Renewable Energy Question #26: Has MI, or have other jurisdictions, incentivized energy storage technologies or included energy storage in a renewable or clean energy standard? Why or why not?

Energy storage technologies have not been included in any renewable energy standards because there has been no need for storage procurement for renewable energy or any other grid services. Massachusetts includes a specific type of energy storage in its clean energy standard (as a non-renewable resource) and Michigan includes incentive credits for renewable electricity that is stored to be used on-peak. But the actual inclusion of energy storage as a renewable energy resource is not done in any state.

As the amount of variable renewable energy increases on the grid, the need for new procedures that bring flexibility to the grid becomes more important. The creation of the Midwest ISO, with the pooling of resources and the reduction of internal boundaries, provides a great deal of added flexibility. Several papers discussing renewables integration describe the tools that can be used that are less expensive than storage for managing increasing levels of renewable energy. Also noted in these reports, the greater use of natural gas generation and reduced use of coal, both of which tend to increase system flexibility and allow greater economic use of variable renewable energy.
(Clemmer, S. 2013. *Ramping Up Renewables*. Cambridge, MA: Union of Concerned Scientists. April.)
Denholm, P. Ela, E. Kirby, B. and Milligan, M. 2010. *The Role of Energy Storage with Renewable Electricity Generation* NREL/TP-6A2-47187 http://www.nrel.gov/docs/fy10osti/47187.pdf

The experience and the research with integration of renewable energy in the Midwest emphasize the management of uncertainty with the use of forecasts of wind production, scheduling practices that allow greater flexibility, transfers between neighboring areas to improve balancing, and active management of wind (i.e. curtailment) due to local constraints. Modern wind turbines can reliably curtail output, but this is largely undesirable because curtailment spills energy that has no marginal costs or emissions. Nonetheless, the tactics, used individually or in tandem with each other, provide enough flexibility and reliability to the system at lower cost than the use of storage technologies.

A recent report for PJM addresses the topic of storage, noting that “Storage can provide several valuable grid services, including instantaneous and short-term balancing, regulation and load-shifting. Nevertheless, variable generation integration studies have generally found that while higher levels of variable generation may increase the use of existing storage (mainly pumped hydro), additional storage is not necessary or economically justified.”
Hinkle, G. and Porter, K. 2012. *Review of Industry Practice and Experience in the Integration of Wind and Solar Generation. Schenectady, NY:* GE Energy (PDF included with this response). When the Midwest ISO took up a study of Storage in 2011, it generally found that there was no compelling need.
http://www.uwig.org/MISO_Energy_Storage_Study_Phase_1_Report.pdf

Where a large concentration of wind development creates challenges for balancing, and curtailments are used, a more common solution has been to increase the transmission in the area. This allows the export of wind energy, and the import of additional reserves that provide grid operators the balance of power they need to maintain system reliability.

There is an expectation that at the level of 80 percent renewable energy in the year 2050, a moderate amount of energy storage will be economic and useful. This result is part of the National Renewable Energy Laboratory’s Renewable Electricity Futures Study, (http://www.nrel.gov/analysis/re_futures/)

the most comprehensive study so far of a very high proportion of energy from renewable generation for the U.S.

Beyond the present lack of need for energy storage as part of a renewable energy standard, there is a challenge to match the functioning of storage with the mechanics of a clean energy standard. All existing standards are designed to reward the energy produced. With storage, the technology does not produce energy. Storage stores energy. Further, an energy production incentive is more valuable to an asset if that asset runs as often as possible. The run time for storage assets can be divided into three functions: absorbing energy (charging); discharging energy; and waiting. That is, a storage asset is designed to hold energy and wait for the circumstances when the absorbing or discharging is particularly valuable. Storage assets are described, and valued, for their instantaneous capacity, not the total energy that will be cycled through. These characteristics of storage would make it difficult and complex for it to be included in a renewable energy standard as they are currently thought of.

There is one example of a state, Massachusetts, including storage in a *clean* energy standard that includes resources other than renewable resources. Massachusetts' Alternative Energy Portfolio Standard includes flywheel energy storage along with alternative technologies such as fossil fuel gasification with capture and permanent sequestration of carbon dioxide, and combined heat and power. To address the challenge of describing the equivalent energy benefits that come from a technology that is providing capacity, the Massachusetts manufacturer of flywheel storage successfully promoted a formula to make an estimate of the benefits of energy passing in and out of the storage, based on the expected use of flywheels for short-term balancing of supply and demand. Assumptions about the intended use of new storage are one of the key factors for defining the benefits of new storage investments.