Powering the transition

How electric vehicles, renewables, and grid technologies are reshaping electric power systems

By Maura Keller, *EA* Contributing Writer

The rapid growth of electric vehicles is transforming the transportation sector, but it is also reshaping the electric power industry. As utilities prepare for rising electricity demand, they face the dual challenge of integrating increasing amounts of renewable energy while ensuring the grid remains reliable, resilient, and affordable.

For electrical utilities, grid operators, equipment manufacturers, and infrastructure providers, the convergence of renewable energy and transportation electrification represents both a challenge and an opportunity. Emerging technologies such as vehicle-to-grid (V2G) systems, smart charging, microgrids, and virtual power plants are creating new pathways for balancing supply and demand while maximizing the value of renewable resources.

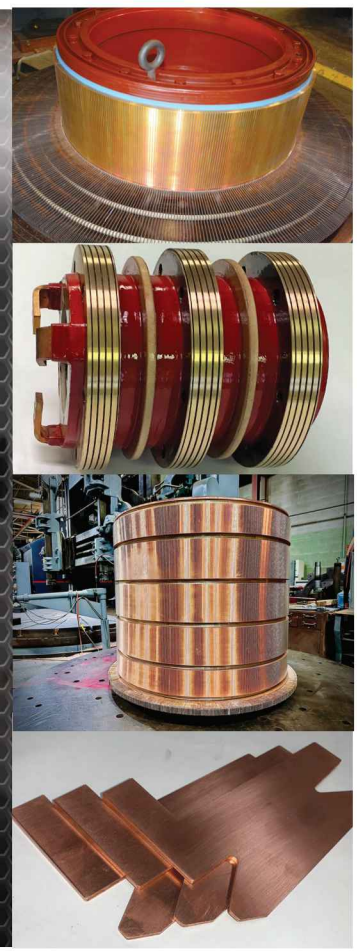
Industry experts say the success of the energy transition will depend on moving beyond traditional approaches to grid planning and embracing more dynamic, distributed energy models.

A new approach to grid planning

Historically, utilities have designed electric systems around meeting peak demand. As EV adoption accelerates, however, simply building additional generation and infrastructure to serve new loads becomes increasingly expensive.

"The traditional design model chases the peak," says Ildi Telegrafi, MSEE, policy fellow at the Alliance for Innovation and Infrastructure. "As EVs penetrate peak demand at higher rates, then the system has to expand more rapidly. This is paid for by the consumer as increased rates and higher supply costs."

Please turn to page 22



Join the 2026 Megger Baker User Conference

October 6th–8th | Fort Collins, CO

Connect with fellow Megger Baker equipment users from a diverse range of industries at our upcoming three-day conference. Set in beautiful downtown Fort Collins, this event provides a dedicated space to share your experiences, explore new technologies, and expand your professional network.

Scan the QR code
for more information or to register for the event

Megger®
Baker Instruments

POWERING THE TRANSITION continued from page 20

Instead, Telegrafi points to a growing shift toward what Telegrafi describes as a peak-flattening model. In this approach, distributed energy resources capable of storing electricity and discharging it during high-demand periods become valuable grid assets.

"The clean energy transition is changing the design model toward peak flattening," Telegrafi says. "Components that can store energy and discharge it at a peak time will be incentivized to do so. This operation reduces both delivery rates and supply costs."

Steve Christensen, executive director of the Responsible Battery Coalition, sees a similar evolution occurring across utility planning efforts.

"It is driving more localized planning instead of the broader, system-wide approach used in the past," Christensen says. "Grids need to be more flexible, ensuring there is sufficient storage to adapt to unpredictable EV charging."

The emphasis on localized flexibility reflects a growing recognition that EV charging patterns can vary significantly by region, neighborhood, and even individual facilities. As a result, utilities increasingly need tools that can respond to changing conditions in real time rather than relying solely on traditional long-term infrastructure expansion.

Balancing renewables and transportation electrification

While EV adoption increases electricity demand, renewable energy introduces another layer of complexity. Solar and wind resources provide clean energy but are inherently intermittent, creating operational challenges for grid operators tasked with maintaining continuous system balance.

"The challenge with integrating renewable energy resources is their intermittent operation," Telegrafi says. Traditional grid operations generally assume scheduled generation will be available when needed. Renewable resources, however, depend on weather conditions that can change rapidly.

Beyond utilities, businesses, municipalities, and fleet operators are also finding new ways to integrate renewable energy and EV infrastructure into their operations

To address this variability, Telegrafi believes new market mechanisms must emerge that better support balancing resources. "In the clean energy transition, market-driven operational dynamics have to be established to balance the intermittent nature of renewables," Telegrafi says.

Christensen agrees that matching renewable generation with EV charging demand presents one of the industry's most significant challenges. "Solar and wind generation is intermittent, while EV charging adds significant, variable loads to the grid," Christensen says. "The challenges lie in matching timing, location, and stability across the electrical network."

Ildi Telegrafi, policy fellow at the Alliance for Innovation and Infrastructure

Energy storage systems increasingly serve as the bridge between those two realities. Batteries can absorb excess renewable generation when it is available and release it when demand rises or renewable output declines. "By storing power when it is abundant and releasing it when the grid is stressed, batteries directly solve the intermittency and capacity issues of a system that relies on wind and solar," Christensen says.

Nikhil Bharadwaj, CEO and co-founder of Xeal, believes better coordination between renewable deployment and EV infrastructure development will also be critical.

"One challenge is that the buildout of large commercial-scale renewable sources and EV charging deployments are still untethered at a high level, leading to inefficiencies in co-benefits," Bharadwaj says. He notes that demand response programs and coordinated management of distributed energy assets can improve economics while reducing the need for costly grid upgrades.

The promise of vehicle-to-grid technology

Among the technologies attracting significant attention is vehicle-to-grid integration. V2G systems allow EVs not only to draw power from the grid but also to return stored energy when needed.

Advocates view V2G as a potentially transformative resource because it leverages assets that already exist. Millions of EV batteries connected throughout the distribution system could collectively function as a vast network of distributed storage resources.

"V2G is a storage mechanism that can balance operational dynamics like energy, voltage, current, power factor, frequency, and protection," Telegrafi says. "V2G is localized and interconnected directly into the distribution systems, changing the infrastructure requirements and enabling a less expensive utility economic model."

Because vehicles spend much of their time parked, Bharadwaj believes they are uniquely positioned to support renewable integration.

"EVs, being flexible loads, are parked during various long dwell times like overnight or at work, making them perfect sinks for renewables like wind overnight or solar during peak duck curves," he says.

Please turn to page 24

Complete Diagnostic Center!

EASA ACCREDITED MEMBER
COMPLIES WITH EASA AR100

Majority woman-owned busines

Founded in 1973, by Bob Ross, Jasper Electric has provided quality motor and rotor repair by being on the cutting edge of technology and using high-quality materials, such as M19 electrical steel. Handling large and small motors alike, we are the future. We have almost every tool needed to repair or rebuild your rotor and stator. Most motors we repair will run as efficiently if not better than when they were new from factory. Our personnel allow us to work smoothly while giving our customers a peace of mind.

JASPER ELECTRIC MOTORS INC.

MEMBER EASA
The Electro-Mechanical Authority

New Stator & Armature Cores • Fiber Optic Laser Cutting • Large Machine Shop • Water Jet • Loose Lams

Core Loss & 15' VPI

- 300 KVA 20 HP to 10,000 HP
- Computer printout sent with each Job
- Water stripping for form wound stators
- Full rewind with 15 ft VPI available
- 1 HP to 10,000 HP
- Infrared hot spot check on each job
- Quality core loss report with each job
- Loop testing for 10,000 HP+ stator cores

Motor Load Testing

- Full 4-Hour load test available or until temperature stabilizes
- Load test up to 1500 HP AC, 925 HP DC
- Voltage test up to 7200 volts AC, 600 volts DC
- Run test as long as necessary, 7500 HP
- Government and utility approved
- Synchronous motor testing
- Computer print-out with efficiency rating

Laminations

- Punch or laser cut
- Pole pieces (laser cut)
- Any size or thickness
- Emergency pick-ups
- Emergency deliveries
- Segment or whole
- Estimate over the phone

- R.D.T. Available
- On-site quotes and repairs
- Stacked in your housing, spider/shaft or shipped loose

New Rotors

- All copper alloys to match conductivity
- Normal turnaround 15-24 Days
- In house aluminum and copper extrusion
- R.O.T. Available

JASPER ELECTRIC MOTORS, INC. Jasper, AL

www.jasperelectricmotorsinc.com/

TWO SERVICE LOCATIONS!

PO Box 1494 • 175 Curry Hwy • Jasper AL 35502
205-384-6071 • Fax 205-384-6073
jemi@bellsouth.net

22673 Hand Rd • Harlingen • Texas 78552
956-421-2446 • Fax 956-421-3616
info@newcoreinc.com

NEW CORE INC.

newcoreinc.com

FACEBOOK.COM/NEWCOREINC

INSTAGRAM.COM/NEWCOREINC

POWERING THE TRANSITION continued from page 22

"Duck curves" show the imbalance between energy demand and solar power generation over the course of a day. The duck curve resembles the silhouette of a duck: The daytime dip represents the duck's "belly," and the steep evening surge represents its "neck" and "head."

According to Bharadwaj, V2G could help reduce reliance on peaker plants while improving renewable utilization. "V2G can play a key role in not just curtailing peaker plant spikes but helping solve the integration challenges of renewables at scale," he says.

Christensen also sees significant potential in V2G, although he notes that practical challenges remain. "V2G might help by essentially expanding a grid's storage capacity," Christensen says. "However, there are many variables that need to be met regarding the number of vehicles connected to a grid when needed."

Battery degradation remains another consideration. Additional charging and discharging cycles may affect battery longevity, although future battery technologies could help address that concern. "As the need for V2G grows, we might see battery technology advance to accommodate the additional charging and discharging cycles," Christensen says.

Creating the right market signals

Experts agree that technology alone will not be enough. Regulatory frameworks, market structures, and policy incentives must evolve alongside technical capabilities.

Telegrafi believes one of the most important steps involves creating market mechanisms that reward EV owners for providing grid services. "The first balancing between renewables and V2G storage is to enable a marketplace that supplies energy from V2G when renewable intermittency occurs," Telegrafi says. "This enables the system to balance energy demanded to energy generated every instance."

He notes that organized wholesale markets operated by independent system operators and regional transmission organizations will likely need new ancillary service structures that recognize and compensate V2G participation.

Bharadwaj identifies several additional priorities, including faster permitting processes and updated regulatory frameworks that encourage innovation. "Faster and standardized permitting, progressive virtual power plant and energy metering laws, and open standards with easy API-based connections can help accelerate growth," he says.

Open standards and interoperability may prove particularly important as utilities, charging networks, renewable generators, and distributed energy resources become increasingly interconnected.

Businesses become energy participants

Beyond utilities, businesses, municipalities, and fleet operators are also finding new ways to integrate renewable energy and EV infrastructure into their operations.

Telegrafi notes that many organizations are deploying increasingly sophisticated behind-the-meter energy systems that combine distributed generation, storage, and managed charging.

"This changes the operating expenses for that entity to where it acts as an energy "prosumer," or producer-consumer, and generates an additional revenue stream where there would have been an expense," he says.

Christensen points to the growing use of microgrids as a particularly notable trend. "We are seeing an interesting proliferation of microgrids to accommodate charging stations or as part of large business campus projects that include employee EV charging," he says.

These systems frequently rely on batteries to stabilize power flows and maintain reliable operations.

Bharadwaj sees opportunities for organizations to use pricing strategies and demand response programs to optimize charging behavior.

Nikhil Bharadwaj, CEO and co-founder of Xeal

Businesses can offer dynamic pricing based on incentivizing EV drivers to charge at lower-cost or greener fuel-mix times, he says. Fleets and municipalities may leverage demand response programs to generate additional revenue streams from their vehicles when not in use.

On the horizon

Over the next decade, experts expect the relationship between renewable energy and transportation electrification to become increasingly interconnected.

Telegrafi believes automated vehicles could dramatically reshape energy consumption patterns and charging behavior. "As the automated vehicle becomes more prevalent, the coordination between EVs to support owner and ride-sharer needs with respect to EV charging needs and V2G will become increasingly important," he says.

Christensen expects V2G functionality to become more commonplace as battery technologies mature and utilities seek additional flexibility. "We will likely see more V2G," Christensen says. "Auto manufacturers will likely make V2G a standard feature in EV firmware."

He also highlights another factor that could influence both transportation electrification and renewable energy deployment: access to critical minerals. Materials such as lithium, nickel, cobalt, graphite, and antimony remain essential for both EV batteries and grid-scale storage systems.

Meanwhile, Bharadwaj envisions a future defined by intelligent coordination among distributed energy assets.

"Virtual power plants with AI-first orchestration layers and digital twins of energy resources, along with renewables and EVs paired with stationary battery systems, are the next wave of smart energy technologies." **EA**