EUCG 2017

EUCG™
Your Energy Information Source

ANNUAL MEMBERSHIP REPORT

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Since 1973, EUCG has brought utility companies together to participate in studies, learn from each other, and share best practices.

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EUCG 2017

EUCG **Vision**

The leading association of global energy organizations enabling our members to optimize resources, drive performance excellence and deliver value to customers.

EUCG **Mission**

We promote end-to-end energy production and delivery excellence by:

- providing relevant, accurate and timely benchmarking information on cost and performance
- promoting outstanding cross functional networking opportunities
- establishing a forum for direct exchange of best practices and lessons learned

Dear EUCG Members:

We are pleased to write to you as the EUCG Board of Directors in this Annual Membership Report. We want to sincerely thank you, the membership of EUCG, for making 2017 another great year for the organization. Since its inception in 1973, EUCG has been a member-driven non-profit trade association focused on serving all of our member companies. EUCG's vision is to be "the leading association of global energy organizations enabling our members to optimize resources, drive performance excellence and deliver value to customers." EUCG is committed to providing the industry's best data and benchmarking studies which will aid our members in making strategic decisions within their own organizations. We are grateful for your active participation.

In 2017, the EUCG Board of Directors and staff continued to work on the strategic initiatives from its updated strategic plan. This work will continue throughout 2018. We are very pleased with the launch of EUCG's new Solar Committee. We are grateful for the energy and enthusiasm of its founding members and encourage you and your company to join this committee if it applies to your business. This exciting new committee will look to expand its membership in 2018 and have its first formal meeting at the Spring 2018 workshop in San Antonio.

2017 was another strong year financially for EUCG. Our financial stability will allow us to continue to invest in member products and services that add value to your membership. As has been said many times, we understand that membership in EUCG is a business decision and, as such, we will continue to make sure that all members receive a positive return on that investment.

2018 promises to be an exciting year for EUCG and its committees. While many of our member companies belong to multiple committees at EUCG, not all do. As you read this report, be sure to look at the all of the great works within all EUCG committees. As you value your specific committee membership, we are certain that your company could benefit from a broad membership in EUCG.

Thank you again for your support of EUCG in 2017 and we look forward to an exciting 2018. It is indeed our pleasure to serve you!

Sincerely,

Your EUCG Board of Directors

Stephanie Maggard
Jesse Medlock
Evelyn Grant
Amy Harris
Matt Dau
Stephen Thornton
David Ward
Eileen Brannon
Chris Utracki
Steve Royall
Ruben Soto

NUCLEAR ENERGY is by far the largest clean-air energy source and also a reliable energy source, which in 2016, fourteen countries relied on to produce 25% or more of their electricity. The average nuclear energy facility is on line 90% of the time, generating on-demand electricity around the clock. Nuclear energy is a secure electricity source that is not subject to changing weather or climate conditions, unpredictable fuel cost fluctuations or over-dependence on foreign suppliers.

NUCLEAR POWER

Continued production of safe, reliable and cost effective nuclear energy are the cornerstones of the nuclear industry. The EUCG Nuclear Committee's Mission supports these efforts by providing members with timely, relevant and comprehensive cost data and the facility to network to resolve industry business operations financial issues to enable sustainable performance improvements in nuclear power.

Message from the Chair:

Today's Nuclear Industry continues as a vital link in delivering efficient energy around the world to sustain economies and quality of life. With new plants coming on line and some older plants being decommissioned, the EUCG Nuclear Committee continues to distribute valued added data and products to its members in a timely and accurate manner. In 2017 the EUCG Nuclear Committee accomplished the following initiatives as directed by the group's strategic plan.

1. Data Access/Management:

Enhance EUCG NC Staffing database structure, usage, and awareness.

This was accomplished by soliciting EUCG Nuclear Committee members' input regarding the use and knowledge of the EUCG Nuclear Committee Staffing database within their respective company. The collected information provided insight to develop communication and education venues for distribution to member companies.

2. Data Improvements:

Improve database products and services to ensure effective usage, credibility and enhanced benchmarking efforts for member companies.

This was accomplished in two areas. The Early Data Exchange database was enhanced by including the following additional data fields: inventory, capital spares and staffing (regular employees and baseline contractors). The second area was in the creation of a Decommission database for the collection of costs and staffing for those plants currently being decommissioned.

3. Member Company Issue Resolution:

Incorporate a disciplined and structured approach for addressing member company issues and assessing member company engagement in EUCG NC and improving communication.

This was accomplished by reviewing the current member company issue resolution process and implementing process changes which enhanced the presentation and exchange of issues. The results provided a more efficient and effective process which was well received by the EUCG Nuclear Committee Membership.

The EUCG Nuclear Committee is the most complete, accurate, and timely industry source for business operations cost data in the world. Data is provided directly by the operating company members and then reviewed and verified by industry peers before the final release. The EUCG Nuclear Committee continues to provide the following nuclear industry cost information to our members:

- Nuclear Operating Cost which includes outage refuel details
- Nuclear Capital Cost which includes major projects
- Nuclear Staffing which includes regular employees and contractors
- Nuclear Industry Benchmark data including the annual Chief Nuclear Officer and Standard Benchmarking reports

The initial release of the previous year's reported data is available to the members in February and the comprehensive/detailed data is available in May. Members also have the ability to initiate ad-hoc data requests as they may arise during the year to address special circumstances or situations for their company.

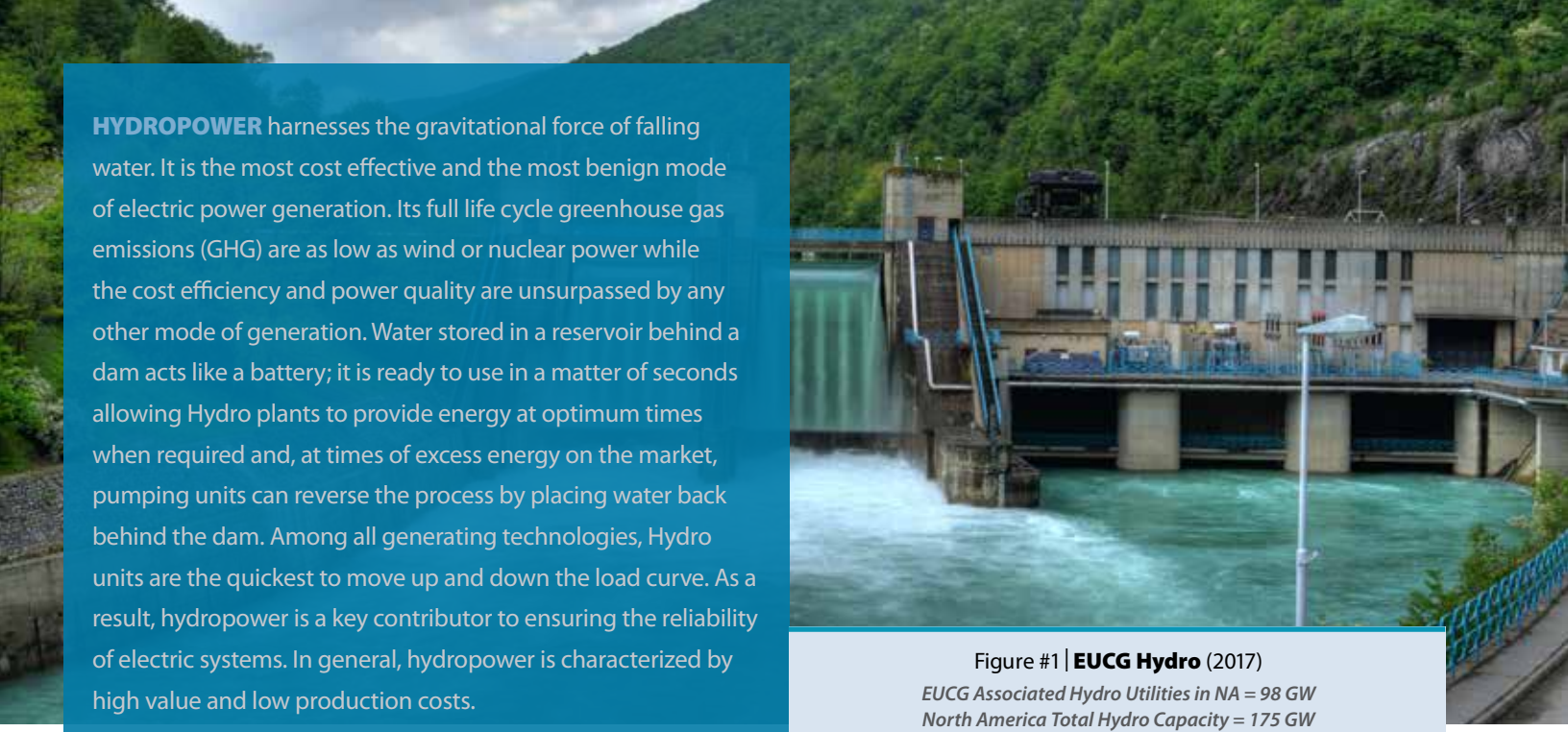
The EUCG Nuclear Committee continues to provide networking opportunities for members to interface with their peers and discuss emerging nuclear business operations issues or items. On a semi-annual basis, these issues are presented before an audience that consists of representatives from nuclear-operating companies in the United States, Canada, China, France, Mexico, Japan, Spain, and Brazil.

The challenge for 2018 for the EUCG Nuclear Committee is to implement the organization's succession plans both within the member companies and the Nuclear Committee Leadership. This will ensure the long-term viability and effectiveness of the Nuclear Industry during a significant transition period for the member companies.

NUCLEAR POWER

Nuclear Committee Members

Ameren Missouri | USA
American Electric Power | USA
Arizona Public Service Company | USA
Asociacion Nuclear Asco-Vandellos | Spain
Bonneville Power Administration | USA
Bruce Power | Canada
Centrales Nucleares Almaraz-Trillo AIE | Spain
CNNC Nuclear Power Operations Management Co. | China
Comision Federal de Electricidad | Mexico
CHUBU | Japan
KEPCO | Japan
SHIKOKU | Japan
TEPCO | Japan
HOKKAIDO | Japan
TOHOKU | Japan
CHUGOKU | Japan
HOKURIKU | Japan
KYUSHU ELECTRIC | Japan
Daya Bay Nuclear Power Operations and Management Co. | China
Dominion Generation | USA
DTE Energy | USA
Duke Energy | USA
Electricite de France | France
Electrobus | Brazil
El Paso Electric | USA
Energy Northwest | USA
Entergy Nuclear | USA
Exelon | USA
FirstEnergy Nuclear Operating Corp. | USA
Horizon Nuclear | United Kingdom
Iberdrola Generacion Nuclear | Spain
Luminant | USA
Nebraska Public Power District | USA
NextEra Energy | USA
North Carolina Electric Membership Corporation | USA
Nuclear Energy Institute | USA
Ontario Power Generation | Canada
PG&E | USA
PSEG | USA
SCANA (South Carolina Electric & Gas) | USA
Southern Company | USA
South Texas Project Nuclear Operating Co. | USA
Talen Energy | USA
Tennessee Valley Authority | USA
Wolf Creek Nuclear Operating | USA
Xcel Energy | USA



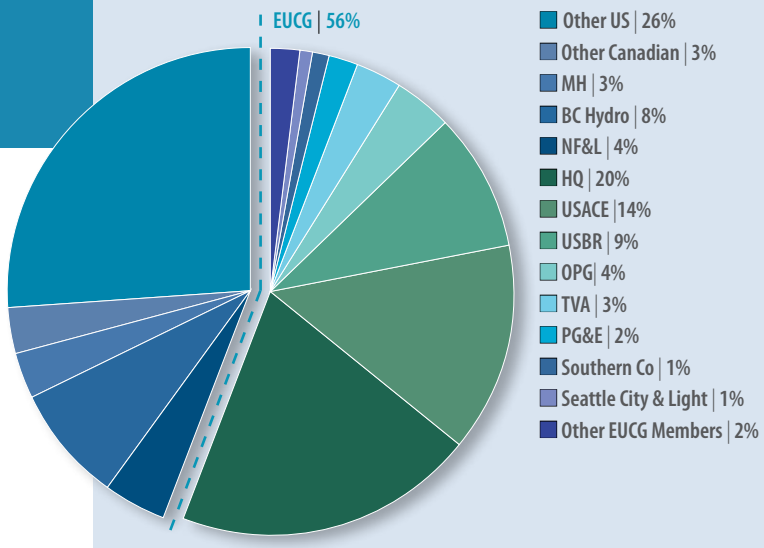
HYDROPOWER harnesses the gravitational force of falling water. It is the most cost effective and the most benign mode of electric power generation. Its full life cycle greenhouse gas emissions (GHG) are as low as wind or nuclear power while the cost efficiency and power quality are unsurpassed by any other mode of generation. Water stored in a reservoir behind a dam acts like a battery; it is ready to use in a matter of seconds allowing Hydro plants to provide energy at optimum times when required and, at times of excess energy on the market, pumping units can reverse the process by placing water back behind the dam. Among all generating technologies, Hydro units are the quickest to move up and down the load curve. As a result, hydropower is a key contributor to ensuring the reliability of electric systems. In general, hydropower is characterized by high value and low production costs.

HYDRO POWER

The Hydroelectric Productivity Committee's (HPC's) mission is to assist member companies in achieving operational excellence by providing relevant, accurate, and timely benchmark information on cost, performance, and best practices. The HPC is currently comprised of 15 international organizations (*figure 1*). Members of the HPC benefit from networking with professionals coming from engineering, operations, accounting, and management positions in hydro utilities. The total capacity of plants operated by EUCG HPC utilities is approaching 100,000 MW, from which over 400 power plants are reported annually in the HPC database *(figure 2 and 3)*.

Figure #1 | **EUCG Hydro** (2017)

EUCG Associated Hydro Utilities in NA = 98 GW
North America Total Hydro Capacity = 175 GW



EUCG Hydro Outside North America

Statkraft = 8.0 GW *ESB = 0.5 GW*
BRA = 1.2 GW

Figure #2 | **EUCG Hydro Database** (2016 Data)

Total: 428 Plants Reported

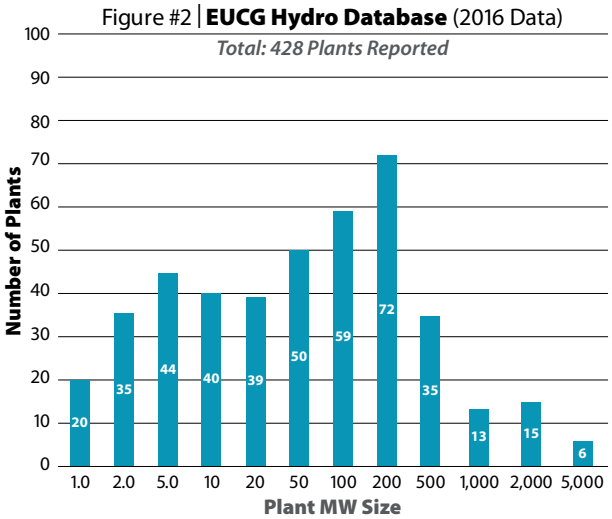
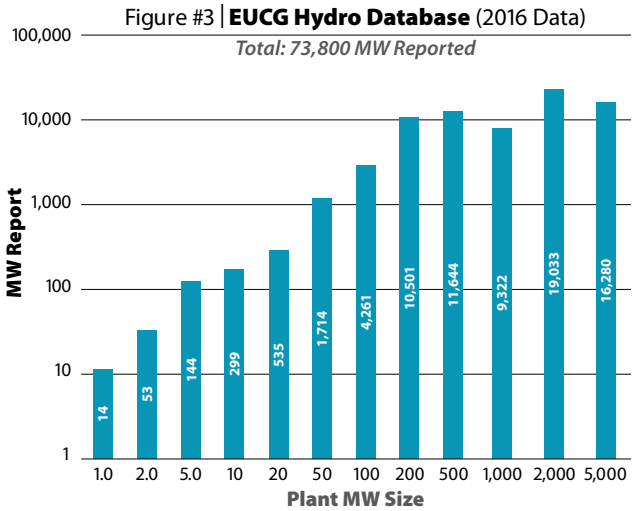


Figure #3 | **EUCG Hydro Database** (2016 Data)

Total: 73,800 MW Reported



Looking Back on 2017

HPC has Three Main Strategic Focus Areas:

1. To continually improve the quality and usefulness of HPC cost and performance data.
2. To provide effective products and forums to help members optimize plant operations.
3. To grow EUCG HPC coverage of the hydropower sector in terms of both installed capacity and number of member utilities.

The Committee had Significant Accomplishments in all Three of These Areas:

To mention a few:

- The annual Peer Data Review was carried out July 2017 in Rosemead, CA. It successfully identified and corrected data submission errors and ensured HPC data for 2016 was complete, consistent, and accurate.
- Continuous benchmarking methodology was used effectively in the evaluation of leading plant performance. This methodology, developed by EUCG HPC, accounts for economies of scale to put hydro plants of all sizes on a level playing field, eliminating the need to separate them into peer groups, as is generally done in traditional approaches. In addition, it quantifies the tradeoffs between plant MW size and the number of units providing insight into the O&M requirements of different Hydro plant designs. In simple terms, this methodology eliminates factors that are outside plant management control, leaving cost performance measures more directly linked to factors for which management can, in fact, be held accountable.
- Spring and Fall workshops delivered many interesting papers. Worth mentioning are papers that sum up industry experience such as measuring Commercial Availability, Outage Performance metrics, Asset Management program best practices, and Lockout/Tagout procedures.

The Year Ahead

The Committee has an ambitious agenda for 2018. It will continue on the path of data quality improvement and at the same time enhance value-added analyses. The plan is to further explore the synergy of collaboration with Oak Ridge National Laboratory. One area targeted for such development is ability to evaluate impact from locational labor or material price indices (which, similarly to economies of scale, are not under management control). Another topic the Committee will continue to pursue in 2018 is the ever-growing issue of integration of intermittent renewables and their impact on hydro plant operations and costs. This is all in addition to the routine tasks such as documenting industry performance, trends and benchmarks in the HPC Annual Report.

HYDRO POWER

Hydro Committee Members

Bonneville Power Administration | USA
Enel Green Power | USA
Eugene Water & Electric Board | USA
Hydro Québec | Canada
Meridian Energy Limited | New Zealand
New Brunswick Power | Canada
Oak Ridge National Laboratory | USA
Ontario Power Generation | Canada
Pacific Gas & Electric Company | USA
Seattle City Light Company | USA
Southern California Edison | USA
Southern Company | USA
Tennessee Valley Authority | USA
U.S. Army Corps of Engineers | USA
U.S. Bureau of Reclamation | USA

Benefits of Membership

Benchmarking is the Main Activity of the Committee.

It is Accomplished through:

— Annual cost and performance reports
— Web based access to database for standard and custom reports
— Staffing and safety survey reports
— Ad hoc surveys run in response to member needs
— Discussions, presentations and networking opportunities at the spring and fall workshops.

Cost and Performance data is collected in the HPC Database accessible to members on the web. Significant effort is given to maintaining high data quality. Data is peer reviewed each year which results not only in better data quality but also a better understanding of the reporting methodologies different utilities use.

Data quality is achieved through:

— Automatic data validity checks
— Peer data audit meetings
— Continuous improvement of reporting standards
— Web access with quick turnaround time
— Centrally controlled website and data security
— User-friendly interface that evolves with users' needs
— Very, very low cost of service

Two semi-annual workshops, held in spring and fall, provide the opportunities to discuss issues and practices with peers. One of the key competitive advantages of HPC membership is the committee's flexibility to address different topics and the speed with which one can obtain information directly from the source. The Committee endorses give-to-get principles by which one has to contribute in order to receive corresponding information from other members.

FOSSIL POWER Challenges to fossil power generation continued to increase in 2017. The Clean Power Plan, Coal Combustion Residuals Rules, updated steam electric effluent limitation guidelines, MATS, future regulatory uncertainty, and increasing capex costs are creating significant changes in the fossil generation market. These regulations, market pressures, and the increasing impact of renewables combined with low natural gas prices, continue to challenge utilities in long-term strategic portfolio planning. General economic conditions and the lack of load growth in many areas are also strong contributors to the challenges faced by generators. Within many areas of the country, our regulated footprint will have flat (or possibly slightly negative) load growth for the near future. That reduced demand puts cost pressures on all fossil facilities.

FOSSIL POWER

Having an opportunity to learn how fossil industry professionals are navigating the rapidly changing utility business from all regions of the country is invaluable. The EUCG Fossil Generation Committee (FGC) provides regular chances for members to meet with subject matter experts from across the industry to learn best practices, and to participate in benchmarking studies that provide them opportunities to learn how other companies are addressing common industry challenges. The committee maintains databases of standard cost and performance metrics, updated annually, for both conventional steam EGUs and CC/CT plants. Members may also sponsor surveys focused on topics of special interest, such as commercial availability, inventory management, cycling costs for combined cycle plants, and lock-out/tag-out procedures.

In addition to benchmarking opportunities, the FGC provides several opportunities to learn best practices. In 2017, the spring and fall EUCG workshops featured presentations and member-led panels on safety case studies and industry safety events, employee-driven safety programs, fleet flexibility, unit retirement decisions and strategies, MATS challenges, CT technology upgrades, NERC CIP compliance, operator training, lock-out/tag-out procedures, lean initiatives and continuous improvement, and identifying metrics for the changing energy market.

Looking to 2018, the committee will focus on creating a long-term strategic roadmap and on reviewing the annual cost and performance databases to ensure continued relevancy. In addition, committee workshop presentations and survey results will be available to members in a searchable, web-based resource library.

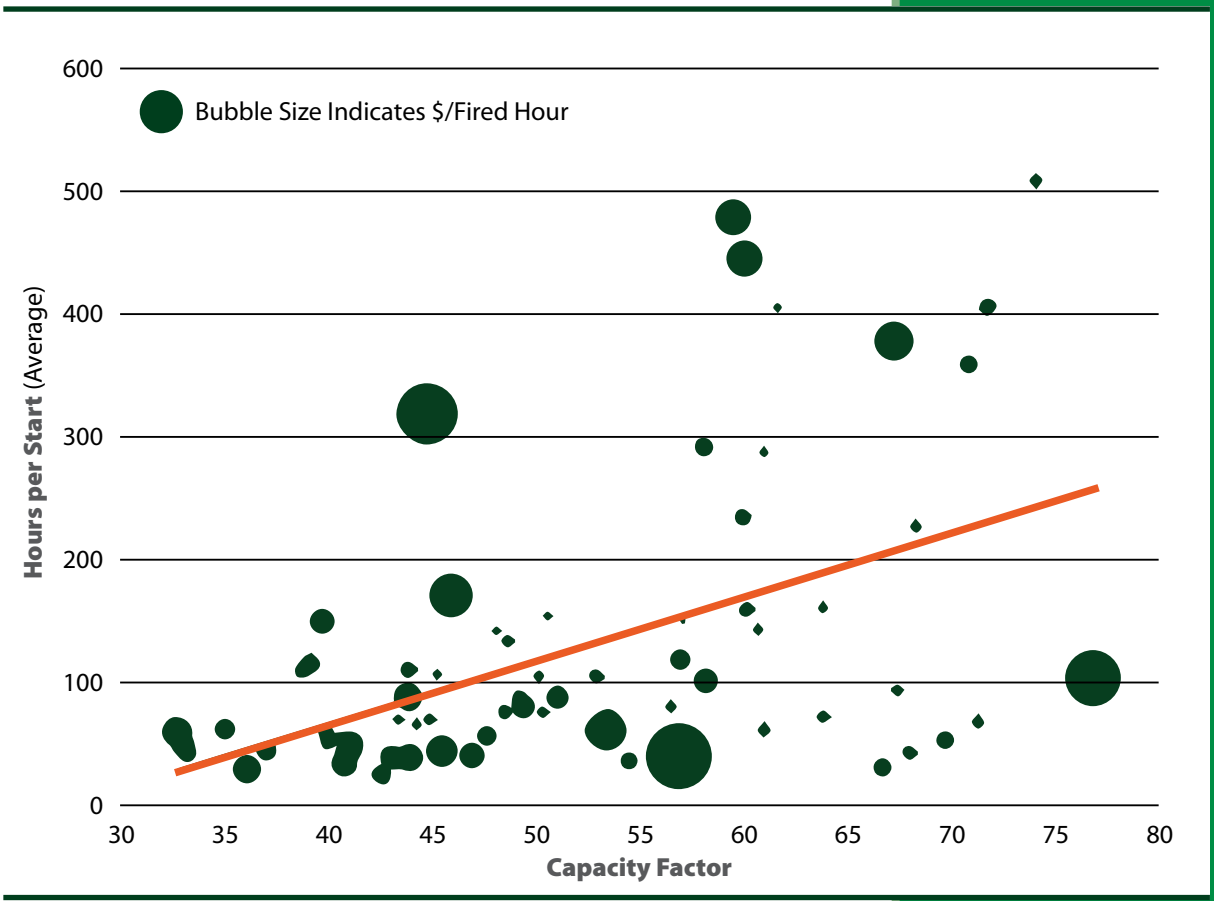
Potential EUCG spring workshop topics include human performance improvement programs, the use of drones in fossil plants, leadership development, CC/CT staffing practices, a panel on safety fairs and hazard recognition courses, lock-out/tag-out best practices, balancing reliability and cost, teaching effective decision-making, coal unit performance improvement, and preparing for major storms.

FOSSIL POWER

Fossil Committee Members

Ameren Missouri | USA
Austin Energy | USA
Consumers Energy | USA
CPS Energy | USA
DTE Energy | USA
Exelon Generation | USA
Hawaiian Electric | USA
Israel Electric Corporation | Israel
Khanom Electricity Generating Co., Ltd. | Thailand
Korea East-West Power Co., Ltd. | South Korea
Lower Colorado River Authority | USA
NB Power | Canada
Ohio Valley Electric Corporation | USA
Omaha Public Power District | USA
Owensboro Municipal Utilities | USA
Pacific Gas and Electric Company | USA
PSEG Fossil | USA
Salt River Project | USA
Southern Company | USA
Tennessee Valley Authority | USA

Example of operating costs of combined cycle facilities with varied operating profiles from peaking to base loaded



SOLAR POWER is the conversion of sunlight into electricity. It's the cleanest and most abundant renewable energy source available. As a result, Photovoltaic (PV) Solar technology has experienced a rapid growth and is predicted, by the International Energy Agency, to reach 3,000 GW globally or 11% of projected global electricity by 2050.

SOLAR POWER

MISSION:

Maximizing the safety, efficiency, reliability, and value of large scale Solar PV technology through standardization of O&M best practices and performance measures

VISION:

Capture and share existing O&M best practices through regular contact and benchmarking among utilities to maximize the safety, effectiveness, and value of PV technology

Message from the Chair:

*I'm very excited to introduce the **"New" PV Solar Committee (PVSC)** to EUCG's family of electric utility members. Our core team with a combined 61 years of experience, have made great progress in the standardization of PV Solar performance measures. We're committed to building new partnerships and strengthen existing ones by leveraging our diverse backgrounds and experiences to improve the PV Solar community.*

Upcoming Solar Member Benefits:

- **Key Performance Indicators (KPIs)** – Standardized financial and plant performance measures for consistent benchmarks between committee members
- **Peer Networks** – Provides opportunities for industry professionals to share knowledge regarding lessons learned, O&M costs, and best practices
- **Member Driven** – Empowers Committee members to determine the content and direction of the committee to meet the needs of the evolving industry
- **Workshops** – Semi-annual workshops that foster interactive discussions between members regarding current and emerging issues facing the industry during a significant transition period for the member companies.

Products and Services

- **Solar Information Database** – Collection of data from Key Performance Indicators (KPIs) that enables users the flexibility to perform customized data analytics to compare performance amongst peers
  - **Safety**
  - **Cost Efficiency Measures – $O&M/kw/MW**
  - **Capacity Factors**
  - **Performance Ratio – Actual Energy/Expected Energy**
  - **Availability**
  - **Energy Yield Ratio**
- **Data Repository** – Provides reference materials that contain information on topics regarding Operations and Maintenance of Solar facilities
- **Solar O&M Best Practices** – Knowledge sharing with industry professionals to improve safety, efficiencies, and value of PV technology
- **Data Integrity Reviews** – Provides a platform to validate data consistency amongst members and arms members with a high level of confidence to share results with benchmark sponsors.

SOLAR POWER

PV Solar Committee Members

Arizona Public Service | USA

Pacific Gas & Electric | USA

Salt River Project | USA

Southern California Edison | USA

Outlook

Our outlook will be focused on a successful launch and implementation of EUCG's newest user group the PV Solar Committee (PVSC).

A successful launch will deliver on all of the major milestones identified in our implementation schedule, including membership growth through solicitation of existing EUCG members who own PV Solar and existing contacts.

Our goal and expectation is to participate in 2018's Spring Workshop at the capacity of a new user group.

Again, we look forward to growing our partnership with EUCG and its members.

Chairman

Ruben Soto

Southern California Edison

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Vice Chair

Jeremy Garcia

Arizona Public Service

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Vice Chair

Ernie Tom

Salt River Project

ernie.tom@srpnet.com

POWER. Every facet of modern society depends on it. **DELIVERY**. Our customers depend on it. **TRANSMISSION** Bulk Power Systems and **DISTRIBUTION** Grid Systems get it done for millions of our customers throughout the world, no matter the generation sources. The technical challenges of keeping the T&D grid up and providing high power quality at a low price are significant. As, in some instances, the mix of generation changes and supply becomes more distant relative to load, the challenges can only grow. This is compounded by the increasing pressures to keep overall costs low, and counter pressures to modernize and harden the grid, and causes the sharing and identification of better practices among utility peers to be abundantly important.

TRANSMISSION & DISTRIBUTION

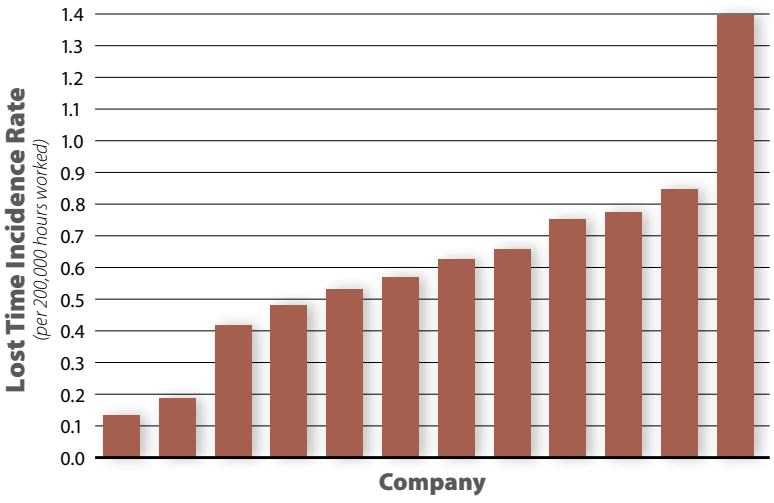
T&D Benchmarking is vital to our overall industry and the individual participating utilities. The ability to partner and collaborate among industry participants to identify better practices presents unique opportunities for the T&D Utility community as compared to other industries. Herein lies the value of participating with the EUCG T&D Committee. The T&D member community allows us to leverage better practices and benchmarked data across the member utilities, as well as engage and expand our community network in a secure environment free of third party influences. To the extent that we can acknowledge and leverage this advantage, our companies, employees, and the customers we serve will reap the benefits.

The efficiencies and discipline required to deliver energy in an expanding and changing environment while controlling costs, maximizing reliability and maintaining employee and public safety, mandate that we collaborate and work together to identify and propagate that next "great idea" that will transform some aspect of our business practices so that the next incremental improvement is realized.

As a member, not only will you have access to current members and their practices, you will have access to more than a decade of best practices presentations. Data is available on a give-to-get basis.

Our T&D Safety, System Reliability and Cost data sets continue to evolve and improve. In 2017, the T&D Committee members kicked off two significant initiatives. One initiative is focused on identifying and developing potential leading indicator metrics within the ever-important Safety arena. The second initiative's focus is to continue to improve the Transmission Cost Study. Growing these particular studies will be the Best in Class. As always, members can be sure that all databases are and will continue to be professionally managed and protected.

Distribution *(no meter readings)*



TRANSMISSION & DISTRIBUTION

T&D Committee Members

American Electric Power | USA

American Transmission Company | USA

Baltimore Gas & Electric | USA

CenterPoint Energy | USA

ComEd | USA

Duke Energy | USA

Ghana Grid Company | Ghana

Hawaiian Electric | USA

Israel Electric Corporation | Israel

Oncor Electric Delivery | USA

Pacific Gas and Electric Company | USA

PECO | USA

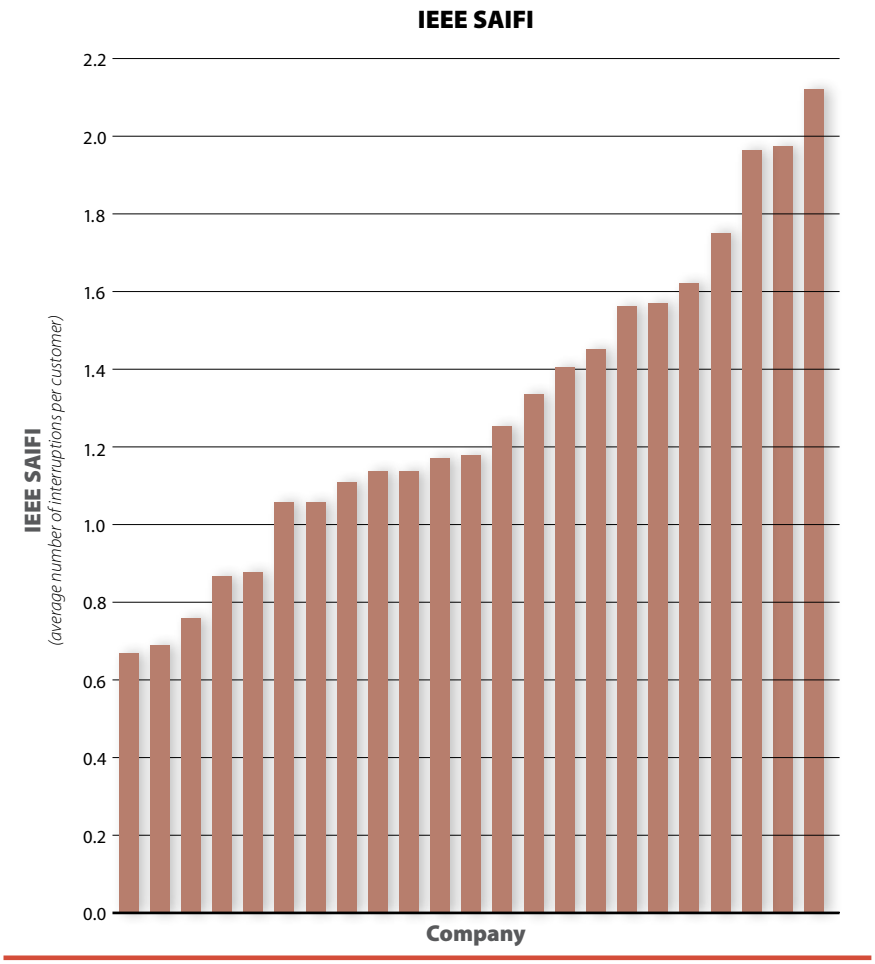
Pepco Holdings | USA

PSEG | USA

Salt River Project | USA

Southern California Edison | USA

Tennessee Valley Authority | USA



This year, EUCG had two productive workshops for our valued member companies. Our workshops have become "can't miss" member events that deliver significant educational, training, and networking opportunities. We are so pleased that EUCG's member companies continue to recognize the value of the collaboration and best practice sharing that takes place at our workshops, and the far-reaching benefits that result in the workplace.

WORKSHOPS

2017 saw EUCG hold its workshops on both coasts that provided wonderful backdrops for education and networking. Our Spring workshop was held in April in Charleston at the Marriott Charleston. We were pleased to have Patrick Schwerdtfeger as the Keynote Speaker. Patrick discussed "Big Data" including technology, data trends, and artificial intelligence. The committee sessions and presentations were top-notch and the networking and best practice sharing were second to none.

In September, we headed out to the Pacific Northwest and made our first trip to Portland, Oregon at the Portland Marriott Downtown Waterfront. The workshop kicked off with a riveting general session with keynote speaker Gary Norland and his impactful talk on the importance of workplace safety. This workshop saw the continued increasing collaboration among committees. There were joint sessions on commercial availability with the Fossil and Hydro committees and another joint session on operations and safety with the Fossil and T&D committees. The networking dinner event, held at the Oregon Museum of Science and Industry, proved to be a great night out for all. At dinner, members were able to continue to enhance their networks and relax among new and old friends.

Going forward in 2018, we will continue to raise the bar on our workshops and ensure that they deliver content you desire and can act upon to improve your company's strategies and results. We will also continue to enhance our execution of all of the operational aspects of the meetings. In April 2018, we will be heading to the Hyatt Regency in San Antonio, Texas. We will then travel west to Denver, Colorado and host our Fall Workshop at the Denver Grand Hyatt. So, please join us in 2018 to learn, network, and better prepare for success in the future.

FUTURE EVENTS

2018 Spring Workshop

Hyatt Regency San Antonio
April 22-25, 2018
San Antonio, TX

2018 Fall Workshop

Grand Hyatt Denver
September 9-12, 2018
Denver, CO

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Your Energy Information Source

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