IEEE Spectrum Spotlights Breakthrough: Virtual Synchronous Machines Poised to Prevent Future Blackouts

IEEE-Standardized Virtual Synchronous Machine Technology Harmonizes Sustainable, Autonomous Power Grids of the Future

Field testing of the technology with 20 VSMs working together

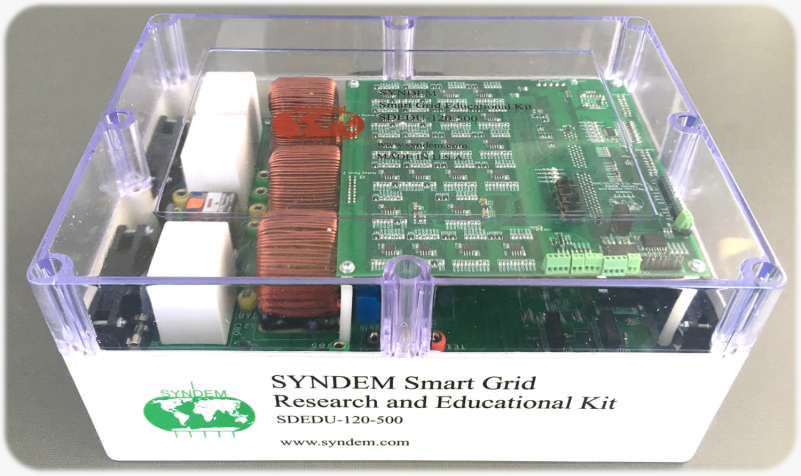
CHICAGO, IL, UNITED STATES, December 16, 2025 / EINPresswire.com/ -- SYNDEM, a global pioneer in renewable energy and smart grid technologies, announces that IEEE Spectrum, the flagship publication of the world's largest professional organization devoted to engineering and the applied sciences, has published a feature article on Virtual Synchronous Machines, co-authored by Syndem Founder & CEO Dr. Qing-Chang Zhong and Teneo Senior Consultant Rui Zhong.

Power grids worldwide are undergoing a profound transformation—from centralized coal- and gas-fired plants to millions of distributed solar panels, wind turbines, batteries and other distributed resources scattered across vast distances. This is not merely a technology replacement. It is a complete reimagining of how electricity is generated, transmitted, and used. And if we get it wrong, we risk more catastrophic blackouts like the one that hit all of Spain and Portugal on April 28, 2025.

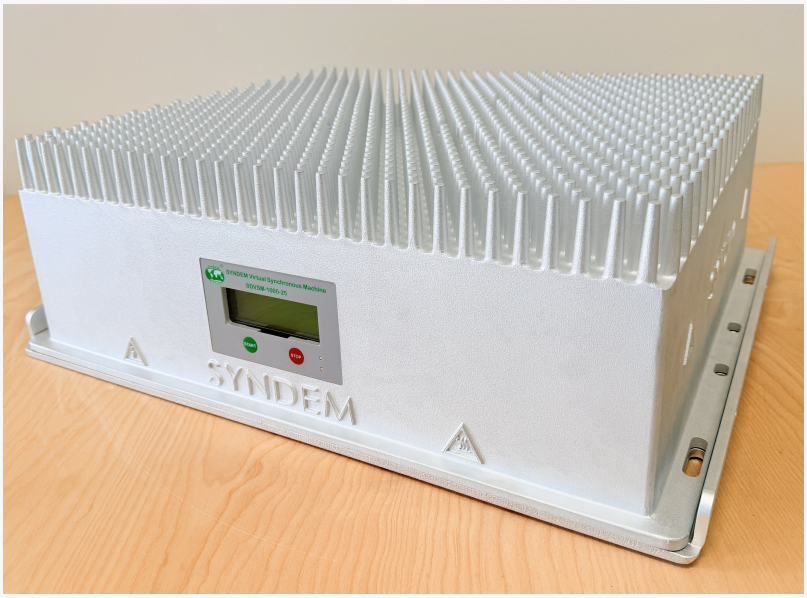
> Sooner or later, this will be deployed worldwide."
>
> *Michael Pesin, Deputy Assistant Secretary at U.S. Department of Energy*

A Virtual Synchronous Machine (VSM) is a power electronic converter that is controlled to behave like conventional synchronous machines. It makes millions of solar panels, wind turbines, electric

vehicles, storage systems, and loads, such as large data centers, compatible and friendly with the grid. As a result, most generation and consumption facilities in a future grid can be equipped and unified with the same synchronization mechanism to maintain grid stability autonomously, in a synchronized-and-democratized (SYNDEM) manner. This approach is poised to prevent large-scale blackouts and to support a smooth transition of power systems from centralized generation to distributed generation.



SYNDEM Smart Grid Research and Educational Kits



SYNDEM Virtual Synchronous Machine

Following Dr. Zhong's two decades of pioneering work on VSM technology, it has now been commercialized by Syndem, standardized globally through IEEE Standard 2988-2024, and is moving into large-scale deployment. VSMs are expected to play a vital role in enabling high penetration of distributed energy resources, advancing sustainability and energy equity, and accelerating the transition to a low-carbon economy.

The holistic theory is established, the enabling technologies are in place, and the governing global standard is approved. However, the full realization of VSMs within the SYNDEM architecture depends on joint ventures and global deployment. This isn't a task for any one group alone. We must act together. Whether you're a policymaker, innovator, investor, or simply someone who cares about keeping the lights on, you can play a role. Syndem invites partners worldwide to join in building future power systems that are stable, reliable, sustainable, and eventually fully autonomous.

Read the full article at https://spectrum.ieee.org/virtual-synchronous-machines.

For technical details about VSM, read Dr. Zhong's book Power Electronics-Enabled Autonomous Power Systems: Next Generation Smart Grids (Wiley - IEEE, 2020).

For workforce development with hands-on skills, see SYNDEM Smart Grid Research and Educational Kits at http://syndem.com/Products.html.

About Syndem
Syndem is leading the global development of next-generation smart grids based on the synchronization-and-democratization (SYNDEM) mechanism to harmonize the integration of renewable energy sources (such as wind and solar), electric vehicles, storage, flexible loads etc. This will enable autonomous operation of power systems without relying on communication networks, improving grid stability, reliability, security, and sustainability, and advance global energy freedom for billions of people with access to low-cost clean electricity. Learn more at www.syndem.com.

About IEEE Spectrum
IEEE Spectrum is an award-winning technology magazine and the flagship publication of the IEEE, the world's largest professional organization devoted to engineering and the applied sciences. With roots going back to 1884, the IEEE organizes research conferences, publishes engineering journals, and is responsible for major technology standards, including most famously Ethernet and Wi-Fi. IEEE Spectrum's mission has remained the same since its founding in 1964: that is to keep the public and IEEE members informed about major trends and developments in technology, engineering, and science. IEEE Spectrum has a monthly print magazine, which goes to IEEE's 500,000 members around the world, as well as a website, which posts a daily mix of news, features, commentary, interviews, and multimedia and attracts about a million visitors every month.

Dr. Qing-Chang Zhong
Syndem LLC
admin@syndem.com
Visit us on social media:
LinkedIn
YouTube
X
