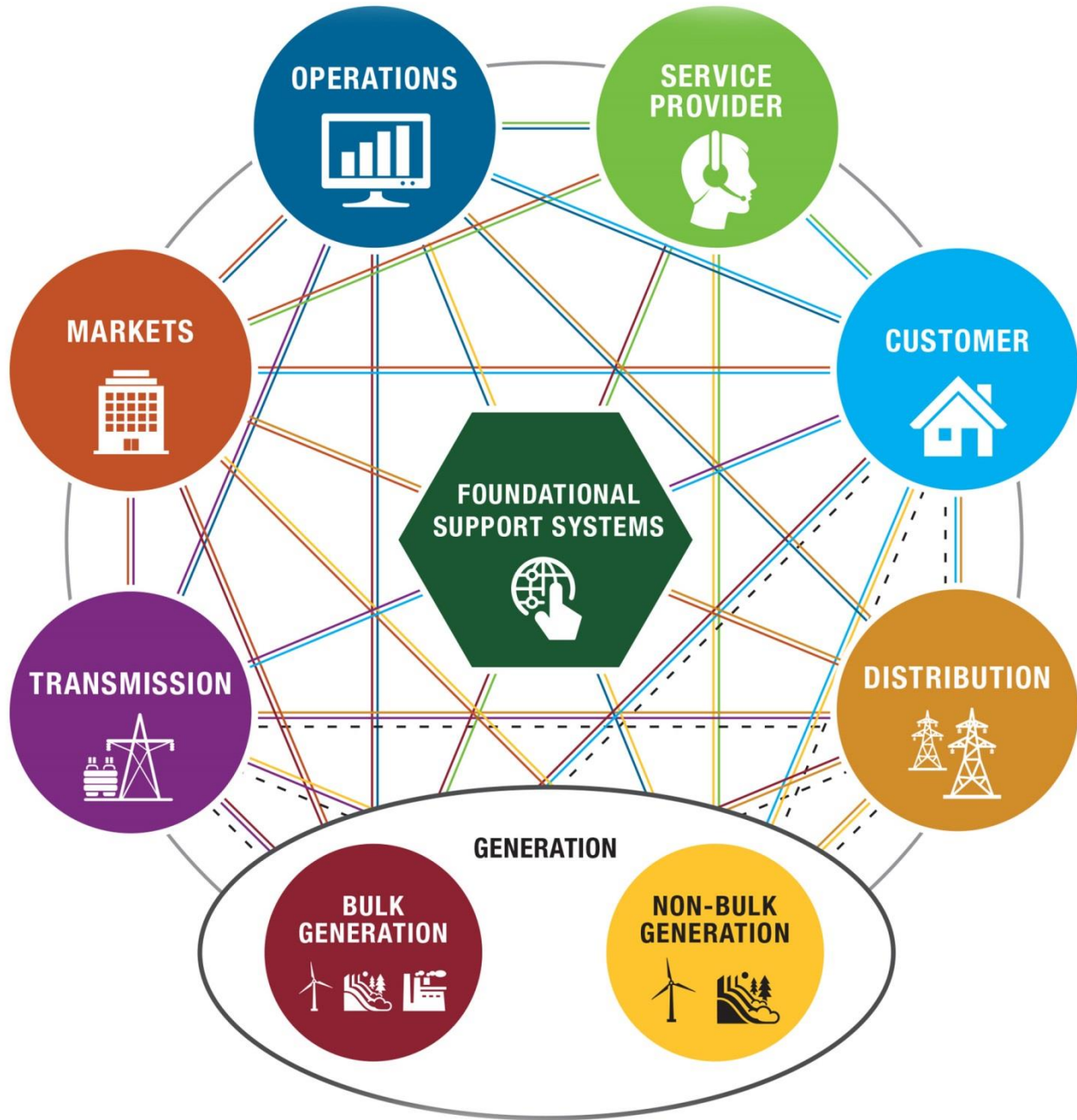


IEEE Smart Grid 2015 Annual Report



© IEEE 2016 The Institute of Electrical and Electronic Engineers, Inc.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For more information, please contact Angelique Rajske Parashis at a.rajski@ieee.org or visit us at smartgrid.ieee.org.

1. EXECUTIVE SUMMARY

2015 marks a year of many firsts and great developments within the IEEE Smart Grid Initiative. In its sophomore year as a graduated initiative, IEEE Smart Grid has really made its mark as a growing technical community. Some successes have included doubling its global reach, developing content from world renowned experts, and collaborating among members from 14 societies. Most importantly, IEEE Smart Grid's developments have set the stage for the future and what it means for us all.

We would like to acknowledge the committed work of the IEEE Smart Grid Committee members from across our 14 partner societies for their involvement and active participation. Those societies and organizational units include:

1. IEEE Communications Society
2. IEEE Computer Society
3. IEEE Control Systems Society
4. IEEE Dielectrics and Electrical Insulation Society
5. IEEE Industrial Applications Society
6. IEEE Industry Electronics Society
7. IEEE Instrumentation & Measurement Society
8. IEEE Power Electronics Society
9. IEEE Power & Energy Society
10. IEEE Reliability Society
11. IEEE Signal Processing Society
12. IEEE Standards Association
13. IEEE Systems, Man, and Cybernetics Society
14. IEEE Vehicular Technology Society

We would also like to acknowledge and thank our Committee Chairs for their leadership and service in 2015 including: Hossein Pakravan of the IEEE Smart Grid Marketing Committee, Dr. Ebrahim Vaahedi of the IEEE Smart Grid Publications Committee, Peter Wung and Mani Venkata of the IEEE Smart Grid Research & Development Committee, Steven Collier of the IEEE Smart Grid Education Committee, Joseph Paladino and Veronika Rabl of the IEEE Smart Grid Policy Technical Support Committee, and Mark Halpin and Stefano Galli of the IEEE Smart Grid Technical Activities Committee.

A special thanks also goes out to Patrick Ryan, Executive Director of the IEEE Power & Energy Society for his guidance and support.

2. METRICS AND ACCOMPLISHMENTS

IEEE Smart Grid has made great strides in its sophomore year as a Technical Community of IEEE. The Collaborative has grown to include 14 partner organizational units, surpassed 86,000 members via seven marketing channels, while at the same time, addressing the most critical issues facing the Grid.

As the second largest Technical Community of IEEE with more than 8,100 members, IEEE Smart Grid is the largest smart grid related Group on LinkedIn with more than 30,000 members, more than 13,000 followers on Twitter, nearly 17,000 newsletter subscribers, nearly 9,000 viewers on FlipBoard, and more than 7,000 regular webinar attendees. Our newest social media channel is Facebook, started mid-year, with more than 700 members.

Some of the hottest topics in 2015 included:

- Big data analytics
- Cyber security of the smart grid
- Rural electrification, micro-grids and renewables
- Global approach to an integrated and smarter grid

One challenge that the IEEE Smart Grid Committee faced early on for practically all of its activities was how to establish different areas of smart grid. This categorization would allow the smart grid contributions and activities to be combined into specific areas for better understanding of the activities and their correlations.

In the past decade, smart grid has evolved into many areas. While the progress has been exciting to watch, it is also creating confusion for the professionals and researchers that need to keep up to date with the progression and adaptation. IEEE Smart Grid Committee recognized the need for an approach to bring discipline in categorizing different areas and initiatives of smart grid. The motivation for this categorization for those interested in smart grid was to get a broader view of smart grid in terms of understanding and training in different subject areas as well as continuing research and adapting to industry applications.

In 2015, IEEE Smart Grid also took a broader scope approach of how we all understand the Grid. As such, our members created the [IEEE Smart Grid Domains and Sub-Domains](#). The idea behind the development of the IEEE Smart Grid Domains & Sub-Domains was to establish a categorization that would allow smart grid contributions and activities to be combined into specific areas for better understanding of the activities and their correlations.

To organize Smart Grid categories in a disciplined way, the [Committee started with the Conceptual Framework 3.0 published by the National Institute of Standards and Technology \(NIST\)](#) providing different domains in the energy industry. The NIST Smart Grid Framework 3.0 is based on the major processes which get executed when conducting the day to day businesses within the energy industry. The IEEE Smart Grid Committee used this diagram as a reference document, but it needed to expand it to cover all the important areas of the Smart Grid.

As such, the following enhancements were made:

1. The generation domain was divided into bulk generation (conventional generation resources) and non-bulk generation (distributed energy resources)
2. Added a domain called “Foundational Support Systems” to cover all other areas which support the main domains
3. Developed sub-domains for each domain

The above additions created a methodical approach for organizing the Smart Grid into [32 sub-domains](#). Each of the 32 sub-domains have been further divided into focus areas covering most of the activities and projects within the Smart Grid arena. The idea behind the development of the IEEE Smart Grid Domains & Sub-Domains was how to establish a categorization that would allow Smart Grid contributions and activities to be combined into specific areas for better understanding of the activities and their correlations.

This first of its kind framework defines what smart grid is and organizes content that spans across numerous disciplines and aspects of smart grid in a coherent and disciplined way. The IEEE Smart Grid Domains and Sub-domains allow smart grid contributions and activities to be combined into specific

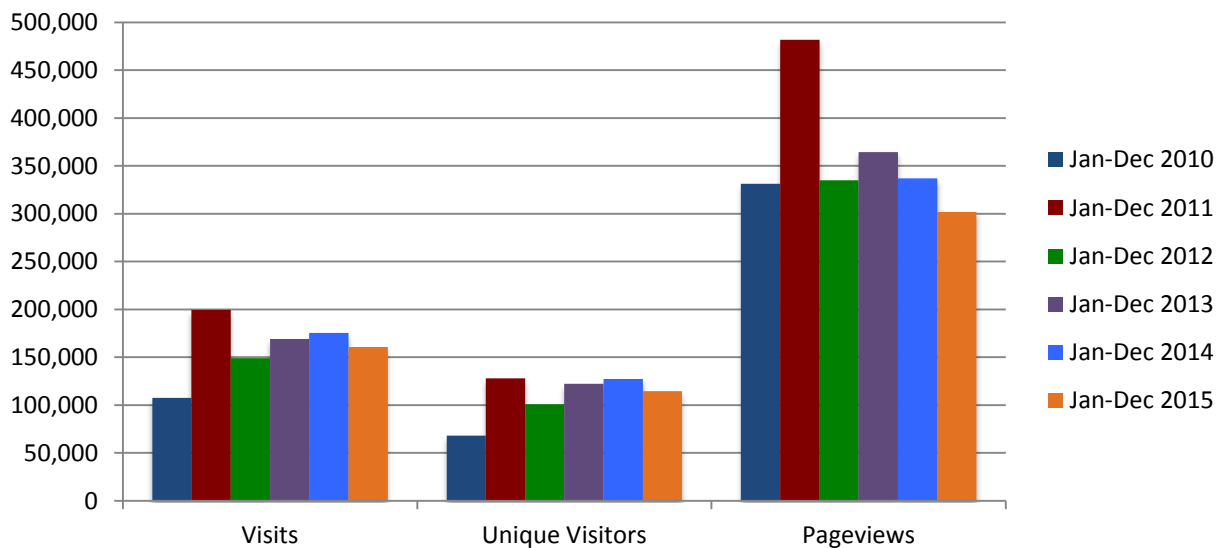
areas for better understanding of the activities and their correlations. This framework allows for future additions to capture the evolution of smart grid.

As a result, we were able to incorporate the Domains into our new portal, launched in September located at smartgrid.ieee.org, which features the Domains as an all-inclusive IEEE-wide search tool, as well as, incorporated it into the [IEEE Smart Grid Newsletter Compendium – IEEE Smart Grid: The Next Decade](#). The purpose of this Compendium is to distill knowledge in a disciplined way to those interested in obtaining a holistic understanding of the Smart Grid. To that end, this Compendium showcases the best of the IEEE Smart Grid Newsletter articles in different areas of IEEE Smart Grid Domains.

2.1 IEEE Smart Grid Basic Overview

IEEE Smart Grid’s website was re-designed and re-launched in September 2015. As a result, visitor and page view traffic dropped for several weeks as old pages were declassified and new pages were logged by Google Analytics. Prior to the re-launch, 2015 visitors were up 5.8% year over year. 2011 was the year that the IEEE Smart Grid Newsletter and Thought Leader Video series was launched, which attracted a large number of visits, many unique visitors, and many page views.

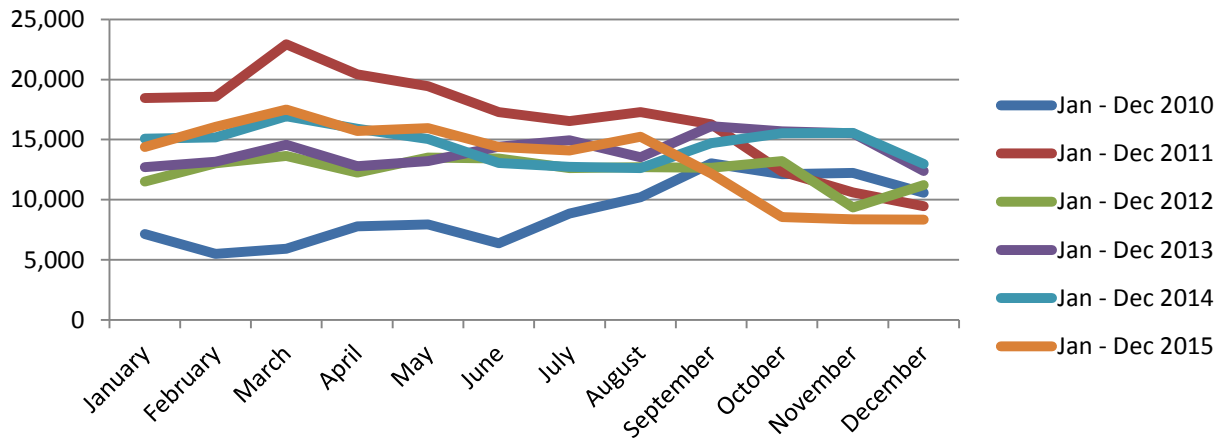
IEEE Smart Grid Basic Overview - Year over Year



2.2 IEEE Smart Grid Monthly Visitor Analysis

The average monthly visitors in 2015 was 13,399 whereas in 2014, the average monthly visitors was 14,611. Prior to the re-launch in September 2015, visitor numbers were ahead of all other years with the exception of 2011. The overall visitors were below in 2011, most likely due to the launch of the SG Newsletter and Thought Leader Video series in 2011 that attributed to rapid growth, the maturity and normalization of Smart Grid and its audience members, and the launch of new initiatives such as, IoT and Smart Cities.

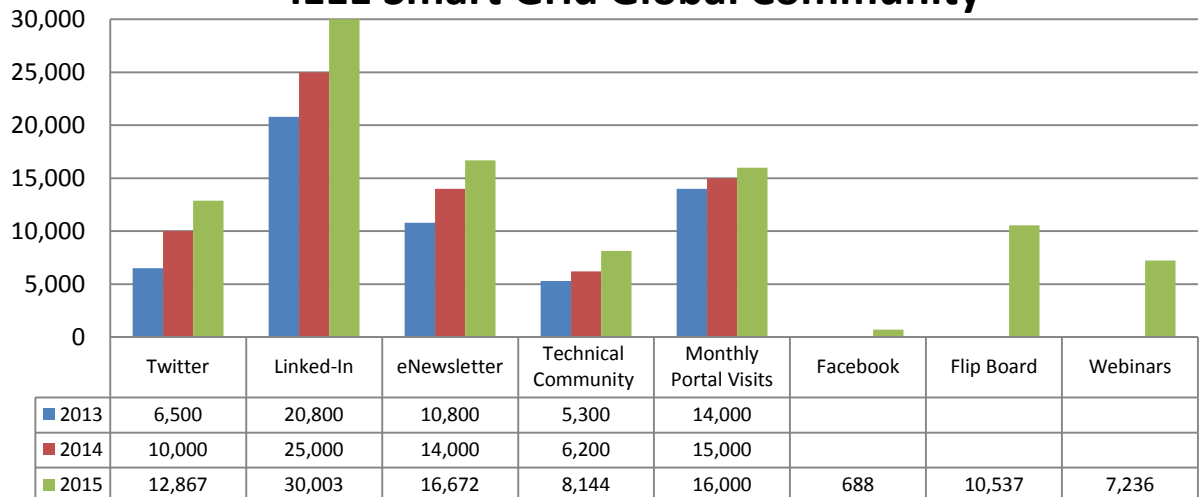
Monthly Visitor Analysis



2.3 IEEE Smart Grid Global Community

IEEE Smart Grid Global Community continues to increase year after year. IEEE Smart Grid has added Facebook, Flip Board and Webinars as new marketing channels in 2015. IEEE Smart Grid’s LinkedIn page is, also, the largest Smart Grid related page on LinkedIn.

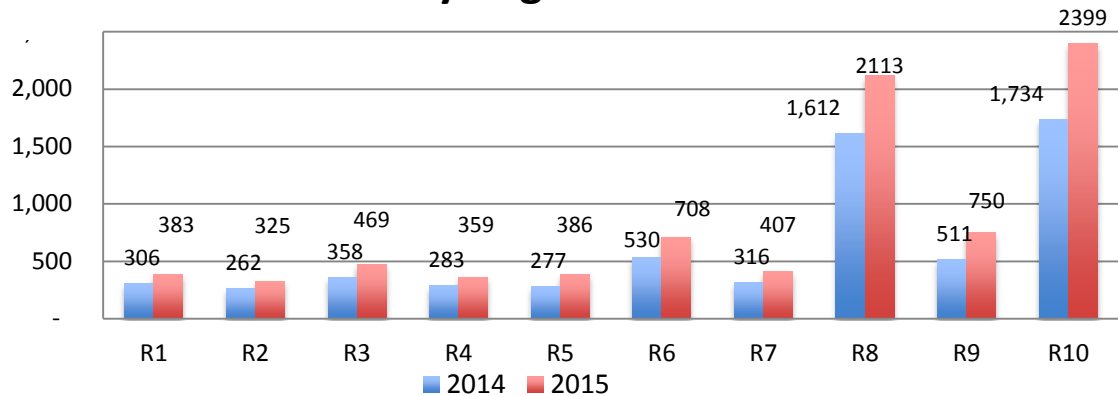
IEEE Smart Grid Global Community



2.4 IEEE Smart Grid Technical Community Members by Region

IEEE Smart Grid Technical Community has grown steadily over time and remains as the second largest Technical Community in IEEE. As of 12/31/14, IEEE Smart Grid Technical Community included 6,189 members and as of 12/31/15, IEEE Smart Grid Technical Community included 8,299 members.

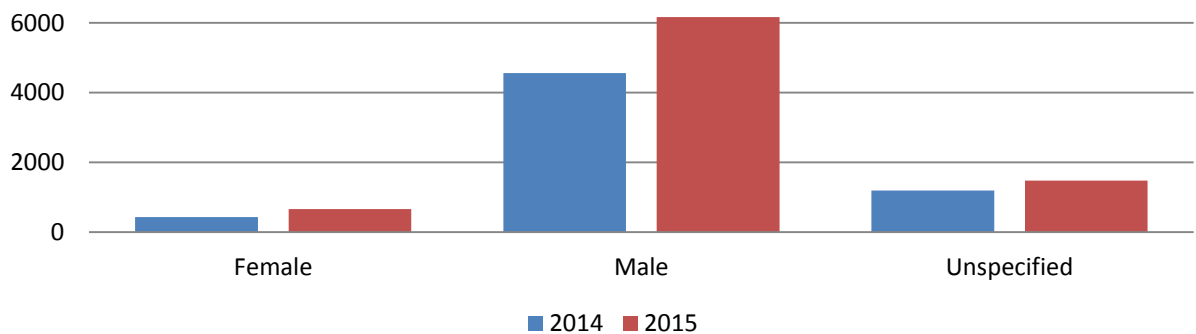
IEEE Smart Grid Technical Community Members by Region



2.5 IEEE Smart Grid Members by Gender

Gender is an optional question when joining the IEEE Smart Grid Technical Community. IEEE Smart Grid is currently working with Women in Power and Women in Engineering to increase its female membership.

Members by Gender



3. COMMITTEE REPORTS

3.1 IEEE Smart Grid Steering Committee

In 2015, the IEEE Smart Grid Steering Committee met on a quarterly basis, with four (4) meetings held. At the beginning of 2015, IEEE Smart Grid consisted of ten (10) partner organizational units. By year end, the IEEE Smart Grid Steering Committee obtained four (4) new Steering Committee Members including:

1. IEEE Industrial Electronics Society
2. IEEE Power Electronics Society
3. IEEE Systems, Man, and Cybernetics Society
4. IEEE Instrumentation & Measurement Society

In addition, the Committee confirmed, approved, and adopted its first IEEE Smart Grid Strategic and Implementation Plan on February 17, 2015.

3.2 IEEE Smart Grid Marketing Committee

In 2015, the IEEE Smart Grid Marketing Committee met on a bi-weekly basis, having met 24 times.

In summary, the Committee was able to develop strategies and ideas to increase the global community of IEEE Smart Grid from 55,058 at year end in 2014 to 86,147 at year end in 2015.

Below is a chart that shows the annual growth of the IEEE Smart Grid Community.

Marketing Channel	2013	2014	2015	2016 Goal
Facebook			639	2,000
Flip board			9,356	13,000
Linked In	20,800	24,695	29,566	35,000
Newsletter	10,800	13,769	16,672	20,000
Technical Community	5,300	5,970	8,064	11,000
Twitter	6,500	9,255	12,588	17,000
Webinar attendees			6,249	9,000
TOTAL	43,400	53,689	83,134	107,000

The Committee was also instrumental in the creation of the IEEE Smart Grid Domains & Sub-Domains, in collaboration with the IEEE Smart Grid Education and Publications Committees. As such, the 9 Domains will serve as a roadmap in helping to develop content in 2016 across all of the IEEE Smart Grid Committees.

In September 2015, the Marketing Committee proudly announced the launch of the new IEEE Smart Grid portal (smartgrid.ieee.org) with an interactive IEEE Smart Grid Domains & Subdomains framework and with more advanced and user-friendly search features.

Some of the new features include:

- A state-of-the-art all-inclusive and interactive IEEE-search tool of the IEEE Smart Grid Domains & Sub-domains. To activate its features, click on the "Domains" tab, select an IEEE Smart Grid Domain that activates a drop-down menu of IEEE Smart Grid Sub-Domains. Upon selecting a Sub-domain, visitors are prompted to content results related to the selected Sub-domain from three search engines, including the IEEE Smart Grid portal, all IEEE websites, and IEEE Xplore
- An "Announcements" section on the homepage will serve as a tool for the latest and most up to date information regarding IEEE Smart Grid
- Logos of the 14 Partner Societies of IEEE Smart Grid with a URL link to their respective websites
- An enhanced "About IEEE Smart Grid" page with the Initiative's Mission, Vision, Objectives, snapshot of its global community, descriptions of committees, and names of leadership and staff
- A consolidated list of all Smart Grid related future events, conferences, and webinars across IEEE in the "Events" tab
- A consolidated list of all IEEE Smart Grid related resources in the "Resources" tab, including news, webinars, research, standards, interviews, policy, and more!

3.3 IEEE Smart Grid R&D Committee

In 2015, the IEEE Smart Grid R&D Committee met on a monthly basis, having met 12 times.

By nature, the smart grid combines all the complex inter-relationships between state-of-the-art technologies, progressive national policies, and best business practices, forming a complex and interconnected entity that will benefit environment, the earth, and humanity. IEEE Smart Grid is thus charged with organizing and simplifying the complex interrelationships inherent in an undertaking as massive as the smart grid. IEEE Smart Grid R&D committee has been charged with the unique and challenging tasks, as defined succinctly by the purpose statement of the committee:

- Engage in identifying emerging pivotal R&D areas in the smart grid related domain and engage the broader IEEE societies in all pertinent areas for collaboration
- Support and collaborate with public/private enterprises to assess priority areas and disseminate smart grid and sustainable energy research and implementation strategies

Mindful of the constraints that are intrinsic to the task, the R&D committee approached this task without any preconceived notions. [The IEEE Smart Grid Domains & Sub-domains](#) have helped steer the research and development conversation within loose parameters. Nonetheless, as with many new fields of interests, our research efforts that will be generated through the normal evolution of the technical, policy, legislative, and economic processes will certainly not fit into the tightly defined bailiwicks now existing in the Domains, and may, indeed need to evolve to accurately describe the research and development landscape.

The first tasks that the R&D committee decided to pursue are: collect, collate, and catalog the ongoing research topics and to create a template for the cache of research topics in order to create a database structure which can be easily searched by a number of search criteria, from the following sources:

- IEEE Standards Association Vision 2030 documents that the IEEE had commissioned from the Power & Energy Society, Communications Society, Computer Society, Controls Systems Society, and Vehicular Technology Society
- Technical programs of conferences and publications
- Quadrennial Energy Report (QER) and the Quadrennial Technology Report (QTR)
- International smart grid related roadmaps, standards, and documents

The Committee is now focused on categorizing their findings of the future into the following framework:

- The domain, subdomain, and focus areas that categorizes each topic
- The organizational unit (society or societies) that has ownership of the topic
- An example of the topic
- The technologies that precede or enable that technology topic. (Upstream technology)
- The technologies whose existence is dependent upon the technology topic (Downstream technology)
- Keywords to be used with IEEE Xplore in the eventuality that the list of database will be used as a relational database which can be translated to a searchable web object

In the near term, the R&D committee is collecting, collating, and categorizing the topic areas and placing them into reasonable structures and order. Since this documentation is also a living object that evolves and changes as the landscape of the smart grid evolves and changes; in the long term, the R&D committee is also seeking and creating new research and development topics to keep pace of the smart grid as it grows before our eyes.

The R&D committee vision for this evolving body of knowledge is both ambitious and practical. All the information gathered must be categorized and links must be created to connect related topics and focus areas. The information must then be converted into a relational database that is designed to be once again, flexible to use and evolve, yet also precise and concise for easy manipulation and convenience. The design of this relational database is in the early stages and the R&D committee is looking for some help in this regard.

3.4 IEEE Smart Grid Education Committee

In 2015, the IEEE Smart Grid Education Committee met on a monthly basis, having met 12 times.

The Committee successfully developed the IEEE Smart Grid Educational Levels, which will be used to help define educational offerings developed by IEEE Smart Grid.

In addition, the IEEE Smart Grid Education Committee worked with the IEEE Smart Grid Marketing and Publications Committees in developing the IEEE Smart Grid Domains & Sub-Domains.

As such, in 2016, the Committee will work on building out the 2016 IEEE Smart Grid Webinar Series with two (2) webinars per month, each focused on a specific domain. All future webinars will be categorized under one of the Educational Levels established and defined by this Committee.

In 2014, 7 webinars were presented and in 2015, 12 were presented. The average number of registrants is 810 and the average number of attendees is 316. The goal for 2016 is to have 18-

24 webinars presented on different IEEE Smart Grid Domains and Sub-Domains. Below is a chart of the IEEE Smart Grid Webinar Series.

Date	Presenter	Title	Registrants	Attendees
1/29/2015	Roberto Saracco	<i>Smarter Citizens for Smarter Cities</i>	552	173
2/26/2015	Lee Stogner	<i>Electric Vehicles, the Smart Grid and the Internet of Things: How Everything will be Integrated in the Smart City of Tomorrow</i>	1019	350
3/26/2015	Imre Gyuk	<i>Energy Storage for a Greener and More Resilient Grid</i>	968	410
4/23/2015	Chris Irwin	<i>Application of a Transactive Energy Mechanism to Perform Ancillary Service</i>	597	210
5/21/2015	Lee Stogner	<i>Smart Cities - How we will Integrate the Smart Grid, Smart Transportation, Internet of Things with Smart People</i>	1500	525
6/18/2015	Frances Bell	<i>Internet of Things - Advanced Smart Inverters for Solar and Distributed Energy</i>	882	385
7/16/2015	Ben Kroposki	<i>Smart Grid Research at NREL's Energy Systems Integration Facility</i>	703	281
8/20/2015	Luis Ochoa	<i>Learnings from Large-Scale Smart Grid Trials in the UK: "CLASS" and "My Electric Avenue"</i>	571	300
9/24/2015	Peter Cappers	<i>Impacts of SGIG Consumer Behavior Studies of Time-Baked Rates on Customer Acceptance, Retention and Response</i>	360	130
10/15/2015	Josh Schellenberg	<i>Using Customer Reliability Benefits to Support Business Cases for Smart Grid Investments</i>	335	104
11/23/2015	Steven Collier	<i>IEEE Standards Enable a Reliable, Secure, Interoperable Smart Grid</i>	867	336
12/14/2015	Ali Ipekchi	<i>Distributed Energy Resources and Grid Modernization</i>	1368	537

3.5 IEEE Smart Grid Publications Committee

In 2015, the IEEE Smart Grid Publications Committee continued to publish the IEEE Smart Grid Newsletter on a monthly basis, with four (4) articles per month. By the end of 2015, the IEEE Smart Grid Newsletter has published 240 articles.

In addition, the IEEE Smart Grid Publications Committee worked with the IEEE Smart Grid Marketing and Education Committees in developing the IEEE Smart Grid Domains & Sub-Domains. Dr. Ebrahim Vaahedi and Hossein Pakravan took the lead in this effort, which now serves as the framework for IEEE Smart Grid content.

Lastly, the IEEE Smart Grid Publications Committee developed the [IEEE Smart Grid Newsletter Compendium "Smart Grid: The Next Decade"](#), the first of its kind promotional compilation featuring 32 "best of the best" insightful articles from recent issues of the [IEEE Smart Grid Newsletter](#); it will be the go-to resource for industry professionals for years to come.

3.6 IEEE Smart Grid Policy Technical Support Committee

The IEEE Smart Grid Policy Technical Support Committee is a newly developed committee in 2015, with the following scope and goals:

Scope

- Identify policy needs to help advance Smart Grid technology
- Provide a two-way link between Smart Grid technical committees and policy makers (including regulators, legislators, and government officials)

Goals

- Provide information and tools to policy makers to help explain and address policy implications on Smart Grid technology evolution
- Provide information and tools to policy makers to help convey Smart Grid applications and experience
- Develop and maintain information on policy makers' needs for Smart Grid functionality, along with responses from Smart Grid technical groups regarding issues and obstacles, if any, in providing such functionality
- Help stakeholders make informed decisions on grid modernization and understand how policy affects grid modernization
- Develop and maintain a list of desirable action items for policy makers to help accelerate smart grid implementation; policy implications will be developed in conjunction with IEEE-USA
- Produce webinars, whitepapers, reports, and newsletter articles, as appropriate

3.7 IEEE Smart Grid Standards Committee

The IEEE Smart Grid Standards Committee met on a monthly basis with three (3) meetings held in 2015. Due to a lack of engagement, the Committee was dissolved in December 2015. Portions of the Committee's goals have been incorporated into the newly developed IEEE Smart Grid Technical Activities Committee.

3.8 IEEE Smart Grid Meetings & Conferences Committee

In 2015, the IEEE Smart Grid Meetings & Conferences Committee membership was never fully formed due to lack of interest. One of the goals assigned to this committee was to keep track of and promote future IEEE sponsored Smart Grid related conferences. This work was done by the IEEE Smart Grid Marketing Committee.

In addition, it was agreed to by the Steering Committee that having a standing committee on Meeting & Conferences did not meet the needs of the Initiative. As such, the Committee was dissolved in December 2015. Portions of the Committee's goals have been incorporated by the IEEE Smart Grid Education Committee.

3.9 IEEE Smart Grid Technical Activities Committee

The IEEE Smart Grid Technical Activities Committee is a newly developed Committee approved by the IEEE Smart Grid Steering Committee in December 2015 with the following scope and goals.

Scope

- Focus on new technologies that are close to adoption and deployment
- Interact with Smart Grid stakeholders (IEEE and non-IEEE) on inter-disciplinary technical topics
- Closely collaborate with the IEEE Smart Grid R&D Committee on tracking technologies that are becoming mature from a research perspective

- Closely collaborate with IEEE-Standards Association (SA), absorbing the scope of the existing IEEE Smart Grid Standards Committee

Goals

(1) Technical Area

- Track technical development of new technologies that are close to adoption and deployment
- Interact with IEEE and non-IEEE stakeholders on inter-disciplinary technical topics
- Coordinate with the IEEE Future Directions Committee (FDC) on Smart Grid and inter-disciplinary initiatives, e.g. Internet of Things, Big Data, Cyber Security, etc.
- Work with IEEE Smart Grid R&D Committee to track the evolutionary changes in the Smart Grid as R&D approaches the implementation and deployment stage

(2) Standards Area

- Track the present standards to make sure they are current and up-to-date as far as the existing technologies are concerned
- Look ahead in the short term to prepare for the incremental evolution of the standards to keep track with the evolving Smart Grid reality
- Make contact with each Standards lead in each IEEE Organizational Unit
- Promote Smart Grid related standards
- Facilitate transition from R&D to standardization and commercialization
- Provide early guidelines for standard development as the R&D work is becoming mature
- Coordinate with the IEEE SA on necessary changes in existing standards, as well as, forecast future standard developments that may be necessary

4. 2016 GOALS

It is expected that smart grid continues its reach into many areas and fields. The smart grid model discussed here set the stage for properly categorizing the smart grid activities into Domains, Sub-Domains and Focus Areas or Initiatives. This categorization helps researchers and industry experts to follow the on-going work, progress research, and develop and increase the industry adoption.

In 2016, IEEE Smart Grid has scheduled the domains into specific months, where content development will be focused in the following order:

- January 2016: Storage
- February 2016: Distribution
- March 2016: Non-Bulk Generation
- April 2016: Operations
- May 2016: Transmission
- June 2016: Foundational Support Systems
- July 2016: Customer
- August 2016: Smart Grid in the Asia Pacific Region
- September 2016: Smart Grid in the European Region
- October 2016: Smart Grid Standards
- November 2016: Smart Grid in South America
- December 2016: Smart Grid Year in Review

In 2016, our functional areas committees will be focused on developing content in these areas with webinars, newsletter articles, interviews, white papers, and trainings. By taking this organized approach, IEEE Smart Grid will really be able to meet its end goal of being the go-to resource globally for all things smart grid related.