

# **American Manufacturing and Systems Integration Capabilities for Power Grid Modernization**



©September 2013

3	Introduction and Scope of this report
4	Research Methodologies
6	Research Findings and Mid-Year 2013 Observations
8	Dynamic Line Rating (DLR) for Transmission Networks
9	Synchrophasor Usage Patterns
11	Energy Storage Units – An Issue of Scale
13	Smart Grid Operational Control Systems
16	Automated Field Devices for Advanced Distribution Automation
18	Automated Metering Infrastructure
19	Electricity Metering Instruments – Smart Meters
20	HAN – Home Area Networking
21	Smart Appliance Loads
21	Substation Modernization Programs
23	Protection and Control Equipment
25	Cyber Security Developments
27	Time Synchronization and Grid Control
29	CAPEX Outlook for Grid Modernization Programs
31	Achieving Grid Modernization Market Potential: Life Cycle Patterns for Core Smart Grid Components
34	Marginal Cost Analysis for Smart Grid Components
36	Manufacturer and Integrator Viewpoints on Grid Modernization Strategies and Capabilities
37	Biggest Challenges to Increasing Smart Grid Manufacturing Capacity
38	Available Manufacturing and Integration Capacity
40	Summary of Viewpoints from Manufacturers and Systems Integrators

## Introduction and Scope of this report

In mid-year 2012, Newton-Evans undertook a study of American manufacturing readiness to provide key grid modernization components, as identified by the Department of Energy (DOE) in its Smart Grid Investment Grant program (SGIG) begun in 2009. Newton-Evans has been involved as a grid modernization research company for more than 30 years. In 2010, Newton-Evans had published a landmark study of SGIG funding, looking in detail at each award and grant provided by the ARRA investments made by DOE.

The 2012 SGIG “manufacturing readiness” study undertaken as a subcontractor to KeyLogic Systems, Inc., a key Department of Energy contractor to NETL, was focused on specific SGIG components addressed by DOE funding. In the year that has passed since the completion of that study, Newton-Evans’ ongoing discussions and research programs have continued with participation by hundreds of utilities as commissioned by several manufacturers, systems integration specialists and in-house, self-funded studies. Together these ongoing discussions and formal studies have enabled Newton-Evans to develop an independent update and prepare a fresh outlook for each of the DOE-identified smart grid components and a number of additional grid modernization components included by Newton-Evans, many on a repetitive basis.

The core technologies identified as SGIG components by DOE and discussed anew in this report are as follows:

- Energy storage
- Dynamic line rating (DLR)
- Operational control systems
  - Energy management system (EMS)
  - SCADA
  - Distribution management system
  - Advanced Distribution Automation (ADA)
  - Outage management system
- Synchrophasors
- Advanced metering infrastructure
- Smart meters
- Home-area networks (HAN) and smart electricity loads

In addition, Newton-Evans has included observations from its own related studies of other essential components of grid modernization. These additional grid modernization components include the following:

- Substation Modernization Programs
- Protection and Control Activities
- Cyber Security Developments
- Time Synchronization
- Grid infrastructure equipment

Newton-Evans also conducted its fifth tracking study of capital investment in grid modernization during the summer of 2013. This report includes key excerpts from that study's findings: *Global CAPEX and O&M Expenditure Outlook for Electric Power T&D Investments: 2013-2014*

### **Research Methodologies**

Newton-Evans Research has discussed the issues surrounding manufacturing readiness and systems integration capabilities with senior electrical equipment manufacturing industry officials, systems integration specialists and expert engineering and operations consultants in both 2012 (using a formal survey) and for the entire year since on an informal basis, using discussions and correspondence. In recent years, Newton-Evans discussed the state of the grid modernization market with scores of manufacturers, integrators and utilities in an ongoing dialogue. As recently as late September, 2013, panel sessions moderated by Newton-Evans' CEO discussed and debated these same grid modernization topics.

These activities continue to be accomplished in one of two major research approaches. The first approach has been the multi-decade tracking studies conducted on three vital grid modernization components encompassing (a) operational grid control systems (since 1984); (b) substation automation and integration activities (since 1988); and, (c) protection and control studies (since 1992).

The second approach has been through the conduct of proprietary research studies on a host of grid modernization topics ranging from a wide array of infrastructure equipment, to operational systems studies, to analyses of third party services. More than 150 proprietary grid modernization studies have been conducted or commissioned for manufacturers, integrators, service providers, other consulting firms and utilities around the country over the past 35 years. To evaluate the manufacturing readiness of the core smart grid technologies, the Newton-Evans team has used the same three primary factors as did the 2012 study, but with new

assumptions and fresh observations that have rationalized placing more importance on market demand for grid modernization products, systems and services rather than on level of investment in manufacturing capacity and capabilities of the workforce.

The focus of the 2012 study had been on supply-side investment. We now believe the late third quarter 2013 focus should be on two factors: (1) market demand as the driving factor confronting both the pace of grid modernization and the commitment to upgrade the nation's electric power grid; and (2) lack of a clear national policy and federal legislation on grid modernization that provides strong incentives and some level of funding. The responsiveness and preparedness of American manufacturers and integrators to meet whatever level of demand arises from the utility marketplace had been demonstrated in the 2012 study via the Newton-Evans survey of U.S. manufacturers and integrators, and this has been repeated in our industry discussions throughout the first nine months of 2013.

A review of the August 2013 edition of the Newton-Evans study on capital expenditure plans by utilities (*Global CAPEX and O&M Expenditure Outlook for Electric Power T&D Investments: 2013-2014; Funding Outlook for Smart Grid Development Based on Summer 2013 Survey Results*) clearly indicates that major investment plans for grid modernization remain largely stagnant or only slowly growing, with from 37% to 47% of all respondents indicating any real growth in planned capital expenditures on a range of grid modernization topics from 2013 to 2014.

We must also keep in mind that the relative maturity (or market readiness) of each of the identified smart grid technology components has an impact on its manufacturability.

As in the 2012 collaborative effort with KeyLogic analysts, Newton-Evans continues to pay attention to the relationship between manufacturing know-how and readiness to these factors:

- (1) Scalability - up and down - of manufacturing capabilities and integration know-how
- (2) The reach of a manufacturer or integration specialist in terms of market coverage
- (3) The perceived barriers to such readiness including technical, regulatory and financial.
- (4) Outside influences including the economic and financial outlook for utilities and
- (5) The financial resources available for new manufacturing facilities to build grid modernization components and to integrate control and monitoring systems.

## Research Findings and Mid-Year 2013 Observations

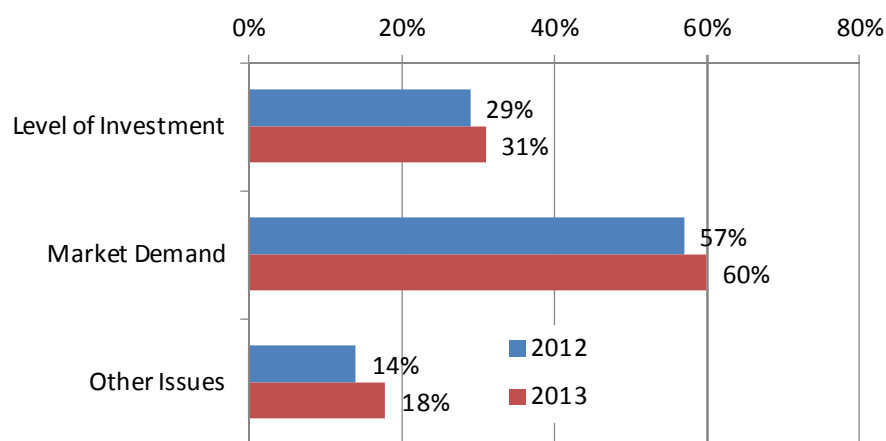
Newton-Evans Research believes that American (*and international*) manufacturers can accommodate (*or quickly prepare to do so for*) more rapid growth in U.S. grid modernization efforts than currently exists. Based on repeated surveys of several of the key manufacturing companies active in smart grid product development and firms involved with systems integration activities, there is sufficient manufacturing and integration capacity to meet expected demand levels for almost all core components of the smart grid identified by DOE as well as the additional grid modernization components studied by Newton-Evans Research Company. The latter group includes the intelligent electronic devices required for various automation projects from transmission level applications down to residential level meters, home area networks and smart appliances.

Regarding the nation's ability to increase systems integration workloads and capabilities, there is sufficient integration expertise available to increase these four activities: (1) dynamic line rating systems; (2) synchrophasor-related control systems used in the nation's high-voltage transmission networks; (3) operational control systems deployed for both transmission and distribution network operations; (4) consumer side technology including infrastructure to accommodate smart meter usage in residential buildings, commercial and industrial facilities and on the grid.

Energy storage development is the one exception to manufacturing readiness in 2013 for two reasons: (1) The energy storage technologies that are the most economically promising are still in the research or pilot stage, and most have not yet been fully commercialized; (2) There are several forms and applications of energy storage technology, some more *market-ready* than others.

Overall, the majority of the industry officials who participated in the formal 2012 Newton-Evans survey and more recently, those who have provided manufacturing and integration status updates in 2013 as part of our ongoing discussions on this topic, continue to believe that the demand for grid modernization technologies would have to triple, or even quadruple, before such demand significantly outstripped manufacturing capacity. For systems integrators, the outlook was less optimistic, indicating that growth can certainly occur, but that project management skill sets are likely not sufficient to accommodate a near-term tripling of business activities. Consequently, when industry officials were asked to identify the greatest barrier to increasing manufacturing and systems integration capacity in the August 2012 study, the majority cited the lack of market demand (see Figure 1). By mid-2013, this factor remains as the most important issue holding back increased investment in both expansion of manufacturing capacity and increases in systems integration team staffing.

Figure 1. What are some of the barriers to smart grid component manufacturing readiness in 2012 and 2013?(Percentages based on a survey of 17 manufacturers and suppliers)



\* Other issues include skilled labor availability, technology limitations, and regulatory Obstacles

Some survey respondents had indicated that a shortage of skilled labor may become a barrier to increasing manufacturing capacity (included in the “Other” category in Figure 1) and called the labor shortage a challenge to future technology advancements. This workforce-readiness issue applies to the deployment, installation, and maintenance of equipment and extends to the provision of planning, development and installation services related to project staffing for the integration efforts required for tailoring operational control systems.