

# DG Controller for Intelligent Hybrid-Renewable Generation Dispatch from Micro-Grid to Smart-Grid

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## ABSTRACT

This paper describes a new technology for micro-grid controls. The DG Controller described here is the first commercially-available product to allow a UDC, Aggregator or a Facility end-user to dispatch, control and manage diverse renewable energy and conventional distributed generation resources located within an end-user's/customer facility.

**Keywords:** micro-grid, DG, renewable, controls, generation

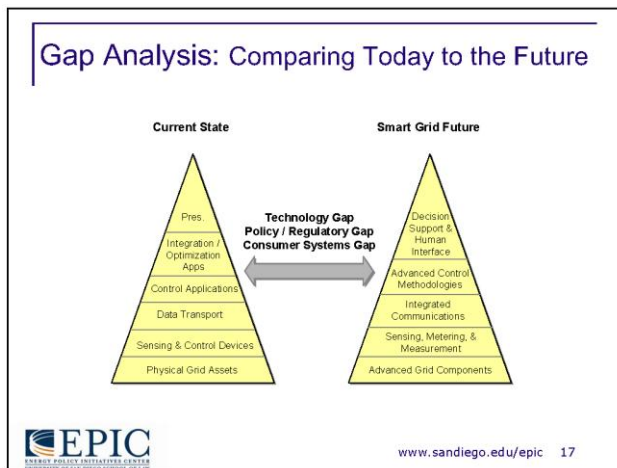
## PROBLEM BEING ADDRESSED

While renewable and distributed generation is increasing, current research shows that there is a gap for the “technologies required to accommodate— and optimize the value of— growing amounts of renewable energy capacity at customer sites and in resource-abundant locations.”<sup>i</sup>

Not only is there gap, but control systems and control applications do not currently have algorithms to manage a variety of multiple or different types of renewable generation resources at an end-user's facility, In many cases controls are OEM furnished (on-board) and are only discrete generation technology specific.

A 2006 IEEE report also identified that a basic issue for distributed generation in microgrids is the “technical difficulties related to control of a significant number of microsources”.<sup>ii</sup>

The following chart from a recent Energy Policy Initiatives Center (a not for profit energy policy organization) study shows a technology gap between current “control applications” and the “advanced control technologies” required to implement a fully functional smart grid:



The DG Controller solution described in this paper fills these gaps and covers these market needs.

## TECHNICAL APPROACH

To fill the market technology gap, XTRLs International has developed a controller for intelligent load-following and demand-response dispatch of customer-owned integrated Distributed Generation in smart-grid applications by Utility Distribution Companies (UDC), demand response aggregators or end-user customers.

## R&D History

XTRLs engineers capitalized on the knowledge and technology developed through a DOE/NETL-funded Distributed Generation project.

The previous research was funded under Cooperative Agreement: *DE-FC26-08NT02874*, “*Integrated Automated DG Demonstration*”

The XTRLs DG Controller was developed as a self-funded follow-on to the DoE research project.

## UNIQUE FUNCTIONALITIES

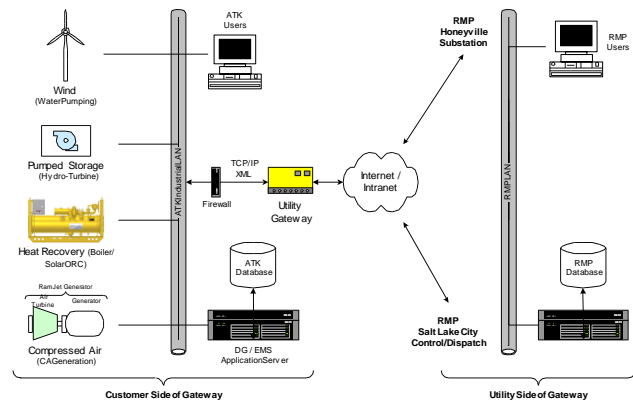
The DG Controller is the first and only commercially-available product to allow a UDC, Aggregator or a Facility End-user to dispatch, control and manage diverse renewable energy and conventional distributed generation resources located within an end-user's/customer facility to:

- Reduce peak demand for UDC and end-user
- Reduce end user energy & operations costs
- Determine renewable energy resource availability and dispatchability
- Mitigate need for transmission & distribution upgrade capital expense
- Provide grid support (VAR & Voltage)
- Support smart-grid, smart metering, and demand response initiatives
- Interface to end-user EMCS/SCADA systems, UDC smart-meters & Demand Response servers
- Provide advanced DG control algorithms and solutions that presently do not exist in the market
- Be Load-sensitive, Time-of-day/weather sensitive, Real-time price sensitive
- Support day ahead, hour ahead, peak/semi-peak pricing & tariffs and DR programs
- Manage Operation of disparate renewable energy generation resources to optimize demand reduction & management when needed.

### Universal Protocol Conversion

The DG Controller includes a Universal protocol translation technology that enables interface with any DG asset, any meter, and any EMS/UCS system. It is also Open ADR standard compliant.

XTRLs has developed an open Protocol Conversion methodology that can be integrated into the controller at the board level, enabling the DG controller to universally communicate with DG/Renewable and Smart Grid devices and equipment.



SYSTEM ARCHITECTURE OF THE DG CONTROL SYSTEM

### Standards-Based

The DG controller is unique in that it uses open standards exclusively and complies with existing and work-in-progress smart-grid standards from all of the leading standards bodies and consortiums:

- National Institute of Standards and Technology
- Institute of Electrical and Electronic Engineers
- GridWise™ Architecture Council
- EPRI Intelligent Consortium
- Utility AMI Open AMI Task Force

The DG Controller also supports these open standards:

- IEC 61970(c) Model for data exchange
- IEC 61850 Grid management, communication networks and systems in substations
- IEC 61968 System interfaces for distribution management Network management
- ANSI C12(c) Revenue quality metering standards
- Open AMI Group of standards for advanced metering infrastructure and home-area networks
- IEEE 1547(c) Monitoring/control of resources
- ASHRAE(c) BACnet
- Open ADR 1.0
- KYZ Meter output, and Serial, Ethernet, Modbus pulse output

## INDUSTRY IMPACT

According to the Edison Electric Institute, Smart-grid technologies are an estimated \$41.5 billion market in the next 5 years. Distributed generation integration is expected to be a large component of the emerging smart-grid technology market.

### Microgrids

In other recent studies, it has been shown that “the worldwide micro-grid market was estimated at \$4.14 billion, up significantly from 2009. This exciting growth is expected to continue at least through the year 2020.

The market segment for institutional and campus microgrids, claiming nearly 45% of total market share in 2010, is expected to cede some of its ownership by 2020 to the commercial and industry microgrid sector, as well as to military and off-grid microgrid types.

In 2010, North America staked a near 74% of total microgrid market share; by 2020 it is expected the microgrid pie will be slightly more evenly distributed among the regions of the world.<sup>‘‘iii</sup>

### Microgrid Controls

A recent (2011) article in Plant Engineering magazine noted that “If the goal is to make electrical grids self-healing and operationally efficient, then utilities will have to give serious consideration to the control engineering aspects of the physical electrical grids.

Control and instrumentation will play a key role in the success of Smart Grids, as better protection and measurement of operational intelligence significantly enhances grid operations.

Although control and measurement technologies (including protocols to interact with field devices) have been proven, systems will need to be upgraded and implemented in the right context.”<sup>iv</sup>

## SUMMARY

This product is first-to-market with a standards-based DG integration/control device with intelligent dispatch to utility grids. No other products with similar functionality are available or pending.

## REFERENCES

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