In collaboration with Accenture

MODERNIZING INDUSTRIAL ENERGY DEMAND

Achieving 24/7 Clean Power Procurement and Consumption in Industry

BRIEFING PAPERS

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Heavy industry contributes over 30% of global energy-related emissions, and is thus critical to enabling global decarbonization.[1,2] Implementing a strategy of modernizing industrial energy that integrates clean power sourcing, electrification and fuel-switching solutions has the potential to rapidly reduce these emissions; sourcing clean power and electrification can already address 43% of industrial emissions.[3]

In support of this, the World Economic Forum recently led a series of multistakeholder workshops, which included the participation of representatives from several high-energy-consuming industries.

This briefing paper outlines insights from these workshops with a focus on clean energy procurement and closer matching of power supply and demand to move towards a 24/7 clean power consumption strategy.

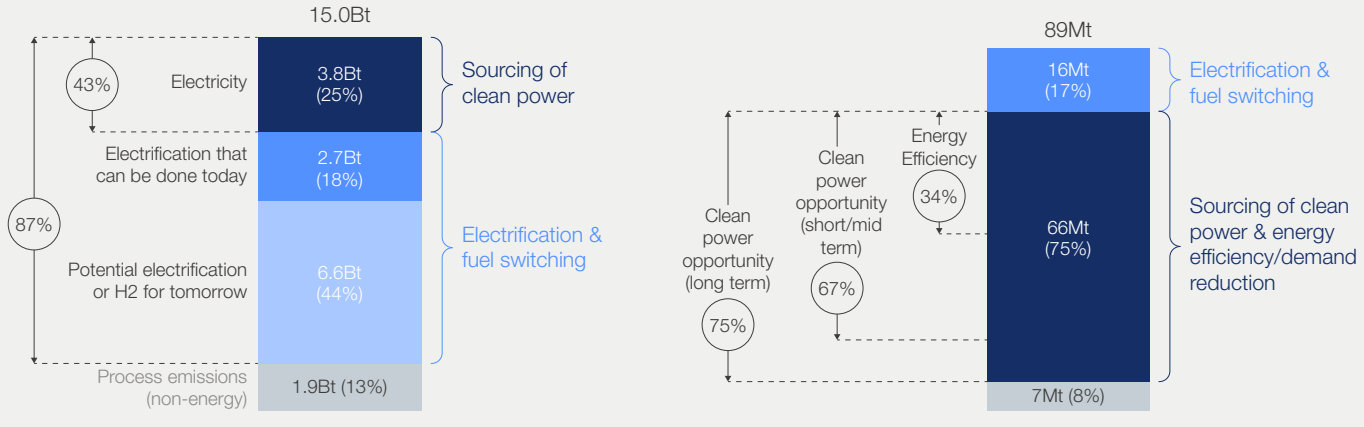
Pursuing 24/7 clean power is a new approach that can be used by industrial companies to meet emissions goals.

Achieving clean power around the clock refers to every kilowatt-hour of electricity consumption being met with a carbon-free source of generation, on the same grid, at every hour of the day, commonly called 24/7 clean power.[4]

Realizing 24/7 clean power means ensuring that electricity is only consumed during times of clean power generation. Practically, this requires adjusting industrial demand (e.g. load shifting), introducing energy supply flexibility and procuring the necessary clean resources. Electricity system modelling shows that granular clean power supply and demand matching leads to lower company emissions and supports the replacement of fossil-based assets with cleaner resources.[5]

Today, 24/7 clean power is primarily pursued through partnerships by technology companies and energy suppliers.[6] Data centres are at the forefront of adopting 24/7 clean power due to their high electricity consumption as a proportion of operational emissions (see Figure 1) and relatively flexible loads. On the contrary, 24/7 remains an untapped opportunity for the industrial sector.

FIGURE 1. **Industrial and data centre operational emissions with clean power decarbonization potential**



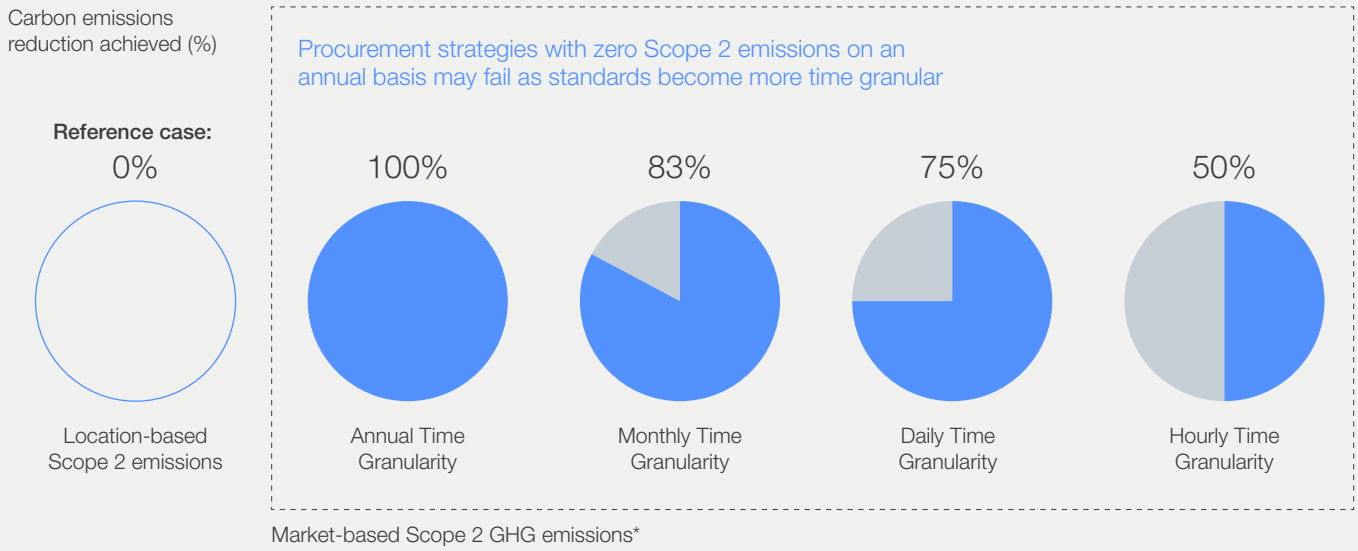
Source: Analysis based on International Energy Agency (IEA) data

The energy-sourcing landscape is evolving to become more granular and transparent.

Regulators, reporting bodies and businesses are influencing the shift to the 24/7 clean power methodology. **Three major trends** are driving the adoption of this more granular and transparent approach to clean power consumption:

1. **In some markets, regulators and governments are incorporating granular clean power matching or tracking** requirements into policy and public procurement that advance beyond the status quo of comparing supply and demand on an annual basis. For instance, this is a consideration for markets wanting to ensure green hydrogen is backed by verified clean power. Examples of granular energy use policies include:
   - The **European Union** (EU) has published rules requiring renewable hydrogen production to be based on 24/7 clean power procurement starting in 2030.[7] It is also implementing enhanced transparency in data reporting on company and product sustainability.[8]
   - The **United States** is seeing a growing emphasis on granular corporate greenhouse gas (GHG) reporting at federal and state levels. The US Securities and Exchange Commission (SEC) has adopted rules to enhance climate-related disclosures by public companies.[9] The US has also proposed an hourly matching requirement for clean power used in the production of clean hydrogen starting in 2028.[10] The US government itself is targeting 50% clean power procurement on an hourly basis for its federal operations by 2030.[11]
   - **India** issued guidelines for a tariff-based competitive bidding process.[12,13] Although 24/7 clean power is not yet required, there is a minimum annual clean resource availability of 90%, supporting India's capacity target of 500GW from non-fossil sources by 2030.
2. **Prominent reporting organizations** are assessing new standards that better reflect actual operations
   - GHG protocol is reviewing its Scope 2 guidance to improve accounting by possibly increasing granularity in time and location.[14]
   - As GHG tracking requirements become more granular, companies may see emissions reported increase, prompting them to adopt or consider new energy-sourcing strategies to meet sustainability targets (see Figure 2).
3. Major energy consumers, on a voluntary basis, are already demonstrating that a transition to more granular energy management is possible.
   - As of April 2024, the UN 24/7 Carbon-free Energy Compact has 148 signatories, including companies, governments and NGOs.

FIGURE 2. **More granular Scope 2 accounting will increase emissions reported by many industrials**



Source: Analysis inspired by Google study

The current cost for adopting 24/7 clean power and its hedging benefit vary by a company's goal and operations, but even a portfolio of wind and solar power purchase agreements (PPAs) can already achieve ~60-75% hourly matching.

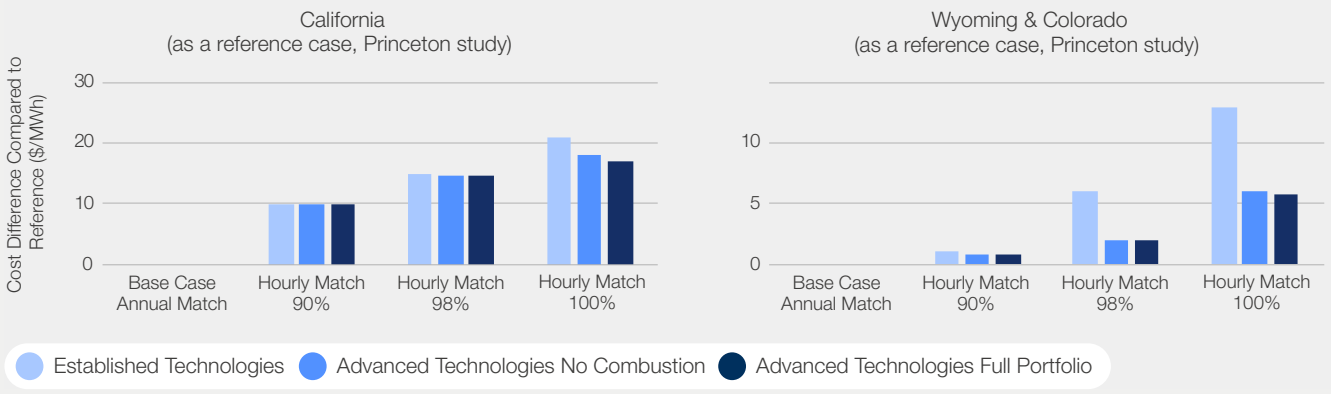
Industrial sites generally require a non-stop supply of energy to run continuous production, making energy system reliability and cost the top priorities while operational load flexibility is seen as less critical.

Premiums for achieving 24/7 clean power vary depending on the location of operations, regional grid source mix and market structures.

According to an analysis conducted by Zero Lab at Princeton University, which modelled regions of California, Wyoming and Colorado, hourly matched clean power can also see very modest cost premiums or no premium at all depending on the particular target (e.g. 90% hourly match in Colorado in Figure 3). The analysis indicates that, while initial costs may be high, they can be reduced over time through additional deployment. Resources available will impact this premium as well, with a wind-only supply providing a substantial increase in hourly matching compared to solar.

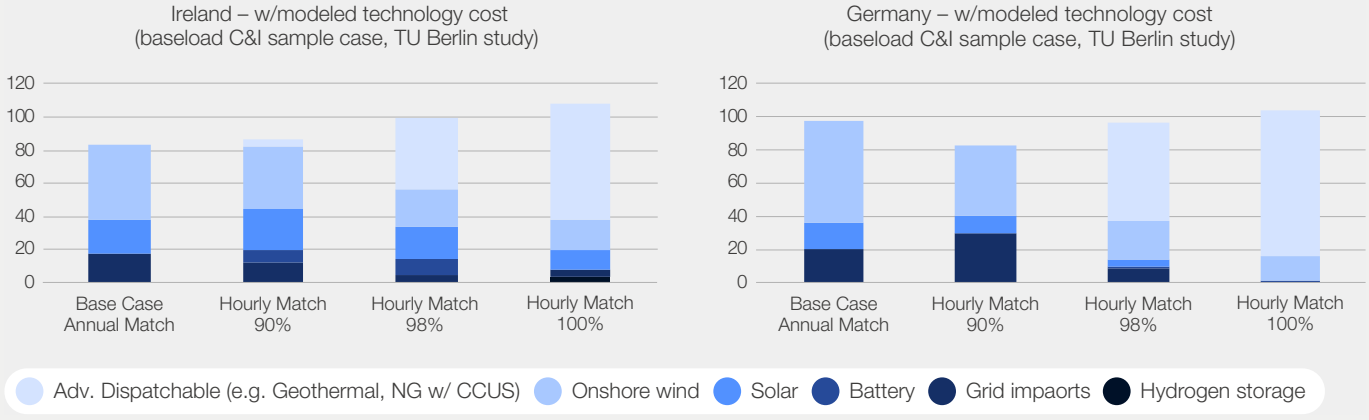
A separate study by Technische Universität Berlin[15] examining cases in Ireland and Germany also concluded that achieving 90-95% hourly carbon-free energy can be done with a small cost premium compared to traditional annual matching. Additionally, reliability concerns are often mitigated by the fact that, in most locations, companies will be drawing continuous power from the grid while working with utilities and partners to add clean resources during a transition to 24/7 clean.

FIGURE 3. **California and Wyoming, and Colorado reference cases**



Source: Princeton University Zero Lab

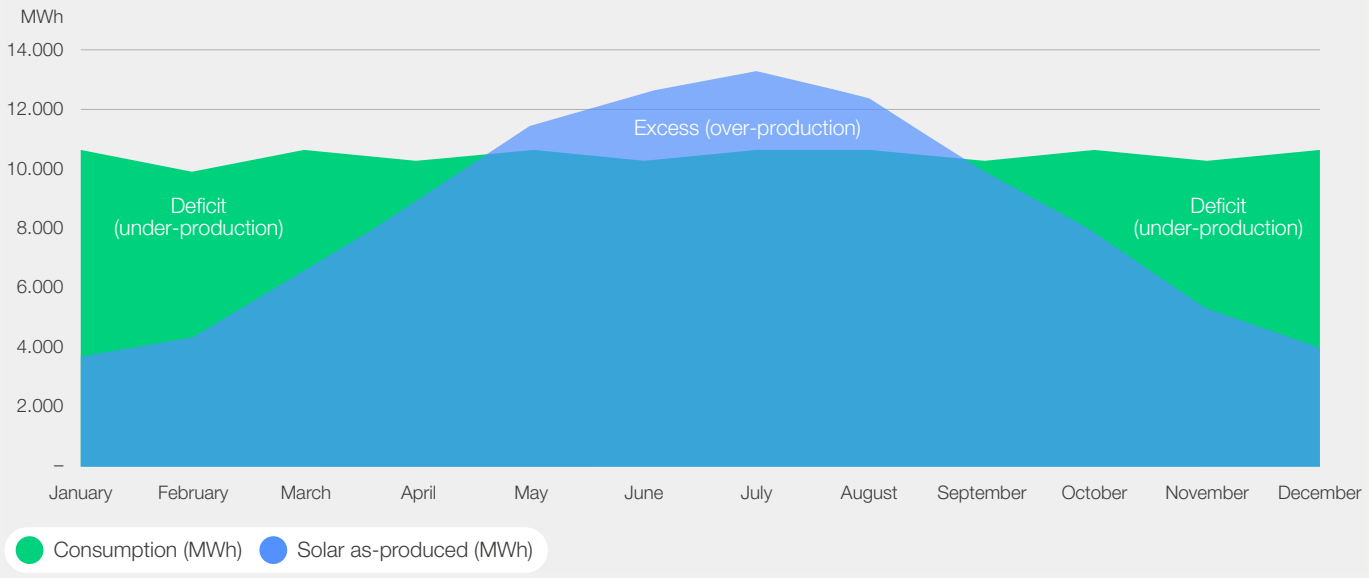
FIGURE 4. **Ireland and Germany reference cases**



Source: Technische Universität Berlin

Other operational and cost drivers beyond $/MWh will also impact the business case of adopting 24/7 clean power. For example, there are opportunities to realize hedging benefits, providing enhanced price certainty by reducing exposure to increasingly volatile market prices.[16,17] Depending on the PPA structure followed, industrials can be exposed to market price volatility in the hours of mismatch (i.e. when supply and demand do not match).

FIGURE 5. **Consumption and solar pay as produced PPA (monthly granularity)**



Source: Eurelectric & Pexapark[18]

A study by Eurelectric and Pexapark[24] indicates that higher levels of hourly matching provide greater hedging benefits.

Furthermore, an optimized portfolio of wind and solar PPAs can already achieve in the range of 60-75% hourly matching, and including a portfolio of co-located energy storage provides up to 90% hourly matching. Research also indicates that hourly matching shares below 100% can achieve greater decarbonization than 100% annual matching.

Demonstrated approaches and successful partnerships indicate the feasibility of a 24/7 strategy despite implementation challenges.

Most industrials have not adopted or planned for 24/7 clean power approaches. The reasons for this vary, but some of the implementation challenges discussed in the workshops are:

- Energy transition strategies and GHG accounting based on disclosure standards not requiring hourly matching (e.g. GHG Protocol[19]).
- Insufficient energy and emissions data available at hourly granularity to understand true operational emissions or to take advantage of 24/7 clean power.
- Concerns about operational reliability or, in some cases, inability to adapt operations to match clean energy supply profiles.
- Inexperience implementing flexibility in operations and lack of proven business case examples.
- Uncertainty surrounding future resource availability due to a mismatch between the pace of infrastructure deployment and growing demand for clean energy.

Leading organizations are already forming groundbreaking alliances or investing to pave the way towards achieving clean power in the industry sector around the clock:

- Nucor Corporation is taking a leadership role by working with its electricity suppliers and engaging policy-makers to access 24/7 clean energy at its steel mills. Nucor, Google and Microsoft have announced a new initiative to aggregate demand and develop business models that accelerate adoption of advanced technology.
- Google and AES are deploying a 500MW portfolio of projects that will supply 90% hourly matched carbon-free power to Google's Virginia data centre campus.
- Iron Mountain has hailed a "landmark series of transactions" that commits the company to 24/7 clean power.
- Anglo American and EDF Renewables formed Envusa Energy, a new company aiming to meet Anglo American's electricity needs in South Africa while developing a regional renewable energy ecosystem (RREE) that supports local jobs and economic activity.
- Dow and X-energy are partnering to deploy an advanced small modular nuclear reactor at Dow's Seadrift site to demonstrate reliable zero-emissions power and reduce site emissions by ~440,000MT CO_2e/year.

Transforming industrial power demand to 24/7 clean likely requires more granular tracking, deployment of shared infrastructure, enhanced demand flexibility, and additional policy support or enablement.

To accelerate the transition towards clean energy consumption around the clock and prepare for regulatory changes, the industrial sector can consider investments in the following tools that were discussed during recent workshops:

- **Data traceability/tracking:** 24/7 models need granular and accurate data on clean power generation and consumption, which must also be reflected in power supply contracts. Industrials can start preparing for more granular procurement and accounting by baselining hourly CFE (carbon-free energy) scores.[20]

- **Demand aggregation and shared infrastructure:** Industrials can aggregate and pool demand across multiple sites or even different organizations.

- **Smart technologies and operational flexibility:** Smart technologies, automation and artificial intelligence can facilitate operational flexibility and certify carbon footprint. For example, granular clean energy certificates have been used to certify hourly matching. EnergyTag has developed a standard for these tools that can be used across the world.

Workshop participants agreed that policy measures have a role to play in enabling 24/7 clean power development. Depending on how this approach fits into a region's energy transition planning, enabling policies include:

- **Incentivize flexibility and energy demand management:** Reform power markets and coordination processes to incentivize flexible consumption of electricity and demand optimization, including using price signals.

- **Align clean product definitions**: Achieve regulatory consistency on what makes a "clean product" (e.g. low-carbon hydrogen requires clean power matching often based on different time intervals in different regions[21]) to create better investment certainty for industrials planning to sell low-carbon intensity products.

- **Invest in regional enabling infrastructure**: The expansion, optimization, and modernization of transmission lines, distribution networks and micro-grids can accelerate the adoption of clean energy in industrial zones.

- **Advance critical energy technologies**: Support demonstration projects of on-site generation (e.g. geothermal, nuclear), long-duration energy storage, and virtual power plants.

Industry has a key role to play in achieving a net-zero energy system. 24/7 clean power can be an effective tool for industries to decarbonize, while also enabling the broader transition for stakeholders along their value chains. Some regulators and businesses, particularly data centres, are already paving the way to more granular tracking and matching of clean power supply with consumption. However, delivering on the potential of 24/7 clean power in industry will require a significant increase in multistakeholder collaboration and engagement on policy and technology.

Annex

Further information

The World Economic Forum's Modernizing Industrial Energy Initiative, supported by knowledge partner Accenture, convenes stakeholders across large energy users to drive the adoption of clean power, electrification and energy management measures through new types of collaboration, partnerships and innovation. The initiative aims to promote collaboration among energy-intensive industries, such as construction materials, chemicals, mining and data centres, to transform industrial energy consumption while generating economic and societal value.

Other resources

Interested companies or stakeholders may wish to view existing case studies and efforts advancing 24/7 approaches:

- The European 24/7 Hub - Eurelectric
- Google 24/7 Clean Energy
- UN 24/7 Carbon-Free Energy Compact
- India Green Trading Ahead Market
- US Green Power Partnership
- FlexiDAO - Granular Tracking Services
- U.S. Department of Energy: Industrial Decarbonization
- Advancing Decarbonisation through Clean Electricity Procurement (IEA)
- EnergyTag

Interested companies should also review other World Economic Forum initiatives within the Centre for Energy and Materials actively working on clean power and industrial solutions, including the Industrial Clusters Initiative.

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Endnotes

1 Net Zero Tracker (2023). World Economic Forum

2 Transitioning Industrial Clusters (2023). World Economic Forum

3 Analysis from WEF's Clean Power for Industry initiative

4 The United Nations compact refers to this as 24/7 CFE (carbon-free energy). In India the term Renewable Energy Round the Clock (RE-RTC) is used.

5 Advancing Decarbonisation through Clean Electricity Procurement. IEA

6 Why 24/7 clean energy beats carbon offsetting (2021). World Economic Forum

7 Commission sets out rules for renewable hydrogen (2023). European Commission

8 Sustainable Finance Disclosure Regulations, the Renewable Energy Directive, the Eco Design Directive, the Corporate Sustainability Reporting Directive, the Corporate Sustainability Due Diligence Directive. European Commission

9 SEC Adopts Rules to Enhance and Standardize Climate-Related Disclosures for Investors (2024). SEC

10 Credit for Production of Clean Hydrogen. IRS

11 100% Carbon Pollution-Free Electricity on a Net Annual Basis by 2030, Including 50% on a 24/7 Basis. Office of the Federal Chief Sustainability Officer

12 Guidelines for Tariff Based Competitive Bidding Process for Procurement of Round-The Clock Power from Grid Connected Renewable Energy Power Projects, complemented with Power from any other source or storage

13 Techno-Economic Analysis of Renewable Energy Round the Clock (RE-RTC) Supply for Achieving India's 500 GW Non-Fossil Fuel Based Capacity Target by 2030

14 Scope 2 proposal summary. GHG Protocol

15 System-level impacts of 24/7 carbon-free electricity procurement in Europe (2022). Technische Universität Berlin

16 24/7 hedging analysis. Eurelectric & Pexapark

17 Are PPAs An Attractive Option In EMEA's Volatile 2023 Energy Market? Engie Impact

18 24/7 hedging analysis. Eurelectric & Pexapark

19 This is true as of May 2024. GHG Protocol is currently undergoing an update, which is expected to complete in 2026.

20 Buyer's Journey - 24/7 Hub. Eurelectric

21 Five-minute settlement implementation. Australian Energy Market Commission (AEMC)