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ISSUE BRIEF

ACTIONS LARGE ENERGY BUYERS CAN TAKE TO TRANSFORM AND DECARBONIZE THE GRID: PROCUREMENT PRACTICES FOR ACHIEVING 100% CARBON FREE ELECTRICITY

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EXECUTIVE SUMMARY

Highlights

- Large energy buyers—including corporates, cities, and institutional customers—have played and will continue to play an important role in driving clean energy in the near term, particularly renewables. However, to ensure that the power sector achieves deep decarbonization¹ over the next two to three decades, large energy buyers will need to take additional actions to play a leading role in accelerating the transition to a carbon-free grid.
- Large energy buyers can implement approaches that help transform the grid such as matching clean energy purchasing with the timing of their energy use, incorporating demand flexibility, purchasing dispatchable clean electricity, adopting enabling technologies (e.g., energy storage), maximizing emissions reductions, and driving an equitable transition to clean energy.
- There is no single strategy for implementing transformative procurement practices, which is why we have highlighted a variety of approaches in this issue brief. Optimal procurement approaches can vary based on differences in customer electricity usage, market context, available product offerings, staff and resources, and differences across grids.
- To enable large energy buyers to implement transformative procurement practices, new products and solutions will be needed. Metrics and recognition programs will also need to be revised to incentivize and encourage more customers to take actions that can facilitate a carbon-free grid.

Context

Our objective is to inform large energy buyers and market stakeholders about opportunities to expand the use of procurement practices that transform grids and can accelerate the transition of the power sector to carbon-free energy sources. Large energy buyers can meet their clean energy² commitments in a variety of ways, yet some procurement practices have greater impact on grid decarbonization than others. This issue brief aims to inform large energy buyers about new and emerging approaches being used globally to drive the grid transformation needed to decarbonize the power sector, including new approaches that consider the timing and location of clean energy used. We discuss a variety of approaches because not all options may be feasible for customers currently, given differences in their electricity usage (size and time of use), location of facilities and the related market context, availability of product offerings, and resources. The focus of this issue brief is primarily on large buyers because they are more likely to be able to implement, and even help create, new solutions for some of the approaches highlighted here, given that large buyers have more staff and resources devoted to energy management and procurement, larger energy loads, and the ability to implement more complex transactions. However, some smaller energy buyers may also be able to implement approaches identified here.

This issue brief begins with a description of the characteristics of transformative clean energy procurement that can enable grid decarbonization. It then explores various methods of procurement and actions by large energy buyers that can facilitate the transition to zero-carbon resources. Based on market experience with new procurement approaches, we provide examples and considerations for large energy buyers that are interested in seeking choices and learning about the range of procurement practices available for accelerating grid decarbonization, as not all options are viable for all buyers. This issue brief concludes with a discussion of the path forward and how metrics, incentives, and market products may need to evolve to enable large energy buyers to increase the impact of their actions on grid decarbonization.

This document was developed based on information provided through a review of actions by leading clean energy buyers, current literature and trade publication articles, discussions with market participants, and a

convening of market stakeholders. The convening, hosted by World Resources Institute and held virtually in November 2020, included perspectives of various market stakeholders including representatives of companies with clean energy goals, utilities, renewable energy developers, government agencies, consultants, clean energy procurement certification and recognition programs, and nongovernmental organizations. The market stakeholder convening was designed to surface insights on the goals and characteristics of advanced procurement practices, barriers to implementing new approaches, and market needs for advancing this type of procurement.

1 INTRODUCTION

Globally, there is growing recognition of the need to decarbonize the power sector by mid-century or sooner to curb global temperature rise to below 1.5 degrees Celsius (°C) above pre-industrial levels (IPCC 2018; SBT n.d.). In response, the European Union and more than 112 governments have committed to net-zero emissions by 2050 or earlier. In the United States, 18 states plus the District of Columbia and Puerto Rico have set targets to rely on 100 percent carbon-free electricity. Many utilities have set similar targets. More than three-quarters of U.S. customers are served by utilities with greenhouse gas (GHG) emissions reduction goals and 53 have carbon-free or net-zero goals by 2050 (SEPA 2021). Large energy buyers³ such as corporates, cities, and governmental agencies have also committed to taking climate action (see Box 1).

BOX 1

LARGE ENERGY BUYER CLIMATE COMMITMENTS

Today, more than 500 companies have established science-based targets to reduce their emissions and more than 1,100 companies have committed to take climate action (SBT n.d.). Further, over 280 companies have joined RE100 and committed to purchase renewable electricity in an amount equal to their annual electricity consumption, which collectively represents more than 300 terawatt hours per year (RE100 n.d.). Globally, nearly 10,000 cities and local governments have adopted GHG emissions reduction targets, while more than 250 cities have announced 100 percent renewable energy targets at the municipal or city-wide level (REN21 2020).

In particular, large energy buyers can play a key role in the clean energy transition because of the size of their electricity demand and their ability and resources to decarbonize their energy supplies. Commercial and industrial customers use more than half of the electricity generated in the United States (RI and TBG 2020). To date, large energy buyers have accelerated grid decarbonization, primarily through renewable energy purchases (Kobus et al. 2021; O’Shaughnessy et al. 2021). In the United States, corporate buyers have driven more than 35 gigawatts (GW) of new renewable energy capacity in the last decade (RI and TBG 2020), out of a total of about 130 GW of utility-scale solar and wind deployed over that same period. In 2018 alone, corporate procurement accounted for 22 percent of all power purchase agreements (PPAs) for renewables in the country (Foehringer Merchant 2019) and Wood Mackenzie estimates that U.S. companies could deploy 85 GW of additional renewable power by 2030 (Shreve 2019; Kobus et al. 2021). Globally, corporate buyers have purchased more than 76 GW of clean energy PPAs since 2011 (BloombergNEF 2021) and, in 2020, large companies executed a record 23.7 GW of clean energy PPAs across 40 countries (BloombergNEF 2021).

However, in the coming decades, the transition to carbon-free energy sources will require far more significant grid transformation than what has occurred so far (Jenkins et al. 2018; Larson et al. 2020; NAS 2020; Bouckaert et al. 2021). These studies show that achieving deep decarbonization will require much more aggressive deployment of variable renewable energy⁴ (VRE) (e.g., wind, solar) than what has occurred to date and large quantities of firm clean energy⁵ (e.g., nuclear, low-impact hydropower, geothermal), with significant support from energy storage and demand flexibility. Fossil fuel generators will need to be largely replaced by emissions-free generation sources, equipped with carbon capture and storage, or converted to run on clean fuels (e.g., hydrogen or renewable natural gas). Grid operators and planners will need to balance supply and demand on grids with higher levels of VRE sources whose generation output varies based on the availability of resources such as sunlight or wind. Substantial new investment in transmission and grid upgrades will be needed and markets will need to evolve

(EEI 2021; Gramlich 2021). Deep decarbonization may depend crucially on the rapid scaling of emerging technologies such as firm clean energy generation, battery storage, and demand flexibility (Bouckaert et al. 2021; Gramlich 2021).

Actions by large buyers will be critical and can accelerate the transition to carbon-free energy sources through a broader set of procurement practices that optimize how, when, and where clean energy is deployed to maximize long-term grid emissions reductions. This issue brief identifies a range of approaches and emerging procurement practices currently being used by large energy buyers globally to decarbonize the grid. Based on experience with these procurement practices, we provide examples and considerations for large buyers that are interested in seeking choices and learning about the range of procurement practices available. In Section 2, we discuss characteristics of transformative procurement and why it is important. In Section 3, we identify approaches to transformative procurement, discuss the benefits and challenges of implementation, and provide case studies of practices undertaken by leading large buyers. Finally, in Section 4, we discuss the path forward to expanding options for large buyers to implement new approaches and accelerate the grid transformation needed to decarbonize the power sector. To catalyze and enable large buyers to undertake transformative procurement practices, new evaluation metrics, incentives, and product offerings will be needed.

Methodology

The findings and recommendations in this issue brief are based on a review of current literature, World Resources Institute’s (WRI’s) experience supporting large energy buyer procurement,⁶ and an examination of case studies of global large buyers and their documented market experiences with new procurement methods. The review of current literature included recent English language articles published in international trade publications and academic journals, articles and reports from relevant trade associations, as well as other articles and publications by global clean energy buyers, research

organizations, consultants, and nonprofits. Further, these findings were informed by a number of recent studies examining the path forward to achieving zero emissions or deep decarbonization in the power sector, such as those issued by the National Academy of Sciences, universities, and government research organizations (Jenkins et al. 2018; NAS 2020; IRENA 2019; UCB 2020; Larson et al. 2020; Bouckaert et al. 2021).

These decarbonization studies and others show the need for large, transformational changes in the power sector in the coming years to achieve deep decarbonization in the next two to three decades, including the need for large-scale increases in deployment of renewables; new transmission lines and grid upgrades; increases in dispatchable forms of clean generation; extending the life of existing zero emitting generators such as nuclear facilities; and increasing deployment of storage, customer load controls and demand flexibility, carbon capture, and other new technologies. Many of these studies demonstrate the need for grid flexibility in the future, including the importance of demand-side actions by customers (including flexibility). In light of these studies' findings, and the types of resources and grid flexibility that they show are needed in the future, our paper examines how large buyers can expand their actions to help drive the large-scale changes needed in the power sector to achieve net-zero emissions.

The information outlined in this issue brief is also based on feedback collected during a convening of industry experts. On November 18, 2020, WRI hosted a two-hour-long online convening to obtain input from a diverse set of market stakeholders, including global companies with clean energy commitments and U.S. utilities, developers, trade associations, nonprofits, government agencies, and entities that manage clean energy recognition programs. These organizations were chosen based on their existing relationships with WRI and on their knowledge and interest in the procurement practices outlined within this issue brief. The full set of participants are detailed in the Acknowledgements. This convening was designed to obtain input on the characteristics of clean energy procurement that can accelerate grid decarbonization,

the range of available transformational procurement practices, the barriers and challenges to implementation, and market and institutional changes needed to enable these typically more complex forms of procurement. During this convening, WRI staff gave a brief presentation on the characteristics of transformative clean energy procurement practices and the transformative procurement practices outlined in this issue brief and collected feedback on these strategies during small group conversations during which all market stakeholders had a chance to participate and provide feedback.

2 CHARACTERISTICS OF TRANSFORMATIVE CLEAN ENERGY PROCUREMENT

To achieve the grid transformation required to decarbonize the electric sector, large buyers can undertake additional actions to address evolving grid needs. Large buyers can increasingly focus on *how*, *when*, and *where* they are procuring and using carbon-free energy to facilitate the transition to 100 percent carbon-free grids.

We define *transformative procurement* as practices that accelerate the transition to carbon-free energy resources and result in substantial transformation of the grid, beyond those widely used today (as illustrated in Figure 1). Transformative procurement is about purchasing and using clean energy to reduce system-wide emissions and accelerate the transition to carbon-free grids by optimizing how, when, and where resources are deployed. For example, large buyers can undertake advanced forms of procurement and practices to maximize emissions reductions, match their clean energy purchases more closely to their loads, increase the flexibility of the grid, deploy technologies that enable decarbonization, and ensure a just transition to zero-carbon resources. In this section, we describe the characteristics and objectives of transformative procurement, and in Section 3, we identify specific procurement practices.

FIGURE 1

TRANSFORMATIVE PROCUREMENT PRACTICES

Source: Authors.

Many large energy buyers have been supporting the deployment of substantial renewable energy capacity, and continued support will be necessary as renewables need to be deployed at rates on the order of two to three times current record installation rates in the United States, and at even higher levels globally, in the coming decades to achieve deep decarbonization (UCB 2020; Larson et al. 2020; Bouckaert et al. 2021). But as grids shift to higher levels of VRE, new practices are needed, not only by utility and grid operators, but customers as well. Grids with high penetrations of VRE are already seeing challenges arise with integrating VRE, and policies are acknowledging that technologies other than VRE will need to play a role in achieving deep decarbonization. Some buyers have already achieved 100 percent renewable energy purchasing targets that meet their electricity demand on an annual basis and are looking for other ways to accelerate decarbonization, while others may be able to incorporate practices identified in this issue brief to address emerging issues and challenges associated with the transition to carbon-free energy.

Transformative approaches can be more complex than clean energy procurement approaches commonly used today, can potentially add cost, and may not be feasible in all contexts. These challenges will likely diminish over

time, as the markets mature and evolve and new solutions are developed. While we focus primarily on procurement practices, some of the approaches discussed in this issue brief extend beyond simple procurement but can be crucial actions that large buyers can take to accelerate decarbonization. Also, we recognize that this paper does not cover all important efforts that buyers can undertake, including those that help fulfill the critical need to implement energy efficiency and electrification.

Before defining the characteristics of transformative procurement, it is important to identify some fundamental features of clean energy procurement that need to be considered when implementing various approaches. First, it will remain impossible to physically track electrons and attribute their use to specific buyers, except in the case of on-site resources. As a result, claims to the “use” of off-site clean energy require an accounting system to validate clean energy usage claims and prevent double counting.⁷ Second, although some practices can be beneficial in that they enable broader clean energy adoption, such as shifting loads to be coincident with renewable generation, buyers can only claim the use of clean energy associated with their procurement actions or supplied through the grid mix.

Below, we identify five characteristics of transformative procurement, summarized in Figure 2, which are based on the authors' assessment of the need to transform the grid in a way that enables deep decarbonization. These characteristics are informed by deep decarbonization studies that identify pathways to the transition to carbon-free grids and related challenges (e.g., Jenkins et al. 2018; NAS 2020; IRENA 2019; UCB 2020; Larson et al. 2020; Sepulveda et al. 2018), market trends and policies calling for 100 percent clean energy (Paulos 2020), large energy buyer actions (some of which are documented here in case studies), and other relevant publications (e.g., Miller 2020; Green Strategies et al. 2020; Carley and Konisky 2020).

2.1 Maximizes Emissions Reductions and Grid Decarbonization

Deep decarbonization will require significant emissions reductions far outpacing historical reductions achieved to date. Large buyer clean energy procurement can contribute to the needed reductions, but not all procurement has equal impacts. Some large buyers are considering *how*, *when*, and *where* they are procuring and using clean energy to maximize emissions reductions. In terms of *how*, large buyers can procure carbon-free energy in ways that more fully align the timing of their energy

use with the production of carbon-free energy sources. They can also operate clean energy projects to maximize emissions reductions and take steps to accelerate the adoption of carbon-free energy in the overall grid mix by engaging in policy and planning processes. In terms of *when*, large buyers can procure clean energy that generates during emissions-intensive periods or utilize clean energy during periods of excess generation on the grid to avoid curtailment. By tying energy consumption more closely to renewable energy generation patterns, customers can reduce reliance on emitting generators that may be needed as backup to meet their loads. Finally, in terms of *where*, large buyers can procure clean energy from local grids where they operate to more closely match their energy consumption to carbon-free sources and can site projects on emissions-intensive grid locations to maximize grid emissions reductions.

2.2 Accelerates Clean Energy Deployment

The grid will need substantial new clean energy capacity to achieve net-zero emissions in the power sector (Larson et al. 2020; NAS 2020; Jenkins et al. 2018; Bouckaert et al. 2021). Large energy buyers can support grid decarbonization by emphasizing procurement practices that drive significant, new clean energy capacity additions. While viable approaches can vary by market structure and financial viability for large buyers, such actions can include entering into long-term contracts (Bartlett 2019) and procuring energy using contracts that send price signals to developers of new projects (Tawney et al. 2018).

On grids with 100 percent clean energy targets, most and eventually all new clean energy capacity will be brought online by the load-serving entities that must comply with clean energy mandates. The speed of this transition matters: 100 percent clean energy by 2035 has much different global climate implications and total emissions profiles than 100 percent clean energy by 2050 (IPCC 2018). In the near term, large buyers can play a critical role in deploying new clean energy faster than the interim targets set by clean energy mandates. Buyers can accelerate clean energy deployment and thereby accelerate emissions reductions by bringing clean energy online prior to meeting policy targets. Buyers can also play an increasing role in encouraging deployment of needed grid infrastructure, including transmission, by participating in planning processes or directly engaging in new transmission projects as an investor or off-taker.

FIGURE 2

TRANSFORMATIVE PROCUREMENT CHARACTERISTICS

Maximizes emissions reductions and grid decarbonization

Accelerates clean energy deployment

Enables broader adoption of clean energy

Enables new technologies and innovations for a zero-carbon grid

Enables an equitable and just transition to a zero-carbon grid

Source: Authors.

2.3 Enables Broader Adoption of Clean Energy

Deep decarbonization will require clean energy deployment by numerous grid actors such as utilities, retail electricity buyers, and local governments. Large buyers can augment the impacts of their own procurement by taking active steps to enable the adoption of clean energy by all grid actors—including other large buyers. Customers can do this through actions that encourage uptake. Although the efficacy of such actions depends on context and implementation, potential enabling actions include making aggregated purchases, supporting community choice aggregation or community-wide projects, providing employee clean energy purchasing programs, and supporting grid upgrades such as transmission network extensions (Tawney et al. 2018).

In addition, customers can ensure that their purchases do not impede broader deployment of clean energy. To unpack this characteristic, it is helpful to understand the concept of grid clean energy carrying capacity (see Figure 3): the finite amount of clean energy, particularly wind and solar, that can be cost-effectively deployed to the grid at any given time (Cochran et al. 2015). For example, some regions have found it difficult to utilize large amounts of solar generation midday, which has caused curtailment in some instances. Due to finite clean energy carrying capacities, the marginal cost of VRE integration tends to increase as more clean energy enters the grid if it cannot be dispatched as needed. As a result, large buyer clean energy procurement can make it harder for future projects to come online. However, large buyers can take measures to prevent their clean energy projects from depleting grid clean energy carrying capacity. Measures to enable broader adoption of clean energy include investing in firm clean energy rather than VRE, adopting energy storage, and engaging in demand flexibility. We explore all of these measures in further depth in Section 3.

FIGURE 3

LIMITED AND EXPANDED CLEAN ENERGY CARRYING CAPACITY

Limited grid clean energy carrying capacity

Most grids have limited clean energy carrying capacity. Conventional large buyer clean energy projects displace other potentially viable projects and deplete grid clean energy carrying capacity.

Expanded grid clean energy carrying capacity

Transformative procurement actions can expand grid clean energy carrying capacity, creating more space for clean energy adoption by all clean energy buyers.

Source: Authors.

2.4 Enables New Technologies and Innovations for a Zero-Carbon Grid

New technology and business model innovations from utilities, third parties, and other market stakeholders will be needed to fully decarbonize the power sector (Larson et al. 2020). Large energy buyers can play a role in driving innovation in the sector and are already beginning to do so, as will be discussed more in Section 3, such as by

- helping to scale emerging technologies such as battery storage (Kava 2020);
- demonstrating ways to use new technology to improve the operations of existing assets, such as by leveraging communication and control technologies, such as smart sensors, for demand flexibility (IRENA 2019);
- helping invest, develop, and pilot new technologies, such as advanced forms of firm clean energy or carbon capture, to help meet demand at all hours (Sepulveda et al. 2018);
- embracing contract structures designed for firm clean energy procurement or variable clean energy procurement with storage; and
- supporting innovative utility programs and policy and business models such as those that allow buyers to undertake 24/7 matching (see Section 3.1) or share storage resources for customer use and use by the utility for grid reliability (Kava 2020).

2.5 Enables an Equitable and Just Transition to a Zero-Carbon Grid

The clean energy transition will depend on the ability to address job transitions and to ensure that broad segments of society, including low-income customers and communities of color, benefit from the transition. An equitable distribution of the costs and benefits of power sector transformation is necessary for the clean energy transition to maintain momentum (Sovacool and Dworkin 2014; Welton and Eisen 2019; Larson et al. 2020). Achieving an equitable and just transition will be an ongoing challenge. Already, marginalized communities, such as low-income communities and communities of color, have received disproportionately small shares of the benefits of clean energy technologies, have suffered disproportionately from the siting of power plants and

associated emissions historically, and face significant barriers to participation in clean energy transition planning and implementation (Welton and Eisen 2019; Carley and Konisky 2020).

Large energy buyers can support equitable and just transitions through their procurement actions. As will be discussed more in-depth in Section 3.6, some buyers are already actively integrating equity into their procurement practices such as by

- influencing where clean energy projects are located;
- encouraging diversity of the workforce used to construct facilities; and
- driving co-benefits of projects, particularly for low-income communities and communities of color.

3 TYPES OF TRANSFORMATIVE CLEAN ENERGY PROCUREMENT

In this section, we explore procurement practices that could help large buyers transform grids (see Table 1). These procurement practices provide pathways for large energy buyers to contribute to the broader grid transformation needed for deep decarbonization. Namely, these practices can drive large volumes of new variable clean energy capacity, deploy firm clean energy, support grid flexibility, and enable key supporting technologies such as demand flexibility and storage. The identification of these practices is informed by our review of market activities, input from stakeholders, relevant literature, and power sector decarbonization studies that identify future grid needs. Where possible, we provide examples and learnings from large buyers that have already undertaken each option.

Transformative procurement is not a one-size-fits-all approach. Optimal procurement practices will vary according to the needs and circumstances of specific buyers, geographic differences across grids, available product offerings, and changing grid and technological conditions over time. Also, it is important to note that often these strategies can be used together; for instance, equity and social justice can—and should—be incorporated throughout and many of the practices identified are designed to address issues related to the timing of clean energy generation and use.

TABLE 1

SUMMARY OF PROCUREMENT PRACTICES AND KEY BENEFITS

Practice	Description	Unique Benefits
Time-coincident procurement	Procurement of clean energy portfolio with an output profile that temporally aligns with the buyer's demand in a given region.	Could support diverse mix of firm, energy, variable energy and enabling technologies.
Demand-side measures	Integration of demand-side measures (e.g., demand flexibility) into procurement portfolio.	Demand-side measures can optimize use of clean energy assets.
Firm clean energy procurement	Procurement of firm clean energy generation, such as low-impact hydro, geothermal, and biomass.	Firm clean energy is a critical component of deep decarbonization of the grid.
Enabling technologies	Procurement of decarbonization enabling technologies such as battery storage and carbon capture.	Enabling technologies can extend the environmental and grid values of clean energy generators.
Emissions-based procurement	Integration of project emissions abatement potential, among other factors, into procurement decision-making.	Maximizes near-term emissions reductions and associated environmental benefits.
Equitable procurement	Integration of clean energy equity and justice concerns into procurement strategies.	Helps support a more just clean energy transition.

3.1 Time-Coincident Procurement

Time-coincident procurement is the practice of purchasing clean energy that aligns with an individual buyer's load on an hourly basis and in the local grid (Miller 2020). Time-coincident procurement could be implemented for a fraction or all of a customer's electricity demand, targeted at specific loads (e.g., electric vehicle charging) or at specific time periods that pose challenges for grid operators (e.g., when there is excess solar generation on a system midday). It can be implemented with on-site and off-site resources.

Time-coincident procurement has several potential benefits: it could increase the clean energy carrying capacity of the grid, reduce the need for curtailment of VRE generation, lessen customer demand for fossil generation, and send price signals for clean energy when needed (see Table 2). Benefits can vary regionally based on the overall mix of resources on the grid, the customer's load profile, the timing of peak demand periods, the amount of VRE on the grid, and other factors. If implemented for a substantial fraction of a buyer's load, time-coincident procurement would encourage buyers to purchase a more diverse clean energy portfolio capable of supplying energy even in hours when VRE is scarce, which would provide greater grid value, or value to the

overall power system, and resource diversity at scale (Gramlich 2021). Time-coincident procurement objectives need to be coupled with goals to support new clean energy to drive new clean generating capacity.

Time-coincident procurement can be done by purchasing clean energy that meets customer loads hourly; shifting customer loads to align with clean energy; deploying storage or firm, dispatchable clean energy; and using emerging market-based instruments for verification. Examples of time-coincident procurement practices seen in the market today include the following:

- **Time-based matching target or 24/7 matching target:** Buyers can establish a target to meet a fraction or all of their load with clean energy sources on an hourly basis. The most ambitious form of time-coincident procurement is 24/7 matching, whereby clean energy portfolios are matched to buyer load every hour of the year (see Box 2). This type of matching may require some combination of all three approaches described below. For instance, Google announced a goal to reach 24/7 carbon-free electricity everywhere it operates by 2030 (see Box 3; Google 2020) and Des Moines, Iowa, announced a plan to reach 24/7 carbon-free electricity by 2035 (see Box 4). Microsoft recently announced a

similar goal to match 100 percent of its electricity consumption 100 percent of the time with zero carbon energy purchases (Joppa 2021). The Biden administration also issued an executive order⁸ on January 27, 2021, calling for agencies to use their procurement authority to help achieve a 2035 carbon-free electricity goal. In the American Jobs Plan⁹, the Biden administration specifically outlines a goal to use the federal government's purchasing power to purchase 24/7 clean power for federal buildings.

- **Load shifting:** Buyers can reshape load profiles, often using thermal or battery storage, to align demand with clean energy availability (see Section 3.2).
- **Firm, dispatchable clean energy or storage:** Buyers can achieve time coincidence by buying more output from firm clean energy resources whose generation profiles align with buyer load profiles (see Section 3.3) or use energy storage to save and dispatch energy when needed (see Section 3.4).

- **Market-based instruments and verification:** Buyers can achieve time coincidence by participating in emerging market-based programs that can help verify time-based transactions. EnergyTag, for instance, is a nascent international organization creating a standard for energy buyers to use certificates to verify the source of their electricity and carbon emissions on an hourly basis.¹⁰ Similarly, M-RETS is an environmental attribute tracking platform that helped facilitated the first-ever hourly renewable energy credit (REC) claim in January 2021 with Google.¹¹

We discuss demand-side actions, storage, and dispatchable clean technologies in more detail in subsequent sections because they can be implemented in a variety of ways, used without necessarily having an overarching time-based matching goal, and employed to provide other grid resiliency and decarbonization benefits.

TABLE 2

BENEFITS AND CHALLENGES OF TIME-COINCIDENT PROCUREMENT

Key Benefits	Key Challenges
<p>Increase grid carrying capacity and value: Time-coincident procurement could increase grid clean energy carrying capacities, depending on the regional grid and implementation by the customer. This could be particularly true for grids with large amounts of variable renewable energy. To the extent that buyer load profiles align with grid demand profiles, time-coincident procurement will generally increase the emissions benefits and grid benefits of large buyer clean energy.^a</p> <p>Contribute to on-peak generation: Time-coincident procurement could result in buyers procuring clean energy portfolios that generate more power during periods of peak demand. Given that electricity costs are strongly driven by peak demand, large buyer contributions to on-peak generation could help utilities and grid operators manage peak costs and facilitate further clean energy integration.</p> <p>Diversify resources: Time-coincident procurement implemented for a large fraction of customer demand could drive buyers to procure more diverse clean energy portfolios, which, all else equal, would be more valuable to the grid and more effective at reducing grid emissions.^b</p>	<p>Additional costs: Time-coincident procurement may involve additional costs, particularly at higher matching percentages, that may need to be weighed against other strategies in light of grid needs.</p> <p>Accounting: Challenges are related to the development and issuance of hourly certificates or a different tracking and verification instrument for hourly accounting, interactions among hourly certificates and other instruments, and the availability and credibility of hourly data.</p> <p>Scope 2 emissions accounting does not provide an incentive for buyers to do time-matching as reporting and claims protocols (such as the Greenhouse Gas Protocol) allow buyers to simply report matching annual consumption with annual clean energy purchasing.</p>

Notes:

a. Miller 2020.

b. Gramlich 2021.

REACHING 24/7 MATCHING

To achieve a 24/7 clean energy target, a buyer's load is matched on an hourly basis with carbon-free energy supplied directly from buyer-contracted technologies as well as carbon-free energy from the regional grid mix. Contracted energy is delivered to the regional grid where each load is connected, based on the customer's hourly load. To implement contracts, buyers must estimate their future loads on an hourly basis for the term of the contract. The supplier must also estimate the hourly generation profile of the mix of generation sources over the term of the contract through modeling and analysis. Verification of such contracts could be provided by utilities or suppliers through third parties or market-based instruments that capture timing of generation, if available.

Contracts for 24/7 clean energy delivery likely involve additional costs relative to standard annual contracts depending on the grid and portfolio of resources used, including the cost of energy storage to address difficult hours for traditional wind and solar generation profiles. Costs may also be higher for matching 100 percent of load with clean energy compared with lower percentages of even 80–90 percent because of the rapidly increasing marginal costs of procuring zero-carbon energy in those difficult remaining hours. Google has indicated that it paid a modest premium compared with undifferentiated retail power for its contract with AES Corporation, which will result in the construction of 500 megawatts of renewable energy and storage and ensure that Google's Virginia-based data centers will be 90 percent carbon-free when measured on an hourly basis (see Box 3).^a Companies like Google may be willing to pay premiums for these 24/7 products in part because the hourly fixed cost matching provides additional hedging value compared with a traditional power purchase agreement.

To achieve 24/7 clean energy targets, strategies can be used to align the timing of clean energy demand and supply. In practice, this alignment of clean energy supply and demand can be facilitated by shifting the timing of energy-intensive activities, or loads, to times when clean energy generation is plentiful or to times when it could be operating but is not being used on the grid (e.g., curtailed). In addition, while renewable energy can be used to match a significant percentage of a buyer's load on a daily basis, current 24/7 clean energy targets include a diverse mix of carbon-free energy technologies able to operate at all hours of the day to be able to match loads on a 24/7 basis.^b

For large energy buyers with a global presence, the emissions they are responsible for may vary significantly based on the carbon intensity of the grids where they operate and on the clean electricity procurement on those same grids. To achieve a 24/7 clean energy target globally, large buyers can undertake regionally specific clean energy procurement practices focused on local grid impact.^c Some experts have noted that it is not feasible or efficient to have all customers individually match their demand with clean energy on a 24/7 basis because grids are inherently designed to address differences in the variability of customer loads. While some customers may want to go the extra mile and match their loads every hour, it can be more efficient to utilize the full power system to manage clean energy delivery to all customers.^d

Notes:

a. AES Corporation 2021.

b. Google 2021.

c. Google 2021.

d. Gramlich 2021.

BOX 3

GOOGLE AND AES CORPORATION'S 24/7 CONTRACT

In May 2021, Google signed a new energy supply agreement with AES Corporation that will serve its Virginia data centers with 90 percent carbon-free energy when measured on an hourly basis, based on Google's methodology. According to information shared by Google, the 10-year contract will deliver all-in power supply at a modest and manageable premium compared with the cheapest benchmark available of passthrough market wholesale electricity prices (which do not include any renewable attributes beyond the inherent grid mix of the PJM wholesale power market). Google has indicated that all-in cost for this around-the-clock carbon-free energy supply is comparable to the more traditional alternative of

procuring renewable energy through multiple individual bilateral power purchase agreements in PJM that would match Google's annual electricity consumption in Virginia.

As the first clean energy procurement deal in the world of its kind, AES will source from a 500 megawatt portfolio of wind, solar, hydropower, and battery storage resources put together from a combination of AES's own renewable energy projects and those of third-party developers. This portfolio will require approximately \$600 million in investment and is expected to generate 1,200 jobs.^a

Note:

a. AES Corporation 2021.

BOX 4

DES MOINES, IOWA, 24/7 MATCHING TARGET

In January 2021, the Des Moines City Council unanimously voted to pass a resolution to achieve net-zero emissions by 2050 and reach 24/7 carbon-free electricity by 2035—the first U.S. city committed to such a goal. This resolution was originally proposed and debated in 2020, but after cost and timing concerns were raised by MidAmerican Energy Co., a resolution was reached, extending the originally proposed 2030 timeframe to achieve the 24/7 matching goal by five years.^a For Des Moines, MidAmerican Energy Co. estimated that achieving 100 percent renewable energy and lithium-ion battery storage by 2050 would require \$8 billion in investment and approximately \$1–2 billion if small modular nuclear reactors were used instead, though some stakeholders indicated these estimates were inflated relative to available data on technology costs.^b MidAmerican Energy Co.'s calculations projected using existing technology available to meet the proposed resolution, in addition to new capacity from wind resources. While the utility provided one estimated approach and cost, the exact method to achieving the

objective has not been determined to date. In the approved resolution, the Des Moines City Council said it will consider a host of solutions to reduce its energy demand and emissions including but not limited to solar, wind, energy storage, geothermal, biomass, energy efficiency, demand control technologies, carbon sequestration, waste reduction, and water systems technologies.

The Iowa Environmental Council, Sierra Club, Des Moines Citizens' Task Force on Sustainability, and organizers at Iowa Citizens for Community Improvement were involved in promoting the plan. A working session was held with other community leaders to obtain input from a broader group of stakeholders in December 2020.^c

Note:

a. Fleig 2021.

b. Tomich 2020.

c. Des Moines 2020.

3.2 Procurement that Incorporates Demand Flexibility

Demand flexibility refers to the inherent ability of certain loads to be temporally or spatially shifted in response to economic or environmental objectives (Dyson et al. 2015). While demand flexibility is not a procurement action itself, flexibility can facilitate clean energy procurement (e.g., time-coincident procurement). For instance, buyers can configure building thermostats to “pre-cool” buildings during the day to maximize their use of peak solar. The pre-cooled buildings would then rely less on grid electricity after the sun has set. However, any claim to use off-site clean energy through demand flexibility must be substantiated through a consensus-based verification system (e.g., RECs).

Demand flexibility could also increasingly be integrated into clean energy product offerings from utilities or suppliers; for example, green tariffs could incorporate demand periods into pricing, incentivizing customers to shift loads (see Table 3). Similarly, buyers could procure clean energy for electric vehicle (EV) charging loads and manage charging to align with periods of abundant clean energy (e.g., wind generation at night).

Demand flexibility is an integral component of deep decarbonization strategies because of the need to manage the diurnal and seasonal variability of VRE at higher penetrations of clean energy on the grid (Jenkins et al. 2018; Larson et al. 2020; IRENA 2019). Leveraging existing flexible loads could reduce peak grid demand by around 20 percent, and the benefits of load flexibility are estimated in the tens of billions of dollars in grid savings per year (Dyson et al. 2015; Hledik et al. 2019). Thus, these kinds of solutions will become more important over time.

Broadly speaking, demand flexibility can be temporal or spatial and implemented with a variety of loads, such as the following:

- **Temporal load flexibility:** Large buyers can shift certain loads to better align with the carbon intensity of the electricity grid (Radovanovic 2020) or based

on the availability of renewable energy. For instance, certain building operations (e.g., water heating) can be shifted to daytime hours when more solar output is available. Over the past several years, Google has worked to shift data center loads to better align with carbon-free energy generation (see Box 5).

- **Geographic/spatial load flexibility:** Some buyer activities can be geographically shifted from one location to another to take advantage of different grid conditions (Koronen et al. 2020). For instance, certain data processing operations can be shifted to other locations based on the clean energy availability at different data centers.
- **EV charging:** Buyers can identify strategic fleet charging strategies that maximize the use of clean energy while minimizing charging costs (IRENA 2019). Buyers with EV fleets could strategically charge vehicles at specific locations with on-site clean energy. Buyers could also use vehicle-to-grid technology to provide grid services using EV batteries, which could help with VRE integration.
- **Building electrification:** Buyers can electrify certain building functions currently powered by fossil fuels, such as space and water heating, which can be served by clean energy and managed and controlled to use electricity at preferred times, including times with abundant clean energy. These electric loads can be integrated into clean energy procurements.
- **Demand response and demand-side services:** Buyers can enroll in utility demand response programs and often receive credit, through special rates, for reducing their energy demand during peak periods of demand and undersupply on the grid (Budhiraja 2019). Alternatively, buyers can bid demand-side services into utility programs or wholesale energy markets, possibly through a third-party aggregation program (Neukomm et al. 2019). While such programs are not clean energy procurement per se, participation could help enable more clean energy availability on the grid.

TABLE 3

BENEFITS AND CHALLENGES OF DEMAND FLEXIBILITY

Key Benefits	Key Challenges
<p>Maximize clean energy use: Demand-side measures can control load profiles to maximize clean energy use for on-site loads.</p> <p>Enhance grid flexibility: Demand flexibility translates to increased grid flexibility and higher grid clean energy carrying capacities.</p> <p>Support new technologies: Large buyers can use their large loads as testing grounds for emerging demand-side technologies.</p>	<p>Regulatory and market barriers: Existing regulatory and market structures may undervalue demand-side services. Electricity rate structures—particularly among smaller buyers—often provide only weak incentives for demand flexibility.^a</p> <p>Further, various economic and market factors pose barriers to wholesale market access for demand-side measures.^b</p> <p>New products: Utilities may face challenges in offering products that blend demand-side flexibility with clean energy supplies because these demand and supply-side products are often managed by different groups in the utility.</p>

Notes:

a. Dyson et al. 2015.

b. Gundlach and Webb 2018.

BOX 5

GOOGLE'S LOAD SHIFTING AT DATA CENTERS

In 2020, Google announced a goal to source carbon-free energy across its data centers on a 24/7 basis by 2030. As part of its efforts to achieve this goal, Google developed a pilot project using a carbon-intelligent computing platform to analyze the load from a single data center and shift the timing of non-urgent compute tasks—such as creating new filters on Google Photos, processing YouTube videos, or adding new words to Google Translate—to times when low-carbon power sources, such as wind and solar, are most available on the grid.^a

Each day during the pilot, Google's carbon-intelligent platform compared two forecasts for the following day: one predicting the average hourly carbon intensity of the local electrical grid

and a second predicting the hourly compute task load profiles. Both forecasts were used to align compute task load profiles with times of greater low-carbon electricity generation.

Results from the pilot program have shown that “carbon-aware load shifting works,” according to Google's carbon computing lead.^b Google has now rolled out the capability across its global fleet. Google also recently announced that it is shifting some loads geographically as well to maximize the reduction in grid-level emissions.^c

Notes:

a. Radovanovic 2020.

b. Radovanovic 2020.

c. St. John 2020; Koningstein 2021.

3.3 Procurement of Firm Clean Energy Technologies

In contrast to variable clean energy generation, “firm,” or “dispatchable,” resources can generate electricity on demand as needed. Firm clean energy technologies include some forms of hydropower, geothermal, and biomass resources. To achieve 24/7 targets, some buyers support the use of dispatchable carbon-free resources as part of resource portfolios, such as nuclear, large hydropower, and fossil generation with carbon capture (see a recent memo supported by 24 organizations¹²), but there is no universal consensus on use of these technologies for customer renewable energy or clean energy goals, particularly outside of a 24/7 carbon-free goal.

As noted in Section 1, firm clean energy sources will likely play a key role in grid transformation given their ability to complement VRE with flexible power (see Table 4; Sepulveda et al. 2018; Larson et al. 2020). Firm clean energy resources can ramp up and ramp down as solar and wind generation fluctuate (although not all firm generating sources are able to ramp equally), enabling customers to reduce reliance on fossil fuel generation. Large buyers could support firm clean energy technologies in several ways:

- **Project development:** Some firm clean energy technologies can already be cost-effectively deployed. For instance, large buyers could procure energy from hydropower projects that utilize existing impoundments and meet low-impact hydropower standards (Moran et al. 2018).
- **Alternative contracts:** The contract structures developed for variable clean energy (e.g., wind and solar) do not necessarily incentivize firm clean energy development. Large buyers can explore contract structures designed for firm resources—such as contracts based on available capacity (dollar per kilowatt) rather than delivered energy (dollar per kilowatt-hour)—as a way to drive a voluntary market for firm clean energy (Sterling et al. 2017; Bird et al. 2019).
- **Pilot projects:** Some emerging clean energy technologies would benefit from pilot demonstrations. Buyers could invest in pilot projects to support the demonstration and scaling of emerging clean energy technologies. For instance, buyers could invest in or purchase electricity from demonstration projects for enhanced geothermal systems that tap deeper geothermal energy resources (Hamm et al. 2019).¹³
- **Advanced market commitments:** Buyers could support the commercialization of emerging technologies by committing to purchase the future output of firm clean energy technologies or signaling their willingness to do so. Such commitments have not been tested, to our knowledge. However, buyers could conceivably invest in an emerging technology under a contract obligating the recipient to eventually sell power to the investor.

TABLE 4

BENEFITS AND CHALLENGES OF USING FIRM CLEAN ENERGY

Key Benefits	Key Challenges
<p>Supply firm power: Firm clean energy can provide power on demand—unlike variable renewable energy sources such as solar and wind. As a result, firm clean energy may be particularly effective at reducing fossil fuel use.</p> <p>Enhance flexibility: Firm clean energy can increase grid flexibility and clean energy carrying capacity.</p> <p>Reduce shape risk: Firm clean energy can reduce shape risk by generating output throughout the day.</p> <p>Provide greater value: Firm carbon-free technologies that can deliver during times when market prices are higher can potentially provide greater value.</p>	<p>High costs relative to variable clean energy: Firm clean energy technologies can cost more per unit of energy than variable clean energy options such as solar and wind.^a</p> <p>Exhausted conventional resources: Much of the easily accessible hydropower and geothermal resources have already been tapped in developed countries.^b However, there can be opportunities for hydro-power development at some existing impoundments and for enhanced geothermal technologies that are less geographically constrained.</p> <p>Contracting: Transaction structures for newer firm techs are less mature than the power purchase agreements for wind and solar today.</p>

Notes:

a. Sepulveda et al. 2018.

b. Moran et al. 2018.

3.4 Procurement that Incorporates Decarbonization Enabling Technologies

Large-scale grid transformation will require rapid increases in clean energy generation supported by enabling technologies such as energy storage, load controls, electrification of buildings and vehicles, or carbon capture (Larson et al. 2020). Large energy buyers can drive grid transformation by incorporating these enabling technologies into their clean energy portfolios. We discussed demand flexibility in Section 3.2. Here, we discuss the potential roles of energy storage and carbon capture as technologies that could enable grid decarbonization. Storage can be implemented either on the demand side to provide demand-side flexibility (as discussed earlier) or through utility-scale systems that can enable system-wide grid flexibility.

Energy storage can perform numerous functions that help integrate clean energy onto the grid, including providing operating reserves, managing curtailment of variable renewable energy, and providing grid ancillary services such as frequency regulation (see Table 5;

Fitzgerald et al. 2015; Bishop Ratz et al. 2020). Large energy buyers can procure energy storage co-located with variable clean energy generators to manage the variability of resources such as solar and wind. Buyers could bid batteries into grid service markets (e.g., ancillary services) to increase both the private and grid value of the investment. Alternatively, energy storage can be a demand-side measure, as discussed in Section 3.2. Buyers can procure behind-the-meter batteries to manage their own load profiles and optimize their use of clean energy.

In some instances, buyers have helped support the development of large-scale batteries that can be operated by utilities to address system-wide grid needs. For example, Sacramento Municipal Utility District is currently offering a program for large energy buyers to access off-site battery storage systems, which are used to support the utility grid while also providing benefits to participating customers that they would otherwise achieve through on-site storage systems (see Box 6).

BENEFITS AND CHALLENGES OF INCORPORATING ENERGY STORAGE

Key Benefits	Key Challenges
<p>Enhance grid flexibility: Energy storage can enhance grid flexibility and increase grid clean energy carrying capacities.</p> <p>Create new value streams: Energy storage can provide several compensable grid services.^a</p> <p>Support new technologies: Large buyer investments could help scale emerging new battery chemistries.</p>	<p>High costs: Relatively high up-front costs remain the primary barrier to energy storage, though costs are falling rapidly.</p> <p>Market access: Existing wholesale market rules generally undervalue energy storage by limiting the services that batteries can bid into wholesale markets. Recent market reforms have begun to address these barriers.^b</p>

Notes:

a. Fitzgerald et al. 2015.

b. Teplin et al. 2019.

SACRAMENTO MUNICIPAL UTILITY DISTRICT'S ENERGY STORAGESHARES PROGRAM

In January 2019, Sacramento Municipal Utility District (SMUD) launched the Energy StorageShares program, which gives commercial customers access to off-site battery storage systems. To participate, customers make an up-front payment to sign up for storage shares, which cost anywhere from \$475 to \$520 per share, depending on the customer's electric rate class. Each share provides one kilowatt of demand charge reduction savings, credited monthly on a customer's electricity bill over a 10-year period.^a To calculate these savings, SMUD analyzes the most recent 12 months of operating data and estimates the optimal battery size that would meet the customer's demand charge reduction needs. This estimate sets the upper limit on the number of storage shares a customer is offered through the program.

Using customers' investments, SMUD can strategically site energy storage systems to maximize grid benefits, such as in locations where feeder circuits are at capacity and where energy storage systems could help avoid or delay further investments. Since launching the program, SMUD has initiated the procurement of a new four-megawatt/eight-megawatt-hour utility-scale battery that will provide 4,000 storage shares for its first tranche of customers.^b

Notes:

a. Costello 2020.

b. Howland 2020.

Carbon capture is the practice of removing carbon emissions from the point of generation (e.g., a smokestack) or directly from the atmosphere. Carbon capture could theoretically convert fossil fuel–based generators such as natural gas into clean energy resources at the point of generation (see Table 6). Finally, direct air capture could be used to offset emissions that cannot be avoided, such as from industrial processes that generate carbon emissions as a byproduct of chemical reactions. As part of its climate commitments, Microsoft is currently exploring carbon capture projects (see Box 7).

3.5 Emissions-Based Procurement

All grid-tied emissions-free generators reduce emissions, but some generators reduce emissions more effectively than others. Buyers can factor emissions abatement

potential directly into their procurement decisions and prioritization of projects. Because the emissions reductions from clean energy projects are determined by which generation sources (e.g., natural gas or coal) are displaced, customers can seek to procure clean energy projects that yield the largest reductions (see Table 7). To assess how to maximize emissions benefits for purchasing, buyers can undertake an emissions impact evaluation of their procurement options (Miller 2020). Salesforce, for instance, developed a matrix to score renewable energy projects across economic, environmental, and social criteria and ultimately rank projects based on their estimated hourly avoided emissions.¹⁴

TABLE 6

BENEFITS AND CHALLENGES OF INCORPORATING CARBON CAPTURE TECHNOLOGIES

Key Benefits	Key Challenges
<p>Reduce or offset emissions: Carbon capture could reduce large buyer emissions directly or offset emissions from buyer activities that are difficult to decarbonize.</p> <p>Decarbonize conventional flexible generation: Carbon capture could decarbonize flexible generators such as natural gas, allowing these flexible generators to remain online in decarbonizing grids.</p> <p>Support emerging technologies: Carbon capture has not advanced beyond the pilot phase. Large buyers could play a role in finding and ultimately helping lower the cost of carbon capture solutions.</p>	<p>High costs: Relatively high costs have stymied the scaling of carbon capture to date.</p> <p>Infrastructure: Large-scale carbon storage would require the development of utility-scale infrastructure to sequester carbon.</p>

BOX 7

MICROSOFT'S CARBON CAPTURE TECHNOLOGY EXPLORATION

In January 2020, Microsoft pledged to become carbon negative by 2030, remove enough carbon dioxide (CO₂) from the atmosphere by 2050 to account for all its emissions since the company's founding, and invest \$1 billion in carbon removal technology.^a As part of these efforts, Microsoft has partnered with the Northern Lights Carbon Capture and Storage project to offer technology expertise and to use the project's facilities for Microsoft's own carbon capture, transportation, and storage goals. Through its partnership with Northern Lights, Microsoft intends to create a new business ecosystem around carbon management and explore how open-source software platforms could foster the technology and business innovation needed to scale carbon capture technology.

Northern Lights is a joint effort among the Norwegian government and energy firms Equinor, Shell, and Total that aims to standardize and scale carbon capture technology across Europe.^b The Northern Lights project will transport liquid CO₂ from capture facilities to a terminal at Øygarden in Vestland County and, from there, CO₂ will be pumped through pipelines to a reservoir beneath the sea bottom.

Notes:

a. Adomaitis 2020.

b. Heikell 2020.

For some buyers, emissions abatement potential may be a primary consideration that determines from where the buyer procures clean energy and from which technology (e.g., wind, solar). For many buyers, emissions abatement potential will be one factor in a multifaceted decision. For instance, emissions abatement potential can complement other considerations for buyers aiming to develop a time-coincident clean energy portfolio. In this example, the goal may be to maximize emissions reductions given a set of constraints around project siting and technology choice.

In considering emissions abatement potential, buyers have three primary levers:

- **Strategic operation:** Buyers could operate renewable energy or storage projects to maximize clean energy output during emissions-intensive times of day and seasons (Miller 2020).
- **Strategic siting:** Buyers can prioritize sites at emissions-intensive grid locations. However, the downside of this approach is that it may not align with the location of their loads, which can prohibit time-coincident purchasing and shift integration challenges to other regions (Green Strategies et al. 2020).
- **Technology choice:** Buyers can choose clean energy technologies (e.g., wind versus solar, firm versus variable energy) based on correlations among output profiles and grid emissions intensity (Google 2021).

3.6 Equitable Procurement

Large energy buyers can integrate equity into their procurement strategies to drive an equitable and just clean energy transition (see Table 8). This can include ensuring that their clean energy procurement practices do not result in higher costs for others. It can also include a number of other strategies to benefit low-income communities or communities of color. Equitable procurement approaches can be integrated into many types of contracts and purchasing agreements and can be combined with the practices discussed above. Equitable procurement practices include the following:

- **Equitable siting:** Buyers can strategically site projects to maximize benefits—including air quality and economic benefits—for marginalized communities. Depending on the context, equitable siting may involve prioritizing low-income communities and communities of color as potential project hosts in some cases, while avoiding siting projects in those communities in other cases. For instance, siting solar photovoltaic (PV) projects in urban low- and moderate-income communities can promote local economic development (Wallasch et al. 2014), reduce urban heat island effects (Masson et al. 2014), and spur local solar adoption through peer effects (Wolske et al. 2020).
- **Engaging local communities:** Buyers can engage local communities in project planning and development. For instance, buyers can work

TABLE 7	BENEFITS AND CHALLENGES OF EMISSIONS-BASED PROCUREMENT	
	Key Benefits	Key Challenges
	<p>Maximize emissions reductions: Emissions-based procurement can maximize the long-term emissions abatement of clean energy. These emissions reductions generate societal benefits as well as direct buyer benefits, such as by helping large buyers achieve decarbonization targets.</p>	<p>Competing objectives: Emissions abatement potential may be one of several factors influencing procurement decisions. Balancing abatement potential with other procurement factors (e.g., time coincidence) may be challenging.</p> <p>Limited access to emissions data: Emissions-based procurement could be evaluated on the marginal emissions displaced by clean energy generators.^a However, marginal emissions data are not often disclosed by grid operators, forcing buyers to rely on predictive modeling or accessible proxy measures.</p>
	<p><i>Notes:</i> a. Miller 2020.</p>	

with Indigenous communities to ensure that project development respects ancestral claims and maximizes local benefits.

- **Third-party verification:** Buyers can pursue third-party verifications of equitable procurement, especially when developing projects in countries with weaker governance. Several potential standards exist, including the EO100 Standard for Responsible Energy Development (Equitable Origin) and Peace Renewable Energy Credit (Energy Peace Partners).¹⁵
- **Equitable supply chain:** Buyers can integrate equity into their clean energy supply chains. For instance, buyers can demand that developers source parts from minority-owned businesses as much as possible. As part of Apple's commitment to become 100 percent carbon neutral by 2030, the company will establish an Impact Accelerator to invest in minority-owned businesses in its supply chain (see Box 8).
- **Equitable workforce:** Buyers can work with developers, utilities, and state and local governments to maximize local hiring or other key metrics in workforce diversity and provide professional development. For instance, buyers can encourage developers to offer local jobs training programs to hire more local labor for project development. Microsoft is currently partnering with Sol Systems to prioritize solar projects and provide educational and training opportunities in low-income communities (see Box 8).
- **Financial commitments:** Buyers can make financial commitments to marginalized communities outside of their clean energy portfolios. For instance, buyers can commit to supporting local PV programs in the cities where corporates operate or use their own buying power to support community-scale projects that can also serve and benefit low-income customers.

TABLE 8 BENEFITS AND CHALLENGES OF INCORPORATING EQUITABLE PROCUREMENT

Key Benefits	Key Challenges
<p>Drive a just transition: Equitable procurement practices can help ensure a more equitable and just distribution of the benefits and costs of the clean energy transition.</p> <p>Prevent energy justice barriers to deep decarbonization: Energy justice issues could pose long-term barriers to deep decarbonization.^a For instance, failure to engage local communities has prompted resistance to renewable energy and delayed or thwarted project development in several cases. By preventing energy justice issues from arising, equitable procurement could facilitate faster and more effective clean energy transitions.</p>	<p>Competing objectives: Emissions abatement potential may be one of several factors influencing procurement decisions. Balancing abatement potential with other procurement factors (e.g., time coincidence) may be challenging.</p> <p>Additional costs and competing objectives: Equitable procurement entails additional costs for large energy buyers that could result in less clean energy deployment (assuming fixed buyer budgets for clean energy investments). As a result, equitable procurement could compete directly with other large buyer clean energy objectives, such as achieving decarbonization by a given year.</p>

Notes:

a. Welton and Eisen 2019.

APPLE'S, MICROSOFT'S, AND XCEL ENERGY'S COMMITMENTS TO EQUITY

In July 2020, Apple committed to becoming 100 percent carbon neutral across its entire supply chain and products by 2030. To drive this goal, Apple will establish an Impact Accelerator to invest in minority-owned businesses that drive positive outcomes in its supply chain and in communities that are disproportionately affected by environmental hazards.^a This Impact Accelerator is part of Apple's broader \$100 million Racial Equity and Justice Initiative, which will focus on addressing systemic equity issues in the areas of education, economic equality, and criminal justice reform.

In August 2020, Microsoft announced a plan to install 500 megawatts of new solar installations in marginalized communities. To implement the plan, Microsoft is partnering with Sol Systems to prioritize projects in urban neighborhoods with high pollution levels and rural communities impacted

by fossil fuel plant closures. Finally, the project will prioritize buying from women- and minority-owned businesses and will provide \$50 million in grants for educational programming and job training in low- and moderate-income communities.

Following its announcement to become 100 percent carbon free by 2050, Xcel Energy has prioritized just transition planning and local community benefits. Since 2006, the utility has retired seven coal plants with zero layoffs and is now actively working with communities in Becker, Minnesota, and Pueblo, Colorado, to draft economic development plans and mitigate the impacts of future plant closures.

Notes:

a. Apple 2020.

4 THE PATH FORWARD

As transformative clean energy procurement practices become more commonplace, and large buyers set increasingly ambitious climate and decarbonization goals, the way we quantify and assess the impact of large buyer clean energy actions should evolve. To enable transformative clean energy procurement practices, new product offerings from utilities and suppliers will be needed for buyers to undertake transformational procurement. In addition, the metrics, incentives, and programs used to track progress need to expand to accommodate a changing landscape. Further, large energy buyers may seek to engage more directly in grid planning and policymaking. Below, we explore some of the potential paths forward to maximize the impact of transformative clean energy procurement.

4.1 Creating New Clean Energy Products and Programs

To enable large buyers to undertake advanced clean energy procurement methods, new product offerings and solutions are needed from utilities and developers, including those that address time-coincident procurement, or products that include a broader mix of carbon-free or enabling technologies (Bird et al. 2019). Utilities and regulators can play an important role in supporting the development of innovative offerings and

new business models that benefit consumers and utilities/suppliers while aiding in grid decarbonization, such as by providing the following:

- **Utility products that incorporate new business models** that supply clean energy while crediting customers for load shifting to help meet grid needs (e.g., products that provide favorable rates for clean energy in which customers shift loads to beneficial times for the grid, such as for managed EV charging with renewables)
- **New products that match timing of clean energy closely to loads**, including products designed for 24/7 clean energy procurement or those that match loads during fewer hours of the year but may align with peak grid periods (e.g., utility products that supply customers with carbon-free resources from a mix of variable and dispatchable zero-carbon resources that match customer demand for all hours of the year)
- **Integrated products that pair clean energy supply with demand-side measures** to meet the needs of customers and the grid (e.g., utility green tariffs offer preferred pricing for customers that incorporate load controls or shift loads coupled with renewables supply)
- **Products that strengthen grid resiliency while meeting customer needs for clean energy** (e.g., large-scale storage assets supported

by and supplied to customers that can also be used by utilities to support grid needs at certain times or under particular conditions)

- **New products that address supply and demand challenges of clean energy on the grid** (e.g., products that incorporate time of use pricing to address availability of clean energy on the grid)¹⁶
- **Products that incorporate new clean energy technologies**, such as forms of carbon-free firm energy or storage that can provide customer and grid benefits (e.g., products that provide benefits to customers in terms of demand charge reduction for supporting grid-scale and utility-controlled storage)

In designing new products and services, the pricing and financial incentives offered to the customers providing these services should reflect the value of any grid benefits and increased resiliency that can accrue to utilities, grid operators, or other market participants. Therefore, regulators can play a key role in ensuring that product offerings are well designed and that the financial incentives accrue to end users appropriately. Customers will more readily undertake more complex procurement approaches if they are appropriately compensated for the grid benefits that they provide.

4.2 New Metrics for Evaluating Impact

New metrics can be developed by customers, recognition programs, nongovernmental organizations, and other evaluators or stakeholders to measure progress and impact.

To date, most corporate clean energy targets have focused on matching electricity consumption with clean energy and renewable energy attributes, including RECs, on an annual basis. As such, the quantity of clean energy procured (in megawatt-hours, MWh) and the emissions rate associated with that amount of energy have long been used as the standard metrics, or criteria, to measure the impact of corporate procurement. In addition, ownership of the environmental attributes or RECs has been a core requirement to support claims about clean energy purchases, per guidance from the Federal Trade Commission's *Green Guides* (FTC 2012), the GHG Protocol Scope 2 Guidance, and others including the Center for Resource Solutions' claims guidance (CRS 2015).

As customer actions expand beyond annual matching of renewable energy to loads, an individual customer's responsibility for, and impact on, emissions from the grid system will need to be quantified using more precise data, which are increasingly available, and new metrics that better track the impact of procurement decisions. Some of these metrics are well-positioned to form a set of decision-making criteria with which to compare procurement options, costs, and benefits, while others are needed to quantify and describe the impact of procurement actions in the normal annual sustainability reporting cycle.

Both use cases—comparing different procurement options and quantifying the impact of procurement actions—will require improved data and standardized methods for measuring implementation of time-based clean energy procurement (e.g., percent of load matched with clean energy on a daily and hourly basis).

Ultimately, GHG emissions are a key metric for success but accelerating the grid's ability to achieve GHG emissions reductions will require new approaches to evaluating impact. The fraction of customer load that is met with clean energy is also a core metric, but it may be possible to measure this with a more granular focus on how closely the timing of purchased clean energy meets customer load on a daily and hourly basis.

Customers and evaluators will need new metrics and tools to measure and verify transformative procurement practices. This can be achieved, for example, by

- developing new metrics with respect to supporting carbon-free energy and enabling technologies, time-coincident purchasing, demand-side flexibility measures, a just energy transition, and the use of 100 percent zero-carbon energy;
- developing new hourly tracking tools and data for measuring the implementation of time-based clean energy procurement (e.g., percent of load time-matched with clean energy);
- elevating the use of clean energy attributes for tracking ownership of the environmental attributes (e.g., clean energy certificates in addition to RECs),¹⁷
- developing tools to track ownership of the environmental attributes of nonrenewable carbon-free energy and other generation that does not

TABLE 9

ILLUSTRATIVE EXAMPLES OF IMPACT METRICS FOR PROCUREMENT PRACTICES

Transformative Procurement Practice	Potential Metrics for Evaluating Impact
Time-coincident procurement	<ul style="list-style-type: none"> ■ Percentage of hourly load matched by regional clean energy over the course of a year ■ Buyer use of products or approaches that incorporate the timing of clean energy generation and match more closely with customer loads or address critical grid periods ■ Customer purchasing that addresses periods of excess clean energy generation on the grid
Procurement that incorporates demand flexibility	<ul style="list-style-type: none"> ■ Increased load flexibility provided to integrate clean energy ■ MWh of load shifted to integrate clean energy ■ Support provided for grid resiliency
Procurement of firm, dispatchable clean energy technologies	<ul style="list-style-type: none"> ■ Fraction of load met with new dispatchable, or firm, clean energy ■ New projects supported based on duration and permanence of purchased clean energy (e.g., long-term contracts)
Procurement that incorporates decarbonization enabling technologies	<ul style="list-style-type: none"> ■ MW of new technologies (such as energy storage and carbon capture) installed ■ \$ invested in supporting additional capacity of new technologies
Equitable procurement	<ul style="list-style-type: none"> ■ Environmental justice issues considered in siting projects ■ Share of benefits accruing to marginalized communities ■ \$ invested in equitable workforce projects

Note: Abbreviations: MWh: megawatt-hour; MW: megawatt.

Source: Authors.

currently generate RECs (e.g., clean energy certificates or all-generation certificate tracking across all regions); and

- developing criteria to recognize activities that enable grid transformation, including criteria to identify procurement that results in new generation sources (long term) and grid benefits.

Table 9 provides illustrative examples of impact metrics that could be used by customers to evaluate their own impact or by recognition programs to identify industry leaders. These metrics are examples identified to spur additional thinking about how to measure evolving practices. Developing and implementing viable metrics will depend critically on the ability to obtain accurate and standardized data, which can be a significant challenge.

GHG Accounting Methods

GHG accounting is another widely used tool to track the emissions impact of buyer actions and can be used alongside other impact metrics. Over the past years, several clean energy advocates and market participants have observed that current GHG accounting methods, particularly the Scope 2 Guidance used for corporate GHG accounting, may need to be revised to more fully reflect the grid emissions impact of large buyer clean

energy procurement and better incentivize transformative action. We summarize some perspectives on potential revisions below.

GHG accounting protocols for scope 2 emissions require companies to calculate and report annual emissions based on two methods: a location-based method that reflects the average emissions profile of the grid (averaged over the course of the year), and a market-based method that reflects the specific attributes, contracts, and other supplier-specific information tracked on a MWh basis over the course of the year. Any contractual information used for the latter method must meet a minimum set of criteria to ensure the enforceability of the claim and no double counting of attributes among customers. In both cases, a customer “matches” their annual electricity use on a per-MWh or kilowatt-hour basis with an emissions factor (either a blended average for the grid or derived from the contractual arrangement).

There are opportunities to update both methodologies with more temporally and locationally precise data, as well as specific opportunities to better distinguish the GHG impacts of different procurement decisions. While the locational method might benefit from improvements, including using consumption-based, time-based emissions factors, some see the locational grid average

as the best available method for reflecting the emissions reductions brought about by additional clean energy capacity added to the grid (Brander et al. 2018).

Other experts have noted that the location-based method, by definition, does not recognize or provide incentive for clean energy procurement or demand-side action. Furthermore, in the United States and many other markets, some stakeholders note that the location-based method may be in conflict with observable and legally enforceable transactions of renewable and other specified power to customers, potentially resulting in double counting.¹⁸ Therefore, some stakeholders suggest maintaining the use of market-based accounting for scope 2 emissions and developing different metrics for impact that may be used by large energy buyers for procurement decision-making alongside emissions reporting (Jones 2021).

It should be noted, though, that the location-based method surfaces key insights about persistent reliance on fossil fuels even when a company may have achieved 100 percent renewable energy claims. Further, the location-based method of emissions accounting can provide a powerful incentive for companies to engage locally and advocate for grid transformation on the electricity grid where they operate.

On the market-based method, advocates have suggested that as more large energy buyers undertake transformative clean energy procurement practices, the equal treatment of all zero-emissions sources needs to be reconsidered. The current guidance enables buyers to obtain the same emissions rate credit for simple and complex clean energy transactions (e.g., a short-term REC purchase versus a long-term PPA or 24/7 procurement) that may have different impacts on the generation mix and grid emissions (Google 2021). Similarly, the GHG Protocol assigns equal emissions rate credit for all clean MWh no matter when and where the generation and consumption occurred.

While the Scope 2 Guidance allows for the use of any type of certificate or contract to be reflected if it meets data quality criteria, some stakeholders have noted the need for certificate-based instruments to cover a wider range of zero-carbon resources as well as greater time granularity. Under the current GHG Protocol, the GHG reduction impact, or “avoided emissions” (apart from the emissions rate conveyed with the instrument), can be

tracked separately from the two scope 2 calculated totals, but further alignment between reporting entities will be required (Green Strategies et al. 2020).

Some have encouraged using hourly grid average emissions factors in the location-based method, ultimately shifting away from using annual averages (Miller 2020). The Scope 2 Guidance addresses this and allows for it—but the data on hourly usage as well as data on hourly emissions factors are not widely available. Analysis conducted in Spain showed that corporate GHG emissions calculated using hourly average emissions factors were 5 to 9 percent higher than emissions calculated using conventional protocols, highlighting the need to further refine and more accurately track procurement impact (Spork et al. 2015).

While both scope 2 totals are required for complete reporting based on current rules, most companies set goals only for their market-based method totals. This means that corporate buyers that have already achieved a 100 percent renewable purchasing goal, for example, have no clear way to report the additional clean energy consumption and emissions reductions produced through additional actions. Setting goals for each method’s results could incentivize further reduction actions until the physical grid (location-based) total is truly zero. The market-based method GHG accounting framework is designed to flexibly allow for whatever instruments a given country, market, or regulatory jurisdiction uses, but making changes to the ways these instruments are designed and used can also indirectly strengthen GHG outcomes.

This section highlights perspectives on changes to the GHG guidance, some of which are conflicting. Any revisions or updates to the protocol would require a stakeholder consensus process.

4.3 Expanding Recognition for Large Buyers

Looking forward, recognition programs, awards, and other incentives that encourage large energy buyers to undertake clean energy action should also recognize the impact that buyers have on accelerating grid decarbonization and reducing overall GHG emissions.

The right incentive and reward structures must be present to encourage buyers to undertake advanced procurement measures, particularly given that they can be more complex or possibly more expensive than

common forms of procurement today. As noted earlier in the discussion of new products, customers should receive financial incentives through rates and product pricing for transformative procurement approaches that benefit the grid or improve grid resiliency, but other forms of buyer recognition should also be structured to recognize transformative actions.

One key challenge for the verification of transformative procurement is that additional data sources are needed to be able to verify complex actions to drive grid transformation. For instance, time-coincident procurement requires hourly data on the timing of load, clean energy supplies, and the underlying grid mix. Other potential metrics such as the illustrative examples highlighted in Table 9 would require additional data collection and standardization. Some buyers may face challenges in providing detailed data, particularly detailed facility-level data, while programs are also limited in their ability to process data. Recognition programs could partially resolve these data challenges by highlighting nuanced buyer actions that are inherently difficult to quantify and verify. For instance, equitable procurement practices may be challenging to quantify and verify, but recognition of such actions by expert panels could still provide a valuable source of validation.

To encourage large energy buyers to set ambitious targets that decarbonize and transform the grid, existing incentive structures, including national recognition programs and sustainability accolades, could be expanded in a variety of ways, such as by

- providing recognition for purchaser actions that accelerate power sector decarbonization, increase grid resiliency, and provide grid benefits that facilitate decarbonization in conjunction with clean energy procurement;
- expanding the suite of clean energy technologies eligible for program recognition to include technologies that can help accelerate grid decarbonization;
- having utilities or other market participants reward large energy users for shifting loads to times that match availability of clean energy resources to minimize renewable energy integration challenges on the grid;
- distinguishing between procurement in terms of emissions or grid transformation and providing enhanced recognition for approaches that materially drive grid transformation and decarbonization, including those that accelerate new clean energy technology deployment, enable broader adoption of clean energy, and encourage an equitable clean energy transition based on improved and robust metrics for impact;
- tying environmental, social, and governance ratings¹⁹ and performance to the overall environmental impact and emissions reductions that corporate buyers achieve; and
- developing national and international clean energy recognition programs to include utilities and suppliers that develop innovative clean energy offerings or accurately track and provide data needed for customers to accurately measure emissions reductions.

4.4 Influencing Grid Planning, Infrastructure, and Policy

Aside from purchasing clean energy, large energy buyers can engage in formal grid and resource planning processes and policy forums to drive change (Tawney et al. 2018; Green Strategies et al. 2020). As more countries, states, and utilities set net-zero or 100 percent clean energy goals, decisions made through formal grid planning processes become more important for large energy buyers with similar goals.

4.4.1 Influencing Grid Planning and Infrastructure

Corporates, cities, and other large energy buyers are well-positioned to engage with national and state regulators, public utility commissions, independent system operators, and regulated utilities to advocate for new utility programs and grid decarbonization practices that take their needs into consideration. They can influence grid policy and planning processes in a variety of ways, such as by

- engaging with regional transmission organizations and public utility commissions to support large-scale grid upgrades (e.g. the Grain Belt Express Project had public support from over a half dozen large energy buyers; see Box 9);

BOX 9

LARGE BUYER INVOLVEMENT IN GRAIN BELT EXPRESS PROJECT

The Grain Belt Express, an almost 800-mile-long high-voltage direct current transmission line, was proposed in response to increased customer demand for clean energy in the Midwest. When the project was first proposed in 2016, General Mills, General Motors, Kellogg's, Nestlé, Procter & Gamble, Target, and Unilever wrote a letter to the Missouri Public Service Commission to express their support for an increased and diversified renewable energy supply in Missouri.^a These companies, which collectively employ more than 10,000 Missourians and own dozens of facilities across the state, are part of a broader trend of corporate buyers using their purchasing power to call for more clean energy during regulatory proceedings.^b

The project has already received regulatory approval in Kansas and Missouri and will deliver up to 4,000 megawatts of wind power from western Kansas to eastern Kansas, Missouri, and Indiana, and is expected to enable up to \$7 billion in electricity cost savings for consumers between 2024 and 2045.^c In addition to reducing electricity rates for customers, the Grain Belt Express will create approximately \$2 billion in estimated economic investment to build the transmission line and the new renewable energy generation, supporting thousands of jobs during construction and generating revenue for local government and landowners in the region.

Notes:

a. Invenenergy 2020.

b. Koester 2016.

c. PA Consulting Group 2020.

- engaging in utility integrated resource planning (IRP) processes to capture large buyer demand for clean energy in utility procurement plans and appropriately assess future clean energy portfolio options;
- intervening or participating in public utility commission proceedings and docketed utility cases to facilitate clean energy deployment, purchasing options, and necessary grid upgrades for the transition to greater clean energy sources;
- working with utilities to develop voluntary purchasing set asides in IRP and designate clean energy capacity for voluntary procurement;
- seeking better and more granular grid data to understand where the grid can host clean energy projects so that customers can better determine where to site projects; and
- engaging with regional transmission organizations and independent system operators to ensure that wholesale market rules enable the transition to clean energy sources.²⁰

4.4.2 Influencing Clean Energy Policies and Implementation Plans

Further, large buyer engagement in policy advocacy can be powerful given the direct tie between policy and customer impact, both at the state and federal level. State and federal legislation has a large impact on large buyer procurement as it can mandate the use of clean energy;

enable access to energy through electric retail choice, third-party financing, and net metering; and spur market development via taxes, incentives, and credits, among other mechanisms.

In the United States, several large energy buyers are already coming together to advocate for state policy change by issuing joint letters; discussing with and educating legislators, state energy offices, and committee members; and supporting the development and approval of legislation. Buyers could also weigh in on implementation plans for state clean energy standards or related efforts. For example, in 2019, cities, corporations, and community-based organizations including the City of Fayetteville, Arkansas; Mars; Target; Unilever; and Walmart formed a coalition to express support for the Solar Access Act of 2019 (SB 145), which removed Arkansas's ban on third-party financing for solar projects and tripled the maximum solar size limit for corporations. Further, on January 25, 2021, 36 U.S. companies representing more than \$5.8 trillion in revenue and 13.5 million employees—including Amazon, Facebook, Google, General Motors, McDonald's, PepsiCo, Target, and Walmart—signed on to the Energy Buyer Federal Clean Energy Policy statement, organized by the Renewable Energy Buyers Alliance. The statement emphasizes the need for ambitious national policies that decarbonize the grid and modernize grid infrastructure to ensure it is resilient, affordable, and customer-focused (Jaburg 2021).

5 CONCLUSIONS

Over the past two decades, large energy buyers—including corporates, cities, and institutional customers—have set increasingly ambitious clean energy targets, adding dozens of gigawatts of clean energy capacity to grids around the world. In setting and meeting these targets, many large energy users have accelerated and will continue to accelerate the transition to clean energy globally.

In the coming decades, the deep decarbonization of the power sector will require more dramatic grid transformation than what has occurred in recent decades. Achieving a zero-carbon grid in a relatively compressed timescale compared with historical rates of change in the electric sector will require changes by all parties, not only utilities, suppliers, and grid operators, but energy users as well. Large energy buyers are particularly well-positioned to accelerate deep decarbonization because of the magnitude of their energy demand; their staff and resources dedicated to clean energy procurement; and their ability to integrate new technologies, innovate, and control their energy usage.

Large energy buyers can drive deep decarbonization by not only purchasing enough clean energy to meet their needs, but also optimizing how, when, and where they use clean energy to maximize long-term emissions reductions. Because grids will need substantial renewable energy capacity additions to decarbonize in coming years, large buyer actions to purchase and support new renewables are critically needed. But to achieve carbon-free grids everywhere, additional buyer actions that help integrate renewables and reduce reliance on carbon-emitting energy sources will continue to become increasingly important. Both supply-side procurement approaches as well as demand-side measures will be needed to match electricity demand more closely to the supply of clean energy to integrate more clean energy on grids.

Transformative procurement is not a one-size-fits-all strategy, however, which is why we have highlighted a variety of approaches in this report. Large energy users have different types of electricity loads, which vary by

size, time of use, and flexibility to be controlled and shifted. Also, large energy buyers operate in different geographies and market contexts and with varying levels of resources, which provide them with different options—therefore, not all supply- or demand-side strategies, technologies, or procurement options will work for all buyers. Not all grids have the same needs either. Achieving net-zero emissions in the power sector will look different regionally, depending on the generation mix (e.g., reliance on hydropower, nuclear, renewables), dispatchability and flexibility of generators, grid operating characteristics, renewable resource potential, and market structure.

While some sophisticated buyers have already begun to shift strategies and goals, as noted in case studies throughout this report, barriers to broader adoption of advanced decarbonization approaches exist. Transformative procurement approaches may be more difficult to implement, unavailable in some markets, or involve increased costs. Furthermore, some actions may be difficult for smaller companies to undertake if they lack sufficient resources, such as full-time energy managers or substantial sustainability staff.

To enable actions by large energy users to transform the grid, customers need new product offerings from utilities and energy suppliers that provide financial incentives for large buyers to take action that can benefit the grid and all customers. In addition, new integrated product offerings that blend clean energy supply with demand-side measures can benefit both customers seeking to drive decarbonization as well as utilities managing the transition to a cleaner grid. Finally, the methods used to measure impact and success need to evolve to capture and recognize new approaches that accelerate grid decarbonization.

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ENDNOTES

1. For the purposes of this document, we define deep decarbonization as the system-wide reduction of CO₂ emissions by 80 percent and higher by 2050.
2. Definitions of clean energy may vary by buyer or certifier. Clean energy includes renewable energy technologies, such as wind, solar, geothermal, and some forms of hydropower and biomass. Some buyers have advocated for expanding eligible technologies for purchasing goals with 24/7 hourly matching to include all carbon-free energy sources, including nuclear and fossil generation with carbon capture, but there is not consensus on use of these technologies outside of a 24/7 purchasing goal. See the March 2021 memo “Federal Higher-Impact Carbon-Free Electricity Procurement” signed by 24 organizations supporting use of a broader suite of carbon-free technologies for federal procurement (Adobe Inc. et al. 2021).
3. For the purposes of this document, we define large energy buyers as end users and exclude utilities and load serving entities.
4. Variable renewable energy sources refer to the availability in generating output due to the availability of the renewable resource, such as sunlight or wind.
5. Unlike variable renewable energy sources, such as wind and solar, which generate electricity only when wind and sunlight are available, firm or dispatchable clean energy resources, such as hydropower, geothermal, or biomass, can generate electricity on demand.
6. World Resources Institute has supported large energy buyers since 2000 through our work with the Green Power Market Development Group initiative, the Renewable Energy Buyers Alliance, the Clean Energy Investment Accelerator, and the American Cities Climate Challenge Renewables Accelerator projects.
7. For example, renewable energy credits in the United States and other regions and Guarantees of Origin in Europe.
8. See White House (2021a).
9. See White House (2021b).
10. To learn more about EnergyTag, see EnergyTag (2021).
11. To learn more about M-RETS, see Gerber (2021).
12. In early 2021, 24 organizations signed a memo supporting high-impact procurement by the federal government and specifically called for eligibility of these technologies (Adobe Inc. et al. 2021). Regarding use of nuclear, one concern is that purchases of nuclear would not necessarily drive a change in the overall resource mix unless from new plants or if purchases led to extension of existing nuclear plants that would otherwise retire. Other environmental concerns are related to nuclear waste disposal and contamination risks.
13. In May 2021, Google signed an agreement with Fervo, a clean energy startup. Starting in 2022, Fervo will begin adding firm geothermal energy to Nevada’s electric grid system, where Google’s commitments already include one of the world’s largest corporate solar-plus-storage power purchase agreements (Terrell 2021).
14. To learn more about Salesforce’s renewable energy procurement matrix, see Salesforce (2019).
15. To learn more about the E0100 Standard for Responsible Energy visit www.equitableorigin.org and to learn more about the Peace Renewable Energy Credits visit www.energypeacepartners.com.
16. For example, see Hutchinson and Bird (2019).
17. The current Scope 2 GHG Guidance allows for the use of clean energy certificates that meet data quality standards.
18. “Taken to its logical conclusion, these kind[s] of legally enforceable rights and claims could call into question the validity of any kind of location-based reporting (since even a grid average will include a mix of power whose RECs have been claimed by someone else)” (Sotos 2015, 45).
19. Environmental, social, and governance ratings are currently designed to help investors assess sustainability practices using publicly available data.
20. For more information on why and how large energy buyers (particularly cities and counties) may want to engage in issues at the wholesale energy market level, and examples of how other similar stakeholders are already working in this area, see Bishop Ratz et al. (2021).

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.

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