COMMENTS ON QUADRENNIAL ENERGY REVIEW: ELECTRICITY TRANSMISSION, DISTRIBUTION AND STORAGE BY THE ENERGY STORAGE ASSOCIATION

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Background

The Energy Storage Association ("ESA") is an industry association that was established over 25 years ago to foster development and commercialization of energy storage technologies. Since then its mission has been the promotion, development and commercialization of competitive and reliable energy storage delivery systems for use by electricity suppliers and their customers.

ESA members represent a diverse group of entities, including electric utilities, energy service companies, independent power producers, technology developers involved with advanced batteries, flywheels, thermal and compressed air energy storage, pumped hydro, supercapacitors and component suppliers, such as power conversion systems. ESA's members also include researchers who are committed to advancing the state-of-the-art in energy storage solutions. See Attachment 1 for a full list of ESA members.

The ESA is committed to the following guiding principles:

- Energy storage is the key to a resilient, efficient, clean and cost-effective grid.
- National and state policy should take full advantage of the opportunity to fully integrate storage to reduce outages and avoid overspending to modernize the grid.
- Investing in energy storage will ensure economic security, foster innovation, and create sustainable jobs.
- Energy storage must be carefully considered by electric utilities, system operators, regulators, policy makers and other electricity providers and customers as we transition to a true 21st century grid.

General Comments

The ESA agrees with the statement by the Department of Energy ("DOE") that "to serve a 21st century consumer base, the grid must adapt to emerging challenges and opportunities: fluctuating energy prices, an increasingly transactive role for customers, integration of distributed energy resources, the need for improved resilience, and the need to act as an enabling platform for reducing greenhouse gas emissions." [1] The ESA also believes that key to that adaptation and ultimately meeting long-term goals is the deployment of energy storage technologies and applications that can enable the transformation of the grid into a more reliable, cost-effective, efficient and cleaner system. Key attributes of energy storage that should be considered in the QER report include:

- **Storage technologies are viable alternatives to generation, transmission, and distribution investments.**
    - In 2014, procurements of 25, 50, 60, 200 megawatt (and more) storage systems are being made across the country, as alternatives to generation, transmission, and distribution investments as costs have become competitive with traditional grid assets, and operational benefits have been analyzed, valued and proven.
    - Energy storage can be controlled with a high degree of accuracy and precision by both transmission and distribution system operators. FERC acknowledged in Order 755 that the speed and accuracy with which energy storage can react has an inherent value to the grid system beyond the energy delivered.[2]
    - Energy storage can provide services that can be transacted in the wholesale market. FERC Order 755 and 784[3] affirmed that ancillary services can be provided by energy storage applications. Additional markets, including eligibility for Capacity and Resource Adequacy, are being considered for energy storage as well.

- **Storage technologies improve the efficiency and utilitization of existing grid assets.**
    - Energy storage can interconnect at points from the generator, throughout the grid system, to the customer location. The basic premise of the utilization of the most effective and efficient resources at all times should remain as the cornerstone of a future, "two-way" grid. The technical capabilities of energy storage will help enable such a practice, even as the supply system becomes more dynamic and localized.
    - Energy storage is fuel-neutral and can be charged from any resource on the grid. In fact, as a flexible resource, energy storage can serve to both inject and absorb supply, providing double the flexible capacity of traditional generation and

[1] U.S. Department of Energy Briefing Memo from Quadrennial Energy Review Task Force Secretariat and Energy Policy and Systems Analysis Staff, United States Department of Energy, September 4, 2014

[2] FERC Order 755 can be found here: http://www.ferc.gov/whats-new/comm-meet/2011/102011/E-28.pdf

[3] FERC Order 784 can be found here: http://www.ferc.gov/whats-new/comm-meet/2013/071813/E-22.pdf

allowing all types of generation, including variable resources, to function more smoothly.

- **Storage technologies improve grid reliability and resiliency.**
  - Energy storage is able to provide seamless back-up power to electric service when the utility grid is compromised.[4]
  - Energy storage technologies, with the implementation of Order 755, are now providing ancillary services for frequency regulation.
  - The State of New Jersey has recognized that energy storage can serve as a reliability resource, instituting an "Energy Resilience Bank" that funds energy storage as back-up to distributed renewable systems in areas of critical need.[5]

Comments on Distribution Energy Storage

Energy storage assets connected to the distribution system that are solely storing electricity to return to the grid at a later time--providing transmission or distribution services, peak capacity, or other ancillary services to the utility--should be able to charge at wholesale electricity market rather than at retail prices. Further, energy storage assets should be able to net their injections from their withdrawals when being assessed transmission and distribution charges as a retail customer. Currently, energy storage at the distribution level must pay retail energy and demand charges while charging, making the operating cost of deploying storage, for peak shaving or ancillary services, at the distribution level higher than at the transmission level[6], and providing a disincentive for storage investments at the distribution level. Regulatory schemes in which the T&D charges are based on total energy (kilowatt-hours) withdrawn from the grid over a billing period do not net out the energy injected back to the grid as part of the storage project's operations. In essence, under this regulatory scheme, storage projects, which withdraw and inject energy as part of their normal operations and which only ultimately use or consume the net of their injections and withdrawals, are unduly penalized. Effectively, the energy is charged twice – once when initially withdrawn from the grid by storage projects, and then again later when the energy is injected back to the grid and is ultimately consumed by another end-user.

Comments on Investment and New Construction

Upgrades to and expansion of our transmission and distribution system can come at a high social and economic cost. Further cost is added when system conditions and policy priorities are subject to change, causing upgrades to be stranded with unnecessary risk and cost passed along to consumers. Energy storage can provide some mitigation to that risk, allowing for more flexible and mobile deployment of assets.[7]

Comments on Transmission Planning and Alternatives

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[4] AEP deployed demonstration community energy storage systems that could provide ancillary services to the utility as well as temporary back up service in case of outage. http://energystorage.org/energy-storage/technology-applications/community-energy-storage

[5] Energy Resilience Bank information can be found here: http://www.state.nj.us/bpu/commercial/erb/

[6] FERC allows storage connected at transmission to net its energy consumption at the wholesale price of electricity (LMP).

[7] One project was relocated from California to West Virginia because the system need changed. That battery system, built into mobile trailer containers, was moved easily by truck.

ESA believes that energy storage can provide an alternative to transmission as laid out in FERC Order 1000. [8] In Texas, a battery project was able to receive treatment as transmission deferral and the utility given rate recovery for the asset. [9] ESA asserts that, in addition to transmission deferral options, energy storage can effectively enable the most efficient use and integration of preferred renewable energy resources while being made available to all resources on the grid. As resources (including preferred) are dispatched effectively with energy storage, the grid can be most reliable and cost effective, at the same time reducing greenhouse gas emissions on the system. Using energy storage to defer investment in additional transmission and distribution assets will provide additional benefits to the utility and consumers. To that end, we recommend including energy storage in any overall transmission planning processes in the context of Order 1000 compliance.

Comments on Storage as Transformational

In order to fully appreciate how energy storage can transform the grid, it is important to note the role storage has already been playing and the full range of benefits those applications provide. ESA has seen that energy storage technologies and applications: enable all generation sources on the grid to operate more efficiently, flexibly, and resiliently; facilitate integration of renewable energy resources on the grid; reduce greenhouse gas emissions; and lower costs for consumers. Energy storage resources are currently deployed and operating on the nation's grid and are used in a variety of applications to balance generation and load in an efficient and cost-effective manner. Energy storage technologies are ideally suited to assist with grid resiliency and increased reliability. Energy storage can reduce greenhouse gas emissions. A study by Carnegie Mellon in October 2008 estimated that 20% of the CO2 emission reduction and up to 100% of the NOX emission reduction expected from introducing wind and solar power will be lost because of the additional ramping requirements these resources impose on traditional generation.[10] Storage provides the flexibility to integrate renewables into the electric grid without consuming additional fossil fuels needed to meet the ramping requirements of renewable energy generation resources.

Many energy storage facilities are in operation or under construction, providing a rich operating history across a range of applications and use cases. The table (*Figure 1*) shows a partial list of energy storage projects planned by utilities and system operators. This is simply a sample of the multiple energy storage projects under development; many more are in development due to mandates from California [11] and efforts in other states.

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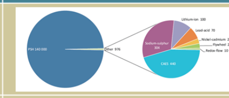
[8] Order 1000 and accompanying documents can be found here: http://www.ferc.gov/industries/electric/indus-act/trans-plan.asp

[9] See story about Presidio, Texas project here: http://www.aep.com/newSroom/newSreleaSeS/Default.aspx?id=1560

[10] Katzenstein, W., and Jay Apt. Air Emissions Due To Wind And Solar Power. *Environmental Science & Technology*. 2009, 43, 253-258. http://pubs.acs.org/doi/pdf/10.1021/es801437t

[11] California energy storage target can be found here: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M078/K929/78929853.pdf

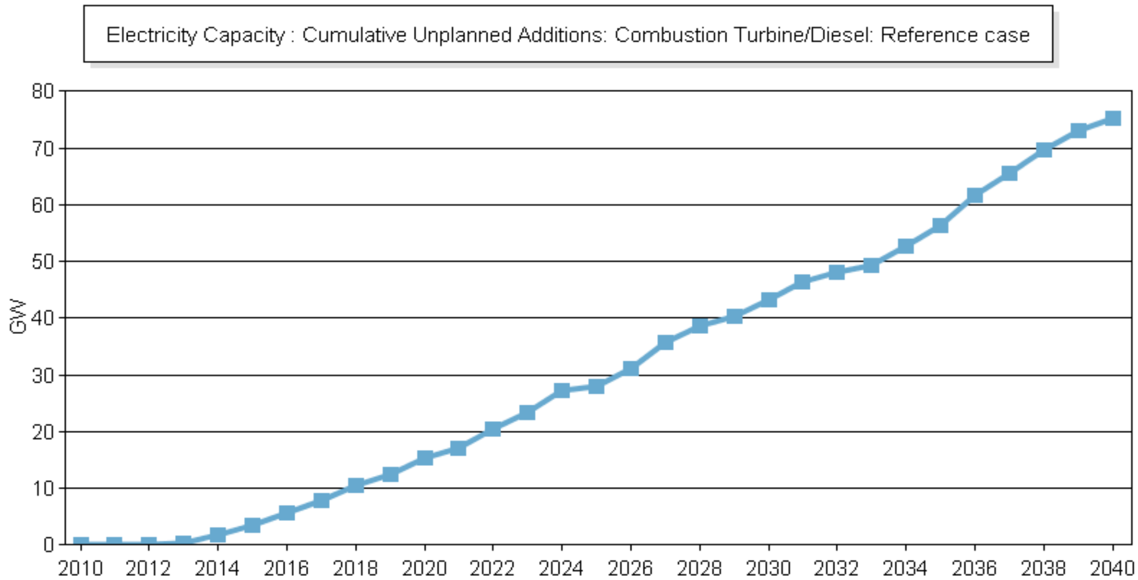
Figure 1. Example Recent Energy Storage Project Development Chart, Courtesy EnerVault Corporation

Organization	Size (Power)/Duration)	Status	Description
	14 GW/6 hours	140,000 MW PHS; 800 MW CAES, NAS, and Flow 250 MW Li-ion, Pb-acid, flywheel	
Terna Rete Elettrica Nazionale	35 MW / 7 hours	Installed NAS	Contract awarded (May 2013)
ほくでん (Hokkaido Electric)	12 MW / 5 hours	Underway	Contract awarded (July 2013)
PG&E	Min 1.5 MW / 4 hours	In Contracting	RPS RFO (Dec 2013) PV+ Storage; 1.9X TOD, penalize intermittency, curtail rights
ieso	50 MW	34 of 50 MW selections announced	RFP issued (March 2014), selections announced (July 2014) to increase wind and solar use
Southern California Edison	50 MW/4 hours	In contract negotiations	RFP issued (October 2013) for local capacity requirements
PSEG Long Island	150 MW /12 hrs	In short-listing (Mar 2014)	RFP issued (November 2014) post Superstorm Sandy
California ISO Shaping a Renewed Future	Avg 58 MW >2 GW Storage Interconnects	Cluster 7 Applications closed (April 2014)	Interconnect application increased from 0 (cluster 6, 2013) to 36 projects Typical size 25 and 50 MW Average application fee: $105k
conEdison	58 MW / 12 hours	RFI July 2014	12 hour demand reduction beginning 2016
HECO	60 MW / 0.5 hours	RFP July 2014	HECO response to PUC over-ruling capital plan because not solving problems of DG
SDGE	>25 MW / 4 hours	RFP September 2014	To meet Local Capacity Requirements, alternative to CT
Terna Rete Elettrica Nazionale	2MW / 4 hours	RFP Oct 2014	Flow battery demonstration
PG&E, Southern California Edison, SDGE	PG&E: 80.5 MW / 4 hours SCE: 16 MW / 4 hours SDG&E 16.3 MW / 4 hours	RFP Dec 2014	First procurement for AB 2514, 1325 MW (October 2013), Procurement plan approved July 2014

The U.S. Energy Information Administration projects that approximately 40 gigawatts of peak generation will be needed over the next 15 years (see *Figure 2)*. Chet Lyons of Energy Strategies Group published a paper titled "Guide to Procurement of Flexible Peaking Capacity: Energy Storage or Combustion Turbines?" making the case that most of this projected peaking capacity can be provided by energy storage.[12]

[12] Lyons, Chet. Energy Strategies Group. Guide to Procurement of Flexible Peaking Capacity: Energy Storage or Combustion Turbines? http://www.energystrategiesgroup.com/wp-content/uploads/2014/10/Guide-to-Procurement-of-New-Peaking-Capacity-Energy-Storage-or-Combustion-Turbines_Chet-Lyons_Energy-Strategies-Group.pdf

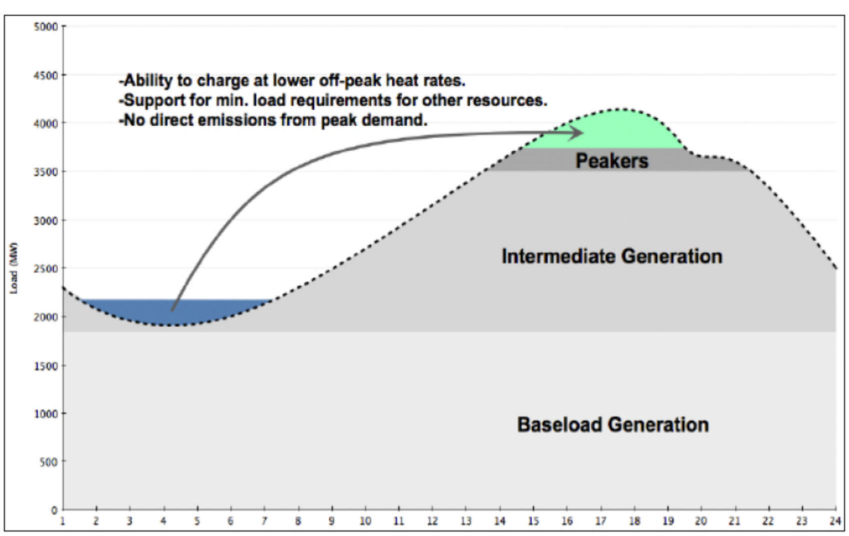
Figure 2. EIA Graph of Peak Generation Needs



Independent Statistics & Analysis
U.S. Energy Information Administration

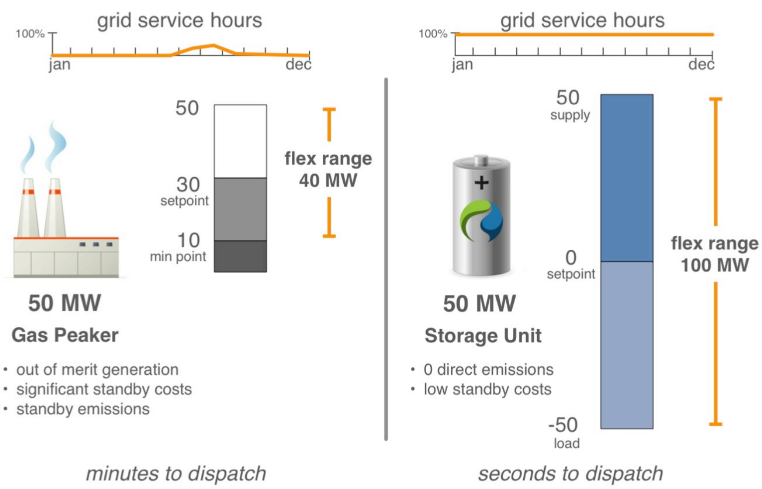
As one tool to reduce the need for combustion turbines in a period of carbon emission reductions, energy storage creates system-wide efficiency, enabling more efficient ramping of existing plants, smooth integration of renewable energy facilities, and shifting of peak load to off peak hours (see *Figure 3* below), all of which increase the efficiency of the entire system. Storage also increases the utilization of existing transmission and distribution-level investments and helps defer the need for new investments in this infrastructure until it can be fully utilized.

Figure 3. Energy Storage for Peak Shaving



Energy storage can provide fuel and resource diversity. Energy storage technologies are resource-neutral, taking a charge from any resource on the grid and releasing the charge to off-set the units with less efficiency, providing double the nameplate capacity as traditional grid resources as they can absorb and release power. In many cases, these charging windows of maximum grid efficiency will absorb more and more renewable supply, as variable resources operate at highest capacities at these times. Additionally, energy storage provides a natural hedge that protects consumers from the rise in cost of any single commodity since it is resource-neutral. Energy storage can be considered a flexible capacity resource that provides both injection and absorption of energy, as in the illustration below (*Figure 4*).

Figure 4. Energy Storage as Flexible Capacity as Compared with Gas Peaker



Comments on Specific Key Questions

Regulation to incentivize desirable characteristics

Regulatory models are key to creating market certainty and appropriately valuing the services energy storage can provide to the grid. ESA recommends the development of market products that fully value the benefits provided by storage and send appropriate price signals for investment. Many of the benefits of storage, such as improved efficiency, resiliency, and flexibility, are not compensated in today's wholesale electricity markets. A study by Carnegie Mellon showed that the use of large-scale storage could save consumers up to $4 billion annually in PJM due to reduced peak prices and reduced reliance on expensive peaking generators.[13] However, the only market construct to compensate storage for this service today in PJM is energy arbitrage where revenue declines as more storage is deployed. Storage assets should be eligible for capacity market payments in regions where these markets exist. And in the cases where market products do not fully value the benefits of storage – which is unfortunately still the norm and, while improvements and new products are expected to be developed, barriers remain –

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[13] Lueken R. and Apt, J. The effects of bulk electricity storage on the PJM Market. Received: 21 October 2013 / Accepted: 14 April 2014 Springer-Verlag Berlin Heidelberg.

policy will need to continue to play a part in driving storage deployment in order to achieve the billions of dollars in potential consumer savings referenced above.

Furthermore, market products for ramping and/or flexible capacity will be needed to attract investment in resources that can reliably integrate large amounts of renewable resources.[14] Without adequate compensation mechanisms to monetize the value created by storage it will be difficult to finance.

In addition to regulatory policy, ESA believes tax policy will also be critical to creating the appropriate incentives for innovative industries to draw private sector investment in these U.S.-developed technologies. While energy storage technologies have been proven to be efficient, clean resources, the investment community and utilities still view them as higher risk than conventional generation technologies. With limited tax incentives, uncertainty would be greatly reduced for investors, entrepreneurs, and manufacturers. Hundreds of companies in nearly every state with technologies that enhance virtually all resources on the electric grid could benefit from these tax credits. Energy storage tax incentives will spur investment in storage technologies, creating jobs and economic benefits while reducing uncertainty in energy markets. Two such tax incentives that have previously been introduced in the U.S. Congress include an investment tax credit for energy storage and a master limited partnership that includes energy storage.

Storage incorporated to maximize benefits

ESA believes that, to capture the full benefit of energy storage technologies and applications, energy storage should be permitted to serve multiple functions. Energy storage resources can provide numerous solutions for challenges to the electric grid—from generation services like arbitrage, ancillary services and renewables firming, to transmission and distribution services such as reducing circuit and line overload, enabling grid resiliency, and voltage support. Because of the ability to provide the grid a variety of services, any program that includes energy storage should allow the capturing, valuation, and monetizing of the multiple benefit streams that energy storage systems provide as stand-alone resources. We believe this full valuation will ensure that projects are cost-effective and achieve the greatest benefit to consumers.

Planning Processes

On the issue of incorporating energy storage in policy and infrastructure planning, ESA could not be more supportive. On the question of whether DOE should undertake sectoral planning, ESA belives that a system approcah rather than technology approach would produce more cost-effective and efficient results.

Recommendations to the DOE

State regulatory bodies trust DOE; leverage that trust to educate states. While state regulatory and legislative bodies have the most direct impact on energy policy and planning, the DOE has the ability to convene these parties and increase understanding of technologies, applications, and policies that can enable energy storage to be considered most effectively in states.

[14] In 2015 the California ISO is implementing a flexible ramping product and new flexible capacity requirements in order to attract the resources necessary to reliably meet California's renewable energy target of 33% renewable generation by 2020.

Develop model policies backed up with analysis. One of the biggest barriers to deployment of energy storage has been simply the omission of energy storage on the "menu" of options. Energy storage should be considered in planning and procurement such that it is considered in any cost-benefits analysis for future generation, transmission and distribution needs. For example, in the state of Arizona, a recent settlement compelled the utility to include a variety of generation sources—including energy storage—in addition to traditional fossil generation to meet peak demands.[15]

Provide data and analysis from projects funded through DOE. As we move to a carbon-constrained future, the reduction in emissions or avoidance of emissions is becoming more important. Given the number of projects DOE has funded and tracked, data on those emissions and other societal benefits should be tracked and quantified such that those benefits can be included in cost-benefits analyses to reflect the true range of benefits of energy storage applications. These analyses should be conducted (and regularly updated) in such a way that enables evolution of technology and scale as opposed to static snapshots. While DOE and its national laboratories have provided excellent research and analysis, often these projects and reports do not reflect a quickly changing landscape of commercial deployment. Information and data developed by the DOE could be utilized more effecively to highlight DOE's efforts and investments inenergy storage.

Provide systemwide benefit analysis with focus on key states. While storage industry players understand costs to deploy their technologies in various applications, there is a need for assitance in identifying and quantifying systemwide benefits within the state and regional context. The National Renewable Energy Laboratory[16] has completed such analysis for two balancing authorities in Colorado. Replication of similar studies by the DOE and other affiliated groups would be very helpful for the storage industry in helping state regulators and utilities justify and build storage asset investments into the overall rate base.

Ensure strong coordination between DOE offices within the agency and other affiliated groups. The QER should offer an excellent opportunity to highlight successful coordination efforts and identify opportunites for improved coordination. Coordination is espcially important for energy storage as storage technoogy applications enhance, interact, and at times replace numerous grid systems represented throughout the DOE agency and affiliated group ecosystem.

Conclusion

The ESA appreciates the opportunity to provide comments on the QER and commends the DOE for including energy storage as a key component of the electric grid infrastructure. We again urge the DOE to not think of storage as an emerging technology but, rather, as a set of generation, transmission, and distribution applications with technology that has been proven and

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[15] DOCKET NO. L-00000D-14-0292-00169 , Case No. 169, APS AND RUCO JOINT REQUEST FOR REVIEW, http://images.edocket.azcc.gov/docketpdf/0000156123.pdf

[16] "The Value of Energy Storage for Grid Applications", National Renewable Energy Laboratory, NREL/TP-6A20-58465, May 2013

deployed in the field for decades—demonstrating the value both throughout the grid and on-site for specific system and end-users. Continued investment in innovation that can improve efficiencies and increase the uses of energy storage will be important for DOE and the national laboratories, but regulatory and legislative policy at both the state and federal level will be key to establishing market certainty and scaling deployments such that the nation can reap the greatest economic, environmental and reliability benefits that energy storage can provide. DOE is positioned as a trusted resource to take a lead on engaging and educating those policymakers in collaboration with industry leaders and the Energy Storage Association.

Attachment 1
ENERGY STORAGE ASSOCIATION MEMBERS (July 2014)

- 1Energy Systems, Inc.
- 24M Technologies, Inc.
- ABB, Inc.
- AES Energy Storage
- AltaLink
- Ambri
- American Vanadium
- Aquion Energy
- ARPA-E
- Argonne National Laboratory
- Axion Power International, Inc.
- Beacon Power LLC.
- Black &Veatch Corporation
- Bosch Energy Storage
- Brown Rudnick LLP
- California ISO
- CALMAC Manufacturing Corporation
- CODA Energy, LLC.
- Customized Energy Solutions
- DNV GL Energy
- Duke Energy
- Dynapower Company LLC
- EaglePicher Technologies, LLC.
- East Penn Manufacturing Co., Inc.
- Energy and Environmental Economics, Inc.
- Energy Power Systems, LLC
- EnerSys
- EnerVault Corporation
- Eos Energy Storage
- EPRI
- Exelon Generation
- FIAMM
- FirstEnergy Service Company
- GE Energy Storage
- Greensmith Energy Management Systems
- HDR Engineering, Inc.
- Highview Power Storage
- Hitachi Chemical Co. America
- Hydrogenics Corporation
- Hyosung Corporation
- Ice Energy
- Imergy Power Systems
- INABENSA
- INGETEAM INC.
- Innovation Core SEI, Inc.
- Landis+Gyr
- LG Chem Power
- MCV Energy Systems, Inc.
- Mitsubishi Electric Power Products, Inc.
- Morrison & Foerster LLP
- National Rural Electric Cooperative Association (NRECA)
- Nation-E
- Navigant Consulting
- NEC Energy Solutions
- NextEra Energy Resources, LLC.
- NGK Insulators, LTD.
- Oncor
- Pacific Northwest National Laboratory
- Panasonic
- Parker Hannifin – Energy Grid Tie Division
- PJM Interconnection, LLC
- Primus Power
- Prudent Energy Corporation
- Public Service Co. of New Mexico
- RedFlow Limited
- Recurrent Energy
- RES Americas
- S&C Electric Company
- Saft America, Inc.
- San Diego Gas & Electric
- Sandia National Laboratories
- SkyPower Services
- Southern Company
- Steffes Corporation
- Stoel Rives LLP
- Strategen Consulting, LLC
- SunEdison, Inc.
- SustainX
- Sutherland Asbill & Brennan LLP
- TAS Energy
- Temporal Power Ltd.
- UniEnergy Technologies
- Viridity Energy
- Younicos Inc.
- ZBB Energy Corporation

Individual Members (19)

- Richard Baxter, Mustang Prairie
- John Boyes, John Boyes Consulting
- Bill Capp, Grid Storage Consulting
- James M. Eyer, E&I Consulting
- Pete Hamilton, Better Energies, LLC
- William V. Hassenzahl, Advanced Energy Analysis
- Darrell Hayslip, Narrow Gate Energy, LLC
- Udi Helman, Independent Consultant
- Michael Kepros, Kepros Battery Consulting
- Matt Lazarewicz, Energy Storage Solutions, LLC.
- Robert Lockhart, Acuity Power Group
- Bob Mango, Independent Consultant
- Jeff Pierson, Bethesda Capital LLC
- Anthony Price, Swanbarton Limited

- Charles Ricker, Ricker Strategic Advisors
- William Riley, Aquifer Based Hydroelectric Systems
- Susan Schoenung, Longitude 122 West, Inc.
- Jim Staudt, Andover Technology Partners
- H. Chandler Williamson, HCW Consulting

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  CARNOT 2G, Inc.
  Halotechnica
  ICL Industrial Products
  Kilpatrick Townsend & Stockton LLP
  Microvast Power Solutions
  National Electrical Contractors Association (NECA)
  North Carolina Sustainable Energy Association (NCSEA)
  Nubenergy
  Wind Energy Institute of Canada
- Individuals/Students
  John Goatcher
  Glenn Skutt
  Zach Taylor