Comparing T&D Capacity Options, On a Risk Adjusted Cost Basis

Including Stationary and Transportable DERs

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for

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and

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Agenda

- Study Purpose
- T&D Planning Uncertainties
- Risk Adjusted Cost Concept and Results
- Merits of DER Transportability
- Conclusions

Team

- Joe Iannucci, DER Advocate
- Jim Eyer, Senior Analyst
- Jim Skeen, Utility Distribution Engineer, P.E.
- Dr. Roger Pupp, Economist, Financial Analyst
- Dr. Thomas Hoff, Engineering Economist
- Susan Horgan, Principal of DUA

- Imre Gyuk (DOE) and John Boyes (Sandia)
- Mark Rawson (CEC)

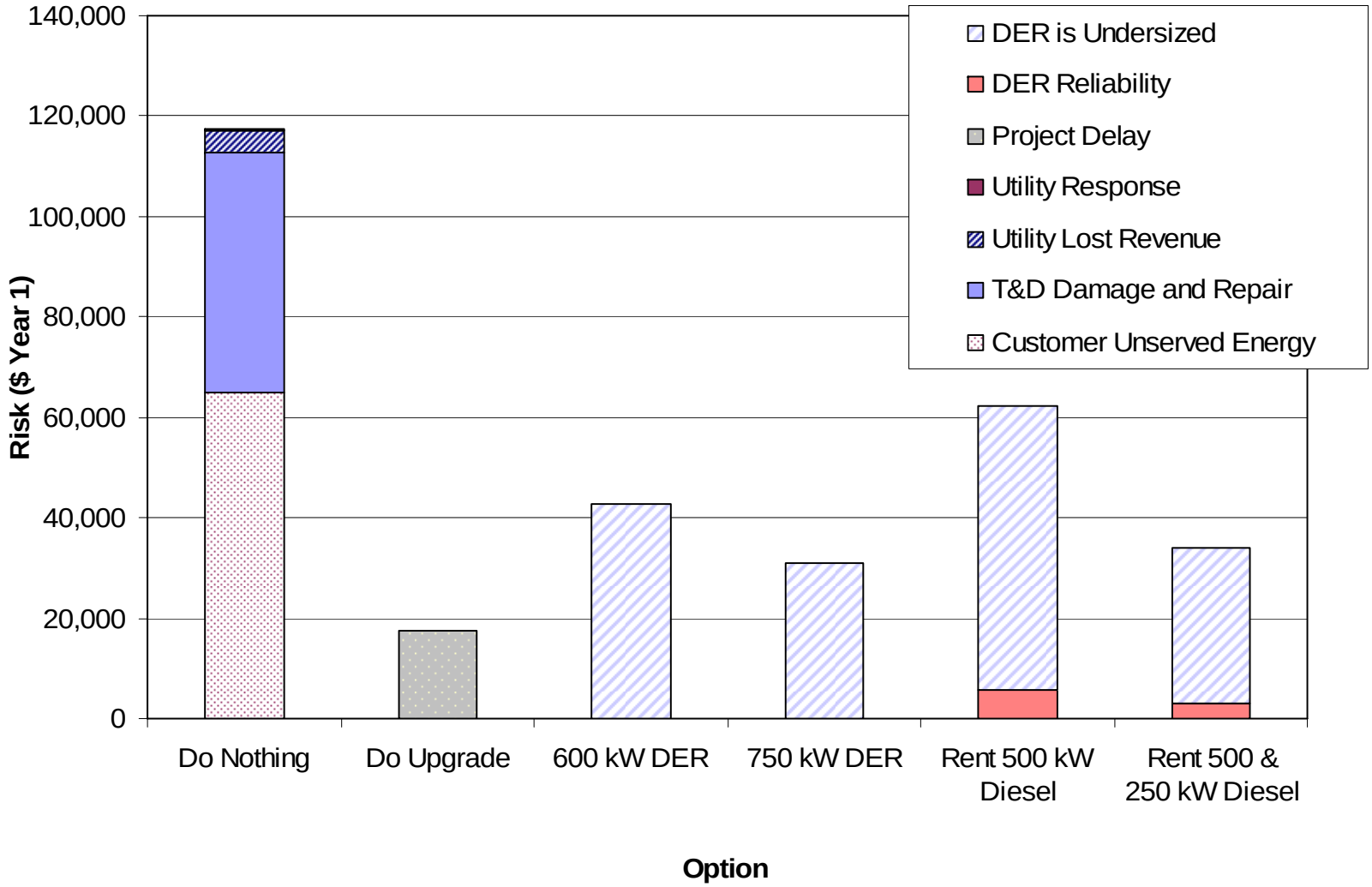
Study Purpose

- Develop and try a basic framework to compare *risk adjusted* cost for T&D capacity options, including DER
  - Hypothesis: More optimal cost-of-service is achieved by selecting T&D capacity options using risk adjusted cost.
- Characterize the merits of DER "transportability"

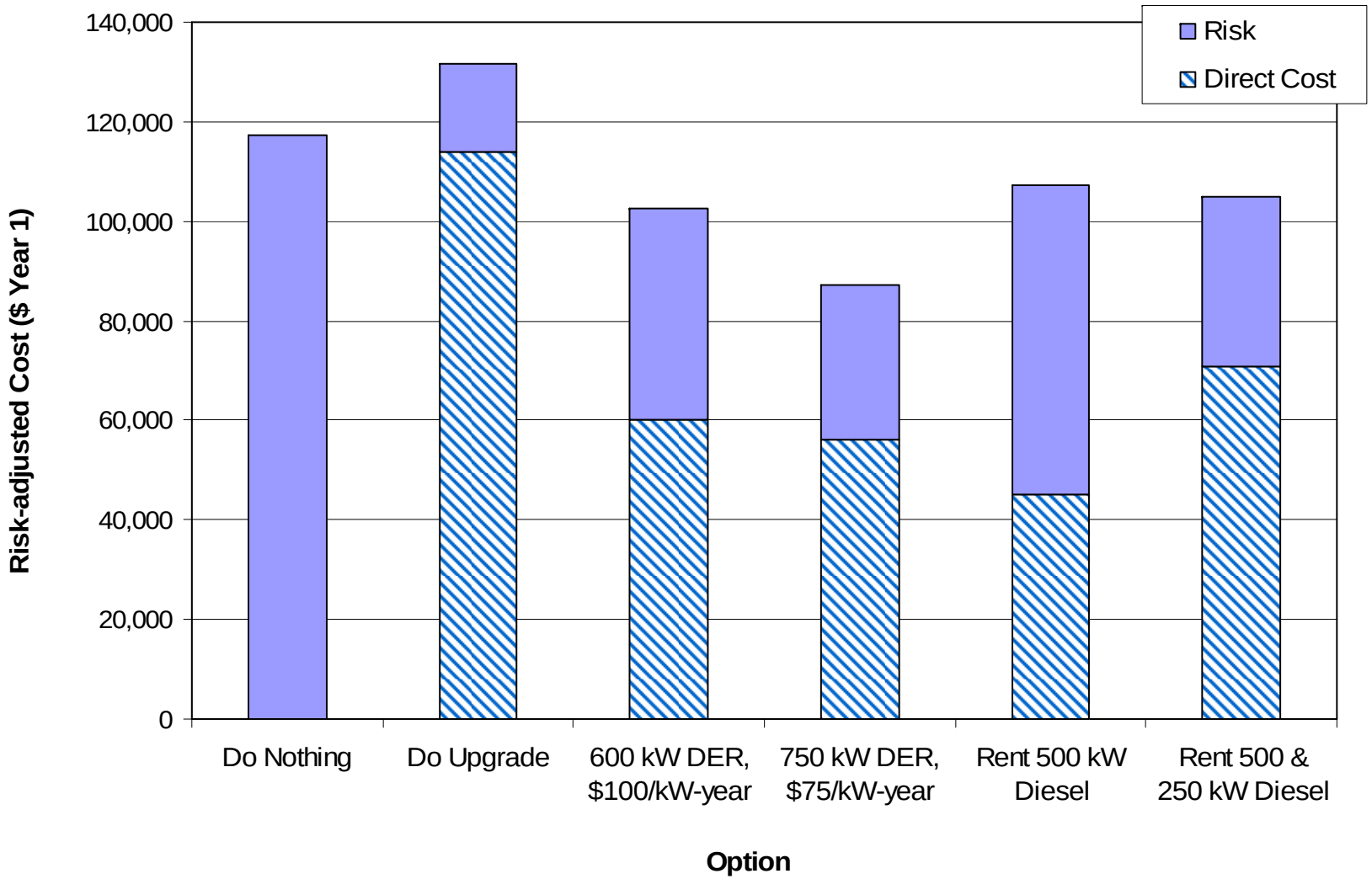
Background

- Ri$k
  - *financial* exposure that is not certain
  - forms: additional cost and/or reduced “profit”
- Explicit evaluation of risk allows utility to
  - ✓avoid unattractive outcomes
  - ✓*accept* risk, to pursue *favorable* outcomes
- Utility pricing
  - *revenue requirements* obscures *actual* risk
  - ☞ “distributed risk” -- all customers pay

Risk Evaluation



Risk Adjusted Cost Example



Key T&D Planning Uncertainties

- "Inherent" Peak Load Growth
  - – Drivers: economic conditions & load mix
- Uncertain Block Load Changes
  - – e.g.; strip malls, housing developments
  - ☞primarily *additions*
- Weather-related Variability
  - ☞ normally design to "extreme" conditions
    - e.g.; one year in ten

Key T&D Planning Uncertainties

- Construction Delays
  - engineering and/or construction staff shortages
  - budget shortfalls
  - “institutional” challenges (e.g., permits)
- Load *Shape* Change
  - load mix
  - energy use pattern
- T&D Equipment Loading History
  - remaining life / reliability

Calculating Risk

Expected Value of Possible Future Outcomes

Load Growth Uncertainty	Temperature Uncertainty	End States	Cost ($) Gross, for End-State	Cost ($) Probability-Adjusted
50% chance load growth < expected **no overload**	90% chance temperature <= design **0% overload**	45% chance **no overload**	**$0**	**$0**
	10% chance temperature > design **7% overload**	5% chance **7% overload**	**$50,000**	**$2,500**
50% chance load growth > expected **10% overload**	90% chance temperature <= design **10% overload**	45% chance **10% overload**	**$170,000**	**$31,500**
	10% chance temperature > design **17% overload**	5% chance **17% overload**	**$425,000**	**$76,500**
		***Expected Value* (Risk)**		**$100,000**

The Case

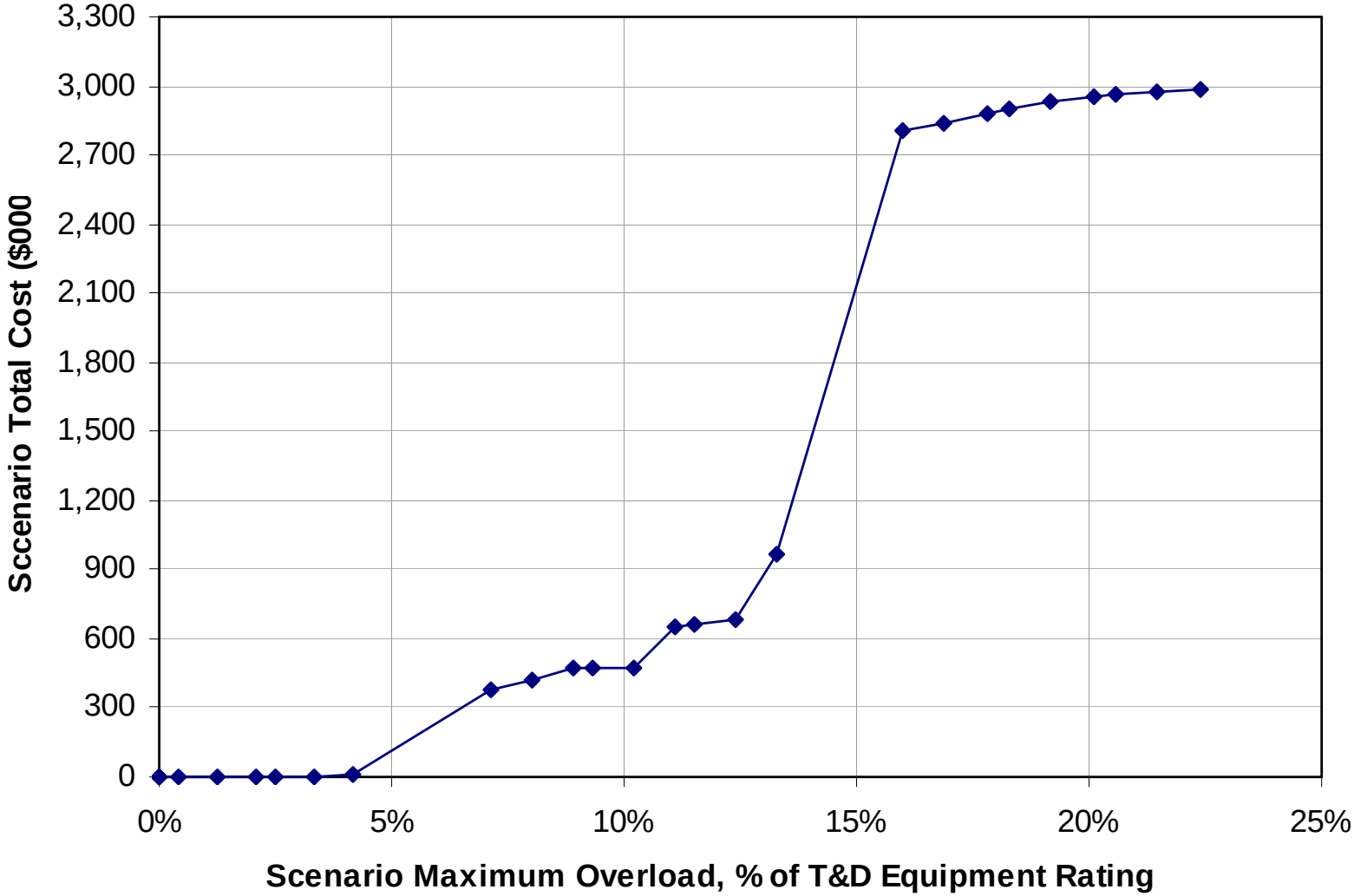
- Upgrade 12 MW to 16 MW (+4,000 kW +33%)
  - cost: $260/kW$_{added}$ * 4,000 kW = $1,040,000
  - "annualized" @ 11% = $114,000/year
- Existing Equipment
  - remaining life 12 years
  - value: $39,600/year of remaining life
- Load
  - previous year peak load 11.7 MW
  - uncertain load growth

Ri$k is Co$t

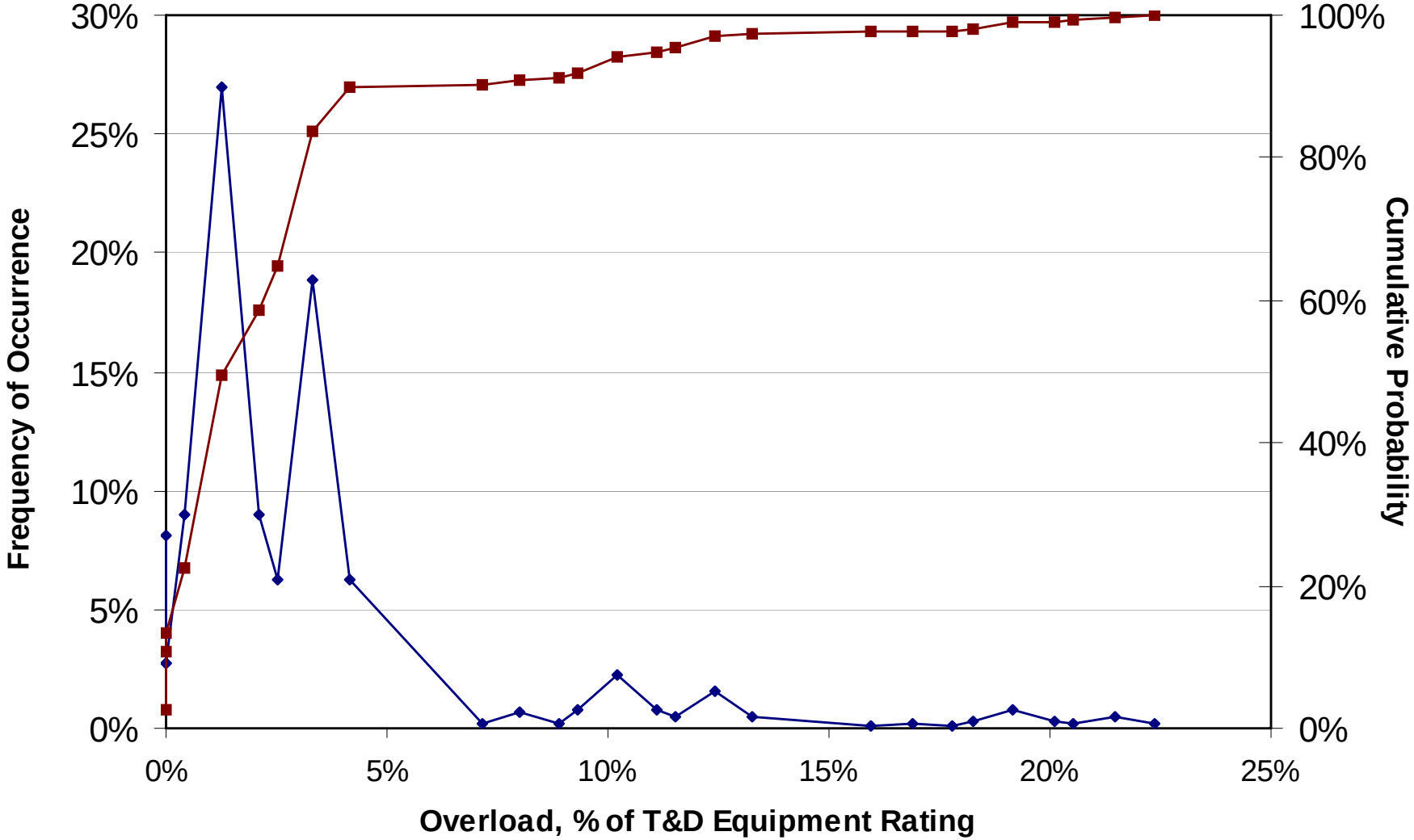
- Cost elements of risk quantified:
  - Utility-related
    - T&D equipment damage -- $39,600/year remaining
    - event “response” -- assumed $1,000/event
    - lost revenues -- assumed 14¢/kWh
  - Customer-related
    - cost incurred due to outages -- monetized
    - assumed $3/kWh of “unserved energy”
    - ☞ NORMALLY reliability indices are “proxy”

☞ All costs evaluated relate to *overloading*.

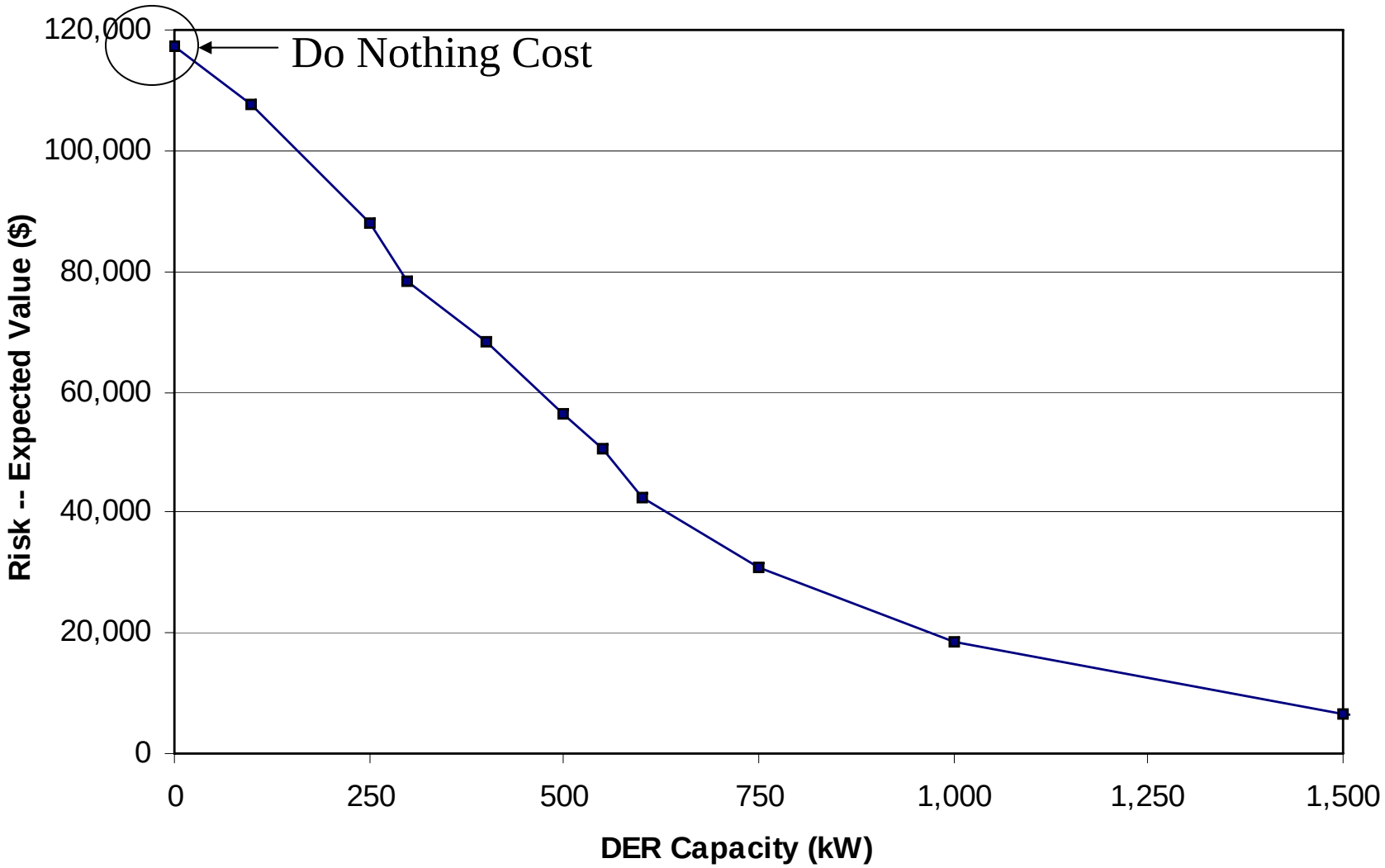
Cost for Possible Future Outcomes



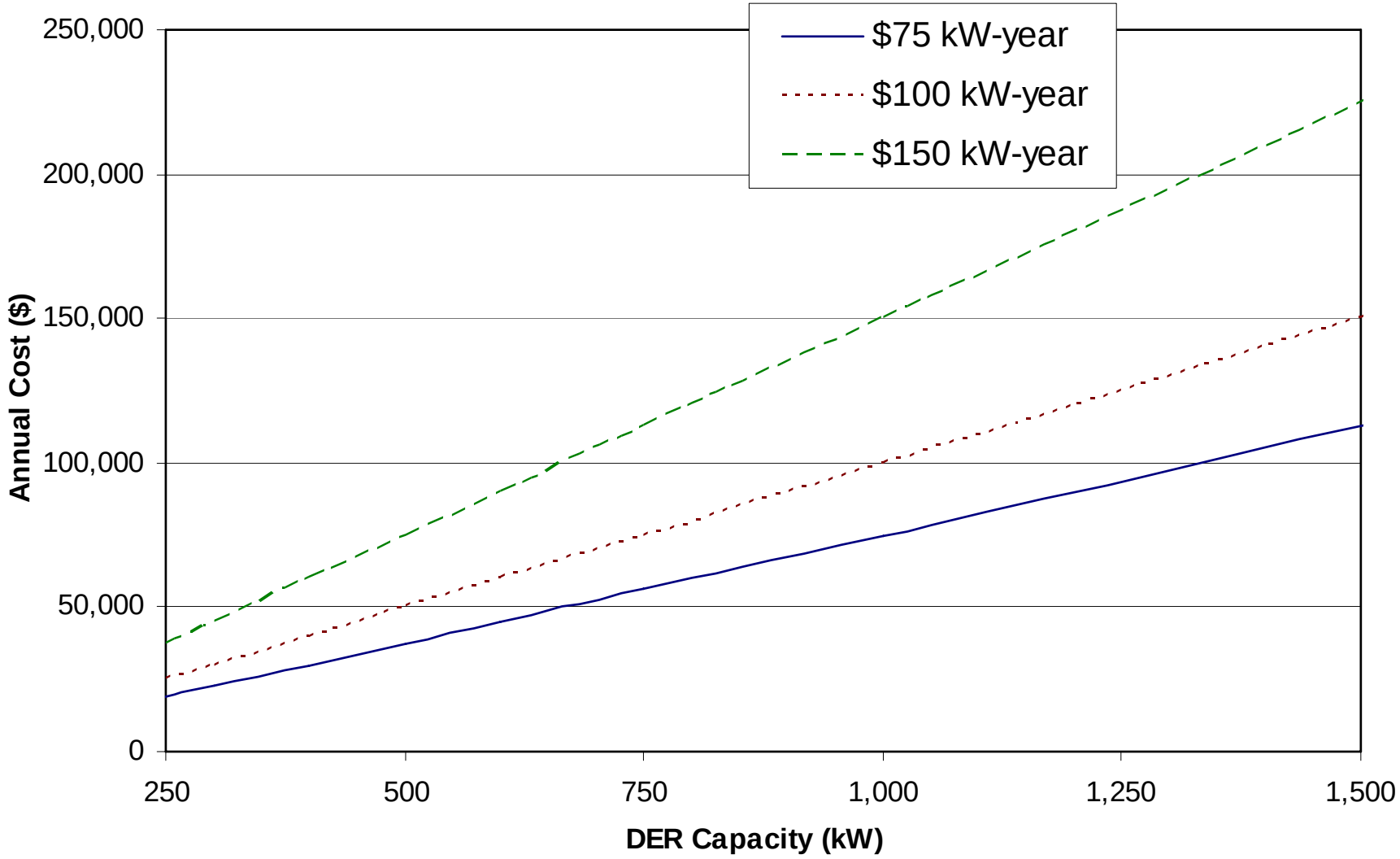
Load Growth Uncertainty



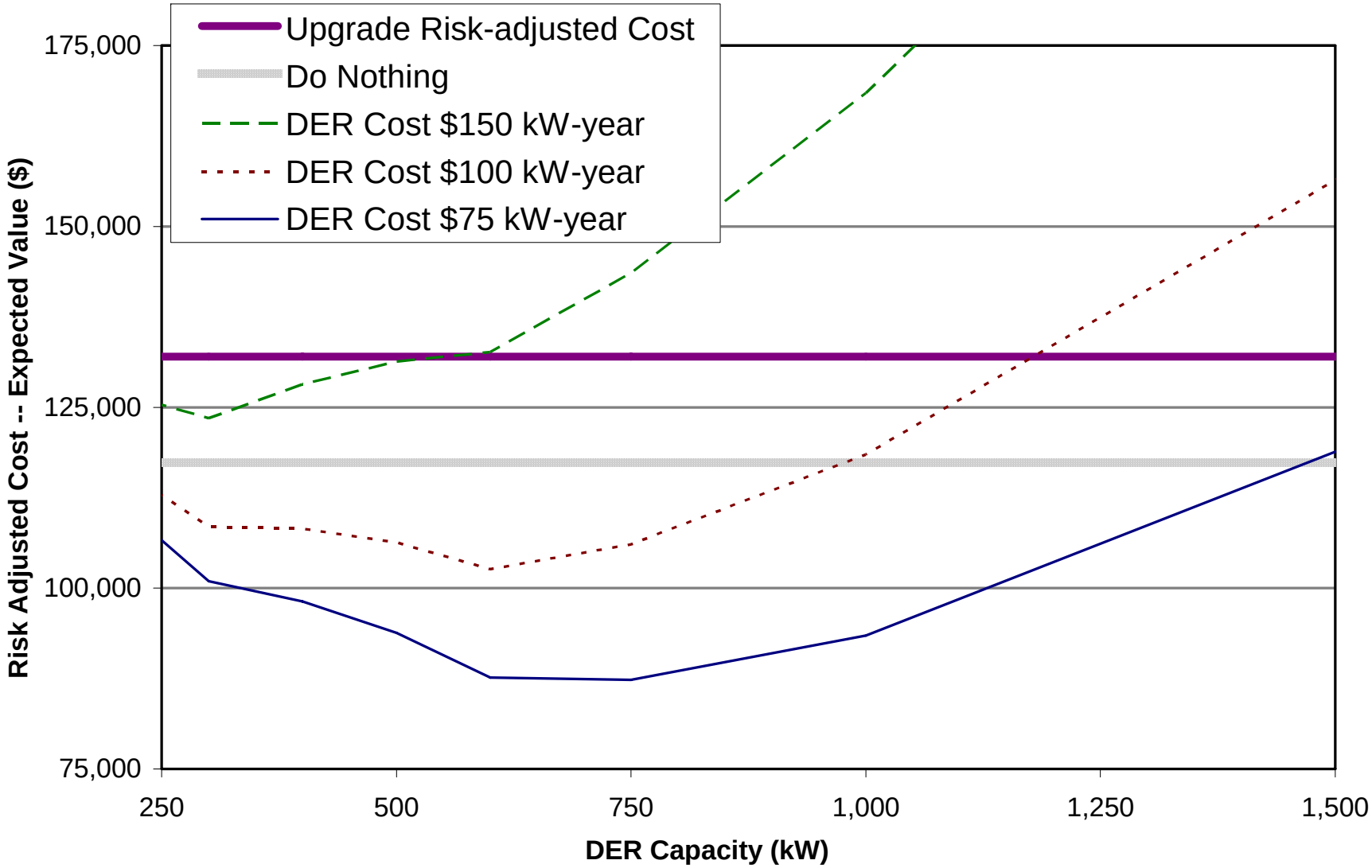
DER "Undersizing" Risk



DER Cost


$75 kW-year
$100 kW-year
$150 kW-year
250,000
200,000
150,000
100,000
50,000
0
Annual Cost ($)
250
500
750
1,000
1,250
1,500
DER Capacity (kW)

Risk Adjusted Cost Results



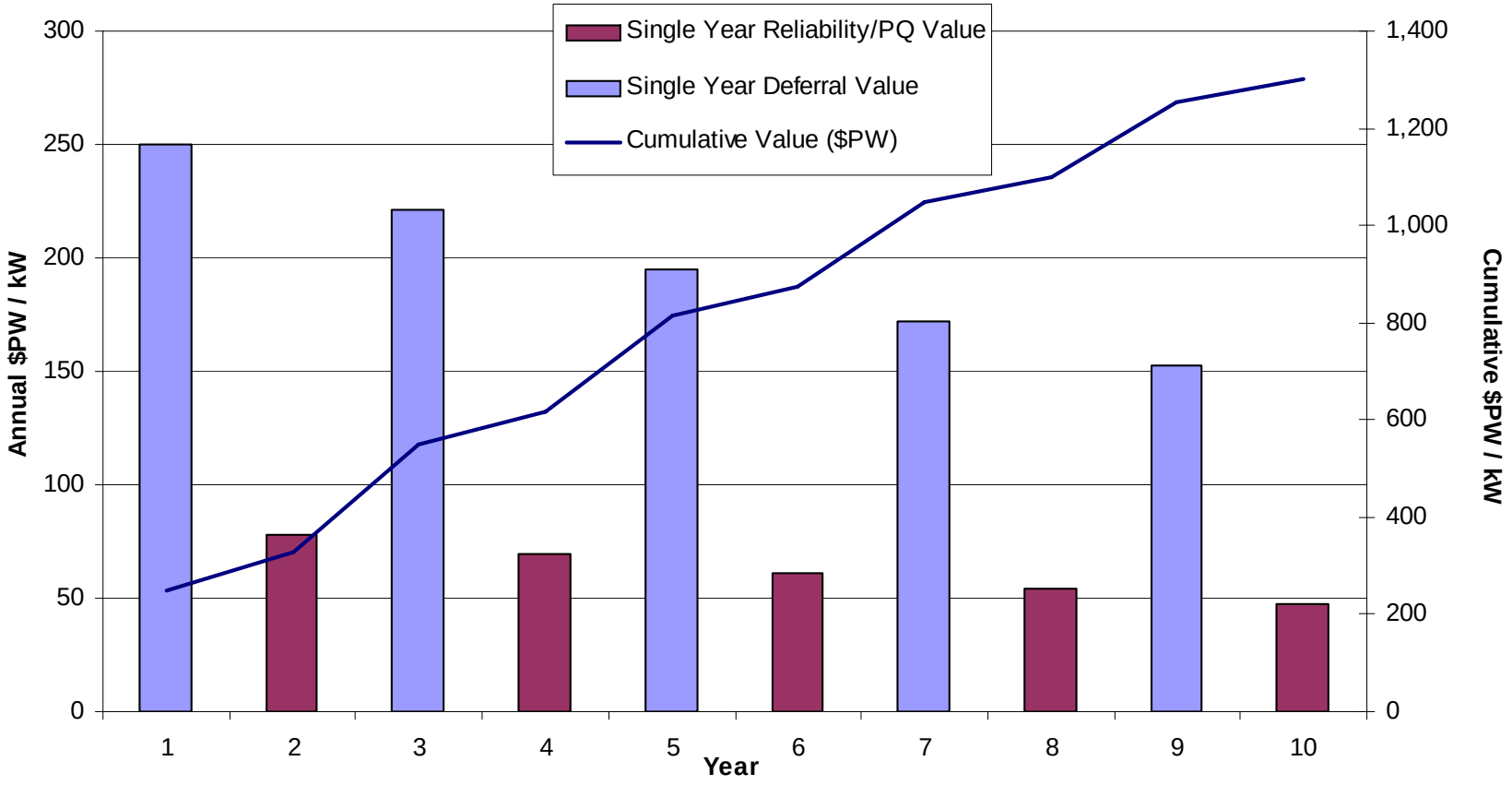
Important Criteria

- ✓ Load Growth Uncertainty
- ✓ Weather Uncertainty
- ✓ Overloading: magnitude, frequency, duration
- ✓ *Customer* Cost Assumed for Outages
- ✓ Existing T&D Equipment
  - Capacity "Headroom" Remaining
  - Type/value
  - Life Remaining
- ✓ Budget/Staff Availability Uncertainty

DER Transportability Value

- Use same capacity several times
  - ✓different locations
  - ✓different seasons
  - ✓different years
- 3x to 5x benefits ($PW) for same kW
- Distribution budget optimization
  - – serve same or more demand (kW) with less $
- Fleet effects
  - – DER reliability (backup units, n+1)
  - – economies-of-scale

Example: Value Proposition for Transportable MES and DGs



Conclusions

- Transportable DERs can have significantly enhanced value (relative to stationary).
- T&D risk is an important though obscured element of the DER value proposition.
- A rich area for additional research
  - “piggy-back” on related developments in T&D planning and engineering
    - especially tools, data, “smart” T&D systems
  - apply methodology to actual cases