Workshop
Distributed Resources Economic Evaluation

EPRI

Chicago
December 13, 2000

Workshop Agenda
Distributed Resources Economic Evaluation
Chicago, December 13

MORNING – Training - Area Investment Planning Tools

Continental Breakfast		8:00 – 8:30
Probabilistic Load Forecasting – LoadDynamics Model	Steve Chapel	8:30 – 10:00
Break		10:00 – 10:15
Investment Strategy – Area Investment Planning Model	Charles Feinstein	10:15 – 12:00
Lunch		12:00– 1:15
AFTERNOON – Economic Evaluation Issues		
Strategic Role of Distributed Resources – Summary of EPRI Research	Charles Feinstein	1:15 – 2:15
Distributed Resources: Separating Myth from Reality	Jonathan Lesser	2:15 – 3:00
Break		3:00 – 3:15
DR Planning & Analysis at MidAmerican Energy	Karen Pedersen	3:15 – 3:35
Discussion		3:35 – 5:00

LoadDynamics Model Training Workshop: Tools for DR Evaluation

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Agenda

- Steps to learning to use the model
- Methodology background
- Tutorials
- Hands-on work

Learning To Use The Model

- Read Section 5 that describes the analytical methodology
- Review Section 2 to become familiar with the user interface
- Do the first tutorial, Section 3, that uses the load growth trend example
- Do the second tutorial, Section 4, that uses the load assessor tool

Agenda

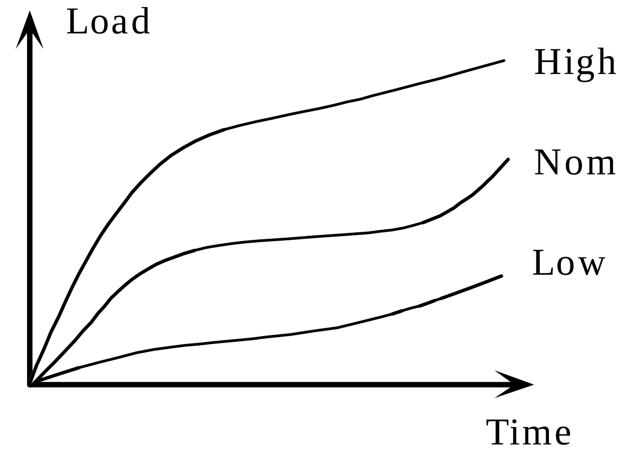
- Steps to learning to use the model
- ⇨ Methodology background
- Tutorials
- Hands-on work

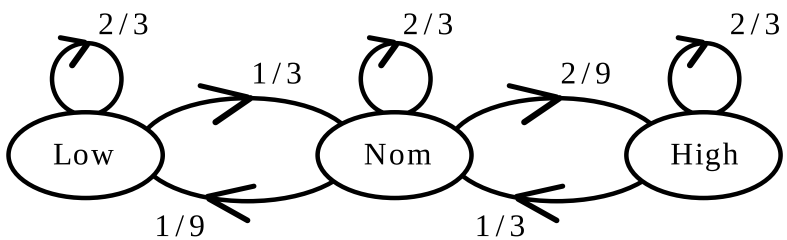
Planning Problem

- Economic value of distribution infrastructure investments is affected by the uncertainty in future load
- Thus when planning long term capacity investment, economic evaluations must include a characterization of possible future load levels
- The question is how to build the load uncertainty information into the economic analysis

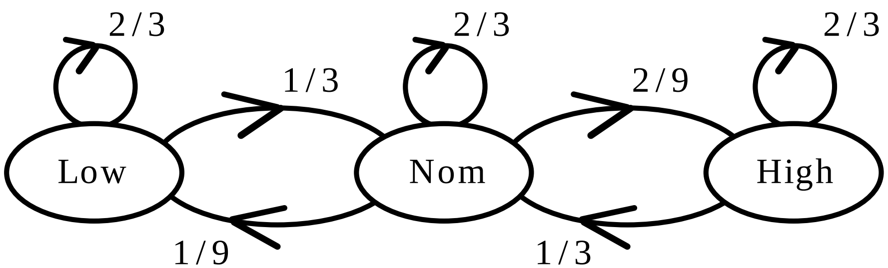
Methodology

- Technical problem:
  - Given current load there is a very large number of possible load trajectories that can result in a given future load level
  - There are many possible future load levels
  - Finding the best investment plan for an area requires some probabilistic understanding of the possible load trajectories





Methodology - Markov chain



To / From	Low	Nom	High
Low	2/3	1/3	0/3
Nom	1/9	2/3	2/9
High	0/9	1/3	2/3

- A key observation : load growth is uncertain but correlated over time
- This lead to the idea that it is useful to describe load growth in terms of trends that persist for uncertain durations
- Key questions:
  - How long does load follow a given trend?
  - When the growth trend shifts, what are the possibilities and how likely is it to follow a specific trend

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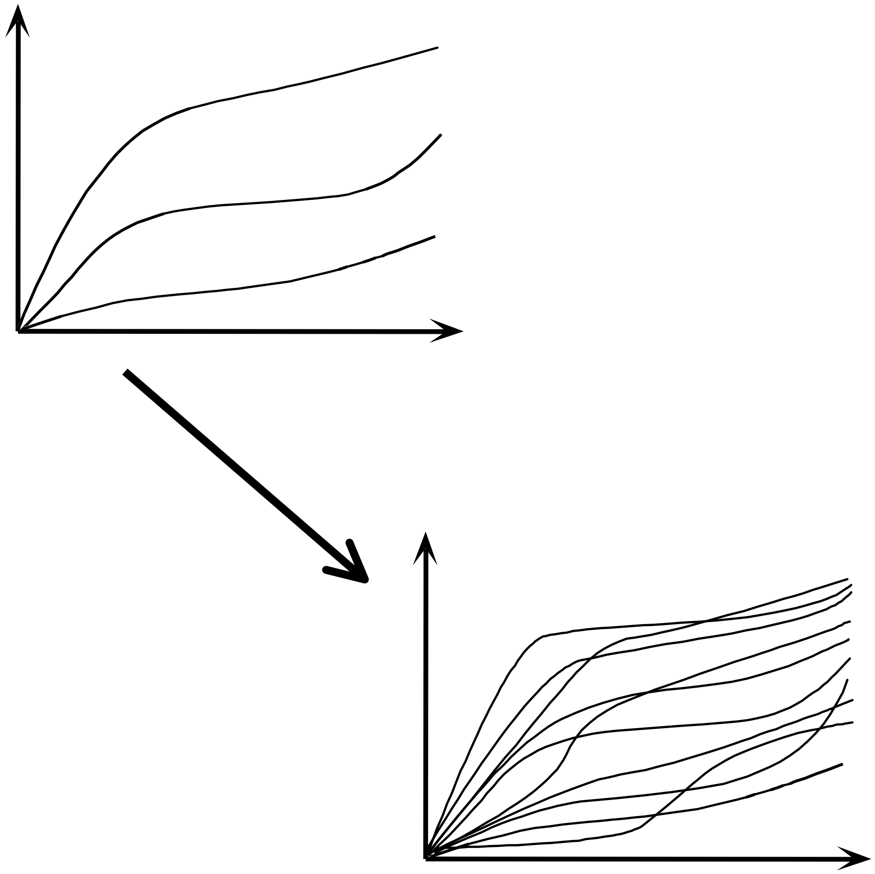
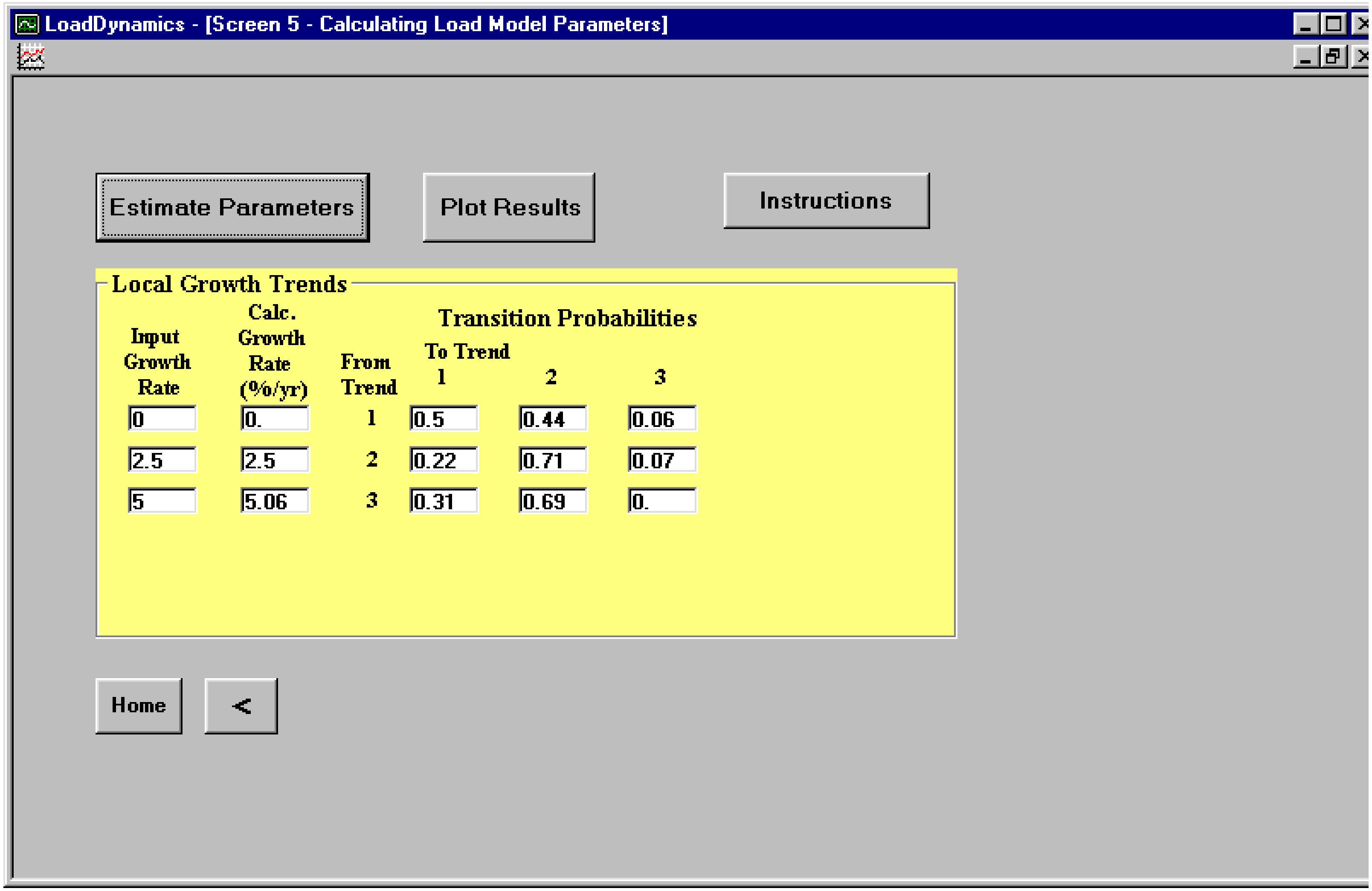
Methodology - Reasons for technical approach



- Feasible to model literally millions of possible load trajectories
- Provides method for describing true uncertainty (regression models that extrapolate historical trends are biased)

Methodology



Agenda

- Steps to learning to use the model
- Methodology background
- ⇨ Tutorials
- Hands-on work

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Area Investment Strategy Model Training Workshop: Tools for DR Evaluation

December 2000

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Agenda

- ⇨ Workshop objectives
- Steps to learning to use the model
- Methodology background
- Tutorials
- Hands-on work

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Workshop Objectives

- Show you how to use the model
- Demonstrate some of the research insights that have been generated from the development and application of the model
  - value of learning
  - value of modularity

Agenda

- Workshop objectives
- ⇒ Steps to learning to use the model
- Methodology background
- Tutorials
- Hands-on work

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Learning To Use The Model

- Study Chapter 3 - basic concepts
- Review Chapter 2 to become familiar with the user interface
- Do the first tutorial, Chapter 4
- Do the second tutorial, Chapter 5 - real utility example

Agenda

- Workshop objectives
- Steps to learning to use the model
- ⇒ Methodology background
- Tutorials
- Hands-on work

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Planning Problem

- Economic value of distribution infrastructure investments is affected by the uncertainty in future load
- Thus, when planning long term capacity investment, economic evaluations must include a characterization of possible future load levels
- The question are:
  - How to build the load uncertainty information into the economic analysis?
  - How to design least-cost investment strategies?
- Accommodate the need to evaluate non-traditional options such as distributed generation

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New focus: DR as a strategy

- Reformulate distribution and DR planning
- The analytical problem

Reformulate Distribution and DR Planning

- Focus on distribution
- Structure problem
- Minimize costs & remove deferral bias
- Base analysis on actual cash flows
- Explicitly treat uncertainty
- Find least cost plans that integrate DR and traditional investments

Analytical problem

- Valuation principles
- Economies of scale
- Limitation of scope
- Uncertainty

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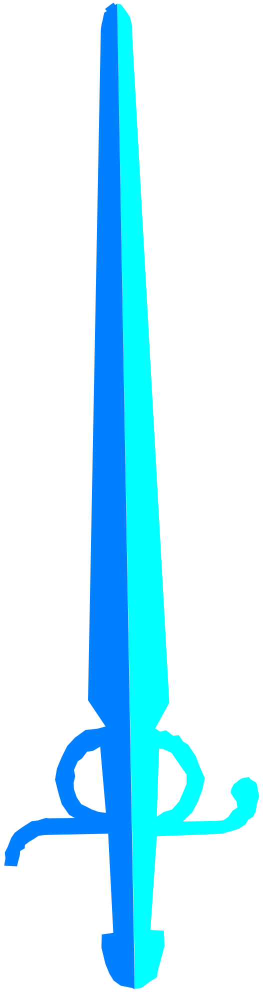
Investment Planning First Principles

- Deferral has direct economic value - opportunity cost of $
  - the higher the cost of $ the greater the value of deferral
  - lumpy investments OK if used some day
- There is a tradeoff between economy of scale and flexibility
  - big resources are generally cheaper but provide no flexibility
  - small investments defer big investments and provide option to revisit big decision
  - option to delay allows learning before deciding
- The value of being able to revisit depends on nature of uncertainty
  - EV, VAR, CORR, Type of Event
  - no uncertainty no value
- Independent of uncertainty, modularity has value
  - easier siting
  - tracks load better

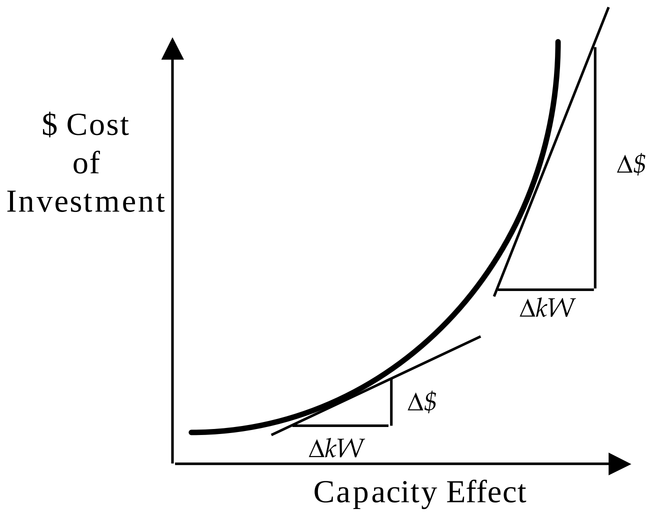
Economy of Scale - The Two-edged Sword

- When to invest in the big stuff?
- Type I Error: convict the innocent
  - avoid investment because first cost is too large
  - this ignores benefits of economies of scale
- Type II Error: release the guilty
  - make investment because the $/kW is small
  - but what if load growth is small or very uncertain?
  - if so, large capital cost for unused capacity for a long time

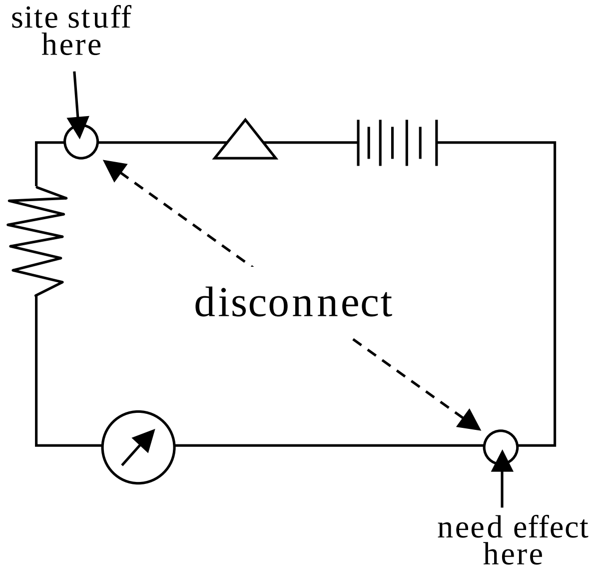


Limitation of Scope - Cost Versus Capacity Effect

- Part I: For DSM & modular investments, increasing costs for a fixed capacity effect



- Part II: Can the modular & DSM investments be located where the capacity needs exist?
  - Yes, but the effect saturates
  - No, so the effect is strictly limited (capacity need but energy benefit)



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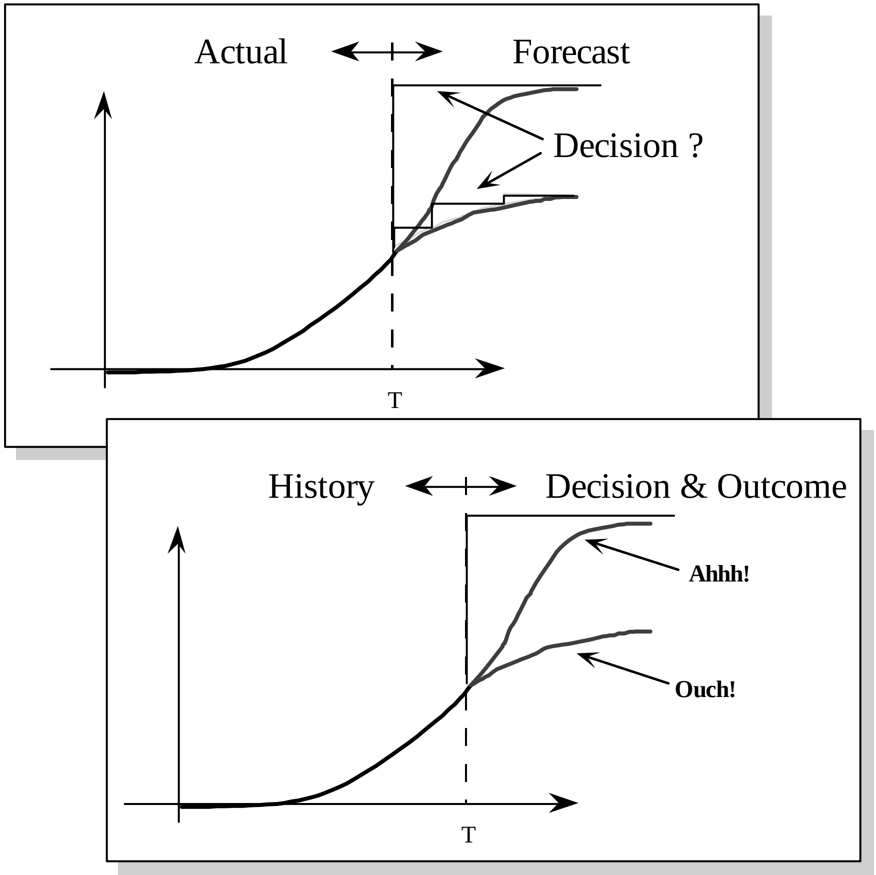
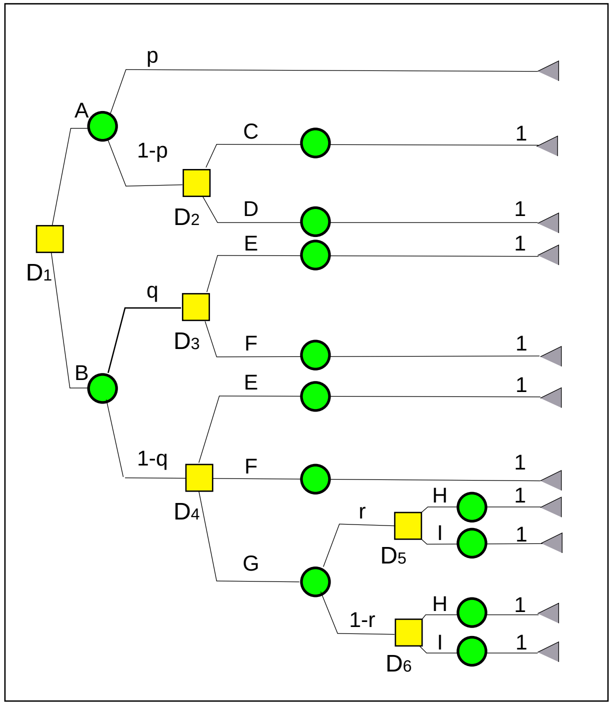
The Uncertain Load Problem

- Uncertain load and lumpy investments create a planning challenge
  - future load is probabilistic
    - can identify the potential for growth
    - but cannot accurately predict if and when it will occur
- The need for new capacity depends on future load growth
- Thus investment value is probabilistic and risky



New Methodology

- Purpose
  - Can the system be made more efficient without sacrificing reliability and quality of service?
  - Find least-cost plan under uncertainty
  - Timed sequence of investments that are contingent of various states of nature
- Overview of model operation
  - Dynamic optimization represented as a decision tree
  - Series of nodes (decision - uncertainty - decision - etc.)



Agenda

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- ⟹ Tutorials
- Hands-on work

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Real Utility Example

- Assumptions
- Case 1: No salvage of DR
- Case 2: Salvage of DR
- Case 3: No learning

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Assumptions

ASSUMPTIONS – CASES 1 & 2			
Technologies (Capacity Alternatives)	***Life***	*Size (kW)*	*Cost ($1000)*
S: Substation	40	20,000	$2,000
F: Feeder	30	6,000	$900
E1: Engine 1	30	3,000	$1,500
E2: Engine 2	30	1,500	$750
E3: Engine 3	30	3,000	$2,250
E4: Engine 4	30	3,000	$2,500
Trend Transition Probabilities (Load Growth Specifications)			
	Low (1%)	*Medium (2%)*	*High (5%)*
Low (1%)	0.75	0.25	0.00
Medium (2%)	0.125	0.75	0.125
High (5%)	0.00	0.25	0.75
Initial Load Growth Rate		“Low” 1%	

COMMON ASSUMPTIONS FOR STUDY		
Time Horizon	12 years	
Discount Rate	5.77%	
Inflation Rate	4%	
Accounting Method	Before Tax Cash Flow	
Initial Load	44,608 kW	
Maximum Area Load	70,000 kW	
Saturation On-Set Load	60,000 kW	
Terminal Value Specifications		
1. Price of Capacity at Terminal Time		$10/kW-yr
2. Escalation on Price of Capacity		1.0
3. Operating Cost of Capacity		$0.02/kWh
4. Escalation on Operations Cost		1.0
CHAPTER 1 inal Load Growth Rate		1%
Variable O&M Cost – S & F	$0.02/kWh	
Variable O&M Cost – Engines	$0.05/kWh	
System Avoided Costs	$0.02/kWh	
Emissions Costs	0	
Load Shape	*Time (hrs)*	*% of Peak*
	0	100%
	88	95%
	264	90%
	8759	25%
	8760	0%
Load Growth Trends		
	Growth Rate	
Low	1.01 (1%)	
Medium	1.0201 (2%)	
High	1.051 (5%)	

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Case 1 "No Salvage"

- Engines are constrained to remain in place once installed
- Least-cost policy: install 20 mw substation

Decision (Stage 1)	Chance	Decision (Stage 2)
PV Cost = 6086.23		
S at t=0.00, L=44608	p=0.139, t=29.59, g=1.013	Terminate at t=12, L=51838
	p=0.567; t=20.62; g=1.018	Terminate at t=12; L=55342
	p=0.294; t=12.40; g=1.030	Terminate at t=12; L=63832

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Case 2: “Salvage”

- Engines can be removed and reused
- Least-cost policy depends on evolution of load growth

Decision (Stage 1)	Decision (Stage 2)	Decision (Stage 3)	Decision (Stage 4)
PV Cost 4800.57 E1	E2	S(-E1, -E2) S(-E1, -E2) S(-E1, -E2)	T T T
	E2	S(-E1, -E2) S(-E1, -E2) S(-E1, -E2)	T T T
	E2	S(-E1, -E2) S(-E1, -E2) S(-E1, -E2)	T T T T E1

[1] (-E1, -E2) means that the two engines are removed (salvaged) and replaced by the feeder and substation investments in stage 3. This allows the same engines to be used in subsequent stages.

Note: this table provides the results through Decision Stage 4.

Case 3: "No Learning"

- No trends in load growth
- Learn nothing by waiting
- Results: least-cost policy is same as before
  - Install engines
  - When growth exhausts engine capacity, install substation
- Costs are higher

ASSUMPTIONS – CASES 3			
Trend Transition Probabilities (Load Growth Specifications)			
	Low (1%)	*Medium (2%)*	*High (5%)*
Low (1%)	0.25	0. 50	0. 25
Medium (2%)	0. 25	0. 50	0. 25
High (5%)	0. 25	0. 50	0. 25
Initial Load Growth Rate			"Low" 1%

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Strategic Role of DR in Distribution Systems

Stephen W. Chapel & Charles D. Feinstein

December 2000

Outline

- Background
- Economic analysis

Background - Why Interest in DR?

- DR
  - Alternative to conventional infrastructure investments
- Politics & Business
  - Deregulate - Big is bad
  - Belief in technology solutions
  - Technology sellers
- Economics & Business
  - Asset utilization
  - Macro investment levels
  - The real issues

Politics and Business

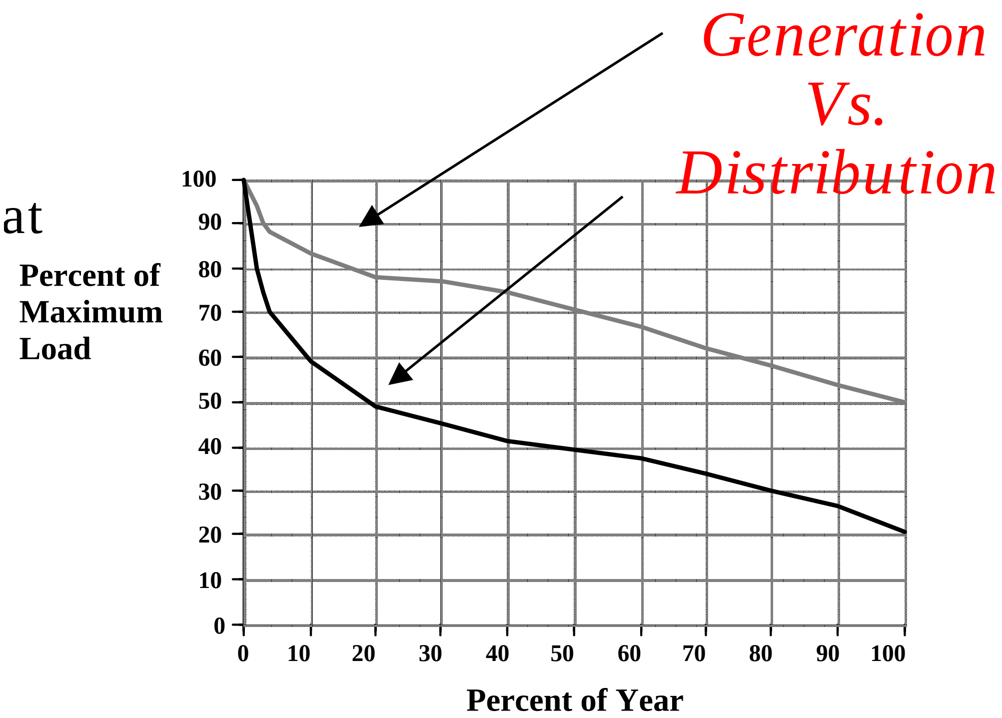
- Deregulate
  - Monopoly power
  - Scale Economies - too cheap to meter
- Belief in technology solutions
  - Computer, Internet, High Tech models
- Small (technology) is beautiful
  - Micro turbines, Fuel Cells, Solar, Wind, Engines

Economics & Business

- Asset utilization?
- Capital Intensity?
- Fixed & variable costs and scale economies?

Economics - Asset Utilization

- Data suggest there is a problem
- Conventional wisdom is that there is fat in the system
- Distributed generation is being promoted as a source of increased efficiency / utilization

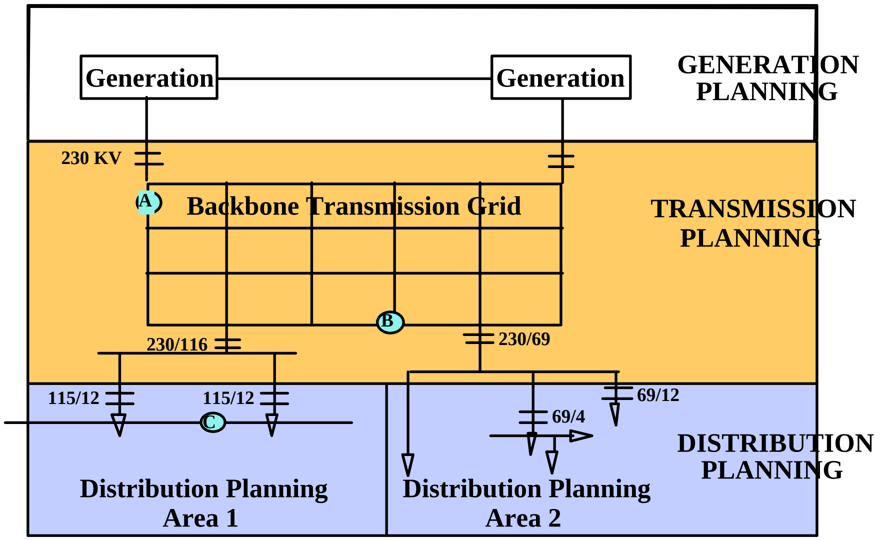


For example, PG&E data show:

- Generation: 70% or greater capacity 50% of the time
- Typical Feeder : 70% or greater capacity 5% of the time

Economics - Macro Investment Levels

- 40% to 50% of electric utility net investment
- Business issues
  - Minimizing investment costs
  - Having "right" infrastructure to meet customer needs
  - Making money
- Key strategic needs
  - Managing assets
  - Linking investment decisions to customer needs



Net Invest.
Gen. = $8.7B
Tran. = $4.5B
Dist. = $13.5B
Total = $26.7B

Economics - The Real Issues

- Fixed & variable costs
- Scale economies
- Load growth
- Deferring big investments & hedging load uncertainty

Fixed & variable cost & scale economies

- DR is not cheaper than system energy
- As DR capacity decreases, $/kW increases
- Scale economies still matter--demand increase surprise?

Load growth & deferral

- DR cannot always defer traditional investments
- Value of deferral related to load growth uncertainty
- DR creates value as a hedge

Outline

- Background
- Economic analysis

Objective

- Determine the conditions under which distributed resources add strategic value to distribution system capacity expansion plans

Assumptions

- DR is an investment
- DR choice based on local conditions
- DR added value:
  - integration
  - hedging
  - reliability
- DR integrated into least cost plan that meets load with sufficient reliability

Approach

- The Area Investment Strategy Model identifies the least cost capacity expansion plan for a distribution planning area
- Problem is represented by several collections of data
  - Investment alternatives, specified with respect to capacity and costs
  - A local planning area, described with respect to load level, load shape, and uncertain load growth dynamics
  - Other parameters, including the cost of emissions, the cost of unserved energy, and the reliability of service
  - Values are selected based on available data found in the literature or provided by member utilities.
- Two kinds of local areas are defined, transmission constrained areas and infrastructure constrained.
- The strategic value of distributed resources is measured with respect to their inclusion in the least cost plans for each area.

Data and modeling assumptions

- Basic planning data
  - T=15 years, r=.06
- Load growth specifications
  - Initial peak load=100MW
  - Sets of 3 annual growth rates: slow set ($\leq$.03), moderate set (<.05), rapid set ($\leq$.10)
- Load shape
  - Load duration curve=PGE feeder (above)
- Investment alternatives
  - T=large transmission upgrade, 50 MW, $300/kW, 40 year lifetime
  - S=new substation, 20 MVA, $200/kW, 40 year lifetime
  - modS=modular substation, 10MVA, $250/kW, 40 year lifetime

Data and modeling assumptions--cont'd

- Investment alternatives (cont'd)
  - SDR=salvageable DR (similar to DSM)
    - six sequential alternatives
    - 2.5 MW each
    - increasing capital costs: $500/kW, $750/kW, $1000/kW, …, $2500/kW
    - 15 year lifetime
  - DG=distributed generation, not salvageable
    - unlimited number available
    - 2.5 MW each
    - capital cost=$500/kW
    - 20 year lifetime

Data and modeling assumptions-cont'd

- Operating Costs
  - Fixed O&M=0.5% of capital cost for all alternatives
  - Variable O&M: T=S=modS=$.05/kWh, SDR=$0, DG=$.07/kWh
  - Emissions: T=S=modS=$.0025/kWh, SDR=$0, DG=$.0025/kWh
- Losses and unserved energy--to measure how DR improves reliability
  - Outage time: T=S=modS=0.25hr/1000hr
  - Unserved energy cost = $7/kWh
  - SDR & DG --> UE cost reduction=50%
  - Losses = 0
- Terminal value
  - Salvage value of capacity = $21.79/kW-yr

Results - Transmission Constrained Areas

- Distributed resources are strategically valuable in local areas that are transmission constrained.
- The value of distributed resources decreases as the local area peak load growth rate increases.
- Distributed resources provide benefit by deferring the need for the large capital investment in transmission capacity.
- Distributed resources provide benefit whether they are load-following or not and whether they are salavageable or not.

Results - Distribution Infrastructure Constrained Areas

- The infrastructure constrained area has limited strategic need for distributed resources.
- The value of distributed resources decreases as the local area peak load growth rate increases.
- The distributed resources provide benefit by deferring the need for the traditional infrastructure capacity investments and not by eliminating the need for the investments.
- In an infrastructure constrained area, distributed resources provide benefit if they are load-following and salvageable. Non-salvageable distributed resources do not provide measurable strategic benefits under the assumptions made in this study.

Results - Infrastructure Constrained Areas (cont'd)

- Non-salvageable distributed resources with very low operating costs may have some strategic value in infrastructure constrained areas

- If it is possible to reduce the uncertainty in forecasting future load growth based on observations of past load growth, then the strategic value of distributed resources increases.

- Reducing the capital cost ($/kW) of non-salvageable distributed resources is critical for such resources to play a strategic role in infrastructure constrained local areas.

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The Economics of Distributed Generation: Separating Fact From Fiction

Dr. Jonathan Lesser
Senior Managing Economist
Navigant Consulting, Inc.

Presented to:
EPRI Distribution Planning Workshop
Chicago

December 13, 2000

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Outline

- Distributed Generation Myths.
  - What are they? Why do they persist?
- What is “Economic” Distributed Generation?
  - What is the proper analytical framework for determining a “good” DG project?
- What Factors Distort the Cost-Effectiveness of Distributed Generation?
  - Why regulation still matters.
  - What are the politics of DG?
- What are the Real Hurdles Faced by Distributed Generation?

DG Myths

- There are many myths surrounding DG that are difficult to eliminate. In part, this is because insufficient attention has been paid to the actual economics of DG.
  - Focus has been on the regulatory/policy context of DG in light of electric utility restructuring.
  - That's important, but economic aspects need to be correctly linked.

- Perpetuating these myths, even to the extent they favor DG, will tend to harm the DG industry in the long run, to the extent that false or over-hyped expectations crash into reality.

DG Myths

➔ Myth 1: DG is Cheaper than System Power.

- Fact: Most DG is more expensive than new central station generation. The smaller the DG package (e.g., microturbines, residential fuel cells, etc.) the more expensive the technology.
  - Sharply higher natural gas prices are adversely affecting operating costs because of generally high heat rates.
- Fact: Economies of scale still matter in the electric industry. They are different than in the "old days," but still exist.
- Fact: The reason that many DG applications look cheap in comparison with system power is because of erroneous comparisons between overall customer rates and DG cost.
  - This is a rate design/regulatory issue that is enmeshed in political considerations.

DG Myths

- **Myth 2: Utilities will become obsolete in the next decade.**
  - Fact: Utilities continue to provide a cost-effective and incredibly reliable service. Widespread DG applications are unlikely to provide the same reliability and cost-effectiveness, especially at the residential level.
  - Fact: Some applications for DG make sense, especially for certain customers who need higher quality and higher reliability power.
  - Fact: Not at all clear that most customers want to be in the generation business themselves.

DG Myths

- **Myth 3: DG can defer "traditional" distribution and transmission costs.**
  - Fact: In some cases, DG can defer those costs. But in all cases, deferral answers the wrong question.
  - Fact: The correct economic evaluation for DG when it is used as a substitute for traditional "poles and wires" investments is to determine the cost of meeting future (but uncertain) local area demand in the least-expected cost way.
    - This requires a more complex evaluation than simple deferral calculations, or calculations based on erroneous T&D avoided-cost calculations. (We'll discuss why those avoided cost calculations are erroneous later.)

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DG Myths

- **Myth 4: Utilities should invest in DG today, even if it is more expensive that traditional T&D investments, because the latter will be "stranded" in a few years.**
  - Fact: This type of economic "logic" is sheer nonsense. Full service utilities today have an obligation to serve. Distribution utilities have an obligation to connect.
  - Fact: Regulators cannot (well, should not) play "gotcha" with utilities for spending too much today or having stranded assets in the future. Utilities need to make the best economic investments today to meet their obligations to their customers.
  - Fact: Some utilities are facing political pressure to install DG as as a "goodwill" measure.
    - Nothing wrong with this. However, utilities and regulators must decide whether the goodwill benefits exceed the additional economic costs.

What Factors Make DG "Economic?"

- **Need to Address Two Critical Issues:**
  - First, we need to define what we mean by "economic" - from whose perspective?
  - Once defined, how do we measure?
- **Defining "Economic"**
  - Economic = "least-cost" subject to well-defined reliability constraints.
    - Otherwise, "least-cost" is always "let the system fall apart."
  - DG applications must be compared on an "apples to apples" basis.
    - Important for potential customers, so they don't get unexpected cost surprises (backup charges, etc.)

Defining Economic DG

- Whose Perspective?
  - Distribution utilities?
  - Individual customers?
  - Society (regulators)?
- Perspective Matters
  - Perspective affected by the economic signals received.
  - Individual customers will base their decisions on the rates they face and the presence of so-called "net-billing" agreements.
  - Distribution utilities will want to ensure they meet their "obligation to connect" at the lowest cost.
    - May have other objectives as well, but those should not necessarily be couched in dollar terms.
  - Society (regulators) may want lowest overall costs, or wish to pursue specific policy goals.

Customer Perspective

- Customers who base their decisions about DG on rates are comparing DG with overall transmission, distribution, and generation costs.
  - Net billing agreements can bias customer choice in favor of uneconomic DG, result in higher costs for other consumers (cost-shifting).
  - If customers separate from existing grid, comparison is reasonable, assuming the customer understands reliability/backup implications.
  - If customers remain on grid, will still need to pay for backup services.

Distribution Utility Perspective

- Distribution Utility Perspective
  - DG applications can serve as a source of local area distribution capacity in lieu of investments in "wires and poles."
  - How to evaluate correctly?
  - First, consider the <u>engineering</u> aspects.
    - Can DG applications be sited where needed?
    - Are there connection issues that will affect system reliability and safety?
    - Do customers want both DG <u>and</u> back-up from their local utility?
  - Second, consider economic aspects.
    - Evaluate DG equivalently with other distribution options.

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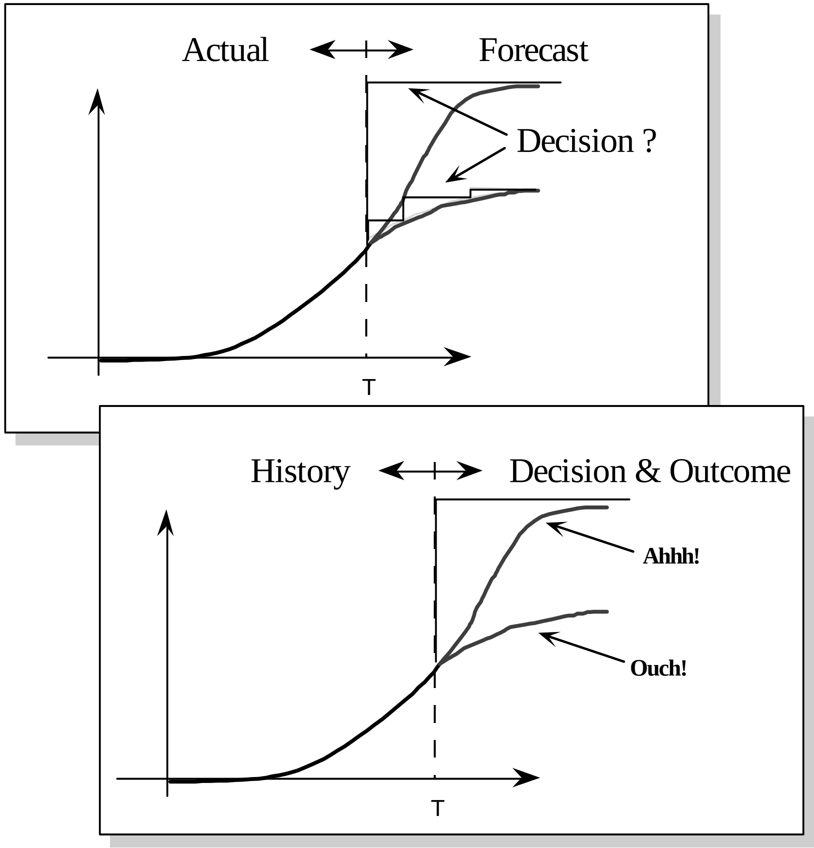
Distribution Utility Perspective

- Uncertain load and lumpy investments create a planning challenge
  - Future load is probabilistic
    - can identify the potential for growth
    - but cannot always predict if and when it will occur
- The need for new capacity depends on future load growth.
- Thus investment value is probabilistic and risky.



Distribution Utility Perspective

➔ To evaluate DG applications, need to consider the probabilistic impacts of uncertain future load growth.

- If customers own DG, distribution utility faced with additional uncertainty - will customers abandon DG at a later date and come back onto system.
  - This may be a critical issue in light of increasingly volatile natural gas and electric prices. If some customers can arbitrage, then costs will be shifted onto those who cannot.
- Want to balance economies of scale that can be achieved by larger "poles and wires" investments versus the benefits of not having unused capital resources.
- Conclusion: load uncertainty matters!

Distribution Utility Perspective

➔ What about other uncertainties?

- Electric and natural gas prices have grown increasingly volatile with the advent of industry restructuring.
- Need to assess the impacts of these uncertainties, especially in light of the potential for DG applications to be "switched-off."
  - Raises the possibility of DG users "arbitraging" the local utility by using DG when cost is low, and relying on the system when costs are high.
- The existence and the impacts of price volatility needs to incorporated into economic calculations and regulatory policy design.

Regulatory Perspective

➔ Some Common Regulatory Perspectives:

- DG is an alternative to poles and wires investments, and an alternative to new central-station generating investments.
  - DG can <u>defer</u> the need to invest in new poles and wires investments.
- There are “barriers to entry” facing DG investments.
- DG is cleaner and more efficient than central-station generation.
- DG is “good” because utilities can’t control it and should not be allowed to own it.
- DG is politically viable.

Regulatory Perspective

➔ DG and Deferral of T&D Investments

- Deferral of poles and wires investments is a potential <u>implication</u> of evaluating DG economics. Should not be an economic <u>goal</u>.
- Models to evaluate the deferral benefits and compare to a traditional expansion plan for a deterministic forecast of future area load growth are wrong!
  - Generally, models determine avoided cost of transmission and distribution on a per-kW basis.
  - Flawed, because distribution investments are "lumpy." Need to compare the direct costs of the investment alternatives.

Regulatory Perspective

- Barriers to Entry
  - DG, like DSM, faces "barriers to entry." Therefore, needs to be subsidized, encouraged by regulations favoring its installation, etc.
  - This reasoning is based on a flawed definition of "barriers to entry."
    - Higher cost is not, in itself, a barrier to entry.
    - Because I cannot afford a Mercedes/Lexus, etc., does not mean those manufacturers face "barriers to entry" compared with Ford.
  - Barriers to entry are factors that prevent firms from entering a market as they would be expected when current prices are <u>above</u> costs. Costs above price ≠ entry barrier.

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Regulatory Perspective

- DG is cleaner and more efficient than generating alternatives.
  - Determining environmental impacts is complex.
  - Location of DG near or within population centers can exacerbate DG's environmental costs.
  - Local siting regulators may be at odds with utility regulators over siting of DG.
  - DG applications such as microturbines usually have <u>higher</u> heat rates (sometimes much higher) than larger units. Less fuel efficient, unless linked to co-generation.

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Regulatory Perspective

➔ Political Viability of DG

- DG is sometimes perceived as a politically astute investment.
  - Provides “local” benefits – e.g., jobs for installers, keeps dollars within the community rather than flowing to large impersonal utilities.
  - Provides a measure of competition for those same utilities.
  - Reduces the need to install “ugly” poles and wires.
- DG may be perceived as politically viable, but:
  - If it does not perform as advertised, political benefits will vanish, especially if DG is used to defer T&D investments necessary for maintaining reliability.
- Political viability will ultimately depend on pregnant chads and Newton’s Revised Third Law:
  - “To every reaction, there is an equal and opposite lawsuit.”

Market Distortions and Hurdles Faced by DG

- Although definition of barriers to entry is often used incorrectly, there are some regulatory issues facing DG applications that present hurdles.
  - Multiple regulators
    - DG must address both utility and land use/environmental regulators' concerns.
    - Often at odds with one another.
    - Cannot let utilities and DG developers get stuck in the middle. Especially true for regulated utilities who must meet obligations and make "prudent" investments.
    - Need clear guidelines for siting applications. What will be allowed and where?

Market Distortions and Hurdles Faced by DG

- Ownership concerns.
  - Are there legitimate antitrust issues that arise if DG is allowed to be owned by utilities?
  - Are owners using distribution investments to cross-subsidize other products & services in unregulated markets?
  - Are owners using exclusionary practices?
  - Is local area market power an issue, because of constrained local area distribution capacity?
  - Are there legitimate system reliability and control issues if DG is operated by third parties and customers?

Market Distortions and Hurdles Faced by DG

- Resolution requires, in part, a clearer definition of the "obligation to connect."
- Working definition:
  - "Ensure that market transactions between generators/retailers and customers are not inhibited, while preserving the overall safety and reliability of the entire distribution system."
  - Need to define reliability standards in order to determine an appropriate least-cost strategy.
- Ultimately, need to clarify the role(s) of DG.
  - Will it be used primarily to generate electricity or will it be used primarily to provide distribution capacity?
  - If it is to provide both, how will the costs and benefits be allocated?

Conclusions

- To be successful in the long-run, DG applications need to be economic.
  - Avoid common myths that will increase overall costs and reduce future system reliability.
  - Clarify the role of local distribution utilities and their obligation to connect.
  - Determine in what context DG applications will be used:
    - Generation or local area capacity?
  - Clarify customer roles and responsibilities for system back-up, safety, and reliability.

Conclusions

- Use the correct economic tools to evaluate DG economics:
  - Incorporate uncertainty and perform probabilistic analyses.
  - Do not use "avoided cost" models to evaluate the "deferral benefits" of DG.
  - Do not use bad economics to mask other legitimate policy goals.
- Eliminate the conflicting roles of regulators.
  - Cannot hold utilities and developers to both utility and environmental regulators who are at odds with one another.