Valuing Reliability

Estimating the value of avoiding the risks associated with T&D reliability failures

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Avoiding an outage ‘event’ avoids various types of cost

The total avoided cost is the sum of the different types of cost

- **Restoration**
  - Rolling a crew, switching to make field ties for partial restoration, installing a mobile
  - Replacement of failed equipment, e.g., fuse, pole, transformer
  - Calls, customer contact, media relations, public information
- **Collateral damage**
  - Explosion, fire, or high-energy fault may damage related equipment
  - Contingency may cause overload-related damage or premature deterioration
  - May cause tripped lines or units that causes uneconomic dispatch
- **Customer claims**
  - Loss of refrigerated food, process batches, medical support
  - Not liable for ‘acts of God’, but provable negligence may be culpable
  - Legal costs to defend against suits, negotiate settlements
- **Penalties, fines, audits, remediation, and reporting**
  - Audit or investigation of root cause (internal and external resources)
  - Compliance with recommendations for future avoidance of that event
  - Costs multiplied by remediation at all similar substations or all reliability programs
  - Possible fines, refunds, or disallowances
  - Cost of increased reporting, scrutiny, and lost ‘benefit of the doubt’
- **Financial impact through lost image/confidence**
  - Loss of customer satisfaction with rates – possibly lower allowed return in next filing
  - Loss of influence with the public and media – dealing from weakness in negotiations
  - Loss of investor confidence – possible decline in share price, bond rating

Event costs are like an iceberg – the visible part is but the tip

The total avoided cost is the sum of the different types of cost

Potential Cost to the Company		Typical Cost per Event
$ 1 Million per year	**Claims & payments**	$50 - $100 per claim made; higher for C&I than residential
$5 Million per year	**Penalties, fines, (PBR-like)**	$10 - $50 per customer out
$10 Million per year	**Outage restoration & collateral damage**	$500-$100,000 per outage
$25 Million per year	**Major event audits, mandated programs, remediations, reporting**	$10,000-$100,000 per MWH $50-$200 per customer out
$25 Million per year	**Adjustments to rate base and allowed rate of return**	$10,000-$100,000 per MWH

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Typical 'customer commitments' cover less than 1% of customers
With reasonable visibility to those affected, but minimal overall impact

<u>Customer refund programs</u> <u>(paid only to those customers whose claim fits the criteria)</u>

ComEd "Commitment"	$60-$100 per customer interruption over 8 hours
IPL refund	$100 per customer interrupted over 36 hours in the storm of July 8, 2001
PacifiCorp guarantee	$50-$100 per customer for missed service levels, e.g., $50 for residential over 24 hours, $100 C&I $25 for each additional 12 hours
Entergy-Texas refund	$33 per customer (for 120,000 customers)
Michigan refund (Rules 44, 45, 46)	$25 per customer for frequent (>7) or long outages (over 16hours normal, over 120 hours catastrophic)
ConEd	$100 (residential) - $2,000 (commercial) for outages over 12 hours that caused spoilage or loss since 1973, increased to $350 - $7,000 after summer of 1999

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Typical PBR-like penalties are just enough to get attention

Usually, the cost to remediate is much more than the annual penalty

PBR-like penalties - based on targets for service quality indicators for the whole company

Utility	State	Custs. (000's)	Target Indicator	Target	CI's Over Target	Penalty ($000's)	Penalty Per CI
IPL	IN	433	SAIFI	0.67	14,506	$1,000	$68.94
SCE	CA	4,271	Outages	10,900	18,300	$1,000	$54.64
SDG&E	CA	1,185	SAIFI	0.90	11,850	$250	$21.10
Westar/KCP&L	KS	1,028	SAIFI	1.44	308,400	$3,000	$9.73
CMP	ME	550	SAIFI	1.80	79,200	$400	$5.05

IPL - $1M penalty (each) assessed for any more than 2 of 8 indicators missed; assume 5% SAIFI miss will trigger

SCE - Has +/-1100 outage deadband; $1M penalty per 183 outages; assume 100 CI/outage

SDG&E - $250k per .01 change in SAIFI up to $3.75M

Westar/KCP&L - Up to $3M penalty for up to .3 miss on SAIFI, increasing geometrically ($300k for .06 miss)

CMP - $400k penalty per 'point', 8% miss on any of 8 indicators (incl. SAIFI, CAIDI) gets 1 point

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Major events that make front-page news are the most expensive

Not only in total but also per customer or megawatt affected

<u>Major event costs – including audit, fines, mandated programs, reporting, and compliance</u>

Custs. (000's)	Year	Event	Audit	Event MWH	Remedy $million	$k per MWH
3,470	1999	Substation failures	✓	5,000	$1,100	$220
3,055	1999	Network failure	✓	2,675	$281	$105
696	1999	Network failure	✓	1,600	$45	$28
1,028	1999	Substation failure	✓	6,000	$56	$9
550	1997	Ice Storm	✓	5,000	$25	$5

$$\frac{\$24\text{k}}{\text{MWH}} \times \frac{.005\text{MW}}{\text{Customer}} \times \frac{\text{Hour}}{60\text{ Min}} = \frac{\$2.00}{\text{CMI}} \times \frac{100\text{ min}}{\text{outage}} = \frac{\$200}{\text{CI}}$$

Evidence indicates that feeder outages due to weather and normal deterioration generate much less remedial cost than substation failures at peak or widespread and catastrophic system events.

For this reason, values equivalent to $200 per CI are used for the latter while values like $25-50 per CI are used for the former.

The impact on rate base and allowed return is also significant

And could be the largest component of avoided cost in the long run

Rev ($Bil.)	Custs. (000's)	Issue	Potential Impact
15.0	3,400	Partial disallowance of remediation in distribution service tariff	$500 million
2.0	1,000	Disallowance of a portion of distribution costs in rate request due to reliability problems	$220 million

On a rate base of $3 billion, a 50 basis point disallowance amounts to $15 million per year, comparable to some of the largest PBR penalties.

With a rate of return on rate base of 11 percent, a disallowance of $100 million from inclusion in the rate base reduces income by $11 million per year.

On a rate increase request of 5 percent of $1.5 billion distribution revenue, granting only 50% of the request would amount to $37.5 million per year.

Changing customer satisfaction through reliability can be expensive

It can take a lot of spending to ‘move the needle’ even a little

Reliability is only one component of overall satisfaction, often about 20%

So, to increase overall satisfaction by 2 points would require increasing reliability satisfaction by 10 points

From the graph on the right, that would require a .5 decrease in SAIFI, e.g. from 1.8 to 1.3, to move power quality and reliability satisfaction from 100 to 110

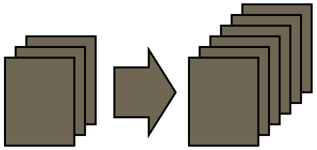
For a company with 1 million customers, a 0.5 reduction in SAIFI requires 500,000 fewer interruptions

If the cost of eliminating each interruption is $100, the total cost would be $50 million for a 2 point improvement in overall satisfaction

Source: JD Power & Associates and Navigant Consulting

Values for reliability can be used in a spending prioritization model

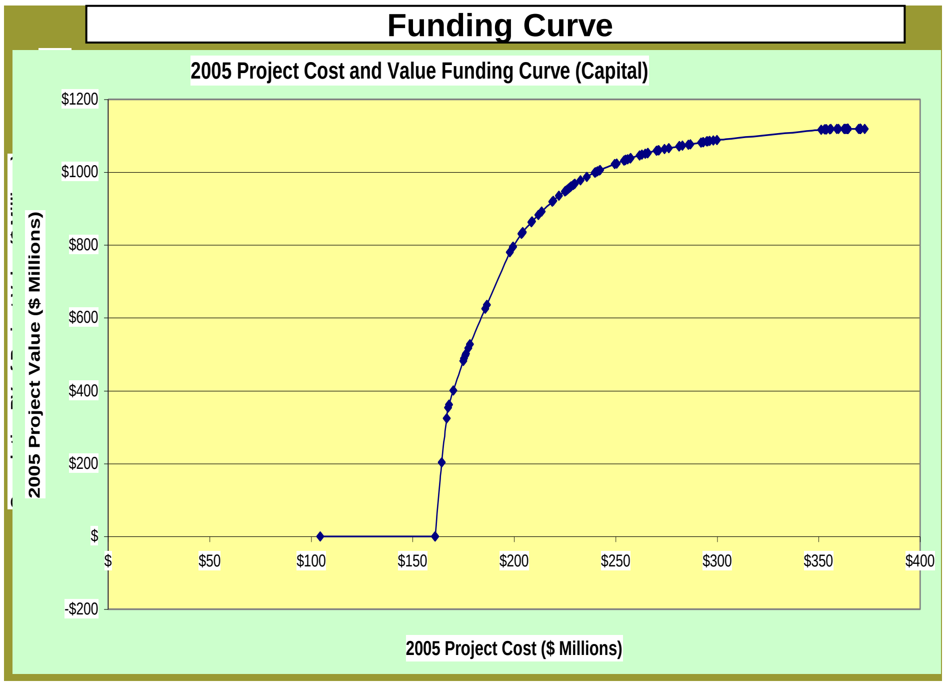
That translates project benefits into dollars instead of just point scoring

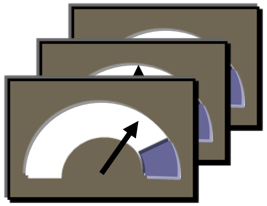


Option Development

Developing cost-effective <u>alternatives</u> for possible funding

- Additions
- Upgrades
- Replacement
- Maintenance
- Standards
- Systems





Results Monitoring

Measuring & managing the <u>drivers</u> of the funded projects and processes

- Benchmarking
- Unit costs
- Failure rates
- Event impacts
- Value added

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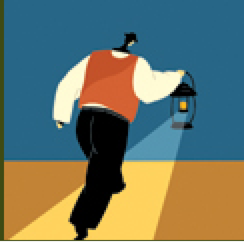
For example, substation load relief must be valued

Using a number like $25,000 per Expected MWH of outage avoided



Project: Upgrade existing 69kV/13.2kV 20MVA transformer with a 50MVA transformer and switchgear

Reason: Loss of either existing transformer (20, 25MVA) would result in load loss of 4 MVA (20MVA in 10 years)

In addition, by 2009 it reaches normal overload condition

Cost: $1,560,000 for 1-50MVA transformer, a circuit switcher, and four new breakers

Benefit: Avoid a 1% chance of having to shed 4 to 20 MW of load for 20 hours during a summer contingency

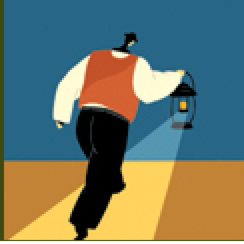
Quick calculation: Benefit of $2,100,000, cost of $1,560,000, ratio = 1.35 (Again, the model has more details)

	Xfrmr Failure	Exposure Factor	MW At Risk	Outage Hours	EMWH Saved	Value per MWH	Annual Benefit	Present Value
1st	**4%**	**25%**	**12**	**20**	**2.4**	**$25,000**	**$60,000**	**$600,000**
Normal	**N/A**	**5%**	**5**	**24**	**6.0**	**$25,000**	**$150,000**	**$1,500,000**
Total							**$210,000**	**$2,100,000**

Note: Even the quick calculation reveals some key points -

- Without the normal overload, the benefit would only be $0.6M. More MW would need to be at risk for $1.56M of cost
- The transformer failure rate, normally 2%, is doubled here because there are two transformers that could fail
- The model has an option to raise the failure rate of the contingency as the normal overload increases significantly

Similarly, distribution reliability can use values like $25 per CI
For example, where worst circuit programs target customer interruptions



Project: Perform remedial work on worst circuits

Reason: Avoid customer interruptions for customers experiencing multiple outages

Cost: $1.5 million for first tier ("worst first")

Benefit: Reduce outages and customer interruptions by 20%, saves operating cost and reduces risk

Quick calculation: Benefit of $3,000,000, cost of $1,500,000, ratio = 2.0 (At a cost of $94 per avoided CI per year)

	Feeder SAIFI	Outs, Cust. Per Feeder	Reduction factor	Feeders Remediated	Outs,CIs Saved	Value per outage,CI	Annual Benefit	Present Value
Outages	-	25	20%	20	100	$500	$ 50,000	$ 333,333
CI's	4.0	1,000	20%	20	16,000	$25	$400,000	2,666,666
Total							$450,000	3,000,000

Note: Many companies rank distribution projects by cost per CI avoided, at rates from $50-$300 per CI

- Effective discount rate is 15% because remediations are assumed to deteriorate at 5% per year

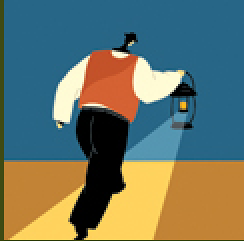
-$25 per avoided CI is (and should be?) about 20% of the value implied by $25,000 per MWH (At 5 kWH per CI)

- When this 'macro' model sets the right benefit ratio and value, a 'micro' model can be used to pick circuits

- Other programs modeled similarly are URD replacement, tree trimming, line inspection/repair, etc.

Reliability event cost parameters facilitate value discussion

Values like $25k per MWH and $25 per CI help to anchor the discussion



Using $25k per MWH for major events and $25 per CI for normal distribution feeder events implies a different value for different types of events, i.e.,

If the typical customer is 4kW, and typical CAIDI is 90 minutes, then $25k per MWH implies $150 per CI (and would be $1.66 per CMI), or 6 times $25:

$$\frac{\$25{,}000}{\text{MWHour}} \times \frac{\text{MW}}{1{,}000\ \text{kW}} \times \frac{4\ \text{kW}}{\text{Customer}} \times \frac{1.5\ \text{Hours}}{\text{Interruption}} = \frac{\$150}{\text{CI}}$$

Starting with values like these, companies may discuss how to vary by:

- Urban versus rural (although usually customer density covers this)
- Visibility or ‘front page news’ factor (e.g., higher for major events)
- Region or jurisdiction (but try it first at equal values for all)

For answers to any further questions, call or e-mail us

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