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THE ECONOMIC VIABILITY OF STORAGE

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Attributes of Energy Storage

- Storage power
- Discharge duration
- Energy and power density
- Footprint and space requirements
- Round-trip efficiency
- Operating costs
- Lifetime discharge
- Reliability
- Response time
- Ramp rate
- Charge rate

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Attributes of Energy Storage (cont.)

- Energy retention and standby losses
- Transportability
- Modularity
- Power conditioning
- Power quality
- Storage system reactive power capability
- Communications and control
- Interconnection
- Decommissioning
- Disposal

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What is the value of the Bulk Energy Storage to a utility?

Net Utility Value =

+ Avoided Utility Costs

- Avoided facility costs
- Avoided operating costs

+ Other Utility Benefits

- Power and fuel hedging value
- Enhanced utility resource operation and integration
- Fulfilling regulatory requirements

- Costs

- Installed cost
- Minimal maintenance and scheduling costs

Avoided Utility Costs

Avoided Capital Facilities	• Future generating units • Transmission facilities • Distribution facilities
Reduced Energy Costs	• Swap high cost generation for low cost generation • Reduced emissions and costs • Improved resource utilization and operation
Reduced Costs of Market Transactions	• Avoided capacity purchases / demand charges • Swap high on-peak market prices for low off-peak prices
Avoided System Losses	• Reduced system losses • Improved system power factor • Improved voltage support
Reduced O&M Costs	• Avoided O&M costs (avoided facilities) • Reduced O&M costs on existing facilities
Reduced Costs for Ancillary Services	• Reduced ancillary services responsibilities / purchases • Ice Bear provides regulation service

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Value of Avoided Capacity

Avoided Generation Fixed Costs	Avoided per-unit ($/kW) capital cost of planned generating unit
	Avoided demand charges for power purchases
	Deferred generation expansion plan
	Fixed O&M costs of avoided/deferred generating units
Avoided T&D Fixed Costs	Average cost of historical or budgeted facilities (divided by load growth)
	Targeted T&D upgrades avoided or deferred by Ice Bear System
	Adjust for peak ambient conditions and losses
	Fixed O&M costs of avoided/deferred T&D facilities

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Other Utility Benefits

Improved system efficiency and reliability	• Reduced average system heat rate • Improved system reliability
Increased potential for market sales	• *Frees-up* generation that can be sold during peak periods • Surplus capacity sale • Surplus energy sale
Natural hedge against power prices	• Swap high on-peak prices for low off-peak prices • Swap high on-peak volatility for low off-peak volatility
Reduced costs for fuel procurement	• Higher utilization of base / intermediate resources • Less reliance on peaking resources (higher cost fuel) • Better utilization of fuel reservations
Enhanced integration of renewable resources	• Addition of more renewable resource capacity • Augment operation / *dependability* of renewable resources

Utility Evaluation Models

- Capacity planning model
- Generation dispatch / market price / marginal cost analysis models
- T&D planning and simulation models
- Financial / COS / rates models

Storage issues are connected to many current proceedings

Proceeding		
Long-Term Procurement Plan	R.10-05-006	Procurement, including procurement required for renewable integration
Renewables Portfolio Standard	R.08-08-009 R.11-05-005	Implementing RPS, including 33% RPS, targets & compliance
Resource Adequacy	R.09-10-032 New OIR (Fall '11)	Capacity procurement to ensure reliability. New proceeding to address changing system needs, including ("non-generic RA") and changes in peak definitions
Storage	R.10-12-007	Implementing AB 2514, requiring assessment of procurement targets for storage
Demand Response	A.11-03-001 et al	Load flexibility mitigates peak needs and can provide integration services
Energy Efficiency	R.09-11-014	Overall load reduction enables system flexibility
Transmission	I.08-03-010	Evaluating transmission barriers to renewables penetration & integration
CAISO	33% RPS Study; Generation Interconnection Reform; Renewable Integration Market & Product Review; Revised Transmission Planning Process…	

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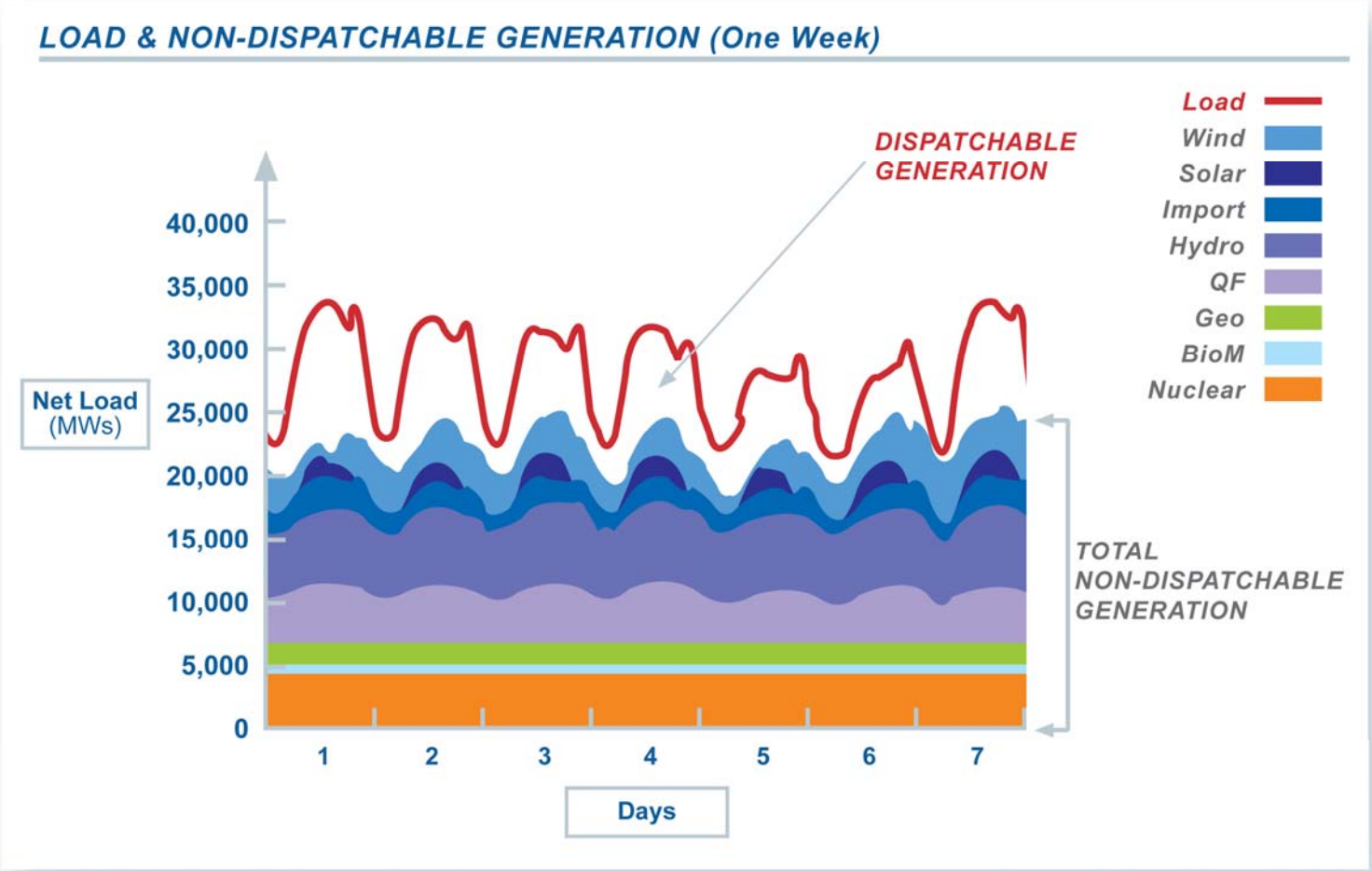
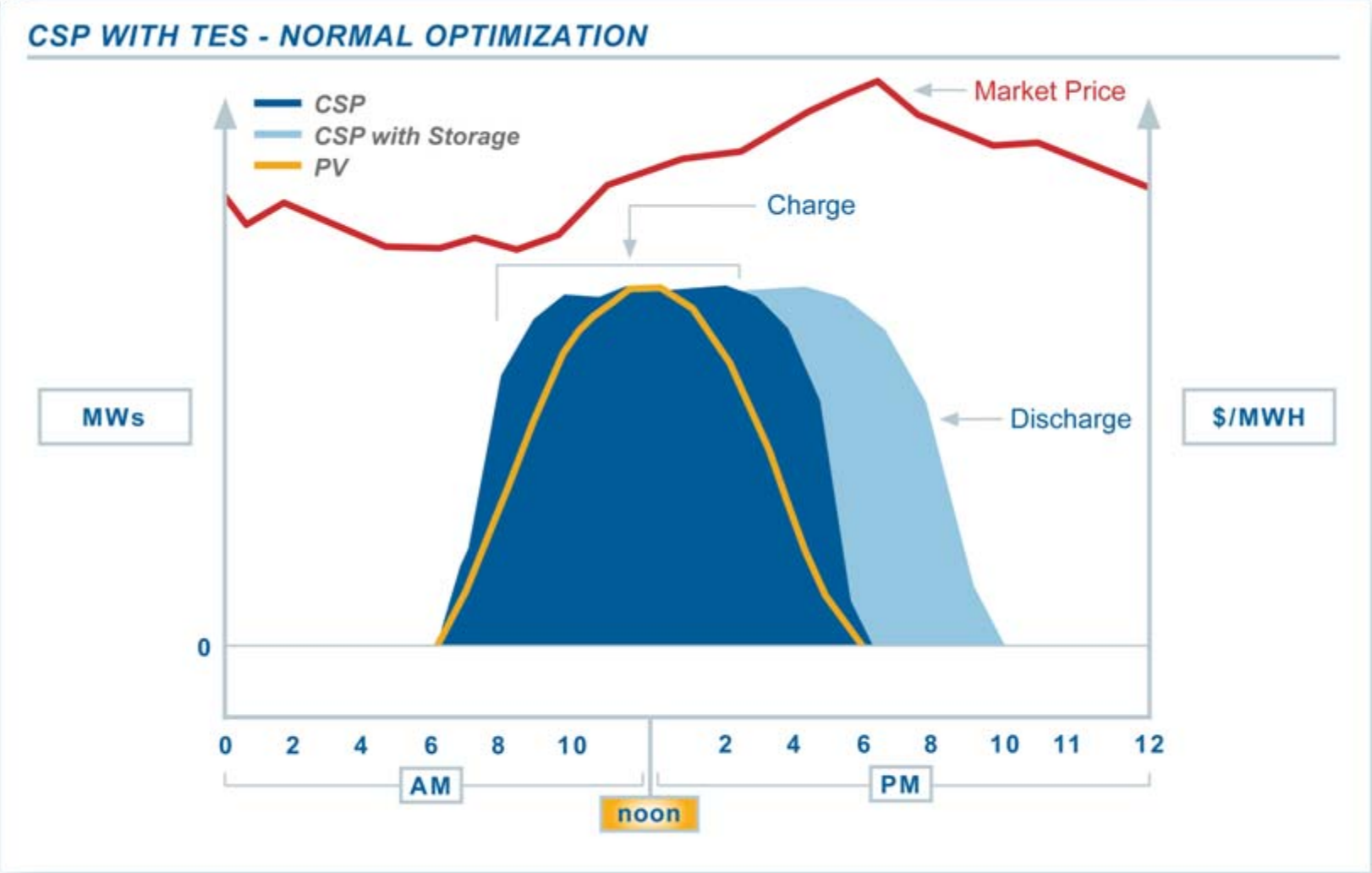
Opportunities for thermal storage technologies

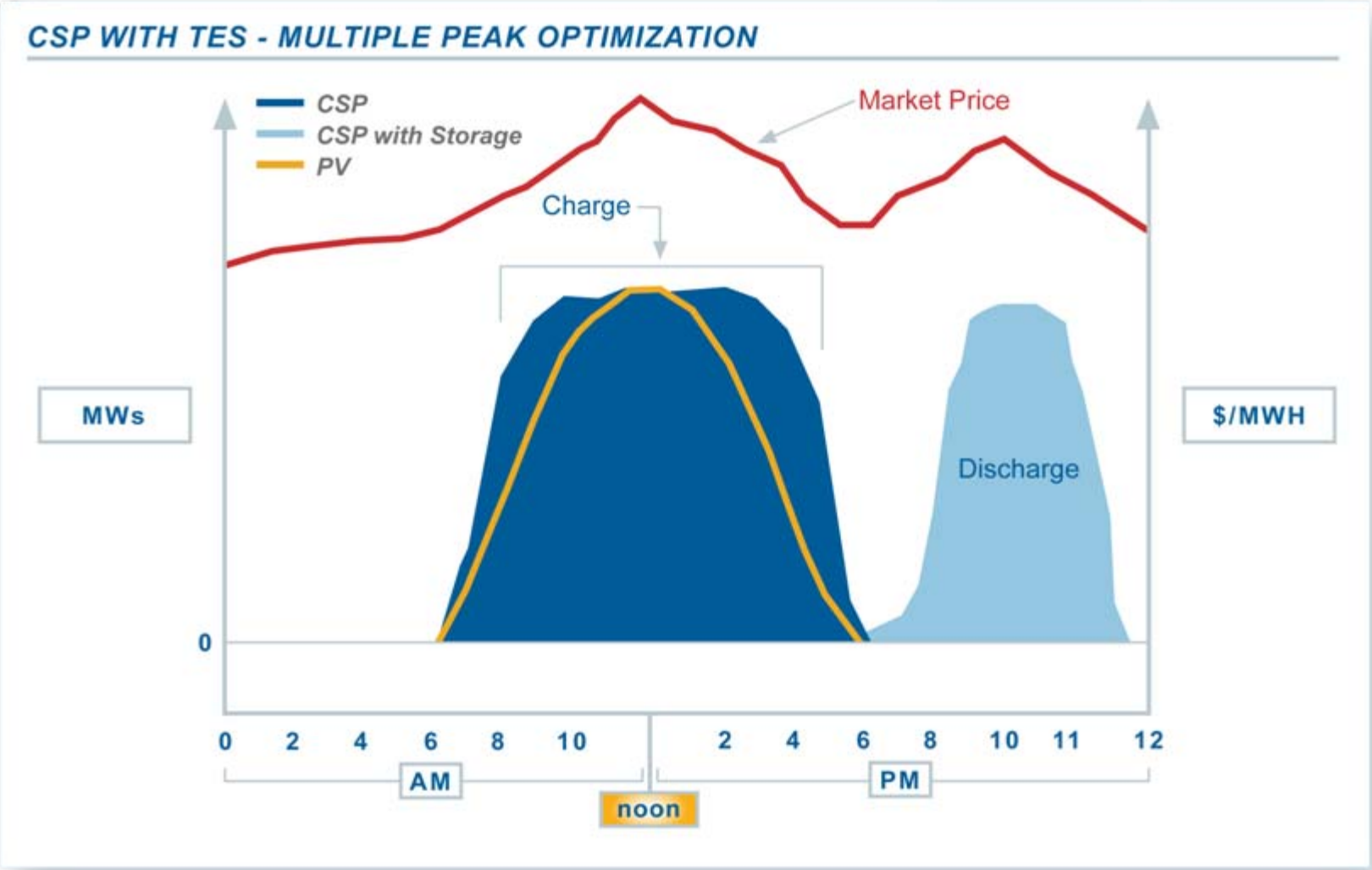
Increasing levels of renewable energy penetration



Storage contributes during periods of highest value



The net system peak is expected to shift to later in the day as renewable penetration increases



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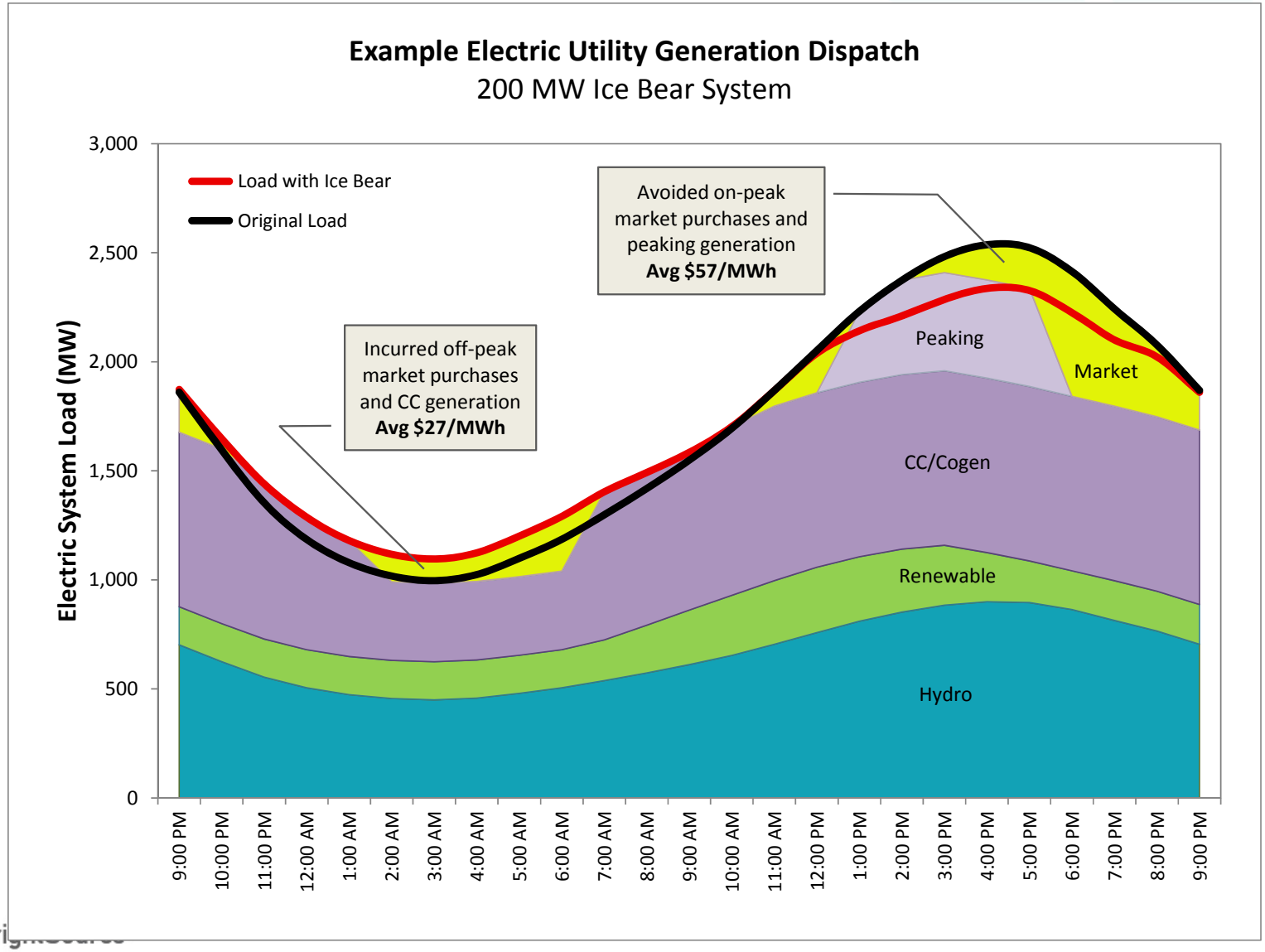
Avoided Energy Costs