

Smart Grid Research Activities

EEE Dept, CSU Sacramento

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The EEE Department at Sacramento State envisions a future of affordable, reliable and environmentally friendly electrical energy made possible by a range of emerging smart grid technologies. The EEE Department will help create this vision with research in a broad range of energy issues while simultaneously encouraging the development of future engineers both at the university and K-12 level.

The Institute for 21st Century Energy lists four broad areas of concern in America's energy future. Any smart grid related student research should reflect how their project addresses one or more of these broad areas.

1. Increase and diversify energy supplies.

It is very likely that the energy usage will globally increase. Many analysts feel that electrical energy in particular will be the energy source of choice for homes, industry and transportation. Where and how is that energy going to be produced? The diversification of energy supplies by the use of so-called green energy production such as photovoltaics, wind power, and hydrothermal is a complex technical challenge with many avenues for research projects.

2. Improve energy efficiency.

No one wants to waste money by wasting energy. But what devices and processes make energy saving worthwhile and efficient? This author's goal is to preserve the quality of life for the energy users without wasting a watt. The devices need to use *just enough* energy to provide the function desired by the user.

This academic year at Sac State, the EEE Department design laboratory will research effective building to grid technologies that allow commercial building operators to reduce energy (baseline reductions), manage time of day usage including demand response (auto DR) during critical energy availability periods, and methods to autonomously determine the building's occupant's energy needs. Examples of possible research include lighting controls, sensors and instrumentation to determine building state variables, energy data visualization, and device inter-operability with building management systems.

Residential energy efficiency may also be addressed. For example how will the Home Area Network enabled appliances work with the advanced metering infrastructure (AMI)? Several students wish to pursue projects that bring bio-medical engineering concepts into an energy focus such as assisting the elderly in safely remaining in their homes despite various health related impairments by controlling lighting, appliances and devices through novel means.

Educational outreach is another wonderful area for student projects. Creation of suitable exhibits and grade school projects that educate and engage our young and upcoming engineers is a particularly innovative area. One idea is the creation of an educational energy game where the young students can role play and see the energy consequences of their game decisions.

3. Modernize and protect energy infrastructure.

The power industry is facing daunting challenges in the future of energy delivery. The grid system is becoming an aging infrastructure that needs large capital outlays to augment, replace and/or improve. For example, the transmission system operators see more frequent energy choke points and other stresses on the transmission system that were not anticipated in the original designs. Thus many approaches are needed to evolve the current electrical grid system to a self-healing, flexible and robust system.

The EEE Dept will shortly be researching technologies suitable for the integration of local energy sources in a structure becoming known as a micro-grid. The ability to seamlessly transfer power from the utility, the local resource (photovoltaic, wind, and other renewable sources) and energy storage (batteries, compressed air systems and other systems) depends on a clear knowledge of the state of the energy system. Digital controls, sensors, communication systems, control systems and other technologies will lead to a system that automatically performs fault detection, fault analysis and fault recovery. This area of research is particularly well suited to collaborative research with other universities, laboratories, utilities, and industrial vendors.

4. Promote environmental stewardship.

The energy researchers wish to help create an energy climate that makes environmental stewardship implicit in the work. Students may wish to research this concern specifically and validate that smart grid technologies are indeed assisting the global goal of long term energy sustainability.