KEMA – Electricity Storage Association:

Assessment of Jobs Benefits from Storage Legislation

Prepared by: KEMA, Inc.

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Proprietary and Confidential

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Acronyms and Abbreviations

CES	Community Energy Storage
CAES	Compressed Air Energy Storages
C&I	Commercial and Industrial (end users)
DOE	U.S. Department of Energy
ITC	Investment Tax Credit
MW	Megawatt
MWh	Megawatt Hour
TOU	Time of Use
T&D	Transmission & Distribution

Executive Summary

Project Summary:

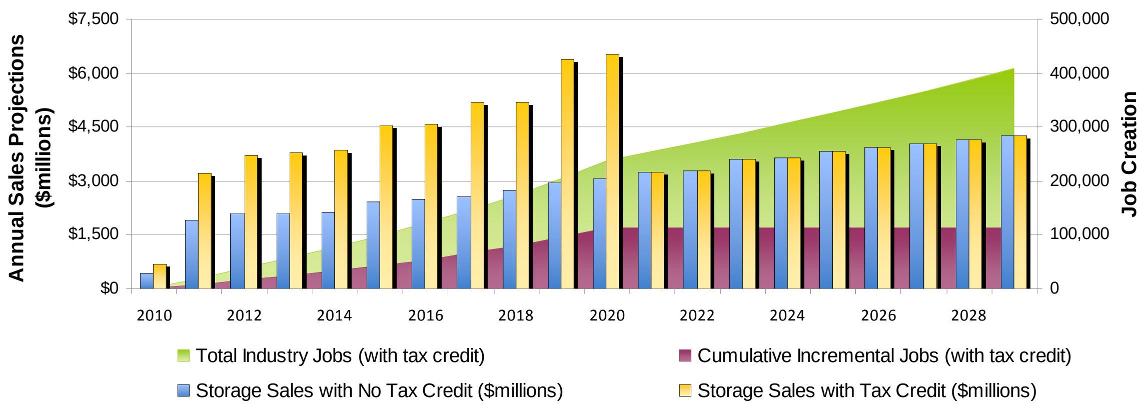
The Electricity Storage Association (www.electricitystorage.org) engaged energy consulting firm KEMA Inc. (www.kema.com) to evaluate and develop potential job creation estimates associated with energy storage legislation pending in Congress. The analysis first quantified the market size of key energy storage application areas and created an energy storage penetration model to examine the yearly megawatt (MW) market size based on the economic payback period. The analysis then assessed how the proposed incentives would increase market penetration for each application area. Incremental job creation was estimated based on the increased market penetration and associated sales revenue generated by the incentives.

Key Points of KEMA Analysis:

114,000 Incremental Jobs Created by 2020. KEMA's analysis projected approximately 114,000 incremental jobs would be created by 2020, a ten-year period, if investors received the proposed investment tax credit currently being debated in Congress. This analysis investigated the incentives from the STORAGE Act of 2009 (S. 1091), which includes a 20% energy investment credit for grid-connected energy storage and a 30% energy investment credit for onsite energy storage through 2020. The analysis predicted only the number of direct jobs created by the incentive and not the number of jobs created in the supply chain.

Figure 1 shows the projected annual storage sales revenue with and without a tax incentive along with the total and incremental jobs created by the incentive over a 20-year time horizon. For the duration of the tax incentive, the penetration of storage increases, which drives the increase in sales revenues and incremental job creation. Though energy storage is expected to be an integral component of our future electricity system, the legislation accelerates penetration and thus the creation of jobs that will accompany the development of the energy storage industry in the United States.

Figure 1: Summary of expected job creation due to the STORAGE Act of 2009



In the study, storage markets were broken down into five major areas defined as:

(a) Ancillary Services or Frequency Regulation / Spinning Reserve,

(b) Renewable Energy Integration,

(c) Community Energy Storage (CES), for High & Medium potential cases,

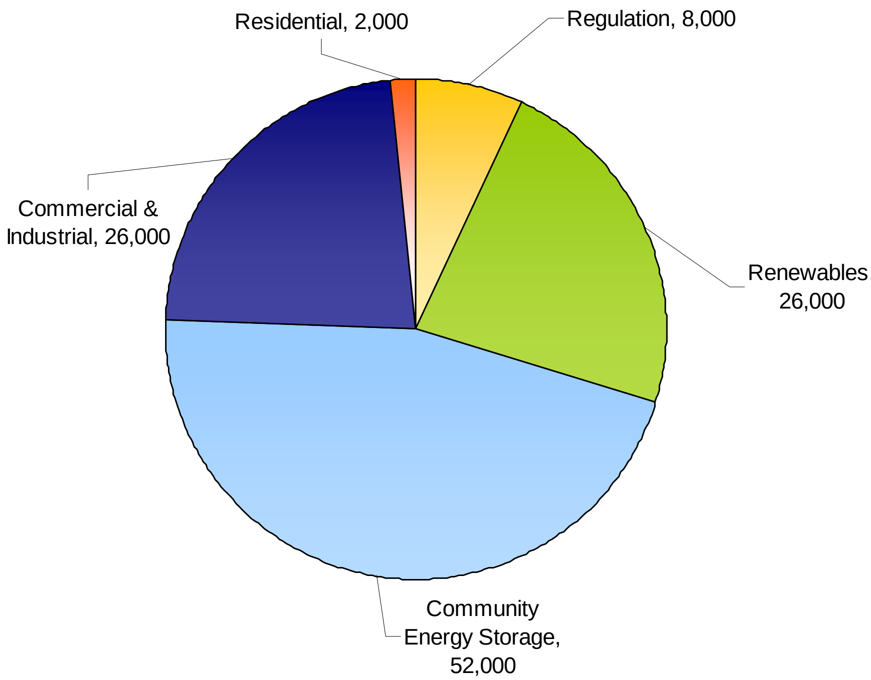
(d) Onsite Storage Application for the Commercial & Industrial Sectors, and

(e) Onsite Storage Application for the Residential Sector

The application areas focus on stationary applications of storage that are currently being targeted, demonstrated or have demonstration programs in process. Though there is a great deal of potential with the electric vehicle (EVs) market, and some of the energy storage technologies assessed in this study can be utilized for EVs, the focus of this analysis is only on stationary applications.

Figure 2 shows the estimated number of jobs created in five major areas of energy storage application area (described in the report methodology section) over the legislation time horizon. Jobs that would have been created in the absence of the tax incentive are not included in this figure.

Figure 2: Job creation estimates by storage application



Additional Benefit Areas:

The benefits of increasing penetration of advanced energy storage is not just limited to the direct impact of green jobs creation; additional benefits can also be expected to be captured from the incentives listed in the proposed Senate Bill. Some of these benefits are listed below:

Accelerate energy storage penetration to mitigate climate change: An incentive of this size would accelerate adoption of existing energy storage technologies and result in societal, economic and environmental benefits. Notably, eligible storage technologies directly impact greenhouse gas emission savings. Energy storage technology is considered a key component for high levels of renewable energy penetration and is an essential tool for future smart electricity grids.

Acts as Tool for Demand Response: When storage is used by end users for applications such as back-up generation or uninterruptible power systems, the device is essentially acting as a clean generation source. Often the traditional technologies, such as diesel back-up generators, cannot meet the emissions requirements necessary to participate in demand response programs. In contrast, if a C&I facility is using an energy storage device for back-up generation, the energy storage device, which generates no emissions of its own, could also act as an instantaneous demand response tool.

Additional Insights:

Incremental Job Creation by Alternative Tax Incentive Scenarios: This analysis provided some key insight into the current incentives provided by the STORAGE Act of 2009. Table 1 shows that increased job creation benefits are observed when the tax credit is increased during the 10 year duration of the tax incentive. Conversely, if the investment tax credit is reduced to 10%, the job creation benefit is disproportionately small because a 10% reduction offset is not sufficient to drive the payback period low enough to have a significant impact on the market penetration curves of storage technologies used in this study.

Table 1: Summary of alternative tax incentive scenarios

Scenario	Grid-Connected Storage	Onsite Storage	Duration of Incentive	Incremental Job Estimate
Storage Act of 2009	20%	30%	2010 to 2020	114,000
Tax Credit Increase	30%	40%	2010 to 2020	250,000
Tax Credit Decrease	10%	20%	2010 to 2020	44,000

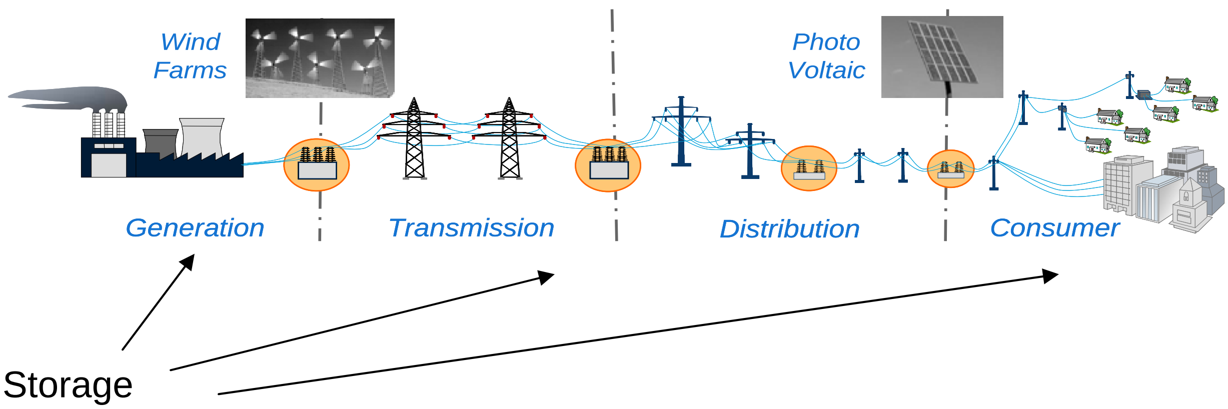
Conclusion

KEMA's modeling shows that job creation can occur from the STORAGE Act of 2009 incentive structure. The Act accelerates the adoption of the technology and thus creates jobs earlier than if the incentive did not exist. By accelerating the market adoption of advanced energy storage technologies, the energy storage legislation will create jobs and will move us closer to the realization of the smart electricity grid of the future, characterized by the full integration of renewable energy, better reliability, and more demand response and emissions control capabilities.

1. Introduction

Energy storage technology holds the promise to provide many benefits across the energy delivery chain, from generation to transmission & distribution to end-users (see Figure 3). Specifically, energy storage technology is considered a key component for integration of high levels of renewable energy penetration and as an essential tool for smart, future electricity grids. In addition, a number of societal benefits, such as emission savings, an alternative to traditional generation plants, or a tool for demand response, can be captured with the deployment of storage technologies.

Figure 3: Benefits of energy storage along the electricity value chain



Energy storage is not new. Pumped-hydro systems and lead-acid batteries have been in operation for many years and the concept of Compressed Air Energy Storage (CAES) has been known for many years as well. Newer technologies that are in the early market adoption stages, such as lithium ion batteries, flow batteries, flywheel, and sodium sulphur (NaS) systems offer improved operational flexibility, and in some cases longer duration or fast response capabilities.

Legislation currently pending before Congress would provide an investment tax credit (ITC) for energy storage systems, including a 20% energy investment credit for grid-connected energy storage and a 30% energy investment credit for onsite energy storage through 2020. To date, there has been little investigation of the potential jobs that could be created by such action. The Electricity Storage Association funded this study and engaged KEMA Inc. to develop estimates.

The energy storage legislation focuses on tax incentives, not grants, which can be applied to specific projects. As the legislation centered on the years 2010 to 2020, KEMA focused on specific markets that are most likely to be near-term and thus enhanced by the pending legislation. These markets, which are comprised of generation, transmission & distribution, and end-user applications and services, are shown in Table 2. The following sections describe the methodology, results and conclusions of KEMA's analysis.

Table 2: Summary of relevant energy storage applications

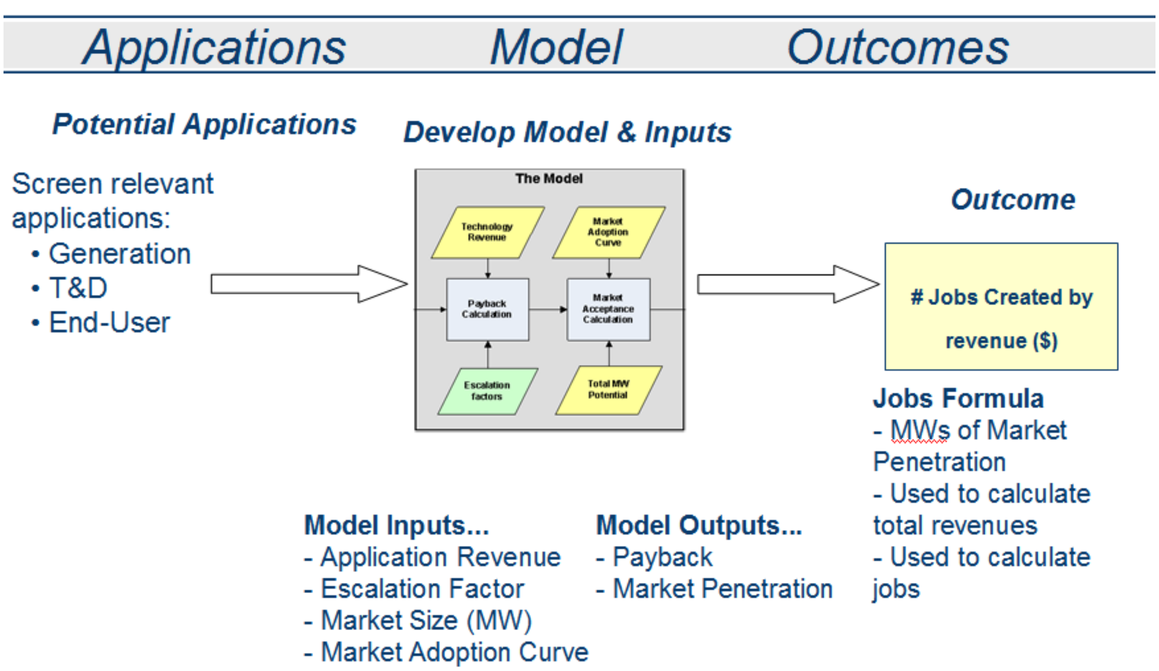
Application	Application Benefits
Grid Connected – Generation Support	Ancillary Services: Regulation, Spinning Reserve and Black Start
Grid Connected – Generation Support	Renewables Integration (Wind and Solar)
Grid Connected – Transmission & Distribution Support	Community Energy Storage – High Potential Case
Grid Connected – Transmission & Distribution Support	Community Energy Storage – Medium Potential Case
Onsite Energy Storage	Commercial or Industrial End User – Electric Service Reliability and Energy Management
Onsite Energy Storage	Residential End User – Electric Service Reliability and Energy Management

2. Methodology

The methodology utilized in this report involved quantifying the key storage market application areas, creating a market penetration curve for the application areas, assessing the yearly MWs of energy storage penetration, and then calculating the revenues associated with those MWs. From the revenues created through the yearly MWs, the model then also calculated the increase in jobs that will be expected in each of the areas. Figure 4 displays this methodology and shows the conceptual approach followed by KEMA and bulleted below:

- Selected and examined the top energy storage markets and assessed their 20-year market size potential
- Assessed the cost of energy storage technologies
- Estimated the economic payback period for each of the selected technologies and created penetration curves for each individual market
- Created a Market Penetration Model using data inputs
- Ran the model for each of the application areas

Figure 4: Methodology overview



2.1 Market Applications and Sizing

The pending legislation focuses on an ITC that can be applied to specific types of projects. Hence, for this project, KEMA examined all areas for energy storage across generation, transmission & distribution, and end-user applications. In particular, we sought to identify applications most likely to drive an increase in market size over a 20-year horizon. The five top applications selected have the potential to offer the highest market penetration by 2020, when the proposed tax credit ends. By application area, these are:

Generation

Regulation / ancillary services. Studies, such as KEMA's "The Benefits of Fast Response Storage Device for System Regulation in ISO Markets,"[1] have shown that fast-response storage devices have the ability to provide regulation and spinning reserve – typically grouped into set of services called Ancillary Services. Today, Independent System Operators (ISOs) are looking at the potential for these devices to act as an alternative to traditional generation technologies to supply these services. In addition, increased deployment of variable, renewable generation resources, especially wind and solar, may increase volatility and thus require an increase in regulation services. Advanced energy storage technologies that have the ability to provide fast-response capabilities for regulation service show promise as a potential solution to the problem. Target regulation markets would include CAISO (California), ERCOT (Texas), MISO (Midwest), PJM (Mid-Atlantic), NYISO (New York) and ISO NE (New England). Because data does not exist for all these markets, a subset was used and benefits were extrapolated across the markets.

The report analysis sees this market as the most near-term, increasing as renewable energy penetration increases throughout the period of the study. The market number is based off the current size of the ancillary services market in deregulated areas.

Renewable Energy Integration (wind and solar). This market area follows the deployment of variable, renewable generation devices, such as wind and large solar systems. For wind, this market is directed at wind-farms, generally 30 MW and above, and large solar applications, generally greater than 1 MW. The intermittency of these applications has the potential to create difficulties in maintaining grid operations. Energy

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[1] Masiello, Ralph. Vu, Khoi. Fioravanti, Richard. *The Benefits of Fast Response Storage Device for System Regulation in ISO Markets*. KEMA Study. June 2008.

storage has the potential to mitigate these potential problems by providing a smoothing function to the generation. For the analysis, KEMA estimated that 20% of the projected variable, renewable generation will require energy storage capabilities to achieve optimal performance. The market sizing approach is based on EIA's Annual Energy Outlook's forecasted growth of intermittent renewable resources.[2]

Transmission & Distribution

Community Energy Storage (CES) – High and Medium Case. Community energy storage is a small distributed energy storage unit connected to the secondary transformers serving a few houses or small commercial loads. As the name implies, the primary benefit of the energy storage device is to benefit a local community by enhancing reliability, reducing required capital investment by flattening peak loads, and compensating for the variability of distributed renewable resources such as solar on roof tops. Typical sizes for single-phase community storage devices in a residential neighborhood would match the size of the distribution transformers – 10 kilovolt-ampere, 25 and 50 kilovolt-ampere, etc. For larger three-phase applications, the devices could be installed in a bank, just like distribution transformers. The batteries will be able to carry their full demand capacity for one to three hours or longer, depending on the application.

There are an estimated 12,240,000 transformers in the 30-50kW range in the U.S. The potential market size was estimated by assuming that CES devices would only capture a modest portion of that market. However, it is this number of transformers that drives the market potential of CES to a comparatively higher level than the other grid-connected application areas.

In our model, KEMA accounted for varying needs for CES systems across utilities and locations. In order to identify the benefits that could be realized by CES systems, KEMA identified high potential and medium potential market opportunities for storage systems. The high potential case is comprised of the small percentage of transformers that suffer from poor reliability due to aging or undersized equipment. Though the market size is smaller, these cases represent the highest economic benefit and the shortest payback periods. The medium potential case is comprised of a larger percentage of transformers with less severe reliability problems but which could still benefit from CES. These

[2] U.S. Energy Information Administration. *Annual Energy Outlook 2010*.

medium potential cases have a lower economic benefit and a significantly longer economic payback period than the high potential cases.

End-User Applications

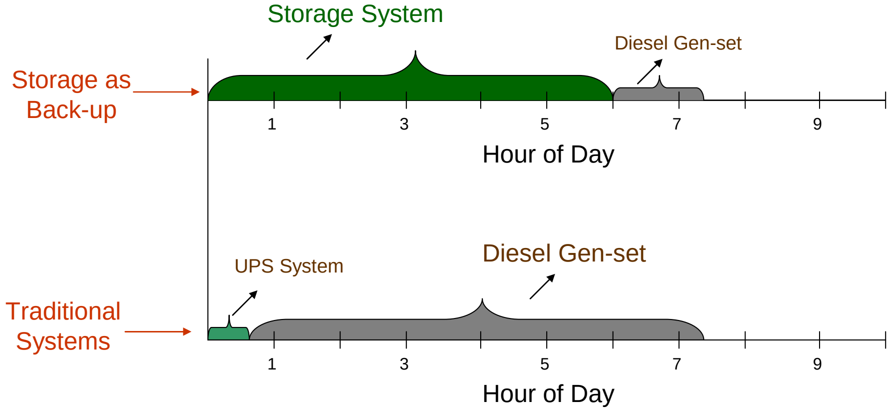
Onsite Storage for Commercial & Industrial (C&I) Users. Commercial and industrial customers are expected to take advantage of multiple value streams associated with onsite energy storage, including time-of-use energy cost management, demand charge management, and electric service reliability and power quality. C&I customers with a high reliability need currently rely upon uninterruptible power supply (UPS) systems and diesel back-up generators. With increased durations and the ability to draw upon multiple value streams, storage systems are increasingly competitive with these alternatives. The financial benefits of onsite storage applications are also expected to increase with the penetration of distributed solar photovoltaic (PV) systems and time-of-use rates.

Onsite Storage for Residential Users. As with commercial and industrial users, residential storage users are able to benefit from multiple value streams, including electric service reliability and time-of-use energy cost management. Residential users with PV systems, particularly those on time-of-use rates, could realize benefits by storing energy for use during peak periods. The amount of the benefit would vary depending on the efficiency of the storage device and the differential between on- and off-peak rates. Today's low penetration of PV systems and residential time-of-use rates is a limiting factor in the amount of the benefit that can be realized today, but as penetration increases, this application could become a compelling driver for residential storage applications.

Potential Opportunity Area – Storage as Back-up Power

One of the predominant applications for the C&I storage area is as a potential alternative to traditional back-up power systems. As advanced energy storage increases its ability to perform multiple charge/discharge cycles as well as increasing duration (multiple hours), the devices begin to look more and more like distributed generation rather than simple battery systems. For facilities that required premium power, back-up systems are comprised of a traditional UPS and typically a diesel generator. The UPS system is used for momentary outages while the diesel generator is used for longer duration outages. An alternative would be to replace this system with an advanced energy storage system. This is represented graphically in Figure 5 below:

Figure 5: Graphical representation of storage as a back-up power system



In this application, the storage system becomes the dominant supplier of back-up power and the diesel system is only used in long duration outages or as a device to power the energy storage system. The advantage to this approach is that the energy storage system, charged at night, will also have the ability to discharge during the day during peak price periods and could be used for demand response (DR) programs. The latter application is important because the emissions associated with a diesel generator often prevent them from being utilized for anything other than emergency generation. A study conducted by KEMA for the California Energy Commission revealed that there is approximately 3,800 MW of back-up generation in the state – approximately 7% of the peak capacity. Utilizing the asset as an instantaneous demand response resource may have a significant impact on future DR programs.

Application Area Summary

From this break out of applications, KEMA calculated market size (in MW) for the top five applications selected over 20 years using estimated growth rates. This technical market potential represents the maximum possible amount of energy storage that could be installed, given only technical constraints. The smaller addressable market was estimated based on reasonable assumptions about technology and market readiness as well as persistence of outstanding challenges.

2.2 Costs and Payback Periods

Advanced energy storage markets are still predominately in a pre-commercialized stage. Hence, the cost of storage devices is expected to decrease over the 20-year study period. In addition, energy storage is made up of a number of competing technologies at varying price points. To address these factors, KEMA listed developing energy storage technologies across a range of durations and used estimated cost data across their 20-year lifetime. These average cost curves were used to estimate the expected cost of advanced energy storage.

KEMA estimated the economic payback period for each of the energy storage applications over the 20-year study period. The payback period was determined by dividing the initial cost of the storage equipment by the net annual benefit derived from the storage equipment to determine the period of time required for the benefits to repay the original investment.

The initial investment cost was derived using the storage system cost curves described above plus estimates of the balance of plant (BOP) costs. The table below shows the breakdown of balance of plant costs for a sample storage project. As shown, the balance of plant costs can often exceed the cost of the storage device itself.

Table 3: Balance of plant costs for a typical storage project

Balance of Plant Costs		
Battery/DC System	$1,000	40%
Power Conversion System and System Integration Components	$625	25%
Enclosure/Housing	$125	5%
Shipping to Site	$125	5%
Site Work	$175	7%
Engineering	$450	18%
Total	$2,500	100%

The balance of plant costs vary by application, with some applications requiring more complex operating processes (e.g. regulation services) and some benefiting from economies of scale by virtue of the size of the storage installation (e.g., renewable energy integration). The table below shows the first year cost estimates used in the model as inputs to the payback calculations.

Table 4: Payback calculation inputs – storage costs

	Regulation	CES-High	CES-Med	Renewable	C&I	Residential
Average Storage Size per Site (kW)	2,000	2,000	2,000	10,000	500	2
Storage Cost Only - Base Year ($/kW)	$1,000	$1,000	$1,000	$1,000	$750	$750
Balance of Plant Costs ($/kW)	$1,500	$1,000	$1,000	$800	$1,000	$1,000
Storage Equipment Installed Costs - Base Year ($/kW)	$2,500	$2,000	$2,000	$1,800	$1,750	$1,750

The net benefits were determined for each storage application based upon a combination of primary and secondary research. The net benefits were determined by identifying the possible value streams for storage, which could include electricity sales or avoided electricity costs, less the costs of operating the storage device. The net benefit estimates were adjusted to account for efficiency losses associated with the storage devices. For some storage applications, an escalation factor was applied to account for changes in the net benefits over the 20-year study period. For example, as the expected financial benefits of onsite storage applications is expected to increase with the penetration of distributed solar PV systems and time-of-use rates.

The combination of decreasing cost curves and increasing storage benefits resulted in payback curves that improve over the course of the 20-year study period. Payback curves were calculated with and without the ITC and used in the next step of the process to determine the market penetration associated with the ITC.

2.3 Market Penetration Modeling

KEMA created an advanced energy storage market penetration model as a basis to estimate the acceleration in market penetration attributable to the proposed legislation. The estimated market penetration of the storage technologies was derived based upon the addressable market sizes and growth rates as well as the economic attractiveness of the storage technologies compared to alternatives.

Addressable market sizes and growth were derived from technical market potential estimates based upon reasonable assumptions about technology and market readiness and persistence of outstanding challenges. For a given storage application, the addressable market size provides an upper bound on the amount of penetration. The model also includes parameters to limit growth in the first year and subsequent years in order not to exceed what the storage industry could realistically accomplish.

The level of storage penetration varies based upon the economic payback and how that payback compares to available alternatives. In the case of regulation services, the alternative might be a combined cycle gas turbine with an average payback of approximately seven years. In the case of onsite storage, the alternative might be a UPS device with a payback of approximately four years. The alternative technologies are a factor in determining the hurdle rate at which storage would achieve significant penetration rates. The market penetration curves that determine storage penetration are derived based on KEMA's years of experience building and calibrating market adoption models, including models used to determine renewable energy penetration rates.

The MW penetration of storage was derived using the payback curves with and without the ITC and used to calculate the incremental sales revenue associated with the ITC. KEMA applied a job creation factor to the incremental sales revenue for each of the storage applications in order to estimate the number of jobs created by the ITC. Based on guidance from ESA and other industry sources, KEMA applied a job creation factor of $200,000 in sales revenue to create one job or equivalently, five jobs created per $1 million in sales revenue. This estimate does not include indirect and induced jobs which would be created in the supply chain from such an investment in storage. Some sources estimate the supply chain jobs at a comparable or even high level than the direct jobs.[3]

[3] Data from *Green Recovery Program* analysis, Political Economy Research Institute, University of Massachusetts - Amherst

2.4 Legislation and Tax Benefits

The Storage Technology of Renewable and Green Energy Act of 2009 (also known as the STORAGE Act of 2009) was introduced in the Senate on May 20, 2009. The legislation, sponsored by Senator Ron Wyden (D-Oregon), would amend the Internal Revenue Code to extend existing energy investment credits to storage technologies. The legislation would:

1. Allow a 20% energy tax credit for investment in energy storage property directly connected to the electrical grid
2. Make such property eligible for new clean renewable energy bond financing
3. Allow a 30% energy tax credit for investment in energy storage property used at the site of energy storage
4. Allow a 30% non-business energy property tax credit for installation of energy storage equipment in a principal residence.[4]

Senator Wyden's goal appeared to be to avoid picking technology winners and losers by basing the tax credit on the amount of energy stored and not the type of technology used.[5] As currently proposed, the legislation specifies a minimum capacity for "qualified energy storage property" for grid connected applications as follows:

(i) has the ability to store at least 2 megawatt hours of energy, and
(ii) has the ability to have an output of 500 kilowatts of electricity for a period of 4 hours.[6]

For onsite storage applications, the minimum capacity specified is as follows:

(i) has the ability to store the energy equivalent of at least 20 kilowatt hours of energy, and,
(ii) has the ability to have an output of the energy equivalent of 5 kilowatts of electricity for a period of 4 hours. [7]

This study focused on assessing increased market penetration of storage due to the energy tax credits. The model did not factor in possible increased market penetration due to making new

[4] http://thomas.loc.gov/cgi-bin/query/z?c111:S.1091:
[5] http://wyden.senate.gov/issues/Legislation/energy/storage.cfm
[6] http://thomas.loc.gov/cgi-bin/query/z?c111:S.1091:
[7] http://thomas.loc.gov/cgi-bin/query/z?c111:S.1091:

clean renewable energy bond financing available to public power providers and other qualifying entities. Thus, our assessment of the job creation potential of the legislation may be considered conservative. In addition, storage incentives seem to be intended to result in accelerated cost reductions of technologies. In our case, we did not take into account the impacts of the storage legislation accelerating the market and correspondingly accelerating the cost reductions.

The model incorporated the effect of the tax credits by reducing the initial investment cost of the storage equipment by the tax credit amount, either by 20% or 30% depending on the storage application. The decision to make capital investments is typically informed by whether the cash flow from the investment clears specific economic hurdles. By reducing the initial cost of the storage systems, the legislation would improve the economic payback and would accelerate adoption of storage.

In addition to the initial equipment costs, the cash flow equation is determined by annual operating costs and annual revenues from energy sales and/or avoided energy costs. The net annual cash flow (revenues less operating costs) that can be realized for a given storage system depends on many factors, including capacity, efficiency, and frequency and duration of charging and discharging.

The penetration model was configured to select storage technology characteristics that would optimize the net benefits that could be accrued by investing in storage. Some storage applications have better paybacks with shorter duration batteries, such as ancillary services of frequency regulation and spinning reserves. The recent report from Sandia National Laboratories identifies a number storage benefits that can be derived from storage systems designed to optimize power over energy as shown in the following table.[8] Though the purpose of the storage legislation is clear, the legislation may further assist the storage market by accounting for the fact that some storage devices have better power characteristics and some storage devices have better energy characteristics. Ensuring that the legislation doesn't favor a category but allows the most efficient device to be utilized may be a goal that requires additional language in the current bill. Table 5 below shows how different storage characteristics can serve best in specific applications.

[8] Eyer, Jim. Corey, Garth.. *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide*, Sandia National Laboratories. Sandia National Laboratories Report #SAND2010-0815. February 2010.

Table 5: Standard assumption values for discharge duration

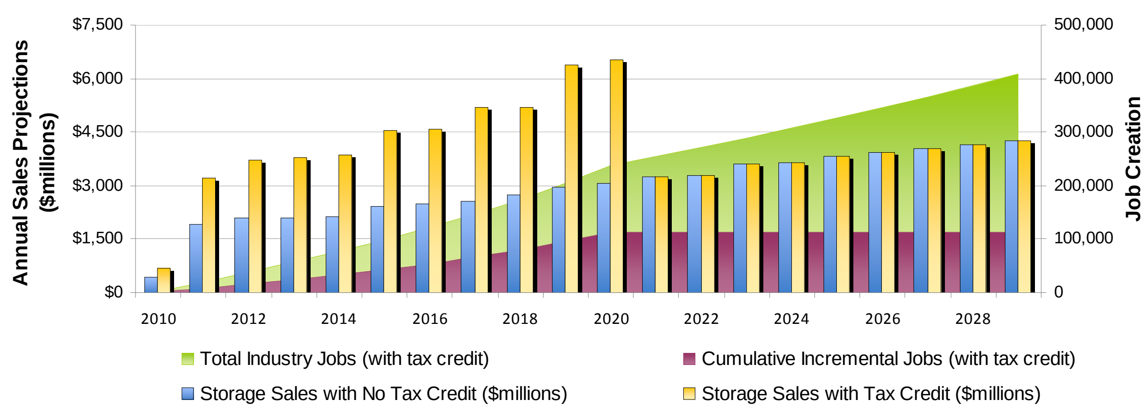
Discharge Duration*				
#	**Type**	Low	High	Note
4	Area Regulation	15 min.	30 min.	Based on demonstration of Beacon Flywheel.
5	Electric Supply Reserve Capacity	1	2	Allow time for generation-based reserves to come on-line.
6	Voltage Support	15 min.	1	Time needed for a) system stabilization or b) orderly load shedding.
7	Transmission Support	2 sec.	5 sec.	Per EPRI-DOE Handbook of Energy Storage for Transmission and Distribution Applications.[17]
13	Electric Service Reliability	5 min.	1	Time needed for a) shorter duration outages or b) orderly load shutdown.
14	Electric Service Power Quality	10 sec.	1 min.	Time needed for events ride-through depends on the type of PQ challenges addressed.
17.1	Wind Generation Grid Integration, Short Duration	10 sec.	15 min.	For a) Power Quality (depends on type of challenge addressed) and b) Wind Intermittency.
17.2	Wind Generation Grid Integration, Long Duration	1	6	Backup, Time Shift, Congestion Relief.
*Hours unless indicated otherwise. Min. = minutes. Sec. = Seconds.				
Source: Eyer, Jim. Corey, Garth.. *Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide*, Sandia National Laboratories. Sandia National Laboratories Report #SAND2010-0815. February 2010.				

3. Results

KEMA's model estimates that 114,000 incremental jobs could be created by 2020 if investors receive the proposed ITC for energy storage technologies. The purple curve in Figure 6 shows the incremental jobs created by accelerating storage sales with a tax credit. The incremental jobs are derived as a function of the increase in storage sales due to the tax credit. When the tax credit ends in 2020, the purple curve levels off to show the total incremental jobs gained through the tax credit. The bar charts represent the annual sales of energy storage systems. Years 2010 thru 2020 show the increased sales that are the result of the tax incentives – resulting from the incentive reducing the payback of the storage systems and thus increasing the penetration over the "no tax credit" case. After the ITC expires, the bar charts align as the paybacks in the two cases are the same.

As the overall assumption of the analysis is that storage will be needed, storage sales and market penetration continue to occur for the remaining years. The green shaded portion of the curve shows the overall number of jobs created by storage throughout the 20-year time frame of the study.

Figure 6: Storage sales projections and incremental jobs

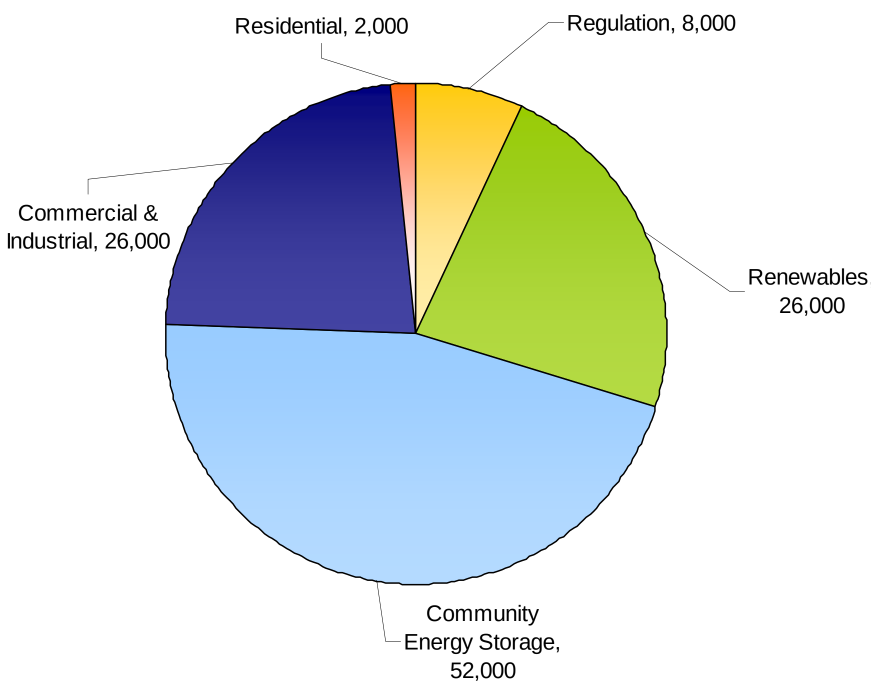


The cost of storage is expected to decline over the analysis time frame, which is evident in the increasing sales penetration numbers in the remaining years. However, it is also evident from the drop in storage sales in 2020 that the projected decline in storage costs is not rapid enough to compensate for the loss of the tax credit in 2020.

Additional key study results are summarized below:

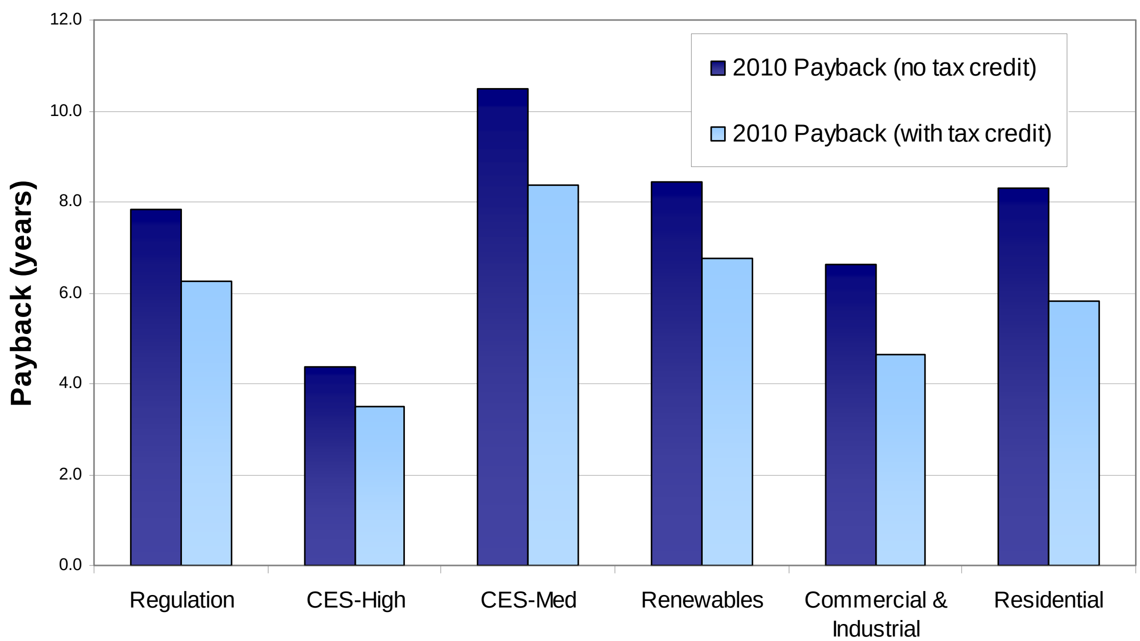
Incremental Jobs Created. KEMA's model shows 114,000 incremental jobs created by 2020 as a direct result of the investment tax incentive for energy storage developers. By storage application, these break down into 8,000 jobs from regulation, 26,000 from renewables, 52,000 from community energy storage, 26,000 from commercial and industrial onsite energy storage, and 2,000 from residential onsite energy storage. Figure 7 displays the results. Jobs that would have been created in the absence of the tax incentive are not included in this figure. A tax incentive of this size would accelerate adoption of existing energy storage technologies and result in $25 billion additional cumulative industry sales by 2020. By some estimates, a comparable number of jobs would be created in the supply chain.

Figure 7: Job creation estimates by storage application



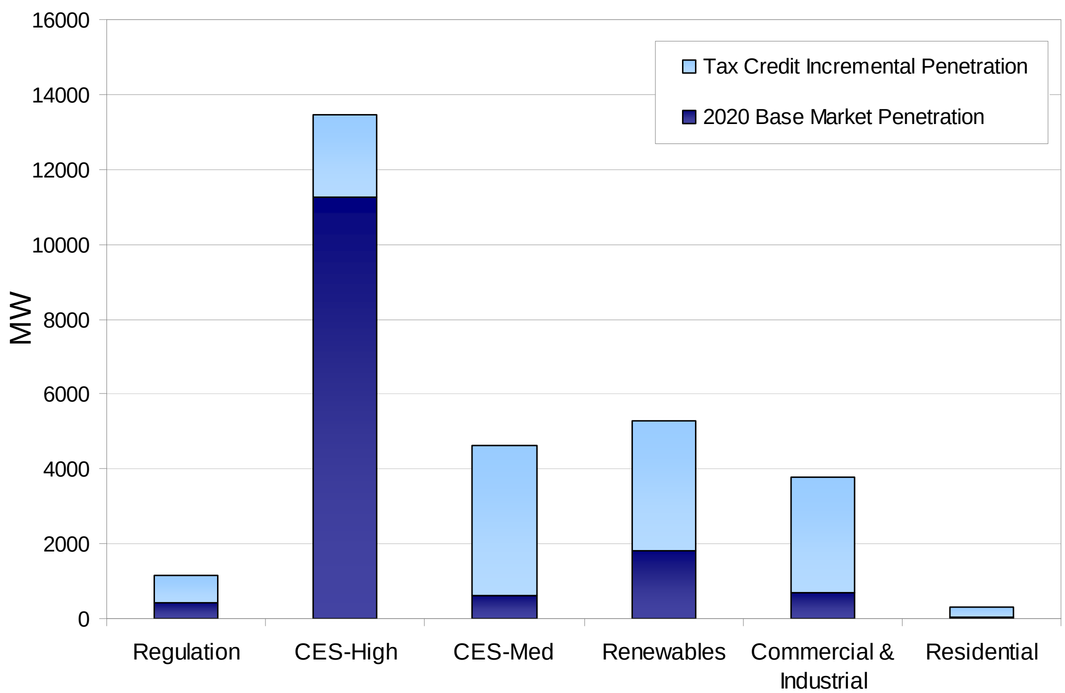
Payback (years) by Application: The impact of the legislation is to lower the overall economic payback period of a project and drive the paybacks to levels that would be more acceptable to faster adoption. Figure 8 provides a summary of the first year paybacks with and without the ITC. This chart shows the impact that the ITC would have in making the storage applications more competitive in the short term. The economic hurdle that a given storage application must meet varies depending on the available alternatives. For the grid-connected storage applications, a typical hurdle rate might be seven years, which is comparable to a combined cycle gas turbine. C&I and residential customers typically require paybacks in the neighborhood of four years or less. As shown in Figure 8, the high potential Community Energy Storage application has paybacks well below seven years even before the ITC. This is in contrast to the medium potential Community Energy Storage application, with paybacks exceeding 8 years even after the ITC. With the help of the ITC, the C&I onsite storage applications are approaching the four year hurdle rate needed to drive significant penetration.

Figure 8: First year paybacks by application with and without ITC



Market Sizing: The incremental penetration of storage due to the ITC is driven by the payback as well as the size of the potential market for the storage application. Figure 8 shows the estimated market penetration of each storage application in 2020 with and without the ITC. The incremental effect of the ITC is depicted by the magnitude of the light blue bar. The combined effect of market size and economic paybacks is particularly evident in the comparison of high and medium potential Community Energy Storage applications. Because the high potential CES application is relatively competitive even before the tax credit, market penetration is high and the incremental effect of the tax credit is not as pronounced as compared to some of the other applications. Though the medium potential CES application has a much larger addressable market, the overall penetration is lower by comparison, but the incremental penetration due to the tax credit is much more pronounced. It is safe to say that without the benefit of the ITC, Community Energy Storage would be much slower to achieve its potential. The regulation services and renewable energy integration applications both get a big boost from the ITC because the ITC pushes the payback beneath the seven year payback threshold at which market penetration is expected to accelerate. The reason for the relatively low penetration of regulation services is that the addressable market is estimated at just 2,000 MW in 2020.

Figure 9: Cumulative and incremental market penetration by storage application, 2020



4. Conclusion

114,000 Incremental Jobs Created by 2020. KEMA's analysis projected approximately 114,000 incremental jobs would be created by 2020 if investors received the proposed investment tax credit currently being debated in Congress. This analysis investigated the incentives from the STORAGE Act of 2009 (S. 1091), which includes a 20% energy investment credit for grid-connected energy storage and a 30% energy investment credit for onsite energy storage through 2020. The analysis predicted only the number of direct jobs created by the incentive and not the number of jobs created in the supply chain. By some estimates, a comparable number of jobs would be created in the supply chain.

In the study, storage markets were broken down into five major areas defined as:

(a) Ancillary Services or Frequency Regulation / Spinning Reserve,
(b) Renewable Integration,
(c) Community Energy Storage (CES), for High & Medium potential cases,
(d) Onsite Storage Application for the Commercial & Industrial Sectors, and
(e) Onsite Storage Application for the Residential Sector

The application areas focus on stationary applications of storage that are currently being targeted, demonstrated or have demonstration programs in process. These areas were selected because of the near-term potential of the applications as well as the aggregate size of the applications. Though it is acknowledged that niche applications of stationary energy storage will add to the overall market, on a percentage basis, the near-term storage market can be represented by the five application areas shown.

Additional Benefit Areas:

The benefits of increasing penetration of advanced energy storage is not just limited to the direct impact of green jobs creation; additional benefits can also be expected to be captured from the incentives listed in the proposed Senate Bill. Some of these benefits are listed below:

Accelerate energy storage penetration to mitigate climate change: An incentive of this size would accelerate adoption of existing energy storage technologies and result in societal, economic and environmental benefits. Notably, eligible storage technologies directly impact greenhouse gas emission savings. Energy storage technology is considered a key component for high levels of renewable energy penetration and is an essential tool for future smart electricity grids.

Acts as Tool for Demand Response: When storage is used by end users for applications such as back-up generation or uninterruptible power systems, the device is essentially acting as a clean generation source. Often the traditional technologies, such as diesel back-up generators, cannot meet the emissions requirements necessary to participate in demand response programs. In contrast, if a C&I facility is using an energy storage device for back-up generation, the energy storage device, which generates no emissions of its own, could also act as an instantaneous demand response tool.

Additional Insights:

Incremental Job Creation by Alternative Tax Incentive Scenarios: This analysis provided some key insight into the current incentives provided by the STORAGE Act of 2009. Table 1 shows that increased job creation benefits are observed when the tax credit is increased during the 10 year duration of the tax incentive. Conversely, if the investment tax credit is reduced to 10%, the job creation benefit is disproportionately small because a 10% reduction offset is not sufficient to drive the payback period for storage technologies low enough to have a significant impact on the market penetration curves of storage technologies used in this study.

Table 6: Summary of alternative tax incentive scenarios

Scenario	Grid-Connected Storage	Onsite Storage	Duration of Incentive	Incremental Job Estimate
Storage Act of 2009	20%	30%	2010 to 2020	114,000
Tax Credit Increase	30%	40%	2010 to 2020	250,000
Tax Credit Decrease	10%	20%	2010 to 2020	44,000

Final Conclusion:

KEMA's modeling shows that job creation can occur from the STORAGE Act of 2009 incentive structure. The Act accelerates the adoption of the technology and thus creates jobs earlier than if the incentive did not exist. By accelerating the market adoption of advanced energy storage technologies, the energy storage legislation will create jobs and will move us closer to the realization of the smart electricity grid of the future, characterized by the full integration of renewable energy, better reliability, and more demand response and emissions control capabilities.

5. Data Sources

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