

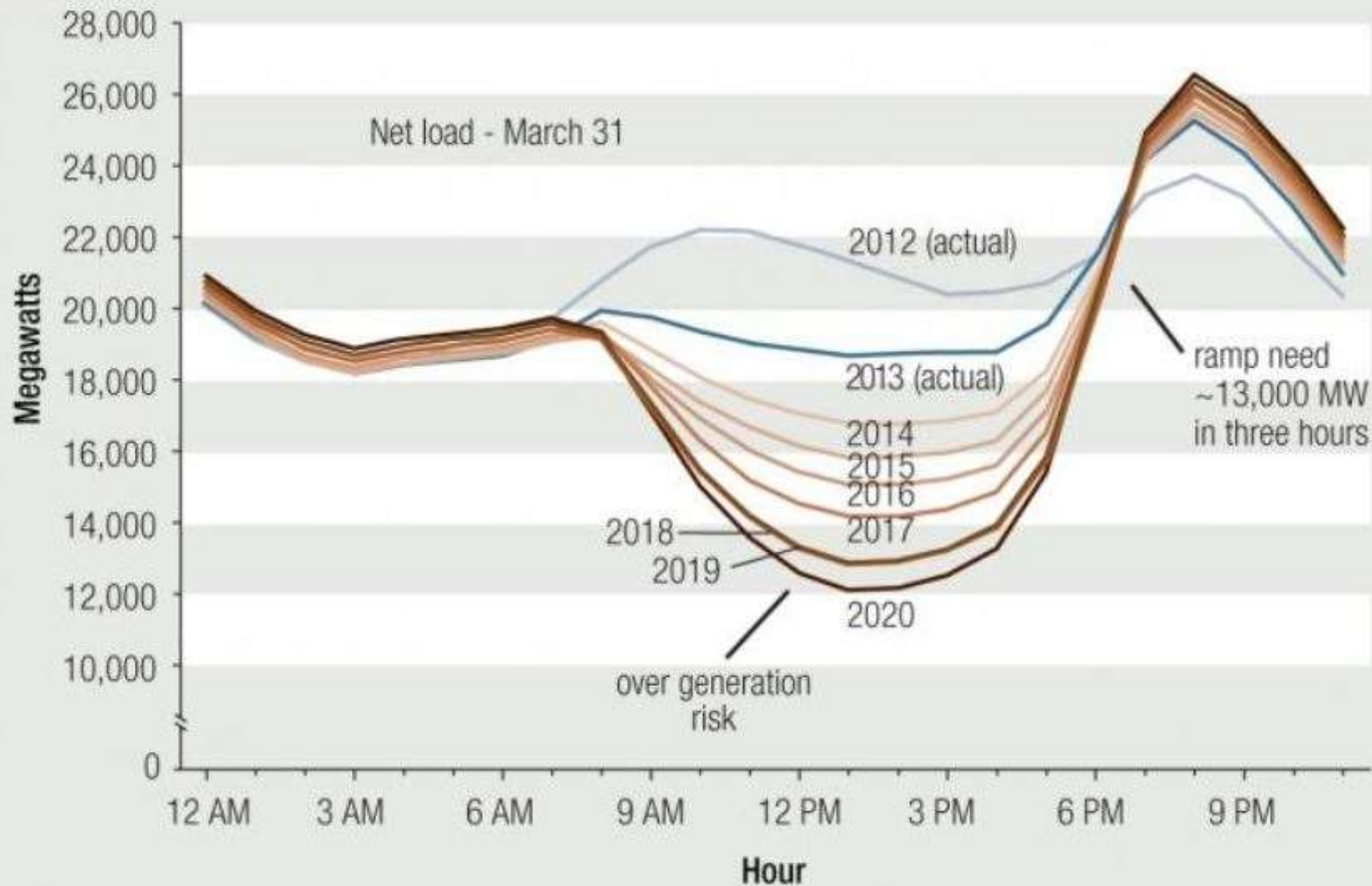
Low-Cost Storage Options: Doubling the Renewable Energy Hosting Capacity

Community Storage Initiative Leadership Forum
July, 2016

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RAP Senior Advisor

Trends in resource development are leading toward a growing need for flexible generating capacity starting in 2015.

PREV



Context: Strategies 3 - 5

Teaching the Duck to Fly

- Targeted energy efficiency
- Peak-oriented renewables
- **Water pumping**
- **Water heating**
- **Air conditioning**
- Rate design
- Battery storage
- Demand Response
- Inter-regional power exchanges
- Retire older inflexible generating units

Overview: Sun and Wind Come and Go

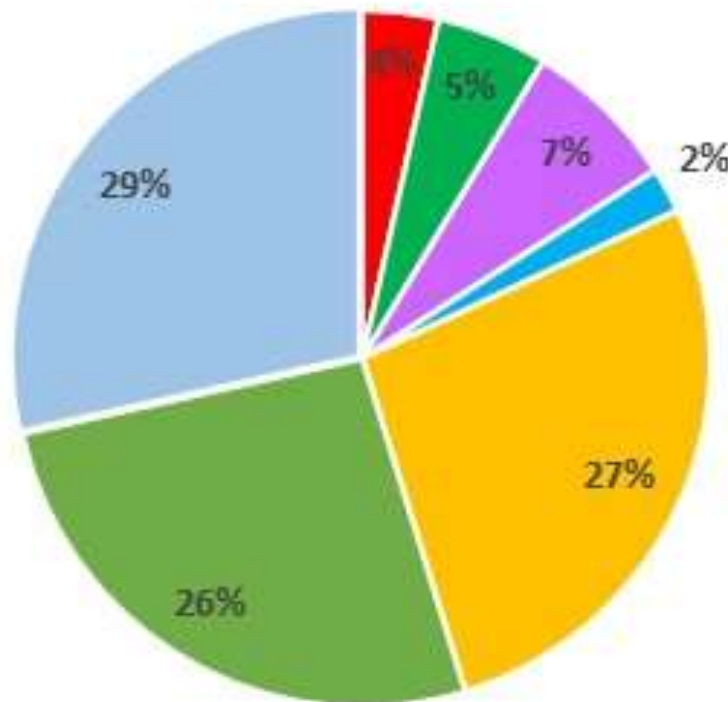


- Air Conditioning
- Water Heating
- Water Pumping



These Are Big End Uses

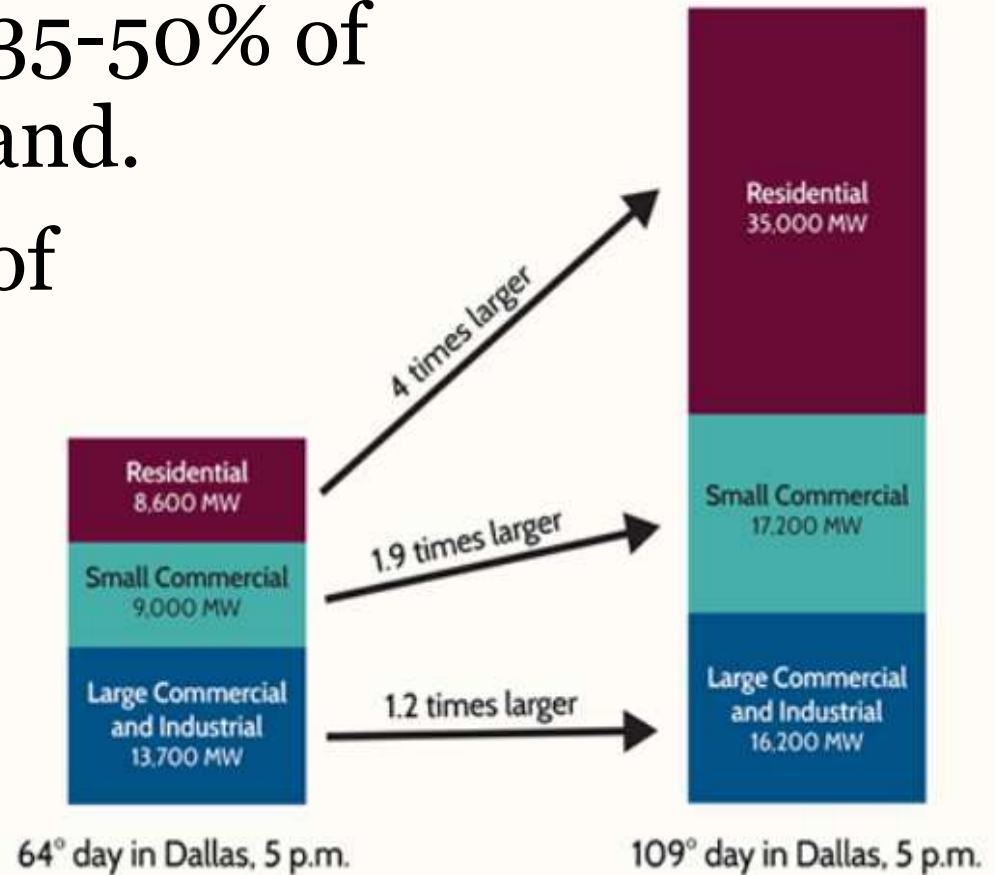
Electricity Usage in the US



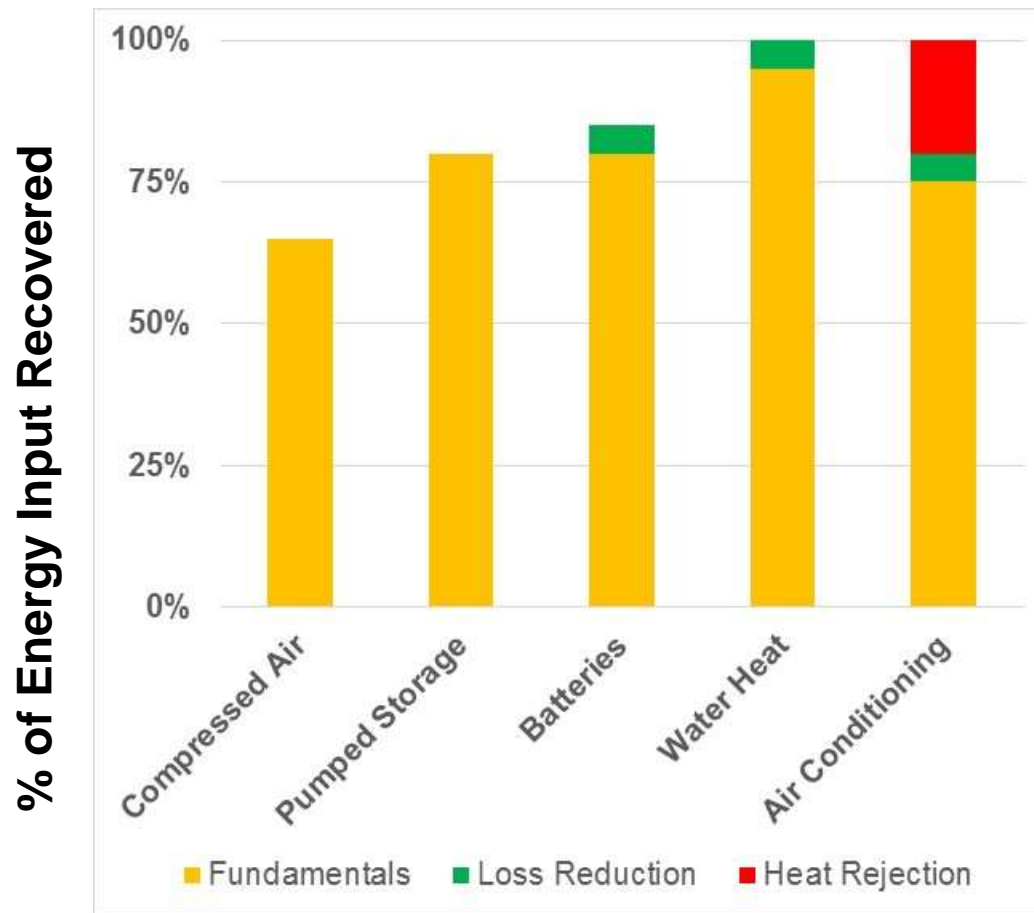
- Res Water Heat
- Res AC
- Commercial AC
- Water/Wastewater
- Other Residential
- Other Commercial
- Industrial

MUCH Bigger Share of Peak Demand

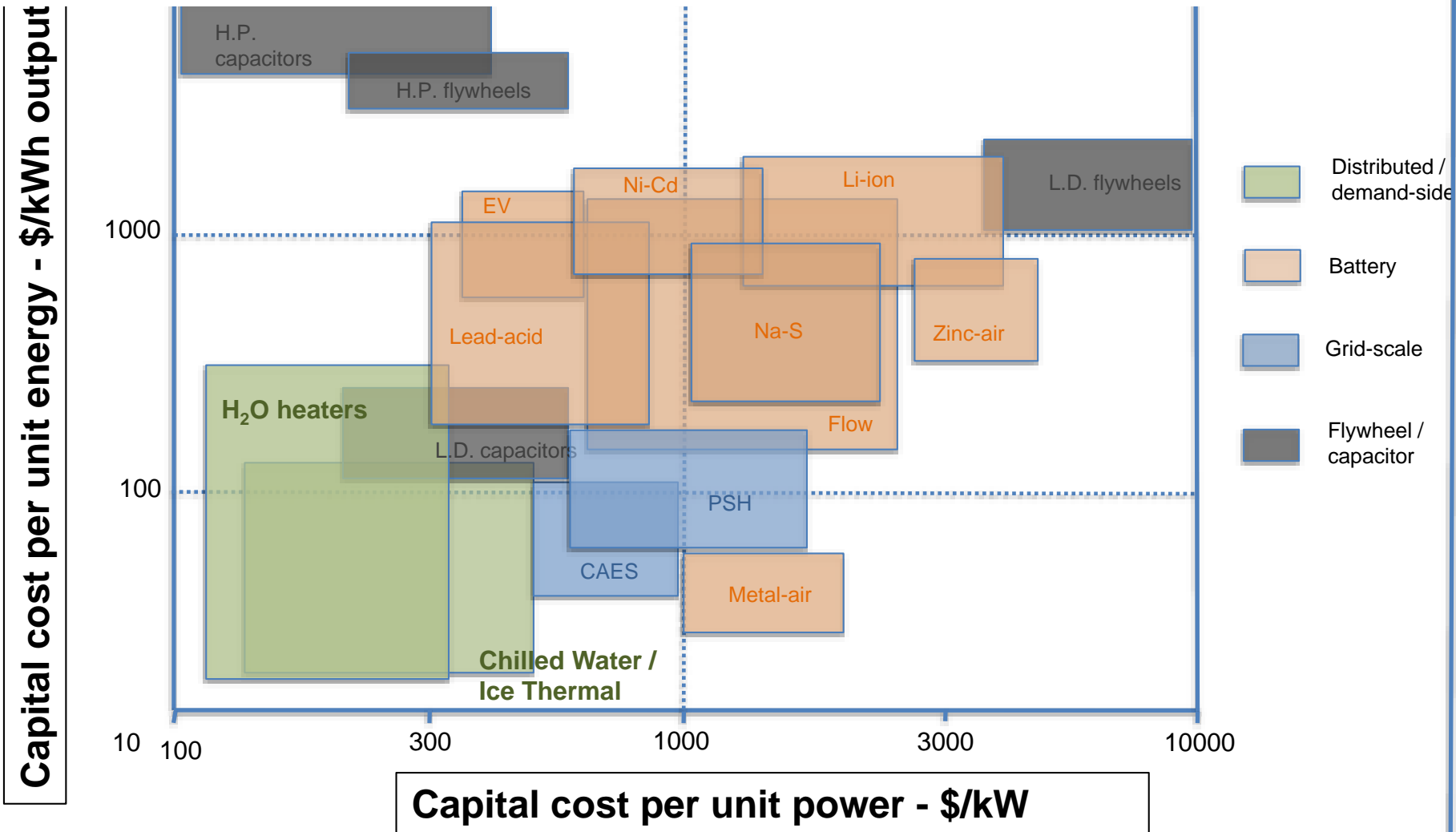
- NREL: Cooling is 35-50% of total US Peak Demand.
- Water heat: ~12% of residential peak demand



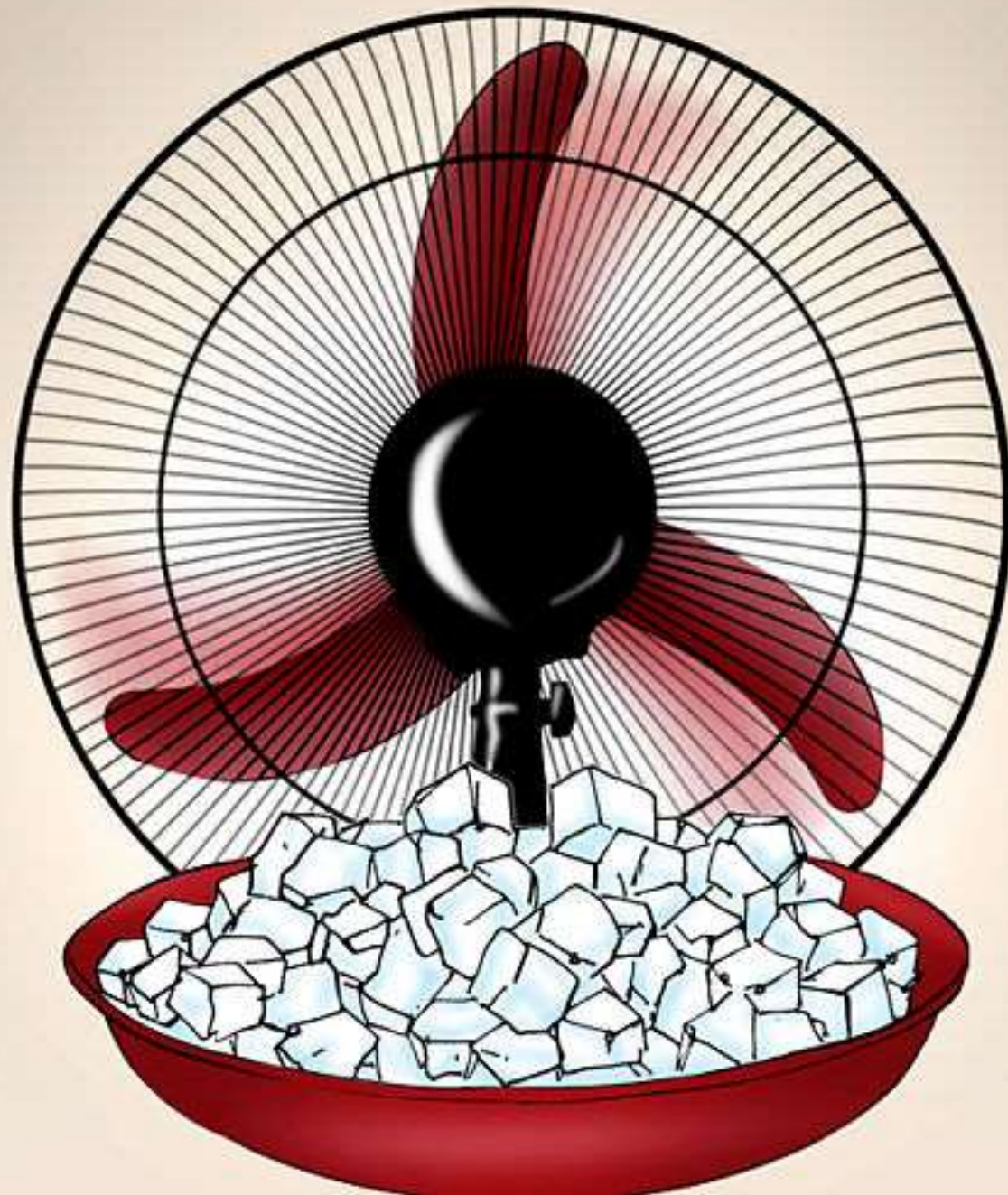
Thesis: Energy Storage Is More Efficient Than Electricity Storage



Thesis: Energy Storage Is More Economical Than Electricity Storage

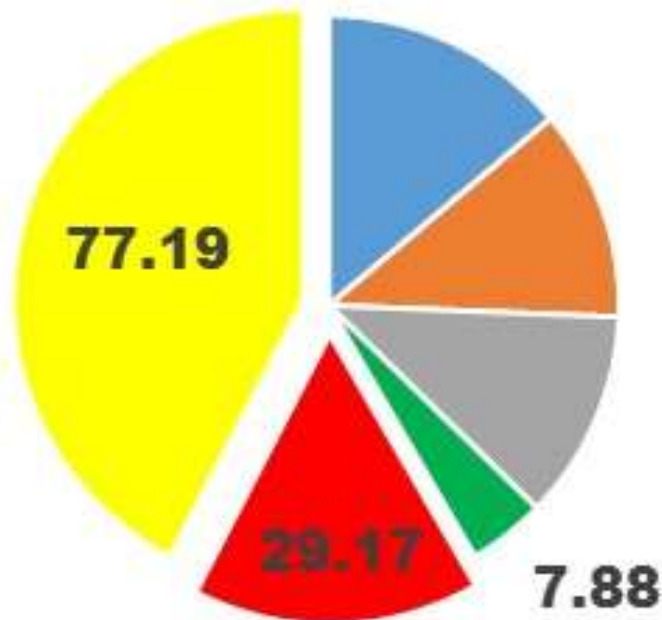






Air Conditioning

Commercial Air Conditioning Billion kWh



- Residential Type
- Heat Pump
- Individual AC Units
- District Chilled Water
- Central Chillers
- Package RTU

Central Chiller Storage

44 tanks provide peak cooling needs for 1 Bryant Square (B of A, NYC).



Photo: © Gunther Intelmann for Cook+Fox Architects

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AC Storage for Strip Malls & Big Box

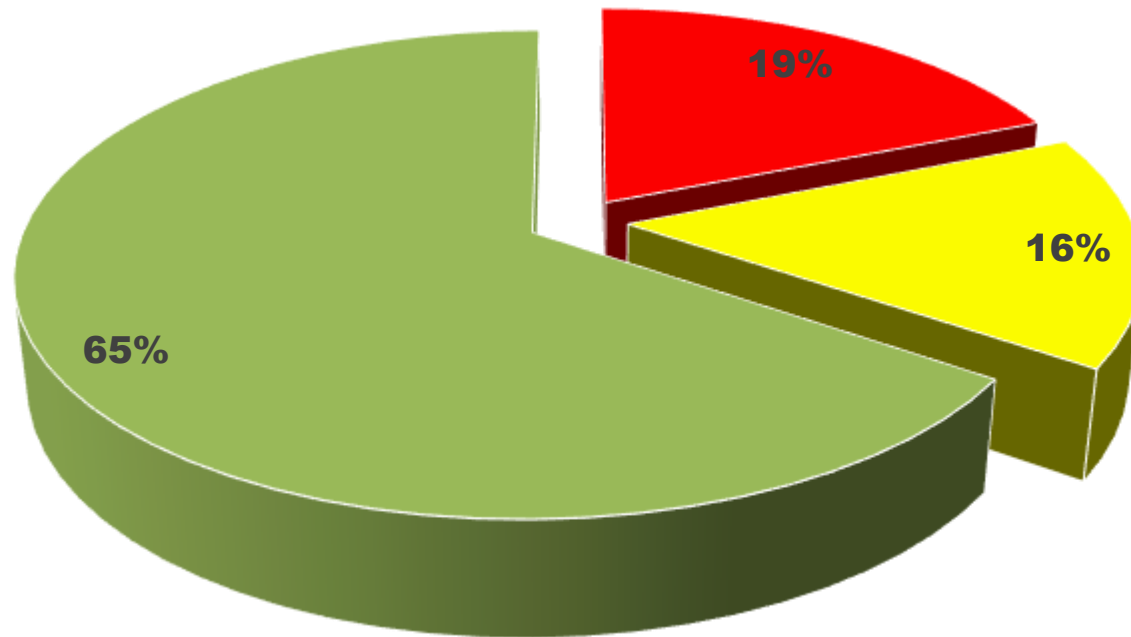


KOHL'S

STAPLES

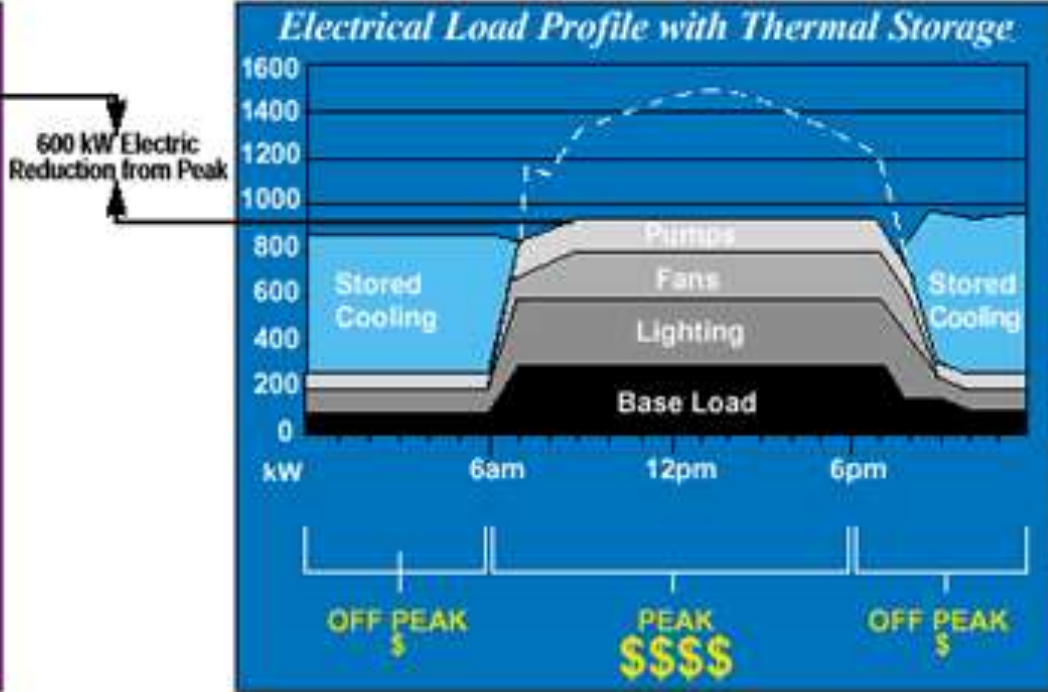
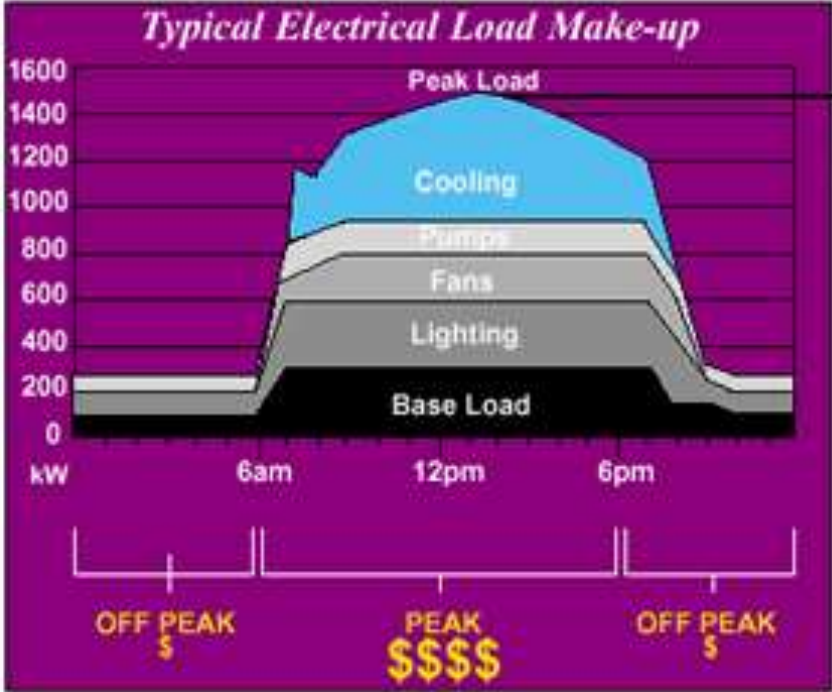


Air Conditioning Peak Load Share



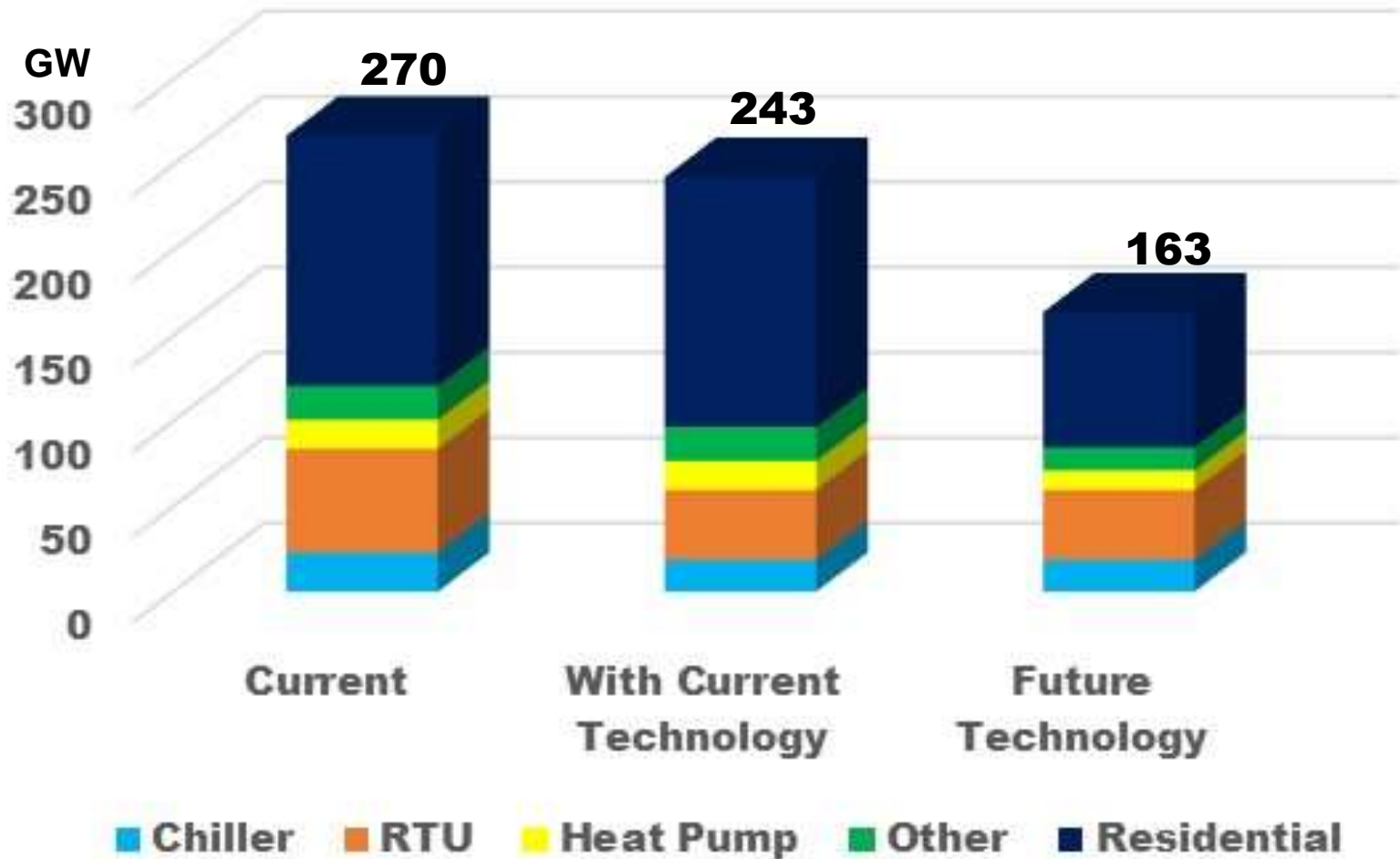
■ **Residential AC** ■ **Commercial AC** ■ **All other loads**

Air Conditioning Energy Shift Impacts

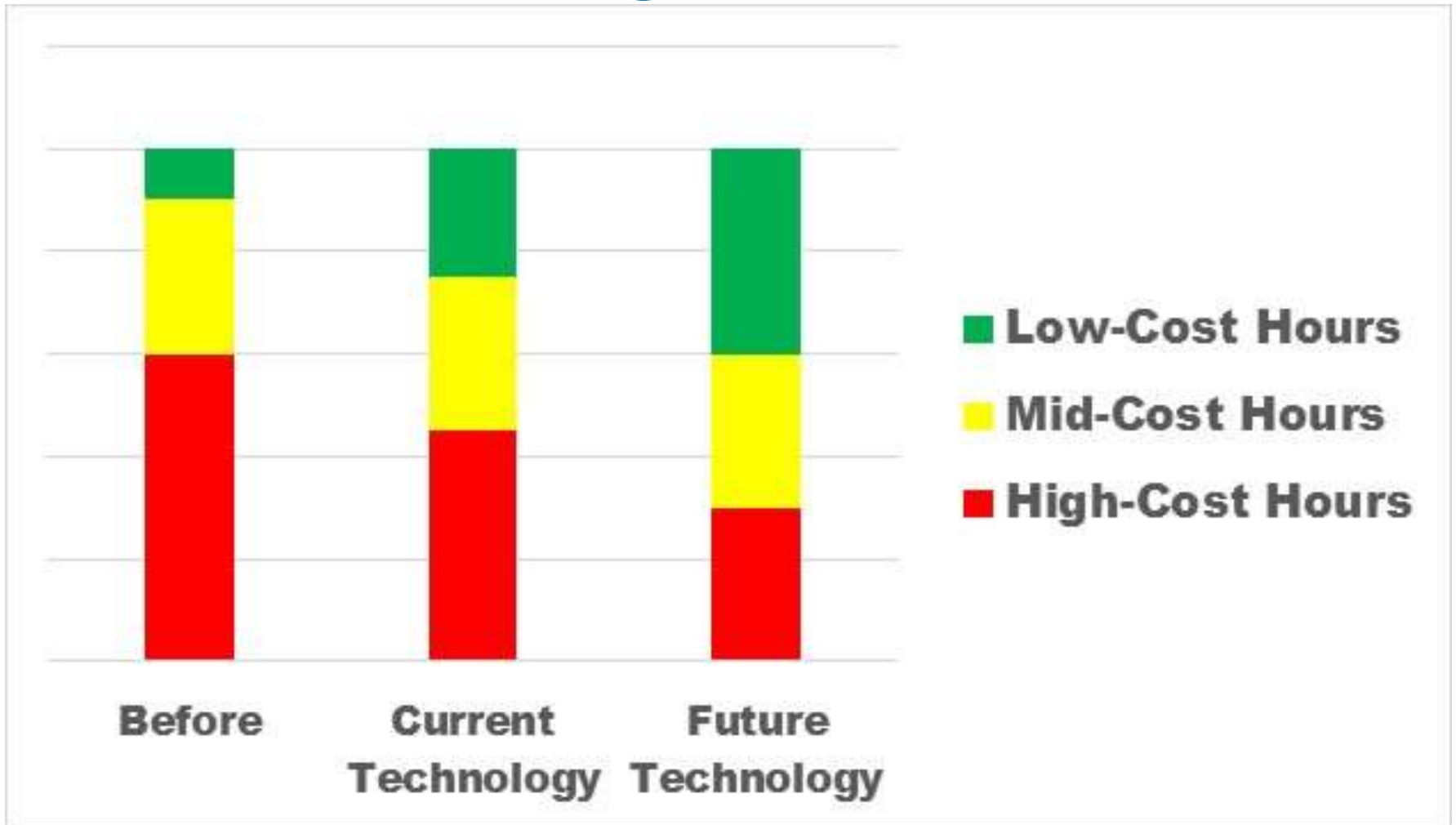


CALMAC

Air Conditioning Peak Load Potential

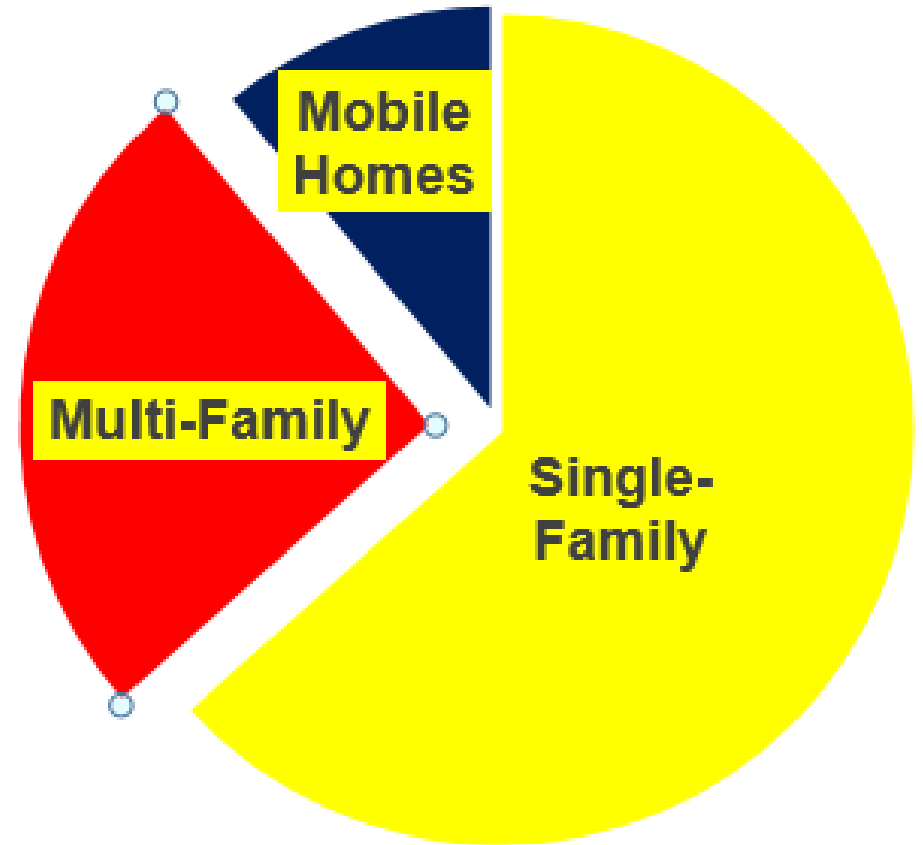


Air Conditioning Load Shift Potential

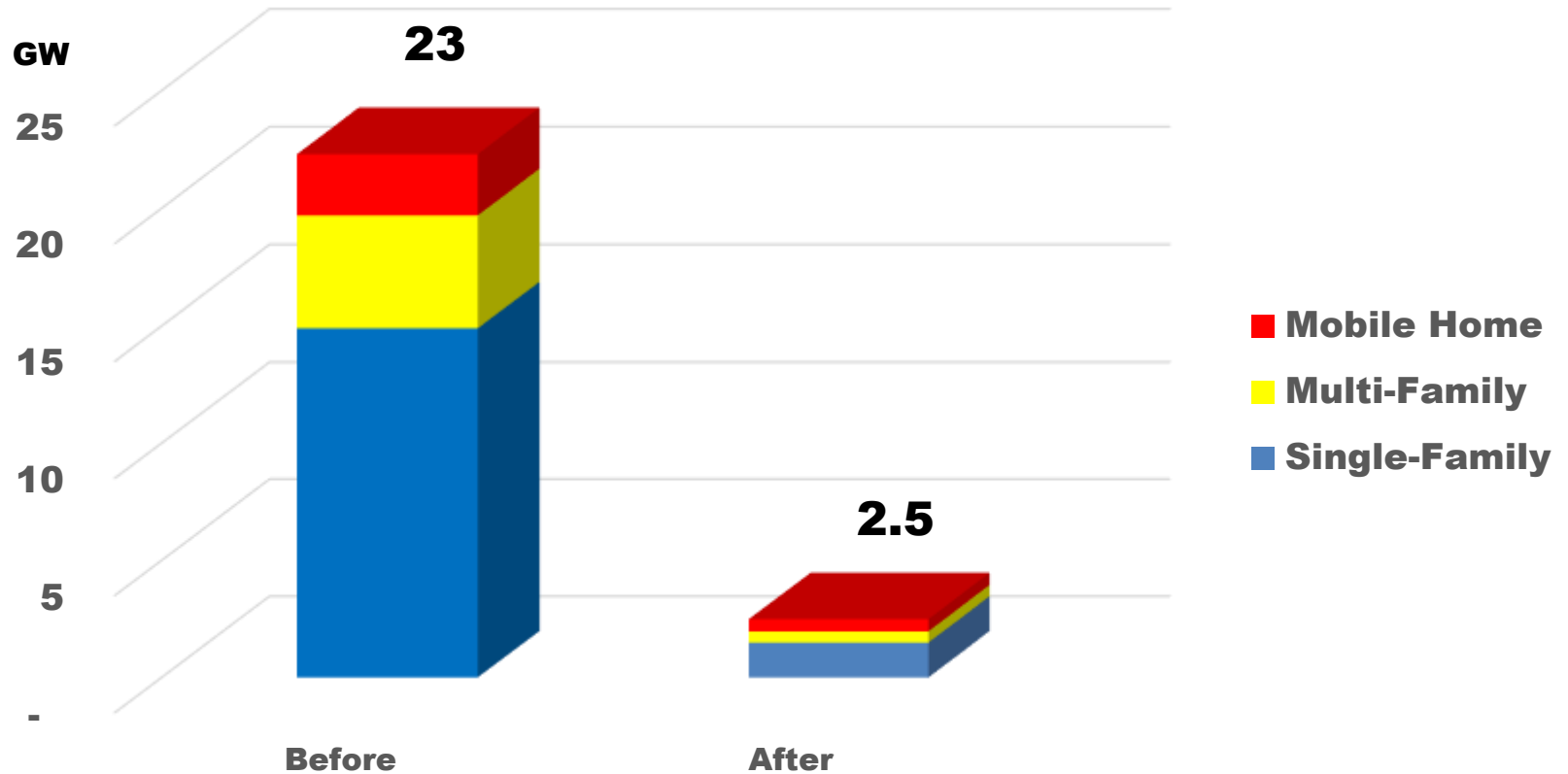


Water Heating: Magnitude

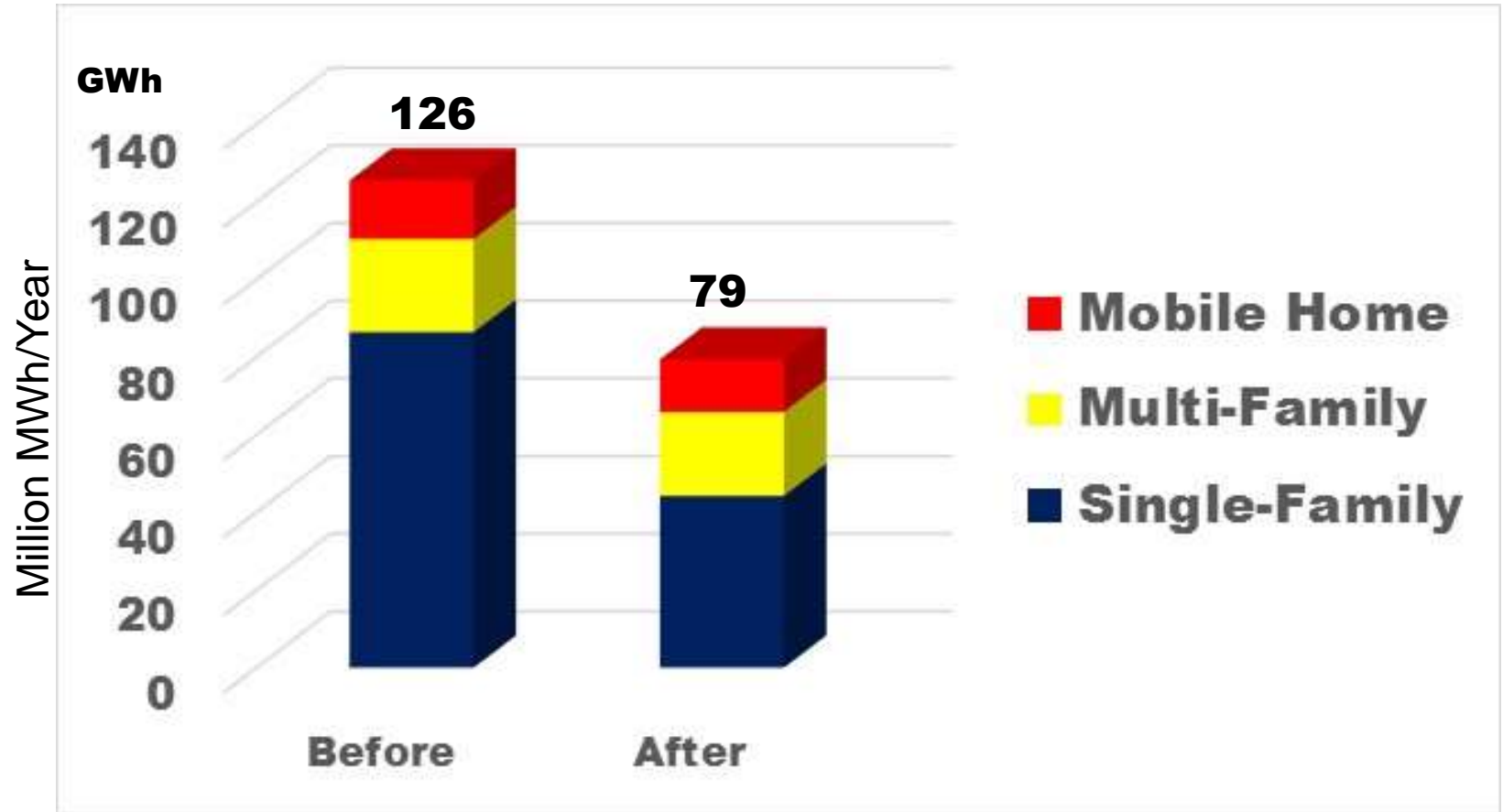
- 45 million electric water heaters
 - ~10% of total residential electricity usage
 - ~12% of residential peak demand
 - ~37% kWh reduction possible with HPWH where applicable



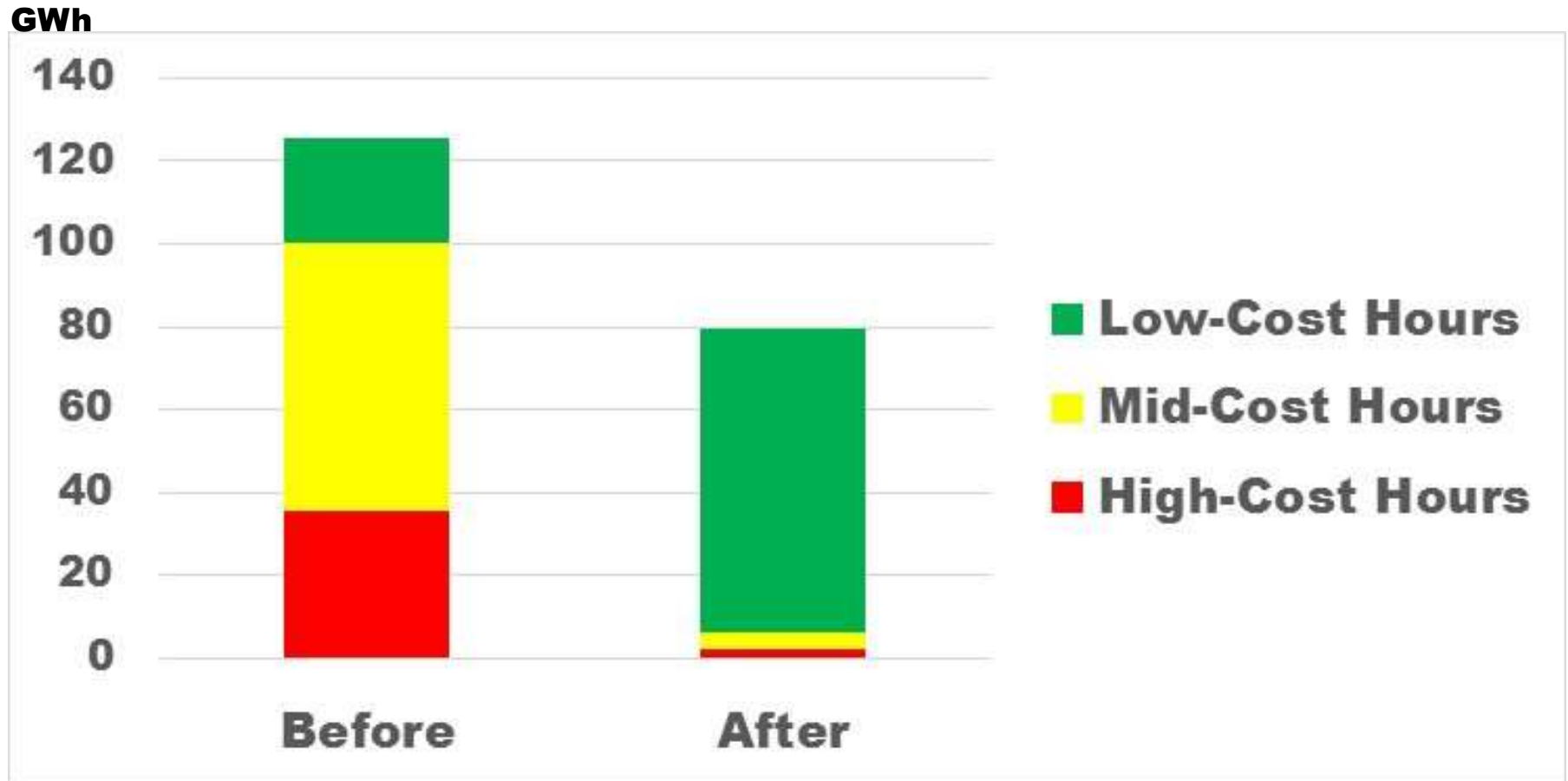
Water Heating Peak Load Impacts



Water Heating Energy Impacts



Water Heating Load Shift Impacts



Strategy Elements

- **Proof of Concept**
 - Pilot Programs
 - National Labs
 - Industry innovation
- **Appliance Standards**
 - AC Storage
 - Controls incorporated in AC and WH
- **Utility Programs**
 - TOU Rates
 - Customer / Trade Incentives
- **Building Codes**
 - AC Storage Mandate
 - Minimum WH Storage Capacity
 - Communications Access to units

Remaining Work

- Water pumping and wastewater treatment potential
- Solar and wind hosting capability provided by storage;
 - Water heaters alone may double this capacity
- Technology review for **residential** air conditioning

We Need Your Help With This

- Pilot results that are published
- Field evaluation of GIWH and AC programs;
- HPWH control trials
- Emerging technology



About RAP

The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power sector. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

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