How Energy Storage Can Pave the Way for Renewable Energy Adoption

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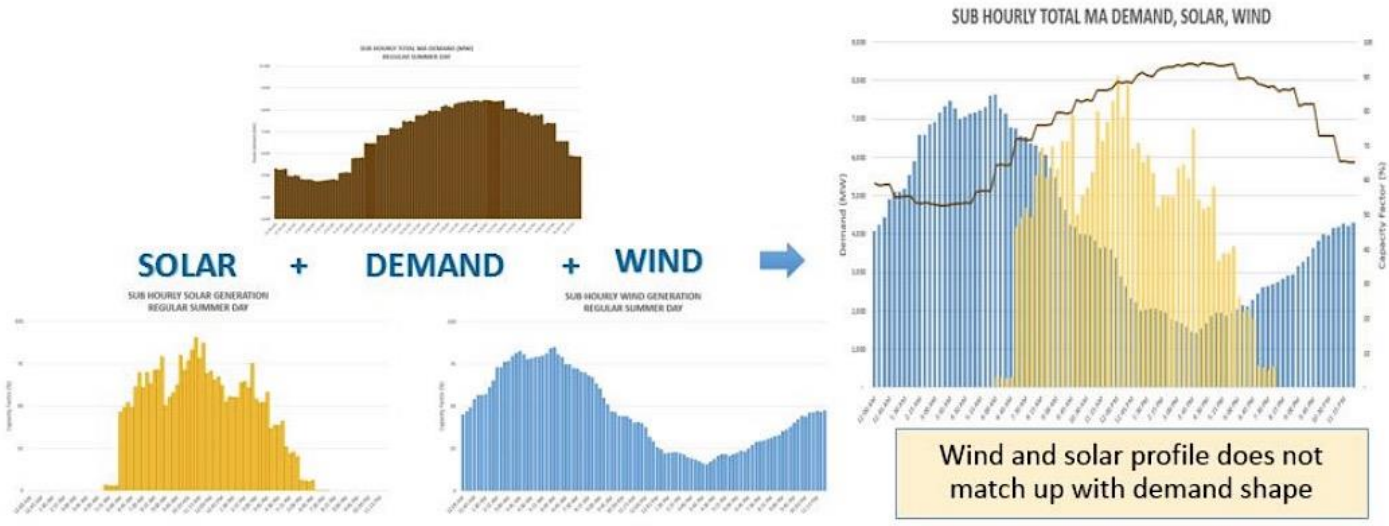
Introduction

Renewable energy offers a hopeful promise to reduce the energy sector's carbon footprint, but many challenges must be addressed before it can be more extensively integrated into our society. One of the greatest barriers to widespread adoption is quite simply that due to the nature of renewable energy – the fact that it is produced only when solar rays, wind, etc. are available – it cannot fully respond to customers' energy demand in real time. Fossil fuels are easy to store, making it far easier to scale up or scale back the amount of energy that needs to be fed into the system. This is not the case for renewable energy. Customers, from businesses to home owners have fluctuating energy needs, and especially in times of peak energy demand, consumers cannot wait for the sun to shine to get the energy they need. Similarly, there are times where energy systems could capture power but offer little benefit to customers, such as if wind blows at night, when energy demand in typically low. A Massachusetts report on the costs and benefits of energy storage illustrates an example of these discrepancies in the charts below:



Graphs of Massachusetts sub-hourly production of solar and wind energy overtop the sub-hourly energy demand curve. Source: "State of Charge" by Massachusetts Department of Energy Resources and Massachusetts Clean Energy Center[1]

Energy storage systems - a means of capturing and holding energy for later use - are rising to meet the challenge of making renewable energy more reliable. Already, companies are pouring investments to

developing storage systems with greater capacity, and government policies are creating incentives for the increased adoption of energy storage. A win for energy storage is also a win for renewable energy, so we need increased investments from the private sector and better government policies. With these important steps, energy storage can bring benefits to a range of stakeholders, demonstrating the potential of better reliability and financial gains.

Current Storage Landscape

The Private Sector

Energy storage is on the brink of widespread deployment, and already many stakeholders have shown their commitment to this possible future of more reliable and cleaner energy. With a handful of companies leading the charge, and more emerging, the private sector has played a particularly large role in expanding the use of storage systems. In fact, the market for energy storage is already estimated to be at $100 billion, and is projected to continue growing significantly.[2] Especially since energy storage can be such a costly undertaking, the private sector's involvement has become an important driver for the expansion of energy storage.

In some ways, economic benefits are perhaps the most compelling aspect of energy storage systems. While energy storage would unleash the potential of renewable energy – which would have a massive impact on reducing reliance on fossil fuels thereby reducing harmful carbon emissions – not everyone agrees that climate change should be a major focus in our society. However, proving that energy storage would improve the resilience of our electric grid and reduce costs for businesses and customers alike could allow renewables and storage systems to play a larger role.

Tesla – more often recognized for electric vehicles and self-driving cars – has expanded its involvement into energy storage, making it one of the most well-known names in energy storage. Tesla has developed lithium battery systems for residential and business use, the Powerwall and Powerpack batteries, respectively. While the Powerwall is more likely to be used in homes with solar panel installations, the Powerpack has the potential to be a more widely used system.[3] Tesla explains the various uses and benefits of their Powerpack system, in general representing the potential of battery storage systems. Such areas include:

- Allowing for the integration of renewable energy sources;
- Discharging energy during times of peak demand;

- Allowing for load shifting during peak demand, that is a process of balancing energy supply by shifting energy use from one time period to another;
- Serving as a backup energy source in an emergency; and
- Having the ability to serve as a disconnected microgrid, improving the operability and resilience of the overall electric grid.[4]

These benefits would result in reduced costs for consumers and businesses who take part in distributed energy resources – that is, those who install their own renewable energy systems to power their energy needs. Utilities also want to take advantage of energy storage, like the investor-owned utility Southern California Edison partnership with Tesla to help prevent blackouts.[5] Energy storage developers see that consumers and utilities want these benefits, and will continue to start new projects. The increased prevalence of energy storage systems will help more groups enter the market to make it more competitive, and eventually reduce the costs of installing storage systems to make them more accessible.

Already, Tesla has found a foothold in several areas. In November of 2016, Tesla announced a major project after its acquisition of SolarCity: to power whole island of Ta'u in American Samoa with solar panels and battery storage.[6] While a small project in the grand scheme of the world's energy use, this undertaking is an important step towards the expansion of clean energy. This microgrid is expected to offset the island's use of nearly 110,000 gallons of diesel per year, its capacity would be able to fully recharge in seven hours, and the island would be able to stay fully powered for up to three days without sun. No longer having to rely on importing costly fuel, this project could also have significant financial benefits for the island. If this project is successful, it would serve as a powerful indicator that the integration of renewable energy and storage systems would undeniably improve the carbon footprint of communities, businesses and more while also allowing them to achieve economic gains.

Again leading the charge on energy storage, Tesla partnered with Sierra Nevada Brewing Company to install a battery storage system.[7] This project will have a capacity of 500 kilowatts and 1 megawatt hour and will support the brewery's 10,000 panel solar array. Breweries are energy-intensive businesses, so this installation will help reduce energy demand during peak times (the batteries would be able to supply energy when demand is high, and store energy when demand is low), thereby reducing electric costs for the brewery and allowing them to be a more sustainable and independent operation.

Another notable company in the energy storage world is Green Charge Networks, founded in 2009 by entrepreneur Vic Shao with the goal of "helping businesses, municipalities, and schools of all sizes use power more efficiently, cut carbon emissions, and reduce costs."[8] Now mostly owned by the French multinational electric utility company Engie, Green Charge has over 48 megawatt hours of battery storage projects deployed or in progress, making it the largest provider of commercial energy storage in the United States.[9] Founder and CEO Vic Shao explains that the private sector has a significant role to play in the expansion of energy storage, since so often governments and utilities don't have the capital to install such large and costly projects.

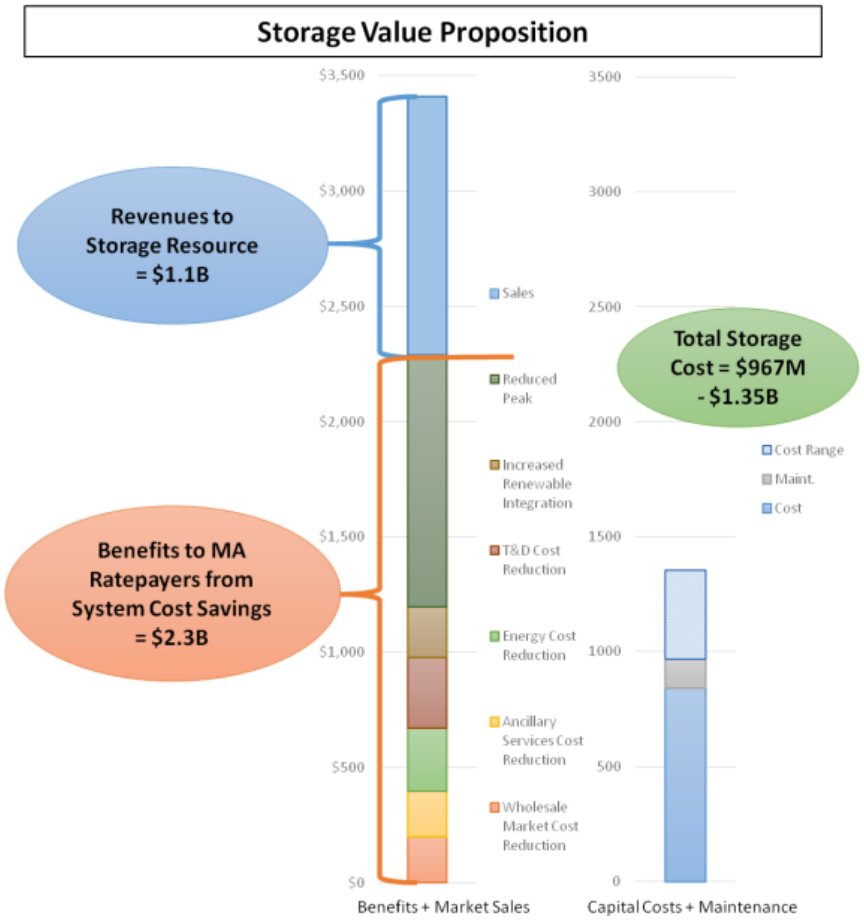
Businesses can see a clear return on investment because customers want to see reduced energy costs. So, not only would energy storage allow for better grid resilience and for more sustainable energy use, but consumers and businesses would benefit as well. What remains now would be to spread this message that energy storage and renewable energy are not just for those who care about reducing climate impact, but that it is also for financially driven stakeholders.

The Role of Government

While the market is a powerful force, governments also play a vital role in determining whether or not a product or service will succeed. California is consistently on the forefront of clean energy and climate change mitigation policies, enacting the United States' first energy storage mandate in 2013. Following in 2016, Oregon became the second state in the nation to implement an energy storage law.[10] This law requires Oregon's two largest electricity producers to deploy at least 5 MWh of energy storage by 2020 and calls for the Oregon Public Utilities Commission to develop a valuation methodology. While this law might not be tremendously detailed, it is an important first step, especially since many utilities face the challenge of complex economic considerations when it comes to energy storage. To ensure that energy storage has the potential to benefit consumers, businesses, and utilities, such regulations and investigations are essential.

Setting even higher targets than California and Oregon, Massachusetts has become the third state to introduce energy storage legislation. Starting with the introduction of a $10 million Energy Storage Initiative in 2015, which included a costs and benefits study, a market signals assessment, and demonstration projects.[11] This extensive *State of Charge* report, released in Fall 2016, offers policy recommendations to "maximize the system benefits of energy storage via long-term ratepayer cost reductions, increased grid resilience and reliability and decreased GHG emissions."[12] To maximize ratepayer benefits, Massachusetts could introduce up to 1,766 megawatts of advanced energy storage capacity, resulting in net benefits of at least $1.7 million and up to $2.4 million to ratepayers. This includes total benefits to consumers in cost savings, storage

revenues, and considers the costs of building and maintaining such a system. Example cost savings to consumers include $275 million in reduced energy costs when energy storage lowering the need for energy production at peak times, $305 million in increased resilience and reduced maintenance costs for the transmission and distribution system, $200 million in reduced costs for ancillary services such as frequency regulation and voltage stabilization, and more. These costs and cumulative benefits are illustrated in the storage value proposition graph below, showing that these recommendations are overall beneficial for ratepayers:



Source: "State of Charge" by Massachusetts Department of Energy Resources and Massachusetts Clean Energy Center

Energy storage could offer significant financial benefits to Massachusetts ratepayers, but the report found that "[t]he biggest challenge to achieving more storage deployment in Massachusetts is the lack of clear market mechanisms to transfer some portion of the system benefits (e.g. cost savings to ratepayers) created to the storage project developer." The report's analysis and recommendations seek to address that. Example

mechanisms to facilitate the deployment and adoption of energy storage could be including energy storage as an eligible technology to the existing Green Communities Designation and Competitive Grants Program, or to amend Massachusetts' Alternative Portfolio Standard to include energy storage. Doing this could "close the revenue gap for storage project developers by creating an additional revenue stream to monetize the system benefits not readily captured by storage developers, but which ultimately flow to all ratepayers in the form of lower electricity prices."[13]

The report recommends mechanisms for Massachusetts to generate 600 megawatts of energy storage capacity by 2025, saving customers an estimated $800 million in system benefits. Based on the roadmap that the State of Charge report laid out, Massachusetts Governor Charlie Baker first signed into law a directive for the Massachusetts Department of Energy Resources (DOER) to determine if energy storage targets would be cost-effective, and by the end of the year the DOER found that such targets were indeed prudent.[14] Now in 2017, the DOER will set and adopt targets by mid-year, and they are to take effect in 2020.

Such laws will facilitate substantial growth in the energy storage industry; nevertheless, there are challenges ahead. Already, the utility Eversource requested $100 million for energy storage in Massachusetts, but some of its proposed upgrades could potentially lead to unintentional microgrids, or what is known as "unintentional islanding."[15] Unintentional islanding occurs during outages, for example, when power lines are down or energy is cut off, but generators or batteries feed energy back into the grid. Customers would benefit from maintaining power even in the case of an outage, but if an area remains electrified when not expected, this could pose a serious threat to line workers.[16] This means that not only could utilities experience a financial loss when customers reduce their energy consumption, but if systems are not carefully installed, or if the interaction of various components of storage systems is not well-tested, then worker safety might also be at stake. Utilities may push back on laws aimed at expanding energy storage for good reason, meaning that careful studies of emerging storage systems and careful federal regulations must continue to ensure that energy storage systems will be safe and effective.

Energy Storage Next Steps

Should energy storage succeed, the United States could see substantial benefits including improvements to grid resilience, improved reliability, lower costs for electric consumers, and reduced carbon emissions. Market and regulatory changes are signaling a move towards the increased adoption of energy storage, but much remains in order for energy storage to be successful. Since energy storage installments can be so costly,

the private sector should continue to look for opportunities to install battery storage systems, to help make consumer gains and sustainability efforts more visible. Should the energy storage market continue to develop, this could help make the storage industry more competitive and make installments and adoption more cost-accessible. Importantly, a business case for energy storage means there is a business case for renewable energy. By improving the reliability and financial gains of renewable energy, storage systems can unleash opportunities for those interested in cutting their carbon impact through cleaner energy.

Government policies can work in partnership with private entities, such as providing financial incentives for companies to build new storage systems. At the same time, careful regulations can help protect utilities whose workers could be hurt if mechanisms of grid connectivity or economic impacts of these changes are not yet well understood. It is integral for public and private stakeholders to continue to work together to ensure that energy storage systems are safe and effective. Then, if we can push businesses and government to continue to seize opportunities to test and expand energy storage, we could realize the full financial and sustainability benefits of renewable energy.

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Notes

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