

Intro to DER

James Woods

11/20/2016

DER vs DG

- ▶ $DG = \text{Distributed Generation}$
- ▶ $DER = DG + \text{Storage}$

May seem like semantics but small storage grew in potential since 2005

What is in DER

- ▶ Definitions vary but Small ($< 49\text{MW}$) generation seems to count with $< 1\text{MW}$ most common.
 - ▶ Plenty of renewable
 - ▶ Small turbine
 - ▶ Backup generators
 - ▶ Battery banks.
- ▶ Combined Heat and Power
 - ▶ Steam Generation
 - ▶ Chill Water
 - ▶ District Energy

Why Would I (Private) Build It?

- ▶ Power Quality
 - ▶ Equipment is sensitive to voltage drops or spikes
 - ▶ Equipment is sensitive to frequency variation.
 - ▶ Wave shape and harmonics
 - ▶ High reactive power needs (Often avoids utility charge.)
- ▶ Reliability (Often combined with quality)
 - ▶ High cost of interrupted power, e.g., hospital
 - ▶ Two common measures
 - ▶ System Average Interruption Duration Index (SAIDI), average total time without power over a year.
 - ▶ Customer Average Interruption Duration Index (CAIDI), average time without given your power is out.
 - ▶ Many more relating to frequency and cost of lost service.
 - ▶ You could have lower rates if you have an interruptible tariff.

Why Would I (Private) Build It? (Cont)

- ▶ Peak reduction
 - ▶ If you have demand (kW) charges, your maximum use.
 - ▶ If you have a coincident peak (kW) charge, you use at system peak.
- ▶ Cogeneration Opportunity
 - ▶ Already need Steam or Chill water
 - ▶ Electricity generation is a bonus
- ▶ Reduction in volumetric (kWh) charges
 - ▶ Net metering just a bit to shave off the high block charges
 - ▶ Peak Pricing Tariff
 - ▶ Real-time Prices.
 - ▶ Nice subsidy.
 - ▶ Actually, social cost, cheaper.
- ▶ The utility side is significantly more complicated.

Three simple ways of thinking about costs

- ▶ The Make vs Buy trade-off (TC).
- ▶ The Minimum Efficient Scale (AC), i.e., volume such that AC is at a minimum.
- ▶ Investment Delay, a time value of money concept.

With all cost estimates the key conceptual problem is to only look at incremental costs.

- ▶ It is often unclear what those incremental costs are relative to.
- ▶ Cost does depend on your point of view.

Example Make vs Buy

- ▶ Assume cost functions of $C = F + \alpha q$ form.
 - ▶ Fixed cost
 - ▶ Constant average variable cost
- ▶ Make vs Buy: Given known q , Choose the least cost technology

Example MES

- ▶ Several definitions of MES
 - ▶ Quantity such that $MC = AC$.
 - ▶ Quantity such that AC decreases very little as quantity increases.

Example Investment Delay

- ▶ Pushing costs into the future can be valuable.
- ▶ Value of delay increases as interest rates increase.
- ▶ Exponential discounting $P = \frac{F}{(1+i)^N}$.
- ▶ Example: Maintenance expenditures of \$100 a year forever.
What is the value of skipping a year?
 - ▶ $PW(Maintenance) = \frac{100}{i}$ At $i = 10\%$ this is 1000.
 - ▶ Delay for 1 year is $\frac{100}{1+i}$. This is 909.09.
 - ▶ The difference is the savings.

How Did We Get to the Current G-T-D Arrangement (MES Argument)

- ▶ Both large scale and small scale originally existed.
- ▶ Large scale developed
 - ▶ Lower AC
 - ▶ Higher MES
 - ▶ Speed of change up till 60s made this the dominate form.
- ▶ Small scale continued to develop
 - ▶ Right sized scale and MES
 - ▶ Decreasing AC
 - ▶ 1978 Qualifying Facilities Era was when they could sell power under some conditions.

Private Choice of Technology (Make vs Buy Argument)

- ▶ Have access to utility power and DG.
- ▶ Several States of Opportunity Costs
 - ▶ If you have no special needs and need to pay full cost of fuel.
 - ▶ If you have 'Free' access to fuel, e.g., wood chips, AC of DG is lower.
 - ▶ If power quality or interruption is not what is desired, AC of utility power is higher.
 - ▶ More complicated diagrams can be made but this works.

Utility Point of View (Make vs Buy Argument)

Please note that lots of power quality issues need to be solved on the D side, with capacitors and transformers. Power quality may actually get worse with new equipment and DG.

- ▶ Utility: Supply customer needs with T+G or with DG.
- ▶ Customer: Decide to take utility solution or provide with private DG.

Fig 3-4

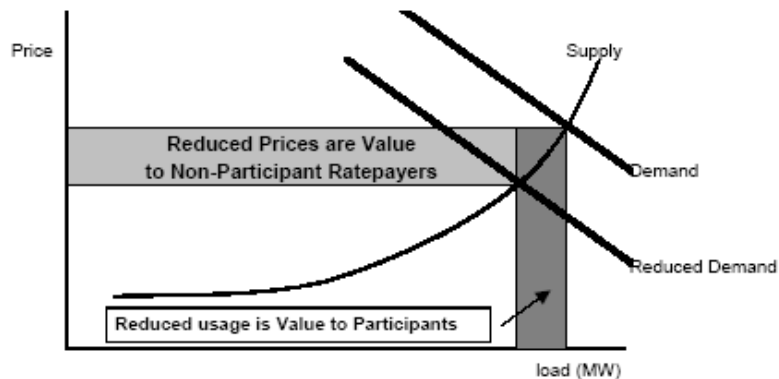


Figure 1: