24th Annual Ohio

Energy Management Conference

Workshop P

Affordable Resiliency – Best Practices & Case Studies in Integrating Backup Generation with Electricity Supply to Minimize Total Cost of Ownership

Tuesday, February 18, 2020
3:15 p.m. to 4:30 p.m.

Biographical Information

Joe Glanzman, Director of Business Development
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Joe began his career with American Electric Power (AEP) as a mechanical engineer in the Resource Planning organization, and has served in several positions of increasing responsibility in AEP's Finance, Regulatory Services, Engineering Services and Project Management organizations. Joe spent the majority of his career within the integrated utility supporting major generation projects, including capital project screening and business case development, engineering and design, planning and scheduling, construction, commissioning and regulatory approval.

Joe joined AEP OnSite Partners in 2017 as the Director of Business Development, where he works directly with customers to deliver energy solutions based upon market knowledge, innovative application of technology and deal-structuring capabilities. AEP OnSite Partners targets opportunities in distributed solar, energy storage, peaking generation, combined heat and power, and other energy solutions that create value for our customers. Joe is married with three kids and lives in Pickerington, Ohio.

Joe holds a BS of Mechanical Engineering from the University of Dayton, an MS of Mechanical Engineering from the Georgia Institute of Technology, and an MBA with a concentration in Finance from The Ohio State University. Joe is a registered Professional Engineer and Project Management Professional.

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Affordable Resiliency

Integrating Backup Generation with Electricity Supply to Minimize Total Cost of Ownership

24th Annual Ohio Energy Management Conference
February 18th, 2020

AEP OnSite Partners offer energy asset services nationwide.

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Slide 2

AF1 Change to 24th not 24nd
Ann Ford, 1/20/2020

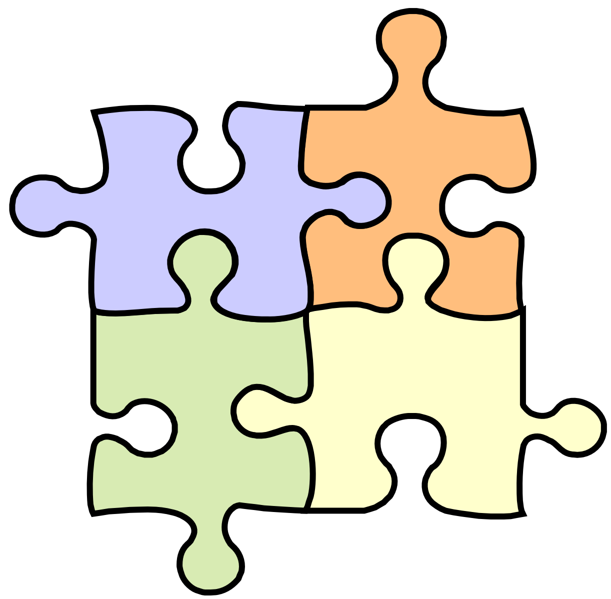
- **Overview**
- **Revenues**
- **Costs**
- **Valuation Techniques**
  - DCF
  - Monte Carlo Simulation
- **Case Study**

Presentation Preview

- Backup Generation can be costly
- Backup Generation can provide substantial benefits
- Must minimize Costs and maximize Benefits before making project investment decisions

Generation Value Streams

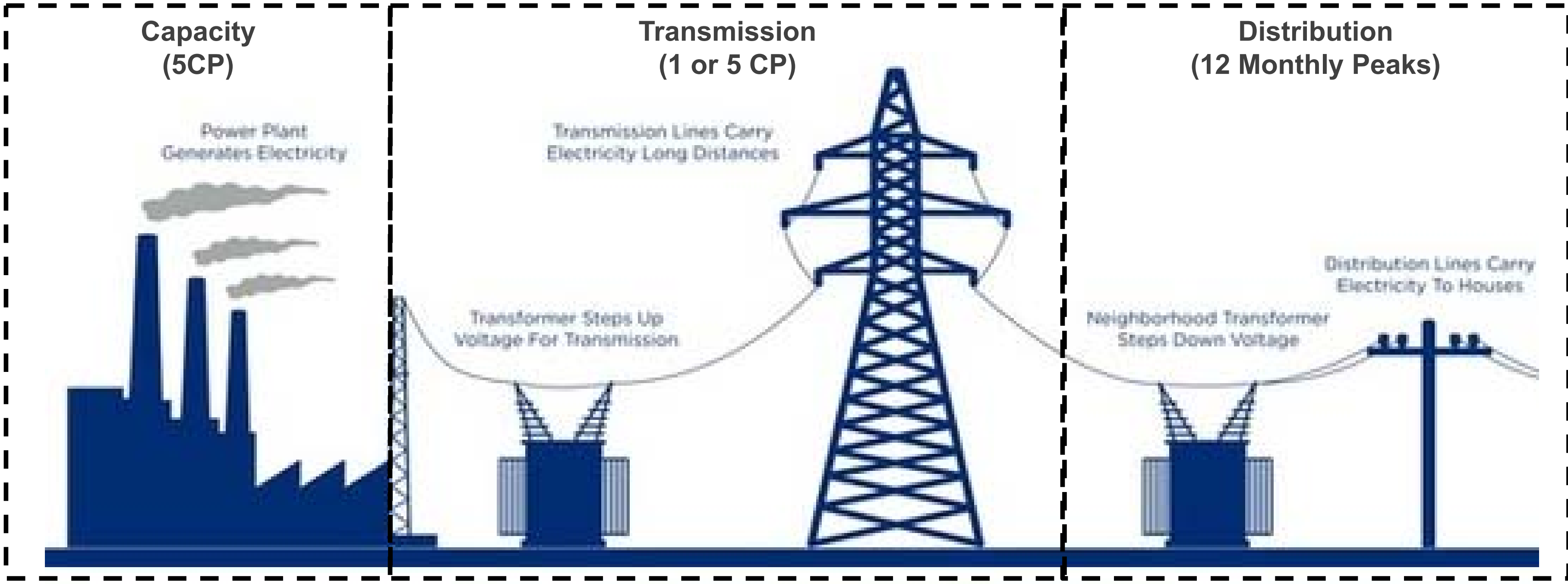
Resilience / Backup
Ancillary Services Market
Energy Savings
Distribution Savings
Capacity Peak Shaving (Demand Response & PLC)
Transmission Peak Shaving (NSPL)



Introduction > Revenues > Costs > Overall Value > Case Study

Why are Trans and Cap so valuable?

Utilities recover the entire fixed cost of power plants and transmission grid investments during the annual peak usage hours (either 5CP or 1CP)



Key Takeaway: Properly dispatched peaking generation reduces the amount of power taken from the grid during these peak hours of the year, eliminating ~30-40% of a typical customer's bill.

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Transmission Peak Shaving

State	Utility	Transmission (NSPL) Calculation Method
IL	ComEd	5CP
OH	AEPOH	1CP
	Dayton	1CP
	Duke	1CP
	Cleveland Ill - FE	5CP
	Ohio Ed - FE	5CP
	Toledo Ed - FE	5CP
PA	Duquesne	1CP
	MetEd/Penelec - FE	5CP
	West Penn - FE	5CP
	Penn Power - FE	5CP
	PECO	5CP
	PPL	1CP

- Network Transmission Service Peak Load Contribution (NSPL)
- Annual Transmission rates are set during the RTO's previous year's peak load hours
- Calculated using either 5 Coincident Peak (5CP) or 1 Coincident Peak (1CP)

Key Takeaway: Running behind-the-meter generation during the peak load hours reduces the customer's transmission rates in the following year.

Capacity Peak Shaving

PLC Management / Avoidance

- Peak Load Contribution (PLC)
- Annual Capacity rates are set during the RTO's previous year's 5 peak load hours
- Running behind-the-meter generation during those peak load hours reduces the customer's capacity rates ***in the following year***.

Demand Response (DR)

- Receive compensation by running generators and/or reducing load
- Must contract with (or be) a PJM Curtailment Service Provider to participate
- Provides ***immediate*** (Year 1) revenues for Peaking Gen projects
- Allows Bundled Market Participation
- DR value goes to $0 in year 2 (when PLC savings "kick in")

Key Takeaway: Running behind-the-meter generation during the peak load hours reduces the customer's capacity rates in the following year, and creates DR revenue in year 1 of operation.

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Peaking Gen Energy Savings

- On-Site Peaking Gen provides an ***embedded energy spread option***
- How often your asset is "in the money" is determined by comparing:

Cost to Self-Produce Energy	Cost of Grid-Supplied Energy
[Unit's Heat Rate x Local Fuel Price] + Unit's Variable O&M	Local Energy Price (LMP) + Local Distribution Company Adders + Avoided Losses

- ***Intrinsic Value*** = The value/savings that can be generated by dispatching the asset against the prices observed in the forward gas and power markets
- ***Extrinsic Value*** = The value of the flexibility of this asset to respond to future changes in gas and power market prices

Key Takeaway: This is not a static analysis! Properly dispatching to maximize energy revenues requires an hour-by-hour comparison of continuously fluctuating fuel and power markets.

Bid Development Details

The cost to run each generator is determined using the cost to operate and the cost avoidance from volumetric LDC Adders:

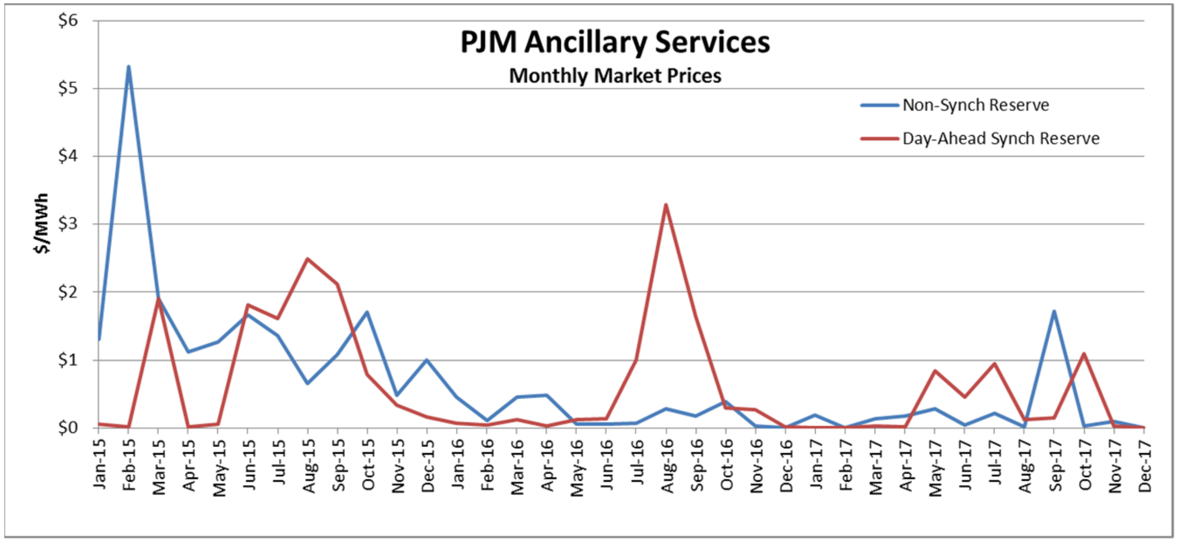
$$Strike\ Price = \frac{HR_{HHV}\ x\ Fuel}{Loss\ Factor} + VOM\ - LDC\ Adders$$

Natural Gas example assuming 5% Loss Factor after deration and $12/MWh VOM

$$NG\ SP = \frac{9.23\ x\ \$3.00/MMBTU}{1.05} + \frac{\$12}{MWh} - LDC\ Adders = \frac{\mathbf{\$38.37}}{\mathbf{MWh}} - LDC\ adders$$

PJM Ancillary Services Market Revenues

- Another revenue stream for Peaking Generation projects
  - Synchronized Reserve
  - Non-Synchronized Reserve
  - Day-Ahead Scheduling Reserve



Introduction | **Revenues** | Costs | Overall Value | Case Study

Installation Cost Components

- **Capital install cost is a major driver of project valuation**
  - Costs are large and incurred up front (DCF)
- **Proper estimate must consider all of the following:**
  - Engineering & Drafting
  - Generator and Enclosures
  - Electrical / Switchgear
  - Fuel tanks and piping
  - Interconnection / Air Permitting
  - Installation Labor
  - Development Costs
  - Project Duration (until In-Service)

O&M Cost Components

- **Ongoing costs of Operating and Maintaining equipment must be considered in project valuation**
- **Fixed O&M Costs:**
  - Insurance
  - Monthly / Annual Testing costs
  - Annual / Periodic Maintenance
- **Variable O&M Costs:**
  - Consumables
  - Run-based maintenance

Key Takeaway: Must properly identify Variable vs Fixed O&M to ensure proper dispatch signal

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Tax Costs

- Peaking Generation projects are potentially subject to Property tax, Federal tax, and Production (or kWh) tax
- Property Taxes – Vary by state, can be sizable, must account for in valuation
- Federal Tax Reform - Tax Cuts and Jobs Act of 2017

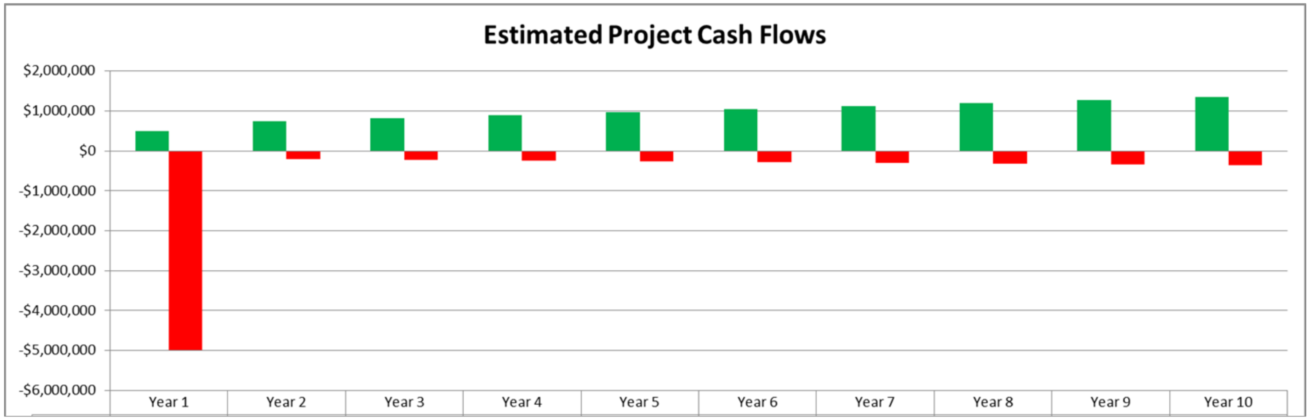
	Before Tax Reform	After Tax Reform
Federal Corporate Tax Rate	35%	21%
Accelerated Depreciation	40%	100%

- These changes improve peaking generation project economics

Key Takeaway: Project valuations can be optimized by i) fully understanding and ii) properly allocating tax ownership and/or liability

Simple Project Valuation: Discounted Cash Flow (DCF) Analysis

- Identify all applicable costs and revenues
- Estimate magnitude and timing of these cash flows
- Perform DCF analysis of the after tax cash flows
- Appropriate Discount Rate



Key Takeaway: Project Valuation varies greatly depending on how well you manage the original install cost, ongoing maintenance, and dispatch of these assets to maximize savings and market revenues.

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Sophisticated Project Valuation: Monte Carlo DCF simulation

- **Performing a single DCF analysis is insufficient**
  - Cash flow graphs intended to provide simple illustration of project costs and revenues
  - **Cannot** rely on single-point estimates to properly value project.
  - Rather, **use Monte Carlo simulation**

- **Why? Project costs and revenues are NOT discrete, fully-predictable numbers**
  - Key inputs (revenues and costs) should be modeled as probability distributions
  - Input assumptions are often correlated
  - Use DCF simulation to produce the entire distribution of valuation outcomes

- **Reality is dynamic… models need to be too!**

Key Takeaway: Monte Carlo simulation of critical DCF inputs should be employed to determine the expected distribution of project valuation outcomes.

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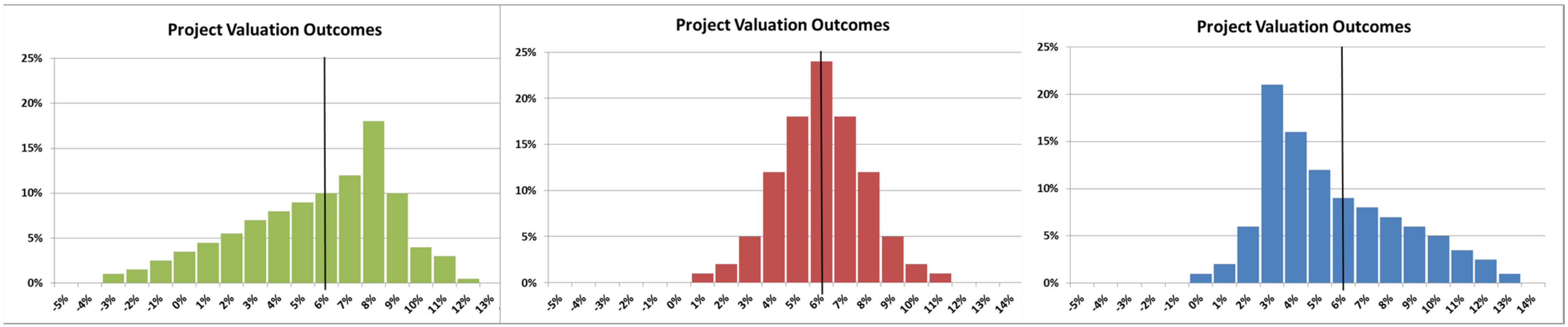
Sophisticated Project Valuation: Monte Carlo DCF simulation

- Beyond the mean… all averages are not alike!



Mean= 6%	Mean= 6%	Mean= 6%
Median= 6.5%	Median= 6.0%	Median= 4.7%
95% CI Range= -2% to 11%	95% CI Range= 2% to14%	95% CI Range= 1% to 12%
Basis Point Variance= 1,023	Basis Point Variance= 336	Basis Point Variance= 827

Key Takeaway: Demand this type of in depth simulation and analysis before committing to a project.

Questions?

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