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Creating a Pathway to Sustainabiliity

Armour College of Engineering
ILLINOIS INSTITUTE OF TECHNOLOGY

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Also:
Restoring Hand Function in Stroke Survivors
using a robotic hand

And:
A Legacy Lives On
in a new undergraduate lab

ENHANCING POWER MARKET OPERATIONS WITH COORDINATED HYDRO-WIND ENERGY

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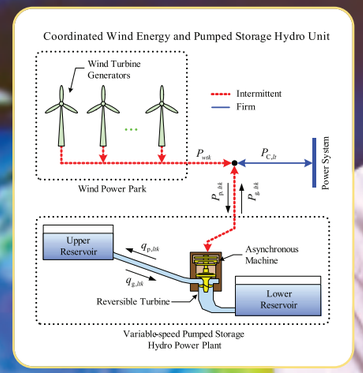
Interconnection Scheme for Firming Coordinated Hydro-Wind Energy Output
IIT's integrated hydro-wind concept connects wind turbine generators to a pumped-storage hydro power plant. Consisting of two water reservoirs located at different elevations and utilizing a reversible turbine, the hydro power plant transforms electric/wind energy into potential energy by pumping water from the lower to the upper reservoir. When energy is needed to supply peak demand, the water is released to produce electricity. The net output to the power system is equal to the sum of the outputs from the wind park and the pumped storage unit.



Background image, 15km Global Wind Map at 80m, developed by 3TIER Inc., www.3tiergroup.com

An international authority in the field of electric power systems planning, operation, and control, Mohammad Shahidehpour has been a member of the faculty of the ECE department for the past 25 years. He has authored more than 300 technical publications and five textbooks in his field. Fellow and Distinguished Lecturer of the Institute of Electrical and Electronics Engineers (IEEE), Shahidehpour has lectured extensively in 25 countries on electricity industry restructuring issues. He served for more than 15 years as editor of IEEE *Transactions on Power Systems* and is currently vice president of publication for the IEEE Power and Energy Society and a member of the editorial board of several international power engineering journals. Shahidehpour has been widely acclaimed for his profound impact on electrical engineering research and education.

Research Expertise

A pivotal researcher at IIT, Shahidehpour has developed a globally renowned program in control and optimization of electric power systems, financial markets and electricity industry restructuring, and decision analysis. To date, he has supervised the research of more than 50 visiting faculty, post-doctoral scholars, and Ph.D. students. During the course of his career, he has served as consultant to the electric power industry and completed numerous technical projects funded by federal agencies and private power companies. Several of his simulation software products are installed in utility companies worldwide. Shahidehpour has developed a master's degree program in electricity markets in collaboration with Argonne National Laboratory, which is offered to the employees of the Korea Power Exchange.

Serving as a capstone for Shahidehpour's notable achievements in energy systems and analysis is the recent establishment of a $12 million partnership between IIT, the United States Department of Energy, the Galvin Electricity Initiative, S&C Electric Company, Endurant Energy, and Exelon to create the Perfect Power Prototype at IIT as a national model for energy efficiency and sustainability [see "Lighting the Way to Perfect Power," page 20].

Applications in Sustainable Energy Systems

The restructuring of the electric power industry and concerns over energy security and global warming have resulted in the rapid deployment of generating units that produce renewable and emission-free energy. Strict emission constraints and high fuel prices, coupled with recent developments in the manufacturing and utilization of large-scale wind turbines and government-sponsored financial incentives to promote alternative sources of energy, have combined to make the future of wind energy extremely promising. However, the intermittency and volatility issues inherent in wind energy remain unique challenges in managing the security of the electricity infrastructure.

With recent support from the National Science Foundation, Shahidehpour and colleague Zuyi Li [pictured on the left], ECE assistant professor, are pursuing a multifaceted approach to this problem. As a key component of the project, IIT researchers are developing a next-generation security-constrained simulation tool that can model the impacts of wind power intermittency and volatility on electric power system operations. The project also includes the development of a novel and efficient strategy for "firming up" wind power generation through hydro-wind coordination in an existing hydrothermal power system [see diagram]. As a result of this research, wind power generation could become more of a dispatchable generation resource with a smaller requirement for reserves.

The outcome of the IIT initiative demonstrates potentially widespread application to other renewable energy forms with similar intermittency and volatility natures, such as solar energy. Implementation of wind energy in practical power systems will ultimately enhance the operation of stressed power systems, reduce the chance of blackouts, lower the emission of greenhouse gases, and improve the nation's overall energy security and sustainability.