American Solar Energy Society
Solar 2008, San Diego
May 7, 2008

Discovering the Distribution Capacity Value of PV

How utilities can maximize PV energy and capacity resource portfolio value: *end-use, least-cost, best-fit*

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Abstract:

Electric utilities (perhaps most) with summer peak demand and RPS policy requirements can develop Distributed PV as a <ins>*negative-cost*</ins> peak-capacity D, T and G resource

PV's strong synergies with energy efficiency, load management, plug-in hybrid-electric cars, local energy storage, demand response

Utility-driven DPV complements but does not replace customer-driven, policy-supported PV

Renewable Portfolio Standard (RPS) design matters

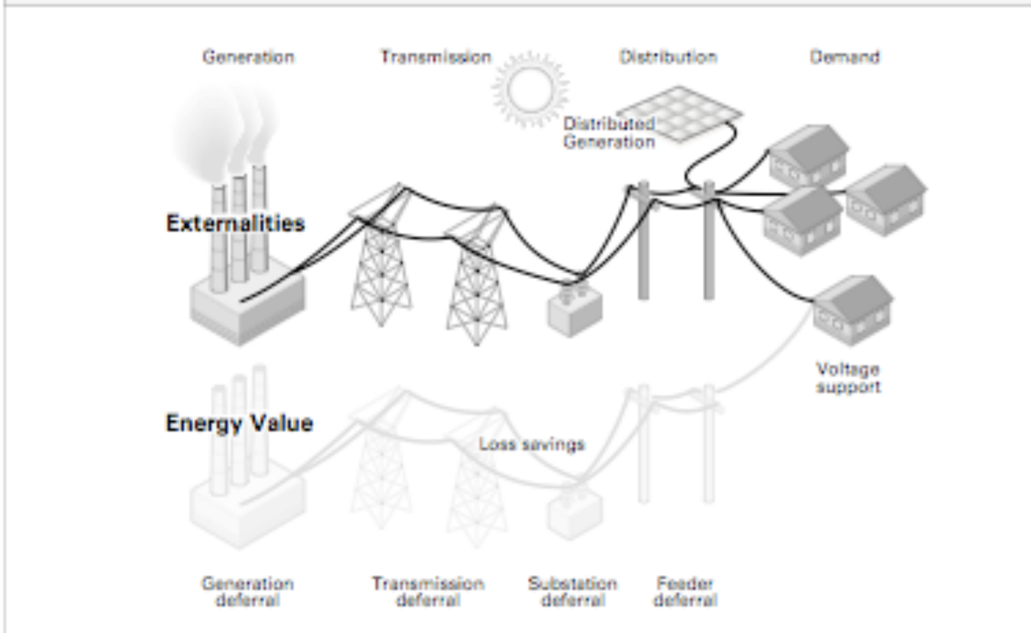
Regulators and policy-makers can reward utility shareholders with better returns and reduce customer energy rates

End use, Least cost, Best fit

Changing perspective from GT&D *to* DT&G

“When we plan for new generation, we assume the wires will be there”
-- West coast utility executive

Figure 1-2: Distributed generation
Adding grid-supporting distributed resources instead saves capital, operating, and external costs systemwide.



Source: Hoff, T. E., "Distributed Generation: An Alternative to Electric Utility Investments in System Capacity" (*Energy Policy* 24, no. 2, 1996), p. 3, fig. 2

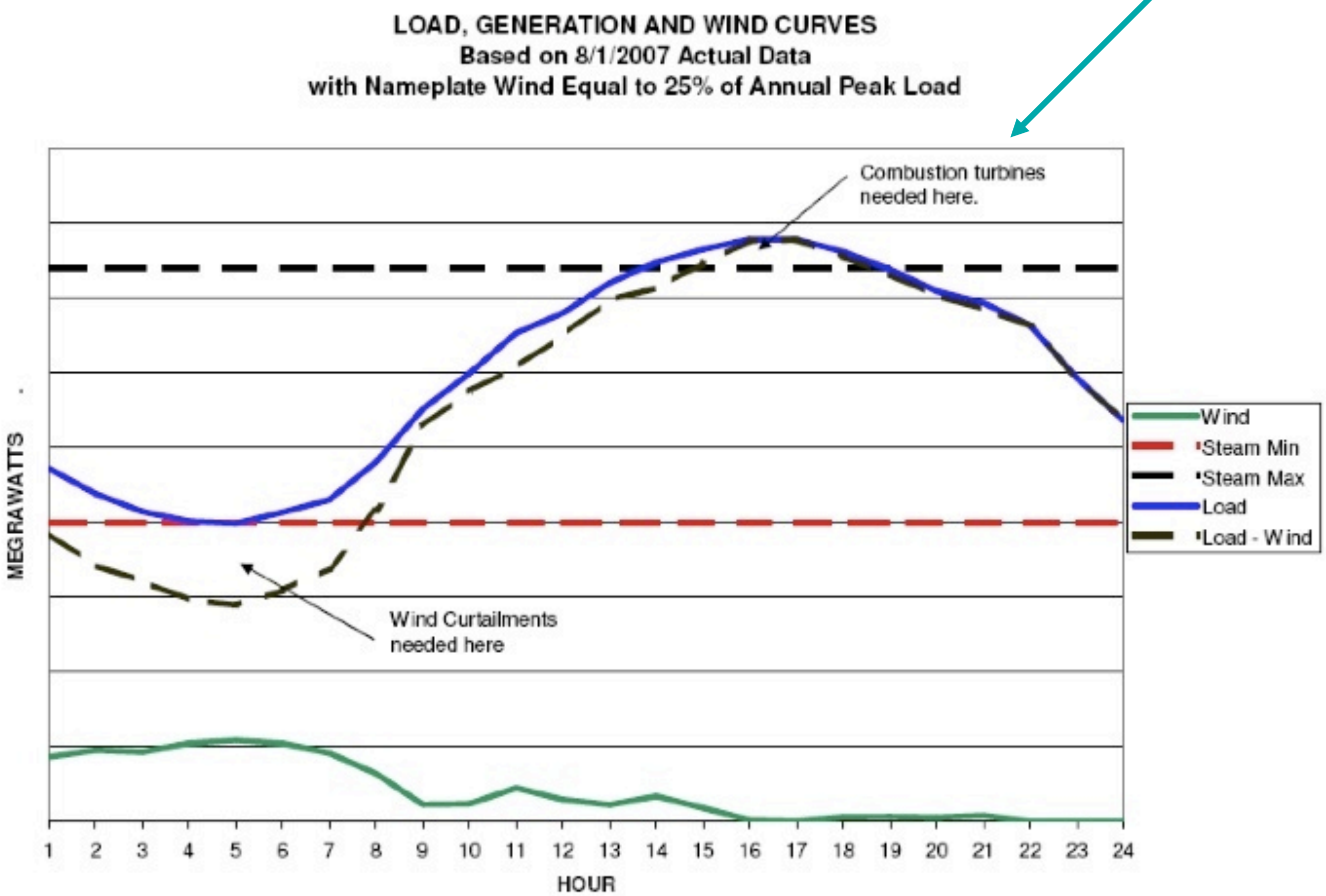
Source: Small is Profitable, RMI, 2003

“Avoided cost” was defined in PURPA 3 decades ago as the avoided generation cost. If long on generation, then avoided cost was fuel and marginal O&M.

System wide actual “avoidable cost” is much greater than just G capacity and fuel, and includes T&D, externalities, and others.

Typical peak day in a Midwest utility

• Strongly dominated by air conditioning loads
• reasonable fit with the solar resource -- peak period 1 PM - 7 PM
• Wind can't serve peak capacity (& dumped off-peak for minimum load)
• Energy efficiency, load management and PV virtually untapped resources
• *If combustion turbines are the answer; what was the question?*



Design for high-availability peak-capacity

• Location -- address specific grid hot spots

• Scale -- match to G, T & D investment deferral requirements

• Timing -- build to assure timely deferral decision

• Orientation -- to meet grid and/or generation peaks

• Maintenance -- assure performance over time

• Synergy with energy efficiency, demand response,
load management and local energy storage
achieves ~ 100% effective load carrying capacity (ELCC)

Distribution feeders' load duration curves mimic system LDCs

- Peak G,T or D capacity required is set by peak hour

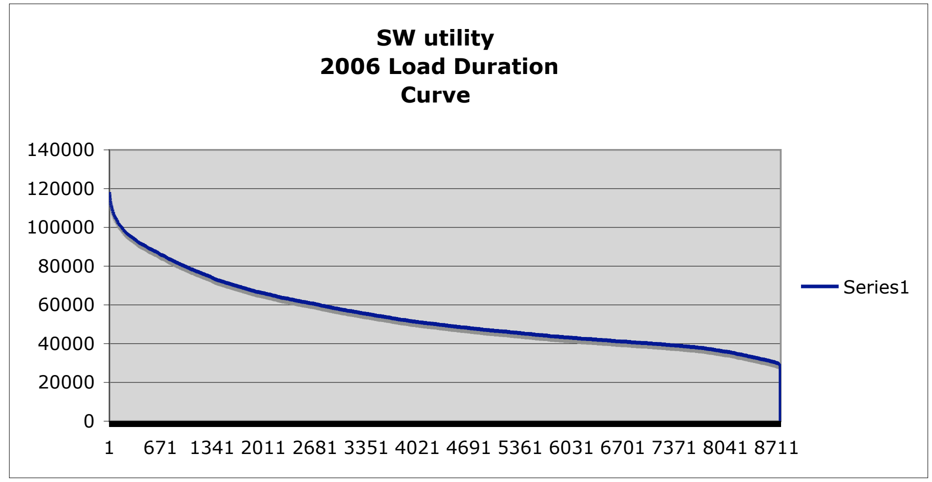
- In summer peaking systems, peak hours = daytime afternoons

- Offsetting peak on the feeder can improve D asset utilization

- PV capacity (yellow box;) correlates with peaky part of load curve -- the most expensive to serve *in summer peaking systems*

- Needs to be "firmed" w/ LM, DR, etc.

- Caveat -- each utility has it's own quirks and differences



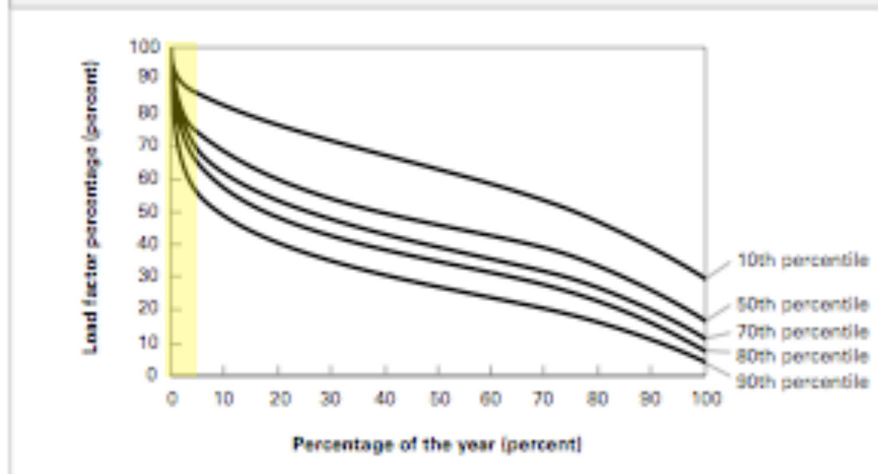


Figure 1-35
Some feeders have far lower asset utilization than others

Source: Iannucci, Joe, Distributed utility—Is this the Future?, 2 December 1992

Source: Small is Profitable, RMI, 2002, p. 81

Distribution System Investment Deferral

(transformers, substations, lines and feeders)

Highest DPV value occurs where

- Peak load on system is nearing its capacity ($0 deferral value if not near capacity)
- Can build out DPV resource in time
- System peaks in hot summer weather
- Highest deferral value = underground or geographically challenging construction

Lines and feeders deferral value >6X transformers and substations

- DPV at load more valuable for wires than substation projects

Examples: net present value for 5 year deferral of high cost lines and feeders projects -- utility's value per kW for such deferral

• Pacificorp	$1,383
• Penn Elec	$2,771
• PSE&G	$ 724
• BG&E	$1,394
• Arizona Public Service	$ 931
• SCE (1995 est. old underground feeders; SIP)	$5,000 - $10,000

Source: DISTRIBUTION SYSTEM COST METHODOLOGIES FOR DISTRIBUTED GENERATION
September 2001, Wayne Shirley, Regulatory Assistance Project (Data from 1995-1999)

Utility-driven distributed PV resource economics

- Analyze net resource costs and benefits (versus busbar or average costs)
- Design PV as a peak capacity resource for D, T & G systems

Peak load value

- Distribution investment deferral
- Transmission congestion relief
- Transmission investment deferral
- Network O&M
- Voltage support
- Line losses
- Reactive power
- Generation capacity
- Generation O&M
- Fuel
- Purchased power
- Minimum load
- Environmental (NOx, CO2, etc.)

Intermediate load value

- Fuel
- Line losses
- Environmental

Policy value

- Net metering payments
- Customer rebate payments
- RPS compliance credits (RECs)

Business model value

- EPACT tax credits (via tax investor LLC)
- State level incentives
- Customer revenue retention
- Sell peak capacity into regional market
- Economic development
- (Cost to secure host sites)

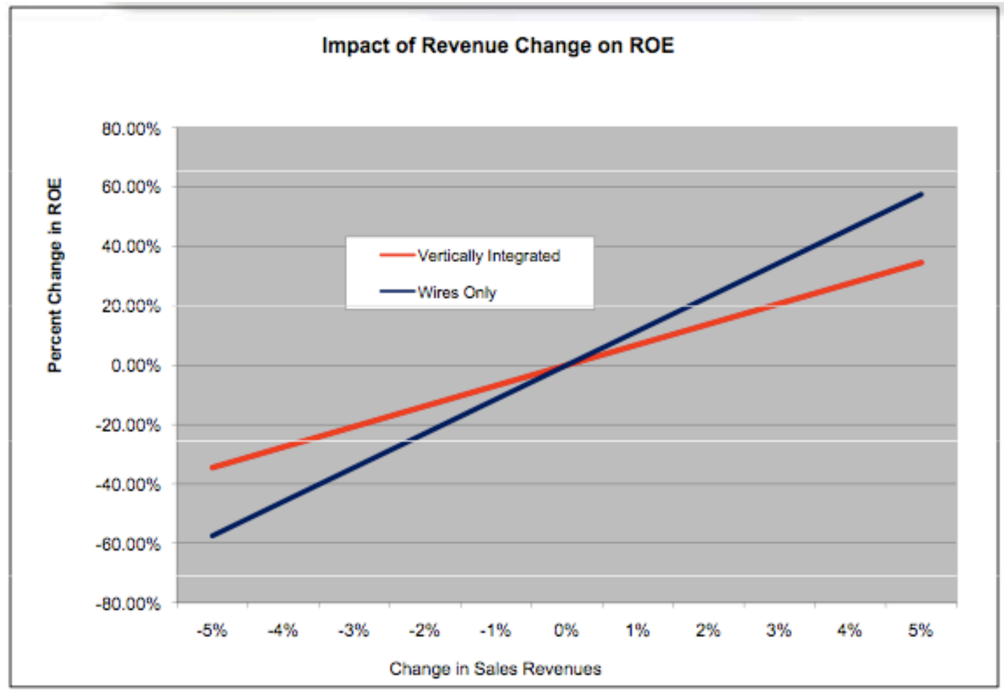
Risk management value

- Minimize generation portfolio cost and risk
- Financial - lower interest rates for low risk PV
- Natural gas price volatility
- Natural gas availability mid- to long-term
- PV system portability
- PV system modularity
- PV system residual value
- Avoid regulatory pre-emption
- Cost of carbon
- Insurance costs
- Investor expectations
- Manage community expectations
- Manage disruptive technology risk
- Grid reliability & outage prevention

Caveats: some value terms are mutually exclusive; some depend on regulatory context; all utilities are different

Which side of the meter?

Effect of lost revenues for customer side PV, energy efficiency, other DER



Source: "Decoupling Utility Profits From Sales: Issues for the Solar Industry" March, 2008, Wayne Shirley, RAP

Key policy questions:

Can PV + EE + DR + LM + storage be some utilities' least-cost-best-fit end-use distribution investments on some circuits? Are RECs a byproduct??

How to share net savings from utility-driven, strategic PV between shareholders and customers?

Different business models, competing interests

- IOU - COU
- Restructured versus continued traditional regulation
- Consumer- or investor-driven solar
  (1st and 3rd party ownership models, PPA, IPP)
- Utility-driven solar
  (PPAs, direct ownership, strategic deployment)
- Net-metering + feed-in tariff + universal solar service ??

Key initiatives to watch

Connecticut -- University of Hartford "Evaluation of Economic Benefits of distributed photovoltaic systems" (3 yr project)

CA PUC -- R&D $ on effect of distributed PV on distribution systems

Renewable and Distributed Systems Integration (RDSI)
DOE, 9 projects, $50 million, 5 years

Lakeland procurement

SDG&E

SCE/ProLogis 250 MW

SEPA SAI -- PV capacity value