Google

24/7 Carbon -Free Energy by 2030

Maud Texier, Head of Energy Development

EPA Webinar on 24/7 Matching

September 22, 2021

Roadmap

1. 24/7 CFE Methodology
2. What does 24/7 CFE mean from a procurement strategy perspective?
3. What are the benefits to electricity purchasers of focusing on 24/7 CFE?
4. What innovations are we working on to move towards 24/7 CFE?

Google’s Energy Journey

Carbon Neutrality

(Offsetting emissions)

Since 2007

Google has purchased enough high-quality carbon offsets and renewable energy to bring our net operational emissions to zero.

100% Renewable Energy

(Reducing emissions)

Since 2017

Google has matched its global, annual electricity use with wind and solar purchases. However, our facilities still rely on carbon-based power in some places and times.

24/7 Carbon-free Energy

(Eliminating emissions)

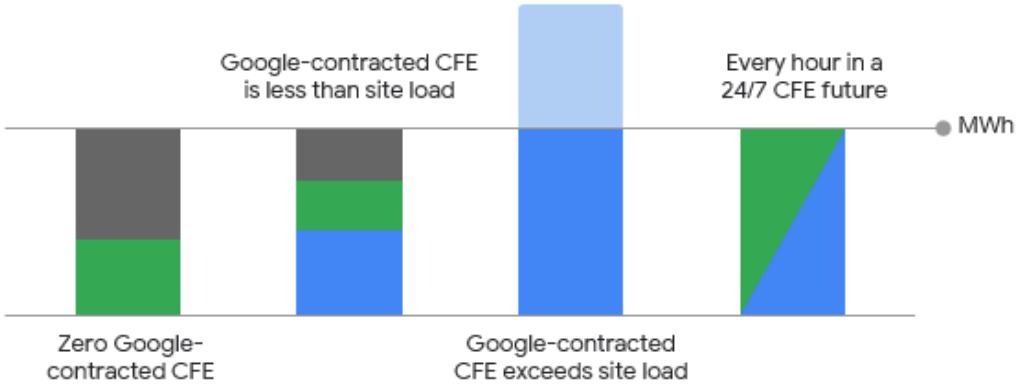
By 2030

Google intends to match its operational electricity use with nearby (on the same regional grid) carbon-free energy sources in every hour of every year.

Methodology

Hourly scenarios in our carbon-free energy framework

- Grid carbon-based energy
- Grid carbon-free energy (CFE)
- Google-contracted CFE
- Excess Google-contracted CFE

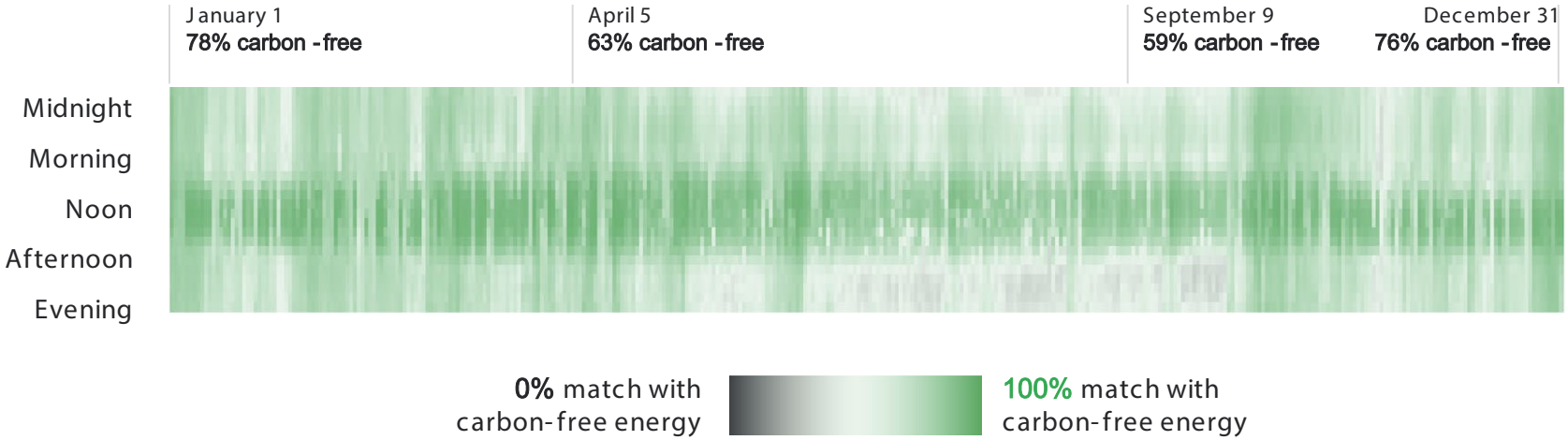


Source: 24x7 White Paper

Google

Every hour of electricity use at North Carolina data center

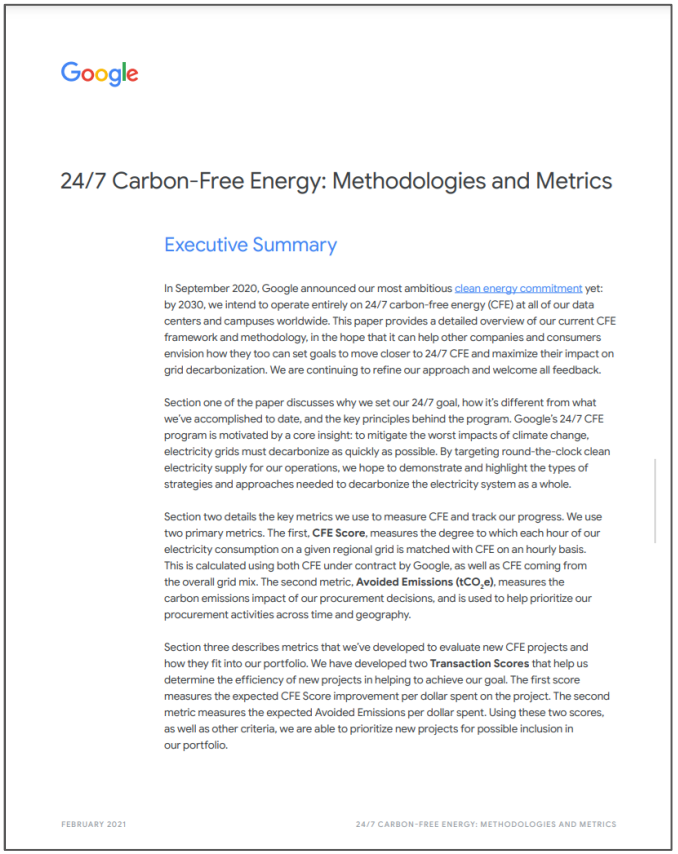
66% of our North Carolina data center's electricity use was matched on an hourly basis with carbon-free sources in 2019



Google

Program Principles

1. **Time-based Matching** : Moving from annual volume-based goal to **hourly** matching of load
2. **Local Procurement** : Moving from global matching of our demand to **local** (regional grid)
3. **Technology-inclusive** : Moving from renewable energy only to **all carbon-free energy** (includes nuclear, CCS, etc.)
4. **Additionality** : We seek to add new clean generation to the grid through our procurement, but recognize additionality is a spectrum.
5. **The Grid is the Ultimate Goal** : The broader goal of 24/7 CFE is to decarbonize the broader electricity grid, which is why we take Grid CFE into account in our methodology



Google

24/7 Carbon-Free Energy: Methodologies and Metrics

Executive Summary

In September 2020, Google announced our most ambitious clean energy commitment yet: by 2030, we intend to operate entirely on 24/7 carbon-free energy (CFE) at all of our data centers and campuses worldwide. This paper provides a detailed overview of our current CFE framework and methodology, in the hope that it can help other companies and consumers envision how they too can set goals to move closer to 24/7 CFE and maximize their impact on grid decarbonization. We are continuing to refine our approach and welcome all feedback.

Section one of the paper discusses why we set our 24/7 goal, how it's different from what we've accomplished to date, and the key principles behind the program. Google's 24/7 CFE program is motivated by a core insight: to mitigate the worst impacts of climate change, electricity grids must decarbonize as quickly as possible. By targeting round-the-clock clean electricity supply for our operations, we hope to demonstrate and highlight the types of strategies and approaches needed to decarbonize the electricity system as a whole.

Section two details the key metrics we use to measure CFE and track our progress. We use two primary metrics. The first, **CFE Score**, measures the degree to which each hour of our electricity consumption on a given regional grid is matched with CFE on an hourly basis. This is calculated using both CFE under contract by Google, as well as CFE coming from the overall grid mix. The second metric, **Avoided Emissions (tCO_2e)**, measures the carbon emissions impact of our procurement decisions, and is used to help prioritize our procurement activities across time and geography.

Section three describes metrics that we've developed to evaluate new CFE projects and how they fit into our portfolio. We have developed two **Transaction Scores** that help us determine the efficiency of new projects in helping to achieve our goal. The first score measures the expected CFE Score improvement per dollar spent on the project. The second metric measures the expected Avoided Emissions per dollar spent. Using these two scores, as well as other criteria, we are able to prioritize new projects for possible inclusion in our portfolio.

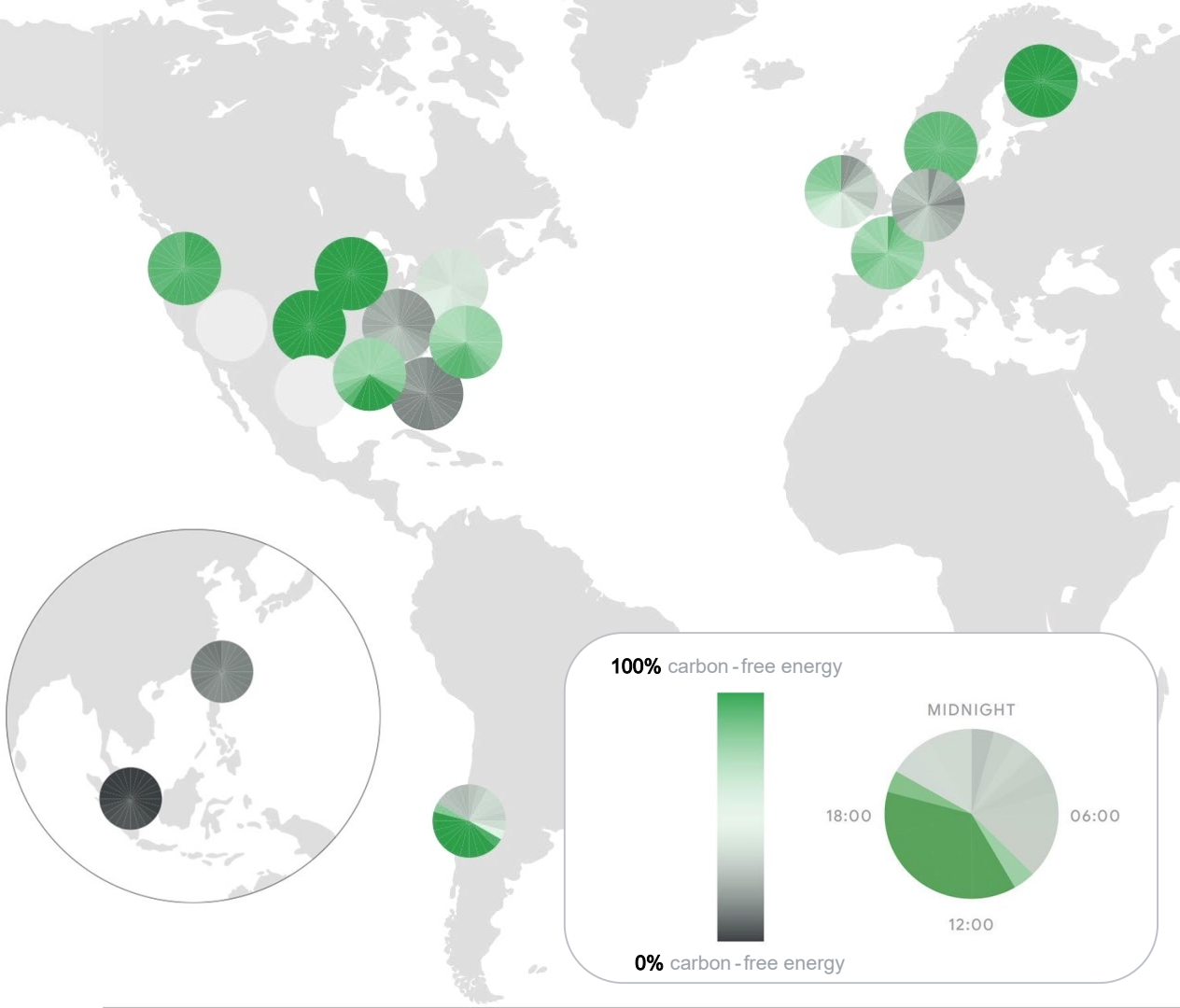
FEBRUARY 2021

24/7 CARBON-FREE ENERGY: METHODOLOGIES AND METRICS

In 2020 , Google reached **67% carbon -free energy** globally on an **hourly basis** .

In the same year, **five of our data centers** operated at **90% carbon -free energy.**

Every hour of Google's carbon -free energy sourcing in January 2020



Procurement Strategy

Procurement Methods and Evaluation

When evaluating projects for inclusion in our portfolio, we consider two key metrics:

1) **CFE Score Improvement** : Project costs / % change in CFE score
2) **Avoided Emissions:** Project costs / tCO2e avoided

We utilize the following procurement methods for our program:

1) Power purchase agreements with CFE assets
2) Retail energy supply agreements combining CFE technologies
3) CFE purchased through utility partners

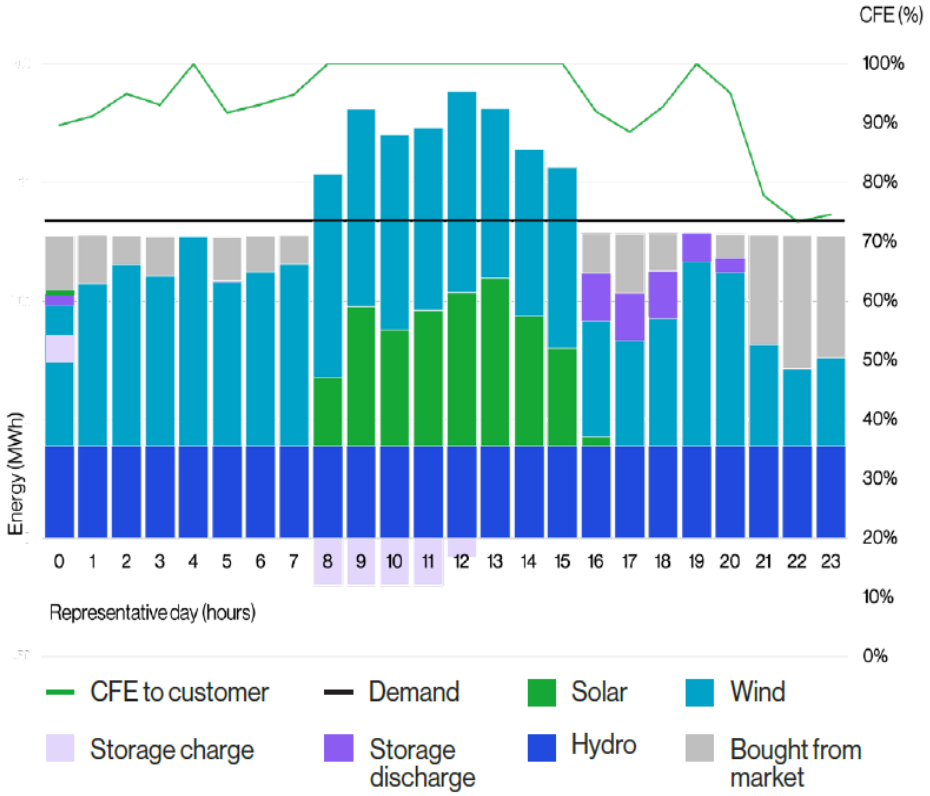
Source: Google 24/7 CFE Methodology Paper

Round-the-clock clean electricity supply

In May 2021, Google and AES announced a first-of-its-kind supply agreement that will guarantee that Google's data centers in Virginia will operate on **90% carbon -free energy by 2024** .

500 MW

New clean energy portfolio added to PJM electricity grid, comprised of wind, solar PV, battery storage, and run-of river hydro.



Source: AES Case Study

Google

Working with utilities on the path to 24/7

In December 2020, the Public Utilities Commission of Nevada approved an energy supply agreement between Google and NV Energy to procure solar and storage for its operations and the grid.

350 MW solar

Up to 280 MW battery storage

Online by 2024

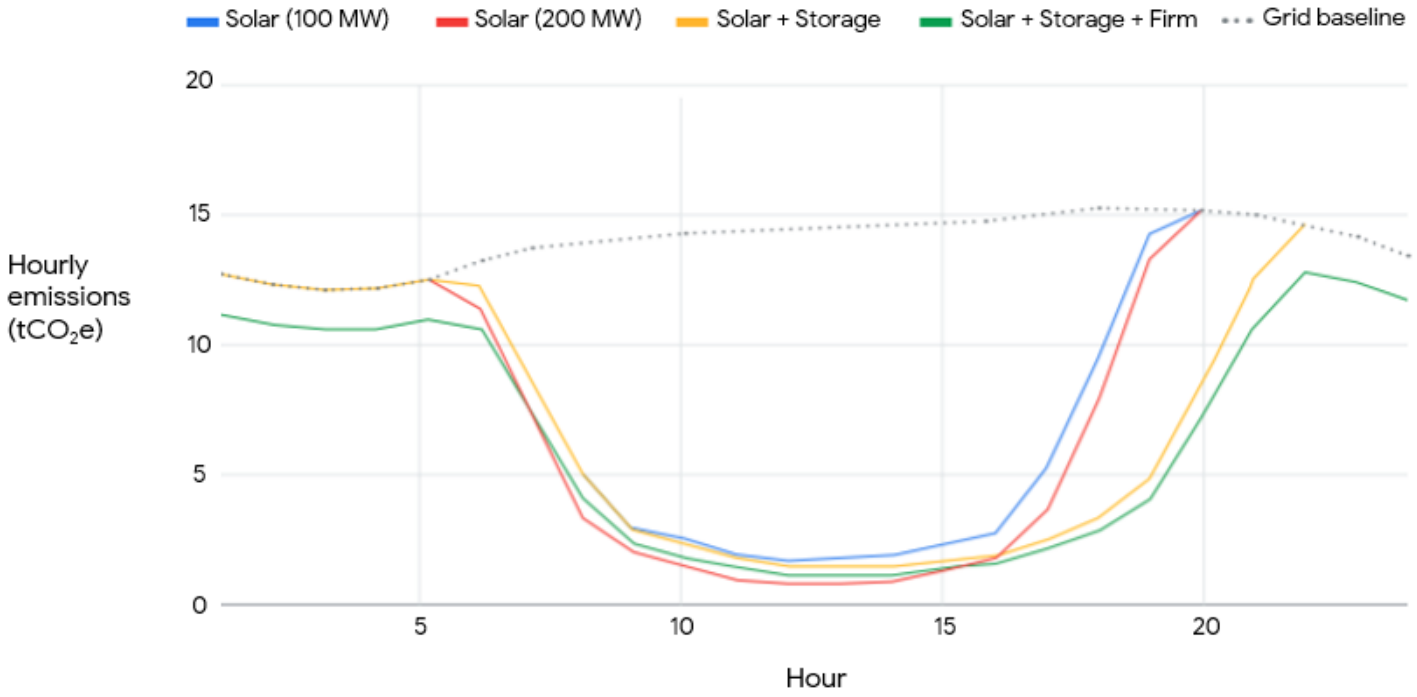
Benefits of a 24/7 CFE Approach

Benefits of 24/7 CFE

1. Greater Emissions Reductions
2. Reducing Financial Risks of Procurement
3. Reducing VRE Integration Challenges
4. Supporting Innovative Technologies
5. Focusing Policy Advocacy

Carbon emissions impact of technology procurement scenarios

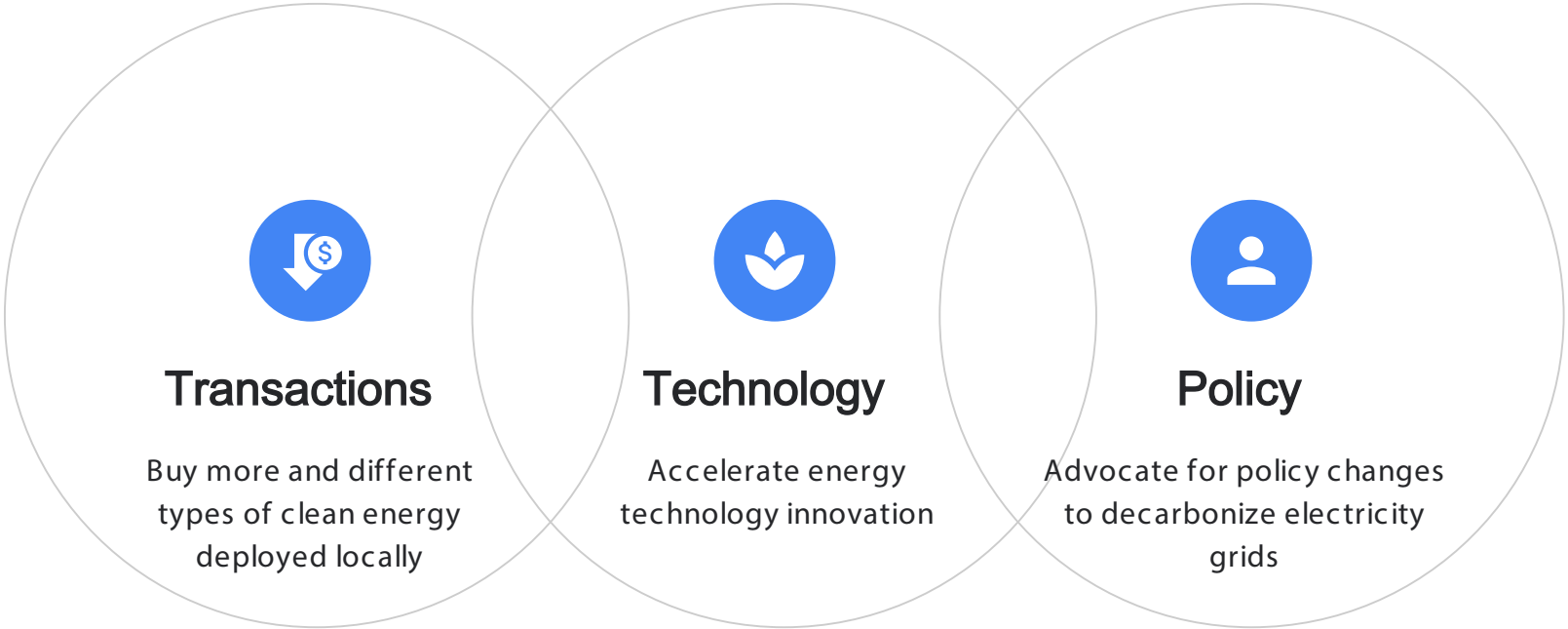
Investing in diverse energy technologies with complementary hourly production portfolios is essential for accelerating progress toward 24/7 carbon-free energy.



Google

Moving Towards 24/7 CFE

How will we achieve our 24/7 CFE goal?



Google

Next-generation geothermal energy

In May 2021, Google announced a partnership with Fervo Energy to develop a first-of-its-kind geothermal project that will bring “always on” clean energy to Nevada’s electricity grids.

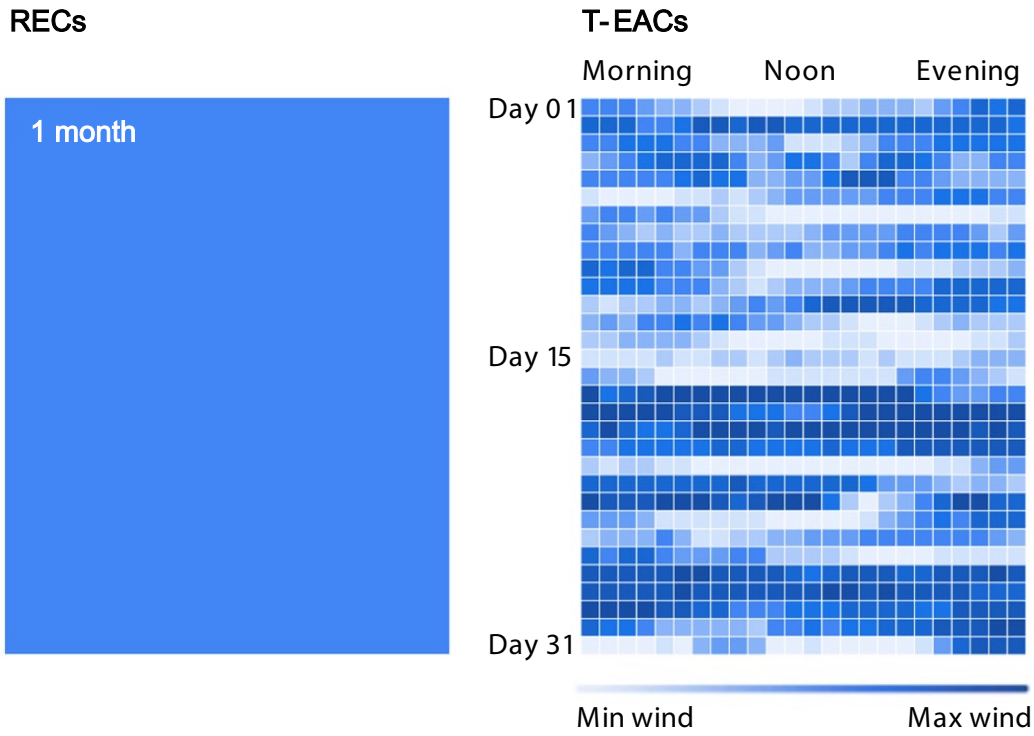
120 GW by 2050

Amount of firm, flexible clean energy that could be generated by geothermal energy in the US with advancements in policy and technology

A timely new approach for certifying carbon -free energy

Time-based Energy Attribute Certificates (**T-EACs**) incentivize production exactly when and where it's most needed

Google-contracted **wind** production in the Midwestern U.S.



Google

The Importance of Updating GHG Accounting Standards

Corporate GHG accounting standards should be updated to both recognize and incentivize higher -impact procurement choices

	ELECTRICITY DEMAND (LOCATION)	PROCUREMENT APPROACH	GRID-LEVEL EMISSIONS IMPACT	MARKET-BASED SCOPE 2 EMISSIONS
Company A	1,000 MWh (Kentucky)	1,000 MWh of unbundled RECs from existing PV projects in California equivalent to 100% of annual consumption	Negligible (projects have already been built, emissions on CA grid lower than KY)	Zero
Company B	1,000 MWh (Kentucky)	Achieve 90% CFE on an hourly basis over the course of a year on electricity grid where consumption occurs	Significant (CFE purchases from new projects avoid carbon-intensive generation on grid where electricity is consumed)	Greater than zero[7]

Upcoming This Week

Thursday, September 23: Google-hosted Climate Week Event Register at:
bit.ly/ClimateWeek-Standards

Friday, September 24th:
Official Launch of 24/7 CFE Compact at UN High-Level Dialogue on Energy

United Nations | UN ENERGY

ENERGY COMPACTS

Google