Smart Grid Information Clearinghouse (SGIC)

Final Report

For the Period: Sep 01, 2009 - Aug 31, 2014

(www.sgiclearinghouse.org)

U.S. Department of Energy Award Number: DE-OE0000031

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Submitted by:

Saifur Rahman, Principal Investigator

Virginia Tech

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Disclaimer

Executive Summary

Since the Energy Independence and Security Act of 2007 was enacted, there has been a large number of websites that discusses smart grid and relevant information, including those from government, academia, industry, private sector and regulatory. These websites collect information independently. Therefore, smart grid information was quite scattered and dispersed.

The objective of this work was to develop, populate, manage and maintain the public Smart Grid Information Clearinghouse (SGIC) web portal. The information in the SGIC website is comprehensive that includes smart grid information, research & development, demonstration projects, technical standards, costs & benefit analyses, business cases, legislation, policy & regulation, and other information on lesson learned and best practices. The content in the SGIC website is logically grouped to allow easily browse, search and sort. In addition to providing the browse and search feature, the SGIC web portal also allow users to share their smart grid information with others though our online content submission platform. The Clearinghouse web portal, therefore, serves as the first stop shop for smart grid information that collects smart grid information in a non-bias, non-promotional manner and can provide a missing link from information sources to end users and better serve users' needs. The web portal is available at www.sgiclearinghouse.org.

This report summarizes the work performed during the course of the project (September 2009 – August 2014). Section 2.0 lists SGIC Advisory Committee and User Group members. Section 3.0 discusses SGIC information architecture and web-based database application functionalities. Section 4.0 summarizes SGIC features and functionalities, including its search, browse and sort capabilities, web portal social networking, online content submission platform and security measures implemented. Section 5.0 discusses SGIC web portal contents, including smart grid 101, smart grid projects, deployment experience (i.e., use cases, lessons learned, cost-benefit analyses and business cases), in-depth information (i.e., standards, technology, cyber security, legislation, education and training and demand response), as well as international information. Section 6.0 summarizes SGIC statistics from the launch of the portal on July 07, 2010 to August 31, 2014. Section 7.0 summarizes publicly available information as a result of this work.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

This project was a cooperative effort among the IEEE Power & Energy Society, EnerNex Corporation and Virginia Tech to design, populate, manage and maintain a public Smart Grid Information Clearinghouse (SGIC) portal. Major contents in the SGIC web portal include:

- ***Smart grid 101*** – which gives background about smart grid in general
- ***Smart grid projects*** – which archives information about smart grid projects in the United States
- ***Deployment experience*** – which is captured under the following topics: use cases, lessons learned, cost-benefit analyses and business cases)
- **In-depth information** – which includes smart grid standards, technologies, cyber security, legislation, education and training and demand response)
- **International smart grid projects** – which archives information about international smart grid projects from countries like the European Union, China and a like.

The project was initiated on September 01, 2009 and lasted for five years. Overall, the SGIC web portal serves as the essential gateway that connects the smart grid community to relevant sources of information that are currently scattered and distributed in the worldwide web.

2.0 Advisory Committee and User Group

The SGIC Advisory Committee and User Group were initiated at the start of the project in September 2009. Names and affiliations of the SGIC Advisory Committee members and the SGIC User Group members are provided in Sections 2.1 and 2.2, respectively. The list of Advisory Committee/User Group meetings is given in Section 2.3.

2.1 SGIC Advisory Committee Members

The SGIC Advisory Committee comprised of 14 members representing government, stakeholders and industry associations, as shown in Table 1.

Table 1. Names and affiliations of SGIC Advisory Committee members

	Name	Affiliation
1	Stacy Angel	EPA - Environment Protection Agency
2	Cynthia Brumfield	UTC - Utilities Telecom Council
3	Dan Delurey	DRCC - Demand Response Coordinating Committee
4	Chris Eisenbrey	EEI - Edison Electric Institute
5	Katherine Hamilton	GridWise Alliance
6	Eric Hsieh	NEMA - National Electrical Manufacturers Association
7	Puesh Kumar	APPA - American Public Power Association
8	Eric Lightner	DOE - US Department of Energy

9	Robin Lunt	NARUC - National Association of Regulatory Utility Commissioners
10	Bob Saint	NRECA - National Rural Electric Cooperative Association (NRECA)
11	Lisa Schwartz	RAP - The Regulatory Assistance Project
12	Matt Wakefield	EPRI - Electric Power Research Institute
13	Sandra Waldstein	FERC - Federal Energy Regulatory Commission
14	David Wollman	NIST - National Institute of Standards and Technology

2.2 SGIC User Group Members

The SGIC User Group comprised 59 members from 45 organizations, as listed in Table 2.

Table 2. Names and affiliations of SGIC User Group members

	Stakeholder Group	Name	Affiliation
1	Research Organization	Keith McAllister	Solar Center, NC State
2		Mark Johnson	FREEDM Systems Center, NC State
3		Austin Montgomery	Software Engineering Inst., Carnegie Mellon University
4		Bob Reedy	Florida Solar Energy Center, University of Central Florida
5		Keith Gossage	National Grid
6		Frank Jakob	Battelle Memorial Institute
7		David Bachus	Battelle Memorial Institute
8		Mark Davis	Battelle Memorial Institute
9		Ryan Hledik	Battelle Memorial Institute
10		Doug Mitarotonda	Battelle Memorial Institute
11		Ahmad Faruqui	Brattle Group
12		Matt Wakefield	EPRI
13	Equipment Manufacturer	Tammy Zucco	ABB
14		Ron Smith	Aclara
15		Cameron Brook	Tendrill
16		David Mollerstuen	Tendrill
17	Prof & Trade Association	John Caskey	NEMA
18		Paul Molitor	NEMA
19		Paul Pietsch	DRCC
20		Joel Hoiland	Utilimetrics
21		Kelly Chrouser	Utilimetrics
22	Consumer Advocate	Stacia Harper	Ohio Consumers' Councel
23		Mark Toney	The Utility Reform Network (TURN)
24	Utility	Robert Frazier	CenterPoint Energy
25		Gene Jensen	AEP
26		Scott Osterholt	AEP
27		Mark Coleman	AEP
28		Paula Hughes	AEP
29		Randy Lowe	AEP
30		Scott Osterhold	AEP
31		Dan Rogier	AEP

32		Kevin Spainhour	Duke Energy
33		Bill Yingling	Pepco
34		Mark Godwin	Florida Power & Light
35		Phil Slack	Florida Power & LIght
36	Consulting Services	Roy Ellis	Capgemini
37		Michael Groomes	Capgemini
38		David Scott	Plexus
39		Jon Previtali	Sun Edison
40		Brett Francis	Fat Spaniel
41		Robert Wilhite	KEMA
42	Standards Organization	Allan Eustis	NIST
43	Regulator	Jason Christopher	FERC
44		David Kathan	FERC
45		Lisa Schwartz	Regulatory Assistance Project (RAP)
46		Richard Sedano	Regulatory Assistance Project (RAP)
47		Jessica Bian	NERC
48		Chris Haun	NJ Board of Public Utilities
49		Michael Worden	NY Dept of Public Service
50		Karin Hieta	CA PUC
51		Rebecca Tsai-Wei Lee	CA PUC
52	Federal/state legislator	Jeff DeRouen	Kentucky government
53		Jim Gardner	Kentucky government
54		Keith Hay	NCSL
55	Environmental Group	Paul Craig	Sierra Club
56	End User	Lan Tran	Tangible
57	Media	Brett Brune	Smart Grid Today
58		Peter Behr	Climate Wire
59		Vivian Kelly	Interprose Inc.

2.3 List of SGIC Meetings

The following table summarizes SGIC Advisory Committee and User Group meetings since the project inception in September, 2009.

Table 3. List of SGIC meetings

	Meetings	**Date**
1	Project Kick-off Meeting	Oct 07, 2009
2	1st Advisory Committee Meeting	Nov 07, 2009
3	1st User Group Meeting	Dec 07, 2009
4	2nd Advisory Committee Meeting	Mar 08, 2010
5	2nd User Group Meeting	Mar 15, 2010
6	3rd Advisory Committee Meeting	Jun 08, 2010
7	3rd User Group Meeting	Jun 15, 2010
8	4th Advisory Committee Meeting	Aug 31, 2010
9	4th User Group Meeting	Sep 02, 2010

3.0 SGIC Information Architecture and Web-based Database Application Functionalities

In this section, SGIC information architecture and web-based database application functionalities are discussed, including: the SGIC web portal content categories and its structure (Section 3.1); the Drupal content management system, which is used to support development of the SGIC web portal (Section 3.2); the SGIC information architecture (Section 3.3), and functionalities of the SGIC web portal (Section 3.4).

3.1 SGIC Content Categories and Content Organization

3.1.1) SGIC Content

The Clearinghouse's content reflects the top-ten items derived from the discussions among representatives from various smart grid stakeholder groups during the 2nd SGIC User Group meeting on March 15, 2010. The list of the top-ten items is shown in Fig. 1.

1. Smart Grid 101
2. Technologies
3. Standards
4. Cyber security issues
5. Legislations and regulations
6. Education, training, research
7. Smart grid projects
8. Business cases/use cases/cost-benefit analyses/best practices
9. International information
10. Additional resources

Fig. 1. Top-ten items that stakeholders would like to see on the Clearinghouse

3.1.2) SGIC Content Organization

The Clearinghouse sitemap shown in Table 4 was created based on the above top-ten list. The green numbers from (1) to (10) represent the top-ten items identified in Fig. 1.

- The landing page of the SGIC web portal contains the following information: contact us, smart grid stories (RSS), content submission, calendar, and frequently asked questions (FAQ).
- The top-ten items can be found in the following sections: Smart Grid 101, Projects, Deployment Experience, In-depth Information and International Information.
- There is also a special page called "MySGIC" (not shown in Table 4), which is discussed later in Section 4.4.

Table 4. SGIC site map

Landing page	Smart Grid 101	Projects	Deployment Experience	In-depth information	International Information
- Contact Us - Smart Grid stories - Content Submission - Calendar - FAQ	- Smart Grid 101 **(1)** - Acronyms & Glossary - Smart Grid Resources **(10)** - NIST Smart Grid Conceptual Model - Consumer Awareness Programs	- Map - ARRA - Others **(7)**	- Use cases - Lessons learned - Cost-benefit analyses - Business Cases - Performance Data **(8)**	- Cyber security **(4)** - Education **(6)** - Legislation & Regulation **(5)** - Standards **(3)** - Technologies **(2)**	- Map - Africa - Americas - Asia - Europe - Oceania **(9)**

3.2 SGIC and Drupal Content Management System

3.2.1) Key Drupal Modules Used

The SGIC web portal was implemented using Drupal Content Management System (CMS) to collect the smart grid related information identified above. Drupal is a free and open-source software package, distributed under the GPL (GNU General Public License), which allows web developers to efficiently populate, manage and organize a wide variety of information on a website. In addition to several built-in functionalities available in Drupal, there are also many available add-on modules that can be downloaded freely. The key Drupal modules used in the development of the Clearinghouse web portal are summarized in Table 5.

Table 5. Key Drupal modules used in the development of SGIC web portal

Drupal Modules Used	**Description**
Aggregator	Aggregate syndicated content (RSS feed)
Backup and Migrate	Backup or migrate the Drupal database
Content	Allow administrators to define new content types
Content Permission	Set field-level permissions for content fields
Favorite Nodes	Allow users to manage a favorite list of contents
Frequency Asked Questions	Manage configuration of questions for a FAQ page
GMap	Display location information on Google Maps
Google Analytics	Add Google Analytic javascript tracking code to all SGIC pages
Image	Allow uploading, resizing and viewing of images
Lightbox2	Overlay images/web page on the current page
Path	Allow administrators to rename URLs
Profile	Support configurable user profiles
Search	Enable site-wide keyword search
Site Map	Display a site map
Statistics	Log access statistics for the site
Views	Create customized lists and queries from the database

3.2.2) SGIC Role-based Permissions

With Drupal, different permissions can be assigned to different users. Permissions allow us to control what users can see or do in the SGIC web portal. In SGIC, the users are classified into two main categories: Anonymous Users and Authenticated Users.

- **Anonymous Users:** This category includes anyone who visits the SGIC web portal without registering their identity. An Anonymous Users can view the SGIC main pages and all subpages, use the search engine, including advanced search and filters, browse and view public-level SGIC contents, as well as access (view) the general public forums.

- **Authenticated Users:** A person can become an authenticated user by registering with SGIC, i.e., providing some required credentials. These include a username (or email), a password, a first/last name and an email address. Once registered, Anonymous Users became Authenticated Users. Authenticated Users can be further classified into four subcategories: General Public, Advisory/User Group, Web Manager and Admin Group.

    a) **General Public:** A person in the general public category, in addition to viewing public-level SGIC contents, can submit documents, multimedia, project information, and register smart grid-related products. They can also access MySGIC page to view their submission status, and add documents to their favorite, as well as posting comments in general public forums.

    b) **Advisory Committee/User Group:** A person in the Advisory Committee/User Group category, in addition to the abilities listed in above, can access special forums designed for SGIC Advisory Committee and User Group members.

    c) Web Manager: A SGIC web manager has the same privilege as an Advisory Committee/User Group member. In addition, the web manager can also create new content in the SGIC database and upload files to the SGIC web server.

    d) **Admin Group:** A SGIC admin group member at Virginia Tech has the same privilege associated with a SGIC web manager with root-level access to the web server and SGIC database. This permits such activities as installation, data back up and updating the site architecture and Drupal modules.

Fig. 2 depicts a pictorial representation of the SGIC role-based permissions.

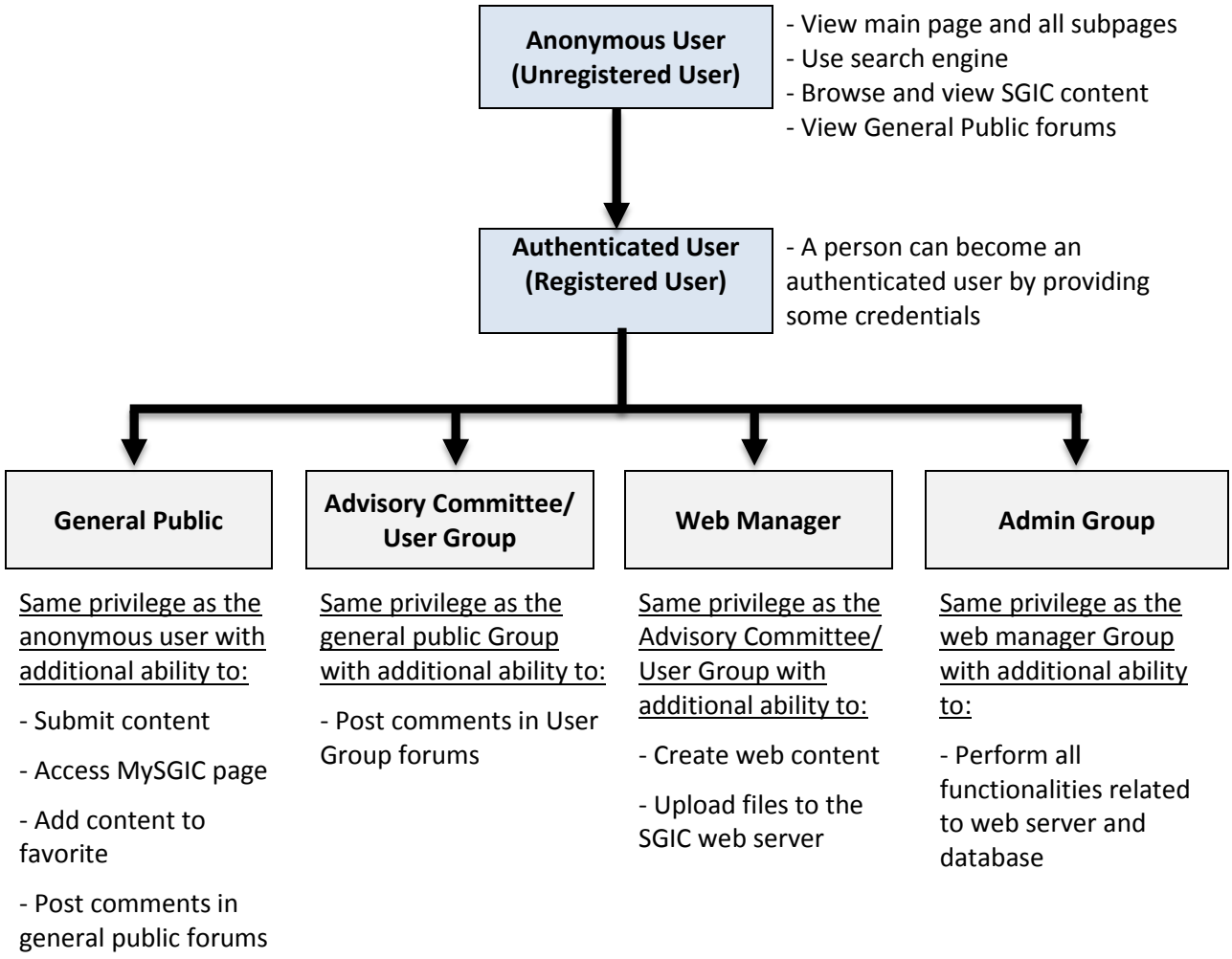

Fig. 2. Pictorial representation of SGIC role-based permissions

3.3 SGIC Information Architecture

3.3.1) SGIC Database Structure

The database for the Clearinghouse's content contains the total of 9 database tables. These database tables are summarized below.

SGIC Database Tables

Database tables hosting SGIC content:

1. Resource Document Database
2. Consumer Awareness Program Database
3. Smart Grid Project Database
4. Use Case Database
5. Standards Database
6. Technology Database
7. Legislation Database
8. Education Program Database
9. International Project Database

Fig. 3. SGIC database tables

Each database table is explained in detail as follows.

3.3.2) Database Table 1: Resource Document Database

For each **resource document** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Title* (Text field)
- Author* (Text field)
- Year * (Content taxonomy field)
- Abstract* (Text field)
- Source* (Text field)
- Smart Grid Domain* (Content taxonomy field)
- Document Classification* (Content taxonomy field)
- Document Type * (Content taxonomy field)
- Document URL (Text field)
- Library URL (Text field)

Note:

- *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.
- *Document Classification* includes 101, business case, cost-benefit analysis, demand-response related, international information, lesson learned, cyber security related, education related, legislation related, project related, standards related, technology related and use case related.
- *Document Type* includes audio presentation, book, docket, fact sheet, hearing/testimony, HTML, newsletter, report, short course, slide presentation, technical paper, webinar and white paper.

3.3.3) Database Table 2: Consumer Awareness Program Database

For each **consumer awareness program** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

-	Title*	(Text field)
-	Organization	(Text field)
-	Program Category*	(Content taxonomy field)
-	State	(Content taxonomy field)
-	Program Description*	(Text field)
-	URL*	(Text field)

Note:

- *Program Category* includes U.S. Federal, U.S. Private Sector, State and Local Government, and State Private Sector.
- *State* includes 50 U.S. states, including Washington DC and U.S. Territories

3.3.4) Database Table 3: Smart Grid Project Database

For each **Smart Grid project** entry, the following information is entered into the Database. Asterisks (*) indicate required fields.

-	Project Title*	(Text field)
-	Lead Organization*	(Text field)
-	Company URL*	(Text field)
-	HQ City*	(Text field)
-	HQ State*	(Content taxonomy field)
-	Year Start*	(Content taxonomy field)
-	Project Summary*	(Text field)
-	Project Contact Information*	(Text field)
-	Project Category*	(Content taxonomy field)
-	Project URL	(Text field)
-	Smartgrid.gov URL	(Text field)
-	Year End	(Text field)
-	No of Meters	(Text field)
-	Sponsor	(Text field)
-	Project HQ Latitude	(Text field)
-	Project HQ Longitude	(Text field)
-	Additional Information	(Text field)
-	Reference	(Text field)

Note: - *Project Category* includes Advanced Metering Infrastructure, Transmission Systems, Distribution Systems, Customer Systems, Equipment Manufacturing, Integrated Systems, Regional Demonstration and Storage Demonstration.

3.3.5) Database Table 4: Use Case Database

For each **use case** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Use Case Title* (Text field)
- Abstract* (Text field)
- Year* (Content taxonomy field)
- Source* (Text field)
- Use Case Library URL* (Text field)
- Document URL* (Text field)
- Smart Grid Domain* (Content taxonomy field)

Note: - *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.

3.3.6) Database Table 5: Standards Database

For each **Standards** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Standard No* (Text field)
- Standard Title* (Text field)
- Year* (Content taxonomy field)
- Brief Description* (Text field)
- Smart Grid Domain* (Content taxonomy field)
- Issuing Organization* (Content taxonomy field)
- Link to Document at SDO Site (Text field)

Note:

- *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.
- *Issuing Organization* includes AEIC, ANSI, DHS, IETF, NRECA, OGC, DNP, IEC, IEEE, ISO, LBL, NEMA, NERC, NIST, SAE, UCAIUG and Zigbee Alliance.

3.3.7) Database Table 6: Technology Database

For each **technology** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Technology* (Text field)
- Description* (Text field)
- Applications* (Text field)
- Reference* (Text field)
- Smart Grid Domain* (Content taxonomy field)
- Key Technology Area* (Content taxonomy field)
- Sample Vendors* (Text field)

Note:

- *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.
- *Key Technology Area* includes Advanced Components, Advanced Control Methods, Sensing and Measurement, Improved Interfaces and Decision Support, and Integrated Communications.

3.3.8) Database Table 7: Legislation and Regulation Database

For each **legislation and regulation** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Title* (Text field)
- State* (Content taxonomy field)
- Legislative Activities* (Text field)
- Regulatory Activities* (Text field)
- Utilities and Rate Schedules* (Text field)
- State-level Incentives* (Text field)
- Additional Resources (Text field)
- Reference (Text field)

Note: *State* includes 50 U.S. states, including Washington DC and U.S. Territories

3.3.9) Database Table 8: Education Program Database

For each **education program** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Title* (Text field)
- Organization* (Text field)
- HQ State* (Content taxonomy field)
- HQ City* (Text field)
- Location* (Content taxonomy field)
- Training Location* (Content taxonomy field)
- Program Description* (Text field)
- Training Level* (Content taxonomy field)
- Program URL (Text field)
- HQ Latitude* (Text field)
- HQ Longitude* (Text field)
- Program Inception (Text field)
- Contact Information (Text field)
- Additional Information (Text field)

Note:

- *State* includes 50 U.S. states, including Washington DC and U.S. Territories
- *Location* includes Online, Online-Multiple, Multiple and at HQ.
- *Training Location* includes 50 U.S. states, including Washington DC and U.S. Territories
- *Training Level* includes (a) Non-degree program: training and certificate courses; (b) Degree program: community college and higher education.

3.3.10) Database Table 9: International Smart Grid Project Database

For each **international project** entry, the following information is entered into the database. Asterisks (*) indicate required fields.

- Project Title* (Text field)
- Lead Organization* (Text field)
- Company URL* (Text field)
- HQ City* (Text field)
- HQ Country* (Content taxonomy field)
- Continent* (Content taxonomy field)
- Project Summary* (Text field)
- Project Contact Information* (Text field)
- Project Category* (Content taxonomy field)
- Project URL (Text field)
- Year Start (Text field)
- Year End (Text field)
- No of Meters (Text field)
- Sponsor (Text field)
- Project HQ Latitude (Text field)
- Project HQ Longitude (Text field)
- Additional information (Text field)
- Reference (Text field)

Note:

- *Project Category* includes Advanced Metering Infrastructure, Transmission Systems, Distribution Systems, Customer Systems, Equipment Manufacturing, and Integrated Systems.
- *Continent* includes Africa, Americas, Asia, Europe, and Oceania.

4.0 SGIC Features and Functionalities

This section describes the SGIC web portal database application functionalities, including search capability (Section 4.1), browse and sort capability (Section 4.2), website social networking (Section 4.3), MySGIC (Section 4.4), SGIC FAQ page (Section 4.5), online content submission platform (Section 4.6), and security measures implemented (Section 4.7).

4.1 Search Capability

The SGIC team has developed the search and advanced search features. The search feature is accessible using the search box located on the top right of all SGIC pages. The advanced search feature is also available, as shown in Fig. 4. A user can search available SGIC content by content type, such as consumer awareness programs, legislative/regulatory, smart grid projects, and use case.

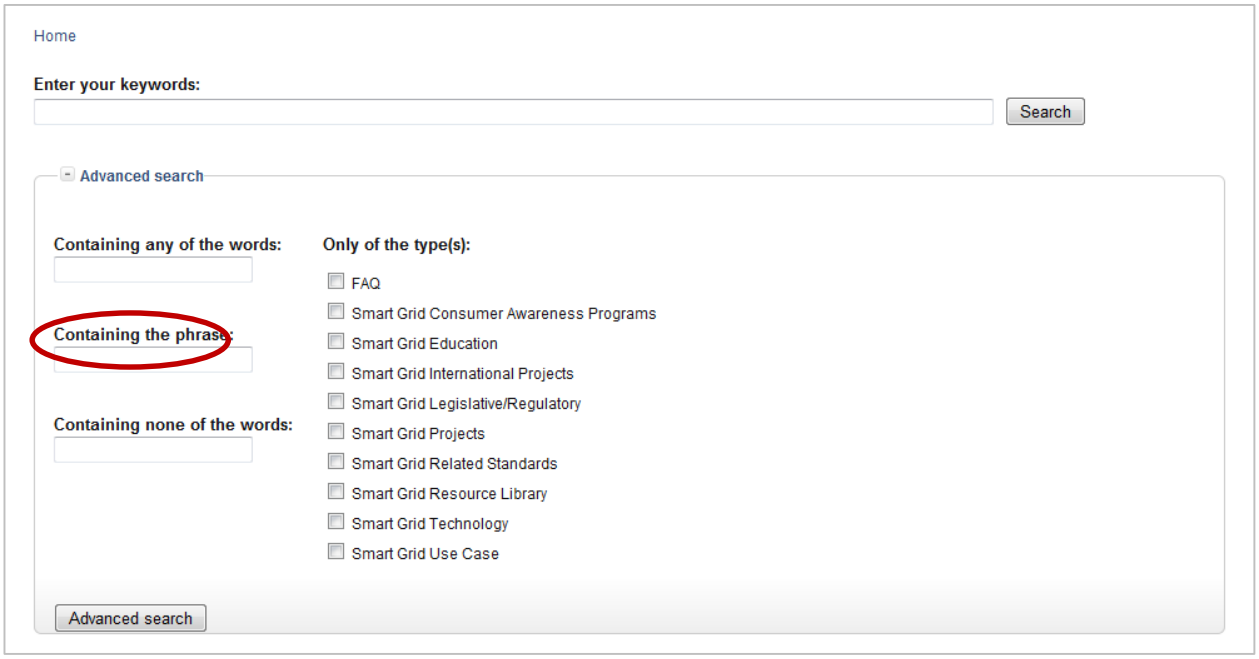

Fig. 4. Search capability in the SGIC portal

4.2 Browse and Sort Capability, including Categorizing, Cataloging and Displaying the Information

The SGIC team developed the browse and sort capability, including cataloging and categorizing all information collected in the SGIC database tables. This browse and sort functionality is available for all SGIC pages that are linked to the nine (9) database tables.

The table below summarizes the relationship between each SGIC page and its associated database table.

Table 6. Relationship between SGIC pages and database tables

Contents displayed on the following SGIC page…	**…are extracted from the following database table.**
Home >> 101 >> SGIC Resource Library Note: parts of the resource document database are also resources for the following pages: - Deployment Experience >> Lessons learned - Deployment Experience >> Cost-Benefit Analyses - Deployment Experience >> Business Cases - In-Depth Information >> Cyber Security	1. Resource Document Database
Home >> 101 >> Consumer Awareness Program	2. Consumer Awareness Program Database
Home >> Smart Grid Projects	3. Smart Grid Project Database
Home >> Deployment Experience >> Use Cases	4. Use Case Database
Home >> In-depth Information >> Standards	5. Standards Database
Home >> In-depth Information >> Technologies	6. Technology Database
Home >> In-depth Information >> Legislation	7. Legislation Database
Home >> In-depth Information >> Education	8. Education Program Database
Home >> International Information	9. International Project Database

For example, the table can be read as follow:

- The content displayed on the SGIC resource library page (as well as those on the lessons learned, cost-benefit analyses, business cases and cyber security pages) is extracted from the resource document database;
- The content displayed on the consumer awareness program page is extracted from the consumer awareness program database, and so on.

The ability to sort, categorize, catalog and display the information provided by SGIC is discussed in more details in Section 5.0 when each SGIC page is discussed.

4.3 Web Portal Social Networking

RSS feed and calendar & upcoming events: The team developed the SGIC social networking capabilities, including RSS feed and calendar & upcoming events. These features are available here:

- **RSS**, URL: http://www.sgiclearinghouse.org/?q=News

  The SGIC team provides live feeds from various smart grid news sources, namely DOE News Releases, SmartMeters.com, SmartGridNews.com, IEEE Smart Grid News, TMCnet.com, EEI, GreenTechMedia and EPRI. In addition, the Clearinghouse also has its own feed that provides information about new content added to the SGIC library.

- **Calendar**, URL: http://www.sgiclearinghouse.org/?q=Calendar

  The SGIC team provides access to smart grid event calendars from SmartGridToday.com, SmartGridNews.com and IEEE Smart Grid.

Facebook, Twitter, LinkedIn and others: all documents on the SGIC web portal can be shared through Facebook, Twitter, LinkedIn, email and others. Fig. 5 depicts social networking options provided in the portal.

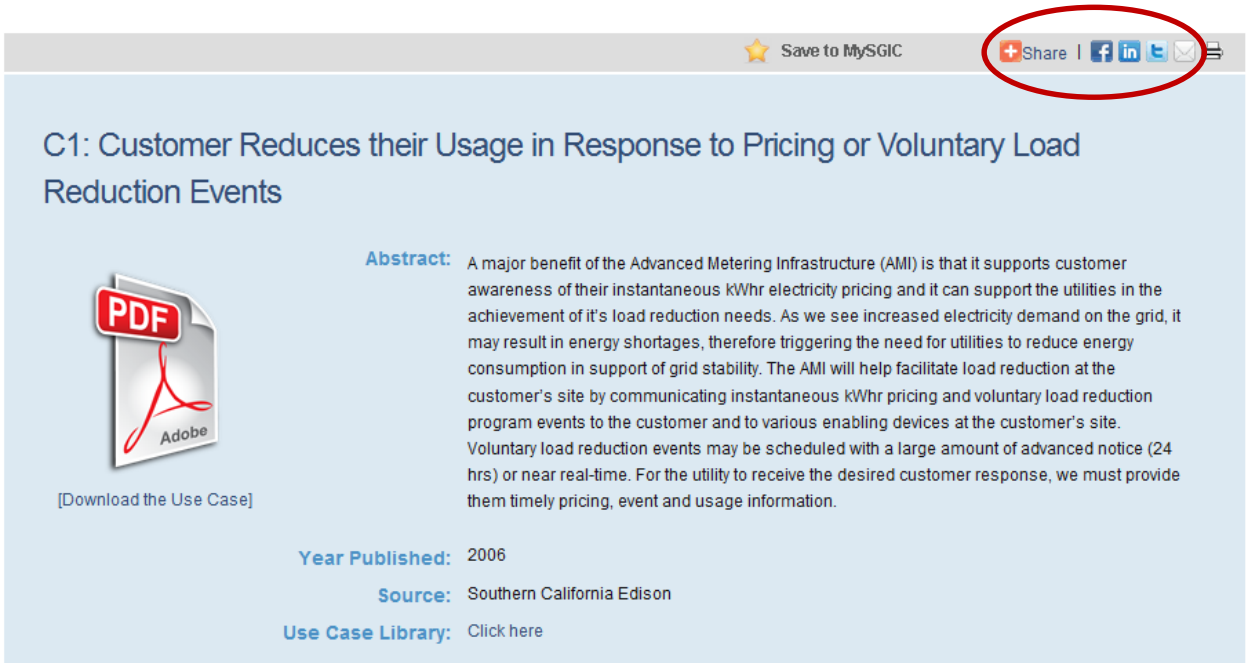

Fig. 5. Web portal social networking

4.4 MySGIC

For authenticated uses, all documents available on the portal can be saved to MySGIC page. See Fig. 6. This feature allows users to create their own library of documents.

Fig. 6. Save to MySGIC/favorite

All documents saved by the user are displayed in MySGIC page. MySGIC page also contains history of content submitted by the user, as well as the status of content submission (approved or in review). See Fig. 7.

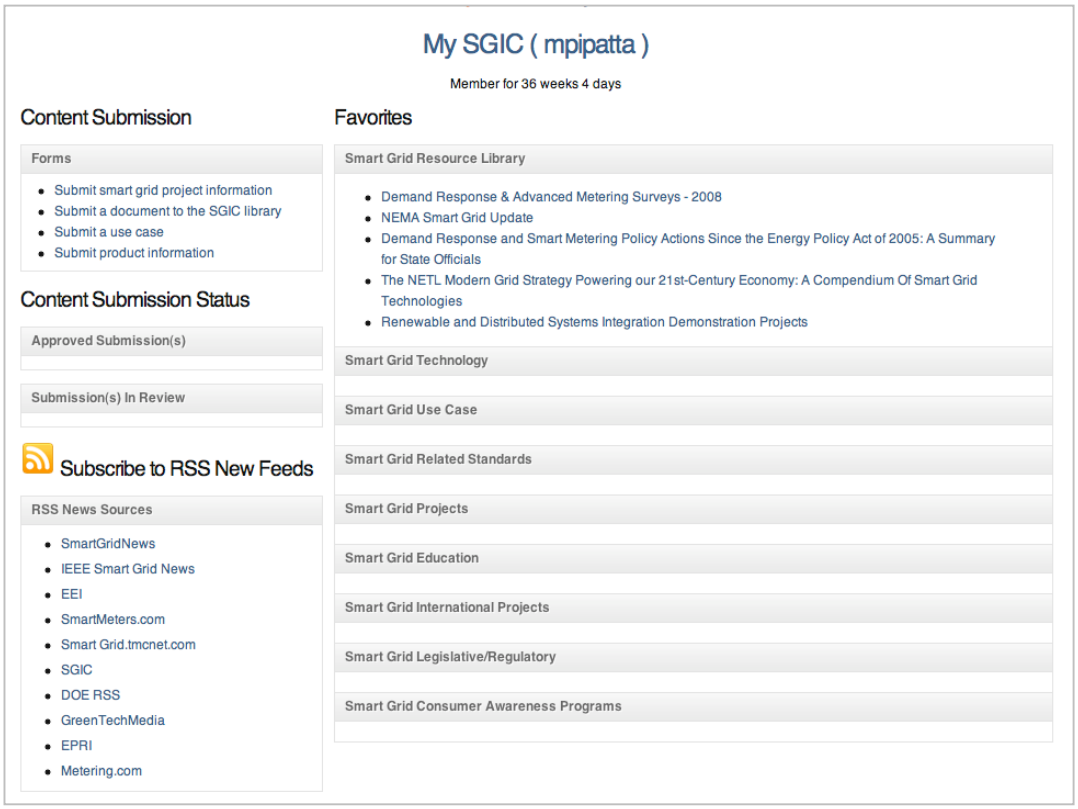

Fig. 7. MySGIC page

4.5 SGIC FAQ Page

The SGIC team created a frequently asked questions (FAQ) page based on questions and comments we received from the public during the beta testing of the site.

The FAQ page is located here: http://www.sgiclearinghouse.org/?q=faq.

4.6 Online Content Submission Platform

The SGIC team developed a content submission platform. Only registered users can submit content. As of August 31, 2014, registered users can submit the following information:

- Documents and multimedia (URL: http://www.sgiclearinghouse.org/?q=node/2080)
- Project information (URL: http://www.sgiclearinghouse.org/?q=node/2079)
- Product registration (URL: http://www.sgiclearinghouse.org/?q=node/2082)
- Use cases (link to EPRI's submission site for using the standard template)

Once the content is submitted, users can view their submission status (approved or in review) in MySGIC section.

4.7 Security Measures Implemented

The Clearinghouse was developed based on the current version of the Drupal Content Management System and supporting web applications, namely, APACHE, PHP and MySQL. As such, it is a stable and secure platform. The security measures taken were based on guidelines widely utilized by websites worldwide and were considered "Best Practices" in website security.

The following section summarizes the security measures being implemented* in the development of SGIC web portal *(*with assistance from IEEE which maintains a database of over 2.7 million articles and over 5,000 document uploads per month).*

4.7.1) Secure Web Hosting

The SGIC web portal is currently hosted at DreamHost, a commercial webhosting platform with the requisite security protocols. Specifically, DreamHost has implemented "mod_security," an open-source web application firewall module that provides protection from a range of attacks including SQL (structure query language) injection, cross-site scripting (XSS), denial of service, etc. The SGIC team enabled the mod_security module to take advantage of the available protection measures. DreamHost also has secure sockets layers (SSL) and the matching signed certificate service available for clients wishing to implement secure hosting. SSL was implemented in the SGIC web portal.

4.7.2) Regular Site Maintenance

The SGIC team performed all necessary housekeeping duties including software updates, user account management, and secure configuring of web applications. The SGIC's core system, Drupal, was regularly updated to the newly released version. Key web applications required by the Clearinghouse web portal, such as Apache server, PHP (Hypertext Preprocessor) and MySQL, were maintained and updated regularly.

4.7.3) Security related to Log-in, Access and Session Management

The Clearinghouse web portal utilized the built-in login and authentication interface provided by Drupal. For added security, the following additional features were implemented:

- Strictly enforce password type, length and strength
- Secure password recovery interface with human test, i.e., CAPTCHA
- Secure procedure for handling password retries

4.7.4) Security associated with File Uploads

For file uploads, the SGIC team has implemented the following features to ensure that the file uploaded does not contain malicious payloads and prevent their execution by:

- Only accepting files from registered users uploading via the website.
- Administering the human test, i.e., CAPTCHA
- Scanning all file uploads for viruses.
- Restricting upload to file types with certain extensions, eg., .pdf, .jpg, .gif, .csv, etc. while preventing executable files with extensions such as .exe, .bat, .pl, .sys, etc.
- Preventing files with system names and special characters from uploading
- Renaming uploaded files ad storing them at a temporary staging area for moderating
- Changing permission of holding folder for uploaded files to non-executable

4.7.5) Security through Regular Backup and Recovery

As per industry standards, the SGIC team performed periodic in-house backups of both the web server and database in addition to the scheduled backup performed by the hosting provider DreamHost. Additionally, backups and printouts were made available for all configuration settings to facilitate the process during restore/recovery of the portal.

5.0 SGIC Web Portal Content

The following table summarizes the amount of contents available on the SGIC web portal by content category.

Table 7. SGIC content by category

SGIC Content Category	Number of documents
Acronyms & glossary	444
Resource library	
- 101	305
- Business cases	81
- Cost-benefit analysis	284
- Demand response related	348
- International information	169
- Lesson learned	322
- Cyber security and privacy related	240
- Education related	106
- Legislation related	194
- Project related	547
- Standards related	312
- Technology related	1138
Smart grid projects (USA)	200
Smart grid projects (International)	
- Africa	1
- Americas	2
- Asia	8
- Europe	43
- Oceania	17
Use cases	274
Standards	167
Consumer awareness programs	
- Offered by US federal government	6
- Offered by private sector and non-profit organizations	13
- Offered by state and local governments	10
- Offered by state private sector and non-profit organizations	36

5.1 SGIC Landing Page

The SGIC landing page contains links to general smart grid information for consumers, smart grid project maps and descriptions about smart grid technologies. It also provides recent smart grid stories, which are RSS feeds from relevant sources (e.g., DOE, SmartMeters.com, SmartGridNews.com, IEEE Smart Grid News, Smart Grid.tmcnet.com, Renew Grid, GreenTechMedia, and EPRI), as well as links to SGIC content submission platforms and SmartGrid.gov.

Fig. 8. SGIC landing page

5.2 Smart Grid 101

The Smart Grid 101 tab contains six sub topics, including: ‘Learn More’, ‘Acronyms’, ‘Resource Library’, ‘NIST model’, ’Consumer Awareness’ and ‘Educational Videos’. Each topic is discussed in more details below.

5.2.1) Learn More

The ‘Learn More’ section allows the general public to find out more about smart grid, in terms of a general definition of a smart grid, how it works and its characteristics.

Fig. 9. SGIC ‘Learn More’ page

5.2.2) Acronyms

The ‘Acronyms’ section contains a collection of smart grid acronyms, which can be accessed alphabetically using the left navigation bar.

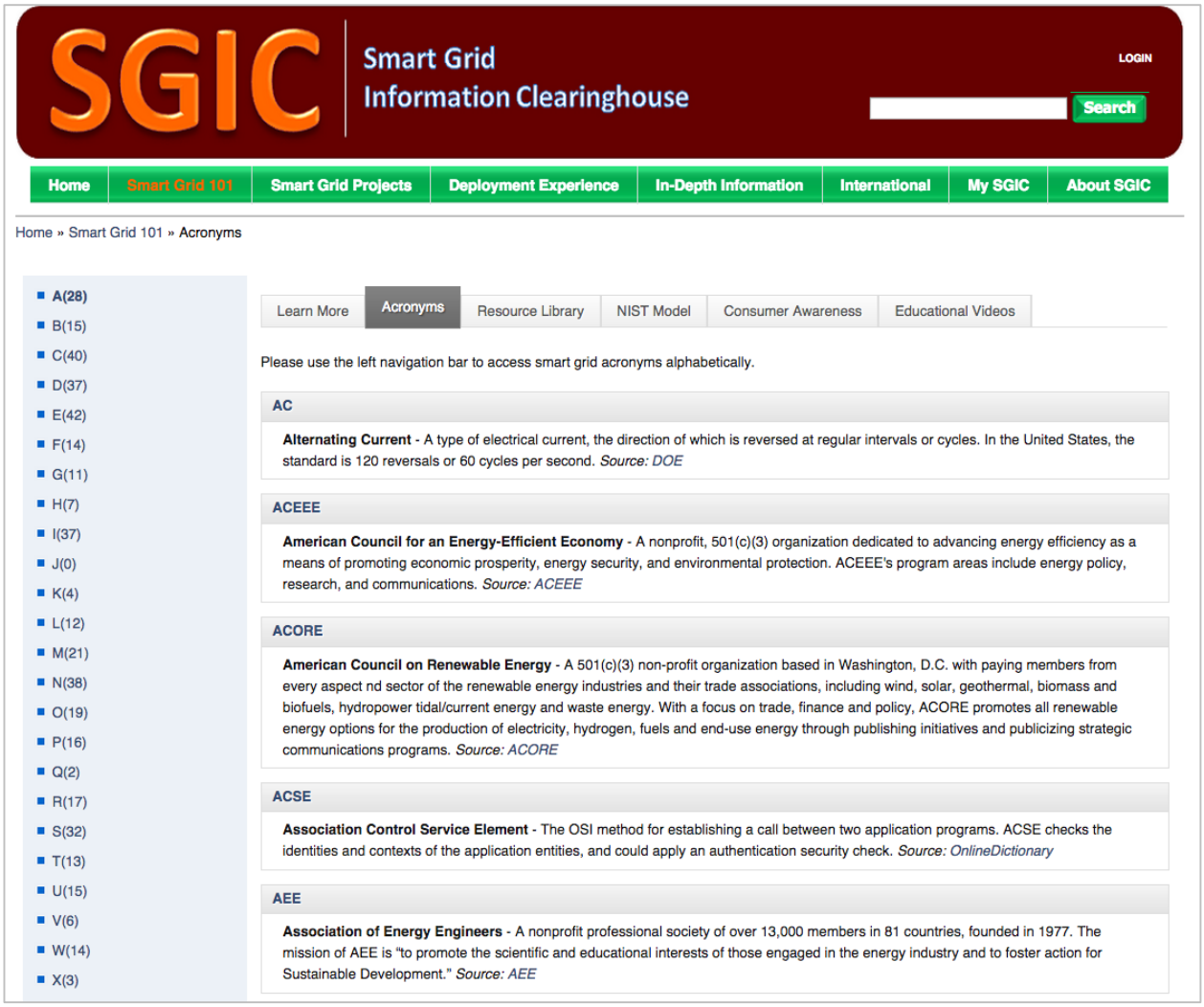

Fig. 10. SGIC ‘Acronyms’ page

5.2.3) Resource Library

The 'Resource Library' section provides a searchable collection of smart grid related documents and multimedia that the SGIC team proactively acquired relevant contents, reviewed them, created a summary, as well as categorized and cataloged the information. All documents and multimedia are categorized by smart grid domains and document classification.

- *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.
- *Document Classification* includes 101, business case, cost-benefit analysis, demand-response related, international information, lesson learned, cyber security related, education related, legislation related, project related, standards related, technology related and use case related.

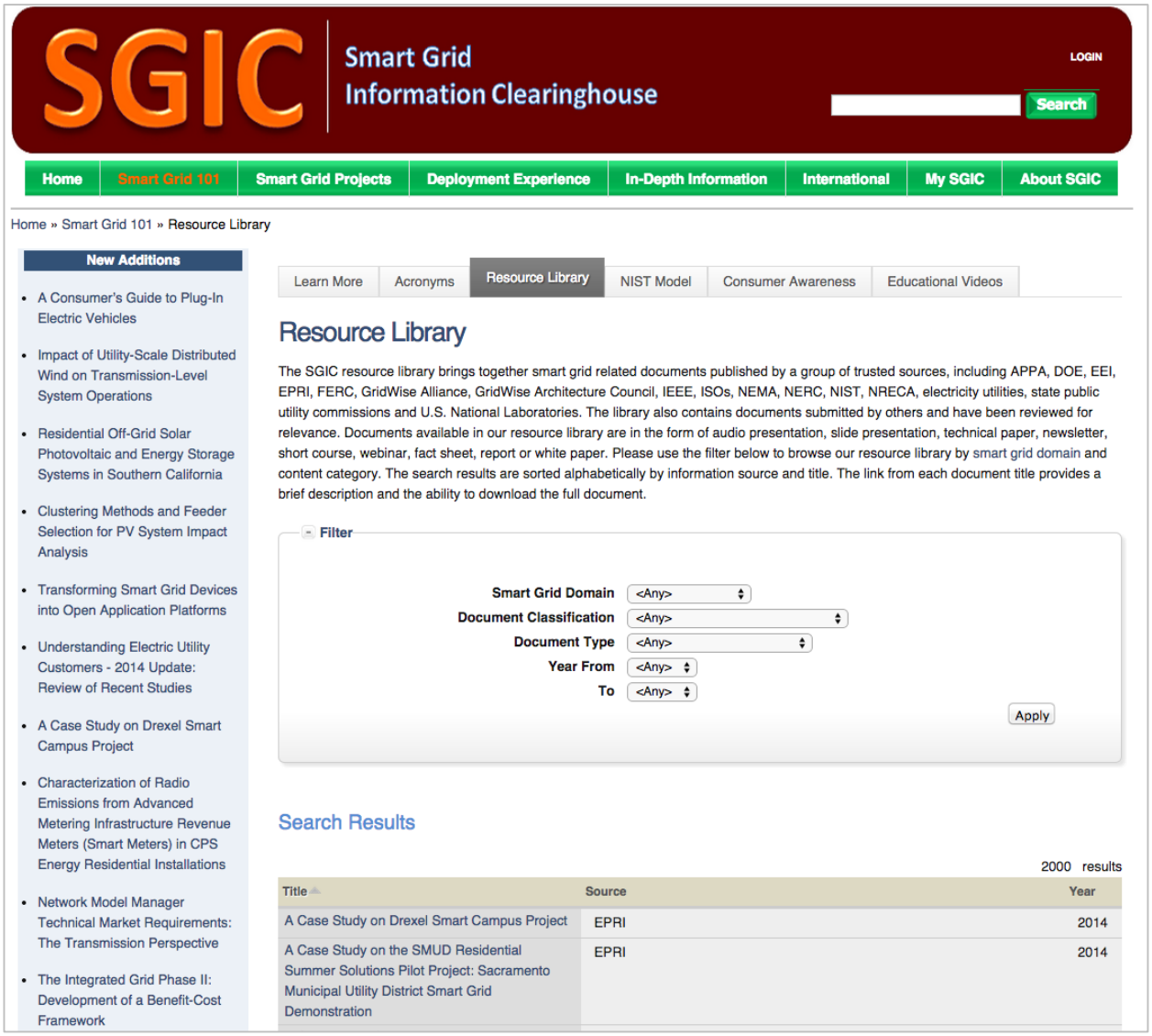

Fig. 11. SGIC 'Resource Library' page

Browse and sort capability: Users can browse the documents in the resource library using the filter, which enables browsing the contents by smart grid domains, document classification and year. As shown, search results are displayed in the table format, which allow users to sort the content by Title, Source, Year and Document Type.

Display: All documents and multimedia in the resource library are displayed in lightbox, as shown below. Users can see the title, front cover, author, year, abstract and source of the document. Users can also download the document by clicking the image or the download link.

Fig. 12. Detailed view for contents in the SGIC resource library

5.2.4) NIST Conceptual Model

This page defines the seven smart grid clouds: generation, transmission, distribution, customers, operations, markets and service providers.

Fig. 13. SGIC 'NIST Conceptual Model' page

5.2.5) Consumer Awareness

This page provides information about various awareness programs offered by federal and state agencies, as well as those provided by the private sector.

Fig. 14. SGIC 'Consumer Awareness' page

5.2.6) Educational Videos

This page hosts educational videos produced by NEMA, "Vids 4 Grids: New Media for the New Energy Workforce" – a series of short videos that demonstrate Smart Grid equipment, explain electrical engineering concepts, and portray careers in electrical manufacturing.

Fig. 15. SGIC 'Consumer Awareness' page

5.3 Smart Grid Projects

Categorizing and Cataloging the Content: The SGIC team proactively searches for smart grid projects both ARRA and non-ARRA funded projects. The team reviews and creates the project summary. All project entries are categorized by project category.

- *Project Category* includes Advanced Metering Infrastructure, Transmission Systems, Distribution Systems, Customer Systems, Equipment Manufacturing, Integrated Systems, Regional Demonstration and Storage Demonstration.

Browse and sort capability: Project database is displayed in various formats including the map view (see Fig. 16) and the list view (see Fig. 17).

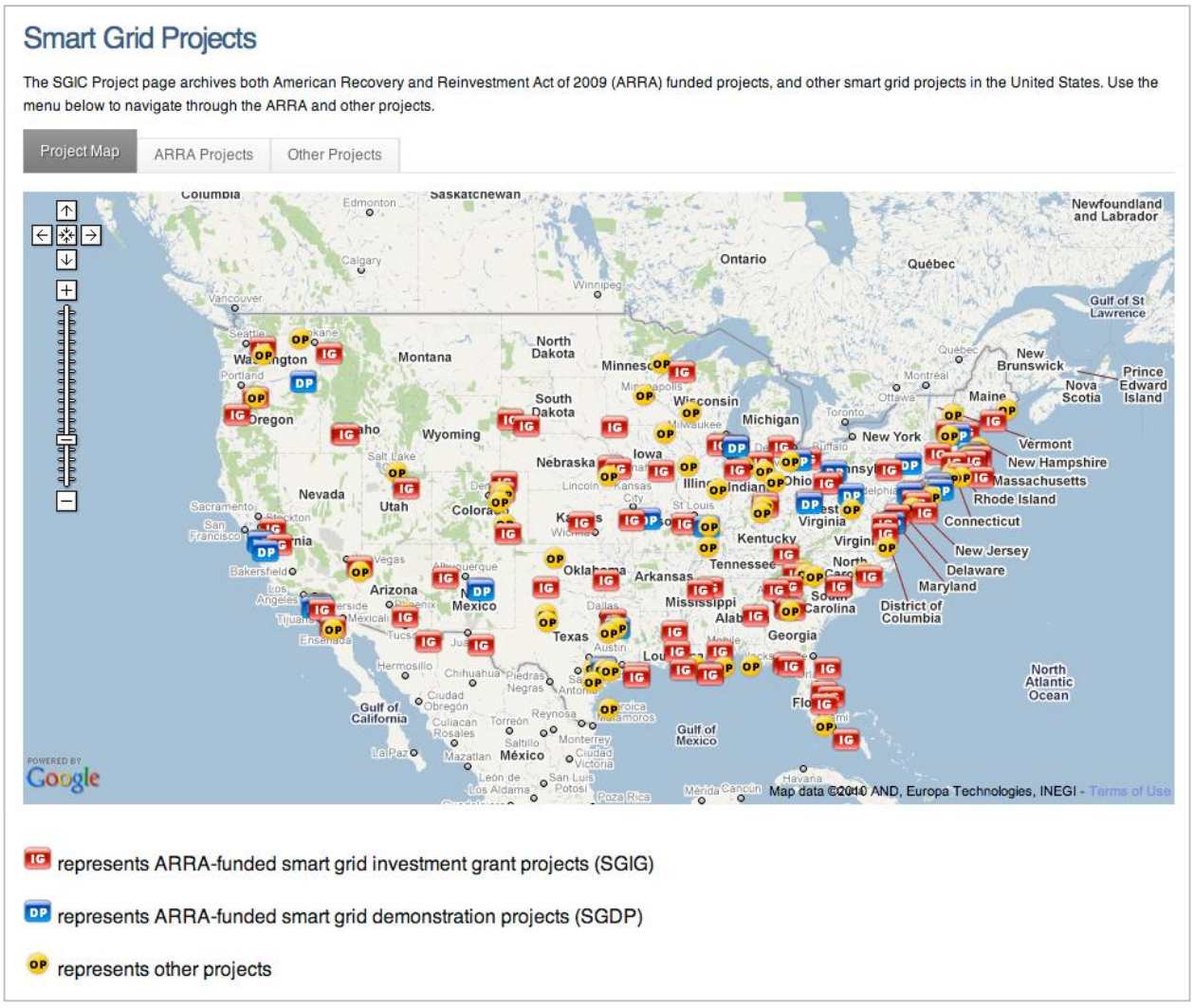

Fig. 16. Map view

The list view allows users to browse the projects by state and by project category. As shown in Fig. 17, search results are in the table format, which allow users to conveniently sort the projects by Project Title, Lead Organization, HQ City and HQ State.

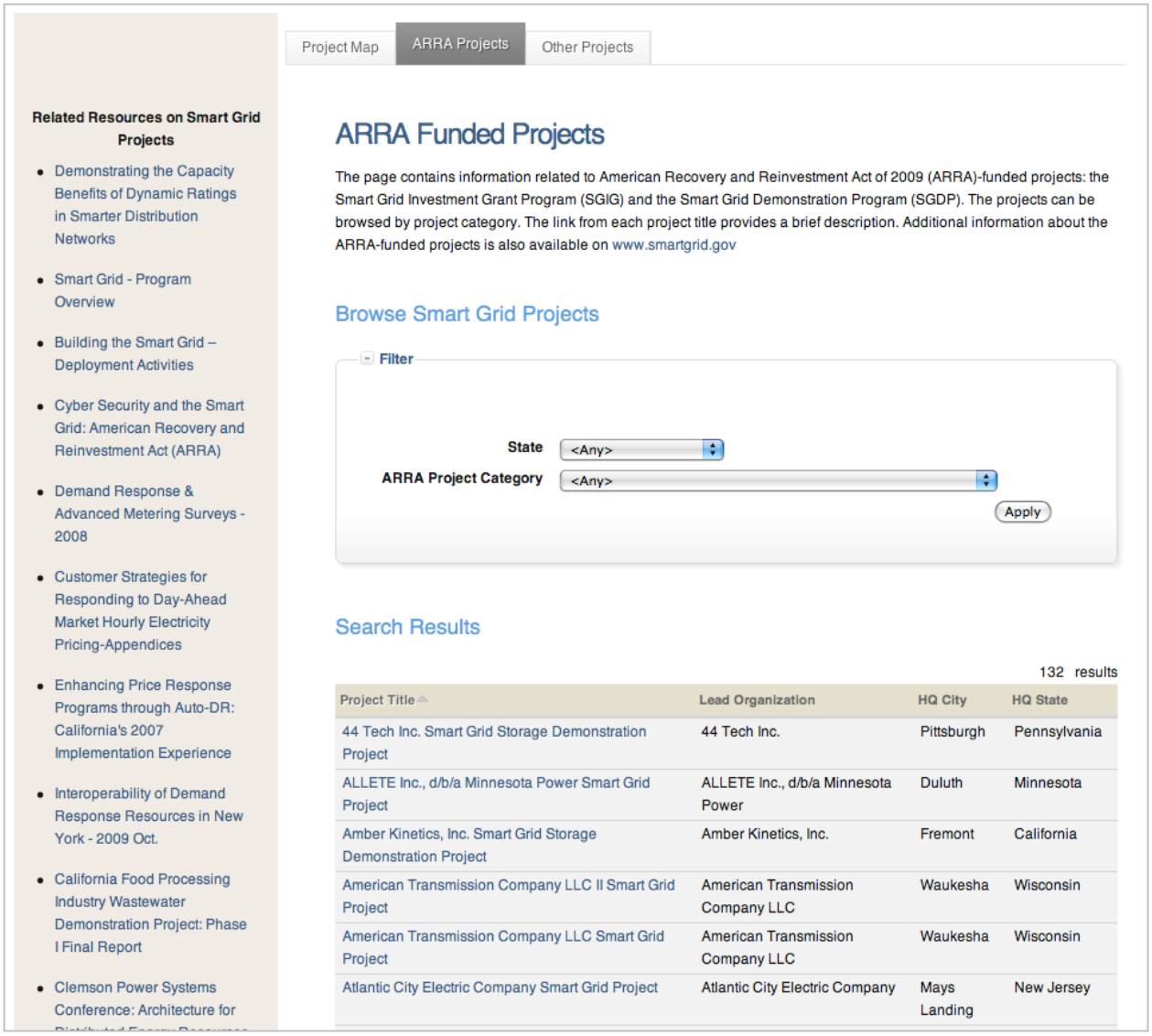

Fig. 17. Browse and sort features for the SGIC project page (list view)

Display: All projects are displayed in lightbox, as shown below. Users can see the title, project map, lead organization, HQ location, project contact information, project category, project summary and additional information. The project URL, if available, will also be displayed.

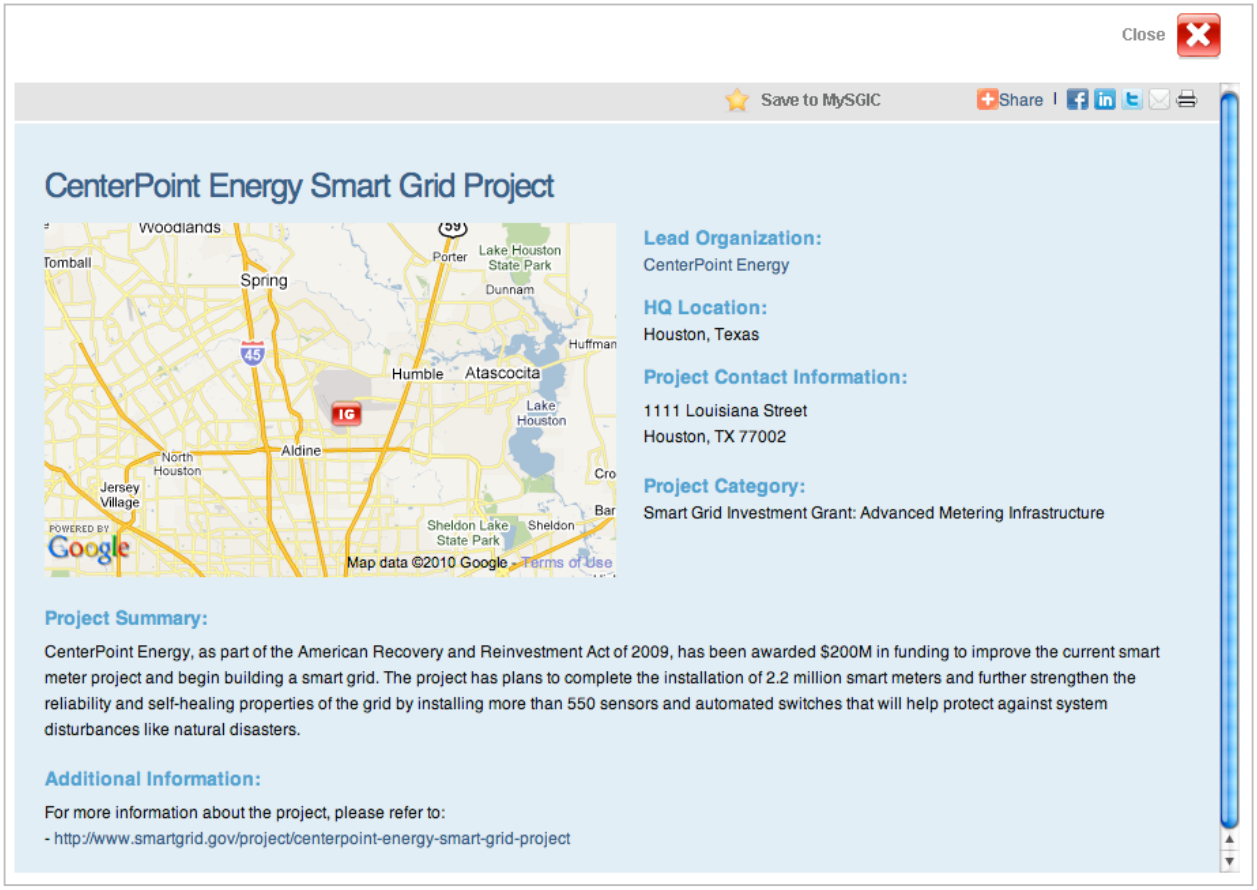

Fig. 18. Detailed view for contents in the smart grid project database

5.4 Deployment Experience

The Deployment Experience tab contains four sub topics, including: 'Use Cases', 'Lessons Learned', 'Cost-Benefit Analyses', and 'Business Cases'. Each topic is discussed in more details below.

5.4.1) Use Cases

Use Cases are the description of smart grid applications that defines the important actors, systems and technologies, and their requirements that are part of the smart grid applications. SGIC web portal provides links and synopses to available smart grid-related Use Cases from trusted sources, such as EPRI Intelligrid and Southern California Edison (SCE).

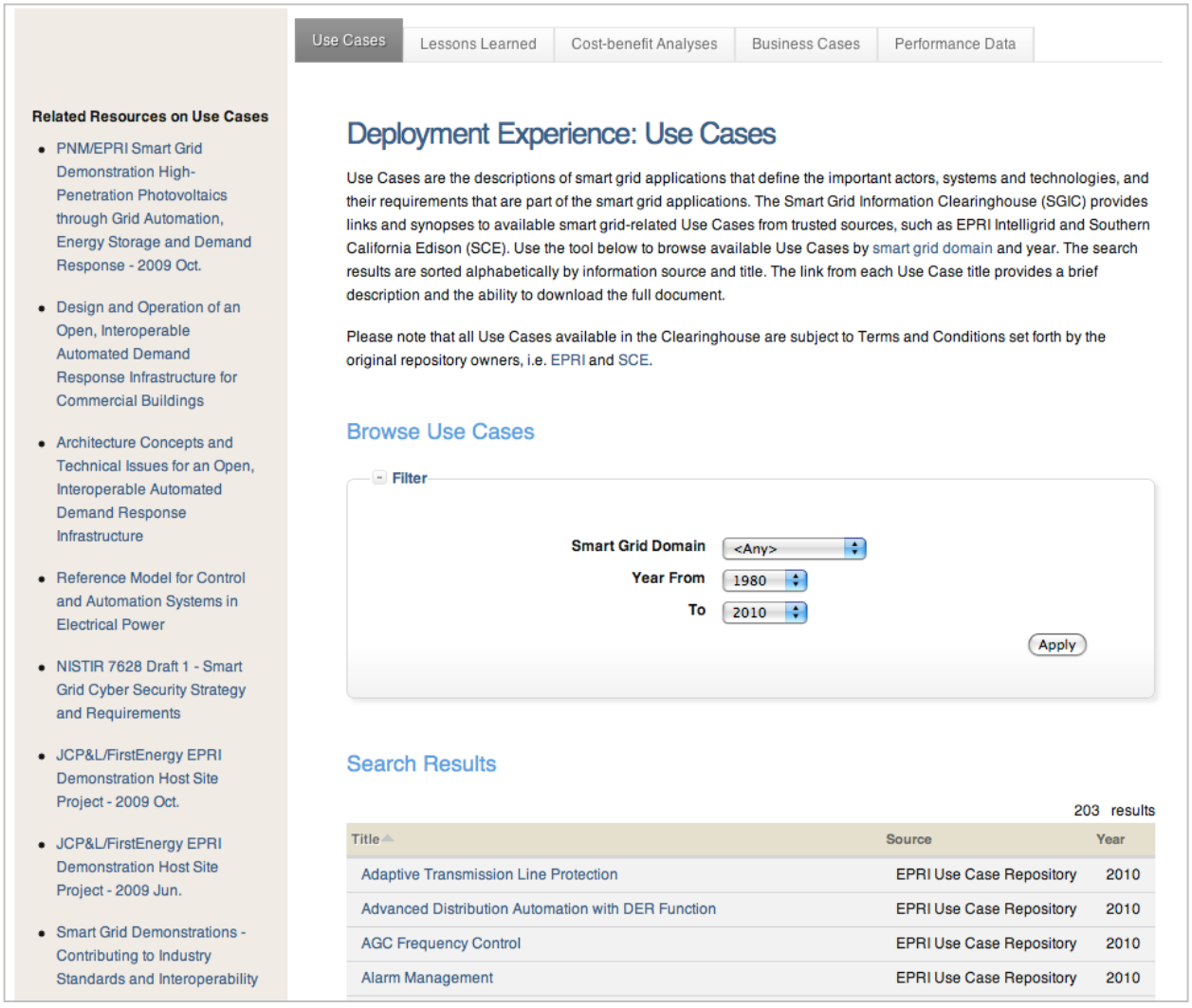

Fig. 19. Browse and sort features for the SGIC use case page

Categorizing and Cataloging the Content: For each use cases, the SGIC team created a summary, as well as categorized and cataloged the information. All use cases were categorized by smart grid domains.

- *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.

Browse and sort capability: Users can browse use cases using the filter, which enables browsing by smart grid domain and year. As shown at the bottom of Fig. 19, search results are provided in the table format, which allow users to sort the available use cases by Title, Source, and Year.

Display: All use cases are displayed in lightbox, as shown in Fig. 20. Users can see the title, abstract, year published, source and link to original use case library. Users can also download the use case document by clicking the image or the download link.

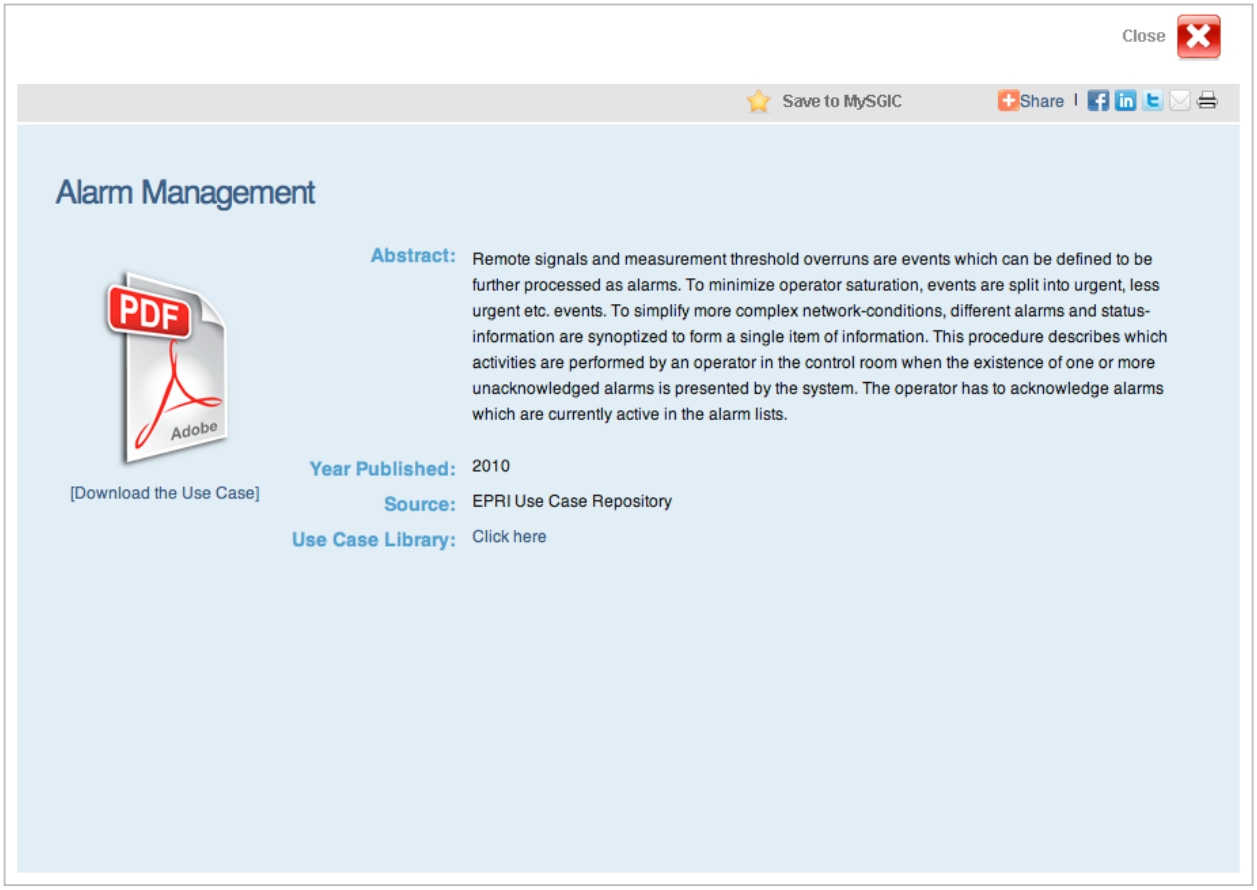

Fig. 20. Detailed view for contents in the use case database

5.4.2) Lessons Learned

Lessons Learned documents were collected from the group of trusted sources to provide information on field experience. This information includes "best practices" and "faults and fixes" that can provide experience, guidelines, and pointers from past and present deployment of smart grid technology. Lessons learned documents were categorized by smart grid domain (i.e., Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider), document type (e.g., audio presentation, book, report, slide presentation, etc.) and year. The search results are sortable alphabetically by title, information source, year and document type. The link from each title provides a brief description and the ability to download the full document.

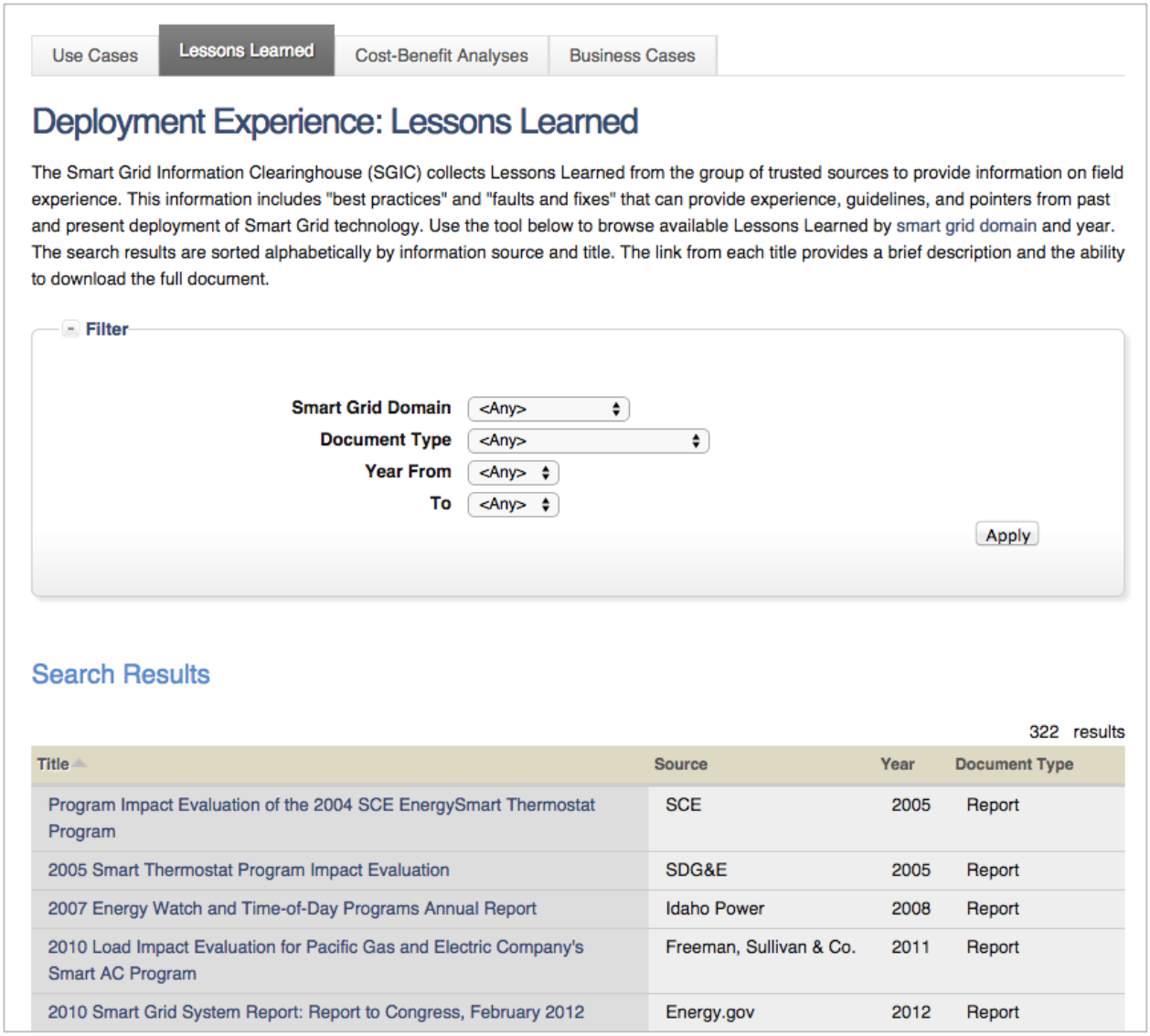

Fig. 21. Browse and sort features for the SGIC lessons learned page

5.4.3) Cost-Benefit Analyses

Cost-Benefit Analyses documents were collected from the group of trusted sources. Similar to lessons learned documents, cost-benefit analyses documents were categorized by smart grid domain (i.e., Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider), document type (e.g., audio presentation, book, report, slide presentation, etc.) and year.

5.4.4) Business Cases

Business Cases were collected from the group of trusted sources to capture the logic behind moving forward on a smart grid project. Business Cases provide the justification for supporting a business need. Similar to lessons learned documents, the SGIC team created a summary, categorized and cataloged all

business cases documents by smart grid domain (i.e., Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider), document type (e.g., audio presentation, book, report, slide presentation, etc.) and year.

5.5 In-Depth Information

The in-depth information tab contains six sub topics, including: 'Standards', 'Technologies', 'Cyber Security', 'Legislation', 'Education and Training' and 'Demand Response'. Each topic is discussed in more details below.

5.5.1) Standards

The SGIC standards page provides information and links to smart grid-related standards from various Standards Development Organizations (SDOs).

Categorizing and Cataloging the Content: The SGIC team proactively searched for smart grid related standards, created a summary, categorized and cataloged the information. All standards were categorized by smart grid domains, and issuing organizations.

- *Smart Grid Domain* includes Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider.
- *Issuing Organization* includes AEIC, ANSI, DHS, IETF, NRECA, OGC, DNP, IEC, IEEE, ISO, LBL, NEMA, NERC, NIST, SAE, UCAIUG and Zigbee Alliance.

Browse and sort capability: Users can browse standards using the filter provided, as shown in Fig. 22. The filter enables browsing the contents by smart grid domains, issuing organizations, and year. As shown at the bottom of Fig. 22, search results are in the table format, which allow users to sort the standards by Number, Title, Issuing Organization and Year.

Display: All standards are displayed in lightbox, as shown in Fig. 23. Users can see the standard number, title, year, brief description, issuing organization, standard information details, and issuing organization's logo. Users can click the image or the link to go to the standards page available at the issuing organization's site.

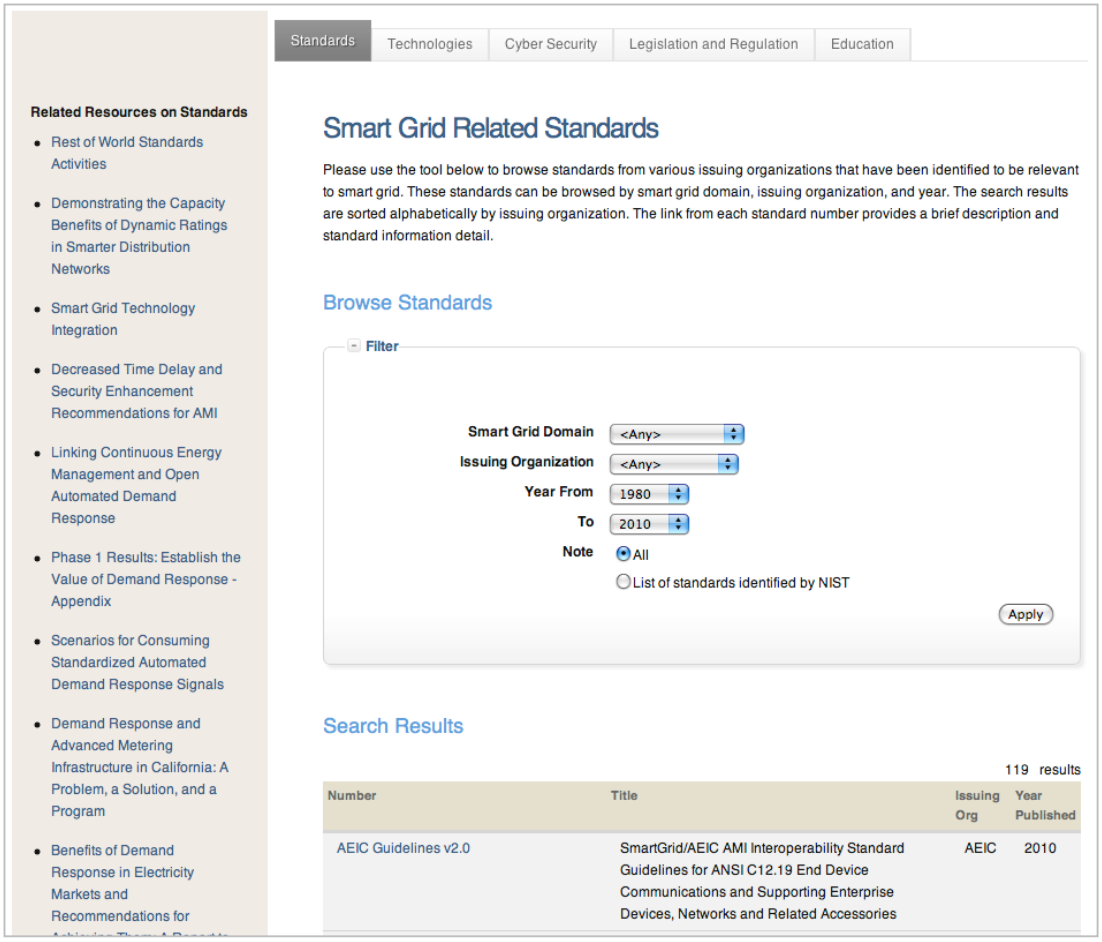

Fig. 22. Browse and sort features for the SGIC standards page

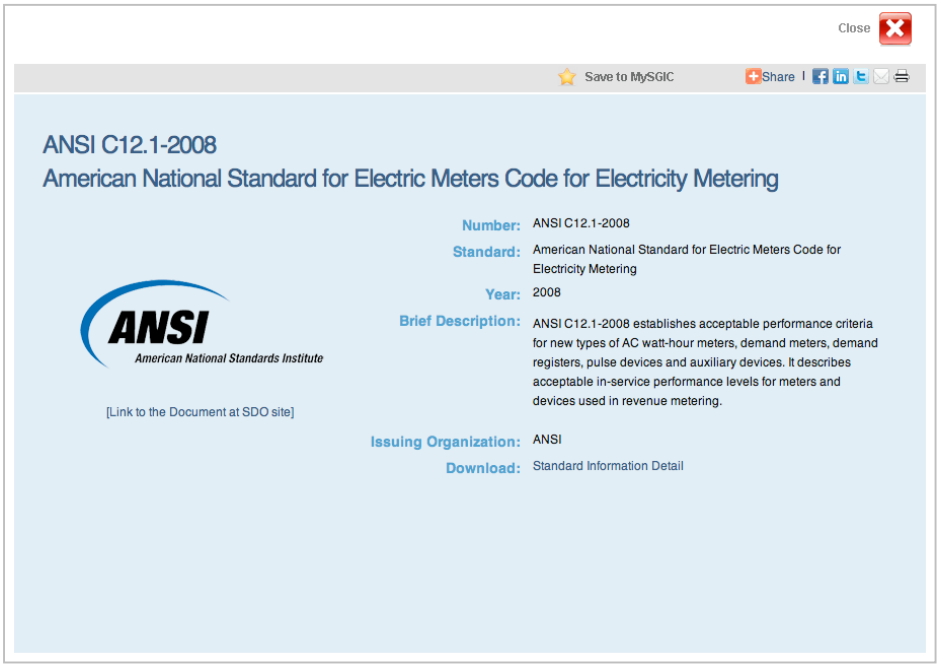

Fig. 23. Detailed view for contents in the standards database

5.5.2) Technology

The SGIC technology page provides examples of smart grid technologies grouped into five key technology areas: integrated communications, sensing and measurement, advanced components, advanced control methods and interfaces and decision support.

Categorizing and Cataloging the Content: The SGIC team proactively searched for smart grid related technologies, created a summary, categorized and cataloged the information. All technologies are categorized by key technology areas.

- *Key Technology Area* includes Advanced Components, Advanced Control Methods, Sensing and Measurement, Improved Interfaces and Decision Support, and Integrated Communications.

Browse and sort capability: Users can browse technologies using the filter provided, as shown in Fig. 24. The filter enables browsing the contents by key technology areas.

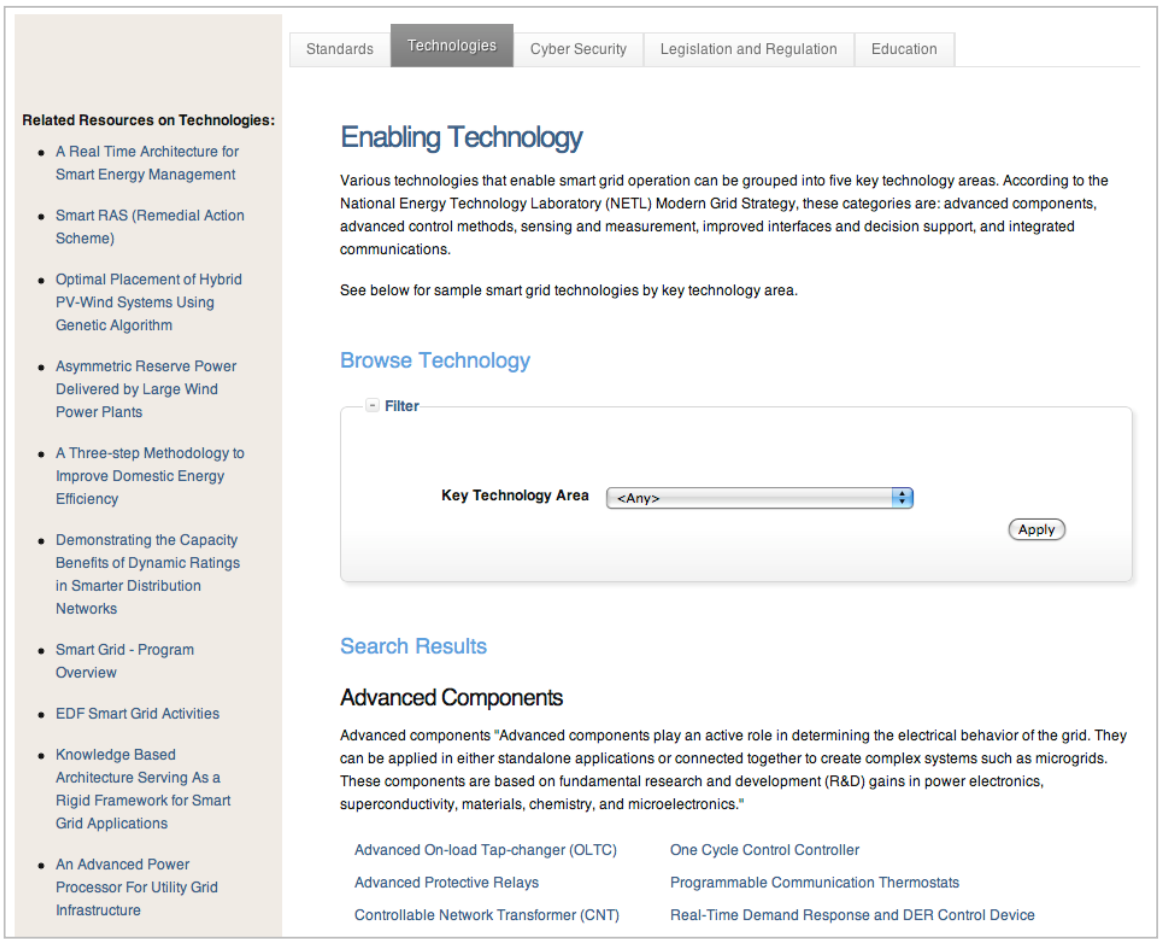

Fig. 24. Browse and sort features for the SGIC technology page

As shown at the bottom of Fig. 24, search results are displayed in the grid view format. This allows users to see all technologies under a particular key technology area.

Display: Technologies are displayed in the format shown in Fig. 25. Users can see the technology title, description, application, and sample vendors. Users can click on a vendor name, which will open the vendor's web page.

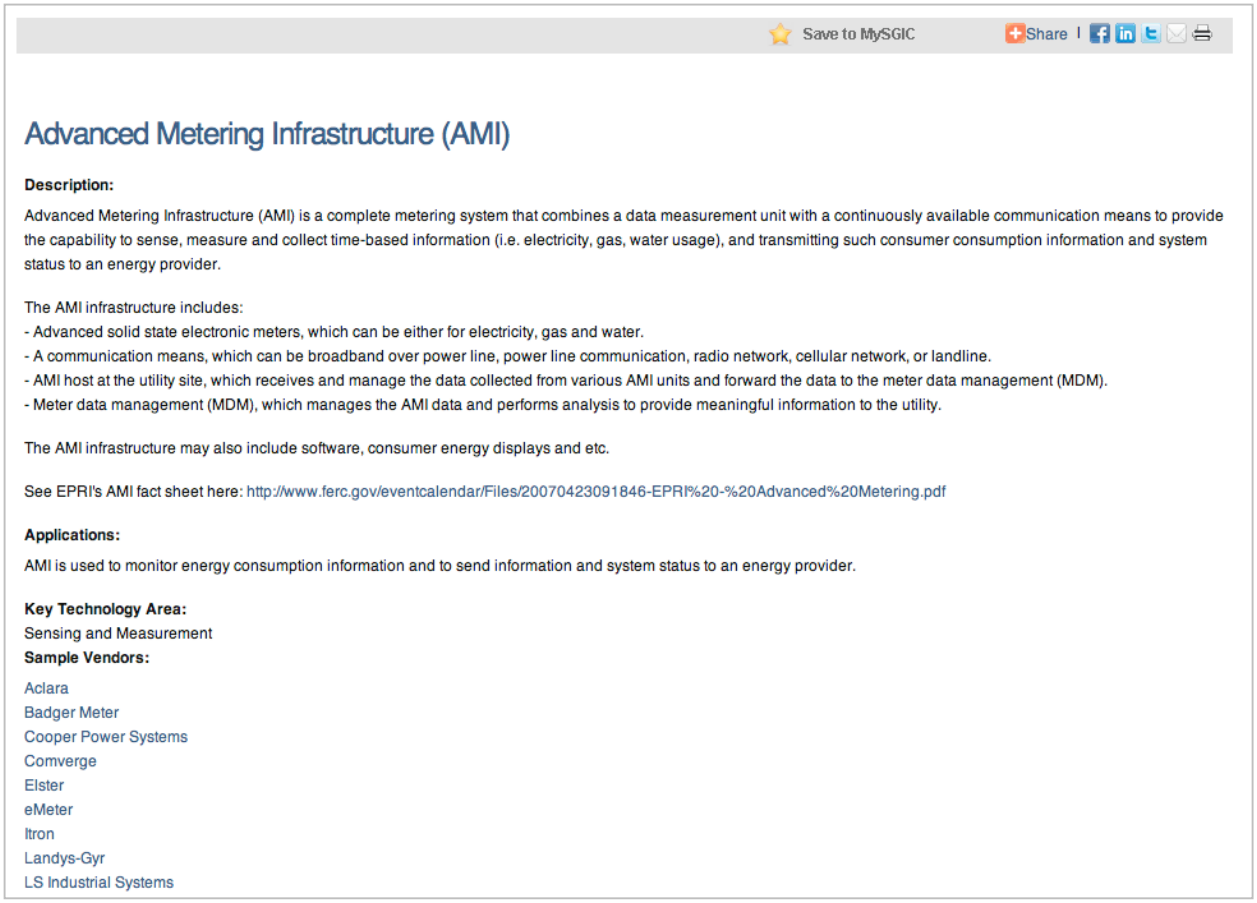

Fig. 25. Detailed view for contents in the technology database

5.5.3) Cyber Security

The SGIC Cyber Security page brings together background information and training courses that are related to cyber security in the smart grid environment. Similar to other documents, all cyber security-related documents were categorized by smart grid domain (i.e., Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider) and year.

5.5.4) Legislation

SGIC summarizes U.S. legislation and regulations at both federal and state level.

Categorizing and Cataloging the Content: The SGIC team proactively searches for legislation and regulation related activities at both federal and state levels. There is no category for activities at the federal level. Activities at state level are categorized by state.

Browse and sort capability: Users can browse legislation and regulation activities as shown in Fig. 26.

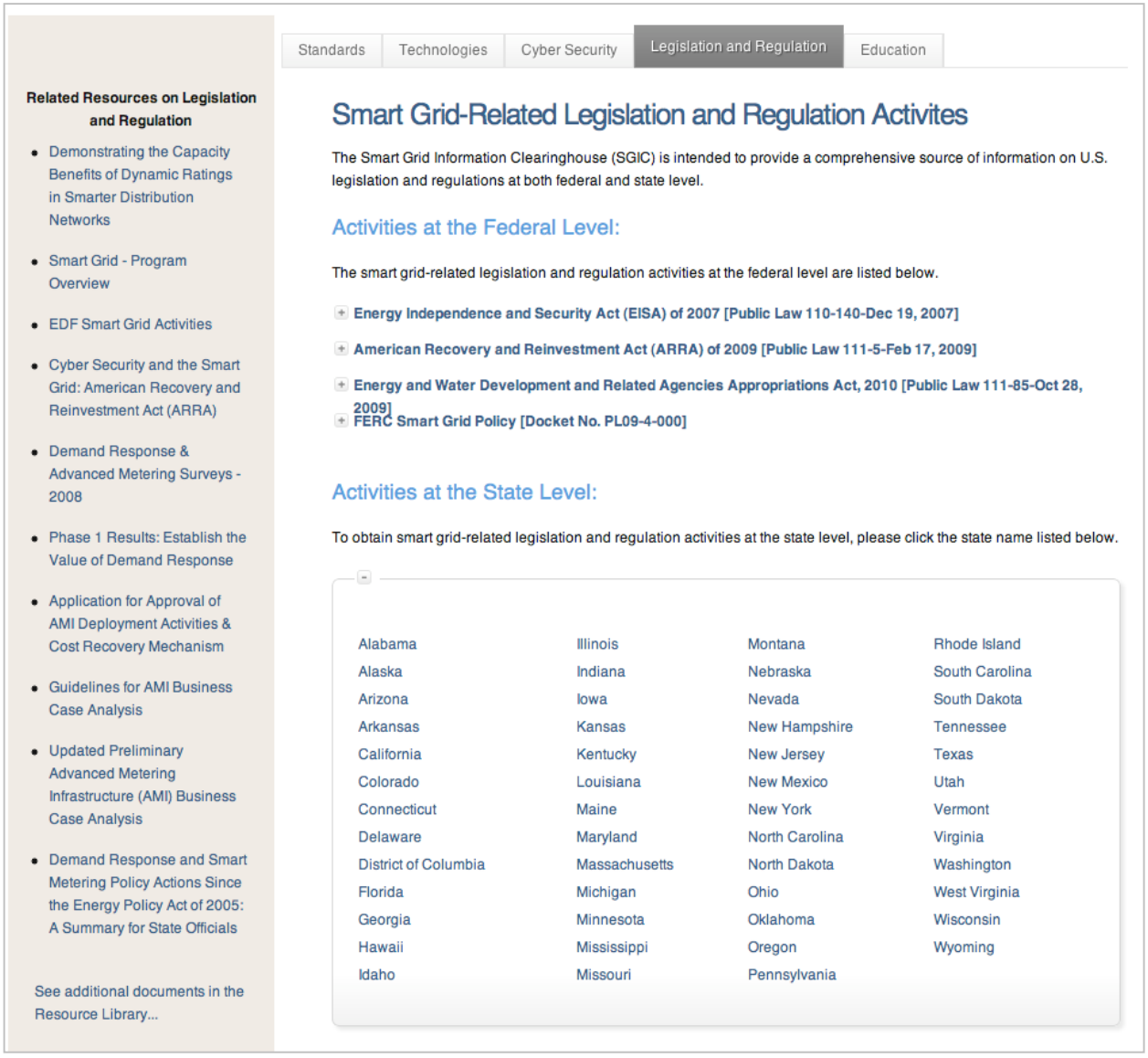

Fig. 26. Browse and sort features for the SGIC legislation and regulation page

As shown at the bottom of Fig. 26, activities at the state level are displayed in the grid view format by state. Users can click on the state name to learn more.

Display: Legislation and regulation activities are displayed in the format shown below. Users can review the activities by state, including legislative and regulatory activities, as well as utilities and rate schedules, state-level incentives, additional resources and references.

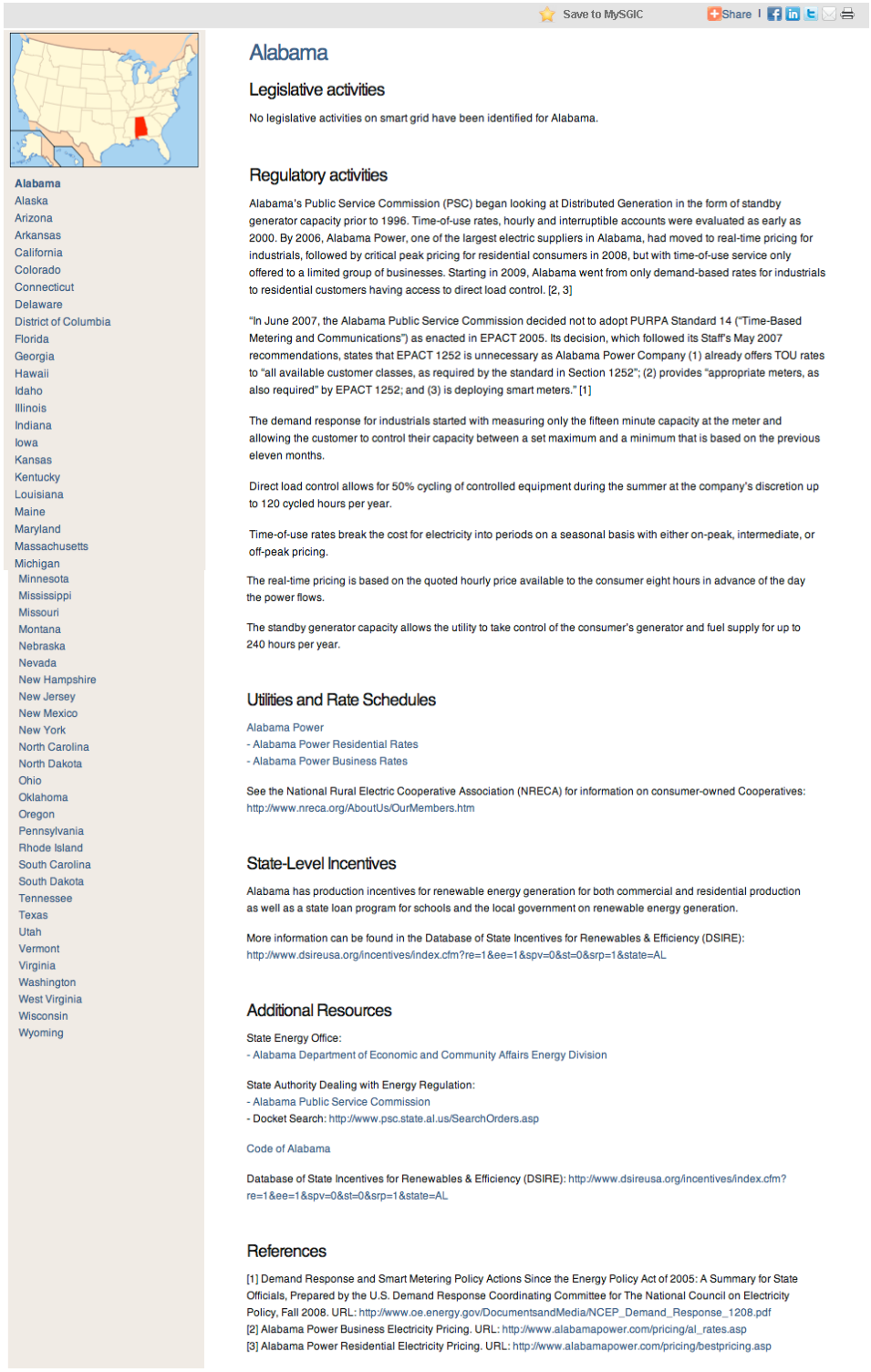

Fig. 27. Detailed view for contents in the legislation and regulation database

5.5.5) Education and Training

The SGIC education page displays DOE-sponsored workforce training programs. All programs are categorized by training locations and training types.

- *Training Location* includes 50 U.S. states, including Washington DC and U.S. Territories
- *Training Type* includes (a) Non-degree program: training and certificate courses; (b) Degree program: community college and higher education.

Users can browse educational training programs using the filter, as shown in Fig. 28. The filter enables browsing the contents by training locations and training types.

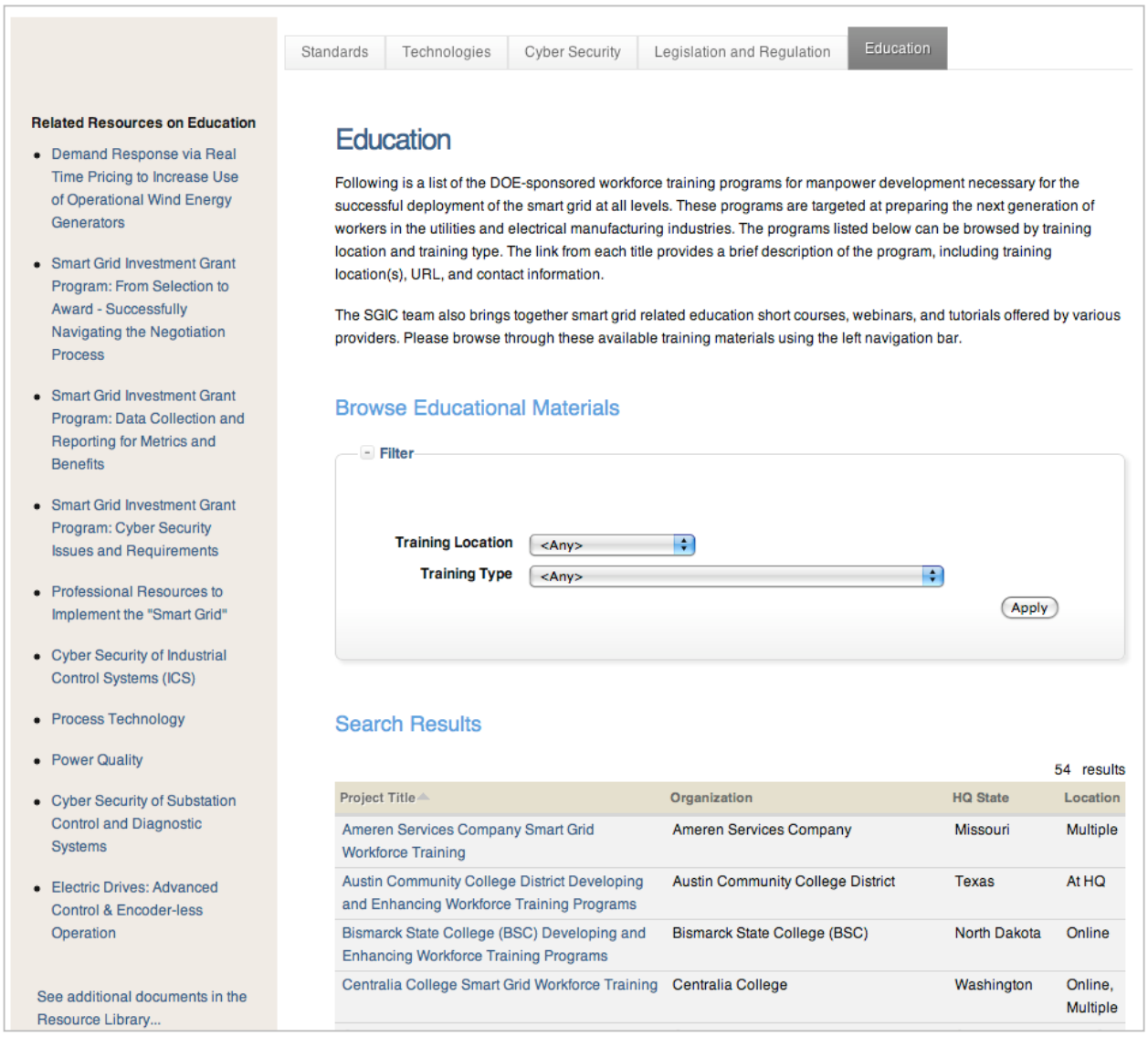

Fig. 28. Browse and sort features for the SGIC education page

As shown at the bottom of Fig. 28, search results are displayed in the list view format. This allows users to sort all programs by Title, Organization, HQ state and Location.

Display: Education programs are displayed in the format shown below. Users can see the program title, organization offered the program, training locations, contact information, program description, training level, URL to the program (if available), as well as the map showing training locations.

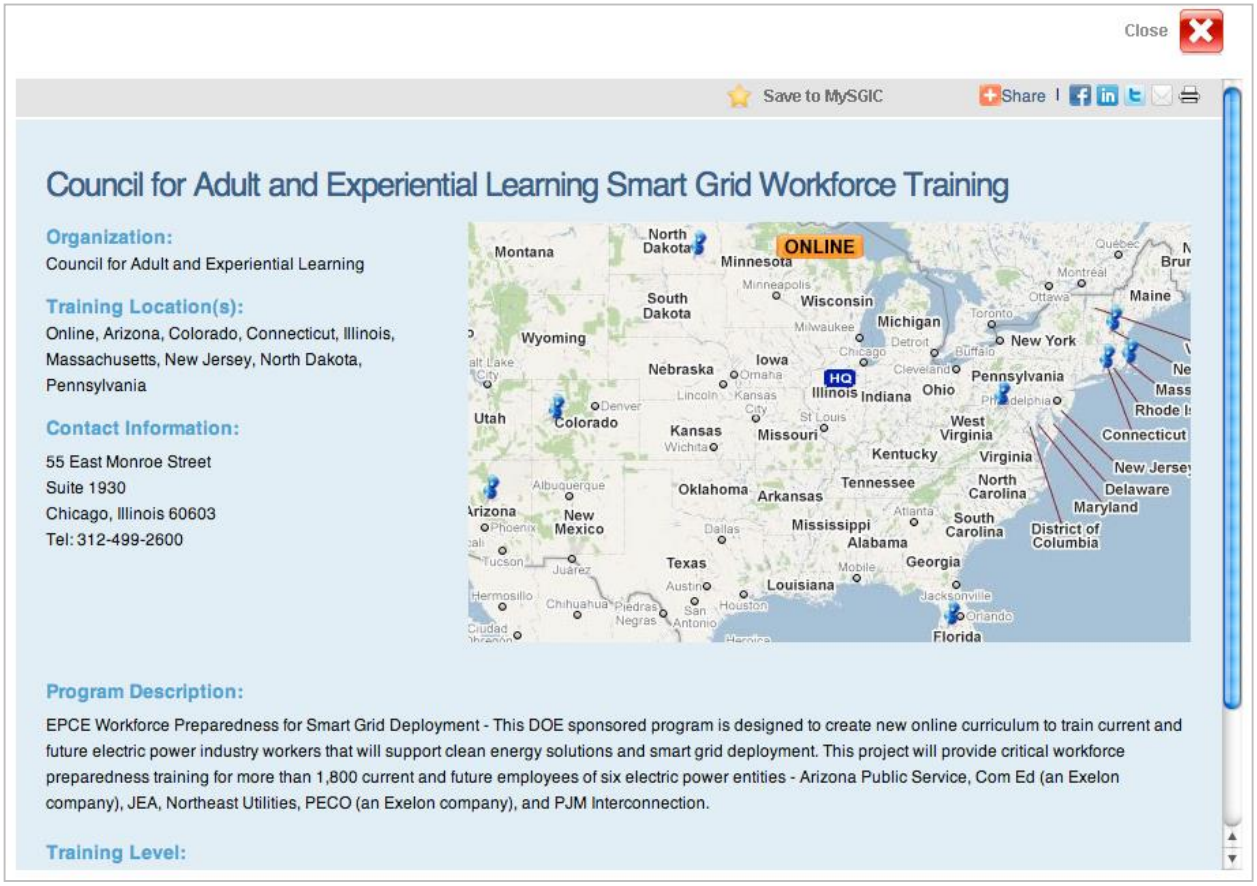

Fig. 29. Detailed view for contents in the education database

5.5.6) Demand response

The SGIC demand response page provides access to demand response-related documents and multimedia. All demand response-related documents were categorized by smart grid domain (i.e., Generation, Transmission, Distribution, Customer, Operations, Markets, and Service Provider), document type (e.g., audio presentation, book, report, slide presentation, etc.) and year.

5.6 International

The SGIC international project page archives information about smart grid projects in Africa, Americas, Asia, Europe and Oceania. The SGIC team proactively searched for smart grid projects internationally. The team reviewed and created the project summary. All project entries were categorized by continent and project category.

- *Continent* includes Africa, Americas, Asia, Europe, and Oceania.
- *Project Category* includes Advanced Metering Infrastructure, Transmission Systems, Distribution Systems, Customer Systems, Equipment Manufacturing, and Integrated Systems.

Project database is displayed in various formats including the map view (see Fig. 30) and the list view (see Fig. 31). The map view enables users to visually see the projects by continent.

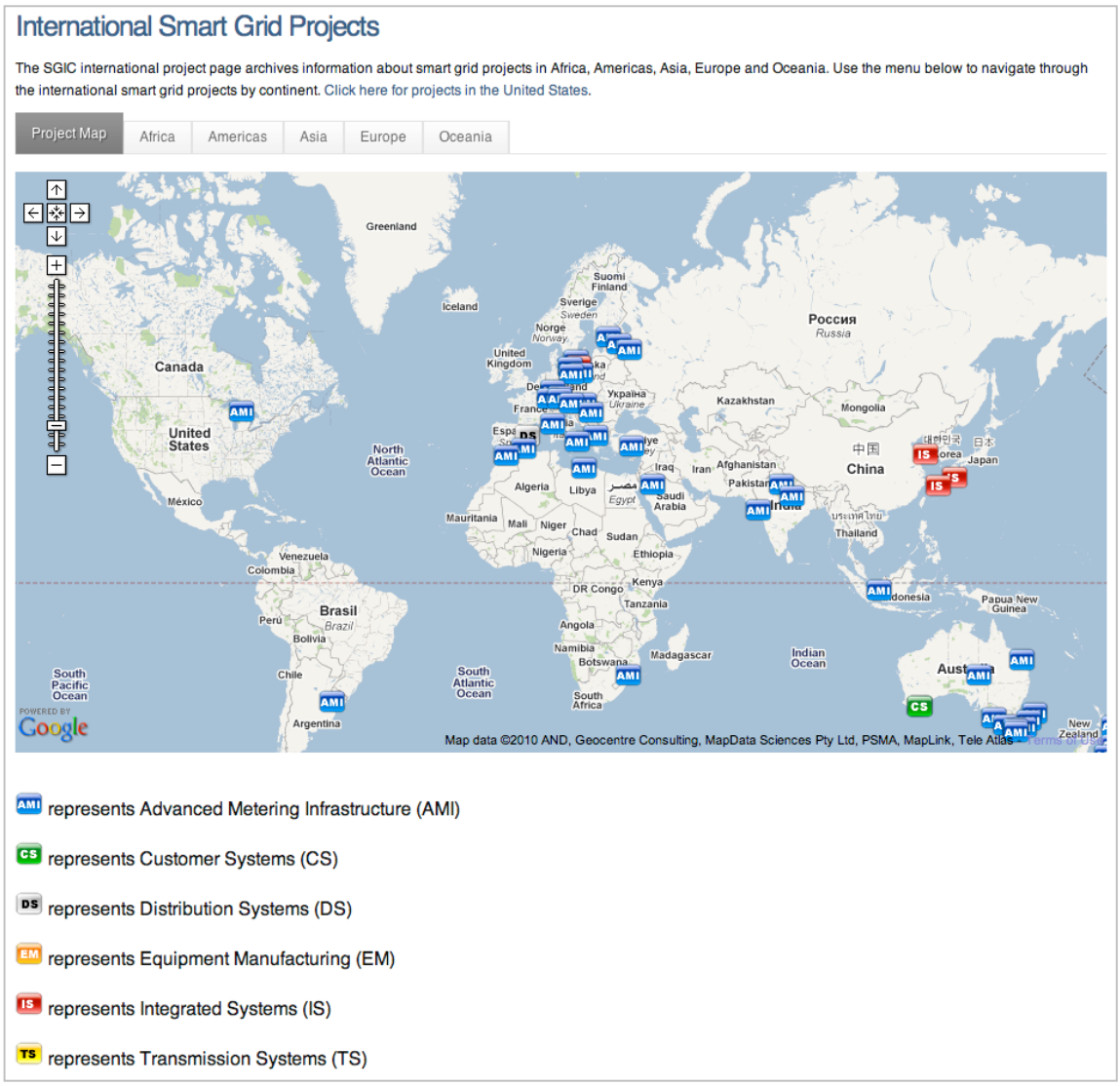

Fig. 30. Map view for international projects

The list view allows users to browse the projects by country and category. As shown in Fig. 31, search results are in the table format, which allow users to conveniently sort the projects by Project Title, Lead Organization, and Country.

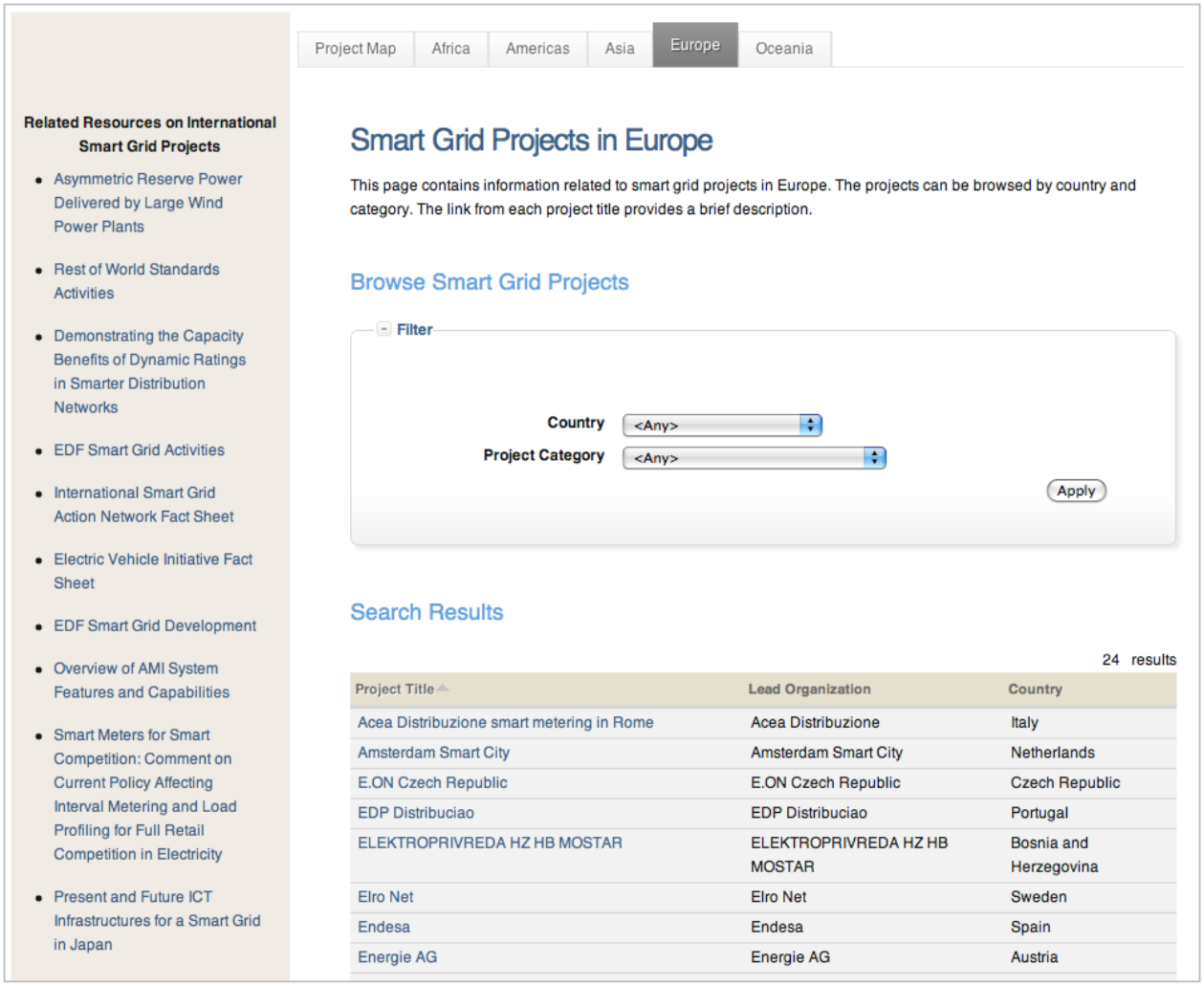

Fig. 31. Browse and sort features for the SGIC international project page (list view)

Display: All projects are displayed in lightbox, as shown below. Users can see the title, project map, lead organization, HQ location, project contact information, project category, project summary and additional information. The project URL, if available, will also be displayed.

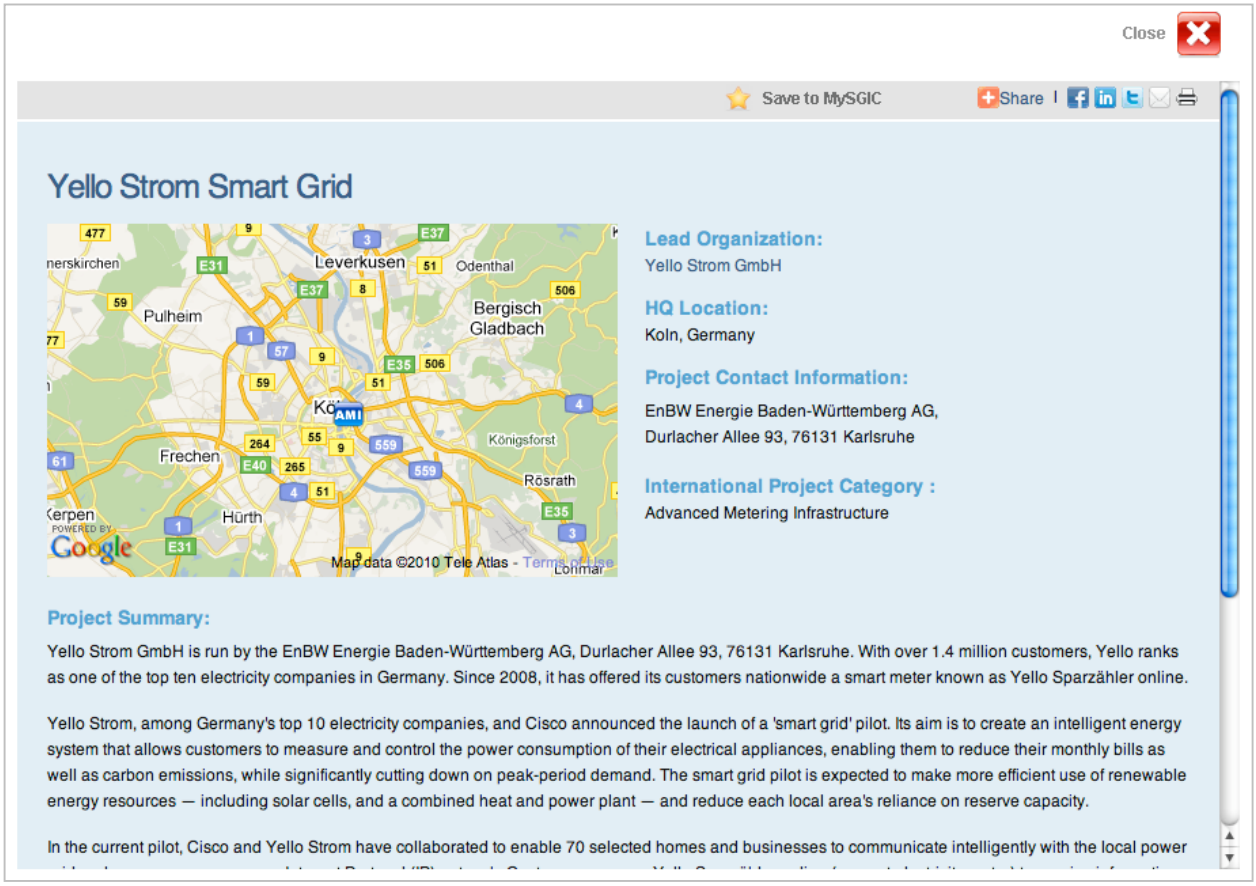

Fig. 32. Detailed view for contents in the international smart grid project database

6.0 SGIC Statistics

We installed Google Analytics, a website statistics monitoring tool, in the SGIC web portal. The objective was to monitor the user activity and to obtain website statistics. This has helped us to understand user preferences and take corrective actions, whenever appropriate. In this section, we present the SGIC web portal statistics from the launch of the portal on July 07, 2010 to August 31, 2014.

The following is a brief overview:

- There were the total of **605,9587 page views.** (See Fig. 33)
- There were the total of **166,554 visits** (61.9% of whom are new visitors).
- The average pages/visit is **3.64.**
- The bounce rate is **51.50%.**
- The average time spent on site is **00:04:12.**

Statistics about top ten countries visiting SGIC web portal are summarized in the table below.

Table 8. Top ten countries visiting SGIC web portal

Country	Visits	Percent
United States	91,617	55.5 %
India	13,126	7.8%
Canada	4,666	2.8%
United Kingdom	3,506	2.1%
Japan	3,158	1.9%
South Korea	3,137	1.9%
Germany	3,114	1.9%
Brazil	2,859	1.7%
China	2,676	1.6%
Australia	2,384	1.4%

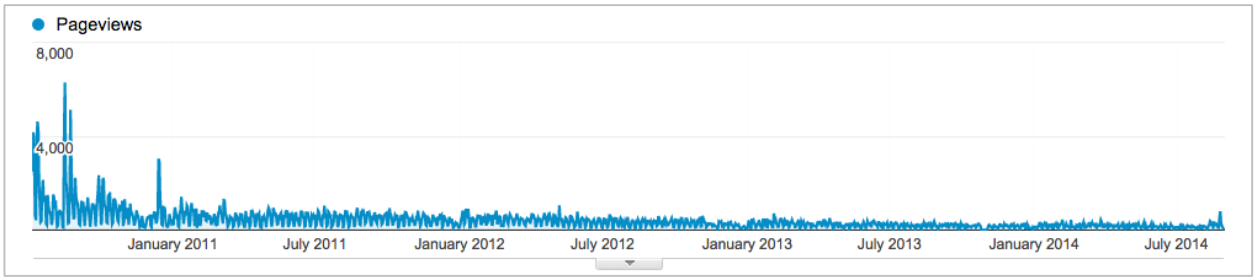

Fig. 33. Number of daily page views from Jul 07, 2010 to Aug 31, 2010 (Total 605,958 page views)

7.0 Publicly Available Information

Results of this work are available from the website at www.sgiclearinghouse.org.

List of publications:

- S. Rahman and M. Pipattanasomporn, “Smart grid information Clearinghouse: Overview of projects and deployment experience,” In Proc. IEEE PES Innovative Smart Grid Technologies (ISGT Latin America) Conference, Medellin, Colombia, 19-21 Oct. 2011.

- S. Rahman and M. Pipattanasomporn, “Smart Grid Information Clearinghouse: A content collection and knowledge discovery model,” In Proc. 16th International Conference on Intelligent System Application to Power Systems (ISAP), Hersonissos, Greece, 25-28 Sep. 2011.