



Measuring Avoided Emissions and Maximizing Impact

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Why focus on avoided emissions?

- 1. Renewable energy procurement transactions do not always equal environmental impact
- 2. Achieve real emissions asap CO2 is cumulative
- 3. Accelerate technology with *all* the attributes we need for a reliable, zero carbon grid
- 4. Model sensible public policy and public understanding

#1. Renewable Energy ProcurementTransactions Do Not Always EqualEnvironmental Impact







100% RE

Need to shift focus from RE MWh to avoided emissions

#2. Achieve Real CO2 ReductionsASAP – Time Matters

% of a CO2 emissions pulse remaining in the atmosphere over time



#3. Commercialize Needed Tech for a Reliable, Zero Carbon Grid





#4 Model Sensible Public Policy



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To build a clean and prosperous future by addressing the climate crisis, protecting the health and welfare of all Americans, and putting the Nation on the path to a net-zero greenhouse gas economy by 2050, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

March 2, 2021

Mr. PALLONE (for himself, Mr. TOND, and Mr. RUN) introduced the following bill; which was referred to the Committee on Energy and Commerce, and in addition to the Committees on Transportation and Infrastructure, Oversight and Reform, Education and Labor, Ways and Means, Natural Resources, Armed Services, Foreign Affairs, Science, Space, and Technology. Intelligence (Permanent Select), and Financial Services, for a period to be subsequently determined by the Speaker, in each case for consideration of such provisions as fall within the jurisdiction of the committee concerned.

Check-in question on MURAL



Avoided Emissions Framework

		Analytic Considerations	
Business Purpose	Relatively Simple - Average Emissions - Historic Baseline - Annual / One Year - National / Regional Market - RE Only - Contracted Generation	More Complex - Marginal Emissions - Forecast Baseline - Hourly / Many Years - Local (considering transmission) - Carbon Free Energy - Contracted Consumption	
Internal Evaluation			
 Compare & prioritize transactions 			
Assess risk profile	+	· · · · · · · · · · · · · · · · · · ·	
Track outcomes	+		
External reporting	+	→	

Google's Energy Journey



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.

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.

24/7 Carbon-free Energy

(Eliminating emissions)



Hourly Carbon-Free Energy Performance at an Example Data Center



Iowa data center hour by hour (2018)

Need To Update and Modernize Scope 2 Accounting

- Current GHG Protocol scope 2 accounting does not reflect accurate quantification of carbon emissions (see table)
- Current rules direct attention away from solving the most difficult grids
- New rules that "recouple" electricity consumption with decarbonization solutions is the path to real zero

	1			
	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

Hourly Scenarios in our Carbon-free Energy Framework



Source: 24x7 White Paper

Google

Program Principles

- Time-based Matching: Moving from annual volume-based goal to hourly matching of load
- 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 energy projects 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 internot to operate entirely on 24/7 carbon-free energy (CFB) at all of our data centers and campuse workdwick into 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 molivated by a core insight to motize the most of unitate change, electricity grids must decarbonize as quickly as possible By tangeting 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 Secrem reasures 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 overail grid mix. The second metric. **VariedEmissions (CC)**, an easures the carbon emissions impact of our procument decisions, and is used to help prioritize our procument 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 to our 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. Ion the project. The second metric measures the expected Avoided Emissions per dollar spent. Ion these two scores, as well as other criteria, we are able to prioritize new projects for possible inclusion in our portfolio.

EBRUARY 2021

24/7 CARBON-FREE ENERGY: METHODOLOGIES AND METRICS



24/7 Carbon-Free Energy by 2030

Our Third Decade of Climate Action:

- **Transactions**: Buy more and different types of clean energy deployed locally
- **Technology**: Accelerate energy technology innovation
- **Policy**: Advocating for policy changes to decarbonize electricity grids



Carbon Emissions Impact of Technology Procurement Scenarios



Working to Make the Data Needed for Grid Decarbonization More Accessible

Data Access Pain Points

- Access to production and consumption data requires non-scalable, expensive solutions
- Lack of transparent grid mix and emissions data with no single source of truth
- Planning tools to get forecasted data are expensive and complex

Accessibility

Provide data and tools in a centralized platform via accessible formats

Standardize

Standardized terminology, methodologies, and data models for improved scalability

Transparency

Attribute sources, expose methodologies, and gain consensus on source of truth

Aggregate

Engage with stakeholders to curate and aggregate required data sources

Surface

Advocate for policy that requires the surfacing of existing data source

Access Needs

Data

Reducing Carbon is What Matters

24/7 RE is progress towards carbon-free <u>consumption</u>

- In Sweden, Vattenfall leveraged Azure's Grid Emissions Tools to create a first-of-its-kind solution to match renewable energy hourly against demand
- From yearly-based data to hourly-based data RECs are time-stamped, and *will be carbon-stamped*
- Carbon stamping methodology leverages available zonal data; aim is to eventually upgrade methodology to LME

Improving Carbon Accounting

3 Axes for Increased Rigor

• Goal to shift toward more accurate, granular emissions accounting with respect to:

1. Time

- 2. Location
- 3. Average/marginal
- Ancillary considerations:
 - 1. Transparency
 - 2. Simplicity
 - 3. Consistency

Emission Rates: No 1-size Fits All

Less Simple/Intuitive/Scalable

More Simple/Intuitive/ Scalable

But we have better and better tools

- No single perfect approach, but some better than others
- Accuracy most important, but other considerations matter
- Rough ranking of approaches
 - 1. Locational Marginal Emissions Rate
 - 2. Econometric Marginal
 - 3. Single Marginal Generator
 - 4. Average
 - 5. Non-Baseload
 - 6. Residual

Emission Rates Matter for CO2 Outcomes

The Shift from Average to LMER

- REsurety and Brattle whitepaper shows the difference in LMEs across the ERCOT footprint – dramatic differences in abatement
- 3x areas to consider in the workshop today:
 - Corporate procurement what to buy?
 - **Power market design** what does the market value?
 - GHG accounting how to measure progress?

