# RE-ENERGIZED

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***Dramatic innovations in electrical systems are underway to increase the energy efficiency of the millions of industrial motors that power fans, pumps and compressors used around the globe. The targeted improvements represent a significant percentage of the world's overall energy usage. A longtime leader in industrial motor design, TECO-Westinghouse continues to produce groundbreaking electrical machines that operate at new levels of speed and energy efficiency.***

Industrial motors are ubiquitous products that work behind the scenes in every production facility around the world. Motors are used in all industrial fields and account for over 68 percent of the electrical energy used in manufacturing and process plants. The technology and design principles underlying industrial motors have been established and accepted for decades. However, the demand for more reliable, energy-efficient motors that provide higher levels of power and a broader range of performance is challenging the designers and manufacturers of rotating electrical systems.

 

# THE THOUSANDS OF INDUSTRIAL MOTORS IN OPERATION TODAY ACCOUNT FOR AN ENORMOUS PERCENTAGE OF THE ENERGY DEMAND PLACED ON THE WORLDWIDE GRID.

TECO-Westinghouse, a leader in motor design and application for over 100 years, invests heavily in innovative new motor designs — and with good reason. The thousands of industrial motors in operation today account for an enormous percentage of the energy demand placed on the worldwide grid. As consumers, businesses and government regulators alike insist on greater energy efficiency and a lower environmental impact, the Design Center and R&D team at TECO-Westinghouse is working on dramatic engineering innovations that can have a significant impact on global energy usage and environmental sustainability.

## The Drive for Greater Efficiency

How can energy efficiency be increased dramatically in a mature, accepted product design such as an industrial motor? The answer is straightforward: The performance of the product must be taken to a new level. Even the most basic design principles need to be re-examined to arrive at a breakthrough product design that reimagines the way the product consumes energy.

The ambitious design goal at TECO-Westinghouse is to introduce a fully integrated, high-speed, megawatt-class motor and high-frequency, variable-speed drive system that dramatically impact the machine's energy needs. This next generation of large electric machines would increase today's maximum rpm speed of 3,600 to 15,000 or even 20,000 rpm, enabling them to be coupled directly to high-speed machines such as gas compressors.

In addition, variable-frequency drives allow a motor to adapt flexibly to changing load demand. New power converter technologies can enable these variable drives to take energy from the grid at one frequency — say 60 Hz — and convert it to the frequency needed to power these high-speed motors.

These new drives not only would provide the power demanded by the motor at the target frequency, but can also provide reactive power to the grid, supporting grid resiliency. This is a highly desirable feature when a greater percentage of power comes from inconsistent, variable sources such as wind and other renewable energy sources.

## Making Complex Design Trade-Offs

TECO-Westinghouse's leadership in developing the next generation of industrial motors is recognized by the industry, as evidenced by the grant the company recently received from the United States Department of Energy. In partnership with researchers at Clemson University, TECO-Westinghouse is currently building a prototype of a new motor and variable-frequency drive that will be tested at full power on a dynamometer at the Clemson University Duke Energy eGRID lab in the fall of 2018. If this test is successful, the product might be commercially available as soon as the fall of 2019.

The TECO-Westinghouse Design and R&D team, along with its academic research partners, had to overcome a series of complex design challenges during the development cycle. For example, if rotors spin at extremely high speeds, what effect does that have on motor cooling and temperature? How does that affect stresses in the rotor? What new dynamics and physical phenomena will come into play — and how does that affect the vibration, wear and rotordynamic behavior? How does high frequency affect motor losses? Which trade-offs are acceptable, and which are not?

Designing a variable-frequency drive is a complex task. Engineers must consider issues such as the effects of high switching frequencies at high voltages, power losses, thermal management of the drive, and safety concerns, such as how the drive handles faults and contains their effects. The extreme innovation required to design the new variable-frequency drive is evident in the fact that TECO-Westinghouse owns 22 patents on this technology alone.

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## Minimizing Development Time, Risk and Expense

Like many manufacturers, TECO-Westinghouse was motivated to introduce this dramatic level of product innovation very quickly, in order to address growing concerns about equipment energy demands. And the emergence of international competitors meant that they needed to keep development costs low for competitive pricing.

Just as TECO-Westinghouse needed to rely on advanced technology to reinvent its core product, the company's engineering team relied on state-of-the-art engineering solutions to bring its design to the prototype stage. The company leveraged advanced design and development tools, including ANSYS simulation solutions, to minimize the time, money and risk involved in exploring extreme product innovations such as the variable drive.

For example, engineering simulation enabled TECO-Westinghouse to make critical performance trade-offs at a very early stage via digital exploration. Product developers were able to answer key questions about thermal management, mechanical stress and electromagnetic performance by applying physical forces and replicating real-world operating conditions in a risk-free virtual design space.

ANSYS simulation tools enabled the development team to test the performance of new, nontraditional materials without investing in full physical prototypes. TECO-Westinghouse engineers were even able to examine various production scenarios so that manufacturing costs could be understood and controlled upfront.

**ANSYS SIMULATION TOOLS ENABLED THE DEVELOPMENT TEAM TO TEST THE PERFORMANCE OF NEW, NONTRADITIONAL MATERIALS WITHOUT INVESTING IN FULL PHYSICAL PROTOTYPES.**

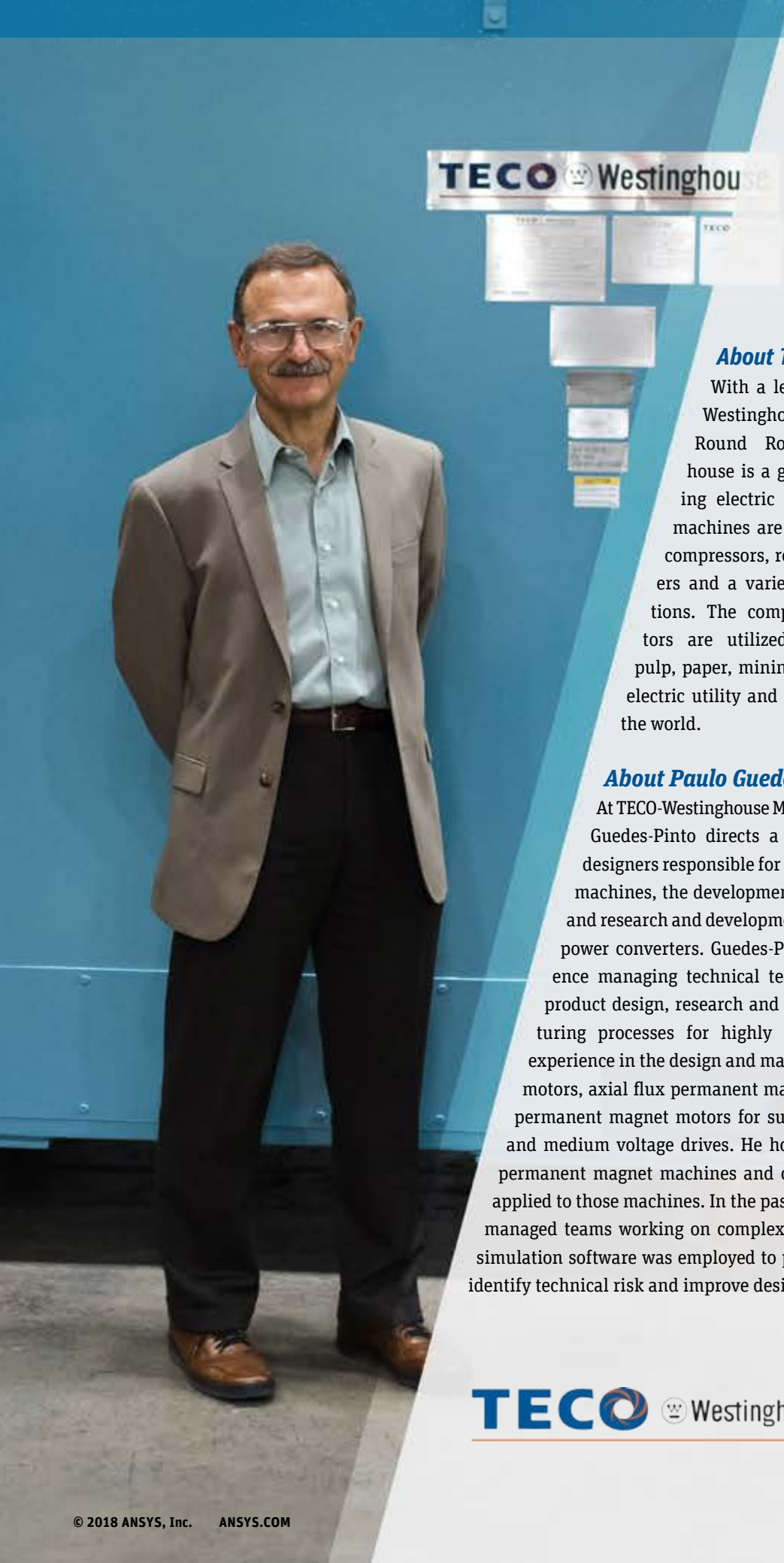
While TECO-Westinghouse is currently constructing a full motor prototype for the test at Clemson University, the build team is working with a high degree of confidence — because the design has been tirelessly tested and verified in a simulated operating environment that replicates real-world conditions with a high degree of accuracy. This is expected to support positive performance results when the prototype goes into testing in the fall of 2018.

## Implications Beyond Industrial Manufacturing

TECO-Westinghouse is focused on delivering innovative motors to the global industrial market. While the company does not engineer propulsion systems, the high-speed rotors, variable drives and other innovations developed by its R&D team could have implications in other industries where energy efficiency is of paramount importance — including automotive and aerospace.

Motors — or, more broadly, rotating electric machines — are now at the heart of industrial manufacturing, electric and hybrid vehicles, and more electric aircraft. As TECO-Westinghouse solves the problem of extremely high-speed rotation and variable speed controls, it's only reasonable to assume that these innovations could inspire product development engineers in other industries as well, leading to energy-efficiency improvements that go well beyond industrial environments.




## About TECO-Westinghouse

With a legacy dating back to George Westinghouse and headquartered in Round Rock, Texas, TECO-Westinghouse is a global leader in manufacturing electric motors. These high-quality machines are used to drive pumps, fans, compressors, rolling mills, grinders, crushers and a variety of other rugged applications. The company's motors and generators are utilized in petroleum, chemical, pulp, paper, mining, marine propulsion, steel, electric utility and other industries throughout the world.

## About Paulo Guedes-Pinto

At TECO-Westinghouse Motor Company (TWMC), Paulo Guedes-Pinto directs a team of 56 engineers and designers responsible for the design of large AC and DC machines, the development of medium voltage drives, and research and development for electric machines and power converters. Guedes-Pinto has 32 years of experience managing technical teams with responsibility for product design, research and development, and manufacturing processes for highly complex products. He has experience in the design and manufacture of large AC and DC motors, axial flux permanent magnet generators, high-speed permanent magnet motors for subsea and land applications, and medium voltage drives. He holds eight patents related to permanent magnet machines and carbon composite structures applied to those machines. In the past 10 years, Guedes-Pinto has managed teams working on complex projects where engineering simulation software was employed to predict system performance, identify technical risk and improve designs.

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