


## The Future of Electric Water Heating

*What we learned from NRECA, NRDC & PLMA's  
Brattle Group Study*

 2016 Hot Water Forum  
Portland, OR

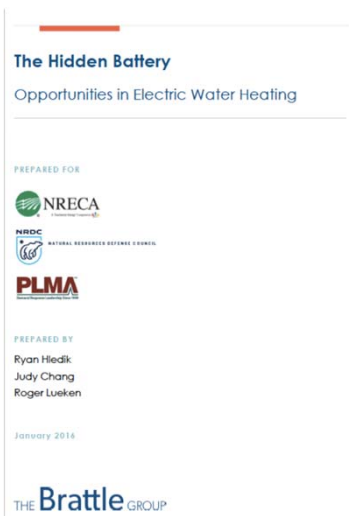
February 22, 2016

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## Topics

- About NRDC
- Why NRDC cosponsored the study
- What the study looked at
- What the study shows
- What's ahead?



## About NRDC

- Natural Resources Defense Council, established in 1970
- International non-profit environmental organization
- Offices in New York, Washington, Chicago, San Francisco, Los Angeles, Beijing
- More than 2 million members and activists
- ~500 lawyers, scientists, engineers and other professionals
- Top priorities include curbing global warming and creating a clean energy future

## Why NRDC cosponsored the study

- Water heating a top household energy use; even modest gains can make a big difference
- Big, rapidly emerging opportunities
  - Storage and controls for flexible, renewables-ready, economic grid
  - Heat pumps for energy savings of ~50%
- Trade-offs
  - Between efficiency at the device & system level
  - Between flexibility & efficiency
- Lots of promise, but nascent analyses
- Expanding policy issues / opportunities
- Effective previous collaboration with NRECA, PLMA and GRE
  - E.g., GEWH legislation in 2015
  - Mutual learning

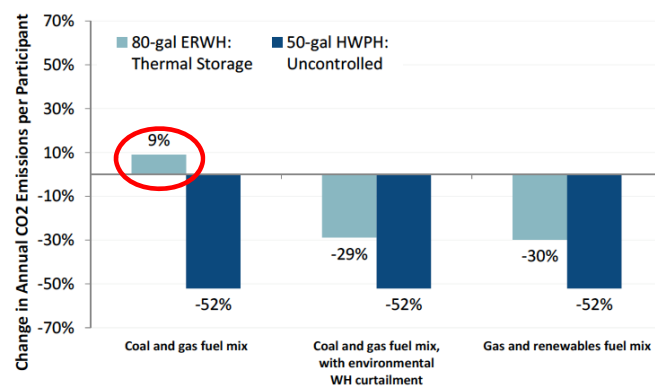
## What the Study Looked At

- Electric Resistance and Heat Pump Water Heaters (ERWH & HPWH)
- Control Strategies: Uncontrolled, peak shaving, thermal storage and fast response
- A few wholesale market scenarios based on MISO and PJM
- System economics and emissions
- Not everything...

## What the Study Shows

### 1. Opportunity for major emissions reductions, e.g.,

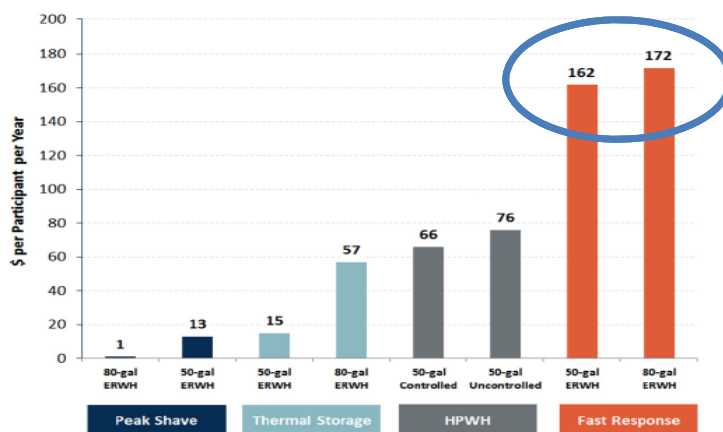
Figure ES-2: Change in Water Heater CO<sub>2</sub> Emissions  
(Relative to Baseline Uncontrolled 50-gallon ERWH)



## What the Study Shows

2. Opportunity for major \$ savings under credible scenarios, e.g.,

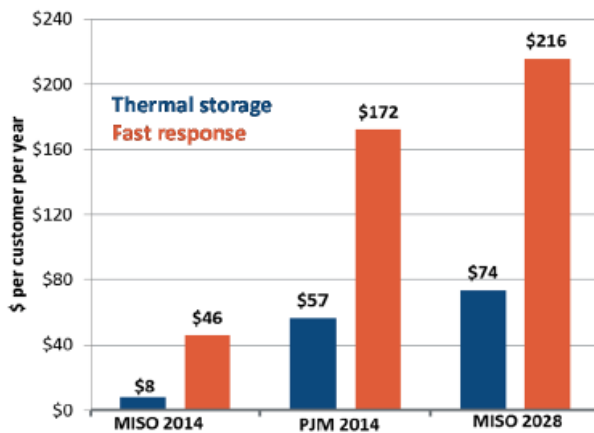
Figure ES-1: Annualized Net Benefits of Water Heating Strategies (PJM 2014)



## What the Study Shows

3. Fast response looks particularly promising

Figure 8: Net Benefits of Fast Response versus Thermal Storage Strategy for 80-gallon Tank



## What the Study Shows

4. No clear single best strategy (i.e., economics and emissions depend on scenario details), value in both HPWH and controlled ERWH
5. Need for more development work, including:
  - Fast response capabilities & benefits
  - Optimal management and dispatch of a portfolio of WH
  - Optimal dispatch considering 'community storage'
  - Analysis of participant and nonparticipant benefits and incentives
  - Impact of adoption rates on wholesale electricity market prices, particularly for ancillary services
  - Other wholesale market settings and assumptions
  - Location-specific distribution benefits
  - Total market potential
  - Comparison with the economics of other energy storage opportunities
6. TIME TO ACCELERATE WORK ON WATER HEATING

## What's Ahead?

- Energy efficiency using longstanding policy tools
  - Standards, utility programs, tax incentives, Energy Star, RD&D
- OEMs, utilities, others, working on a range of HPWH and controlled ERWH projects
- Array of policy fronts for storage & DR
  - DR & FERC 745; CA storage mandate; 2018 IECC update; DOE eyeing comm protocols; DOE grid R&D work, more
- Community Storage Initiative launched by PLMA, NRECA & NRDC, and welcoming others
- Ideas? Questions?

## Ideas? Questions

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