Creating A Clean, Affordable, and Resilient Energy Future For the Commonwealth

Massachusetts Department of Energy Resources

COMMONWEALTH OF MASSACHUSETTS

Charles D. Baker, Governor
Karyn E. Polito, Lt. Governor
Matthew A. Beaton, Secretary
Judith Judson, Commissioner

Energy Storage Initiative
State of Charge Study

Massachusetts Clean Energy Conference

Worcester, MA

September 22, 2016

Michael Judge
Director
Renewable and Alternative Energy Division

Energy Storage Initiative

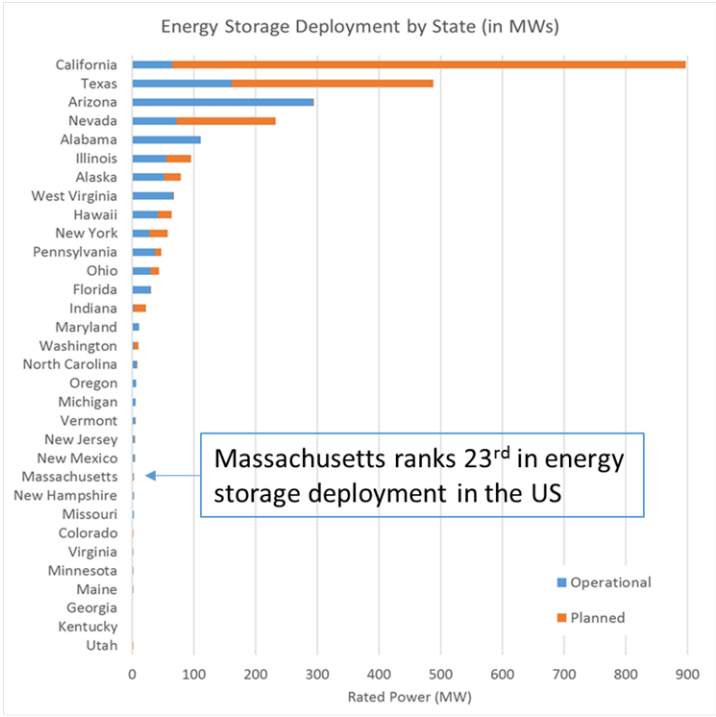
- **$10 million** initiative launched in 2015
  - *State of Charge* study
  - Demonstration projects
- Robust stakeholder engagement
- Study details:
  - Technology and market landscape
  - Comprehensive modeling of the cost and benefits of deploying storage
  - Economic use cases of specific storage applications
  - Economic development opportunities
  - Policy and program recommendations to grow storage deployment and industry in MA

"Massachusetts will continue to lead the way on clean energy, energy efficiency, and the adoption of innovative technologies such as energy storage."
- Governor Baker, Feb 2016, Accord for a New Energy Future Press Event

"Given the recent advances in energy storage technology and cost-effectiveness, it is hard to imagine a modern electric distribution system that does not include energy storage."
Utility stakeholder perspective

Energy Storage Growth & Deployment

US grid is expected to have **4500 MW** of energy storage by 2020

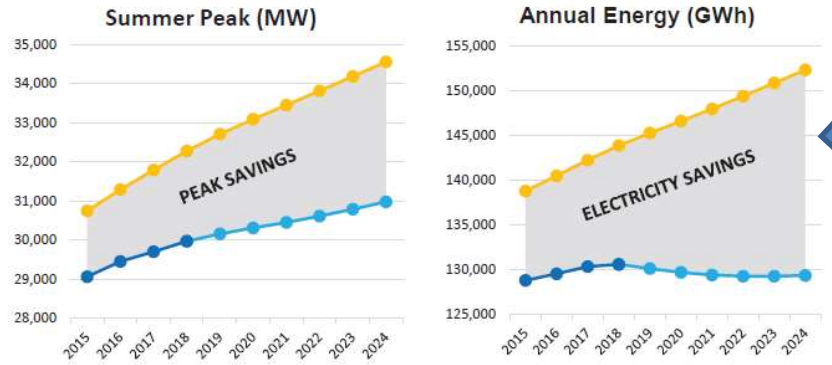


The cost of energy storage is rapidly declining and lithium-ion battery prices have decreased over **50%** between 2012 and 2015

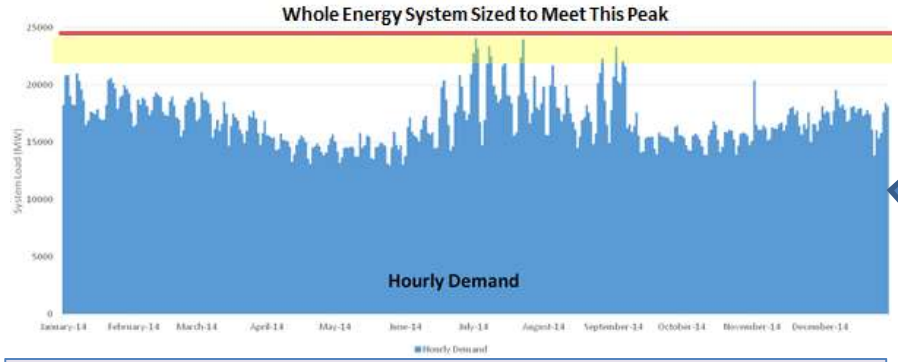
US Market for Advanced Energy Storage technologies is expected to grow by **500%** in next five years. There is a huge opportunity to expand the Commonwealth's successful clean energy industry.

Massachusetts Energy Challenges: Storage is "Game Changer" for Meeting Peak

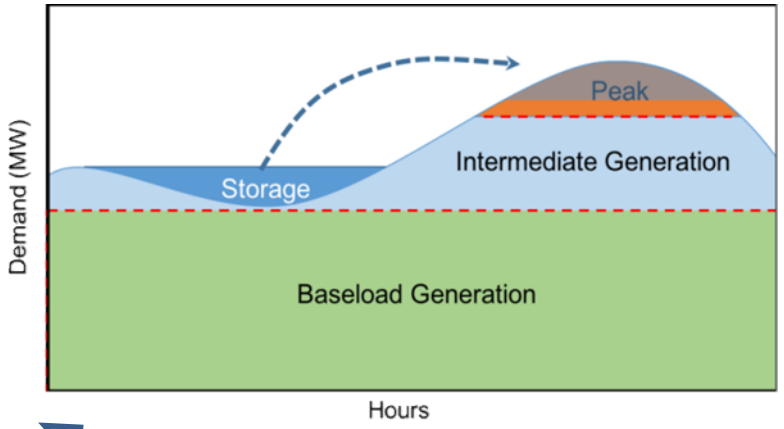
ISO-NE *State of the Grid 2016 and* System Annual Hourly and Weekly Demand



The need to size grid infrastructure to the highest peak usage results in system inefficiencies, underutilization of assets, and high cost



Top 1% of Hours accounts for 8% of MA Spend on Electricity
Top 10% of Hours accounts for 40% of Electricity Spend



Energy storage is the only technology that can use energy generated during low cost off-peak periods to serve load during expensive peak.

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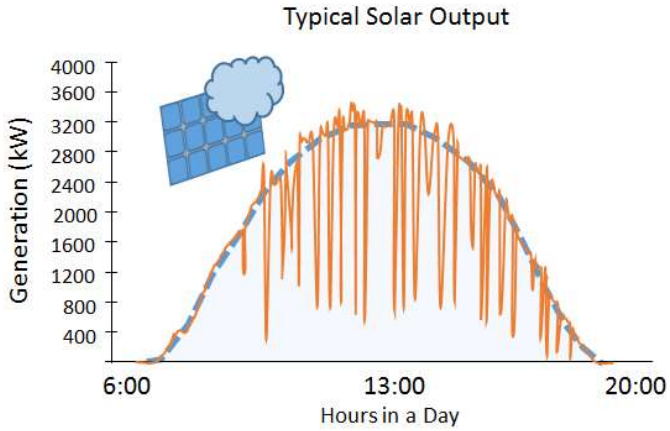
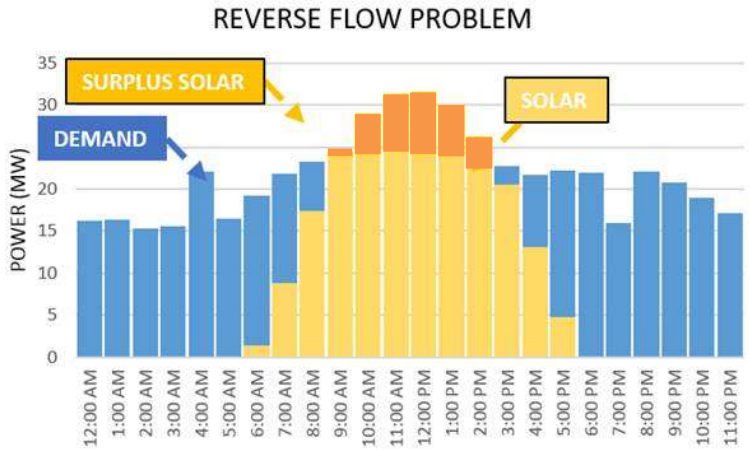
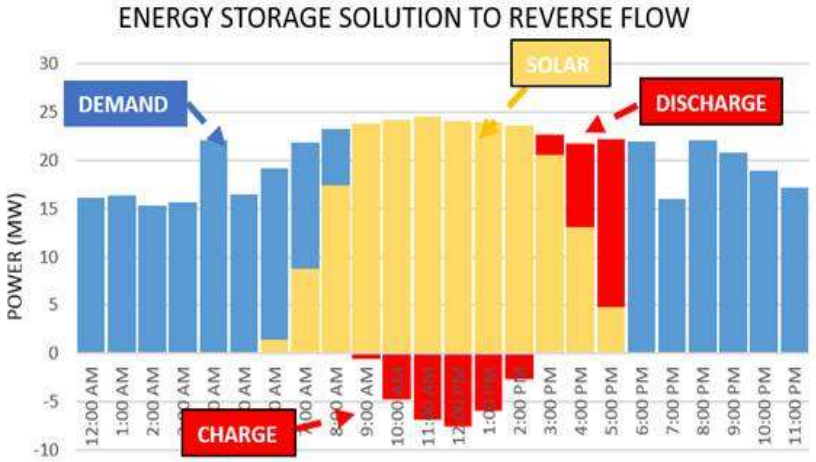
Massachusetts Energy Challenges: Storage reliably integrates more Renewables



According to ISO-NE "State of the Grid – 2016" more fast and flexible resources will be needed to balance intermittent resources' variable output.

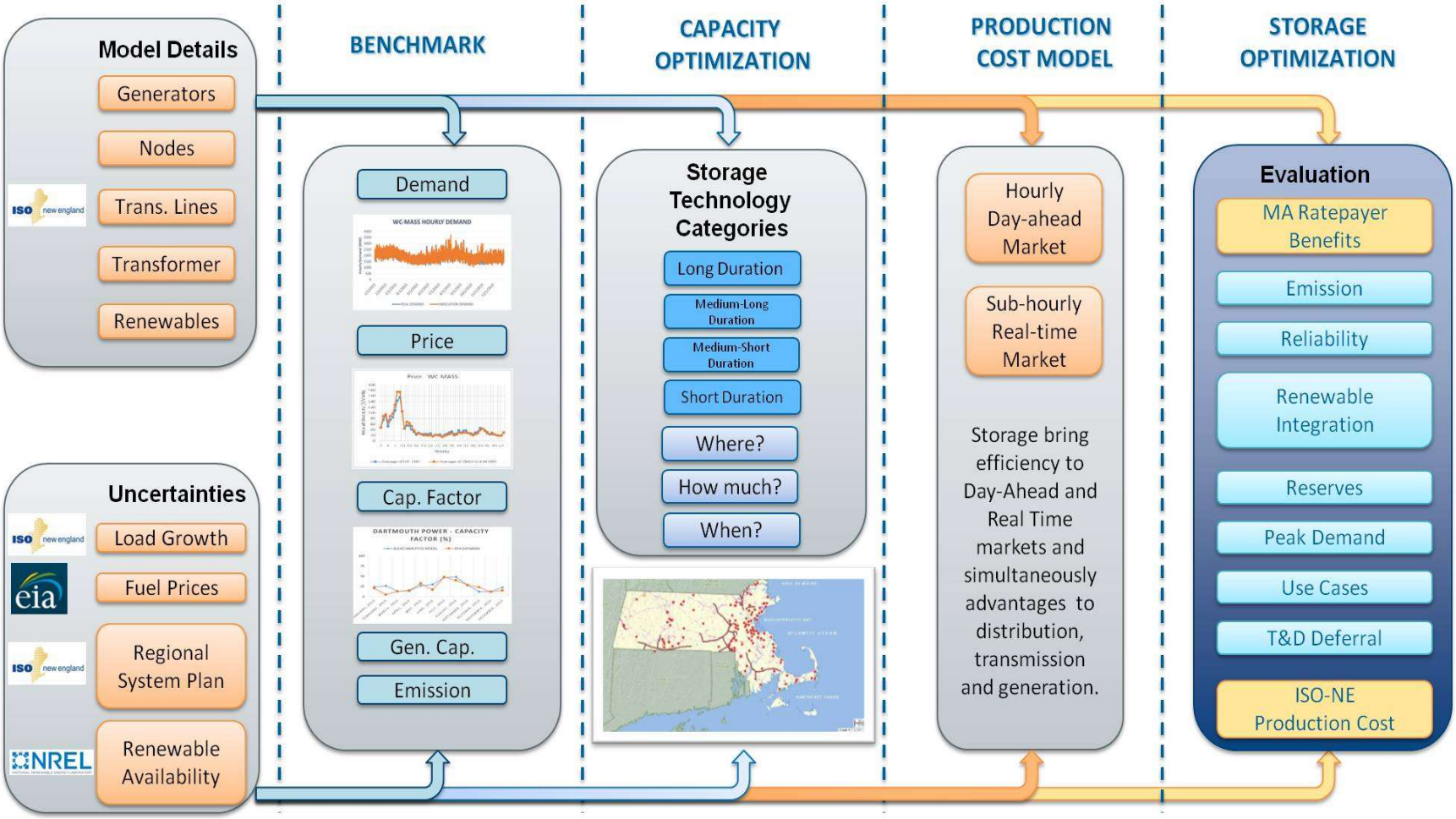
<u>Storage can provide this flexibility</u>.





With 55,000+ distributed solar projects and growing, storage can manage reverse power flow at substations

Advanced Storage Optimization Model



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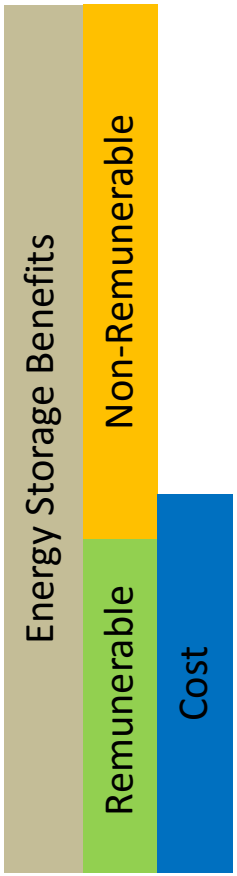
Model Results: Significant Benefits and Cost Savings from Optimized Storage

Benefit Categories	Benefit Description	
Wholesale Market Cost Reduction	Energy storage can be a flexible and rapid tool that help generators operate more efficiently through: 1) less wear and tear, 2) less start up and shut down costs, and 3) reduced GHG emissions.	$197M
Ancillary Services Cost Reduction	Energy storage would reduce the overall costs of ancillary services required by the grid system through: 1) frequency regulation, 2) spinning reserve, and 3) voltage stabilization	$200M
Energy Cost Reduction	Energy storage replaces the use of inefficient generators at peak times causing: 1) reduced peak prices which 2) reduces the overall average energy price. This also benefits the natural gas supply infrastructure.	$275M
T&D Cost Reduction	Energy storage 1) reduces the losses and maintenance of system, 2) provides reactive power support, 3) increases resilience, and 4) defers investment	$305M
Increased Renewable Integration	Energy storage reduces cost in integrating renewable energy by 1) addressing reverse power flow and 2) avoiding feeder upgrades	$219M
Reduced Peak	Energy storage can provide peaking capacity to 1) defer the capital costs peaker plants and 2) reduced cost in the the capacity market	$1093M
Total System Benefits		$2,288M

Study Findings



Opportunities:

Energy Storage has potential to provide benefits to the Massachusetts ratepayers, including:

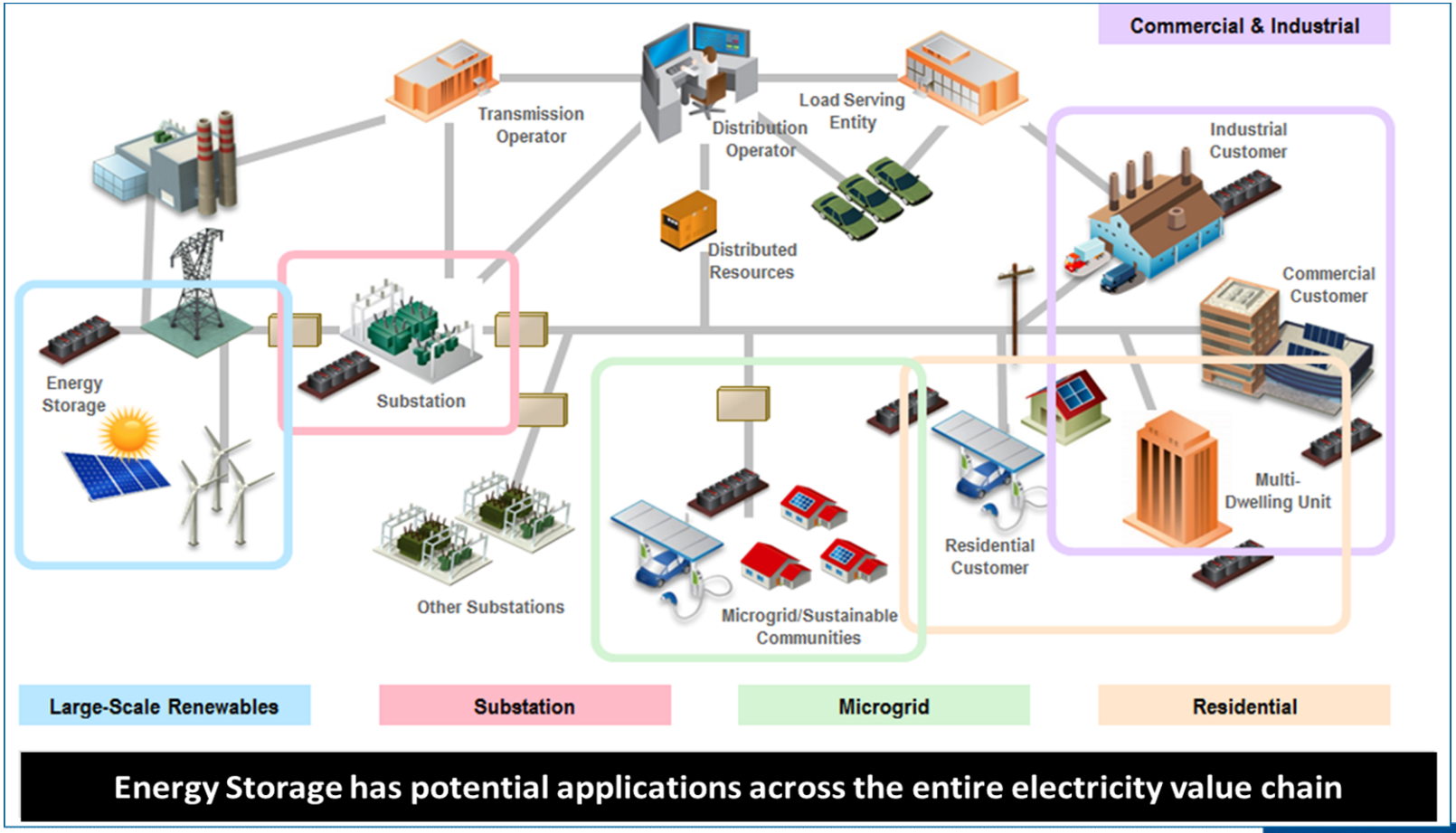
- Reducing the price of electricity
- Lowering peak demand and deferring investment in new infrastructure
- Reducing the cost to integrate renewable generation
- Reducing greenhouse gas (GHG) emissions
- Increasing the grid's overall flexibility, reliability and resiliency
- Generating nearly $600 million in new jobs

Barriers:

- Business models for storage in very early stages
- Energy storage systems need a way to be compensated for a greater portion of their cost benefit in order to achieve market viability

Storage Application Use Cases

The Study analyzed the economics and business models of ten storage use cases to inform specific policy and program recommendations



Source: 2015 Electric Power Research Institute

Study Recommendations

The Commonwealth can nurture the energy storage industry and grow the deployment of storage in Massachusetts through programs and initiatives

- Funding for Demonstration projects
- Establish and Clarify Regulatory Treatment of Utility Storage
- Grant and Rebate Programs
- Storage in State Portfolio Standards
- Paired with Clean Energy procurements
- ISO Market Rules
- Initiatives to Grow Companies

If adopted, the Study recommendations have the potential to yield:

- **600 MW of new energy storage by 2025**
- **$800 million in cost savings to ratepayers**
- **350,000 metric tons reduction in GHG emissions over a 10 year time span**
- **Equal to taking over 73,000 cars off the road**