U.S. RESIDENTIAL IG-POD PROGRAM

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Abstract

This white paper has been prepared by Michael R. McCormick, Fredericksburg, VA to describe the immediate benefits of applying electrical Inverter Generator Point of Delivery (IG-POD) technology to approximately 70 million[1] detached residential homes in the United States, providing full-load emergency power during power outages due to storms (See Table 1) and grid equipment failures to save human lives and reduce U.S. economic impact.

Storms have the ability to cause irreparable damage and irretrievable loss of revenue in a matter of minutes, downtime is, in a word, disastrous. Electrical power outages, surges and spikes are estimated to cost more than $150 billion[2] in annual damages to the U.S. economy.

The information furnished in this document is provided for the purpose of proposing a faster, more cost effective and significantly less complex technological program with providing residential power supply during power outages and should not be construed as an engineering technical guide.

Table 1
U.S. Storm Outages[2]

Year	Total Storm Outages	People Affected, U.S.
2008	2,169	25.8 million
2009	2,840	13.5 million
2010	3,149	17.5 million
2011	3,071	41.8 million
2012	2,808	25.0 million
2013	3,236	14.0 million
2014	3,634	14.2 million
2015	3,571	13.2 million

[1] United States Census Bureau, (2016), Census of Housing, Historical Census of Housing Tables 2000, Single-family Detached Homes, Retrieved from https://www.census.gov/hhes/www/housing/census/historic/units.html
[2] Eaton, Blackout Tracker, (2015), Retrieved from http://electricalsector.eaton.com/forms/BlackoutTrackerAnnualReport

Introduction

Electrical IG-POD technology is not new and approximately 1.5 million U.S. residents currently utilize permanent IG products to provide full electrical load supply during electrical power outages. In cooperation with Executive Order No. 13653, 78 Fed. Reg. 215 (November 1, 2013)[3], the benefit of establishing a national IG-POD program would support the pursuit of utilizing technology to improve the Nation's preparedness and resilience in preparing for impacts of climate change.

IG-POD Benefits

- Reduce human deaths during power outages,
- Provide a proactive immediate low cost solution to residential power outages,
- Generate 42 million new jobs nationally (5 yr. program),
- Provide utility companies a minimum of 1,500 GWh load shedding opportunities,
- Build coalition with gas companies increasing gas usage and cost sharing,
- IG manufacturing revenue increases $2 billion and grow jobs by 5% per each market increase point,
- U.S. economy would grow by approximately $224 billion over a five year period,
- $2.2 billion per year (5 yr. program) $11.2 billion in sales tax revenue nationally,
- IG-POD program would outperform the 2009 Recovery Act cost to job ratio 90 to 1,
- 100% added Recovery funding can offset cost,
- 68,000 IG-POD annual maintenance jobs,
- Annually $1 billion in parts manufacturing and $80 million national sales tax.

[3]U.S. Publishing Office, (2016), Executive Order No. 13653, 78 Fed. Reg. 215, (2013, November 1), Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2013-11-06/pdf/2013-26785.pdf

U.S. Philosophical Change

Historically, we have a tendency to over think long term national issues with only broad solutions that exasperate the problem looking past less complicated solutions that can save lives today. Electrical grid systems are essential for cost effective delivery of electricity but extremely vulnerable to catastrophic events that can destroy major transmission grids or distribution equipment, which have components that can take a year or more to obtain replacements. Can U.S. residents be expected to wait that long with no electricity? Of course not! A week without electricity forces U.S. residents to use up available leave from work causing significant hardship and business' loss work production. IG-POD technology can significantly reduce exposure and loss of life to these types of events. So tell U.S. residents they will continue to experience loss of lives until Smart Grid technology is complete, even though it does not reduce loss of life only improves reliability. Changing our view point on critical path priorities will require a change nationally to implement the right technology today to protect human lives, while the U.S. rebuilds the electrical grid infrastructure to meet future demands efficiently and less vulnerable to catastrophic events. So let's change the point of delivery from the grid to IG-POD technology that provides higher assurances of safety during power outages than having nothing.

Smart Grid Philosophy

The U.S. microgrid strategy or Smart Grid programs are administered by the U.S. Department of Energy (DOE) Office of Electricity Delivery and Energy Reliability (OE)[4].

The DOE and OE are charged with leading national efforts to modernize the electric grid, enhance energy infrastructure reliability and security, and facilitate recovery from disruptions in electric power supply.

[4] Department of Energy, Office of Energy's Office of Electricity Delivery and Energy Reliability (OE), (2016), Recovery Act Smart Grid Programs, Retrieved from https://www.smartgrid.gov/recovery_act/index.html

In carrying out this mission the OE, along with utilities and other entities, are investing funds to demonstrate and deploy smart grid technologies and infrastructure through the American Recovery and Reinvestment Act (ARRA) Smart Grid Investment Grant (SGIG) program and Smart Grid Demonstration (SGD) program. The intent of these programs is to collect sufficient real-world field data (2009 – 2016) to verify the costs, performance, and benefits of smart grid technologies and systems operating on the electric grid.

What is a Microgrid?

A microgrid is a small energy system capable of balancing captive supply and demand resources to maintain stable service within a defined boundary. Microgrids are defined by their function, not their size. Microgrids combine various distributed energy resources (DER)[5] to form a whole system that's greater than its parts.

The Microgrid Benefits[6]

- Reducing Peak Demand - The extent to which smart grid technology influences peak demand reduction through the application of smart devices, the change in consumer behavior, and enabling greater use of renewable and distributed resources;
- Improving Asset Utilization and Operational Efficiency - The extent to which centralized and distributed generation, transmission, and distribution assets are better utilized through demand-side management, system optimization, and improved system visualization and awareness resulting in deferral of infrastructure investments;

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[5] Microgrid Institute, About Microgrids 2014, http://www.microgridinstitute.org/about-microgrids.html
[6] Department of Energy, Office of Energy's Office of Electricity Delivery and Energy Reliability (OE), DOE Smart Grid Computational Tool Users Guide 2.0, July 2011, https://www.smartgrid.gov/files/US_DOE_Smart_Grid_Computational_Tool_User_Guide_Version_2.0.pdf

- Enabling Distributed Energy Resources and Renewable Energy - The extent to which additional penetration or additional features of distributed energy resources and renewable energy are implemented due to the automation, control, and sensing abilities of the smart grid;
- Reducing Greenhouse Gas Emissions - The extent to which a smart grid might lead to reduced emissions of environmental pollutants and reliance on foreign-supplied fuels;
- Improving Reliability and Power Quality - The extent to which reliability is improved through the application of smarter sensing, communications, control devices, and integrated grid management systems.

Microgrid Disadvantages

- Complex technology[5],
- Limited "best practices"[6],
- Limited qualified design engineers[6],
- 35 to 50 years to establish new infrastructure[5],
- $1 to $2 trillion initial cost estimates,
- Same vulnerabilities as old grid (failures, storms, etc.),
- Since instituting the DOE Smart Grid 8 year program[5] over 100 million[6] without power and hundreds of humans have died in the U.S. unnecessarily.

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[5] Microgrid Institute, (2014) About Microgrids, Retrieved from http://www.microgridinstitute.org/about-microgrids.html

[6] Department of Energy, (2011, July) Office of Energy's Office of Electricity Delivery and Energy Reliability (OE), DOE Smart Grid Computational Tool Users Guide 2.0, Retrieved from https://www.smartgrid.gov/files/US_DOE_Smart_Grid_Computational_Tool_User_Guide_Version_2.0.pdf

Future Federal Energy Policies[7]

For these benefits to be realized, improved federal policies that address the specific components of IG-POD's are needed. These systems tend to be underutilized and undercompensated for the services and social and economic benefits they provide. The traditional utility business model does not adequately incentivize either customer generation of power or efficiency.

In addition, most regulatory policies are not designed for residential customers, who are also generators, a factor that limits deployment. An equitable regulatory environment for energy technologies would encourage greater adoption of IG-POD's and ensure that all economic, environmental, and security benefits and services of these products are recognized and captured. In addition, government support for research and development and public-private partnerships will lead to lower-cost technologies and increased market adoption, resulting in a cleaner, cheaper, and stronger grid by reducing the residential homes from the power outage crisis.

Congressional support and investment in programs that ensure that the technologies of the future are developed and produced domestically are vital to maintaining U.S. leadership in the clean energy arena and saving human life in the United States of America.

[7] Microgrid Knowledge.com, (2016, February 29), Federal Support Promotes Microgrid Technology: Pew Report, Retrieved from http://microgridknowledge.com/microgrid-technology-pew/

U.S. Storms

Eaton's Blackout Tracker Annual Report for 2015[2] was based on reported power outages in the U.S. as shown in Table 2 below reflects the top ten States by outages between 2013 and 2015. California and Texas are top two states in each year but the East Coast states and neighboring states make up the majority of the reported storms for the past three years.

Table 2
Top 10 U.S. States Storm Outages[2]

2015 Storms	2014 Stroms	2013 Storms
1.California (417)	1.California (537)	1.California (464)
2.Texas (201)	2.Texas (178)	2.Texas (159)
3.New York (173)	3.Michigan (164)	3.Michigan (153)
4.Ohio (155)	4.Pennsylvania (148)	4.Pennsylvania (144)
5.Michigan (152)	4.New York (148)	5.Ohio (136)
6.Pennsylvania (144)	5.Ohio (143)	6.New York (125)
7.North Carolina (121)	6.New Jersey (105)	7.Virginia (117)
8.Virginia (106)	7.Washington (104)	8.New Jersey (116)
9.Washington (104	8.Illinois (102)	9.Washington (104)
10.Indiana (100)	9.North Carolina (100)	10.Massachusetts (98)

Catasropic Weather Outages

A study, assessing changes in the reliability of the U.S. Electric Power System (August 2015) by Lawrence Berkeley National Laboratory and Stanford University confirmed that catastrophic weather is increasing power outage durations.

Both of these institutions, who deemed their report "the most comprehensive study of this topic to date," examined 13 years worth of data on the annual duration and frequency of power interruptions for a large cross-section of U.S. electricity distribution utilities. While the number of blackouts per year hasn't dramatically changed, the duration has, and researchers concluded that the weather is the primary factor for this change.

[2] Eaton, Blackout Tracker, (2015), Retrieved from http://electricalsector.eaton.com/forms/BlackoutTrackerAnnualReport

The Study's Conclusion

The study[2] suggests that increasingly severe weather events are linked to a 5 to 10 percent increase in the total number of minutes customers are without power each year, according to the study's lead author Peter Larsen, Berkeley Lab Research Scientist and Stanford PhD candidate.

Factoring data related to lightning strikes, precipitation levels, wind speed and temperatures, researchers discovered some interesting effects. For instance, a mere 5 percent increase in annual average wind speeds produced a 56 percent increase in the total amount of time that a utility's customers were without power over the course of a year. Furthermore, a 10 percent increase in annual precipitation translated to a 10 percent increase in the duration of an outage.

Based on the studies extensive research suggest that storm events will continue escalate at a high rate with longer outage durations impacting millions of humans in the U.S., significantly impacting the economy and continue to create hostile environments that will take human lives.

[2] Eaton, Blackout Tracker, (2015), Retrieved from http://electricalsector.eaton.com/forms/BlackoutTrackerAnnualReport

Why IG-POD Program?

Today's challenges of addressing aging electrical grid systems and the increase in storms in the United States, microgrid technology is a 35 plus year and approximately $1 trillion[18] endeavor, not to mention the technological complexity issues and though microgrids can significantly improve electrical power reliability and security, the grid is still vulnerable to downed lines and equipment failures still leaving U.S. residents with no power.

Compared to microgrid technology, IG-POD technology provides a primary point of delivery of electrical power when power outages occur.

Inverter Generator Technology

An inverter generator (IG) creates alternating current (AC) power through a two-step process. In the first step it generates DC power and then converts it to AC using a microprocessor controlled inverter in the second step.

The generation of DC begins almost as soon as the engine begins turning the generator. As the engine increases in speed, the DC voltage rises. As the load increases, the voltage will fall. The microprocessor controlling the inverter compensates by sensing the AC output voltage of the generator and adjusts the speed of the engine to keep the voltage at a consistent level. This saves fuel since the engine only turns as fast as necessary instead of at a constant high speed.

[18]Microgrid Media, (2016), 5 Unstoppable Drivers Of Microgrid Growth in, Retrieved from http://microgridmedia.com/5-unstoppable-drivers-of-microgrid-growth-in-2016/

As demand increases, the microprocessor speeds up the engine and power production increases, but the signal does not change. The result is a very clean and consistent AC signal no matter how much power is drawn, up to the generators capacity.

Since the engine runs at the lowest possible speed necessary to meet the power demand, it is quieter during periods of low demand than a conventional generator and uses less fuel to produce clean power.

Most standby generators operate automatically. They "stand by" waiting for an interruption of power from the electric company's local distribution lines. They are ready 24 hours a day, seven days a week, and 365 days a year.

Automatic Transfer Switch

At the center of a standby generator system is the automatic transfer switch. Day in and day out, it continuously monitors the power supply from the electric company. When that supply is interrupted, the transfer switch takes action. The switch starts the generator and checks to ensure that it is generating power. The switch then disconnects the circuits it controls from the utility's supply lines and connects them to the generator supply lines.

The switch from utility power to generator power is not instantaneous. Depending on the transfer switch and the generator, startup and switch over may take between ten to thirty seconds. The generator will continue to operate and supply power to the house as long as it has a supply of fuel (oil, gasoline, natural or propane).

When the electric utility restores power to the lines, the transfer switch will sense the power and begin a shut-down procedure in most IG-POD generators. When the utility power is stable and within acceptable limits, the transfer switch moves the residents' electrical system back onto the utility supply. This reduces the load on the generator and it begins to cool down.

The generator will continue to operate in a cool-down mode for up to ten minutes before the transfer switch shuts it off.

In-Use Maintenance

An often overlooked aspect of residential standby generators is that they are internal combustion engines that require oil for lubrication. Standby generators monitor their oil supply and will shut down if that supply runs low. During extended periods of operation, checking the oil periodically ensures the generator continues to operate uninterrupted.

Natural gas is the best choice for fueling a standby generator in most areas. Rural areas and regions with frequent earthquakes are better served by Liquefied petroleum (LP) gas, which is supplied in tanks rather than by local supply pipes.

Scheduled Maintenance

One convenient aspect of modern standby generators is their ability to do some things automatically without human intervention, such as starting up automatically in an emergency and performing self checks to ensure it is ready when you need it and can be integrated with the utility company's Smart-Meter (if applicable), providing monitoring features.

Every week, the automatic transfer switch will conduct a system self test that includes starting your home generator and running it for ten or fifteen minutes. During operation, home generators monitor the oil level and will shut off the generator if it drops to a level that would damage the generator.

All generators need periodic maintenance as well (See Table 3), oil deteriorates, filters need changing and so do spark plugs. All U.S. generator manufacturers have set intervals for the maintenance of home generators that include changing the oil, spark plugs, air filter and oil filter.

If the generator has a liquid cooled engine, the coolant also requires periodic checking and replacement. Annual maintenance cost can range from $100 to $150.

Table 3 **Typical Generator Operating Maintenance Schedule**
First 5 Hours
Change Engine Oil
Every 8 Hours or Daily
Clean Debris
Check Engine Oil Level
Every 100 Hours or Annually
Change Air Filter
Change Engine Oil and Filter
Replace Spark Plugs
Check Valve Clearance
Check Torque of Engine End Cover Bolts
Check Circuit Breaker Torques
Annually
Clean Oil Cooler Fins

Operating Cost Example

The average half-loaded 22-kw generator[19] consumes approximately 184 cubic feet of natural gas per hour and based on national average rates (See Table 4), that's $1.53 per hour or $36.70 per day (24 hour period).

Table 4 **IG-POD – National Average Fuel Cost[8]**	
Fuel Type	**Price**
Diesel	$2.23/gallon
Gasoline	$1.98/gallon
Propane	$2.85/gallon
Natural Gas	$8.31/Mcf*
Electricity	12.01¢/kWh**

**Mcf—equals the volume of 1,000 cubic feet (cf) of natural gas*

***kWh – killowatts (1,000 watts) per hour*

[8]Department of Energy, Energy Information Administration and Energy Efficiency & Renewable Energy (2016), Retrieved from Fuel Rates, https://www.eia.gov/tools/faqs/faq.cfm?id=97&t=3

[19]Generac, (2016), Guardian 22kW with Whole House Switch, Retrieved from http://www.generac.com/all-products/generators/home-backup-generators/guardian-series/22kw-6551-whole-house-switch?lang=en-US

The IG-POD Technology Program

The varying benefits of an IG-POD program provide significant impact to addressing the issues surrounding reliable electrical utility services in the United States.

Reducing Fatalities

IG-POD technology will help save lives during sweltering and refreezing weather keeping residents heating and cooling systems operating as in the case of (Brewer, 2012) [9] below.

- 23 deaths were attributed to the 105 degree heat and related violent storms that ravaged the eastern United States starting on, June 29, 2012. As of July 3, 2012 evening, 1.4 million remained without power in the seven-state area affected by the storms.

The following heat-related fatalities during the June 29, 2012 severe weather event could have been prevented with IG-POD technology and most of the residential customers could have had power during the 7 day outage.

- “Three elderly people died in St. Louis, Missouri due to lack of air conditioning.”
- “A man in Kansas City was found dead inside a mobile home where the temperature was over 115 degrees.”
- “A 72 year-old man without air conditioning was found dead in his home.”
- “According to the National Weather Service, heat is the leading cause of weather-related fatalities in the US. Those most at risk are infants, seniors and those with chronic medical conditions.”

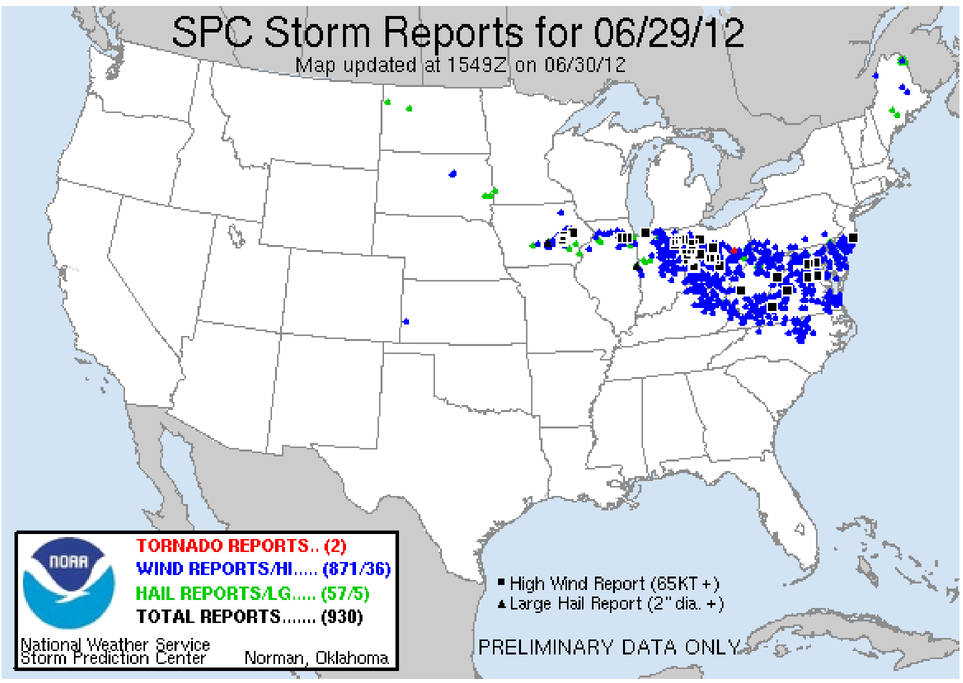
[9] Brewer, J. (2012, July 24) US death toll rises from heat wave and power outages, Retrieved from https://www.wsws.org/en/articles/2012/07/heat-j04.html

Seven U.S. States impacted by Storms

The June 2012 Mid-Atlantic and Midwest derecho[10] was one of the most destructive and deadly fast-moving severe thunderstorm complexes in North American history. The progressive derecho tracked across a large section of the Midwestern United States and across the central Appalachians into the Mid-Atlantic States on the afternoon and evening of June 29, 2012, and into the early morning of June 30, 2012 (See Table 5) and NOAA map.

Table 5
Seven State Storm Damage

Ohio	Over 1 million customers lost power in Ohio, with power outages widespread across roughly two-thirds of the state.
Pennsylvania	32,500 customers lost power.
New Jersey	206,000 customers without power.
West Virginia	672,000 customers lost electricity.
Maryland	168,000 customers without power.
Washington, DC	68,000 customers were without power.
Virginia	1 million customers lost power in Virginia, which was the largest outage in the state's history not related to a hurricane.



[10] Mid-Atlantic and Midwest derecho, July 4, 2012, (n.d.), In Wikipedia, Retrieved April 1, 2016, from https://en.wikipedia.org/wiki/June_2012_North_American_derecho

Proactive low cost IG-POD Technology

At an average cost of $3,200 (See Appendix A) per residential dwelling, the utility provider can turn-key the installation in one day and the technology is already proven reliable in the market and U.S. manufacturers are capable of meeting the demand over a five year period at an estimated cost of $224 billion nationally and fallen power lines will not impact residents with an IG-POD system. IG-POD technology currently meets all Federal and State required regulations and standards but not all States have adopted residential laws governing residents distributing electrical power back to the utility provider.

Different fuels emit different amounts of carbon dioxide (CO2)[11] in relation to the energy they produce when burned. To analyze emissions across fuels, compare the amount of CO2 emitted per unit of energy output or heat content. IG-POD's operating on natural or propane gas will generate less CO2 and less impact on the environment. Table 6 below reflects the pounds of CO2 emitted per million British thermal units (Btu) of energy for various fuels:

Table 6
IG-POD CO2[11]

Fuel Type	CO2
Diesel	161.3
Gasoline	157.2
Propane	139.0
Natural Gas	117.0

[11] Department of Energy, Energy Information Administration and Energy Efficiency & Renewable Energy, (2016) How much carbon dioxide is produced when different fuels are burned?, Retrieved from https://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11

IG-POD Natural Gas Key Advantages:

- Unlimited fuel source - refueling not necessary
- Quieter engine noise level
- More emission compliant
- More convenient fuel source
- Gaseous engines do not have a problem with "wet stacking like diesels

IG-POD Load Shedding

For those electrical power utilities using AMI (Advanced Metering Infrastructure) Smart-Meter technology would be able to communicate with IG-POD systems to utilize load shedding during extreme summer load demands. If available, an IG-POD Load Shedding agreement between the resident and power provider (similar to current commercial agreements) would be necessary to include but not limited to: kWh rebate rate to the resident to offset the energy cost of operating the IG-POD system. These AMI meters[12] not only measure how much electricity is used, but also at what times during the day. Smart meters are also designed to transmit pricing and energy information from the utility company to the consumer (two-way communication). Utility companies who provide their customers with smart meters are able to implement a variety of load reduction and energy saving programs, helping reduce the cost of providing electricity to a community.

[12]GE Appliances, (2011, January 3), What is AMI? , Retrieved from http://geappliance.esecurecare.net/app/answers/detail/a_id/20/related/1/session/L2F2LzEvdGltZS8xNDYxMDAyNTg1L3NpZC81OHJueWxPbQ%3D%3D

IG-POD Gas Company Coalition

As part of the IG-POD program, electrical power companies (EPC) would be required to enter into a coalition agreement with local gas supply companies (GSC) by supporting the EPC with turn-key IG-POD installations (gas line service connections) and mandated by Federal guidelines to reduce gas fuel rates during outages comparable to electrical utility rates.

- Reduced gas/propane rates during power outages (EPC responsible for notifying GSC)
- Reduced installation unit rates for gas service to IG-POD equipment
- Increased gas demand during off-peak periods (summer months)
- Increased job growth to support fuel source connections to IG-POD installations

Nationally Job Growth

Starting an IG-POD program in the U.S. with approximately 70 million[1] detached residential homes (including town houses and row house) is an enormous undertaking and for the purposes of this proposed program, five years is selected as the achievable IG-POD implementation program cycle (See Table 6) below and (See Appendix A) for details.

Table 6
IG-POD Program Cycle – New Jobs

Program Cycle	Jobs Nationally		Jobs Per State (50 States)	
	Total Jobs Per Yr.	Total Jobs Daily	Total Jobs Per Yr.	Total Jobs Daily
Units/1 Yr	210 million	823,529	4.2 million	16,471
Units/2 Yrs	105 million	411,765	2.1 million	8,235
Units/3 Yrs	70 million	274,510	1.4 million	5,490
Units/4 Yrs	52.5 million	205,882	1 million	4,118
Units/5 Yrs	42 million	164,706	840,000	3,294

[1] United States Census Bureau, (2016), Census of Housing, Historical Census of Housing Tables 2000, Single-family Detached Homes, Retrieved from https://www.census.gov/hhes/www/housing/census/historic/units.html

Manufacturing Production Growth

IG-POD manufacturer revenue could increase $2 billion[13] and grows jobs by 5% per each market increase point. Technavio's analysts forecast that Residential Portable Generator[14] market in the U.S. to grow at a compound annual growth rate (CAGR) of 10.38 percent over the period 2012-2016. One of the key factors contributing to this market growth is the occurrence of frequent natural events in the U.S. The Residential Portable Generator market in the U.S. has also been witnessing the increased focus on eco-friendly generators. The IG-POD program would significantly grow manufacturing production, job growth, real estate growth to support new plants and shipping industry to support this level of growth.

U.S. Economy Growth

The U.S. economy would grow in excess of $224 billion over a five year period with the IG-POD program (See Appendix A) for details. Table 6 above and Table 7 below does not include incidental jobs created to support this level of job growth or manufacturing jobs.

Table 7
IG-POD Program Cost

Program Cycle	Units Nationally		Units Per State (50 States)	
	Total Units/Yr.	Total Cost/Yr.	Total Units/Yr.	Total Cost/Yr.
Units/1 Yr	70 million	$224 billion	1.4 million	$4.4 billion
Units/2 Yrs	35 million	$112 billion	700 thousand	$2.2 billion
Units/3 Yrs	17.5 million	$56 billion	350 thousand	$1.1 billion
Units/4 Yrs	8.7 million	$28 billion	175 thousand	$560 million
Units/5 Yrs	4.4 million	$14 billion	87.5 thousand	$280 million

[13]The Wall Street Journal, (2012, November 6), A Sales Surge for Generator Maker, Bob Tita, Retrieved from ttp://www.wsj.com/articles/SB10001424127887324894104578103334072599870
[14]Technavio, (2012), Residential Portable Generator Market In The US 2012-2016, Retrieved from http://www.researchbeam.com/residential-portable-generator-in-the-us-2012-2016-market

IG-POD Recovery Funding

The proposed IG-POD program compared to the American Recovery and Reinvestment Act of 2009 (ARRA) demonstrates the failure of a poorly conceived broad program to a strategic IG-POD program. Based on the Congressional Budget Office report[15] the ARRA has generated approximately 2 million jobs between 2009 and 2015 (5 years) at a cost of $836 billion and compared to the 5 year IG-POD program would generate 48 million jobs costing approximately $224 billion, 90 to 1 cost ratio per job created (See Table 8). Increasing the current 2009 ARRA to fund the IG-POD program and not funding any additional microgrid projects will force the utility industry to commit to a long term U.S. electrical grid infrastructure capitalization through rate increases to meet to long term grid reliability objectives with microgrid technology strategies nationally.

Table 8
Job Growth Comparison

Program	Jobs	Reinvestment Cost	Cost Ratio/Job	Duration
2009 ARRA	2 million	$836 billion	$418,000	5 years
2016 IG-POD	48 million	$224 billion	$4,467	5 years

IG-POD Training Program

At the end of the IG-POD program we simply cannot just cut 48 million jobs. A job transition plan has to be developed to retain and realign the workers to new jobs opportunities through training internship program. This critical sub-program is necessary to sustain a large portion of the jobs being created during the 5 year program. One third of the IG-POD jobs are

[15] Congressional Budget Office, (2015, February 20), Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output in 2014, Retrieved from ,https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/49958-ARRA.pdf

low skilled helpers and in an effort to retain a large portion of these workers, the job skills must be elevated to be able to obtain higher wages and long term employment.

IG-POD Maintenance Program

The IG-POD program does require routine maintenance (See Table 3, page 13) work each year in accordance to the manufacturer's maintenance schedules. Under the 5 year IG-POD program, in the first year and based on IG-POD equipment run-hours and or 12 months from install date, the generator will need servicing, like changing the oil and filter on all 14million generators in the first year. The actual maintenance cycles can be managed through Smart-Meter technology. This maintenance requirement provides the opportunity to train the low skilled workers to become certified residential generator service technicians, providing 68,000 national jobs (See Table 9) to maintain the generators at higher wages and bring in new workers to backfill the job replacement cycles with lower paying wages for IG-POD installations. Table 9 below is based on 4 IG-POD units being serviced daily and 255 work days per year, generating annually $1 billion in manufacturing revenue and $80 million in Sales tax revenue. See Appendix A for details.

IG-POD Maintenance Jobs
Table 9

Maintenance Cycle	Jobs Nationally		Jobs Per State (50 States)	
	Total IG-POD Units Per Year	Total Jobs Daily	Total IG-POD Units Per Year	Total Jobs Daily
Jobs/1 Yr	3.5 million	13,725	70,000	275
Jobs/2 Yrs	7 million	27,451	140,000	549
Jobs/3 Yrs	10.5 million	41,176	210,000	824
Jobs/4 Yrs	14 million	54,902	280,000	1,098
Job/5 Yrs	17.5 million	68,627	350,000	1,373

Conclusion

The 5 year IG-POD program can reduce human death and the impact on the U.S. economy during power outages. Unprecedentedly, the IG-POD program will generate over 48 million of jobs nationally for blue collar and low skilled workers and significantly increase manufacturing production of new equipment, repair parts and products to build the IG-POD equipment will substantially increase the U.S. Gross Domestic Product (GDP). The key factor to the success of the IG-POD program will require swift and full bipartisan approval to save lives and to grow the American economy.

Compared to previous U.S Presidents, the next President in 2017 will achieve the highest job performance rating in history.

Table 19
Jobs by U.S. President[19]

	United States Presidents				
Jobs Created	**Regan**	**Clinton**	**Bush**	**Obama**	**2017 TBD**
	12.6 million	21 million	5.7 million	9.3 million	42+ million

[20]Long, H, (2016, January 13), Did President Obama really create 14 million jobs?, Retrieved from , http://money.cnn.com/2016/01/13/news/economy/obama-jobs-state-of-the-union/

References

Brewer, J, (2012, July 24), *US death toll rises from heat wave and power outages*, Retrieved from https://www.wsws.org/en/articles/2012/07/heat-j04.html

Congressional Budget Office, (2015, February, 20), *Estimated Impact of the American Recovery and Reinvestment Act on Employment and Economic Output in 2014*, Retrieved from https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/49958-ARRA.pdf

Eaton's Blackout Tracker Annual Report , (2015)*Eaton's Blackout Tracker Annual Report for 2015*, Retrieved from http://electricalsector.eaton.com/forms/BlackoutTrackerAnnualReport

GE Appliances, (2011, January 3), *What is AMI?*, Retrieved from http://geappliance.esecurecare.net/app/answers/detail/a_id/20/related/1/session/L2F2LzEvdGltZS8xNDYxMDAyNTg1L3NpZC81OHJueWxPbQ%3D%3D

In Wikipedia, *Mid-Atlantic and Midwest derecho, July 4, 2012*, (n.d.), Retrieved April 1, 2016, from https://en.wikipedia.org/wiki/June_2012_North_American_derecho

Long, H, (2016, January 13), *Did President Obama really create 14 million jobs?*, Retrieved from , http://money.cnn.com/2016/01/13/news/economy/obama-jobs-state-of-the-union/

Microgrid Institute, (2014), *About Microgrids*, Retrieved from http://www.microgridinstitute.org/about-microgrids.html

Microgrid Knowledge.com, (2016, February 29), *Federal Support Promotes Microgrid Technology: Pew Report*, Retrieved from http://microgridknowledge.com/microgrid-technology-pew/

Microgrid Media, (2015), *5 Unstoppable Drivers Of Microgrid Growth in 2016*, Retrieved from http://microgridmedia.com/5-unstoppable-drivers-of-microgrid-growth-in-2016/

Technavio, (2012), *Residential Portable Generator Market In The US 2012-2016*, Retrieved from http://www.researchbeam.com/residential-portable-generator-in-the-us-2012-2016-market

Tita, B, (2012, November 6), *A Sales Surge for Generator Maker*, Retrieved from http://www.wsj.com/articles/SB10001424127887324894104578103334072599870

U.S. Census Bureau, (2016) Census of Housing, Housing and Household Economic Statistics Division, *Historical Census of Housing Tables 2000 Single-family Detached Homes*, Retrieved from https://www.census.gov/hhes/www/housing/census/historic/units.html

U.S. Department of Energy, (2016), Energy Information Administration and Energy Efficiency & Renewable Energy, *Fuel Rates*, Retrieved from https://www.eia.gov/

U.S. Department of Energy, (2016), Energy Information Administration and Energy Efficiency & Renewable Energy, *How much carbon dioxide is produced when different fuels are burned?*, Retrieved from https://www.eia.gov/tools/faqs/faq.cfm?id=73&t=11

U.S. Department of Energy, Office of Energy's Office of Electricity Delivery and Energy Reliability (OE), (2016), *Recovery Act Smart Grid Programs*, Retrieved from https://www.smartgrid.gov/recovery_act/index.html

U.S. Department of Energy, Office of Energy's Office of Electricity Delivery and Energy Reliability (OE), (2016), *DOE Smart Grid Computational Tool Users Guide 2.0*, Retrieved from https://www.smartgrid.gov/files/US_DOE_Smart_Grid_Computational_Tool_User_Guide_Version_2.0.pdf

U.S. Department of Labor, (2016), *May 2015 National Industry-Specific Occupational Employment and Wage Estimates*, Retrieved from http://www.bls.gov/oes/current/naics4_237100.htm

U.S. National Average Sales Tax Rate, Sift Media, Accountingweb.com, (2016, August 4), *US Average Combined Sales Tax Rate Down Slightly in Q2*, Retrieved from http://www.accountingweb.com/tax/sales-tax/us-average-combined-sales-tax-rate-down-slightly-in-q2

U.S. Publishing Office, (2016), *Executive Order No. 13653, 78 Fed. Reg. 215* (2013, November 1), Retrieved from http://www.gpo.gov/fdsys/pkg/FR-2013-11-06/pdf/2013-26785.pdf

Appendix A

IG-POD Data and Analysis

The IG-POD man power and cost projections are based on 70 million U.S. residential detached homes and the assumption that it will require 3 full-time employees (FTE) to install one IG-POD per day in an eight hour day. The assumptions include; 1 certified electrician, 1 installer helper and 1 certified gas installer/plumber as defined in the U.S. Department of Labor (See Table 11). The median hourly wage plus a standard estimate rate of 25% for employer overhead cost and 25% profit, which is negotiable and only for the purposes of this cost example. Actual cost will vary and will be determined by the performing utility entity installing the IG-POD equipment in accordance with proposed future Federal Recovery guidelines.

Table 11
IG-POD Labor Types[18]

Occupation Code	Occupation Title	Median Hourly Wage
47-2111	Electricians	$28.17
49-9098	Helpers--Installation, Maintenance, and Repair Workers	$13.60
47-2152	Plumbers, Pipefitters, and Steamfitters	$23.63
	Total Labor Per Hour	$65.40
	Overhead (25%)	$16.35
	Profit (25%)	$20.44
	Total Labor Cost Per Hour (3 Man-Crew)	$102.19
	3 Man-Crew (8 Hrs.) per/ID-POD Unit	$817.50

[18]Department of Labor, May 2015 National Industry-Specific Occupational Employment and Wage Estimates, http://www.bls.gov/oes/current/naics4_237100.htm

The next step was to determine the number of work days per year. Taking the normal 365 days per year and deducting weekend days and allowing 6 holidays equals 255 work days per year. The 255 work days was used in Table 6 (from page 18) below to determine the number of IG-POD's installed per day per State for each year.

Table 6
IG-POD Program Cycle – New Jobs

Program Cycle	Jobs Nationally		Jobs Per State (50 States)	
	Total Jobs Per Yr.	Total Jobs Daily	Total Jobs Per Yr.	Total Jobs* Daily
Units/1 Yr	210 million	823,529	4.2 million	16,471
Units/2 Yrs	105 million	411,765	2.1 million	8,235
Units/3 Yrs	70 million	274,510	1.4 million	5,490
Units/4 Yrs	52.5 million	205,882	1 million	4,118
Units/5 Yrs	42 million	164,706	840,000	3,294

* Note: Total Jobs Per Yr. divided by 255 work days

In Table 12 below shows the cost associated with each residential electrical panel size with a typical 22 kW generator needed for a 100 AMP panel. For the purposes of this analysis, the 200 AMP (Ampere) panel cost data was used to calculate the IG-POD cost. The electrical panel cost was determined by taking the average retail cost ($4,799) of a whole house 22 kW generator and using 45% of that cost to estimate a wholesale volume manufacturing price.

Table 12
IG-POD Sizing and Pricing**

Panel Size	100-AMP	150-AMP	200-AMP*	400-AMP
Cost (Wholesale):	$1,000	$1,500	$2,200	$3,000
Sales Tax (8.454%)[16]:	$84.54	$126.81	$185.99	$253.62
Labor Cost:	$817.50	$817.50	$817.50	$817.50
Total IG-POD Cost:	$1,902.04	$2,44.31	$3,203.49	$4,071.12

* Note: Average Residential Panel Size **Note: Does not include wage income tax.

[16] U.S. National Average Sales Tax Rate, Sift Media, Accountingweb.com, (2016, August 4), US Average Combined Sales Tax Rate Down Slightly in Q2, http://www.accountingweb.com/tax/sales-tax/us-average-combined-sales-tax-rate-down-slightly-in-q2

In Table 13 below shows the Tax revenue generated by the sale of 70 million generators. The estimate is based on the percentage of residential AMP panel sizes multiplied by the percentage residential homes multiplied by wholesale pricing and then multiplied by the national average sales tax rate.

Table 13
IG-POD Sizing

Panel Size	100-AMP	150-AMP	200-AMP*	400-AMP
Cost (Wholesale):	$1,000	$1,500	$2,200	$3,000
% Residential Market:	20%	20%	50%	10%
% of Residential Homes:	14,000,000	14,000,000	35,000,000	7,000,000
Sales Tax (8.454%):	$1,183,560,000	$1,775,340,000	$6,509,580,000	$1,775,340,000
Total Tax Revenue:	$11,243,820,000			
Tax Revenue /Yr. (5 Yr Program):	$2,248,764,000			

In Table 14 below shows the added benefit of the IG-POD program with ability to provide 1,500 gigawatts per hour (GWh) to the electrical grid nationally based on a 22kW generator. The residential IG-POD program through Smart-Meter technology can provide utility companies load shedding opportunities.

Table 14
IG-POD Electrical Load Shedding Availability

70 Million IG-PODs	Kilowatt-hour	Megawatt-hour	Gigawatt-hour
22 kW:	1.54 billion	1.54 million	1.54 thousand

One kilowatt (kW) equals 1,000 watts, and one kilowatt-hour (kWh) is one hour of using electricity at a rate of 1,000 watts. One megawatt (MW) = 1,000 kilowatts = 1,000,000 watts. One gigawatts (GW) = 1,000 megawatts = 1 billion watts.

IG-POD Maintenance

The following tables below provides the details to the number of jobs created, annual labor cost, annual manufacturing revenue and annual Sales tax nationally.

Table 15 below from page 21 show the number daily jobs nationally and per State.

Table 15
IG-POD Maintenance Jobs

Maintenance Cycle	Jobs Nationally		Jobs Per State (50 States)	
	Total IG-POD Units Per Year	Total Jobs Daily	Total IG-POD Units Per Year	Total Jobs Daily
Jobs/1 Yr	3.5 million	13,725	70,000	275
Jobs/2 Yrs	7 million	27,451	140,000	549
Jobs/3 Yrs	10.5 million	41,176	210,000	824
Jobs/4 Yrs	14 million	54,902	280,000	1,098
Job/5 Yrs	17.5 million	68,627	350,000	1,373

In Table 16 below shows the cost for the job position to maintain IG-POD's annually.

Table 16
IG-POD Maintenance Labor Cost

Occupation[18] Code	Occupation Title	Median Hourly Wage	Maintenance Parts		Total Cost Per Year
49-9099	Maintenance and Repair	$18.49	$12.00	**Parts**	
	Overhead (25%)	$4.62	$1.01	**Tax**	
	Profit (25%)	$1.16	$13.01	**Total Cost**	
	Four IG-PODs Serviced Per/Day (8 hrs, 1 man crew)	$97.07	$24.27	**$ Per Unit**	
IG-POD Annual 3% Escalation (Labor & Parts)/Unit			**Parts**	**Tax**	
	Year 1 Cost Per IG-POD Unit	$24.27	$12.00	$1.01	$37.28
	Year 2 Cost Per IG-POD Unit	$29.76	$12.36	$1.04	$43.16
	Year 3 Cost Per IG-POD Unit	$30.65	$12.73	$1.08	$44.46
	Year 4 Cost Per IG-POD Unit	$31.57	$13.11	$1.11	$45.79
	Year 5 Cost Per IG-POD Unit	$32.52	$13.51	$1.14	$47.16

[18]Department of Labor, May 2015 National Industry-Specific Occupational Employment and Wage Estimates, http://www.bls.gov/oes/current/naics4_237100.htm

In Table 17 shows the labor and parts cost to maintain the IG-POD units annually with a 3% cost escalation factored (See Table 16 above) in the second year the units are installed. This work is performed by the electrical utility company. This does not include any labor for gas service technicians because gas companies typically do not perform maintenance on gas lines.

Table 17
IG-POD Annual Maintenance Cost

Maintenance Cycle	Jobs Nationally		Jobs Per State (50 States)	
	Total IG-POD Units Per Year	Total Annual Cost	Total IG-POD Units Per Year	Total Annual Cost
Units/1 Yr	14 million	$522 million	280 thousand	$10 million
Units/2 Yrs	28 million	$1 billion	560 thousand	$21.5 million
Units /3 Yrs	42 million	$1.6 billion	840 thousand	$33.2 million
Units /4 Yrs	56 million	$2.3 billion	1,1 million	$45.6 million
Units /5 Yrs	70 million	$2.9 billion	1.4 million	$58.7 million

In Table 18 below the estimated manufacturing revenue and Sales tax revenue generated annually from maintaining the IG-POD equipment.

Table 18
IG-POD Maintenance Miscellaneous

Revenue Year	Total IG-POD Units Serviced	Nationally Revenue		State Revenue (50 States)	
		Annual Manufacturing Parts Revenue	Annual Sales Tax Revenue	Annual Manufacturing Parts Revenue	Annual Sales Tax Revenue
Year 1	14 million	$168 million	$14 million	$3.4 million	$284 thousand
Year 2	28 million	$346 million	$29 million	$6.9 million	$585 thousand
Year 3	42 million	$535 million	$45 million	$10.7 million	$904 thousand
Year 4	56 million	$734 million	$62 million	$14.7 million	$1.2 million
Year 5	70 million	$945 million	$80 million	$18.9 million	$1.6 million

Appendix B

Glossary

advanced metering infrastructure

Is an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utility companies and customers.

alternating current

Alternating Current (AC) is a type of electrical current, in which the direction of the flow of electrons switches back and forth at regular intervals or cycles. Current flowing in power lines and normal household electricity that comes from a wall outlet is alternating current. The standard current used in the U.S. is 60 cycles per second (i.e. a frequency of 60 Hz).

American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act of 2009 (ARRA) (Pub.L. 111–5), commonly referred to as the Stimulus or The Recovery Act, was a stimulus package enacted by the 111th United States Congress in February 2009 and signed into law on February 17, 2009, by President Barack Obama.

billion

The number equivalent to the product of a thousand and a million; 1,000,000,000 or 10^9.

British thermal units

The British thermal unit (BTU or Btu) is a traditional unit of work equal to about 1055 joules. It is the amount of work needed to raise the temperature of one pound of water by one degree Fahrenheit (Physical analogue: one four-inch wooden kitchen match consumed completely generates approximately 1 BTU).

carbon dioxide

A colorless, odorless gas produced by burning carbon and organic compounds and by respiration. It is naturally present in air (about 0.03 percent) and is absorbed by plants in photosynthesis.

cubic feet

To calculate the volume of a given item or space in cubic feet, measure the length, width and height in feet and multiply the results together. For example, a storage unit 10 ft long, 6 ft wide and 8 ft high could be described as having a capacity of 480 cubic feet (10 x 6 x 8 = 480).

Department of Energy

The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions.

derecho

A **derecho** (pronounced similar to "deh-REY-cho" in English, or pronounced phonetically as " ") is a widespread, long-lived wind storm. **Derechos** are associated with bands of rapidly moving showers or thunderstorms variously known as bow echoes, squall lines, or quasi-linear convective systems.

direct current

Direct current (DC) is electrical current which flows consistently in one direction. The current that flows in a flashlight or another appliance running on batteries is direct current.

distributed energy resources

Distributed energy resources (DER) are smaller power **sources** that can be aggregated to provide power necessary to meet regular demand. As the electricity grid continues to modernize, DER such as storage and advanced renewable technologies can help facilitate the transition to a smarter grid.

electrical grid

An electric grid is a network of synchronized power providers and consumers that are connected by transmission and distribution lines and operated by one or more control centers. When most people talk about the power "grid," they're referring to the transmission system for electricity

electrical power companies

An electric utility is a company in the electric power industry (often a public utility) that engages in electricity generation and distribution of electricity for sale generally in a regulated market.

Federal guideline

The Code of Federal Regulations (CFR) is the codification of the general and permanent rules and regulations (sometimes called administrative law) published in the Federal Register by the executive departments and agencies of the federal government of the United States.

gigawatt hours

Gigawatts abbreviated as GWh, is a unit of energy representing one billion (1,000 000,000) watt hours and is equivalent to one million kilowatt hours.

inverter generator

An inverter generator is state-of-the-art technology combining monitoring and protection against ground faults on outlets and equipment and the generator engine will only operate at the rpm speed needed to power the load you require.

kilowatt

A measure of 1,000 watts of electrical power.

kilowatt hour

The symbol kWh, kW h, or kW h is a derived unit of energy equal to 3.6 mega joules. If the energy is being transmitted or used at a constant rate (power) over a period of time, the total energy in kilowatt-hours is the product of the power in kilowatts and the time in hours.

liquefied petroleum

Liquefied petroleum gas or liquid petroleum gas (LPG or LP gas), also referred to as simply propane or butane, are flammable mixtures of hydrocarbon gases used as fuel in heating appliances, cooking equipment, and vehicles

load shedding

The deliberate shutdown of electric power in a part or parts of a power-distribution system, generally to prevent the failure of the entire system when the demand strains the capacity of the system.

megawatts

One **megawatt** (MW) = 1,000 kilowatts = 1,000,000 watts. For example, a typical coal plant is about 600 MW in size. Gigawatts measure the capacity of large power plants or of many plants.

megawatt hour

Is equal to 1,000 Kilowatt **hours** (KWh). It is equal to 1,000 kilowatts of electricity used continuously for one **hour**.

meter

An electricity meter, electric meter, electrical meter, or energy meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device.

microgrid

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

million

The number equivalent to the product of a thousand and a thousand; 1,000,000 or 10^6.

million cubic feet

MCF is an abbreviation denoting a thousand cubic feet of natural gas. A natural gas well that produces 400 Mcf of gas per day operates with a daily production rate of 400,000. A single Mcf is equal to approximately 1,000,000 Btu (British thermal units) of energy. The "M" in MCF comes from the ancient Roman letter M, which stood for one thousand. One million cubic feet is instead denoted as MMcf.

Office of Electricity Delivery and Energy Reliability

The Office of Electricity Delivery and Energy Reliability (OE) provides national leadership to ensure that the Nation's energy delivery system is secure, resilient and reliable. OE works to develop new technologies to improve the infrastructure that brings electricity into our homes, offices, and factories, and the federal and state electricity policies and programs that shape electricity system planning and market operations. OE also works to bolster the resiliency of the electric grid and assists with restoration when major energy supply interruptions occur.

point of delivery

A location that a residential inverter generator takes over automatically from a failed utility distribution system connection.

Smart Grid Investment Grant

The Smart Grid Investment Grant (SGIG) program aimed to accelerate the modernization of the nation's electric transmission and distribution systems

Smart Grid Demonstration

Smart grid demonstration project initiative will conduct several regional demonstrations and supporting research focusing on smart grid activities related to integration of Distributed Energy Resources.

Smart-Meter

A smart meter is an electronic device that records consumption of electric energy in intervals of an hour or less and communicates that information at least daily back to the utility for monitoring and billing.

National Oceanic and Atmospheric Administration

Administration is an American scientific agency within the United States Department of Commerce focused on the conditions of the oceans and the atmosphere.

Appendix C

Acronyms

Acronym	Definition
IG-POD	Inverter Generator Point of Delivery
U.S.	United States
kW	Kilowatt
kWh	kilowatt hour
MW	Megawatts
MWh	megawatt hour
GW	Gigawatt
GWh	Gigawatt hours
DOE	Department of Energy
OE	Office of Electricity Delivery and Energy Reliability
ARRA	American Recovery and Reinvestment Act
SGIG	Smart Grid Investment Grant
SGD	Smart Grid Demonstration
DER	Distributed Energy Resources
AC	Alternating Current
DC	Direct Current
LP	Liquefied petroleum
Mcf	Million cubic feet
cf	Cubic feet
NOAA	National Oceanic and Atmospheric Administration
DC	District of Columbia
CO2	Carbon Dioxide
Btu	British Thermal Units
AMI	Advanced Metering Infrastructure
EPC	Electrical Power Company
GSC	Gas Supply Company
CAGR	Compound Annual Growth Rate

About the Author

Independent Management Professional for the past 10 years with 40 years of experience managing over $7 billion in construction and IT projects for both the Federal Government and Commercial organizations and is a well-known author, consultant, and authority on the subjects of Construction Management (CM), Project Management Office (PMO), Project Management (PM), Facility Management (FM), Building Operations & Maintenance (BOM), Business Process Management (BPM), Risk Management (RM), Human Resources Management (HRM), and Leadership.

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