EPRI

QUICK INSIGHTS

Program on Technology Innovation: How Large Electricity Customers Reduce their Indirect Scope 2 Greenhouse Gas Emissions

This Technology Innovation (TI) program Quick Insight (QI) explores how large commercial and industrial (C&I) electricity consumers account for and report the greenhouse gas (GHG) emissions embedded in the electricity they buy to operate their businesses, and existing and emerging approaches companies can use to reduce these emissions.[1] It is intended to provide a quick overview and point to additional technical resources for senior executives and managers responsible for GHG emissions accounting, sustainability reporting, and corporate decarbonization strategy.

KEY POINTS

- A GHG emissions inventory accounts for the GHG emissions and removals attributable to a company's operations over a calendar year. A GHG emissions inventory typically includes a company's direct scope 1 emissions (e.g., emissions from combusting fossil fuels to generate electricity) and indirect scope 2 emissions (e.g., emissions associated with company purchases of electricity, heat, steam, and cooling for its own use). GHG inventories include emissions of carbon-dioxide (CO_2) and other GHGs (e.g., methane).
- Scope 3 emissions are indirect and include 15 categories of "upstream" and "downstream" emissions. For example, scope 3 emissions for a natural gas supplier include emissions from combustion of the natural gas by their customers. Scope 3 emissions typically are considered optional for voluntary reporting, but stakeholders increasingly are requesting this information.
- Scope 2 emissions associated with buying electricity for a company's own internal consumption often is a comparatively large source of GHG emissions for C&I customers and municipalities, yet it can be challenging for these entities to reduce these emissions because they are not under their direct control.
- Existing GHG accounting protocols and practices provide a strong incentive for companies to procure renewable energy (RE) and renewable energy credits (RECs) to reduce the scope 2 GHG emissions they report associated with the electricity they consume. Consequently, in recent years many companies in the U.S. and internationally have focused on buying RE (e.g., wind and solar) and RECs to meet their voluntary corporate sustainability goals, including reducing reported CO_2 and GHG emissions.
- There is growing controversy about the efficacy of using RE and RECs to reduce reported corporate scope 2 emissions, and there is now widespread recognition this approach may lead to inaccurate attribution of GHG emissions. In response to these concerns, the GHG Protocol in 2022 began a comprehensive three-year long effort to review and potentially revise the existing GHG Protocol's Corporate Standard, Scope 2 Guidance, Scope 3 Standard, and Market-based accounting approaches.[2] This review is expected to result in publication of revised accounting guidance by the end of 2025.

[1] For more information about GHG accounting concepts and methods, see *Greenhouse Gas Emissions Accounting for Electric Companies: A Compendium of Technical Briefing Papers and Frequently Asked Questions*. EPRI, Palo Alto, CA: 2021. 3002022366.

[2] See https://ghgprotocol.org/ghg-protocol-standards-and-guidance-update-process-0 for information about the GHG Protocol review.

- In response to growing concerns about the potential mismatch between RE procurement and end-use energy consumption, some large well-known corporate energy buyers now are focusing on procuring "time-matched" RE and "24/7 carbon-free energy" (aka 24/7 CFE). The U.S. federal government also has started to procure large amounts of 24/7 CFE as required by Executive Order 14057[3] issued in 2021.
- One key challenge facing companies trying to reduce their scope 2 emissions is how to estimate the GHG emissions embedded in the electricity they buy. This also is a challenge to electric companies who often are requested to provide this same information to their customers.

ACCOUNTING FOR ELECTRICITY PURCHASES IN CORPORATE GHG ACCOUNTING

A GHG emissions inventory is an assessment of the direct and indirect GHG emissions and removals attributable to a company's operations over a calendar year. The most widely used standard in the United States and internationally is the GHG Protocol Corporate Standard.[4] Corporate operations and activities cause direct and indirect GHG emissions which are categorized under the GHG Protocol in three "scopes."

Scope 1 Emissions

Direct emissions, referred to as scope 1, are emissions from equipment and facilities owned or controlled by a reporting company and operational activities that physically release (or remove) GHGs into (from) the atmosphere. For example, a steel manufacturer would include emissions associated with the operation of its blast furnaces in scope 1, while an airline would account for the GHG emissions of its airplanes as scope 1.

Scope 2 Emissions

Indirect emissions are classified either as scope 2 or scope 3, and result from sources that are not owned or operated by the company but are essential to its operations. Scope 2 emissions refers specifically to emissions associated with *electricity*, heating, cooling, and steam purchased by an entity for its own use.[5] A large component of many non-energy producing electricity customers' total GHG emissions is the scope 2 emissions associated with buying and using electricity to operate their businesses.

Scope 3 Emissions

Scope 3 emissions refer to all other indirect emissions not included in scope 2. For many corporations not engaged in energy production or fossil fuel combustion, the majority of their GHG emissions often are indirect to their operations and are associated with their "value chain" activities. The GHG Protocol Scope 3 Standard guides companies on how to prepare and report 15 categories of "upstream" and "downstream" scope 3 emissions resulting from value chain activities.[6]

ESTIMATING SCOPE 2 EMISSIONS ASSOCIATED WITH BUYING ELECTRICITY

Many end-use electricity customers, particularly consumer-oriented large C&I customers, want to know the GHG emissions intensity (i.e., tCO_2e/MWh) of the electricity delivered by their local electric utility – sometimes referred to as a *load-based emissions factor (EF).* Companies need this information to account and report their scope 2 GHG emissions and potentially to reduce them.

Unfortunately, it is impossible to track electricity generated by specific power plants through the electric power grid and delivered to a specific end-use customer. In limited cases, it may be possible to identify specific power plants that supply electricity to end-use customers (e.g., "island" power systems and microgrids), but in most cases the electricity delivered to consumers is undifferentiated "grid power." Because of this, a methodology is needed to attribute power system GHG emissions to end-users.

[3] Executive Order 14057 - *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*, December 8, 2021.

[4] https://ghgprotocol.org/corporate-standard.

[5] Scope 2 also includes GHG emissions associated with electricity transmission and distribution systems (T&D) line losses associated with transmitting electricity from where it is generated to load-serving entities (LSEs) and end-use customers.

[6] Additional guidance on defining and calculating emissions from the 15 scope 3 categories can be found in the Scope 3 Standard supplement, *Technical Guidance for Calculating Scope 3 Emissions*. https://ghgprotocol.org/sites/default/files/standards/Scope3_Calculation_Guidance_0.pdf.

While several different approaches have been developed in recent years – and a variety of start-up companies[7] – are focused on this issue, there currently is no widely-agreed upon approach for developing load-based EFs.[8]

Given this, electricity customers often use an *annual grid average EF*[9] as a proxy to estimate and report their scope 2 emissions associated with purchased electricity. Typically, this is a generation-weighted EF averaging all GHG emissions (or CO_2 only) associated with all power generation resources operating in a defined grid region for a specified period of time (e.g., calendar year). Annual grid average EFs for the entire U.S. disaggregated into 25 sub-regions are available in the Emissions & Generation Resource Integrated Database (eGRID) maintained by the U.S. Environmental Protection Agency.[10] Electric companies also use annual grid average EFs to estimate and report scope 2 emissions associated with electricity they buy from others to power their own operations and for other GHG accounting purposes.

Reducing Corporate Scope 2 GHG Emissions

In recent years, many companies in the U.S. and internationally have focused on buying RE (e.g., wind and solar) and RECs to meet their voluntary corporate sustainability goals, including reducing CO_2 and other GHG emissions. A large and growing group of leading sustainability-oriented companies procure enough RE and/or RECs to equal 100 percent of the megawatt hours (MWh) of electricity they consume annually.[11]

Buying Renewable Energy and Renewable Energy Certificates

To drive rapid deployment of RE and decarbonization, many states have adopted regulatory programs establishing renewable portfolio standards (RPS), clean energy standards (CES) and other programs requiring electric companies to procure and track RE generation and other types of "clean energy." Most RPS programs allow electric utilities and other power generators to create and trade RECs to demonstrate RPS compliance. Typically, RECs record the generation of one MWh of electricity by a specified "renewable" resource (e.g., wind and solar), as defined by the specific RPS program.

Procuring Renewable Energy to Reduce Reported Scope 2 GHG Emissions

Scope 2 emissions associated with purchased electricity often is a comparatively large source of GHG emissions for C&I customers, yet it can be challenging for these entities to reduce these emissions because they are not under their direct control. This is particularly the case for companies engaged in certain activities, such as finance, high technology and service-oriented companies, because these types of entities typically have comparatively low scope 1 direct emissions.

The only direct action these electricity customers can take to reduce their scope 2 electricity-related emissions is to reduce their energy consumption (e.g., by installing energy efficiency upgrades) or installing behind-the-meter RE such as rooftop solar photovoltaic panels. These approaches often can be optimized to reduce some of a company's scope 2 emissions, but many companies will continue to purchase large amounts of electricity – along with the associated scope 2 emissions.

In the absence of being able to take direct action to reduce their Scope 2 emissions more significantly, many companies have focused on procuring RE and RECs to reduce their reported Scope 2 emissions, and more recently, a few leading sustainability-oriented technology companies have started to procure "24/7 carbon-free energy" (aka 24x7 CFE) resources (described below) to reduce these reported emissions.

Existing GHG accounting protocols and practices provide both a strong incentive and a way for companies to procure RE and RECs to reduce the scope 2 GHG emissions they report associated with the electricity they buy. Under existing corporate voluntary GHG accounting standards, companies can report their electricity-related scope 2 emis-

[7] For example, FlexiDAO, Granular Energy, Kevala, Singularity, and WattTime.

[8] For a summary of load-based accounting approaches, see *Methods to Account for Greenhouse Gas Emissions Embedded in Wholesale Power Purchases*, EPRI, Palo Alto, CA: 2019. 3002015044.

[9] Some RTOs and ISOs publish GHG intensity data for their operating footprint. The US EPA's eGRID program also publishes emission intensities for grid sub-regions of the U.S. One challenge using eGRID and other EF databases is that publishing typically lags one or more years behind the current reporting period.

[10] https://www.epa.gov/egrid.

[11] For a list of companies who have taken a pledge to use 100 % RE annually, see https://www.there100.org/.

sions using either a "locational" and/or a "market-based" approach and associated GHG emissions factors (EFs). This allows companies that purchase RE and RECs to report zero GHG emissions (i.e., 0 tCO_2e/MWh consumed) associated with the RE they buy even though they still use electricity from a grid that may be supplied by fossil-fired power generation. This disconnect has motivated some electricity customers to seek out 24/7 CFE supply agreements to better match their hourly power consumption with carbon free electricity supply.

In recent years, corporate consumers have used different approaches to acquire RE and make related environmental sustainability claims. For example, companies operating in deregulated markets can choose to buy electricity that has a lower GHG emissions content than the electricity supplied by their incumbent power provider. This approach has led some companies to develop renewable and 24/7 CFE power purchase agreements (PPAs). For example, several large commercial customers particularly in high technology (e.g., Apple, Google, Microsoft) have reduced their reported Scope 2 emissions by generating RE onsite, procuring RE via PPAs, and buying and retiring RECs.

In deregulated power markets, an electricity buyer can purchase some or all of the electricity output from a new wind or solar facility for a fixed length of time using a PPA. Using this type of "physical" renewable PPA, a RE generator sells both electricity and RECs directly to a corporate energy buyer bypassing their local utility. Alternatively, a retail access customer can buy RE from a competitive retail supplier, who in turn may contract with RE developers or purchase and retire RECs.

In some regulated markets, a corporate electricity buyer can indirectly purchase all or a portion of the electricity output from a new wind or solar facility for a fixed length of time by participating in an electric utility-sponsored "green" tariff program, where the RE is designated for that particular customer, rather than to all of the utility's customers. In each of these examples, large corporate buyers enter into an agreement with RE generators (directly or indirectly) to purchase some or all their facilities' output and the related RECs.

Using Renewables to Reduce Reported Scope 2 Emissions is Controversial

In recent years, there has been growing recognition this approach to reducing a company's reported scope 2 emissions may lead to inaccurate attribution of GHG emissions. In 2020, Google highlighted this issue when it reported that despite having contracted for 100% RE to meet the annual electricity consumption of the company's worldwide data centers, the data centers continued to rely on undifferentiated regional "grid power" to meet a significant portion of their electricity consumption, ranging from six (6) to 82 percent depending on its location and corresponding demand profile. Globally, Google reported:[12]

> *"Although we matched 100% of our global, annual electricity consumption with renewable energy in 2019, on an hourly basis 61% of all the electricity we used was matched with regional, carbon-free sources….Without Google's purchases of renewable energy this figure would have only been 39%, equivalent to the existing "grid mix" in regions where we operate."*

A more recent systematic quantitative modeling and analysis of the mismatch between RE generation and the load profiles of different types of large C&I customer types concluded:

> *"For buyers, the results of this analysis showed that current corporate procurement practices will not typically provide energy that is sufficient to meet all of a company's load for significant portions of the year. This gap means that, in reality, buyers continue to rely heavily on electricity from their regional electric grid, which often has a significant fossil fuel component and corresponding carbon footprint. Even with the addition of battery storage, the mismatch between variable renewable energy supplies and customer load is only reduced, not eliminated."*[13]

[12] "24/7 by 2030: Realizing a Carbon-free Future," Google, September 2020, https://www.gstatic.com/gumdrop/sustainability/247-carbon-free-energy.pdf ,accessed April 20, 2022.

[13] Columbia University, *Advancing Corporate Procurement of Zero Carbon Electricity I the United States: Moving from RE100 to ZC100*, 2021, p. 16.

Buying versus Consuming 100% Renewable Energy

Critics of market-based GHG accounting have long pointed out that there is a critical difference between the content of power purchased by an end-use customer using a PPA or other type of financial contract, and the content of the electric power actually dispatched and consumed by the same customer. This distinction can lead to confusing and disparate claims as to what extent a company has reduced its use of non-renewable, carbon-emitting power resources.

To better understand how *buying* and *consuming* 100% renewable energy differ, consider a hypothetical commercial facility shown in Figure 1 that has a "flat" around-the-clock electric load of 100 MW (e.g., a computer data center). As shown, the company enters into a PPA for the output from a nearby 346 MW solar farm. Over the course of one year, the solar farm expects to generate 876,000 MWh of RE (100 MW x 8,760 hours) and an equal number of RECs. This output equals the facility's annual load of 876,000 MWh.

Using existing market-based GHG accounting methods, the company shown in Figure 1 may claim to consume 100% RE and may report zero scope 2 emissions associated with their annual power consumption as shown in the pink box in the lower right-hand corner. This is so because the solar PV facility included in the PPA generates enough RE *annually* to equal the total amount of electricity the company consumes. However, this claim is not based on the actual physical flow of electricity but rather a "contract path."

The electricity that actually would be delivered to the facility is undifferentiated by source and would include both RE and other power generation resources operating on the grid simultaneously. As shown in Figure 1, the "location-based" emissions associated with this facility's electricity consumption would be 458,000 tCO_2e – far greater than the 0 tCO_2e that would be reported using the market-based approach.

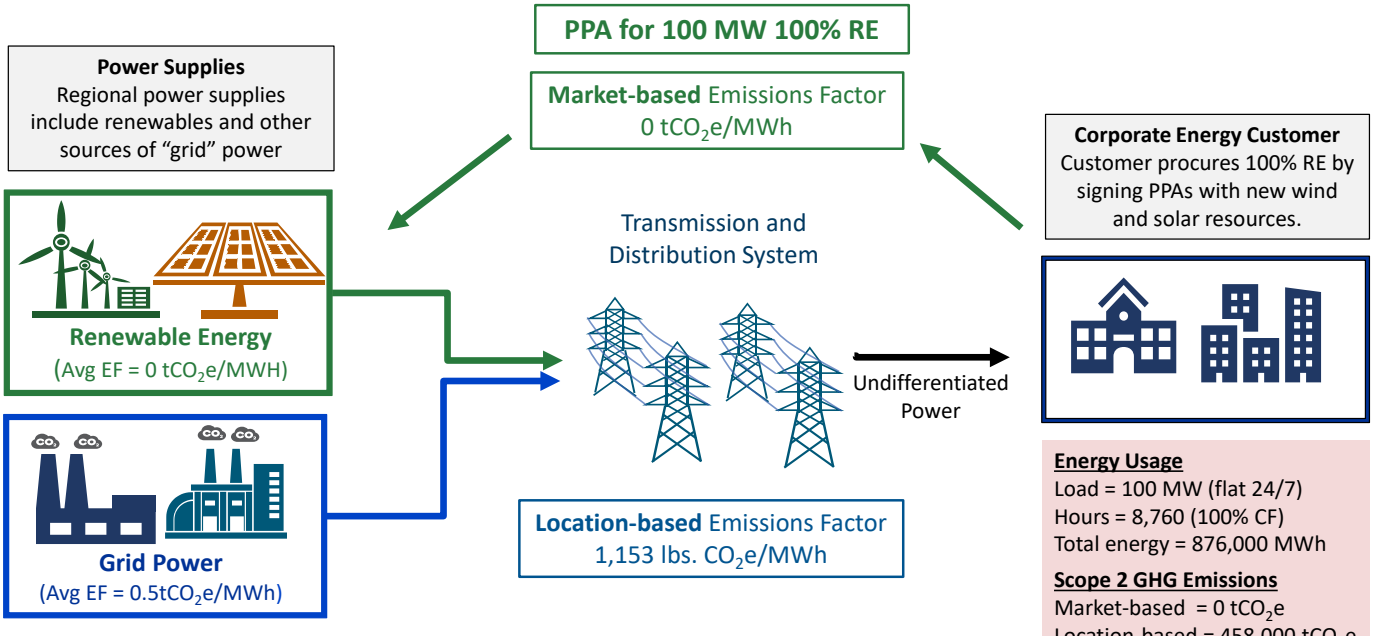

Figure 1. *Buying versus Consuming 100% Renewable Energy*
Source: *EPRI 2022.*

Electricity Delivered to Customers is Undifferentiated

The electricity dispatched in real-time to end-use customers typically is undifferentiated and is generated by a mix of generation resources operating on the grid as shown in Figure 1. Even if an electric customer could purchase a 100% 24/7 CFE power product by contract, the customer may continue to consume undifferentiated "grid" power in real time.

One factor that differentiates contracted and consumed electricity is that the energy output profile of contracted RE resources may not match a customers' hourly load on a 24/7 basis. C&I customers may purchase enough RE and/or RECs to equal their electricity consumption on an annual basis, but their real-time electric load typically does not match this annual average load. This means a customer that procures 100% RE still will receive undifferentiated "grid" power that often includes fossil-fired power resources that emit GHGs during some hours of the day and year – particularly when contracted RE do not operate (e.g., when the wind is not blowing, or the sun is not shining).

Additionally, RE resources (or RECs) may be associated with RE generated in a balancing area (BA) or ISO/RTO that is geographically different from where the contacted electricity is consumed. In the US, companies are allowed to acquire and retire RECs created by RE generated virtually anywhere in the U.S. as the basis for reporting reduced scope 2 emissions. This locational mismatch is another reason RE procurement does not translate directly into reduced GHG emissions.

Growing Interest in Procuring 24/7 Carbon-Free Energy

In response to growing concerns about the potential mismatch between RE procurement and end-use energy consumption, several large corporate C&I customers, including Google, Microsoft, Iron Mountain and others, have turned to procuring "*carbon-free energy*" that more closely matches their actual corporate hourly electricity load profile on a 24/7 hourly basis every day of the year (aka *24/7 Carbon-free Energy*). This shift from procuring 100% RE on an annual basis to procuring 24/7 CFE on an hourly basis marks a potentially important evolution of corporate efforts to promote clean energy and increase deployment of RE and a broader range of "carbon-free" generation technologies.

The United States federal government also is now beginning to procure large amounts of 24/7 CFE, as required by Executive Order 14057[14] (EO 14057) issued by President Biden in 2021. The federal government is the largest consumer of electric power in the U.S., and EO 14057 is designed to leverage this buying power to push development and deployment of 24/7 CFE by requiring all federal agencies to (i) purchase 100% carbon-free electricity on a net annual basis by 2030: and (ii) purchase 50% carbon-free electricity on a 24/7 basis by 2030.

Using GHG Emissions Offsets to Reduce Reported Corporate Scope 2 GHG Emissions

In addition to the approaches described above, electric companies and others have developed and/or used GHG emission offset credits to reduce their reported GHG emissions. In simple terms, GHG offsets provide a way for a company to substitute "external" GHG emission reductions that may be less expensive to achieve than reducing its own direct or indirect emissions.[15] To date, most companies that develop or purchase GHG offsets do so to reduce their reported direct scope 1 emissions, but there is no explicit reason companies cannot use issued GHG offset credits to reduce their reported scope 2 and/or scope 3 emissions. While many entities purchase and use GHG offset credits to reduce their GHG emissions, this approach is not recognized by the GHG Protocol as a way to reduce reported GHG emissions. Rather, the GHG Protocol encourages reporters to record a "memo item" identifying and describing any GHG offsets and other emissions mitigation approaches a company may have used during a reporting year and to report an organization's net GHG emissions taking into consideration these additional measures.

[14] Executive Order 14057 - *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability*, December 8, 2021.

[15] For more information about GHG emissions offsets and associated EPRI research products, see https://esca.epri.com/GHG-Accounting-Markets-and-Offsets.html#GHG-Accounting.

NEXT STEPS

EPRI has been engaged in GHG emissions accounting for more than 20 years. During this time, EPRI has assisted member electric companies to develop and report comprehensive corporate GHG emissions inventories, and taken part in expert working groups focused on improving GHG accounting and reporting for electric companies and combined utilities.

Currently, EPRI Program 201 (*Energy, Environmental, and Climate Policy Analysis)* leads an ongoing project focused on *Scope 3 GHG Emissions Accounting for Electric Companies and Combined Utilities.*[16] This project builds upon two previous EPRI projects completed in 2021[17] and 2022.[18]

To address the challenges described in this QI, EPRI plans to expand our current GHG emissions accounting research activities in 2024 and beyond to assist EPRI members with navigating this complex and rapidly evolving area. In 2024, Program 201 plans to launch a new EPRI supplemental project to continue our research on scope 3 and related GHG accounting issues. In 2024, we also plan to launch a new *GHG Accounting Supplemental Program* to be included in EPRI's 2025 Annual Research Portfolio. Program 201 also is collaborating with Program 246 (*Electricity Market Design and Operation*) to explore GHG accounting issues related to electricity dispatched and delivered through organized wholesale power markets.

In 2022, EPRI published a white paper exploring the how some large C&I customers have started to procure 24/7 CFE to better match their actual hourly load to hourly generation of RE and other carbon-free resources. In 2023, EPRI has built on this exploratory work and created an interest group on 24x7 CFE to continue to explore this topic collaboratively with the EPRI members.

EPRI RESOURCES

To learn more about the GHG emissions accounting issued discussed in this QI, please refer to the EPRI resources below which are available at no cost to EPRI members and the public:

- *Quick Insights. Program on Technology Innovation: Key Challenges in Electric Company Greenhouse Gas Emissions Accounting*, EPRI, Palo Alto, CA: 2023. 3002028297
- *Greenhouse Gas Emissions Accounting for Electric Companies: A Compendium of Technical Briefing Papers and Frequently Asked Questions*, EPRI, Palo Alto, CA: 2021. 3002022366.
- *Methods to Account for Greenhouse Gas Emissions Embedded in Wholesale Power Purchases*. EPRI, Palo Alto, CA: 2019. 3002015044.
- *24/7 Carbon-free Energy: Matching Carbon-free Energy Procurement to Hourly Electric Load*. EPRI, Palo Alto, CA: 2022. 3002025290.
- *Understanding Source-based and Load-based Greenhouse Gas Emissions Accounting*. EPRI, Palo Alto, CA: 2022. 3002024037.
- *Scope 2 GHG Emissions Accounting for Electric Power Companies*. EPRI, Palo Alto, CA: 2022. https://public-download.epri.com/PublicAttachmentDownload.svc/AttachmentId=79139.
- *RECs and GHG Accounting*. EPRI, Palo Alto, CA: 2022. https://esca.epri.com/pdf/Back-Pocket-Insights/BPI_Scope-2-RECS_GHG-Accounting.pdf.

[16] For more information about this EPRI supplemental project, see https://www.epri.com/research/products/000000003002025796.

[17] *GHG Emissions Accounting for Electric Companies* (2020-21).

[18] *Exploring the Role of GHG Emissions Offsets to Achieve Corporate Decarbonization Goals* (2022).

About EPRI

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Together, we are shaping the future of energy.

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