Investments in training and research facilities

A custom smart grid lab on a budget

Many technical education teachers often think that their dream lab is out of reach because of the lack of funding or space. However, writing concrete project specifications is the first step towards its realization. This is what Dr. Deese, a college electrical engineering professor, has done to turn his ideal advanced smart grid lab into reality while staying within budget. The key enabler in this process: finding the right partner.

In many countries, investments in power grid modernization are rising. For optimal returns on investments, a qualified workforce is necessary to implement changes and make full use of new technologies.

Increased reliability, efficiency, and resilience, as well as improved security and sustainability are among the benefits of smarter electric power grids. Driven by digitalization, the grid modernization requires skilled technicians and engineers, thus greatly impacting training and skills requirements. Colleges and universities are key to creating a pipeline of qualified power and energy technicians and engineers.

Changes in the energy industry require updates of existing training programs and of training facilities. This can prove challenging for educators, specially for undergraduate or small institutions.

“As a graduate student and post-doctoral researcher, I worked with the Interconnected Power System Laboratory (IPSL) and Reconfigurable Distribution Automation and Control (RDAC) Laboratory at Drexel University. Upon making the transition to The College of New Jersey (TCNJ) in 2010, I realized how important an advanced power laboratory would be to my success. I formulated the idea of a lower voltage smart grid – one that focuses on use of innovative technologies over large power flows”, says Anthony Deese, Ph. D., then Assistant Professor of Electrical Engineering.

„Many large electrical and computer engineering programs in the US feature advanced power engineering laboratory facilities. The SEPS Laboratory allows TCNJ faculty, students, and researchers to capably work alongside colleagues from larger institutions.“

Dr. Anthony Deese, PhD
Associate Professor, Department of Electrical and Computer Engineering, The College of New Jersey, USA

This is when the idea of a Smart Electric Power System (SEPS) laboratory emerged, aimed at supporting TCNJ's growing power engineering program.

A twofold objective

The SEPS Lab would not only outline techniques that faculty researchers and smaller, undergraduate institutions may employ to develop a practical yet effective power engineering laboratory; it would also create a laboratory addressing emerging technologies to ensure its relevance in the modern engineering world.

Definition and funding of the project

Dr. Deese then listed precise requirements in terms of technologies. The SEPS would cover remote measurement and control, power electronics converters, direct current transmission, renewable power generation, and grid-connected energy storage.

To finance the creation of this SEPS Lab, Dr. Deese decided to submit a project proposal to the National Science Foundation, which was accepting project proposals under its Major Research Instrumentation Initiative. The grant was awarded for a little less than 100 thousands US dollars, and that proved to be enough.

Three design principles

1. **Robustness and versatility**
   The laboratories of undergraduate institutions must facilitate the study of introductory as well as advanced topics and be versatile enough to be operated by novice as well as experienced engineers.
2. **Cost/space efficiency**
   Smaller institutions are often most sensitive to funding and space limitations; the laboratories must provide significant research and teaching opportunities.
3. **Commercial availability**
   The construction and testing of custom hardware requires time and effort; faculty researchers can turn to vendors to benefit from their expertise and support.

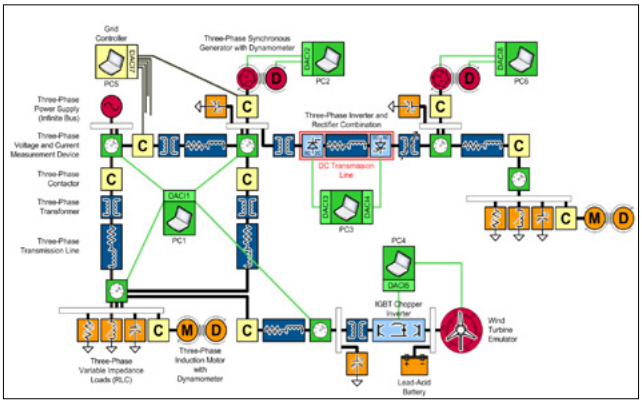
Close collaboration with the supplier
To create the lab layout and select the right equipment, Dr. Deese teamed up with Festo Didactic electrical engineers. Together they created a powerful, customized lab that answered all requirements from existing power energy training systems. This setup is also reconfigurable, i.e., all the components can be rearranged for further experiments as the connections are not fixed.

"Dr. Deese's project resonated with our team. We regularly help our clients customize learning systems to meet specific training needs. But designing such a complete, complex smart power grid was a first for us. My colleagues and I worked a lot; it strenghtened our expertise and prepared us for many similar subsequent projects. We are proud to have helped Dr. Deese realize his ideal smart grid lab", says Mathieu Plourde, professional electrical engineer and product manager of the electric power technology learning solutions at Festo Didactic.

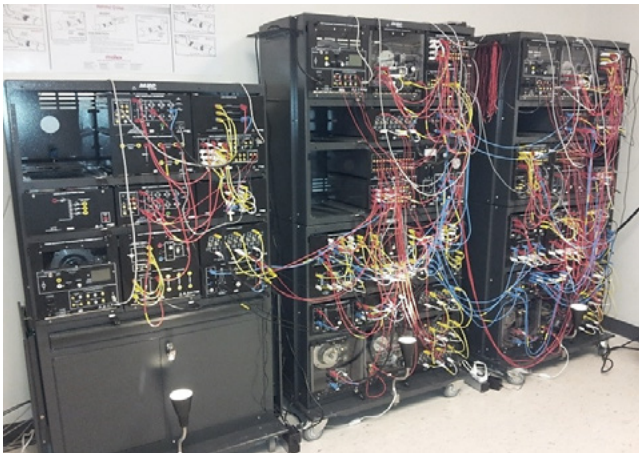
The SEPS Lab is composed of various synchronous generators with associated prime movers, induction motors with associated dynamometers, transformers, transmission lines, contactors, constant-impedance loads, renewable generation-emulator modules, battery storage devices, and power electronic converters.

A lab that stands the test of time
The SEPS Lab was officially opened in 2012. During its first year of use, it was mainly used for the Power Systems and Renewability course. It is still fully relevant and an essential part of the Power Engineering programs.

"The lab has exceeded my expectations. I am proud of the fact that it is 'one of a kind', one type of advanced power laboratory that even larger institutions do not have access to", says Dr. Deese.



Nominal configuration of the SEPS Lab


The SEPS Lab consists of three workstations. The fully reconfigurable six-bus, three-phase power system hardware operates with ratings of 208 V (at 60 Hz) and 0.2 kW.

For more information about the SEPS Lab:
https://sites.google.com/site/anthonydeesephd/lab

Interested in learning more about the equipment?
Go to labvolt.festo.com and enter "electric power technology training systems" in the search field.

About Festo Didactic
Festo Didactic is a world-leading provider of technical training and further education. The product and service portfolio offers customers – vocational schools and universities, research centres and industrial customers – integrated educational solutions in a wide range of technological fields and topics. Festo Didactic is part of the globally oriented, independent family-owned company Festo, with offices in 61 countries.

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