SUBMISSION OF THE CLEAN ENERGY STANDARD STORAGE COALITION ON THE SENATE ENR CES WHITE PAPER

EXECUTIVE SUMMARY

The Clean Energy Standard Storage Coalition[1] ("the Storage Coalition") supports Congressional action to establish a national Clean Energy Standard (CES) to aggressively support the deployment of clean energy technologies, explicitly including energy storage technologies.

As the Committee has recognized, a CES will achieve multiple public policy objectives such as enhancing national security, reducing oil imports, cutting harmful air pollution, and generating jobs. It is a proven tool for creating and retaining innovative economic activity in the US. Energy storage is a necessary and integral component of a CES. Energy storage devices achieve the positive impacts of clean generation, can be used regardless of natural resource availability and further enhance the value of clean resources such as renewables.

Energy storage supports national security by directly strengthening the stability and robustness of the electric grid and helps enable a greater percentage of clean and domestically produced energy to be utilized instead of oil. Energy storage optimizes existing grid assets by allowing generators to operate more efficiently, and at higher levels of energy efficiency, and can defer or even avoid the need for peaking power plants and transmission facilities. Energy storage allows renewable and off-peak energy usage for distributed applications such as heating, cooling, and plug-in electric or hybrid vehicles.

Energy storage reduces air pollution by providing a non-emissive source of power and by several positive systemic impacts such as load shifting to avoid the current need to use high heat rate generators during peak periods, reducing transmission and distribution congestion and line losses (which are substantially higher during peak periods), and enabling greater renewable energy deployment. Storage also reduces peak power demand, thus yielding large energy savings and reduced fossil fuel consumption.

The storage industry is a growing domestic technology industry currently manufacturing products in the US and has a very large potential for job growth. Energy storage offers policy makers an additional tool to help utilities meet a federal Clean Energy Standard – and do it affordably, efficiently, reliably and, of course, cleanly. It is an essential part of the long-term success of a CES; storage devices help the integration of clean, variable energy sources into the electric grid.

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[1] Members include: A123 Systems, AES Energy Storage LLC, Aquion Energy, Beacon Power Corporation, California Energy Storage Alliance, CALMAC, Debenham Energy LLC, Fluidic Energy, Ice Energy, National Hydropower Association, Powergetics, Renewable Strategies LLC, Steffes Corporation, Sunverge Energy, SustainX, Xtreme Power. Contact for purposes of this Submission: David Nemtzow, Ice Energy Inc., dnemtzow@ice-energy.com

The Storage Coalition is pleased to provide the attached responses to the Committee. We look forward to responding to any additional questions the Committee has regarding energy storage.

QUESTION 2. WHAT RESOURCES SHOULD QUALIFY AS "CLEAN ENERGY"?

On what basis should qualifying "clean energy" resources be defined? Should the definition of "clean energy" account only for the greenhouse gas emissions of electric generation, or should other environmental issues be accounted for (e.g. particulate matter from biomass combustion, spent fuel from nuclear power, or land use changes for solar panels or wind, etc.)?

Energy Storage as Clean Energy

Clean energy resources should be defined on their ability to meet multiple public policy goals including but not limited to reducing greenhouse gas and other air pollutants such as NOx, SO_2, particulate matter, and mercury, and minimizing the land use impacts of generators and transmission lines. Energy storage meets and exceeds these qualifications while helping all other forms of clean energy (including nuclear and variable renewables) be used more effectively.

The Clean Energy Standard Storage Coalition[2] believes strongly that energy storage should qualify as clean energy and play a role in helping utilities meet their obligations under a Clean Energy Standard (CES).

Energy storage is a necessary and very valuable component of a CES. Energy storage devices affordably achieve the positive impacts of clean generation, including reduced greenhouse gas and ambient air emissions. Additionally, energy storage helps grid operators maintain grid reliability and manage the increasing usage of variable renewable generators. It can be used regardless of variable resource availability.

Energy storage supports national security by directly strengthening the stability and robustness of the electric grid and helping enable a greater percentage of clean and domestically produced energy to be utilized instead of oil. Energy storage optimizes existing grid assets by allowing generators to operate more efficiently, and at higher levels of energy efficiency, and can defer or even avoid the need for peaking power plants and transmission facilities. Energy storage allows renewable and off-peak energy usage for distributed applications such as heating, cooling, and plug-in electric or hybrid vehicles.

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Storage reduces air pollution by providing a non-emissive source of power and by several positive systemic impacts such as load shifting to avoid the current need to use high heat rate generators during peak periods, reducing transmission and distribution congestion and line losses (which are substantially higher during peak periods), and enabling greater renewable energy deployment. Storage also reduces peak power demand, thus yielding large energy savings and reduced fossil fuel consumption.

The energy storage industry is a growing domestic technology industry currently manufacturing products in the US and has a very large potential for job growth. Energy storage offers policy makers an additional tool to help utilities meet a federal Clean Energy Standard – and do it affordably, efficiently, reliably and, of course, cleanly.

Energy Storage and Grid Operations

The electric industry faces the multiple challenges of maintaining reliable service, reducing greenhouse gas emissions, and holding down costs. Traditionally, most unexpected changes to the electricity grid would come from the demand side; fossil fuel generators were a controllable grid resource that could be turned on and off quite reliably. However, with an increase in variable renewable generators, now the supply side of the grid has become more variable. Storage can release energy, reduce load, create load, and/or charge in order to help balance the grid and thus solve grid challenges by providing just-in-time energy and a multitude of other solutions.

In addition, without grid storage technologies, generation, transmission, and distribution systems must be overbuilt so as to be able to supply (with reserve margins) the highest anticipated amount of electricity that consumers might demand at any given moment. For example, California uses 5% of its generation capacity for *less than 50 hours per year* and 25% of its supply capacity is needed less than 10% of the time. In other words, a significant portion of grid assets and resources sit idle for most of the year just to be available for occasional – if not rare – peak events. This significant asset under-utilization imposes very high costs to ratepayers and increases greenhouse gas emissions – and can be greatly lessened or even avoided by the use of energy storage.

Grid operators look holistically at total likely demand and available supply to determine which resources it needs to either procure or shut down to maintain a constant supply and demand balance. Energy storage technologies can, and are, designed to replace existing requirements for synchronizing and stabilizing the grid.

Energy storage is useful at all parts of the grid. Similar to water infrastructure, energy storage should be both remotely located (like a large reservoir) and at the point of use (like water towers on building rooftops). Both the water system and the power system need storage in both locations (near the source and near the load/consumer) to operate efficiently and reliably. It does not need to be physically coupled with generation because storage is a flexible solution. From bulk storage and transmission applications (such as fly wheels) to distributed and use-oriented applications, energy storage can play an important role.

Unfortunately, the complex cost recovery, power procurement and incentive structures currently built into our regulated electrical system do not adequately encourage the adoption of even cost-effective and commercially viable grid storage technologies. Inclusion of energy storage in a CES will help overcome this barrier and greatly accelerate its deployment, to the benefit of the grid, utilities and end users.

The following outlines some of the ways energy storage interacts with the grid and provides public benefits:

- *Storage Technologies Allow for the Efficient Management of Demand and Supply Fluctuations.*
    - *Minute-to-minute demand fluctuations.* For proper functioning of the electrical grid, minute-to-minute fluctuations in demand must be met precisely by system supply to maintain the quality of the power flowing to consumers. Energy storage can provide frequency regulation at lower cost and with fewer emissions, while making the additional 2% to 4% of previously withheld (for reserve) generation available for sale.
    - *Daytime demand fluctuation*. Electric demand varies greatly over the course of a single day. During peak demand periods (mid afternoon in most of the US) the cost of supplying energy is much greater than when demand is low, such as at night. Storage allows both utilities and consumers to store cheap energy generated during off peak times and sell or use it during the day, rather than pay enormous premiums for peak period supplies.
    - *Long-term demand fluctuation.* Over the course of a year, demand for electricity varies considerably, typically in the summer due to air conditioning use. Without energy storage, the electricity supply system, including generation, transmission and distribution, must be sized to meet the highest anticipated peak demand. Often times, generators used to meet peak demand are fuel inefficient, costly, and emit high levels of greenhouse and ambient pollutants. Storage allows grid operators to meet peak load requirements more efficiently and economically, and greatly optimize the supply system.
    - *Variability of renewable generation.* Solar and wind power are vital for America's future, but their output of electricity varies with the availability of sunshine and wind, posing challenges for utilities that have historically relied on more predictably available resources. Energy storage offsets variations in renewable electricity production and thus plays a vital role in integrating these variable generation resources into the grid and making large-scale and distributed renewable generation even more attractive and valuable.

- By using storage to cost-effectively meet peak demand and operate the system more efficiently, utilities can defer hundreds of millions of dollars in capital expenditures to upgrade their system for the growing demand. This has the direct effect of *decreasing costs and giving ratepayers relief from rising energy and power prices*.

- *Deployment of energy storage creates green manufacturing and installation jobs*. It has been estimated that every 50 MW of energy storage creates over 300 permanent jobs. A March 2010 report by KEMA, a leading energy consulting, testing and certification firm, concluded that with incentives the energy storage industry can create approximately 114,000 incremental, direct jobs over 10 years.

- Storage is seen by Congress, the Department of Energy, and statute as *a key aspect of the growing Smart Grid.* When combined with an intelligent monitoring system, storage allows for the efficient, reliable, and stable operation of the grid. Storage also adds stability as plug-in electric and hybrid vehicles are increasing in use.

- Storage represents a *clean energy export opportunity*. The high-level engineering and skilled manufacturing required to produce energy storage devices correspond with U.S. competitive advantages. By accelerating the deployment of this innovative family of technologies at home, the U.S. can become the global leader in what will be an integral part of the global clean energy economy of the future.

Should qualifying clean energy resources be expressly listed or based on a general emissions threshold? If it is determined that a list of clean energy resources is preferable, what is the optimal definition for "clean energy" that will deploy a diverse set of clean generation technologies at least cost? Should there be an avenue to qualify additional clean energy resources in the future, based on technological advancements?

The Storage Coalition[3] does not take a position on this question. However, should the Committee decide a detailed listing is appropriate we request that the full scope of applicable energy storage technologies be considered; the language from S. 3935 and S. 3617 is appropriate:

> Such term may include hydroelectric pumped storage and compressed air energy storage, regenerative fuel cells, batteries, superconducting magnetic energy storage, flywheels,

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thermal energy storage systems, and hydrogen storage, or combination thereof, or any other technologies as the Secretary shall determine.

Should the standard be focused solely on electricity generation, or is there a role for other clean energy technologies that could displace electricity, such as biomass-to-thermal energy?

The standard must incorporate other clean energy technologies that displace electricity, such as energy storage. These technologies are necessary to shift, displace, and use electricity in such a way as to increase the quantity of clean energy delivered to the grid and improve the efficacy and energy efficiency of the grid; for many applications these non-generating variants (such as thermal energy storage for air conditioning or heating) are the most highly energy efficient option, further contributing to the CES's goals for a clean and affordable electric system. Non-generation options, such as energy storage (thermal or otherwise), can directly displace electricity generation from other sources and should be included in the CES.

QUESTION 3.
HOW SHOULD THE CREDITING SYSTEM AND TIMETABLES BE DESIGNED?

What interim targets and timetables should be established to meet the standard's requirements?

The crediting system should be designed to incorporate energy delivered through energy storage within the Clean Energy Standard. As discussed elsewhere in the Storage Coalition[4]'s responses, energy storage is a necessary and very valuable component of a CES and offers policy makers an additional tool to help utilities meet the objectives of a CES affordably, reliably and cleanly.

As demonstrated by the States that qualify energy storage in their RPSes or similar policy mechanisms, there are several methodological options available for including energy storage in a CES, in part reflecting storage's unique capability among clean energy resources of balancing electric supply and demand and helping manage peak power demand.

Generally speaking these options that are currently in use and are applicable to a CES include:

1. *Include energy storage as a qualifying CES technology*. Make energy storage eligible as a qualifying CES resource on the same basis as other clean energy resources.
2. *Include energy storage as a qualifying CES technology but in a separate tier*. Make energy storage eligible in the CES but in a special tier or class of certain CES technologies, such as load management, demand response, distributed generation and/or energy efficiency.
3. *Bonus credits for coupling with clean energy sources:* If a CES-qualifying clean energy resource is coupled with qualifying energy storage the CES-qualifying resource would be given bonus clean energy credits as a multiplier on a kwh basis. The clean energy source should be integrated with the renewable generator either physically or electronically. (This can be tailored even further such as to give bonus credits for peak period delivery of clean energy resources.)
4. *Clean Capacity Credit.* Qualifying clean energy resources would receive *additional* credits for each MW they contribute to the reserve margin requirement. CCCs would supplement rather than replace CES credit payments and provide additional revenue for the reserve margin contribution.

Regardless of the option utilized, CES legislation would no doubt need to authorize the appropriate federal agency to consider and adopt specific rules to implement storage's participation in a CES.

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The Storage Coalition strongly believes that regardless of the specific methodology used by the CES it should be storage technology-neutral (i.e. allowing batteries, thermal, flywheels, pumped hydro, and other storage technologies to qualify). Furthermore, energy storage does not need a timetable different than for other clean energy resources in a CES.

What are the tradeoffs between crediting all existing clean technologies versus only allowing new and incremental upgrades to qualify for credits? Is one methodology preferable to the other?

The Storage Coalition does not take a position on the issue of crediting all existing clean technologies versus only allowing new and incremental upgrades to qualify for credits. However, the Storage Coalition does believe strongly that energy storage should be treated just as are other clean energy technologies however the above question is eventually resolved.

Should partial credits be given for certain technologies, like efficient natural gas and clean coal, as the President has proposed? If partial credits are used, on what basis should the percentage of credit be awarded? Should this be made modifiable over the life of the program?

Yes, partial credits are an appropriate way to credit certain technology families. Energy storage may best fit in a CES as under a system of partial credit or credit multipliers. As discussed in the general response to Question 3, there are several methodological options for including storage in a CES. These options may require partial credits or credit multipliers.

The Storage Coalition suggests as one option providing bonus credits for coupling with clean energy sources. If a CES-qualifying clean energy resource is coupled with qualifying energy storage – either physically or electronically since co-location should not be mandated – that CES-qualifying clean energy resource would be given bonus CES credits, on a multiplier per storage-coupled MWh basis. This can be tailored even further:

- *Bonus credits for peak performance:* a CES-qualifying clean energy resource would be given bonus credits for performance during peak periods.
- *Bonus credits for reducing scheduling error*: a CES-qualifying CES resource would be given bonus credits reflecting an agreed-upon methodology regarding the amount that it is able to reduce the day ahead scheduling error.

The CES-qualifying resource might receive a multiplier of its credit such as 1.5 for being coupled with energy storage.

Is there a deployment path that will optimize the trade-off between the overall cost of the program and the overall amount of clean energy deployed?

Experience at the state level with RPSes shows increased attention up-front to compliance mechanism and enablers such as energy storage will help reduce the total costs of a CES. Including energy storage in the CES will drive early deployment of the infrastructure needed to best integrate renewable energy into the electric grid while simultaneously providing an important, affordable clean energy resource option for utilities to consider in meeting their CES obligations.

What would be the effect of including tiers for particular classes of technology, or for technologies with different levels of economic risk, and what would be a viable way of including such tiers?

The Storage Coalition[5] believes strongly that a tiered approach could work well (as many state RPSes have demonstrated) and believes that a tiered system is well suited to accommodate energy storage (and vice versa).

There are significant precedents by the states for both the use of a tiered approach and for the inclusion of energy storage in CES goals. At present, energy storage can be counted towards RPS/RES/AES goals in seven states, including Massachusetts, Ohio, Hawaii, Pennsylvania, Connecticut, North Carolina, and Oklahoma, among which Massachusetts, Pennsylvania, Connecticut and Ohio use a tiered approach. Where a tiered system is used, energy storage is included as a 'Tier II' or 'Alternative Energy' technology.

The mechanisms for inclusion of energy storage and methodology for quantification vary from state to state. For example, Ohio specifically qualifies "energy storage" and counts "the [full] amount of electricity dispatched from the storage facility." (SB 221) Massachusetts compares the relative CO2 reductions of storage to that of renewable generation in the state, and counts "65% of the electrical energy discharged." (225 CMR 14.00)

Furthermore, other States are also actively supporting energy storage through targeted legislation. California recently passed an 'Energy Storage Portfolio Standard' bill asking the CPUC to "determine appropriate targets, if any, for each load-serving entity to procure viable and cost-effective energy storage systems." (AB 2514). And other states, such as Texas, are currently advancing legislation that would support goals to expand the installation of energy storage.

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QUESTION 4. HOW WILL A CES AFFECT THE DEPLOYMENT OF SPECIFIC TECHNOLOGIES?

The Clean Energy Standard Storage Coalition[6] believes that, if improperly designed by not incentivizing storage or other clean capacity solutions, a CES will strain the grid by adding additional variable energy resources. The result will increase the deployment of inefficient and emissions-intense fossil fuel plants to provide grid services needed to ensure system reliability.

If, however, the Congress takes the lead from the seven states (Mass., Conn., Penn., Ohio, N.C., Hawaii and Okla.) that have already included energy storage in their RPS regimes, the use of energy storage will expand, and along with it the myriad benefits of the technology.

Energy storage supports national security by directly strengthening the stability and robustness of the electric grid. Energy storage devices reduce air pollution by providing a non-emissive source of power and by several systematic impacts: enabling greater renewable energy deployment and load shifting generation to reduce transmission congestion, resulting in large energy savings and cutting fossil fuel power requirements. They generate jobs as the energy storage industry is a growing domestic technology industry manufacturing in the US.

Energy storage offers policy makers an additional tool to help utilities with limited access to re-newable and other clean energy resources meet the objectives of a CES. It is also an essential part of the long term success of a CES; storage devices help the integration of variable energy sources into the electric grid.

The electric industry faces the multiple challenges of maintaining reliable service, reducing greenhouse gas emissions, and holding down costs. While producing more electricity from renewable energy sources like wind and solar reduces emissions, it can also make managing the grid and maintaining reliable service more difficult because both wind and solar power are variable resources. In addition, without grid storage technologies, generation, transmission, and distribution systems must be overbuilt so as to be able to reliably supply the amount of electricity that consumers demand at any given moment of the year. This situation imposes higher costs to ratepayers and increased greenhouse gas emissions.

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Unfortunately, the complex cost recovery and incentive structures built into our electrical system do not adequately encourage the adoption of energy storage technologies. Inclusion of energy storage in a CES will help overcome this barrier.

QUESTION 5. HOW SHOULD ALTERNATIVE COMPLIANCE PAYMENTS, REGIONAL COSTS, AND CONSUMER PROTECTION BE ADDRESSED?

How much new transmission will be needed to meet a CES along the lines of the President's proposal and how should those transmission costs be allocated?

The Clean Energy Standard Storage Coalition[7] responds by noting that energy storage technology can defer or even eliminate the need for new transmission lines in many circumstances. Estimates for new transmission requirements with and without substantial deployment of energy storage are being developed. Reducing transmission congestion and providing load shifting and distributed power can defer or cancel planned transmission expansions, resulting in large cost savings and substantial public benefits, including many times averting or significantly shortening the transmission siting and approval process.

In many states line losses are the largest load on the grid. In California for example, at least1,500 MW of the nearly 60,000 MW of supply or generation is due to the transmission system line loss, with losses increasingly substantially during peak periods when the system is most congested. This is primarily because generators are not always located near the load center and are often instead located remotely.

In cases where storage might be physically and directly coupled to remote renewable generators, it does not help solve the congestion problems and other delivery problems, however storage does help solve this problem (along with many others) when located in or close to the load center, thus diminishing transmission stress and congestion .

Storage, especially when it is located near end users is a very useful and valuable partial alternative to transmission (and distribution) as it reduces the burden placed on the delivery system and therefore line losses are greatly lessened. Recognizing production cycles and flow patterns on the grid will allow the most efficient use of energy, such as including the transmission of wind energy at night when the grid today is underutilized and to store it at the load center for use when demand is high during the day.

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- *Are there any technological impediments to the addition of significantly increased renewable electricity generation into the electrical grid?*

Yes, the addition of significantly increased variable renewable electricity generation (e.g. wind and solar) onto the grid poses immense challenges for utilities and Balancing Authorities, such as the Independent System Operators, that have traditionally relied on predictably available, dispatchable, but also inefficient and polluting, fossil fuel powered generators. Energy storage helps offset variability in renewable electricity production and thus provides an efficient and clean way of overcoming some of the technological impediments to the addition of significantly increased renewables on the grid.

In addition to the general question posed above, policy makers may also want to consider several others, including:

- What will balancing authority dispatch look like with an increase of non-dispatchable supply replacing the conventional generators today?
- What will the demand curve look like with the thousands of distribution generation sites and electric vehicles?
- How will we manage the transformed power system?
- Wind and solar are inverter based technologies and they will displace synchronous machines. How will the power system deal with local and grid-wide frequency challenges?

In more detail, the grid must address the following fluctuations, all of which are exacerbated by variable renewable generators and all of which can be smoothed and firmed by energy storage:

- *Seasonal demand fluctuation.* Over the course of the year, demand for electricity varies considerably, principally due to the use of air conditioning. Without energy storage, the electricity supply system, including generation, transmission, and distribution, must be sized to meet (with reserve margins) the highest anticipated peak demand. Often times, the generators used to meet peak demand are inefficient, costly, and emit high levels of greenhouse and ambient pollution. Storage allows grid operators to meet peak load requirements more efficiently and economically.
- *Nighttime oversupply.* The past reliance on inexpensive baseload generation has always been a driver for energy storage at night. Today, wind is increasingly curtailed in many parts of the country because baseload plants are running for reliability reasons, taking up room in the supply mix and “blocking” wind energy. Increased use of storage, either to handle variability or to absorb bulk amounts of energy, will relieve nighttime over-generation problems.
- *Daytime demand fluctuation*. Just as over the course of a year, electricity demand varies greatly over the course of a single day. During peak demand periods, usually in the mid afternoon, the cost of providing electricity is much greater than when demand is low at night. Storage allows utilities and/or consumers to store cheap energy generated at night and sell or use it during peak periods of the day, rather than pay premium rates for daytime generation.
- *Variability of renewable generation.* Solar and wind power are vital for America’s future, but their output of electricity varies with the availability of sunshine and wind, posing challenges for

utilities that have historically relied on predictably available, but inefficient and polluting, fossil power. Figure 5.1[8] below demonstrates the variability of wind in Tehachapi, California during the month of April in 2009. The graph shows the output of one wind plant on 30 separate days; the same plant generated either nearly zero energy or more than 1600 MW at the same time of day depending on the weather. Energy storage can offset such variations in renewable electricity production and thus plays a vital role in making large-scale renewable generation even more attractive and valuable.

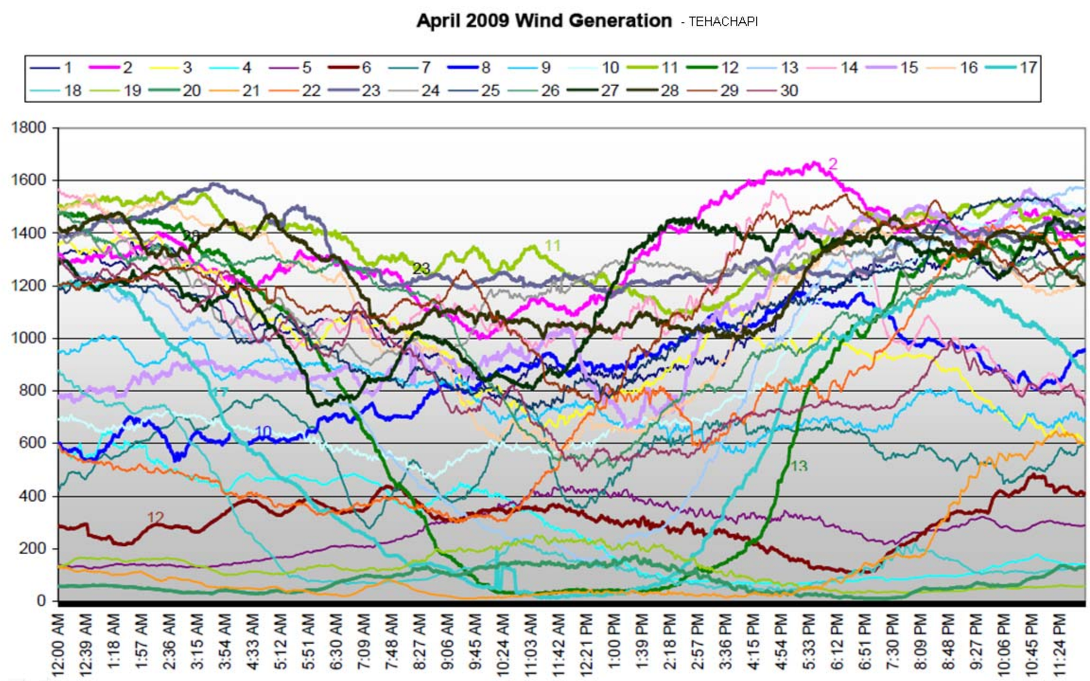


Figure 5.1

- *Minute-to-minute demand fluctuations.* For proper functioning of the electrical grid, minute-to-minute (and even second-to-second) fluctuations in demand must be met precisely by system supply to maintain the quality of the power flowing to consumers. This ancillary service, known as frequency regulation, is provided by all grid operators. Currently, to meet these moment by moment needs, generators provide frequency regulation and maintain capacity reserves (an amount of generation which they do not sell). Energy storage can provide frequency regulation at lower cost and with fewer emissions, while making the additional 2% to 4% of previously withheld generation available for sale.
- *System Inertia and Frequency Response.* As the California Independent System Operators has noted:

  As larger volumes of variable energy resources displace more and more synchronous generation, there will be time when the synchronized inertia on the system could have negative impact on the established stability limits of the system. During high variable energy

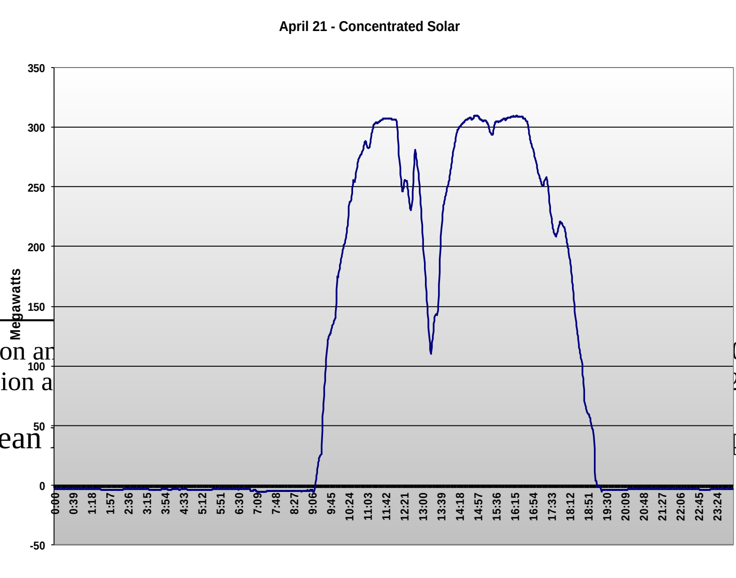
[8] Jim Detmers (former VP of Operations of CAISO), "Renewable Integration Challenge: Today and Tomorrow: Impacts, Actions and Opportunities," Presented on February 16, 2011.

production and low system load (off-peak hours or during weekends or holidays), there may not be enough rotating mass or inertia on the system to arrest frequency decline and/or enough governor response to stabilize the system frequency following a contingency. This could results in under-frequency relays picking up and disconnecting load from the system.”[9]

In other words, without storage, grid operators will have difficultly integrating high variability energy resources during off-peak hours.

- *Local voltage issues*. Existing transformers were designed for electricity to flow uni-directionally, and the mechanical switches in transformers throughout the distribution lines would switch a few times a day. With distributed generation, electricity will have bi-directional flows, and voltage swings can occur on the local level. These swings occur more often and faster than the mechanical transformers were designed for. Distributed storage can prevent these swings from occurring.
- *Increased Maintenance Costs for Existing Peaker Power Plants.* CAISO points out that “While renewable resources displace gas generator production, the gas fleet committed to provide energy and ancillary services will face an increasing number of starts and stops and will operate more often at minimum operating levels, compared to a benchmark scenario that does not include incremental renewable production.”[10] Storage can provide these same ancillary services with more precision, greatly lower emissions, and at lower cost than gas peaker power plants.
- *System Volatility:* The variability of electricity supply and demand may dramatically increase, creating new pressures on the electricity grid, which needs to be in a constant state of equilibrium. Accurately predicting future wind or solar generation can be very challenging. Storage provides a cleaner option for balancing the inherent volatility caused by adding increased renewables to the grid.

Figure 5.1



[9] CAISO, “Discussion an ... 010, pg. 12.

[10] CAISO, “Discussion a ... 2010, pg. 4.

Figure 5.2[11] shows the output from a concentrated solar plant in the Mojave Dessert of California over the course of one day. As shown, in a few minutes, this plant unexpectedly dropped its output 50MW and then over 100 MW; this was due not to clouds but to water in the jet stream, a weather event that few, if any, could have anticipated. At present, grid operators lack the ability to effectively forecast their output for all possible weather events, that can affect the output from some generators. Storage can convert the output from such a facility into predictable electricity that is easier for grid operators to control and even more valuable to utilities and customers.

Traditionally, most unexpected changes to the electricity grid would come from the demand side; fossil fuel generators were a controllable grid resource that could be turned and off quite reliably. However, with an increase in variable renewable generators, now the supply side of the grid has also become more variable. Storage can solve these grid challenges, while reducing emissions.

Finally, Figure 5.3 summarizes some of the features and characteristics of conventional (i.e. fossil) generators, variable renewable generators and energy storage. As is demonstrated, storage can provide certain key functions needed to ensure system-wide reliability, particularly with additional variable generation on-line, more quickly, smoothly, and cleanly than any other technology.

[11] Detmers, Jim. *Ibid.*

Figure 5.3

Functionality	**Conventional Generators**	**Variable Renewable Generators**	**Energy Storage**
Controllable	Yes	No	Yes
Automatic Governor Response	Yes	No	Yes
Automatic Voltage Regulation	Yes	No	Yes
Fuel Shortages	Yes	Yes (lack of wind or sun)	No
Excessive Generation Risk	Yes	Yes	No
Solve Local Voltage Issues	No	No	Yes
Bi-directional (generation or load)	No	No	Yes
Fast Response Time (under 5 minutes)	Generally, No	No	Yes
Requires startup time	Yes	No	No
Frequency Regulation	Yes	No	Yes
Regulation Up/Down	Yes	No	Yes
GHG and other pollution	Yes	No	No

QUESTION 6.
ARE THERE POLICIES THAT SHOULD BE CONSIDERED TO COMPLEMENT A CES?

What are the specific challenges facing individual technologies such as nuclear, natural gas, CCS, on- and offshore wind, solar, efficiency, biomass, and others?

The technologies represented by the members of the Clean Energy Standard Storage Coalition[12] demonstrate that energy storage provides an effective way to eliminate inefficiencies and increase the reliability of the electric grid; reduce costs to ratepayers; and enable the increased penetration of renewable power. However, the complex cost recovery, power procurement and incentive structures built into our electrical system do not adequately encourage the adoption of cost-effective commercially viable grid storage technologies. Without appropriate policy intervention, needed investments into energy storage will either not be made at all or will be made more slowly and at greater cost.

In addition to including storage in a CES, the Congress should pass other legislation promoting the use of storage. First and most importantly, storage would benefit from a storage-specific Investment Tax Credit as introduced in the 111th Congress (including S.3617, S. 3935, H.R.4210 and others). The goal of the STORAGE Act is to offer incentives to foster innovation and deployment of energy storage technologies without picking technology winners and losers. Under the STORAGE Act, grid-connected energy storage systems would receive a 20-30% ITC, and also make available Clean Renewable Energy Bonds (CREBs) to finance these projects by publically owned utilities.

Moreover, Congress should support energy storage, as well as the grid's overall efficiency, by authorizing Peak Demand Reduction Goals. The American Clean Energy Security Act, passed by the House of Representatives in the last Congress include such Peak Demand Reduction Goals, which call for case-by-case use of peak demand reduction goals for the nation's utilities. Storage is one key technology for managing peak power demand and the establishment of such goals for utilities will accelerate their consideration of the use of cost-effective and commercially viable storage to help manage their peak demand growth.

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[12] Members are: A123 Systems, AES Energy Storage, LLC, Aquion Energy, Beacon Power Corporation, California Energy Storage Alliance (CESA consists of A123 Systems, Altairnano, Applied Intellectual Capital/East Penn Manufacturing Co., Inc., Beacon Power Corporation, CALMAC, Debenham Energy, Deeya Energy, Enersys, EnerVault, Fluidic Energy, General Compression, Greensmith Energy Management Systems, HDR, Inc., Ice Energy, International Battery, Inc., LightSail Energy, Inc., MEMC/SunEdison, Powergetics, Primus Power, Prudent Energy, RedFlow, RES Americas, ReStore Energy Systems, Saft America, Inc., Samsung SDI, SANYO, Seeo, Sharp Labs of America, Silent Power, Sumitomo Electric, Suntech, SunPower, Sunverge, SustainX, Xtreme Power, and Younicos. The views expressed in these Comments are those of CESA, and do not necessarily reflect the views of all of the individual CESA member companies), CALMAC, Fluidic Energy, Ice Energy, National Hydropower Association (NHA represents more than 180 companies in the North American hydropower industry), Powergetics, Steffes Corporation, Sunverge Energy, SustainX, Xtreme Power

Another policy alternative is a "Clean Capacity Credit" system. Such a policy would be similar to a CES but would set the credits in megawatts rather than megawatt-hours. Qualifying clean energy resources would receive credits for each MW they contribute. Such credits could supplement rather than replace CES credits by allowing *additional* credits for each MW they contribute to existing reserve margin requirements.

Will the enactment of a CES be sufficient for each technology to overcome its individual challenges?

The enactment of a CES that incentives energy storage will help, but alone it would not be sufficient to overcome the challenges to the optimal deployment of cost-effective energy storage. In addition to including storage in a CES, storage needs to overcome resistance to its initial cost and thus needs an ITC comparable to those offered for many other energy resources. For some energy storage technologies, like pumped hydro, the federal licensing scheme can take several years. Smarter, more efficient regulatory procedures are needed to provide project developers the certainty needed to secure investment and/or utilize incentives that may expire before licensing as well as construction is completed.

Additionally, various actions from the Federal Energy Regulatory Commission (FERC) and state Public Utilities Commissions are also necessary. At present, most existing tariffs and energy markets do not fairly compensate storage for its ability to quickly and accurately respond to regulation signals, manage peak power demand, defer traditional supply-side expenditures, etc. By removing these barriers to the full valuation of storage's benefits and costs, FERC and State PUCs will greatly improve energy markets and will accelerate the adoption of cost-effective energy storage. Fortunately, FERC and several PUCs are already advancing these issues.
Combining Congressional action through a CES and other legislative measures, along with the various actions underway at FERC and State PUCs to restructure key aspects of electricity regulation, and other actions at the State and federal levels can collectively provide the proper incentives the industry needs to make America the leader in this key aspect of the clean energy economy.

What is the current status of clean energy technology manufacturing, and is it reasonable to expect domestic economic growth in that sector as a result of a CES?

Although there are differing methods for measuring the potential for energy storage, a recent, comprehensive study by GTM Research estimated the nationwide market for "fast energy storage" to be 7,137 MW and for "energy-oriented, load-shifting energy storage" to be 85,000 MW.[13] With only a very small fraction of this potential currently installed, these figures represent an enormous possibility for growth in the impact energy storage can have, if supported by inclusion in a CES and other appropriate legislation.

Deployment of energy storage creates green manufacturing and installation jobs. It has been estimated that every 50 MW of energy storage creates over 300 permanent jobs. A Marcy 2010 report by KEMA, a leading energy consulting, testing and certification firm, concluded that with incentives the energy storage industry can create approximately 114,000 incremental, direct jobs over 10 years.[14]

The U.S. is poised to lead the world in energy storage manufacturing, in part due to the boost given to the industry through the Recovery Act. Including storage in a CES would be enormously effective at boosting the U.S.'s manufacturing capacity for storage, which is poised to become a key element of the new energy economy around the world.

[13] "Grid Scale Energy Storage: Technologies and Forecasts Through 2015" by John Kluza, Published by GTM Research, April 17, 2009, Available at: http://www.gtmresearch.com/report/grid-scale-energy-storage-technologies-and-forecasts-through-2015.

[14] "KEMA – Electricity Storage Association: Assessment of Jobs Benefits from Storage Legislation", KEMA Inc., March 29, 2010

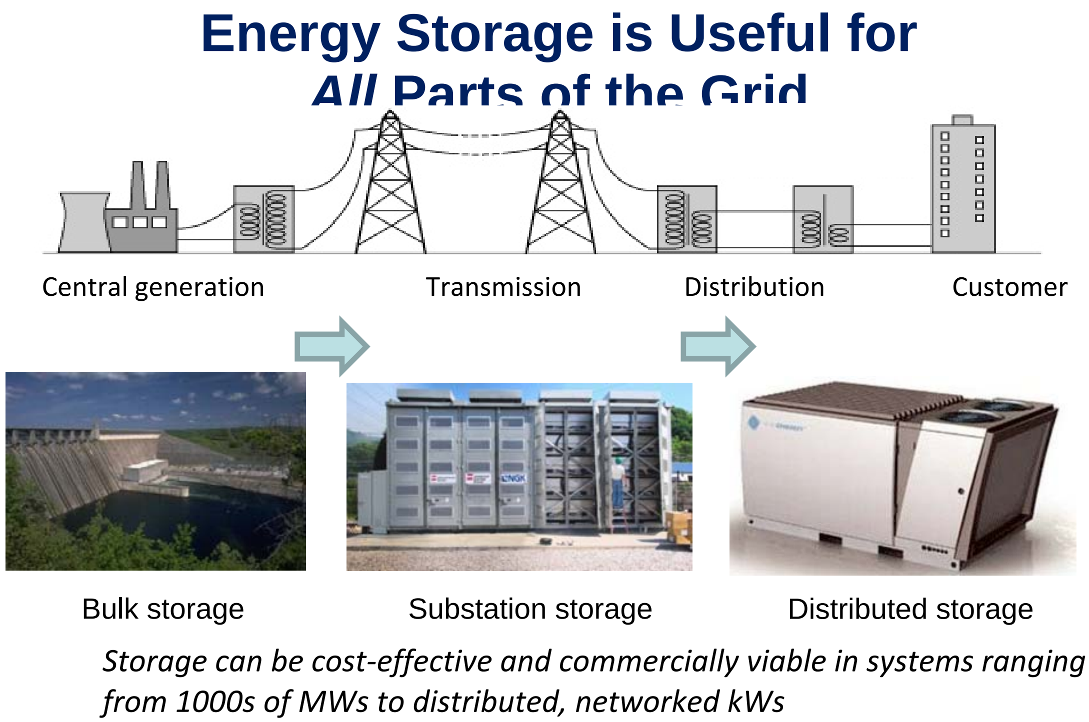

Figure 1.1: Energy Storage is Useful for All Parts of the Grid

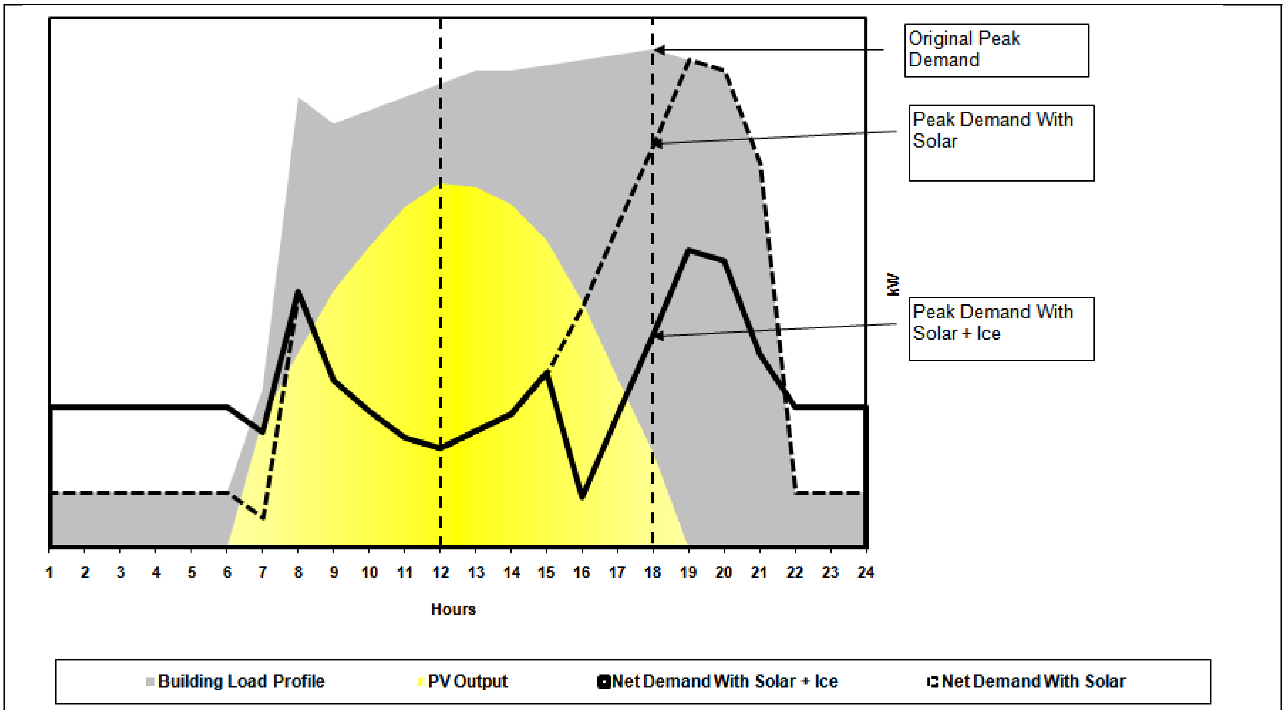

Figure 1.2: Storage Provides Firm kW Demand Reduction

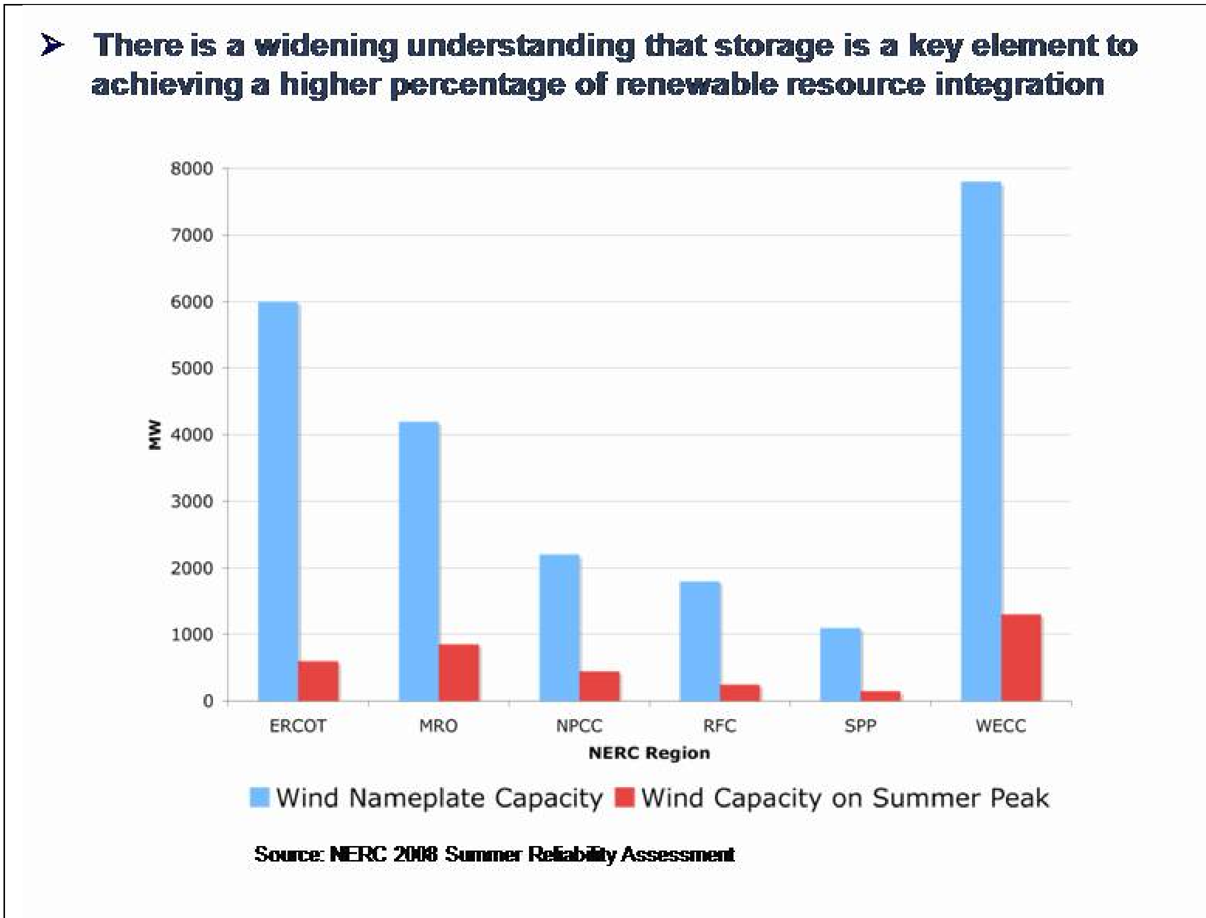

Figure 1.3: Storage Brings Off-Peak Load to Surplus Baseload Generation & Wind
Source: NERC 2008 Summer Reliability Assessment

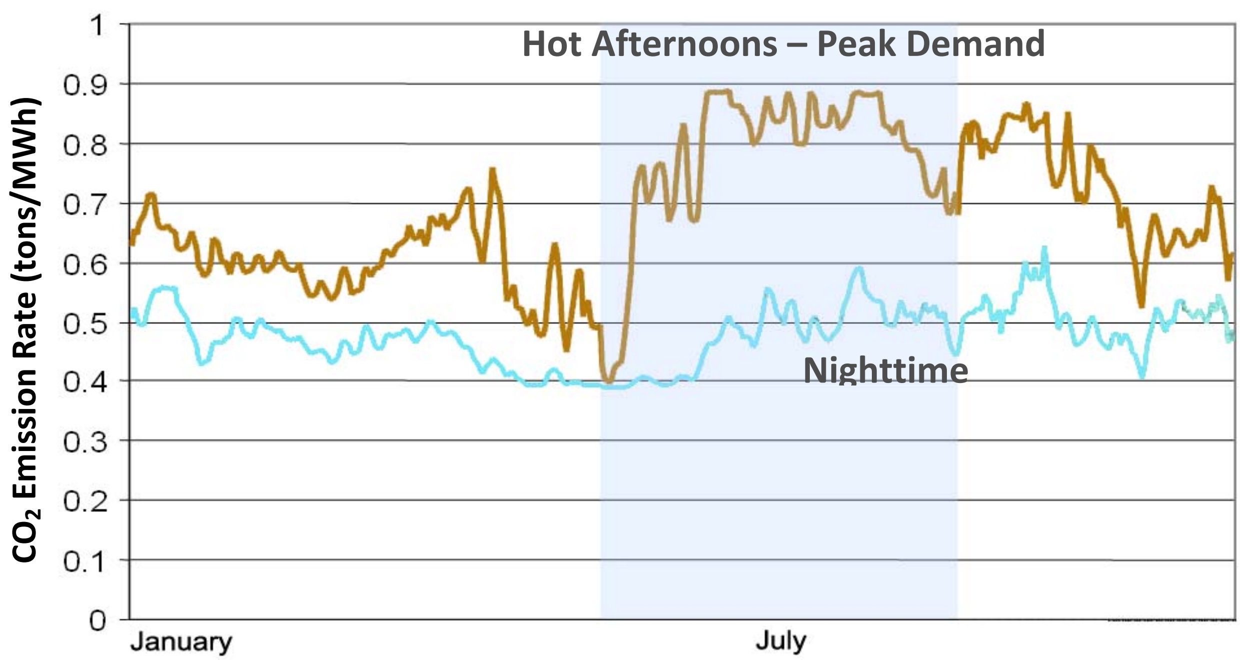

Figure 1.4: Why Smart Energy Storage Matters: CO_2 Emissions Are Higher at Peak
Source: Southern California Edison data

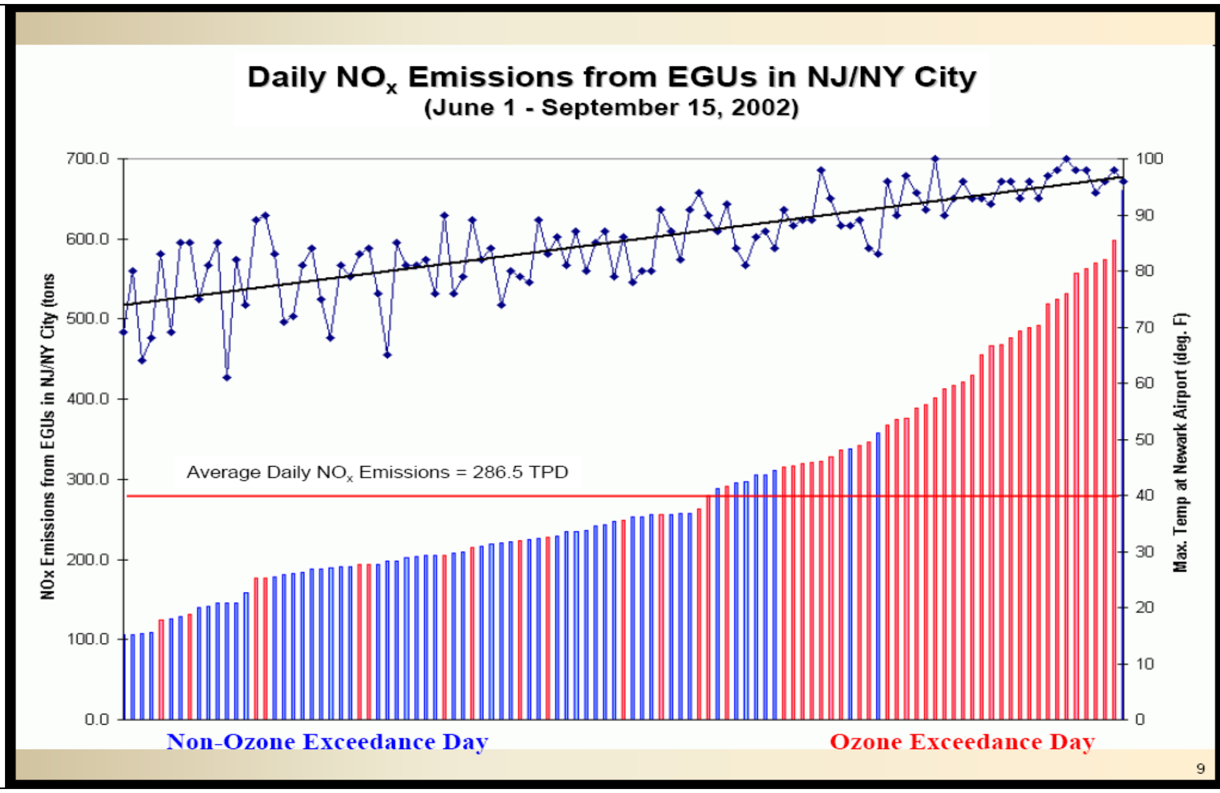

Figure 1.5: The Same Peak Days are Ozone Exceedance Days

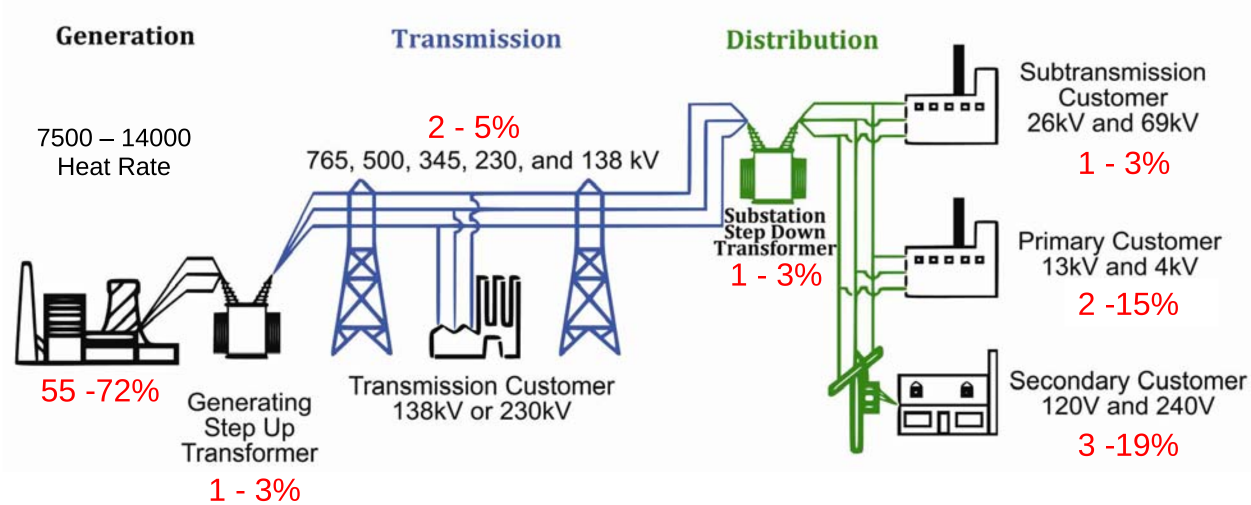

Figure 1.6: Typical Electrical System Average Losses

Figures from Response to Question 5

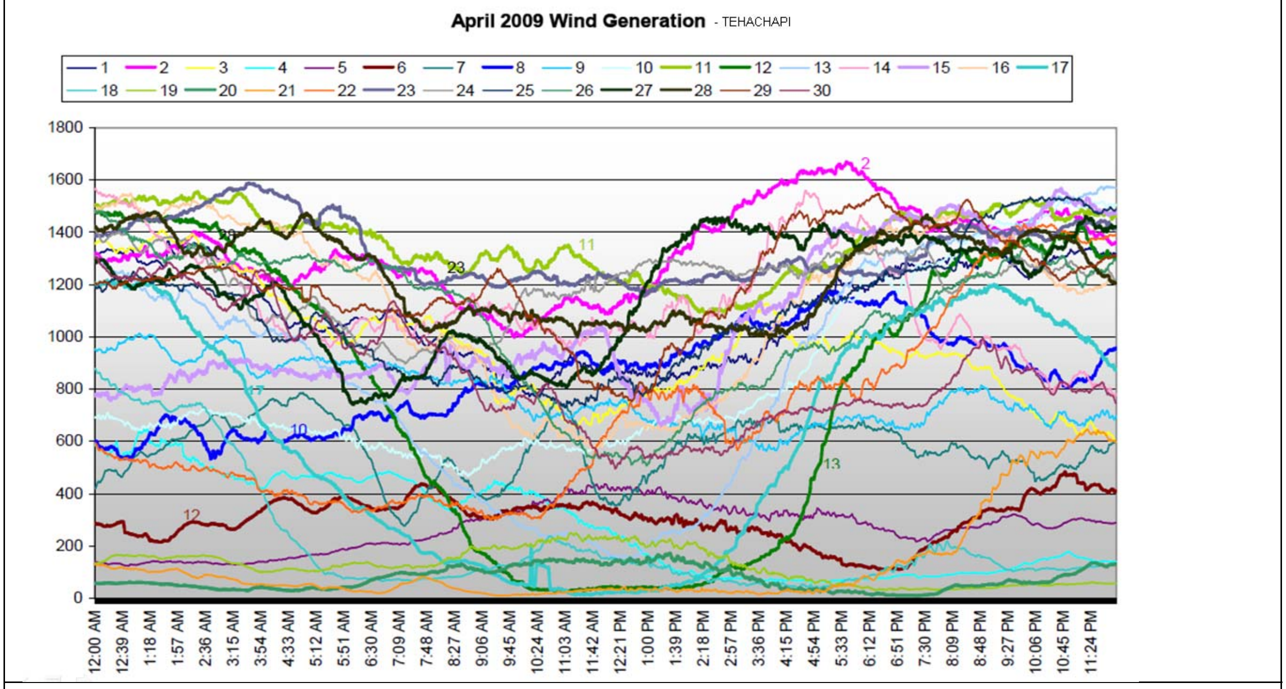

Figure 6.1: April 2009 Wind Generation
Source: Jim Detmers (former VP of Operations of CAISO), "Renewable Integration Challenge: Today and Tomorrow: Impacts, Actions and Opportunities," Presented on February 16, 2011.
Description: This figure demonstrates the variability of wind in Tehachapi, California during the month of April in 2009. The graph shows the output of one wind plant on 30 separate days; the same plant generated either nearly zero energy or more than 1600 MW at the same time of day depending on the weather. Energy storage can offset such variations in renewable electricity production and thus plays a vital role in making large-scale renewable generation even more attractive and valuable.

Functionality	Conventional Generators	Variable Renewable Generators	Energy Storage
Controllable	Yes	No	Yes
Automatic Governor Response	Yes	No	Yes
Automatic Voltage Regulation	Yes	No	Yes
Fuel Shortages	Yes	Yes (lack of wind or sun)	No
Excessive Generation Risk	Yes	Yes	No
Solve Local Voltage Issues	No	No	Yes
Bi-directional (generation or load)	No	No	Yes
Fast Response Time (under 5 minutes)	Generally, No	No	Yes
Requires startup time	Yes	No	No
Frequency Regulation	Yes	No	Yes
Regulation Up/Down	Yes	No	Yes
GHG and other pollution	Yes	No	No

Figure 6.3: Summary of Characteristics of Conventional Generators, Variable Renewable Generators, and Energy Storage
Description: This figure summarizes some of the features and characteristics of conventional (i.e. fossil) generators, variable renewable generators and energy storage. As is demonstrated, storage can provide certain key functions needed to ensure system-wide reliability, particularly with additional variable generation on-line, more quickly, smoothly, and cleanly than any other technology.

SIGNATORIES OF THE SUBMISSION ON THE SENATE ENERGY & NATURAL RESOURCES COMMITTEE WHITE PAPER ON THE CLEAN ENERGY STANDARD

FOR THE CLEAN ENERGY STANDARD STORAGE COALITION ("THE STORAGE COALITION")

A123 Systems

AES Energy Storage, LLC

Aquion Energy

Beacon Power Corporation

California Energy Storage Alliance (CESA)[15]

CALMAC

Debenham Energy LLC

Fluidic Energy

Ice Energy

National Hydropower Association[16]

Powergetics

Renewable Strategies LLC

Steffes Corporation

Sunverge Energy

SustainX

Xtreme Power

as of 4/11/11

[15] The California Energy Storage Alliance consists of A123 Systems, Altairnano, Applied Intellectual Capital/East Penn Manufacturing Co., Inc., Beacon Power Corporation, CALMAC, Debenham Energy, Deeya Energy, Enersys, EnerVault, Fluidic Energy, General Compression, Greensmith Energy Management Systems, HDR, Inc., Ice Energy, International Battery, Inc., LightSail Energy, Inc., MEMC/SunEdison, Powergetics, Primus Power, Prudent Energy, RedFlow, RES Americas, ReStore Energy Systems, Saft America, Inc., Samsung SDI, SANYO, Seeo, Sharp Labs of America, Silent Power, Sumitomo Electric, Suntech, SunPower, Sunverge, SustainX, Xtreme Power, and Younicos. The views expressed in these Comments are those of CESA, and do not necessarily reflect the views of all of the individual CESA member companies. For further information: http://www.storagealliance.org.

[16] The National Hydropower Association, representing more than 180 companies in the North American hydropower industry. For further information: http://hydro.org/