17 Electric Utility-Related Electricity Storage Benefits, Featuring T&D Deferral

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by

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Agenda

- ☞**Menu of possible benefits**
  - 17 Direct Benefits
  - 5 Incidental Benefits
- Featured Benefit: T&D Deferral
- Conclusions
  - Aggregate Benefits: Value Propositions

Background

- 2003 - 2004 California Energy Commission (CEC) Storage Demonstration Program
  - proposals addressed "value propositions" **($)**
    - rather than technology or applications
    - **value proposition = benefit(s) – cost**
  - produced "Benefits Handbook" used by proposers to develop value propositions
- Developed "National" Benefits Guide Published by DOE/SNL in 2004
  - ☞ California-centric

The Benefits Guide

- **Update** for **2008** is pending
- Describe and Estimate
  - ✓ 17 Benefits' Magnitude ($)
    - ☞ Primarily in terms of avoided cost
  - ✓ Maximum Market Potential (MW)
  - ☞ *generic* values established using subjective but transparent assumptions
- ✓ Somewhat High Level
- ✓ Technology Agnostic
- ✓ Value Proposition Examples

Benefit Categories

- Electric Supply
- Grid Operation (a.k.a. Ancillary Services)
- Grid System
- End-User/Utility Customer
- Renewables Integration
- Incidental

☞Some overlaps among benefits.

Electric Supply

- Electric Energy Time-shift ($/MWh)
  - Buy Low (off peak) and Sell High (on peak)

  ☞ Arbitrage = ***Simultaneous*** *purchase (@ "bid" price) and sale (@ "offer" price) to derive profit from a difference in prices.*

- Electric Supply Capacity ($/MW)
  - offset need for generation *equipment*
  - avoided generation resource on the margin

Grid Operation
(a.k.a Ancillary Services)

- Load Following
  - up or down when charging or discharging
- Area Regulation
  - ☞ “rapid” up and down => 2x benefit
- Electric Supply Reserve Capacity
  - storage is excellent reserve capacity
- Transmission Support
  - damping & stability, per EPRI
- *Local* Voltage Support

Grid System

- Transmission Congestion Relief
- Transmission and Distribution (T&D) Upgrade Deferral
  - may have especially high value
    - ☞ very location-specific
  - compatible with several other benefits
- Substation Onsite Power
  - backup

End-User/Utility Customer

- Time-of-Use Energy Cost Management
  - "energy time shift" *by energy user*
  - ☞ requires tariff with time-of-use energy pricing
- Demand Charge Management
  - reduce peak demand
  - ☞ requires tariff with demand charges
  - ☞ probably reduces energy cost too
- Improve Electric Service Reliability
- Improve Electric Service Power Quality

Renewables Integration

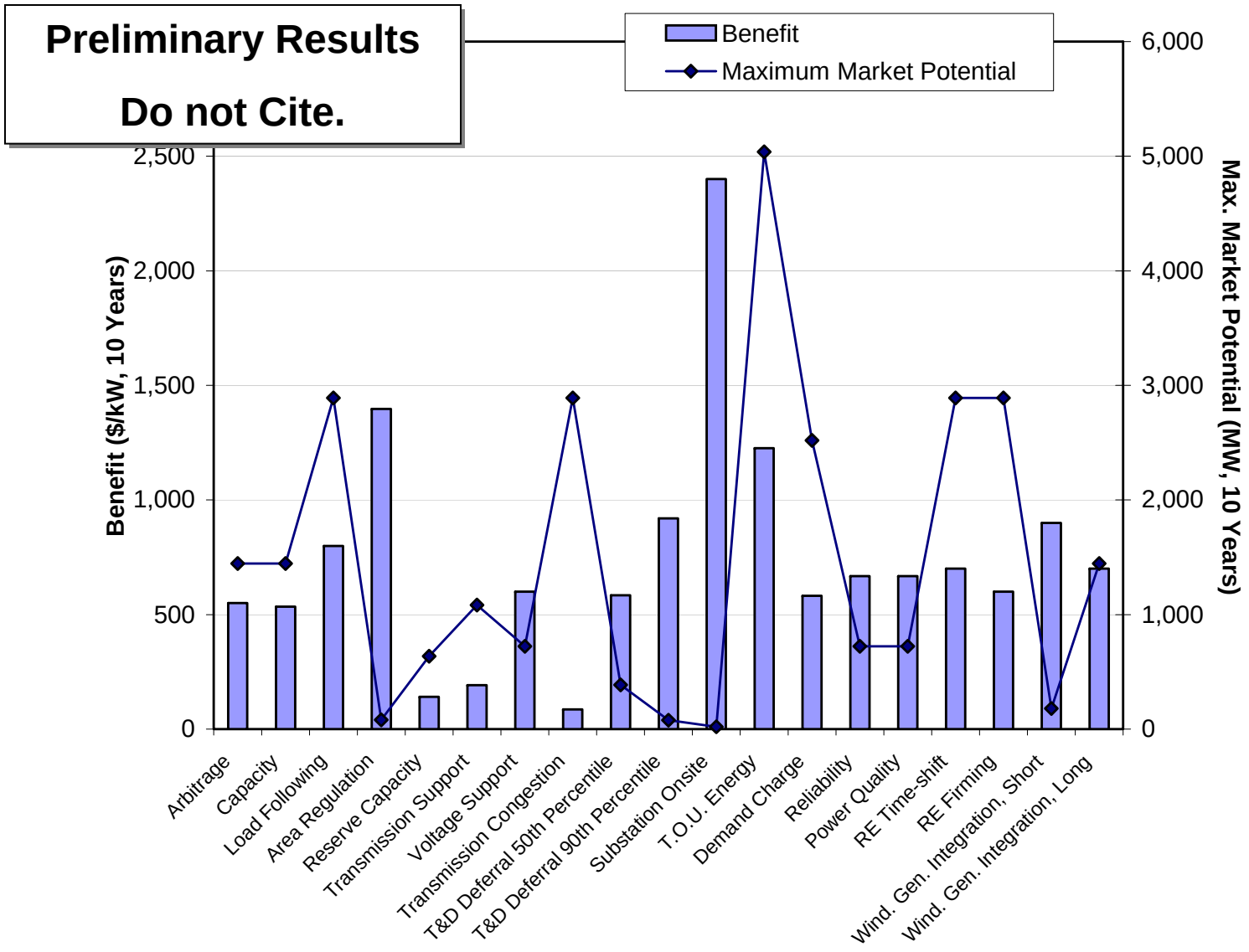
- Renewables Energy (RE) Time-Shift
  - wind and baseload RE generation
- Renewables Capacity Firming (during peak)
  - wind and solar generation
  - addresses mostly diurnal variation
- Wind Generation Grid Integration
  - ✓ power quality
  - ✓ ramping & load following (output “volatility”)
  - ✓ minimum load violations
  - ✓ unexpected wind generation shortfall

Incidental Benefits

- Avoided T&D "I^2R" Energy Losses
  - on peak minus off peak
- Avoided Transmission Access Charges
- Increased Asset Utilization
  - generation & transmission, possibly distribution
- Reduce T&D Investment Risk
  - DOE/Sandia report by DUA is pending
- Generation Dynamic Operating Benefits (EPRI)

  Reduced: 1) ramping, 2) part load operation, 3) wear and tear, 4) fuel use (per kWh), and 5) air emissions.

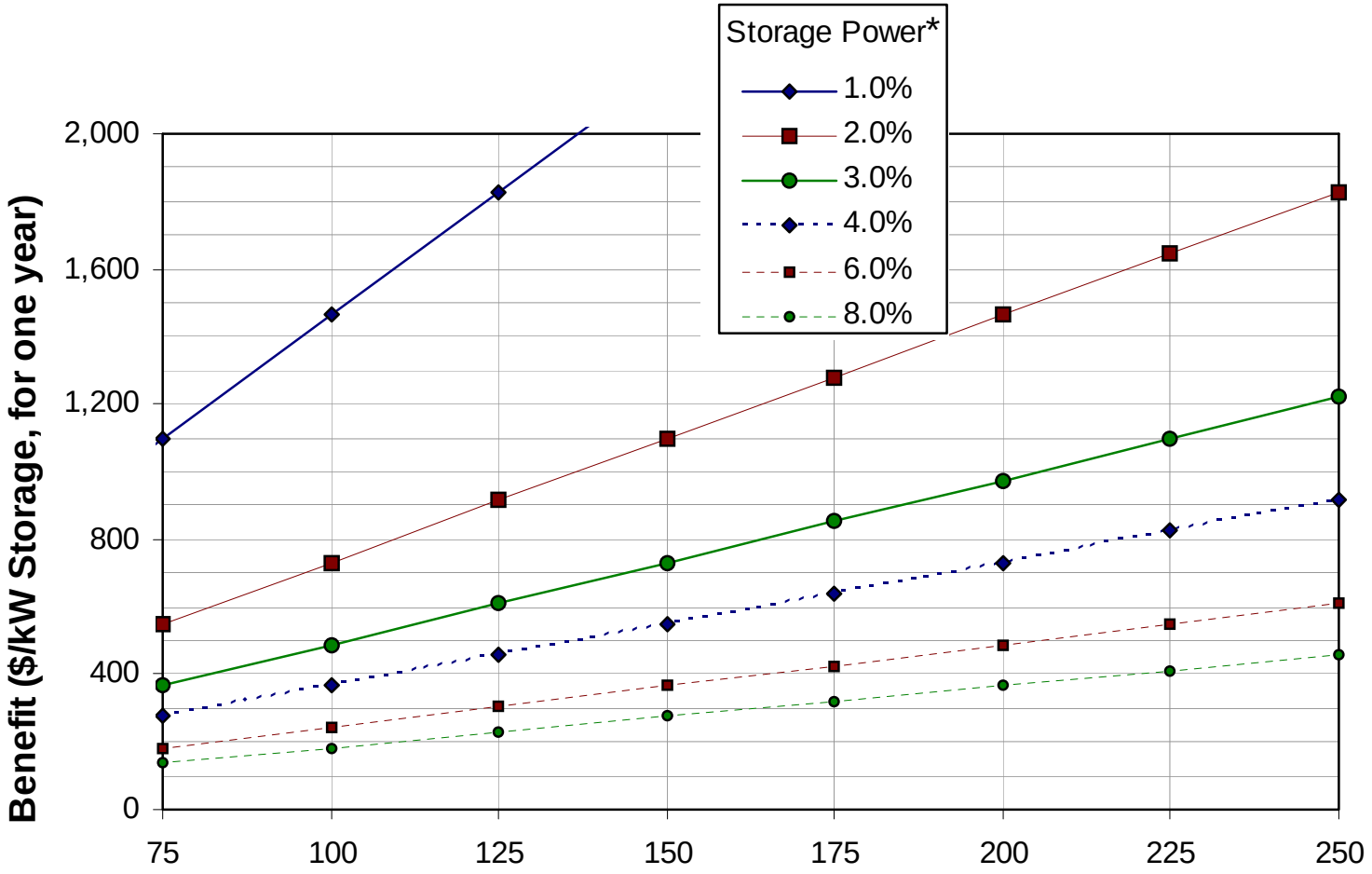
Benefits Market Potential



T&D Deferral Background

- Significant Benefit ($) Possible
- Limited Storage *Cycling*…for High Benefit
- Distributed Deployment
  - ✓ richer value propositions possible
  - ✓ if transportable: multiple deployments
- Pending DOE/Sandia Report
  - ✓ survey of existing research
  - ✓ important context such as indicators
  - ✓ generalized benefit estimation framework

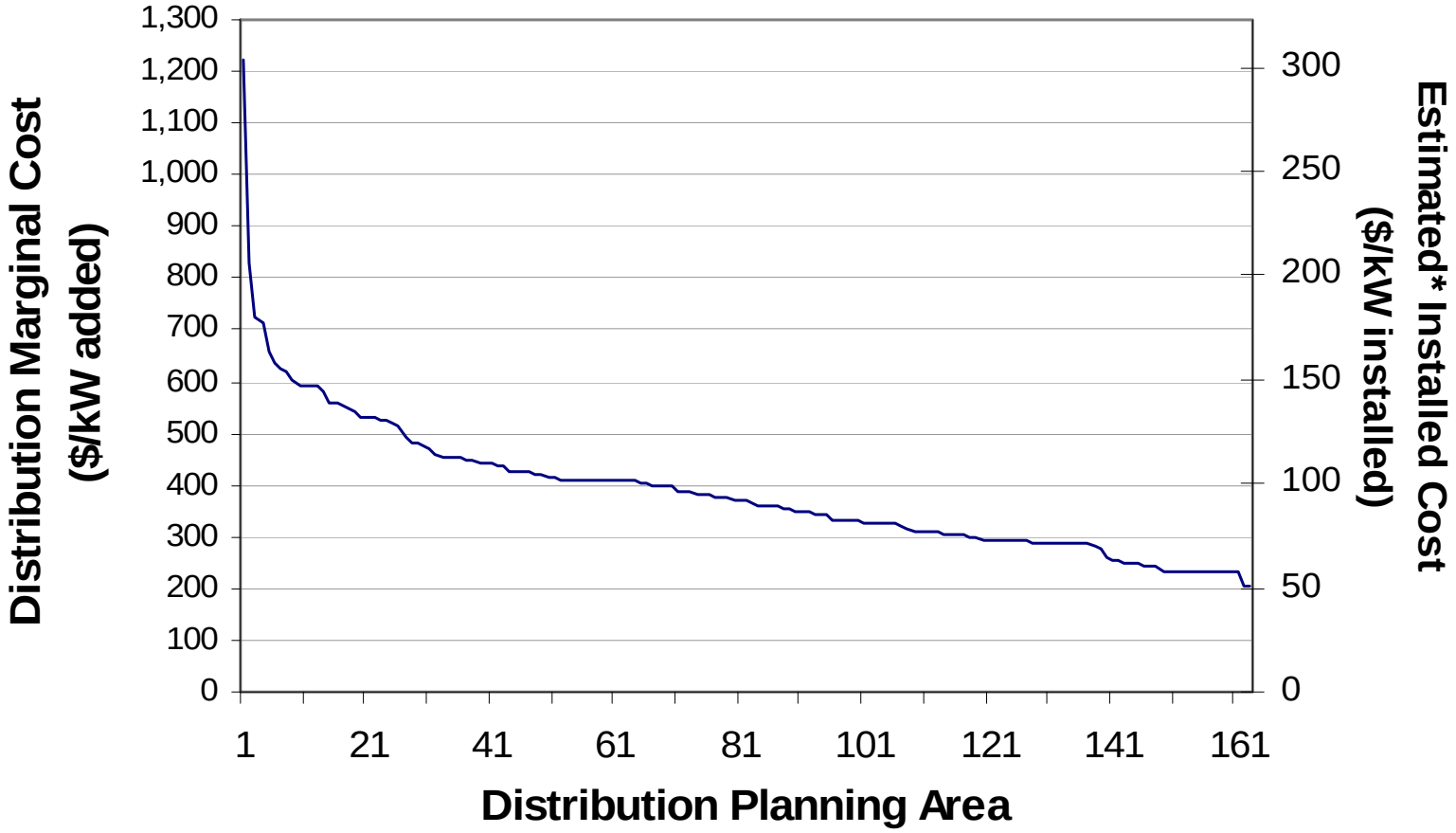
T&D Upgrade Deferral Benefit:
Generalized Estimation Framework



Fixed Charge Rate = 0.11
T&D Upgrade Factor = 0.33

*Storage power relative to EXISTING T&D Capacity.

Range of Distribution Upgrade Costs



Sources: PG&E and EPRI

* T&D Upgrade Factor = 0.33

Value Proposition Examples

- Transportable storage for T&D deferral and PQ/Reliability at two or more locations
- PV + storage: capacity firming, energy time-shift, reliability, T&D deferral, congestion relief
- Small A/C: “load from hell,” energy time-shift, small motors’ effect on Voltage
- Central wind => distributed storage

Conclusions

- Emphasize *Value Propositions*
  - ✓ less emphasis on applications & technology
  - ✓ need artful aggregation of benefits (> cost)
  - ☞ many storage opportunities require two or more benefits (combined) to exceed cost
- Increasingly Rich Possibilities for Attractive Value Propositions
  - menu of benefit categories
  - increasing value for those benefits
  - distributed resources (storage, generation, DR)

Conclusions

- T&D Deferral
  - ☞ potentially high value element of attractive value propositions for a growing number of locations
- Before purchase of storage many *prospective* users need:
  - ✓ improved familiarity with the storage option
  - ✓ more evidence about benefits
  - ✓ better risk and reward sharing and means to internalize some benefits (efficient pricing)

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