ETOWN CONCEPT FOR SMART GRID SIMULATION AND DEMONSTRATION PROJECTS

West Virginia University

Concept Overview

West Virginia University researchers are defining a research and development demonstration program in "Smart Grid" and "Microgrid" development and deployment at community and regional levels. The program is based on a recommendation developed by WVU researchers in a Microgrid research development workshop. The recommendation is:

> *Develop an "ETown" Smart Grid Simulation and Demonstration Program that ties together physical and virtual demonstration testbeds and integrates energy production and use, sustainable environments, human factors, and implementation and adoption of Smart Grid and Microgrid technologies.*

ETown is based on integration of six inter-related aspects of community life and economic enterprise: Energy (Use), Environment, Electronic (Communications), Experimental, Educational, and Ecological.

"ETown" is an environmentally conscious, energy efficient, "low-carbon footprint," knowledge economy, community-oriented program. It is a merging of physical real environments and virtual environments to explore and experiment with operational, social, behavioral, political/regulatory, environmental, and economic issues related to Smart Grid technology deployment and its adoption by civic, social, and industrial, and government entities.

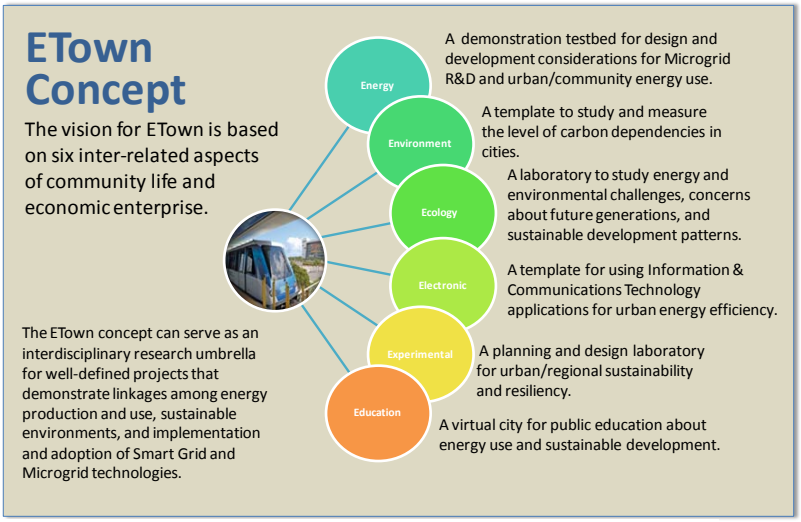

Figure 1. The ETown Vision

Potential To Develop ETown at West Virginia University

The WVU Advanced Energy Institute (AEI) encourages interdisciplinary energy research and development projects and supports development of innovative concepts by WVU researchers. The ETown concept as developed by WVU researchers is an innovative approach to research and development in new grid technologies, their deployment, and societal acceptance of them.

Significance

The ETown concept is targeted to development of research proposals that address issues of national significance. ETown provides an R&D real-world demonstration testbed environment for:

- Establishing a collaborative, multi-disciplinary laboratory for integration of Smart Grid and Microgrid technologies (DG, alternative/sustainable/traditional sources, control strategies, data use.).
- "Branding" of innovative approaches to modeling and demonstrating Smart Grid and Microgrid applications for well-designed communities of the future.

- Demonstrating and studying human interactions with Smart Grid and Microgrid technologies
- Developing planning and design guidelines for urban/regional sustainability and resiliency based on grid innovations.
- Developing a research template for ICT (information and communications technology) applications for urban energy efficiency
- Modeling and demonstrating a low-carbon footprint city or region.

Opportunity for WVU and Collaborating Partners

A Smart Grid is shaped by and greatly impacts our built environment and the way we live and work. Therefore, concepts of Smart Grid and sustainable communities are closely intertwined. ETown as a living laboratory enables concept exploration (such as where Microgrids may be best deployed), emerging technology testing and evaluation, and development of models for system planning and delivery for electricity, all of which are required to transform the nation's aging centralized power grid into a decentralized, more efficient, more reliable, and more climate and alternative-energy-friendly system.

U.S. DOE emphasizes in its Smart Grid Research and Development Multi-Year Program Plan (MYPP), 2010-2014, that advanced modeling and simulation will be required to test new technologies and overcome the traditional long timeframe in the electricity industry for testing, obtaining regulatory approval, and deploying new technologies in the national electricity grid, including the need for ability to

> "…portray Smart Grid performance and economic impacts on both actual and representative segments of the U.S. distribution grid, in context with surrounding bulk generation and transmission systems, market structures, reliability coordination, and utility operations." *U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, Smart Grid Research and Development Multi-Year Program Plan: 2010-2014, Chapter 3.3 Modeling, p. 38.*

A virtual Microgrid can model a physical Microgrid which can in turn provide data to improve the models underling the virtual Microgrid. Modeling, simulation, and visualization technologies are significant enablers for interdisciplinary research because they can unify visually mathematical models from participating disciplines (e.g., economics, engineering, consumer behavior, design, etc.). Running a virtual environment in parallel with a physical environment enables moving innovation swiftly to the real environment and solving real world problems in an optimized virtual environment.

Better decision support tools and new modeling capabilities will be needed because of the differences between current power systems technologies and next-generation, Smart Grid approaches to improving the electric grid. Successful deployment of Smart Grid depends upon simulation models that represent accurately technology performance in tests and that enable performance evaluation in an environment that matches the real-world environment. Three key overarching challenges that must be met are (*Smart Grid R&D: 2010-2014 MYPP, p. 39.*):

- Accurate models of engineering characteristics
- Control strategies, and
- Operation of a wide variety of Smart Grid assets with sufficient fidelity so that options for the design and configuration of a Smart Grid can be explored and continue to evolve.

The ETown concept can serve as an umbrella research and development collaborative that systematically links well-defined projects that demonstrate linkages among energy production and use, sustainable environments, and implementation and adoption of Smart Grid and Microgrid technologies.

A Microgrid Demonstration Program, based on the ETown concept, will illuminate and lead thinking in Smart Grid/Microgrid technology application, policy issues, and regulatory mechanisms.

Partnership Development

WVU AEI will develop strategic partnerships with utilities, government agencies, and energy industry partners as well as economic development residential development partners to design, develop, and implement the ETown concept.

Research Goal

The research goal for an ETown partnership is to sponsor, promote, and stimulate a range of new projects based on identified needs for modeling simulation, and visualization in energy systems development and management, including management of Energy R&D. Examples of research theme areas are:

- Create a modeling, simulation, and visualization capability for Smart Grid applications and sustainable energy use that is recognized as an international leader for analysis quality and relevance.
- Support US DOE need for forecasting R&D needs and impact of proposed and in-process R&D, including training for analysts and decision-makers.
- Energy systems research that incorporates modeling and simulation to address real-world problems.

Facilities and Capability Development

The physical ETown environment can be implemented in several ways. Examples include:

- A built or re-built "livable" community
- A research park community
- A continuity of government / continuity of operations center

The ETown partnership will select one or more methods for establishing ETown as a physical/virtual living laboratory for research about how sustainability and livability are affected by new grid technologies.

Summary

The success of the ETown research collaborative depends upon the expertise, intellectual engagement, enthusiasm, and research and development resources of the participating organizations. It will, in effect, create a new research community with a collective focus on the use of modeling, simulation, data integration, and visualization to solve important social, economic, scientific, and engineering problems in energy systems. The partnership focus will have transformational impact on the broader scientific and engineering community. Properly focused and resourced, it will establish the ETown partnership as a leading research center in Smart Grid and related applications for sustainable energy use in well-designed communities.

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