

Combined Heat and Power and the Power Grid

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99%+ of CHP Users Are Connected to the Grid

- CHP systems are typically sized to the base thermal load at the site
 - Maximizes heat recovery and operating hours
 - Results in maximum efficiency and emissions benefits, and best economics
 - For most users, CHP provides only a portion of their power needs
 - The grid is needed for supplemental power and standby/back up power
 - For some users with large thermal loads in relation to site electrical demands, sizing to thermal load results in excess power generation over and above plant needs
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CHP / Grid Integration Issues

A key element to the market success of CHP is the ability to safely, reliably, and economically interconnect and interact with the utility grid system.

- Interconnection requirements
 - Supplemental and standby/backup tariffs
 - Market access for excess power
 - Ancillary services
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Grid Integration Issues Can Influence...

- Prime mover selection and configuration
 - CHP system sizing
 - CHP operating strategy
 - Project timelines and cost
 - Project economics
 - Energy and emissions savings
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Interconnection Requirements for On-site Generators Serve an Important Function

- The safety of utility line personnel must be maintained at all time
 - The safety of the equipment must not be compromised
 - The reliability of the distribution system must not be compromised
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Uncertainty in Interconnection Requirements Can Add Time and Cost to CHP Projects

- Interconnection rules may not be consistently applied
 - Interconnection rules may not establish clear requirements for timelines and fees.
 - Protection requirements and required protection equipment may not be commensurate with the size and potential impact of smaller generators.
 - Requirements for utility studies may not be commensurate with the size of the generator.
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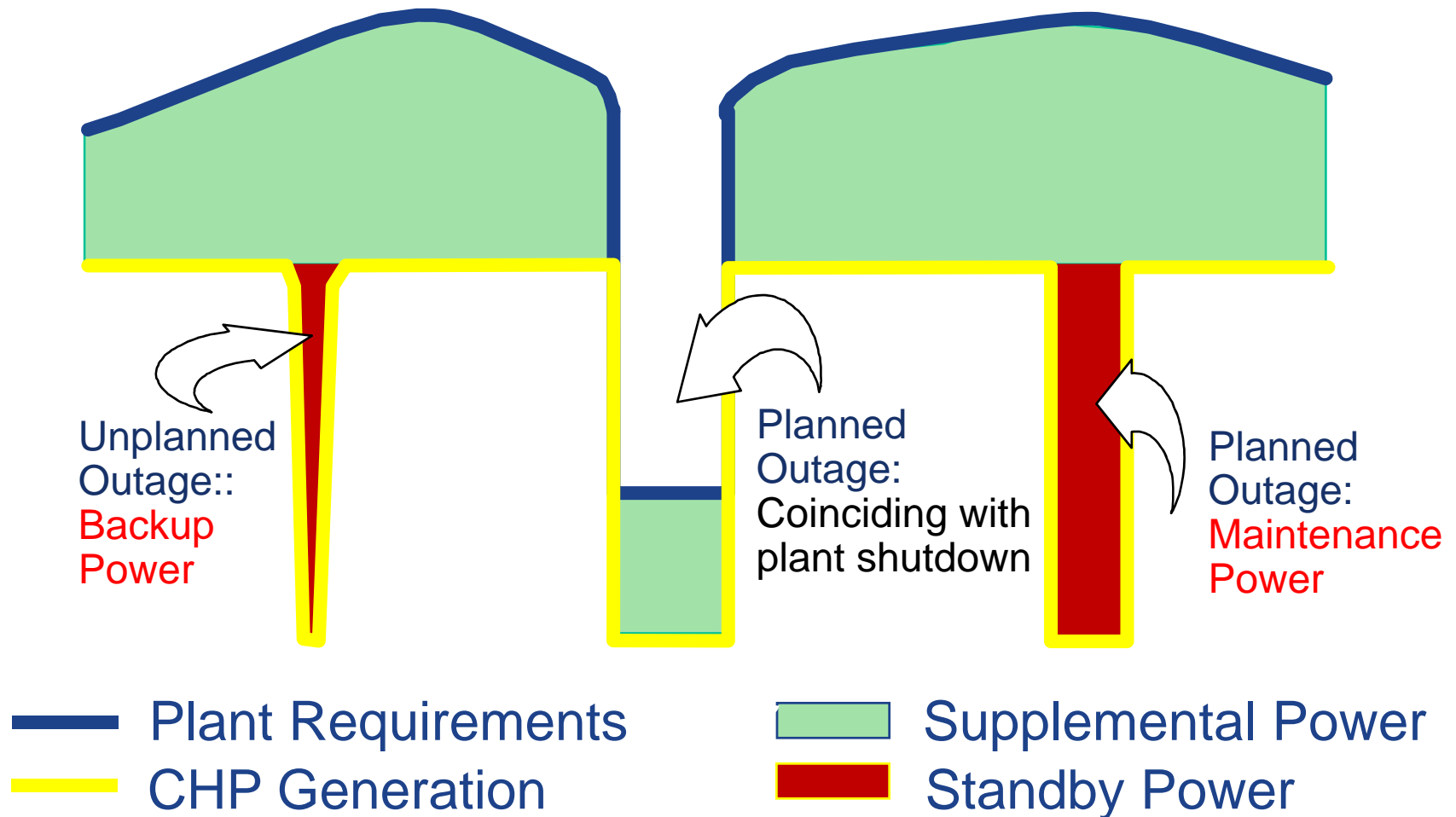
Design Considerations for Interconnection Requirements

- Interconnection fees commensurate with system complexity
 - Streamlined procedures with simple decision-tree screens
 - Practical and predictable technical requirements based on existing technical standards (IEEE 1547 / UL 1741)
 - Standardized, simplified interconnection agreements
 - Dispute resolution procedures to resolve disagreements
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Standby / Back-up Rates

- Partial Requirements services are often provided under different rate schedules than for non-generating customers
 - *Supplemental Service* – serves site demand in excess of CHP generation, often supplied at the applicable full-requirements tariff
 - *Standby Service:*
 - *Back-up* – serves a customer’s load during an unscheduled outage of the CHP system
 - *Scheduled Maintenance* – serves a customer’s load, without penalty or reservation charge, while the CHP system is being serviced
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Standby / Back-up Rates

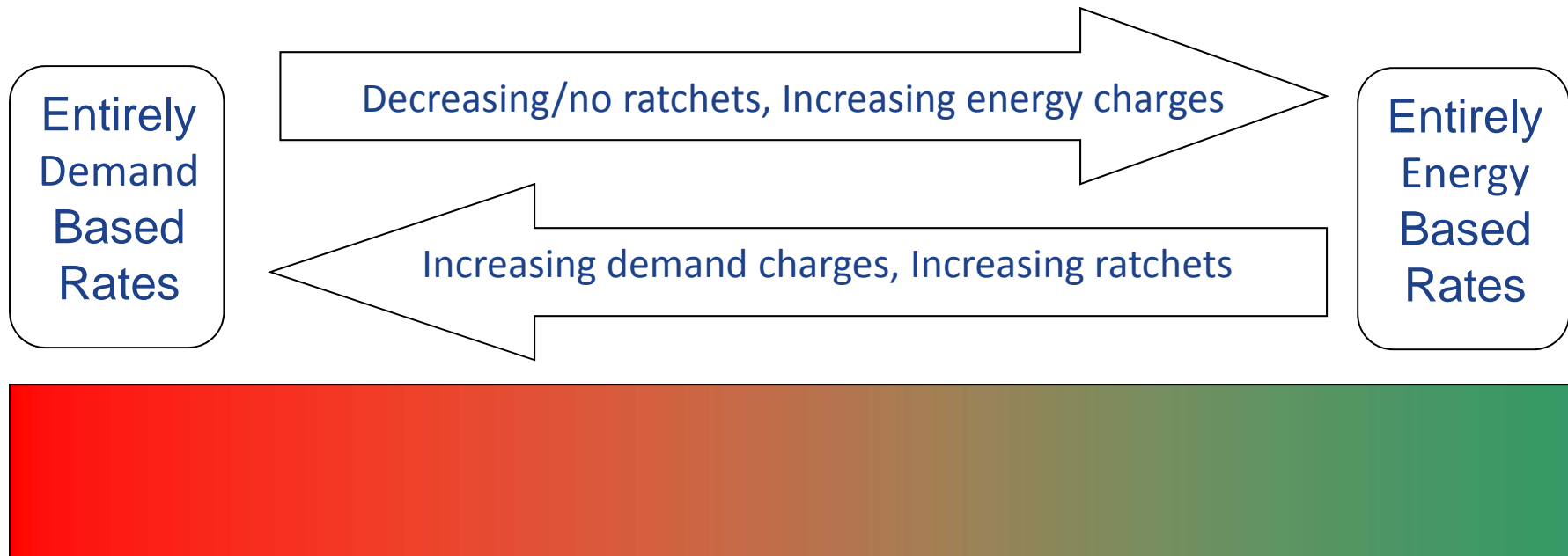


Courtesy of Brubaker & Associates

Impacts of Rate Structure on CHP Economics

Unfavorable for CHP

Favorable for CHP



Design Considerations for Standby Rates

- Create a reasonable balance between variable charges vs. contract demand or reservation charges
 - Reflect load diversity of CHP customers in charges for shared delivery facilities
 - Offer daily, or at least monthly, as-used demand charges for backup power and shared transmission and distribution facilities
 - Allow the customer to provide a load reduction plan for all or a portion of its back-up needs
 - Promote scheduling planned maintenance service at nonpeak times
 - Provide an opportunity to purchase economic replacement power
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Sale of Excess Power

- Sizing CHP to the thermal load results in the most efficient CHP system and maximizes energy and emissions savings
 - Thermal load-based CHP systems in industrial facilities such as refineries, chemical plants and paper mills often generate more power than is needed on site
 - The ability to sell that excess power ensures that all the energy and emissions savings are realized
 - The ability to sell that excess power provides an additional revenue stream for the industrial and can improve project economics
 - CHP can, and does, participate in both capacity and energy markets
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Ancillary Services

- Ancillary services that CHP can potentially provide include:
 - *Operating & Spinning Reserves* supply electricity if the grid has an unexpected need for more power on short notice
 - *Regulation & Frequency Response* service corrects for short-term changes in electricity use that might affect the stability of the power system
 - *Reactive Power & Voltage Control* service corrects for reactive power and voltage fluctuations caused by customer operations
 - CHP participation in these markets is still limited
 - Complexity of the rules and requirements
 - Limited staff time and resources at the CHP host site
 - Uncertainty by the system operator about CHP capability and performance
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Conclusions

- CHP users remain interconnected to and integrated with the power grid
 - Grid integration issues can make or break a CHP project
 - If grid integration is properly designed, CHP can help support a more cost effective, efficient, robust and clean grid system
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