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The Future of Energy Storage: Adopting Policies for a Cleaner Grid

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I. Introduction

The view that promoting the use of energy storage systems produces environmentally attractive results has been standard in policy circles.[1] Policymakers have been enthusiastic about energy storage systems primarily because of their belief that cheaper and more prevalent storage options could help facilitate the integration of increased renewable energy generation and speed up the transition to a low-carbon grid.[2] This beneficial outcome, however, is not guaranteed. Cheaper storage could also facilitate a higher usage of fossil fuels than the current fuel mix, causing an increase in greenhouse gas emissions. In fact, California's Self-Generation Incentive Program, which is the state's pioneering funding program developed to incentivize energy storage among other technologies, has led to an increase in greenhouse gas emissions,[3] showing that it is this possibility that must be considered in policymaking. Therefore, it is important to design policies that help ensure that the increased use of energy storage leads to a reduction of greenhouse gas emissions, rather than to an increase. Thus, the first goal of this Article is to challenge the common belief that increased energy storage would necessarily reduce greenhouse gas emissions. We show, instead, that under certain scenarios the opposite could be true. Our second goal is to analyze the failure of the current regulatory and policy landscape to provide incentives for a desirable level of deployment of energy storage and the reduction of greenhouse gas emissions, and propose policies that would correct these inefficiencies.

II. Standard Policy Arguments for Energy Storage

Solar and wind power are becoming increasingly important as many states move towards cleaner energy sources. However, both are intermittent and variable.[4] If the sun is not shining, or the wind is not blowing, these resources cannot produce electricity. While certain aspects of their production profiles are fully predictable,[5] their output can be variable even within short spans of time due to harder-to-predict factors like sudden cloud cover. Further, peak demand periods do not perfectly correspond to the peak generation times of solar and wind resources.[6] Therefore, providing electricity from solar and wind energy reliably during the whole day requires smoothing out their output throughout the day. In addition, while all traditional power plants can be dispatched when they are needed, the same is not true for wind or solar, as they both heavily depend on weather patterns.

In this context, energy storage is often presented as a panacea to the many challenges utilities around the country face due to a desire for a higher penetration of renewable energy resources and distributed energy resources.[7] With energy storage, wind or solar energy can be stored when there is excess demand and injected into the grid later when

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1. *See, e.g.*, Ethan L. Elkind, U.C. Berkeley Law & UCLA Law, The Power of Energy Storage 8–10 (2010), https://perma.cc/73MZ-ZUV6; Jeff St. John, *How Energy Storage Can Cut Peaker-Plant Carbon for the Clean Power Plan*, Greentech Media (Sep. 24, 2015), https://perma.cc/56CP-ZUYT.
2. *See, e.g.*, U.S. Dep't of Energy, Grid Energy Storage 5 (2013), https://perma.cc/J62X-JYED.
3. *See* Itron & Energy + Env't Econ., 2016 SGIP Advanced Energy Storage Impact Evaluation, Figure 3-13 (2017), http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442454964.
4. *See* Paul L. Joskow, *Comparing the Costs of Intermittent and Dispatchable Electricity Generating Technologies*, 101 Am. Econ. Rev. 238, 238 (2011).
5. *See* Phil Taylor, *Can Wind Power Be Stored?*, Sci. Am. (Sept. 28, 2009), https://perma.cc/L5WZ-NHPJ.
6. *See* Gwen Bredehoeft & Eric Krall, *Increased Solar and Wind Electricity Generation in California Are Changing Net Load Shapes*, Today in Energy (Dec. 9, 2014), https://perma.cc/4QUF-A3VW.
7. *See* Lin Deng et al., *What Is the Cost of Negative Bidding by Wind? A Unit Commitment Analysis of Cost and Emissions*, 30 IEEE Transactions on Power Sys. 1805 (2015).

the supply is insufficient to meet the demand. Energy storage can also help with minute-to-minute smoothing that would be necessary when a cloud passes by, as well as larger smoothing needs when a large amount of wind energy is generated during off-peak demand hours.[8]

A corollary to the assumption that energy storage is necessary for the integration of renewable resources is that it would also lead to a reduction of greenhouse gas emissions.[9] For example, when a storage system is paired with a clean generator, it can store the excess clean energy generated at times of low market demand to inject it into the grid at a later time, reducing the need for generation from the bulk system generators, which are often fossil-fuel powered. Moreover, it is not even necessary for energy storage to be paired with a clean energy generator to help reduce greenhouse gas emissions. Since marginal emission rates—the amount of emissions that result from the additional electricity generation—vary by time and location,[10] a stand-alone energy storage system can also lower greenhouse gas emissions by charging at times when marginal emissions are low and discharging at times when marginal emissions are high. For example, energy storage can reduce emissions by charging at times when natural gas plants are on the margin—the last generator that is required to meet the demand—and discharging when coal plants, which pollute more, are on the margin. Essentially, energy storage can help reduce emissions by moving the generation away from the times when dirty generators are providing the marginal power, and replacing it with generation from less carbon-intensive resources.

III. Potential Negative Effects of Energy Storage on Greenhouse Gas Emissions

Standard policy arguments in favor of energy storage assume that it is necessary for the integration of renewable resources. If there is enough diversification among the renewable energy resources, however, energy storage may not be necessary. A recent study suggests that even though energy storage might be necessary if the decarbonization efforts are dependent on very high shares of wind and solar energy, it is not a requisite if a diverse mix of flexible, low-carbon resources is employed.[11] In some cases, overbuilding wind capacity to meet multiple times the peak demand to reduce the need for shortage, for example, might be cheaper than providing storage capacity.[12] Moreover, as illustrated below, the increased deployment of energy storage may result in an increase in greenhouse gas emissions, not a reduction—contrary to the standard perspective.

A. *Effects on Existing Fossil Fuel Plants*

Energy arbitrage—purchasing wholesale electricity when the price is low and selling it when the price is high—can help lower the total cost of meeting the electricity demand by reducing the need to generate electricity when it is costly to do so.[13] But, because the external costs of greenhouse gas emissions are not currently reflected in wholesale electricity prices, such arbitrage decisions will be made without considering the resulting changes in emissions. As a result, energy storage can increase emissions if the cheaper energy resources that are used in charging are dirtier than the more expensive energy resources that are displaced during discharging. The academic literature confirms that this pattern could occur.[14]

Perverse incentives may be more pronounced if the cost functions of dirtier generators have a particular shape. The fixed costs of turning on certain generators, such as coal, are high, but the variable operational costs once the generator is turned on are low.[15] This pattern creates incentives for such a generator to continue operating once it is already on, as long as it can get sufficient revenue from the electricity it generates to cover its variable costs. Without energy storage, the amount of generation from such a generator would be limited by market demand. However, when paired with energy storage, it can continue generating and storing electricity to sell later. For example, at times of low demand, such as during the night, coal plants that normally operate below capacity will have incentives to generate more electricity than needed and store it.

Perverse effects from energy storage can also result from the way in which electricity markets function. The electricity grid is an interconnected, and capacity-constrained, network that allows electricity to be traded over long distances. The use of energy storage can reduce network congestion at certain locations, freeing up network capacity to allow flow of more energy. This newly freed up capacity may facilitate an increase in the use of dirtier sources, the usage of which was previously limited by the finite capacity of transmission lines.

In addition, energy storage can change emissions over a longer period by affecting the profitability of fossil fuel plants. Many coal plants engage in long-term coal purchase agreements that usually have minimum purchase requirements.[16] Energy storage would allow such plants to buy and burn the amount of coal that they are obligated to

8. *See* Richard Schmalensee & Vladimir Bulovic, Mass. Inst. of Tech. Energy Inst., The Future of Solar Energy 61 (2015), https://perma.cc/S478-9CNH.
9. *See* Amy L. Stein, *Reconsidering Regulatory Uncertainty: Making a Case for Energy Storage*, 41 Fla. St. U. L. Rev. 697, 709 (2014).
10. *See* Joshua S. Graff Zivin et al., *Spatial and Temporal Heterogeneity of Marginal Emissions: Implications for Electric Cars and Other Electricity-Shifting Policies*, 107 J. Econ. Behavior & Org. 248, 249 (2014).
11. *See generally* Fernando J. de Sisternes et al., *The Value of Energy Storage in Decarbonizing the Electricity Sector*, 175 Applied Energy 368 (2016).
12. *See* Geoffrey Heal, *Notes on the Economics of Energy Storage* 11 (Nat'l Bureau of Econ. Research, Working Paper No. 22752, 2016).
13. *See, e.g.*, Schmalensee & Bulovic, *supra* note 8, at 285-88.
14. *See, e.g.*, Richard T. Carson & Kevin Novan, *The Private and Social Economics of Bulk Electricity Storage*, 66 J. Envtl. Econ. & Mgmt. 404 (2013); Joshua Linn & Jhih-Shyang Shih, Resources for the Future No. RFF DP 16-37, Does Electricity Storage Innovation Reduce Greenhouse Gas Emissions? 24 (2016).
15. *See* Keith E. Holbert, Ariz. State Univ., Electric Energy Economics 1 (2011), https://perma.cc/GPS3-69H8.
16. *See* Steve Vied, *Burning Less Coal*, Energy Cent. (June 27, 2016), https://perma.cc/9KLY- TVL2.

buy without any financial consequences. This effect would improve the profitability of coal plants, and allow them to remain in the market longer, thereby increasing emissions.

B. Effects on Efficiency Losses

Even if there is no difference between the carbon intensity of the marginal generators during the charging and discharging periods, energy storage can still increase emissions because of efficiency losses. Energy losses occur during charging and discharging energy storage systems, as well as during transmission and distribution.[17] As a result, the total generation needed to provide the same amount of electricity to the consumers with energy storage is higher, leading to higher overall emissions. If these efficiency losses are sufficiently high, energy storage can lead to increased emissions even when it uses less carbon-intensive generation to displace more carbon-intensive generation.

Furthermore, large-scale energy storage paired with generators will change the generation mix in the market. As a result, the total distance electricity has to travel in the aggregate through transmission and distribution lines, and, therefore, the amount of losses, will change. If energy storage leads to more generation closer to customers, such as local solar farms, the electricity would travel shorter distances, reducing losses. But, if energy storage leads to generation that is further from customers, such as offshore wind, and has to be transmitted long distances, energy losses might increase.

C. Effects on Incentives for Future Fossil Fuel-Fired Plants

Although the issue has not been fully analyzed, evidence suggests that under certain circumstances, storage could lead to the addition of fossil fuel capacity. One study concludes that depending on the responsiveness of renewable generation to the changes in electricity prices, overall emissions may decrease or increase.[18] Because energy storage enables energy arbitrage, the price difference between peak and off-peak periods is reduced.[19] This effect changes the investment incentives for each resource differently. To illustrate, wind generators usually produce electricity during off-peak times, so an increase in off-peak electricity prices would lead to more wind investment.[20] However, a reduction in peak prices usually decreases incentives for solar investment.[21] How exactly the mix of new capacity investments changes as a result of such changes in electricity prices depends on how price sensitive each resource is. Wind generation, if highly price responsive, would go up significantly when faced with higher off-peak prices, and displace fossil fuel plants.[22] Solar generation, however, would go down significantly when faced with lower peak prices if it is highly price responsive, and would be replaced by fossil fuel generators.

D. Interactions With Existing Policy, Regulatory, and Market Structures

If a generator has market power, it can submit a bid over its marginal cost and withhold capacity to increase market prices, and, hence its profits. For example, consider a setting where coal-fired generators have market power and can withhold capacity from the market to keep market prices high. In this case, energy arbitrage is more likely to be between more efficient combined-cycle natural gas plants, which would be on the margin during off-peak time periods when there is not enough coal capacity, and less efficient simple-cycle natural gas plants, which would be on the margin during peak time periods.[23] Because now, the arbitrage is among natural gas plants, instead of being between coal-fired and natural gas plants, the potential emission benefits of standalone energy storage, as well as of energy storage paired with renewable resources, are lower compared to the benefits that could accrue in a competitive wholesale market.[24]

Interactions with other policies and regulations can also create perverse incentives. For example, under the Clean Air Act, new construction, major upgrades, or changes in the method of operation would trigger a new source review, and more stringent standards.[25] However, an increase in the hours of operation is not considered a change that would trigger a new source review.[26] This regulatory regime might create incentives to couple energy storage with existing coal-fired plants, which would cause an increase in the plant's hours of operation but not trigger a new source review, instead of meeting the peak demand by building a new plant, which would be subject to more stringent standards.[27] Under this scenario, emissions would increase as a result of the availability of storage.[28]

IV. Inadequacy of the Current Regulatory and Policy Landscape

A. Inadequacy of Direct Investment Incentives

Federal and state policymakers have channeled several billion dollars towards energy storage research, development,

17. *See* Jordan Wirfs-Brock, *Lost In Transmission: How Much Electricity Disappears Between a Power Plant and Your Plug?*, Inside Energy (Nov. 6, 2015), https://perma.cc/9BKV-7477.
18. *See* Linn & Shih, *supra* note 14, at 4.
19. *See id.*
20. *See id.*
21. *See id.*
22. *See id.* at 25.
23. *See* Ramteen Sioshansi, *Emissions Impacts of Wind and Energy Storage in a Market Environment*, 45 Envtl. Sci. & Tech. 10728, 10731 (2011).
24. *See id.*
25. *See* 42 U.S.C. § 7411(a)(2), (a)(4), (f) (2012), ELR Stat. CAA §111.
26. *See* Prevention of Significant Deterioration of Air Quality Rule, 40 C.F.R. §51.166(b)(2)(iii)(f).
27. *See* Paul Denholm & Tracey Holloway, *Improved Accounting of Emissions From Utility Energy Storage System Operation*, 30 Envtl. Sci. & Tech. 9016, 9021 (2005).
28. *See id.*

and pilot projects, and established procurement mandates for energy storage, providing direct investment incentives for energy storage. These policies are intended to encourage the deployment of energy storage systems indiscriminately, without regard to whether their use might be harmful to society. Furthermore, even when there is direct evidence of actual negative emissions impacts of energy storage systems these policies are not revised or corrected.[29]

Some direct investment policies are more targeted, seeking to create incentives for energy storage systems only if they are paired with renewable generators. For example, Puerto Rico's storage mandate, adopted in 2013, requires that all future renewable generators include some minimum quantity of storage capacity.[30] Although such a targeted policy can tip the balance towards investment in paired energy storage and renewable generator systems, it can also decrease the amount of investment in other types of energy storage systems—systems that can reduce greenhouse gas emissions, even when they are not paired with a renewable generator.

B. *Inadequacy of Indirect Price Incentives*

To ensure proper investment signals, energy storage systems must be able to participate in all the markets in which they can provide services, and they must receive compensation for all these services. However, current regulations, which were designed with more traditional resources in mind, create a barrier to establishing such a framework. While there are some state and federal level policies that allow for some types of energy storage systems to be compensated for some of the benefits they provide to the grid, they are not sufficient to ensure efficiency. More importantly, the greenhouse gas emissions-consequences of energy storage systems should be taken into account to ensure that energy storage systems can indeed help to achieve clean energy and climate policy goals.

V. Policies Needed to Achieve Efficient Incentives

In perfectly competitive markets, the price of a good reflects the true value of that good to the society, which is necessary for economic efficiency. But, current price signals do not accurately reflect the true societal value of energy storage systems for three reasons. First, electricity prices do not consider the external costs associated with electricity provision. Second, energy storage systems cannot fully participate in all the markets they could provide value for. Third, energy storage systems earnings do not accurately reflect their true value. Achieving efficiency requires solving all three of these problems.

A. *Internalizing Externalities*

If the greenhouse gas emissions effects of energy storage systems are not evaluated in policymaking, the resulting outcomes might indeed be detrimental to climate policy goals. When externalities such as greenhouse gas emissions are present, markets left to their own devices do not produce socially desirable results.[31] The most economically efficient way of internalizing an externality is to impose an economy-wide tax on greenhouse gas emissions.[32] This first-best policy requires congressional action, and, therefore is not feasible to adopt and implement in today's political climate.

The next best policy to make sure that the outcome in electricity markets is socially desirable is to ensure that the costs of the externalities are reflected in wholesale electricity markets. Carbon emissions in the electricity sector can be internalized by a policy that makes dirty generators pay for each ton of carbon they emit, either in the form of an adder, or an allowance price in a cap-and-trade policy. Such carbon pricing would make it costlier for emitting resources to generate electricity, forcing them to bid higher prices in the wholesale market, creating an advantage for clean resources, and ensuring that wholesale electricity prices are lower when only clean energy resources are producing, and are higher when dirtier energy resources are also being dispatched. This is not a solution that can be implemented quickly, however, because it requires coordination and agreement amongst state and federal policymakers, the Federal Energy Regulatory Commission (FERC), Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs).

Consequently, as more states are looking into integrating energy storage systems into the grid immediately, an interim policy tool is needed to ensure socially beneficial energy storage deployment in the near term. A societal cost-benefit analysis can help state regulators both incorporate greenhouse gas emission impacts of energy storage systems into decisionmaking, and eliminate socially undesirable investments. The cost-benefit analysis would monetize the expected benefits and costs of a particular energy storage system given the specific network characteristics of the area of the planned investment. Such an analysis can prevent investments in energy storage systems that would use high carbon intensive generation to displace low carbon intensive generation. An added advantage of cost-benefit analysis is that it can include emissions related to the construction and the operation of the storage systems.[33]

While such use of a cost-benefit analysis can be a solution in the short term, it is not sufficient in the long term. First, it can be applied only to investments over which state regulators have jurisdiction. Therefore, it cannot prevent

29. *See* Graff Zivin et al., *supra* note 10, at 249.
30. *See* Jeff St. John, *Puerto Rico Mandates Energy Storage in Green Power Mix*, Greentech Media (Dec. 27, 2013), https://perma.cc/Z8A7-JAT7.
31. *See, e.g.*, Paul Krugman & Robin Wells, Microeconomics 250-52 (2008).
32. *See id.* at 251.
33. *See* Paul Denholm & Gerald L. Kulcinski, *Life Cycle Energy Requirements and Greenhouse Gas Emissions From Large Scale Energy Storage Systems*, 45 Energy Conversion & Mgmt. 2153 (2004).

an unregulated energy company from investing in energy storage systems that might have detrimental emissions consequences. Second, carrying out a comprehensive analysis for every single investment opportunity might be burdensome given the expected increase in energy storage projects over the next decade, and may delay construction.

B. *Eliminating Barriers to Entry*

Currently, ISOs and RTOs integrate energy storage systems into their organized wholesale markets differently. Certain energy storage technologies already are allowed to provide energy and ancillary services in some of the organized markets by using existing participation rules. However, because these rules were designed with traditional generators in mind, they lack the flexibility to recognize unique characteristics of energy storage systems.[34]

Redesigning market rules to ensure that energy storage systems participate to the full extent of their unique technical capabilities would increase the efficiency of the electricity markets. FERC has already shown some limited progress towards this goal by aiming to remove some of the barriers currently hindering electric storage resources in its 2016 Proposed Rule.[35] In the proposed rule, FERC recognizes that energy storage systems have the ability to provide a variety of services such as energy, capacity, and regulation, yet are restricted by rules that were designed for other resources.[36] Therefore, FERC seeks to require ISOs and RTOs to revise their tariffs to accommodate the participation of energy storage resources based only on their physical and operational characteristics, and their capability to provide energy, capacity, and ancillary services.[37] For example, FERC proposes new bidding parameters such as charge and discharge time and rate, which can give ISOs and RTOs information about the characteristics about energy storage systems, and hence the services they can provide.[38]

However, these proposed changes, while a significant step towards increasing efficiency, are still limited in scope. Performance requirements, which penalize energy storage systems for not being able to provide certain services while charging, still remain.[39] Additionally, market rules and technological requirements vary from one market to another, making it more difficult to enter into more than one market with the same energy storage technology.[40] If, instead, market rules and eligibility requirements in all jurisdictions were uniformly based on the technical attributes that are required for a particular service, the existing barriers for energy storage systems, as well as barriers for any other new energy technology that may be viable in the future, would be eliminated.

C. *Eliminating Barriers to Earning Multiple Value Streams*

For energy storage systems, ensuring accurate price signals requires eliminating the barriers for earning compensation for multiple value streams. An accurate price signal depends on unbundling the different services that energy storage systems can provide and ensuring that they get compensated for each service. The current regulatory framework makes it difficult, or impossible, for an energy storage system to participate in the market for every service that it has the technical ability to provide. Therefore, current price signals do not reflect the full value of energy storage systems. This inability of storage systems to participate in the markets for services they have the technical ability to provide leads both to an under-utilization of existing storage systems and to an under-investment in new storage systems. Therefore, an efficient policy must recognize the differential benefits that each storage system provides, and allow energy storage systems to be compensated for all these benefits.

Until recently, however, the regulators and the stakeholders in the electricity markets were more concerned about the opposite issue. In January 2017, FERC issued a Policy Statement that addressed the concerns about storage systems receiving both cost-based and market-based compensation.[41] The first concern was the potential for combined cost-based and market-based rate recovery to result in double recovery of costs by the electric storage resource owners, to the detriment of cost-based ratepayers. The second concern was the potential for cost recovery through cost-based rates to inappropriately suppress competitive prices in the wholesale electric markets, to the detriment of competitors that do not receive cost-based rate recovery.[42] FERC's 2016 Proposed Rule also discussed double compensation; FERC proposed that distributed energy resources that participate in one or more retail compensation programs, such as net metering, not be eligible to participate in the wholesale markets as part of a distributed energy resource aggregation.[43]

While prohibiting duplicate compensation for the same service is necessary for economic efficiency, ensuring that distributed energy resources can be fully compensated for the unique benefits they can provide at every level—generation, transmission, and distribution—is also necessary,

34. *See* Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, 157 FERC ¶ 61121, para. 13 (proposed Nov. 17, 2016) (to be codified at 18 C.F.R. pt. 35) [hereinafter 157 FERC ¶ 61121].
35. *See id*. at 14.
36. *Id.* at 17.
37. *See id*. at 56-57.
38. *See id.* at 58-59.
39. *See* Advanced Energy Economy, Comment Letter on Proposed Rule on Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators 41 (Feb. 13, 2017) [hereinafter AEE February Comments].
40. *See* Advanced Energy Economy, Comment Letter on Proposed Rule on Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators 10 n.15 (June 5, 2016).
41. *See* FERC, Utilization of Electric Storage Resources for Multiple Services When Receiving Cost-Based Rate Recovery, Policy Statement, 158 FERC ¶ 61051 (Jan. 19, 2017).
42. *See id*. at 1, 11.
43. *See* 157 FERC ¶ 61121, *supra* note 34, at para. 96-102.

and perhaps more important, for economic efficiency in energy storage deployment. In addition, a framework for compensating unbundled ancillary services, which energy storage systems can provide even when they are not already online, is lacking.[44]

Because the revenue potential based on only one category of benefits does not justify the current high upfront investment that is needed, one value stream is not enough to give enough incentives for large scale deployment. Therefore, a new framework that allows compensation for different value streams should be considered, even if those value streams are based on benefits that accrue to different parts of the market and, thus, have to rely on different compensation mechanisms. Setting up a framework for accurate valuation is especially critical as behind-the-meter energy storage systems are likely to become more prevalent in the recent future. Behind-the-meter systems can provide benefits to both the distribution system and the wholesale market and thus have the potential to confer large benefits on the grid. Therefore, limiting the source of compensation of these systems to only one of these levels, as the current regulatory framework does, hinders efficiency.

One solution to these dual problems would be for FERC and state regulators to coordinate and explicitly lay out the categories of benefits of energy storage systems and how to compensate for each benefit. While this task is not easy, the current state-level initiatives can provide a useful foundation for this route. For example, New York State currently is in the process of establishing a methodology to value all distributed energy resources.[45] The New York State Public Service Commission recently issued an order to outline a framework that is generally described as a "value stack" approach.[46] In this approach, distributed energy resources, including energy storage systems, are compensated for their energy value, capacity value, and environmental value of their net exports. In addition, the systems that can reduce demand during the ten highest usage hours of a utility's territory are paid a demand reduction value, and the systems located at "high value" grid locations are paid a locational system relief value.[47]

This value stack framework has the potential to provide compensation for the value that distributed energy resources provide at all levels. Furthermore, if all states start using such an unbundled approach to compensate energy storage systems, rules can be crafted to determine which actor would compensate an energy storage system for each value component, based on where the benefits accrue. The environmental value that energy storage systems provide by avoiding emissions, if it exists, can be paid by the state itself, because it would be reflective of a state policy. Preventing double compensation is also easier under this approach. For example, if a system is being compensated for its energy value already by this framework or by the wholesale markets, the same system would not be compensated for its energy value by any other retail program, but would be allowed to be paid for its distribution level benefits by a retail program. Similarly, if a system is already being paid for the environmental value through this value stack approach, it would not be allowed to participate in additional programs such as renewable energy credit markets.

VI. Conclusion

Energy storage systems hold the key to decarbonization of the electric grid, and thus a clean energy future. However, contrary to the common assumptions relied on by policymakers to promote policies that indiscriminately encourage more energy storage deployment, there are circumstances under which energy storage systems can increase greenhouse gas emissions. In this Article, we describe some of these circumstances, filling an important void in the current debate, and discuss the shortcomings of the current regulatory and policy framework to provide sufficient incentives for socially beneficial energy storage deployment. Finally, we outline the reforms that are necessary to realize the clean energy future promised by increased energy storage deployment. To ensure that energy storage systems can indeed help achieve climate policy goals, externalities related to greenhouse gas emissions should be internalized, entry barriers should be eliminated, and market rules should be modified to guarantee accurate price signals that can value all the benefits energy storage systems have the technical ability to provide.

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44. *See* AEE February Comments, *supra* note 39, at 52; Tesla Motors, Inc., Electric Storage Participation in Regions With Organized Wholesale Electric Markets, Docket No. AD16-20-000 (Jun. 6, 2016).
45. *See* N.Y. Pub. Serv. Comm'n., Supplemental Staff White Paper on DER Oversight (2017).
46. Order on Phase One Value of Distributed Energy Resources Implementation Proposals, Cost Mitigation Issues, and Related Matters, Case Nos. 15-E-0751 & 15-E-0082, N.Y. Pub. Serv. Comm'n. (2017).
47. *Id.* at 10.