Converting your ideas into a commercial start-up is not that simple. There are many unforeseen hurdles that you will encounter as you begin working your ideas into a commercial reality. It took me nearly ten years to launch my company SYNDEM (a conjoining of the terms synchronized and democratized), which plans to offer a solution to power systems that are going through a paradigm change from a centralized regulation system to a democratized interaction system. With millions of distributed generators and loads connected to the power grid, which continues to rapidly grow, there is a stability issue. Different people are looking at and addressing this problem in various ways. I started focusing more closely on it in 2001. The result was the development of three generations of virtual synchronous machines (VSMs), with the first generation called the synchronverter, a basic and conceptual implementation of the VSM. However, converting this lab curiosity into a real-world solution to harmonize power systems was not easy.

Even though the seed for my start-up company was first planted in 2008 with the development of the synchronverter, it took another decade to formally launch it. Raising funds to deliver products was another challenge. I waited for some indicators. My vision came closer to reality with the invention of the robust droop control, which was then proven to be universal for converters with different types of impedances, making it the second-generation VSM. Next, the removal of phase-locked loops from power converters in 2011 was another sign of encouragement. Finally, the development of the synchronized and democratized grid architecture in 2013 to harmonize power systems with the synchronization mechanism of synchronous machines (Figure 1) was the biggest driver. This not only allowed distributed generators to meet the requirements of Federal Energy Regulatory Commission (FERC) Order 842 on providing primary frequency response (PFR) but also enabled most loads to provide PFR.

Although I had a solution, I realized that the market ten years ago...
was not ready for a SYNDIEM solution. It needed understanding and education on VSMs, which was a big challenge. While I continued my research and teaching, I also started writing and talking about VSMs and their benefits to users around the world. In July 2017, I delivered the semiplenary talk “Synchronized and Democratized Smart Grids” at the 2017 World Congress of the International Federation of Automatic Control (IFAC). This marked a key milestone in educating the world on harmonizing power systems using VSMs because the IFAC World Congress is the world's largest in control theory and systems engineering, attracting more than 3,000 participants worldwide. Furthermore, the SYNDIEM grid architecture has been included in the IEEE Power & Energy Society Task Force on Primary Frequency Response as a Path to the Future. I have been invited to join the CIGRE Task Force on ac fault response options for HVDC voltage-source converters and the National Grid (United Kingdom) Expert Working Group on Fast Fault Current Injection and VSM. Over time, I saw that there was a growing interest in the solution on which I had been working. The release of FERC Order 842 was a blessing in disguise for VSMs.

**Funding and Manufacturing**

Envisioning the need and witnessing the growing interest in the market, I finally founded SYNDIEM in May 2017. Although forming the company online was easy, getting funds for the start-up was another project. At the moment, the company is operated with our own funds, so we are looking for investors. Several strategic investors from the United States, Canada, Ireland, and Africa have approached us, and we expect to finalize partnerships with some investors in a year or so.

Concurrently, to build up the ecosystem needed to deploy the SYNDIEM grid solution worldwide, we have formed a SYNDIEM Alliance, which consists of suppliers, customers, and other organizations from across the globe. The first SYNDIEM Alliance member is PERUN Technologies, which provides a power electronics and control launch ramp with configurable hardware; dedicated software; and ready-to-use

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**Uneven bondline thickness causes concentrated stress, which impacts reliability.**

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**Problem:**

- Tilted Substrate
- Lack of Thickness

**Solved:**

- Even Thickness

**Common InFORM stand-offs:**

<table>
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<th>Description</th>
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<th>Part Dimensions (x and y) (Millimeters)</th>
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<td>.75–2.5 per side</td>
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</table>

Contact our engineers:
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advanced control algorithms. The second member, Invent2026, is a Chicago-based nonprofit focused on building new technologies in midwest towns and neighborhoods that have been most impacted by changes in the U.S. manufacturing economy.

Since the market for our VSM technology is broad, we are optimistic about its growth. We have set up a concrete road map and are developing residential solar VSMs as an entry to the market, providing a mobile power solution for customers who do not have or have lost access to the power grid, e.g., during extreme weather conditions such as hurricanes. We are currently working with GroupNIRE, a clean-energy development company in Texas providing testing, certification, and consulting services for renewable technologies, to build a residential SYNDEM smart-grid test bed at GroupNIRE’s 2,000-acre field demonstration site. The test bed is expected to be completed in 2019. We are also developing research and educational kits to train future experts who will help deploy SYNDEM smart grids in the global marketplace. Meanwhile, we plan to build up manufacturing facilities in Chicago to assemble and test products in house, with critical parts outsourced from partners and our Alliance members. We have talked to local authorities and companies about this and found that Chicago is a perfect home for us. As soon as the investment we need is secured, we will finalize the site and start building manufacturing facilities.

About the Author
Qing-Chang Zhong (zhongqc@ieee.org) is an IEEE Fellow and holds the Max McGraw Endowed Chair Professor in Energy and Power Engineering at the Illinois Institute of Technology. He is a Distinguished Lecturer of the IEEE Control Systems, Power Electronics, and Power & Energy Societies. He is the founder and chief executive officer of SYNDDEM, which leads the global development of next-generation smart grids with the synchronization mechanism of synchronous machines to harmonize the integration of renewable energy sources (such as wind energy and solar power), electric vehicles, energy storage systems, and flexible loads to provide primary frequency response.