

Truly Green

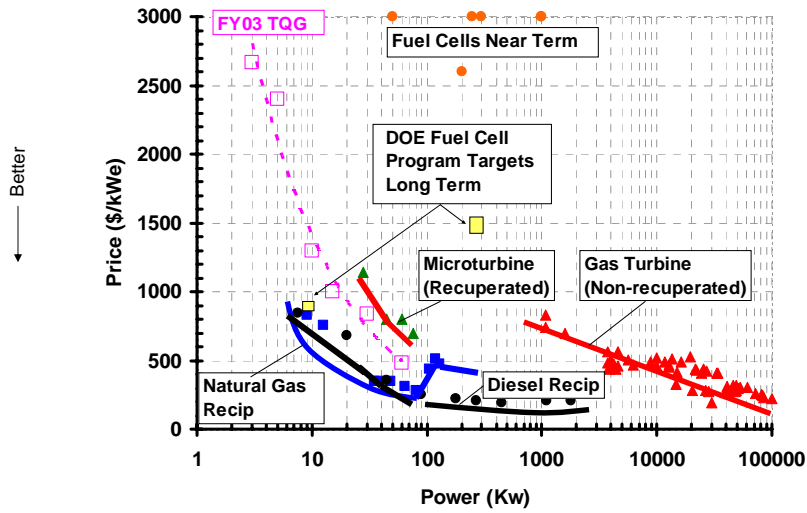


Challenges

- Equipment cost/Selection
- Operating costs
 - Fuel (consumption and price)
 - Maintenance
- Emissions regulations
- Utility interconnection issues
- Utility Rate Structure
 - Demand, energy, backup
 - Evaluate based on site conditions

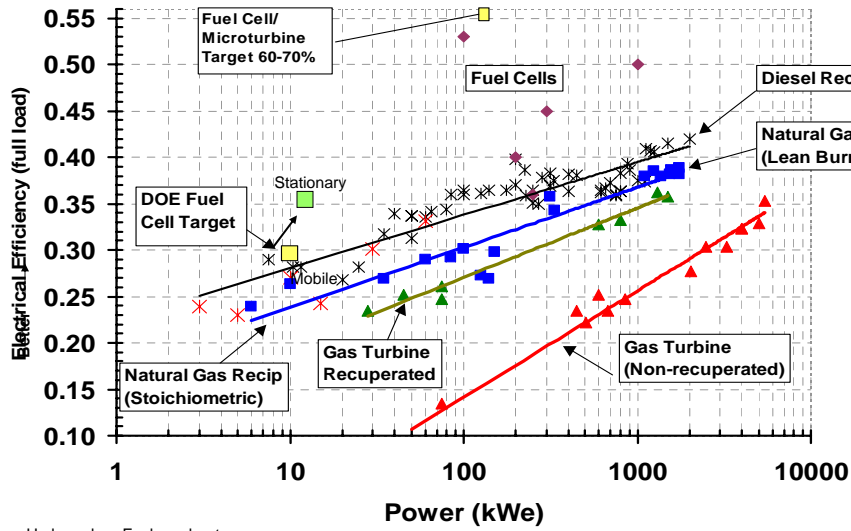
Distributed Generation Decisions

Equipment Costs Vs Technology



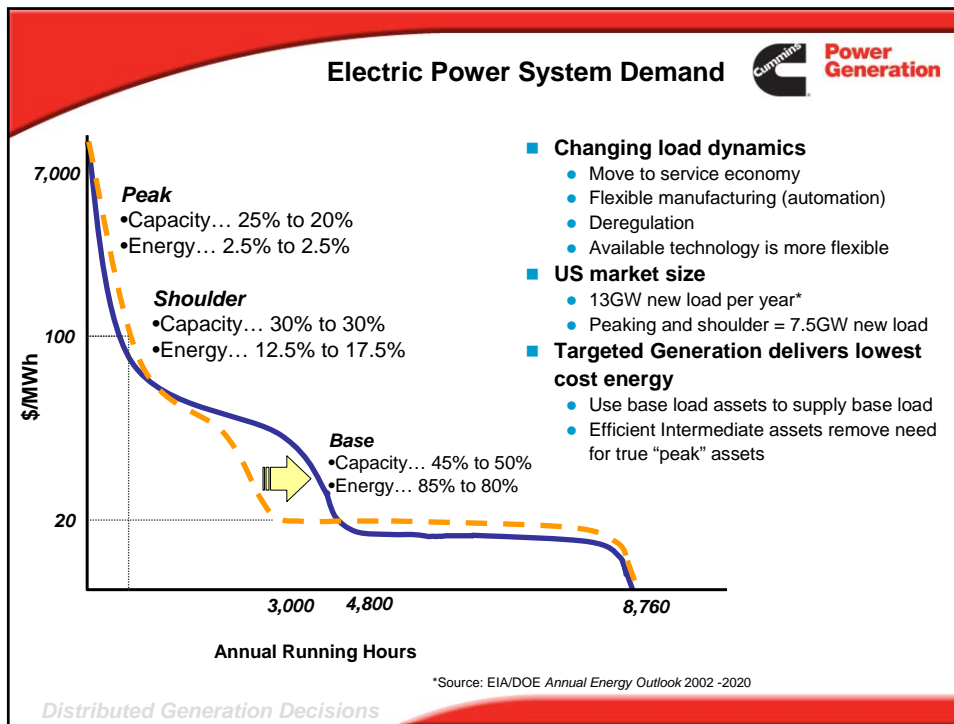
Distributed Generation Decisions

Thermal Efficiency Vs. Technology



Hydrocarbon Fuels-no heat recovery

Distributed Generation Decisions



Selection Factors

Market Segment	Operation Hours per Year	Low Initial Cost	Low Fuel Use	low Maint. (\$/hr)	Low Emissions
Standby	<200	High (Green)	Low (Red)	Low (Red)	Low (Red)
Interruptible	100-500	High (Green)	Low (Red)	Low (Red)	Medium (Yellow)
Peaking	1000-2000	Medium (Yellow)	Medium (Yellow)	Medium (Yellow)	High (Green)
Distributed Generation	>2000	Medium (Yellow)	High (Green)	High (Green)	High (Green)

Importance: High = green
Medium = yellow
Low = red

Distributed Generation Decisions

Cummins Generator Sets



- Diesel
 - 10kW to 2.5 MW
 - Low Hour/Peaking that is also Emergency
- Natural Gas (Stoichiometric)
 - 25kW to 1250kW
 - Low Hour/Peaking that is also Standby
- Natural Gas (Lean Burn)
 - 334kW to 2.0 MW
 - Prime Power/Cogeneration
- Paralleling Systems
- Cogeneration/Total System Design

Distributed Generation Decisions

Integrating DG into a Site

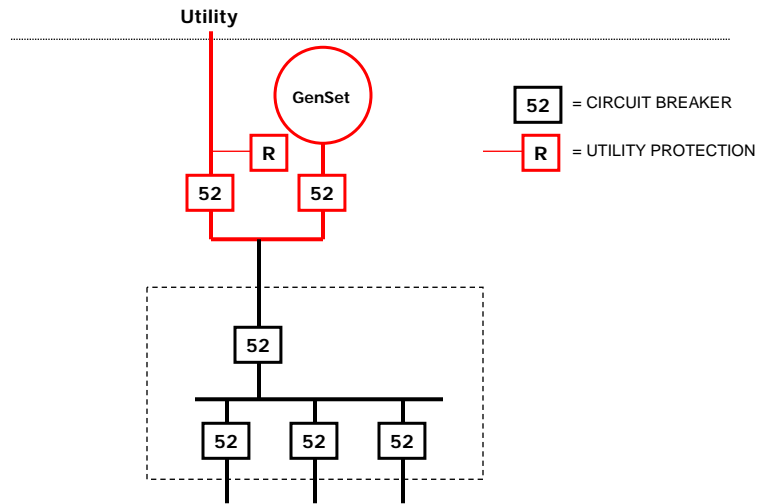


New Systems:

- Low Voltage/Medium Voltage
 - Selection based on system design, capacity
- NO DISTURBANCE
 - **Soft Transfer Systems**
 - » Hard closed transition doesn't work
 - **Paralleling/Soft Transfer Systems**
 - » To stay connected, or not: that is the question...
- Cogen/Renewable any size
- Retrofit Systems
 - Paralleling and Large Generator Sets

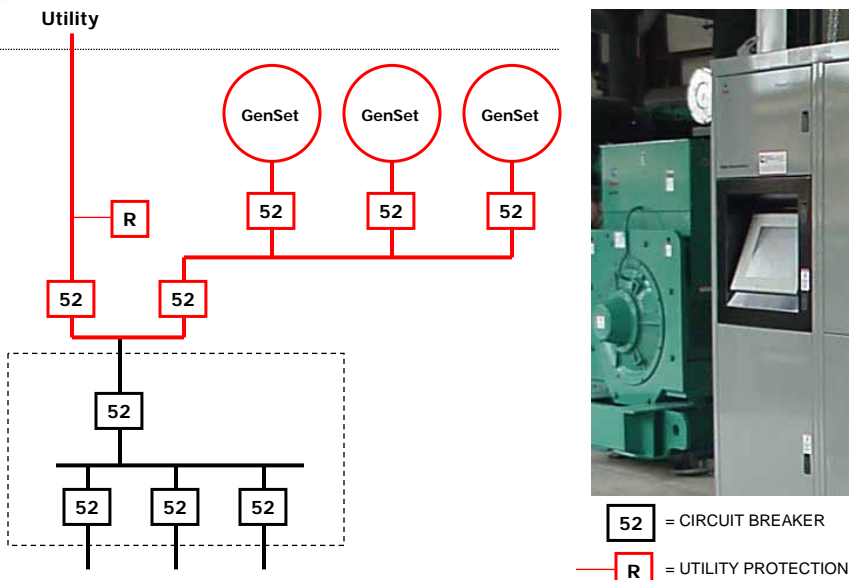
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New Installations



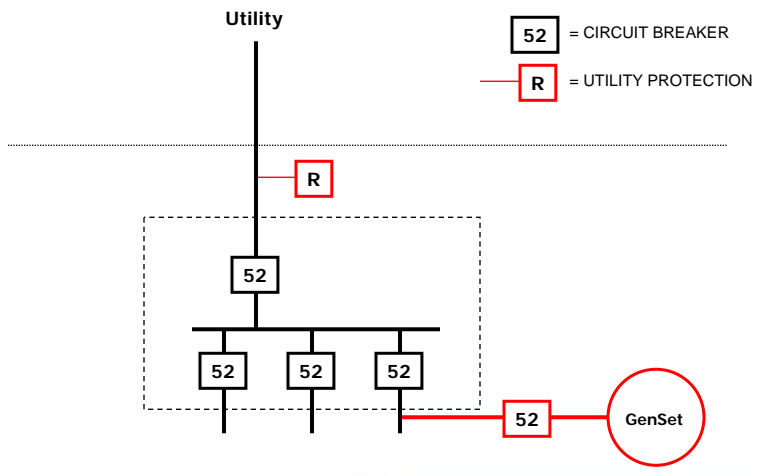
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New Multiple Unit Installations



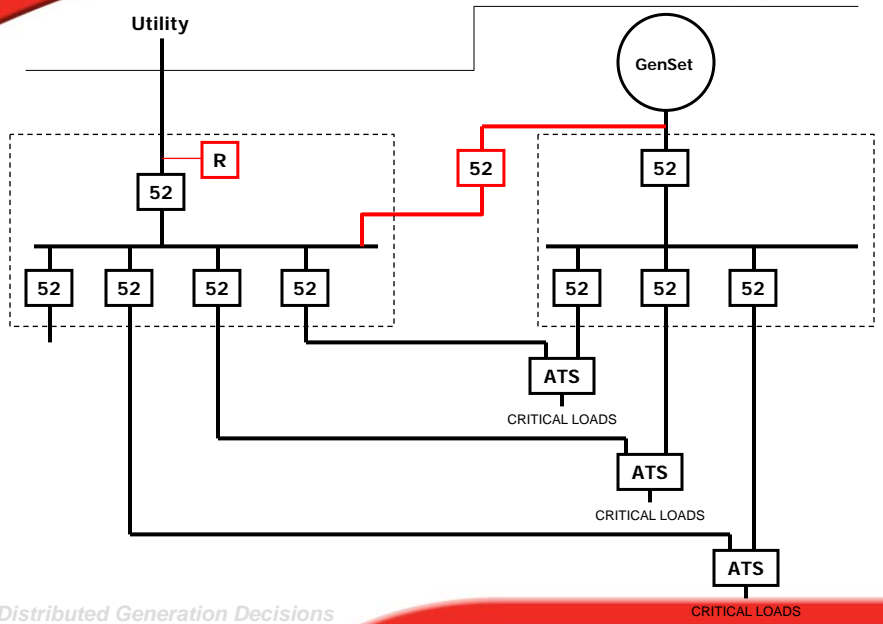
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Typical Small DG or CHP



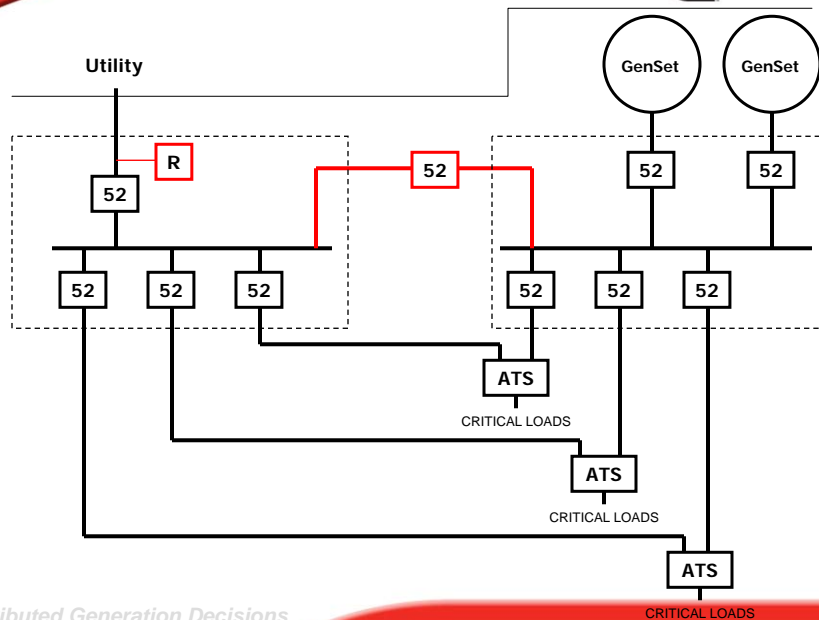
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Retrofit: Single Generator Set



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Retrofit: Multiple Gensets



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CRITICAL LOADS

Utility Interconnection



- Design Depends on:
 - Local conditions
 - Codes and Standards
 - Utility Practice
 - More Variety than Generator
- Common Protective Devices:
 - Over/Under Volts, Hz
 - Reverse Power
 - Directional Current
- Distribution Changes

Distributed Generation Decisions

Pros and Cons for DG



- Pro:
 - Low risk venture
 - Returns can be very good
 - Improves Facility Power System Reliability
 - “Free” Standby
 - Test/Exercise Benefits
- Con:
 - Most Customers are not in the power generation business
 - Return may not be as high as other projects competing for capital
 - More complex power system
 - less reliable?
 - Environmental Issues
 - Exhaust
 - Noise

Distributed Generation Decisions

Big Things to Remember...



- Best technology for a site depends on:
 - Fuel availability, cost
 - Emissions Restrictions
 - Efficiency
 - Mechanical Concerns
- There is no one best technology that will work for every site
- Technology is driving costs down, so owners need to keep watching for opportunities
- Success Depends on Relationship with Utility Service Providers

Distributed Generation Decisions