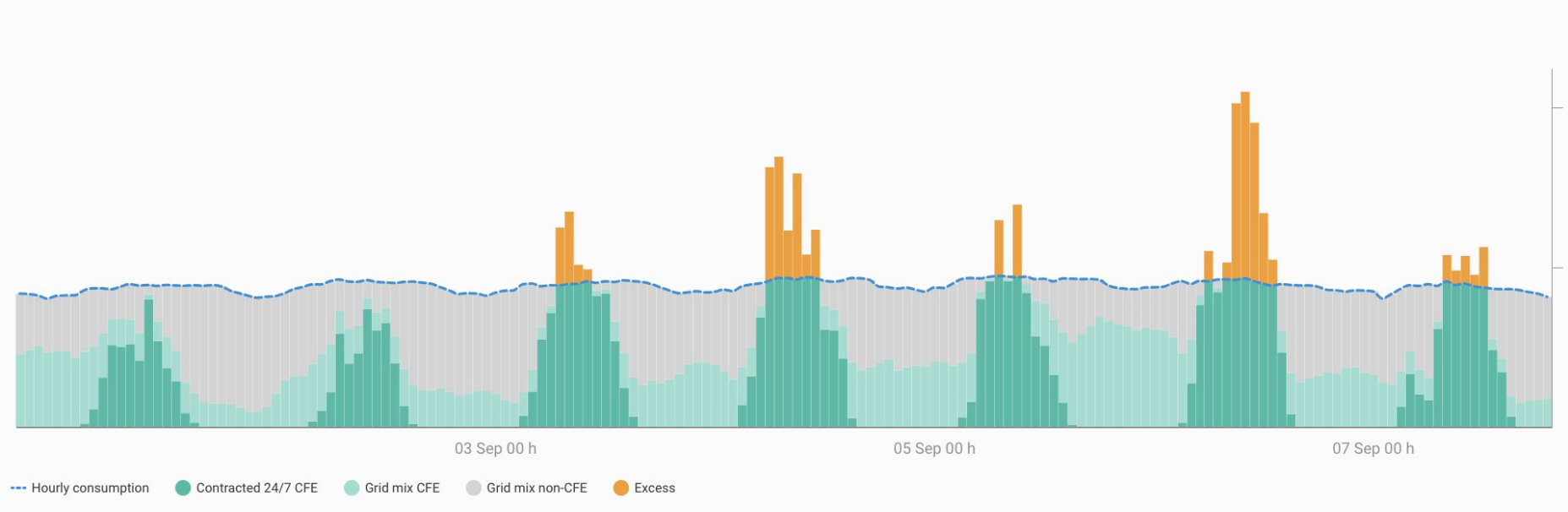
## Procure

TEACs marketplaces, utility models, clean firm power

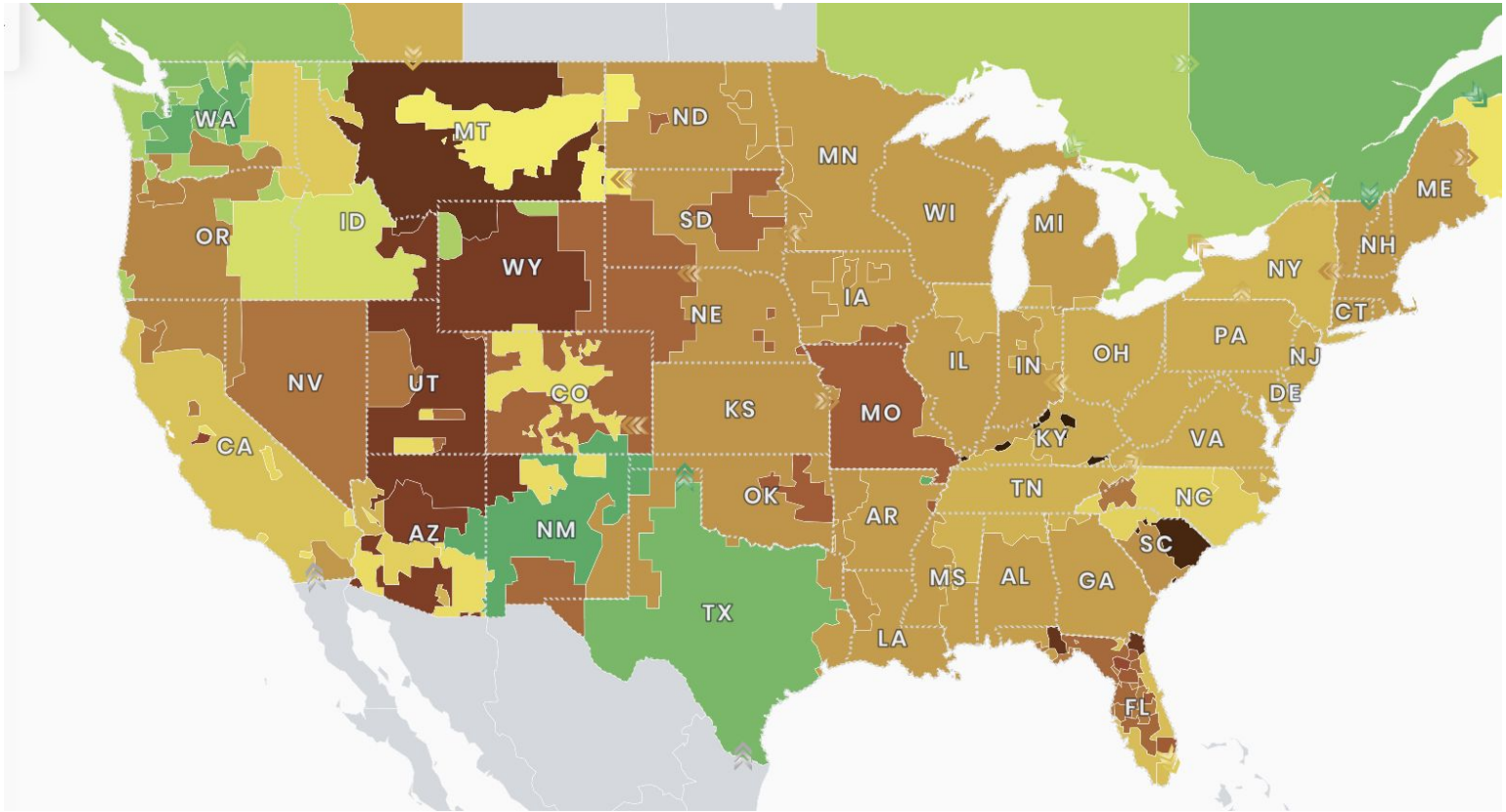
# Measure Regionally and Hourly

| | |
|---|---|
| **Consumption** | • Hourly consumption data from our data centers can be collected from utilities or energy suppliers depending on the structure |
| **Production** | • Hourly production data from PPAs and REC deals can be collected from suppliers/developers, schedulers, TSOs, energy hubs, and registries |
| **RE Certificates** | • Hourly RECs data can be available depending on the registry, and typically needs to be coupled with hourly production data for verification |
| **Grid Emissions** | • Hourly grid emissions data is available from many utilities; in the cases where it is not, grid modeling is used |

# Flexidao for Hourly Meter + REC Tracking



# Electricity Maps for Hourly Grid Emissions



# Optimize Regionally and Hourly

**Demand Response**

- Lower energy consumption when utilities notify of a demand response grid event

**Load Shifting**

- Shift load based on which grids are running the cleanest operations, and allow cloud customers to select specific regions

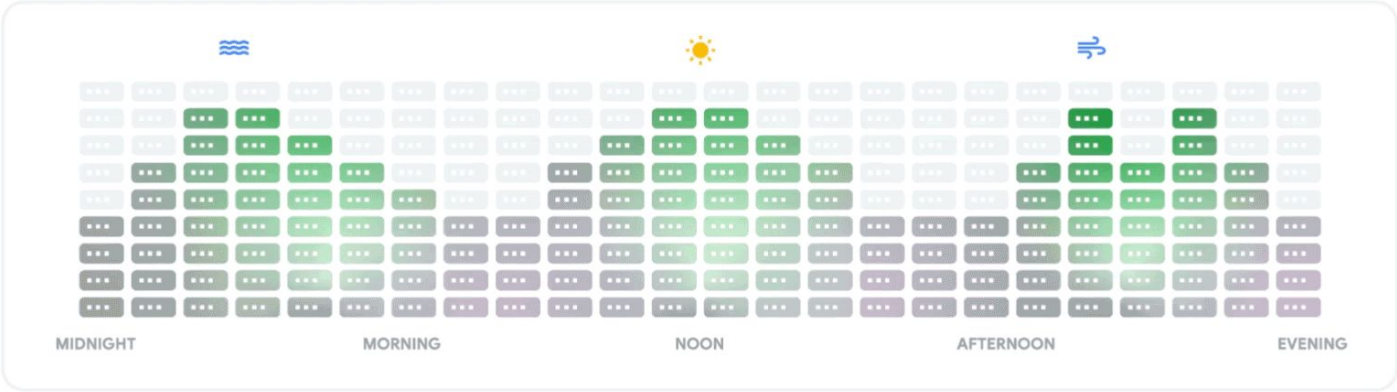
# Demand Response

# Hourly Shifting

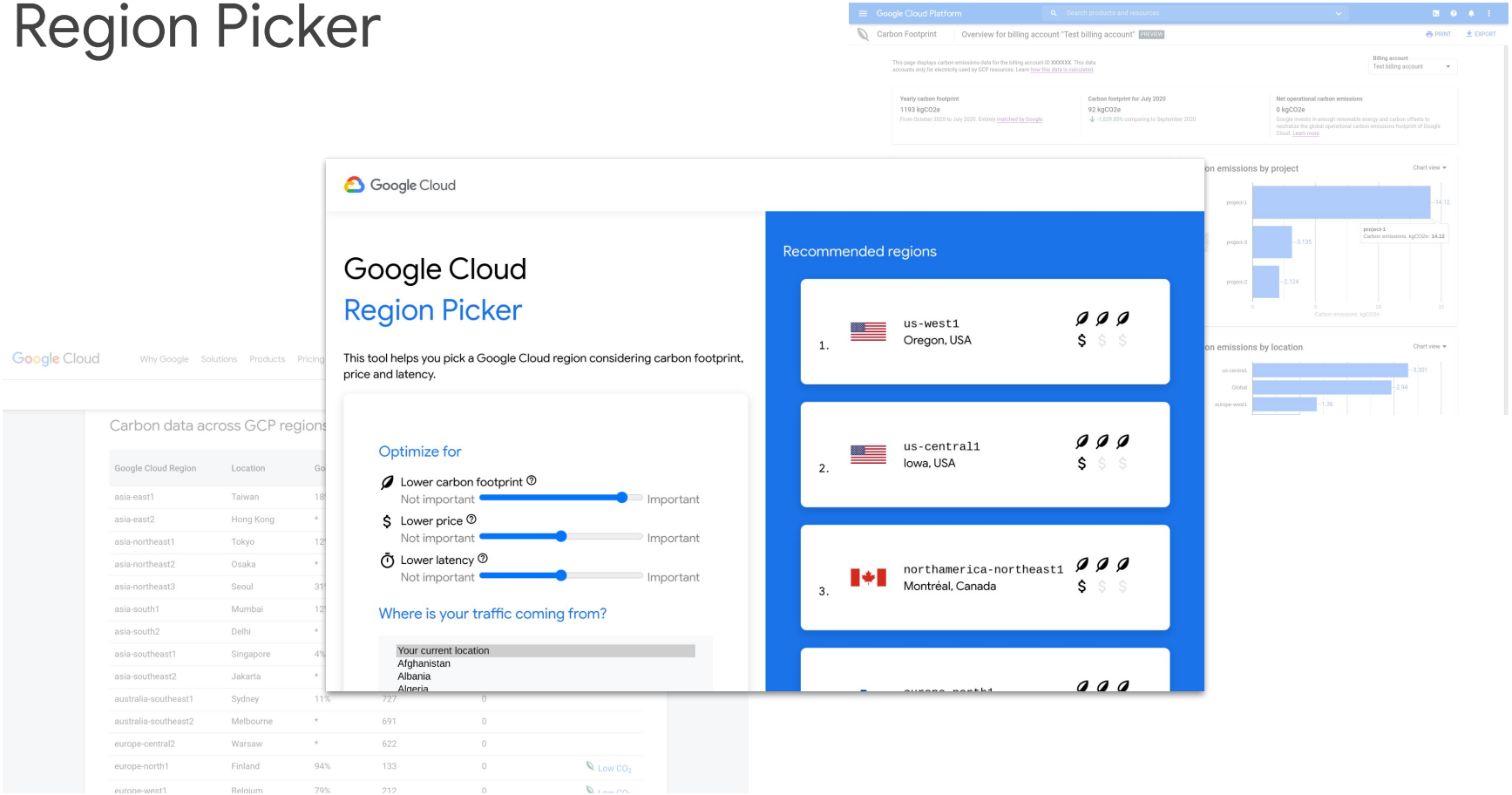
## Conventional compute load

Execution of compute tasks throughout the day, regardless of carbon impact

# Location Shifting



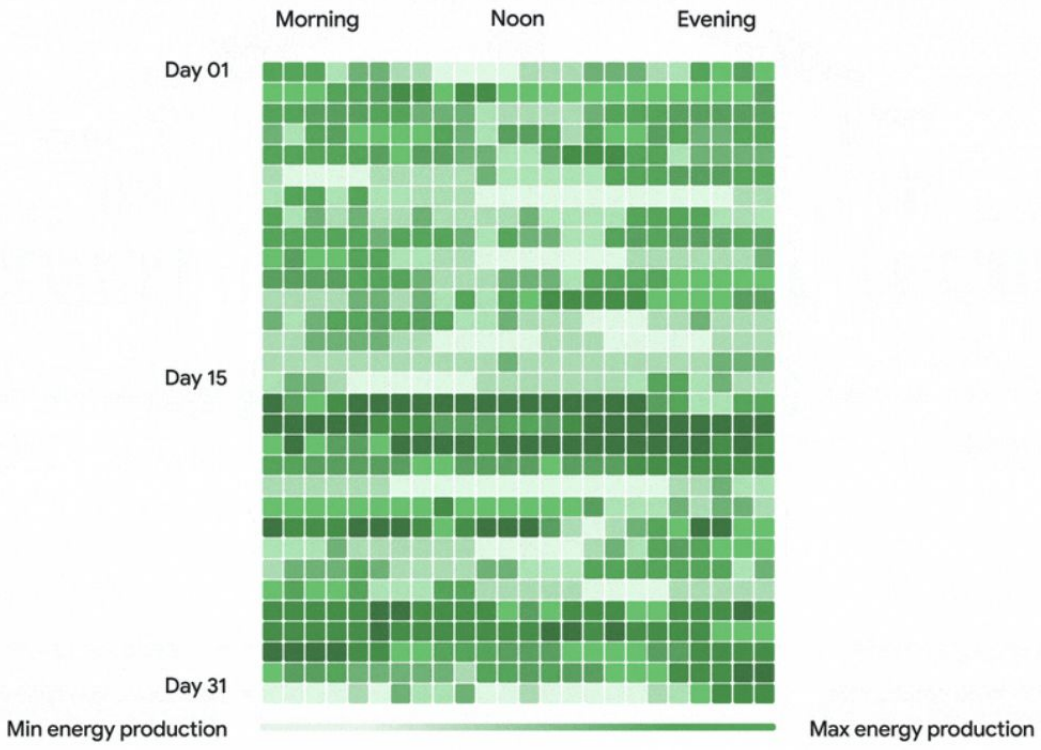
# Region Picker



# Procure Regionally and Hourly

| | |
|---|---|
| **TEACs Marketplaces** | • Marketplaces to sell excess and buy hourly RECs (T-EACs) |
| **Clean Energy Transition Tariff** | • Hourly production data from PPAs and REC deals can be collected from suppliers/developers, schedulers, TSOs, energy hubs, and registries |
| **CFE Manager** | • Hourly RECs data can be available depending on the registry, and typically needs to be coupled with hourly production data for verification |
| **Clean Firm Power** | • Investments in nuclear and geothermal, coalitions across buyers for advanced clean technologies |

# TEACs Marketplace

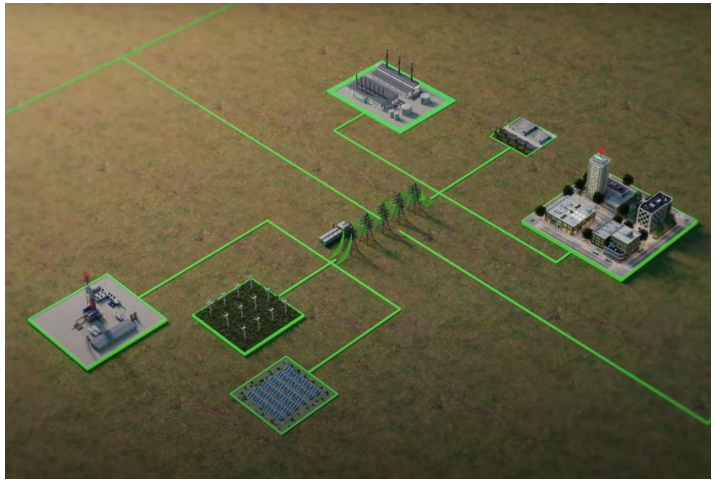


# Clean Energy Transition Tariff

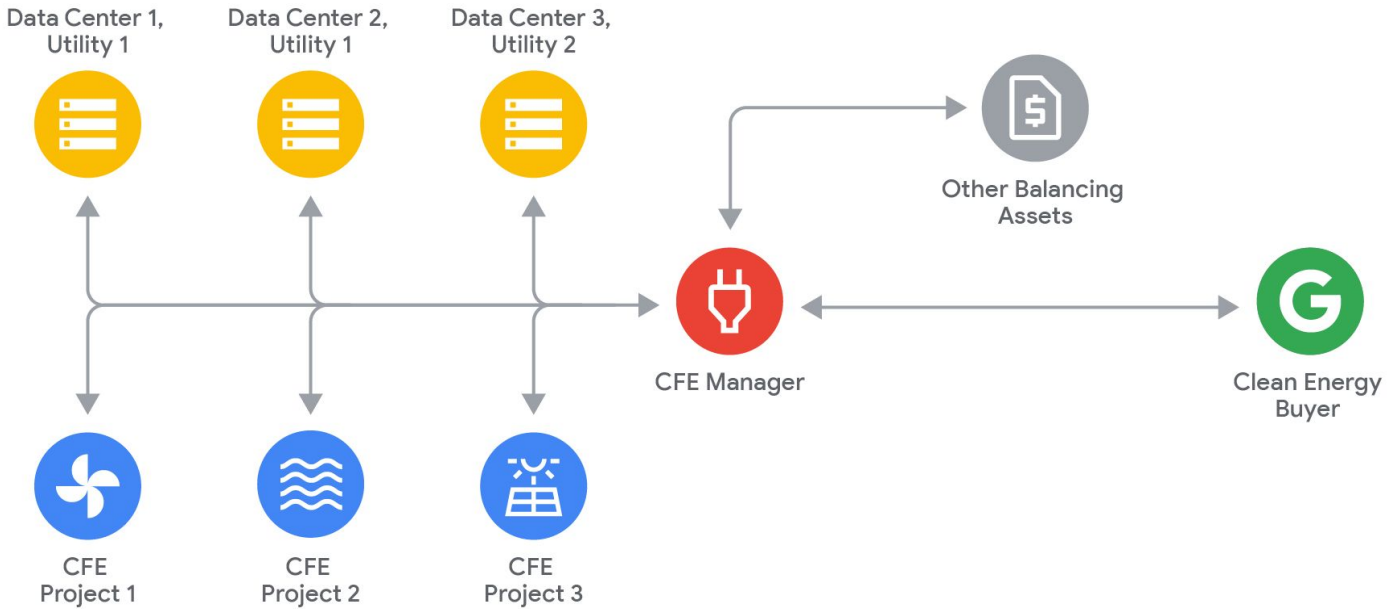
We filed our first CTT, with NV Energy in Nevada, which will **bring 115 MW of enhanced geothermal power** to the Nevada grid, expected online in 2030**.**

## Key Pillars

- **Focus on Clean Capacity:** Resources that can provide clean capacity to support reliability and customer energy goals.
- **Incorporation into Utility Integrated Resource Planning:** Consideration of existing and planned utility investments ensure efficient investment in customer-specific resources under the CTT.
- **Unlocking the Full Power Value for the Customer:** Provides a full energy and capacity credit against the standard rate, as opposed to avoided cost models that incentivize lowest cost procurement with diminishing value.
- **Scalable for other energy customers:** CTT is a scalable model to unlock diverse clean capacity investments.



# CFE Manager Model




| PPAs | Supply Agreements | DC Sites | Effective Price | CFE % |
|---|---|---|---|---|
| ↓0 | ↓1 | 3+ | Known | Guaranteed |

# Clean Firm Power

Five technologies we believe will play a critical role in decarbonization by 2030 and beyond:

- long-duration energy storage
- next-generation geothermal
- carbon capture and storage
- advanced nuclear
- hydrogen

FERVO ENERGY

Kairos Power

03

# Looking Ahead

# Areas of Data and Software Climate Development

Data standardization and tools for utilities, suppliers, and registries

Mainstream carbon accounting platforms to support granular data

Battery operators supporting 24/7 CFE optimization and tracking for T-EACs

# Thanks!