MV Green Power

Thermal Storage Cooling: An Overlooked Utility Resource

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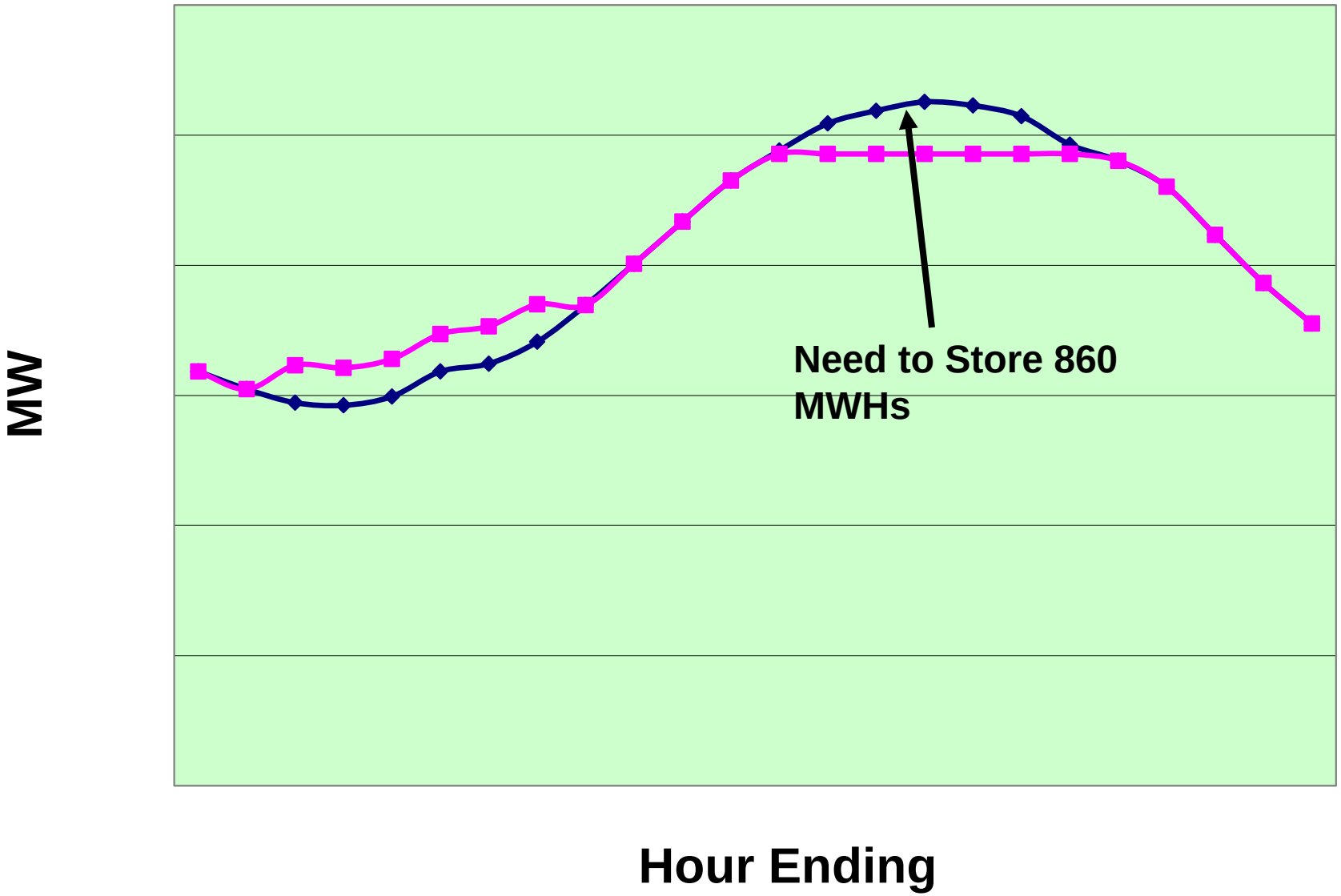
Thermal Storage Cooling

Cold Air or Chiller Water

Electricity

Night time

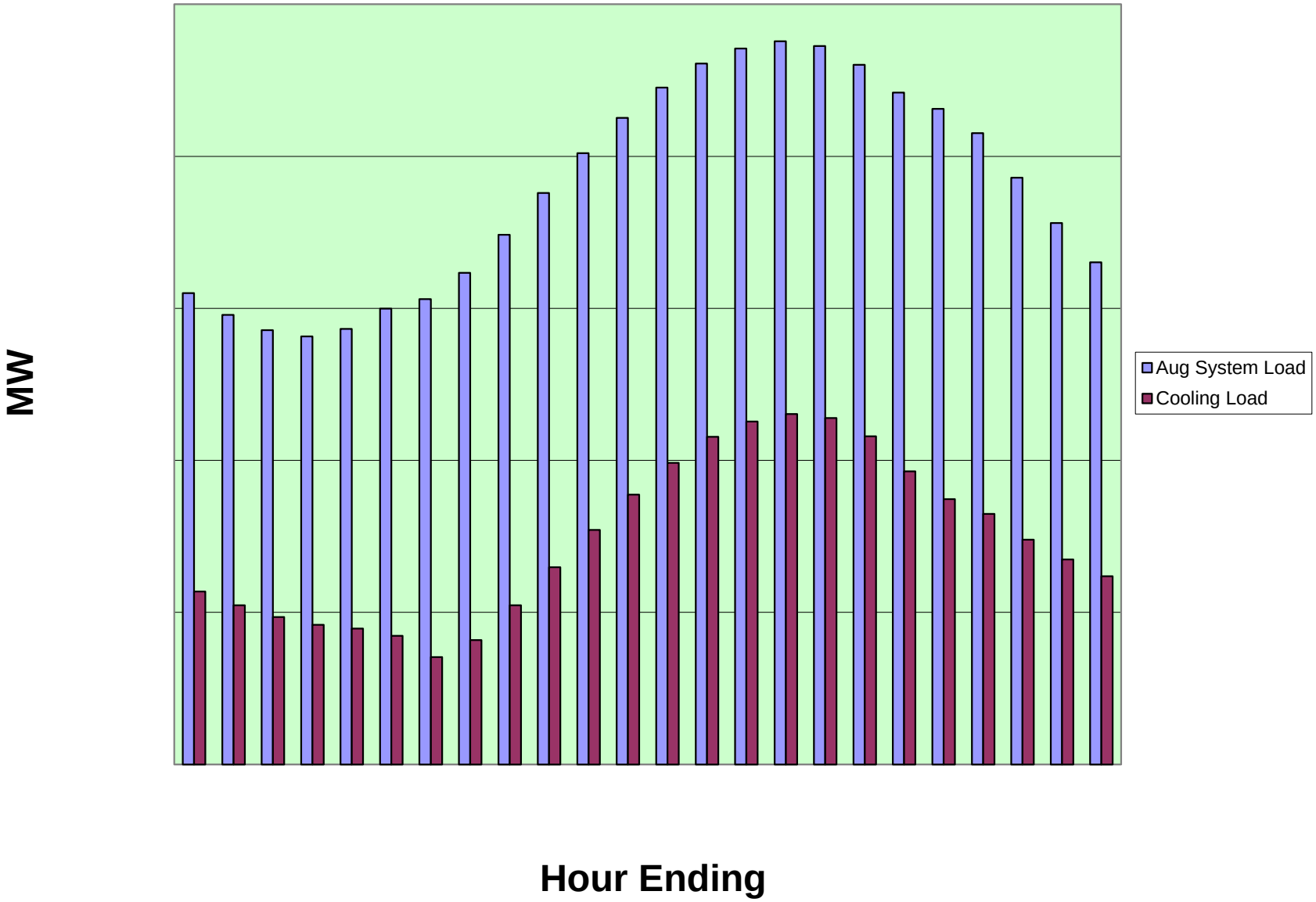
Shaving Peak by 200 MW



Cost Factors in Organized Markets

- **Transmission Cost– based on Load at time of Coincident Peak $/MW**
- **Ancillary Service Cost – typically allocated like Transmission cost $/MW**
- **Energy cost – varies every 15 minutes $/MWH**

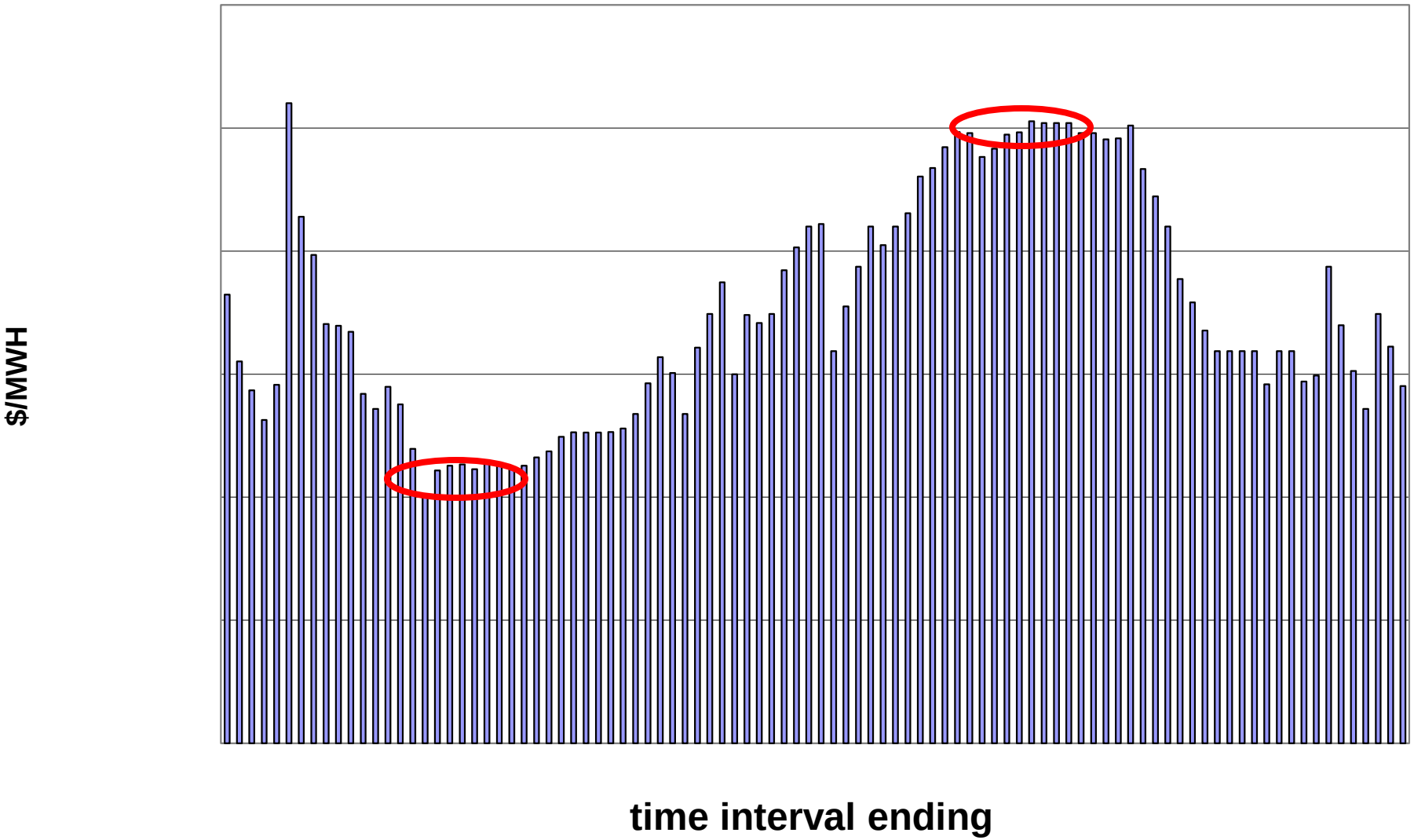
Avg August System & Cooling Load



Value of Thermal Storage
Austin Energy –Case Study

- **Assume 100 MW of Load Reduction at Time of Coincident Peak**
- **Requires 300 MWH of Daily Energy Shift**
- **Transmission Cost Reduction = $40,000 per MW**
- **Ancillary Service Cost Reduction = $9,000 per MW**
- **Energy Cost Reduction Based on Shift of 300 MWH each Day for 100 Summer days**

Avg prices - July 2010



Value of Thermal Storage

- Transmission cost reduction:$4.0 million/yr
- Anc.Service Cost Reduction: $0.9million/yr
- Energy Shifting Cost Red: $1.8 milion/yr
- Value: $6.7 million/yr

Cost of Thermal Storage

- 1 MWH Requires 1200 TonHours
- 300 MWH = 360,000 TonHours
- @$130 per TonHour
- Cost = $47 million
- Value = $6.7 million/yr
- Cost to Value Ratio = 7

Chilled Water Storage Tank

- 98 ft diameter x 40 ft high
- Stores 17,000 Ton Hours

Modular Ice BankTanks

Each 7.5 ft diameter, 8.5 ft high tank stores 160 TonHours

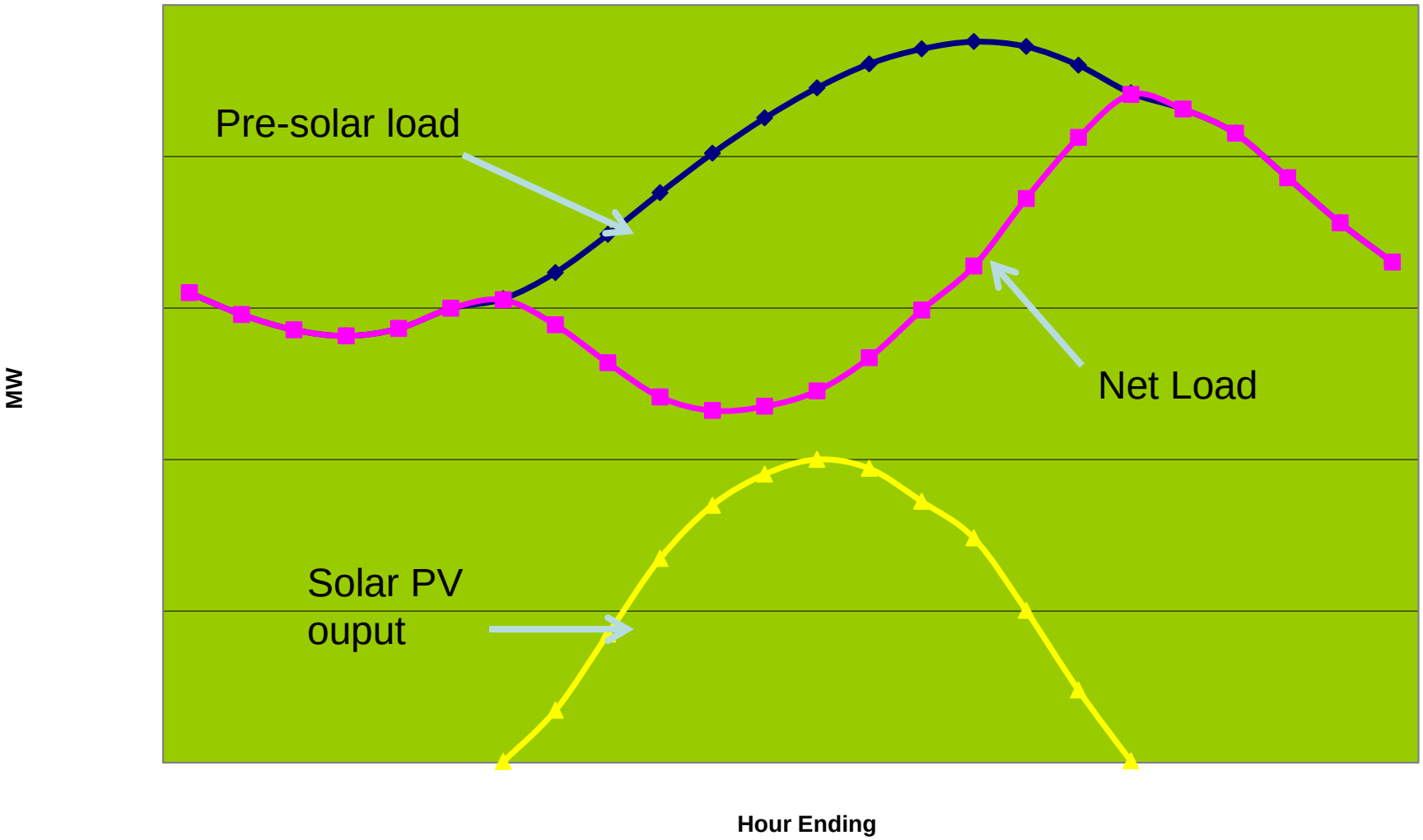
Ice on Coils – Large Tank

- **3,000 TonHours**
- **900 sq ft**
- **10 Ft High**

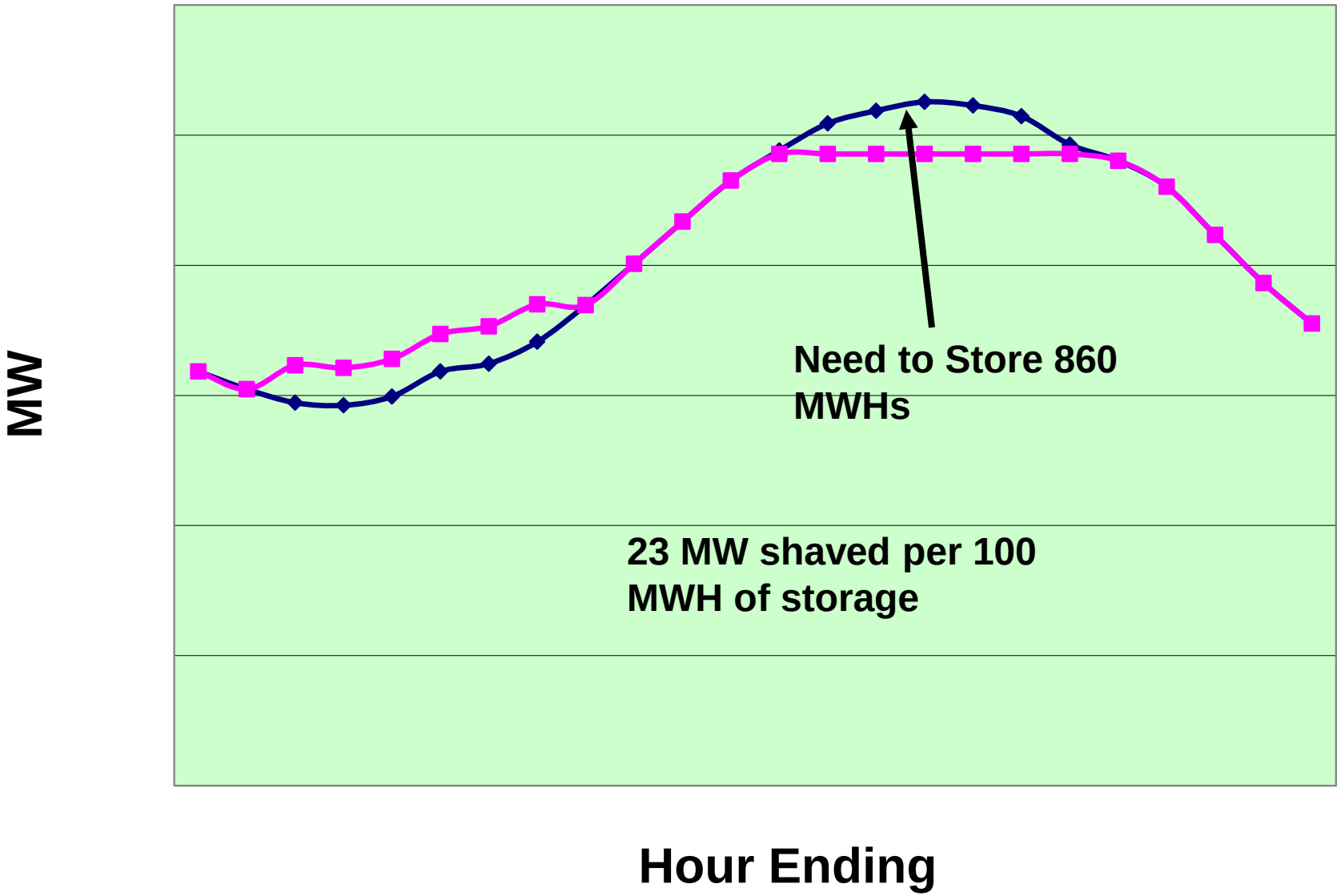
- **Approx 1 sq ft per 300 sq ft of bldg floorspace**

Rooftop Units

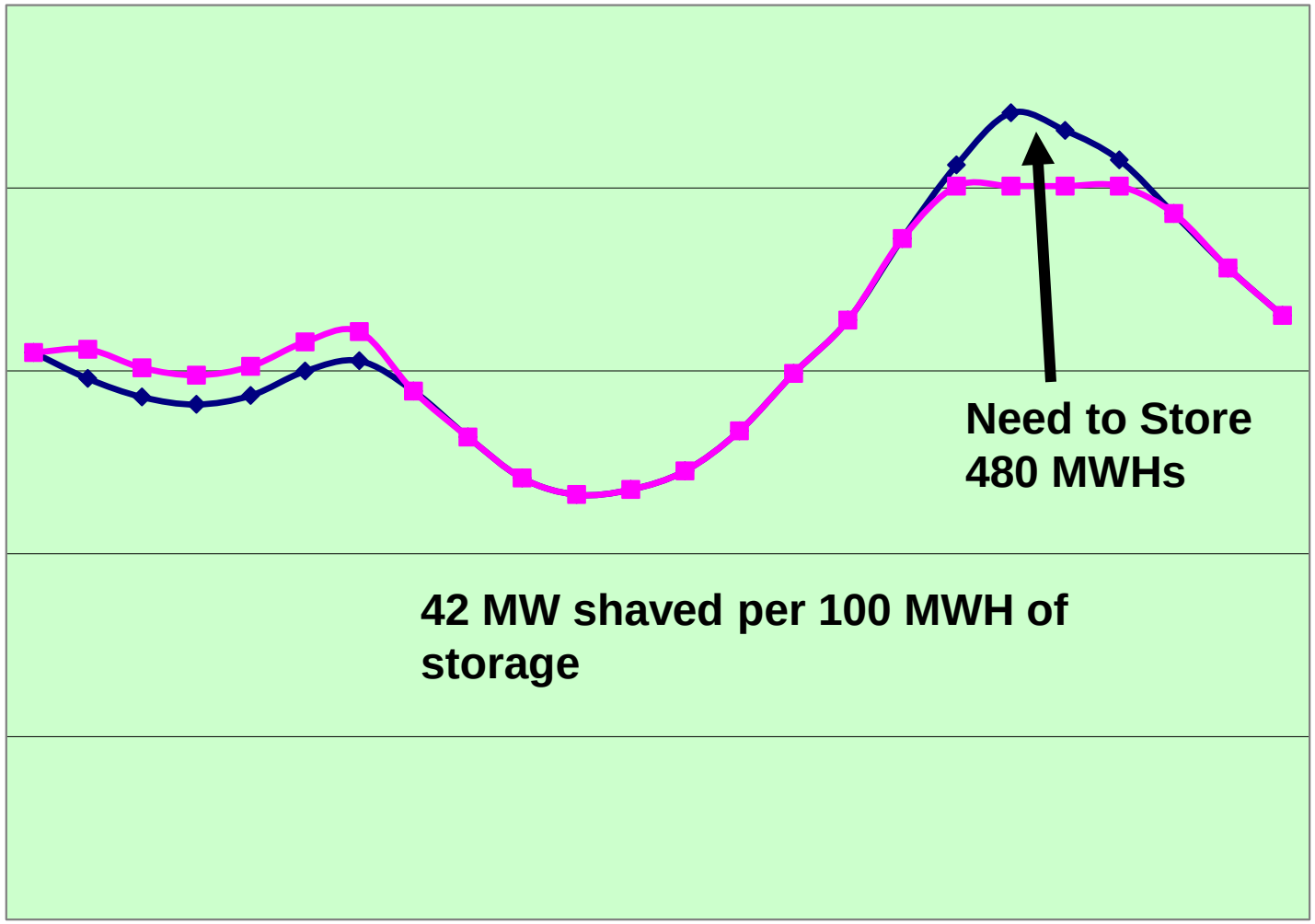
Impact of 1000 MW of Solar



Shaving Peak by 200 MW



Shaving 200 MW from Peak



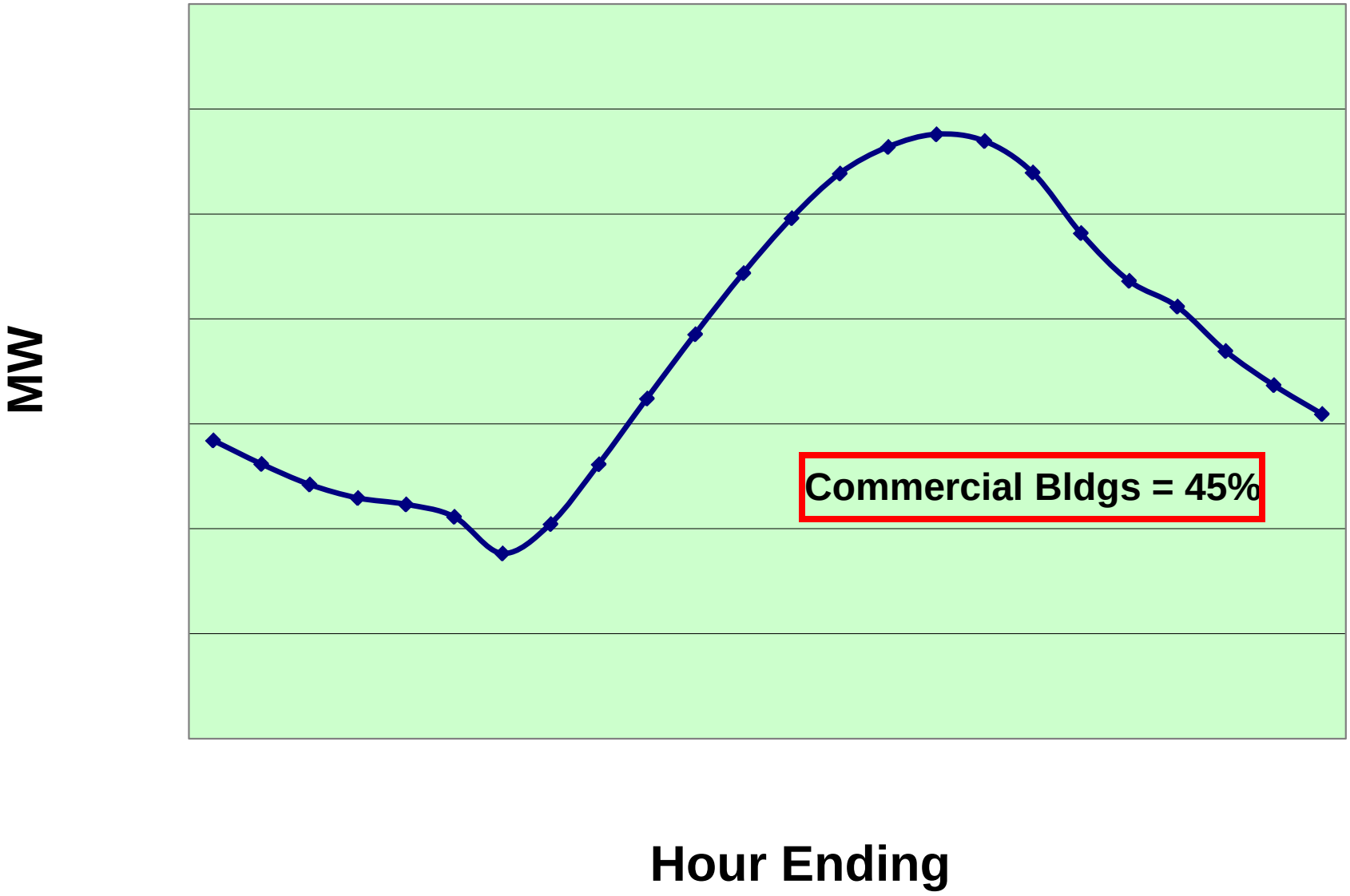
Concluding Thoughts

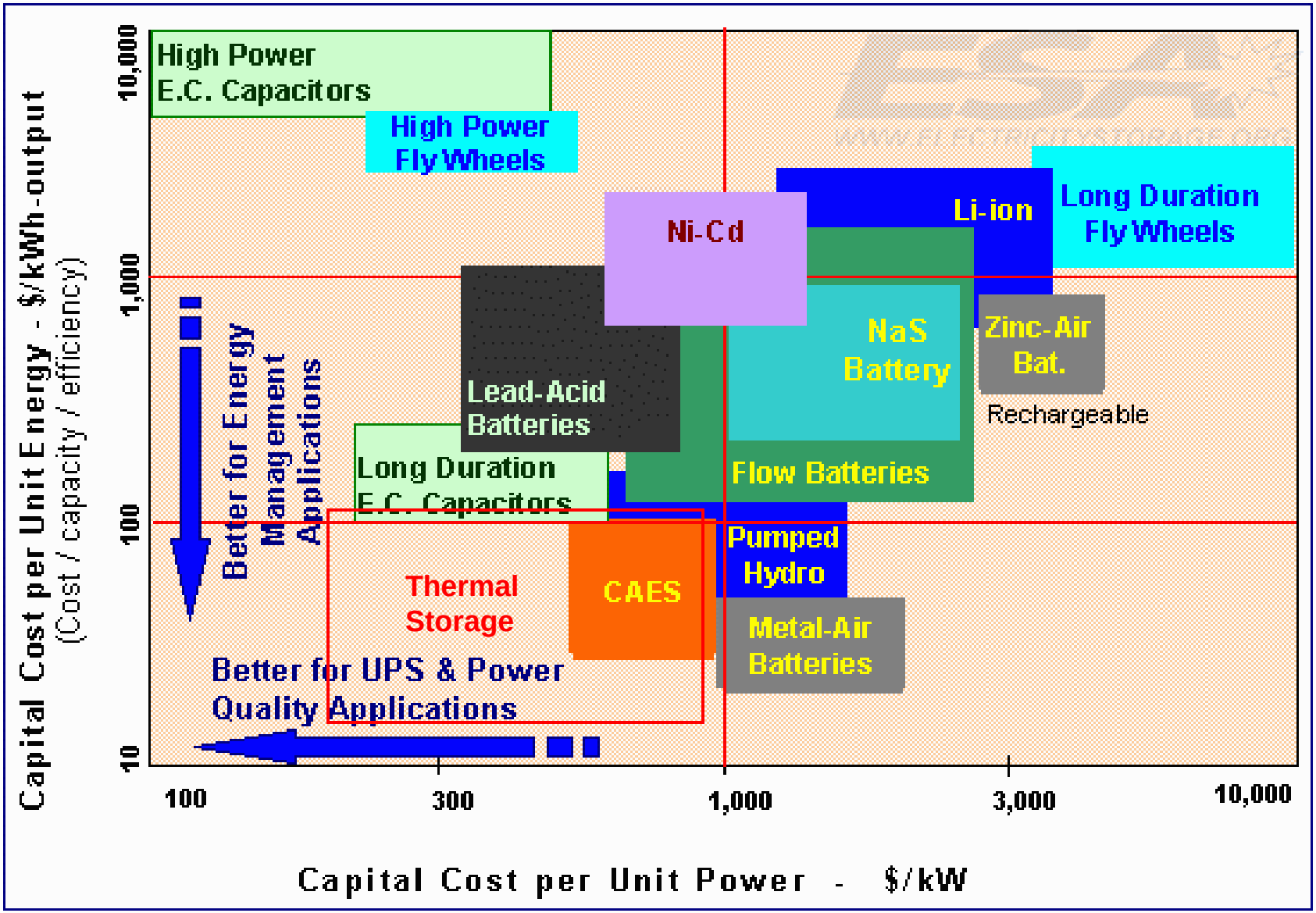
- **Centralized Dispatch by AE**
- **Increasing night time load facilitates wind integration**
- **How can AE encourage widespread adoption of storage cooling in planned buildings and cooling system retro-fits ?**
- **Possibly through bldg codes coupled with incentives**

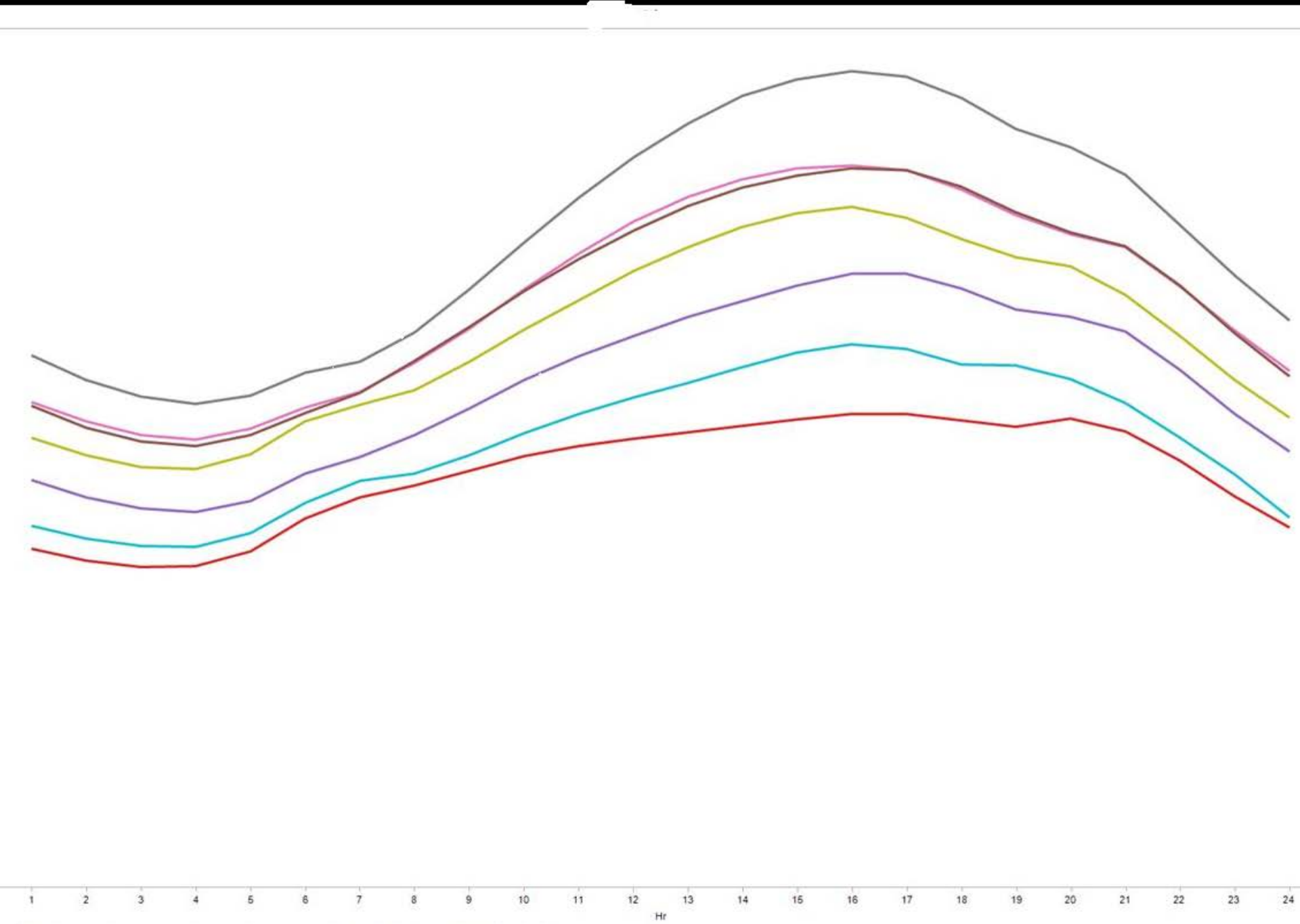
Thermal Storage Cooling Systems in Austin Energy

District Cooling #1	52,000 TonHours	10 MW
District Cooling #2	26,000	5 MW
Mueller Energy Center	8,000	1.5 MW
3M	3,540	755 kW
Bowie High School	2,600	362 kW
Austin Convention Center	6,000	500kW
Airport	15,000	1,064 kW

Cooling Load

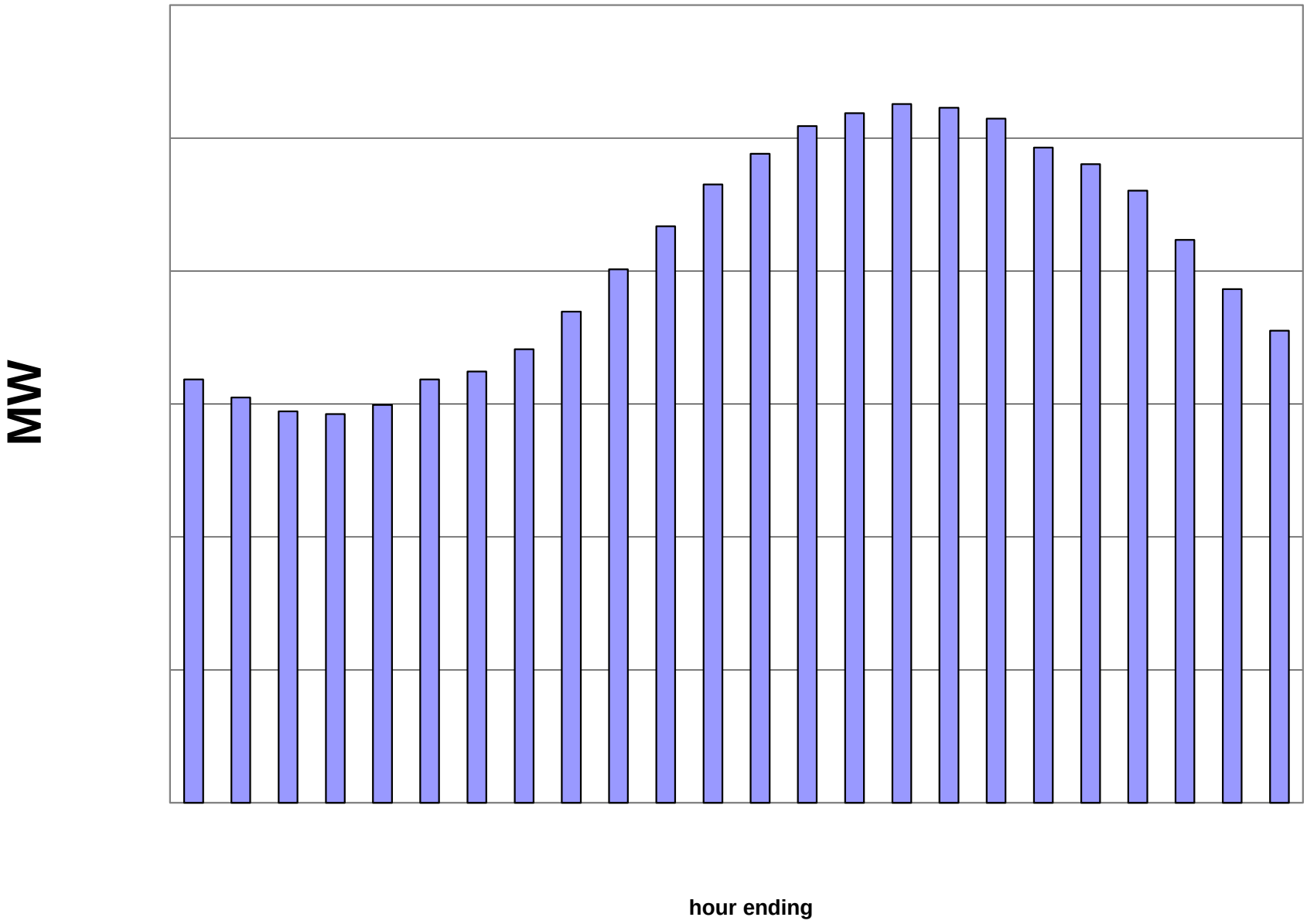



Capital Cost per Unit Energy - $/kWh-output
(Cost / capacity / efficiency)
10,000
1,000
100
10
High Power
E.C. Capacitors
High Power
Fly Wheels
Ni-Cd
Li-ion
Long Duration
Fly Wheels
Lead-Acid
Batteries
NaS
Battery
Zinc-Air
Bat.
Rechargeable
Long Duration
E.C. Capacitors
Flow Batteries
Pumped
Hydro
Thermal
Storage
CAES
Metal-Air
Batteries
Better for Energy
Management
Applications
Better for UPS & Power
Quality Applications
100
300
1,000
3,000
10,000
Capital Cost per Unit Power - $/kW



age of Load for Hr. Color shows details about Month. The view is filtered on Month, which has multiple members selected.

Peak Day of 2010



Hrs of Storage vs Peak Reduction