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LNG Liquefaction Cycle Efficiency Analysis

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Carnot Work

- Carnot Cycle Work

- $W_{\min} = T_o \Delta S - \Delta H$

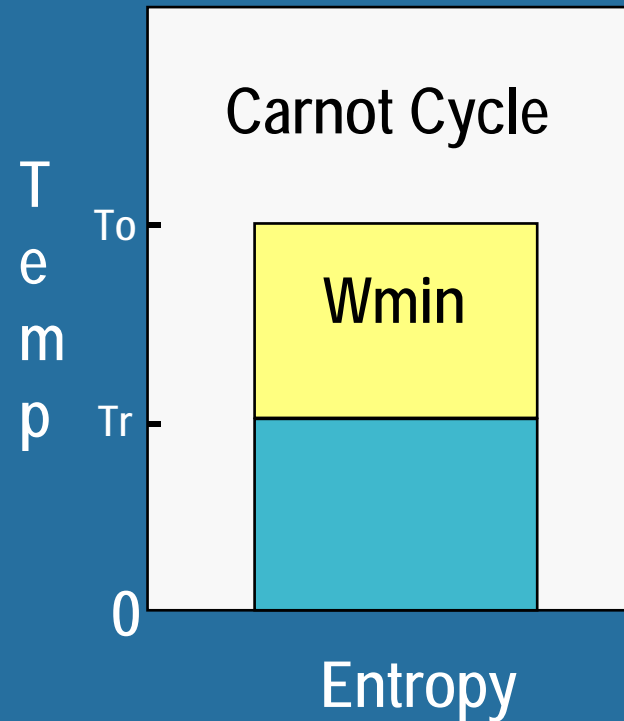
- Carnot efficiency

$$\frac{W}{Q_o} = \frac{(T_o) - (T_r)}{(T_o)}$$

- COP

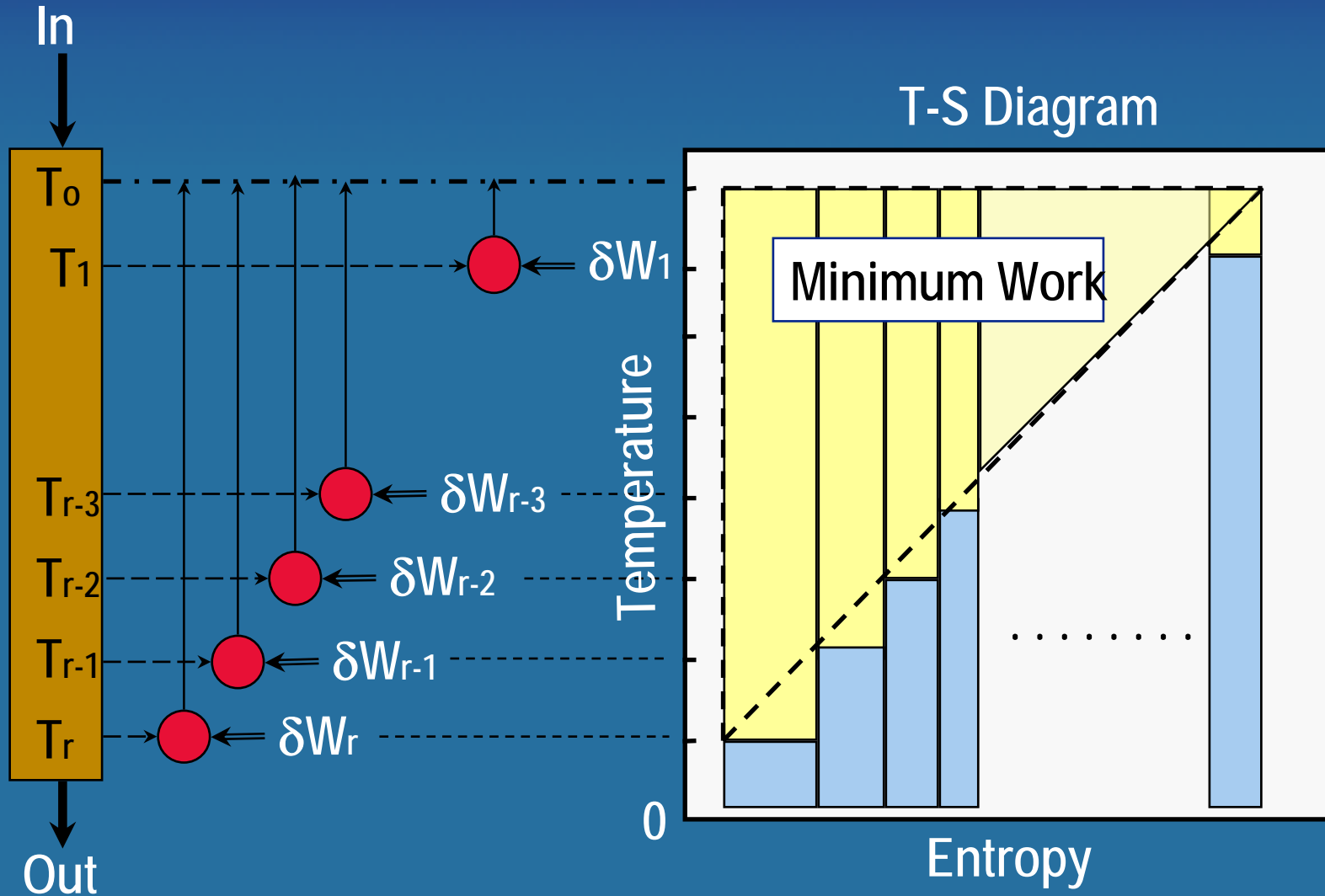
$$\frac{Q_r}{W} = \frac{(T_r)}{(T_o) - (T_r)}$$

Temperature-Entropy Diagram

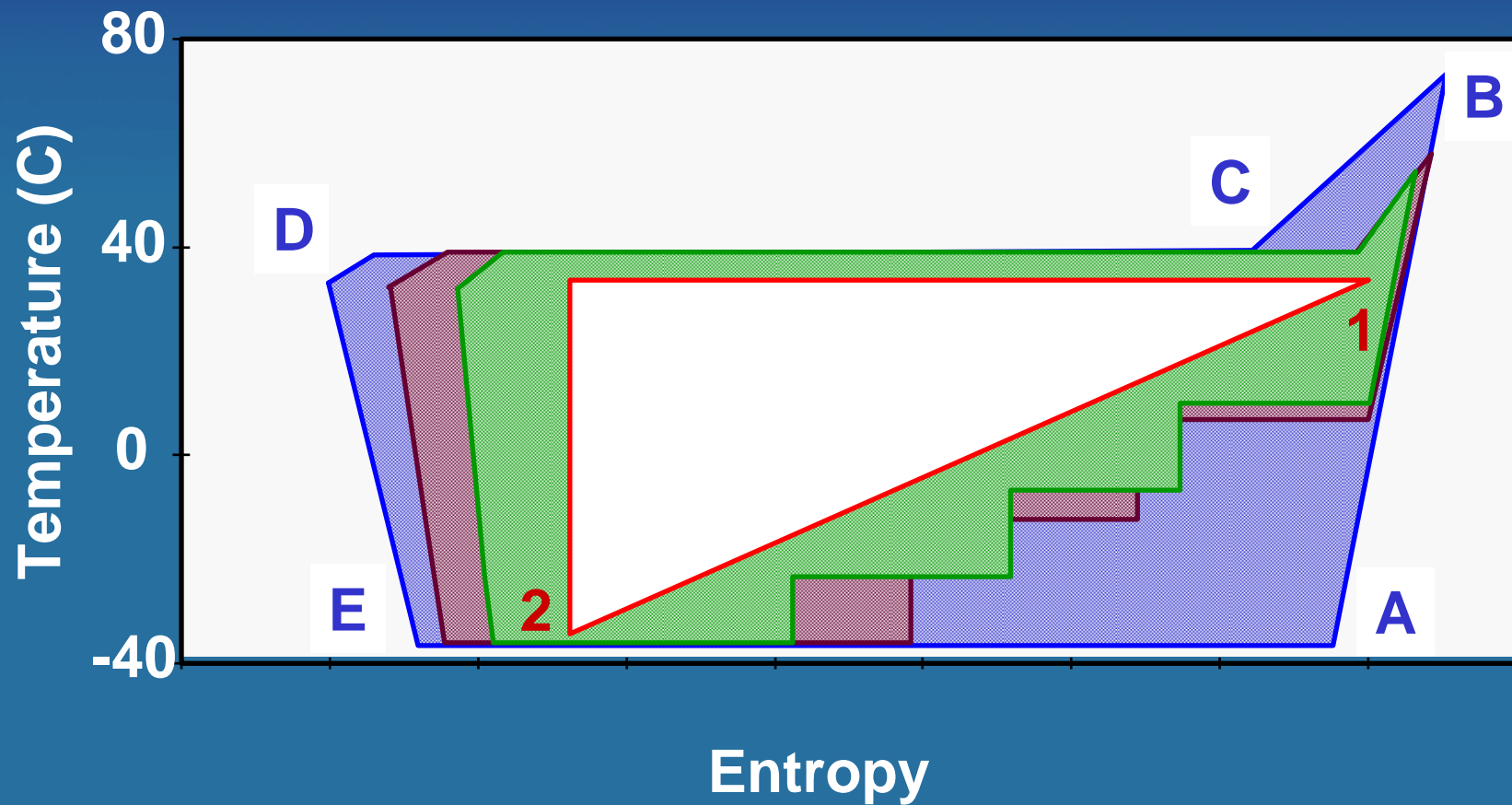


Carnot Work Over a Temperature Range

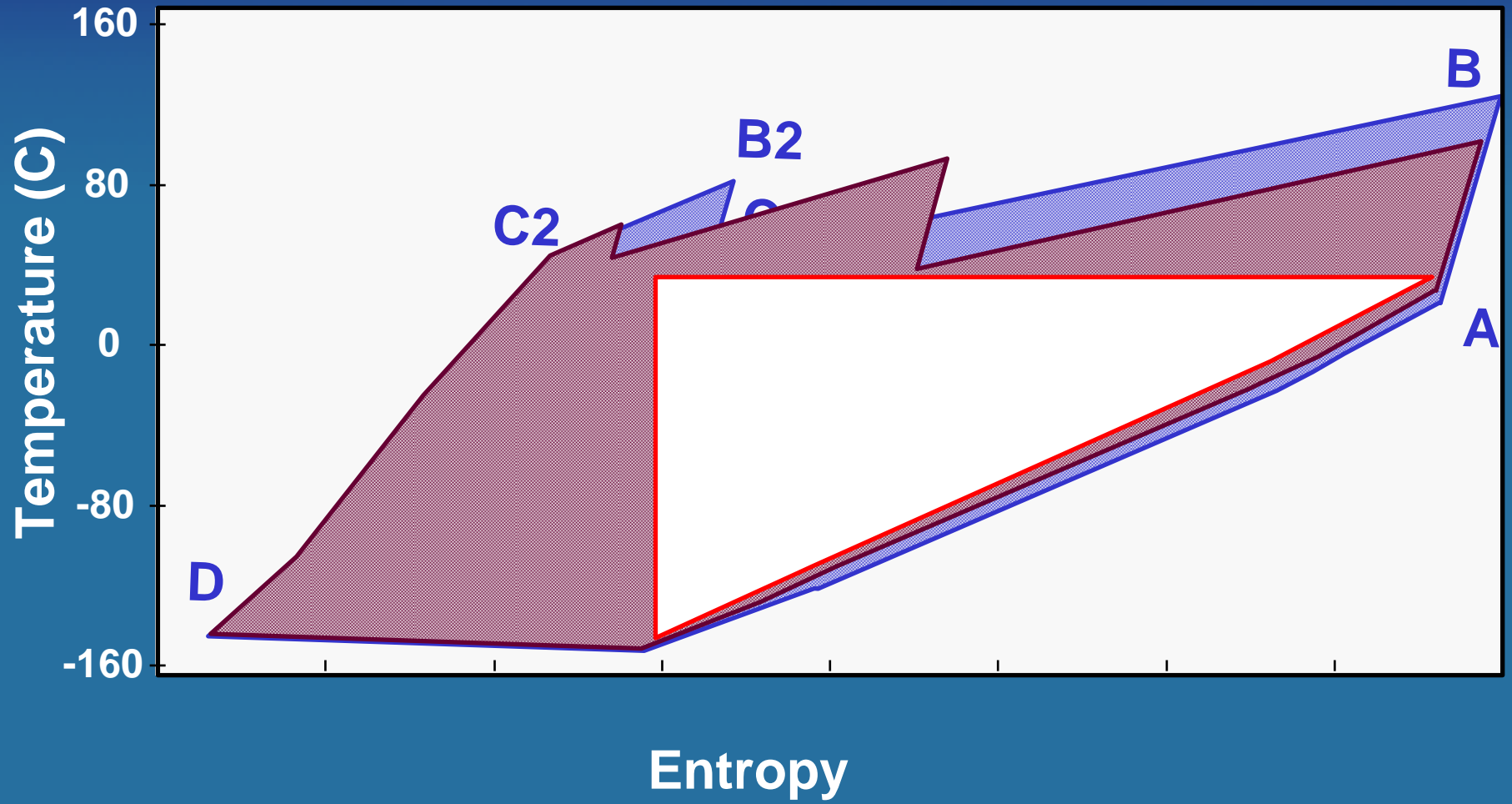
Minimum work: $\delta W = T_0 \delta S - \delta H$



Temperature-Entropy Diagram Pure Component System

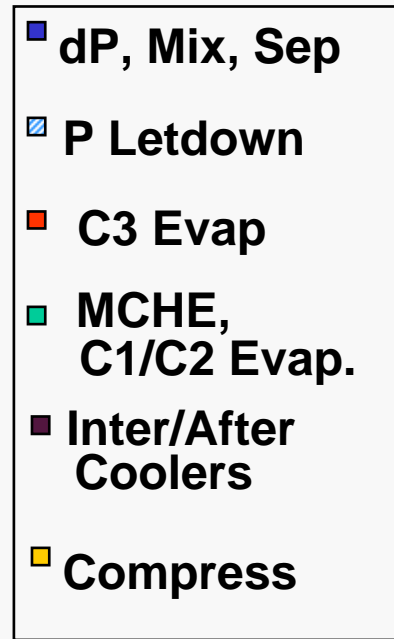
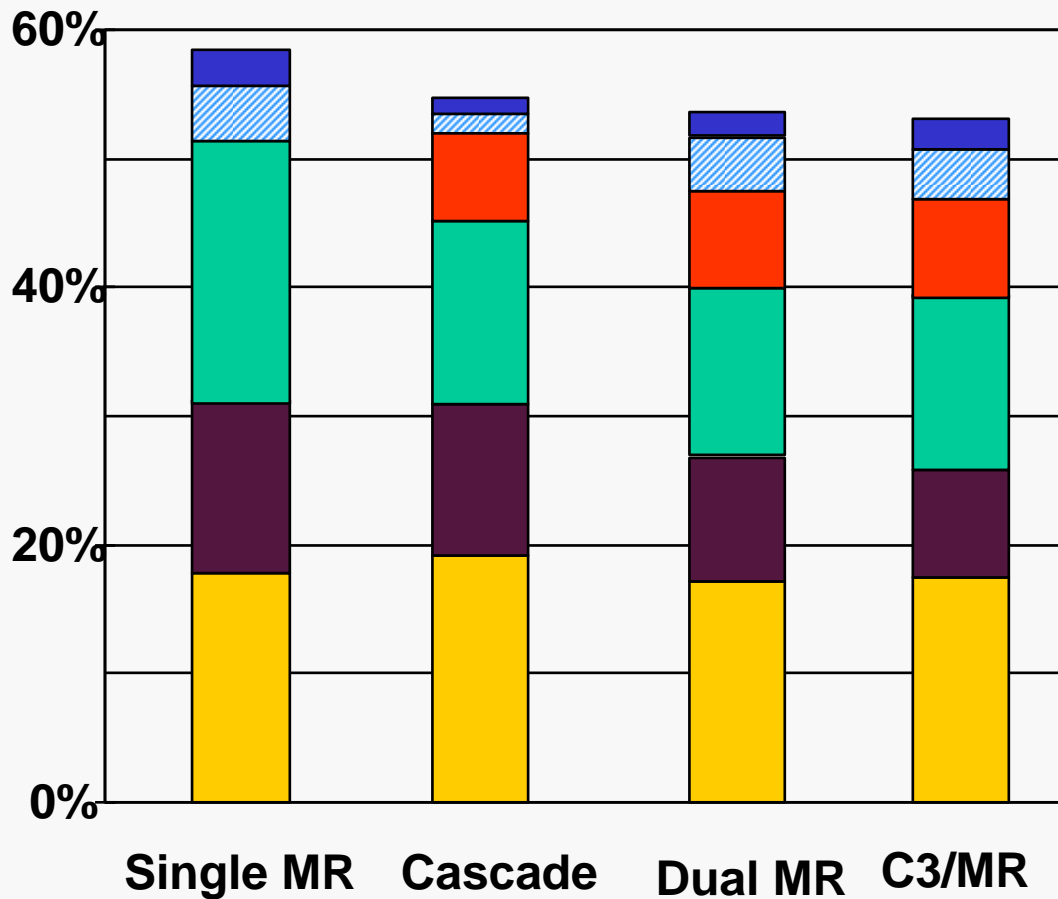


Temperature-Entropy Diagram Mixed Refrigerant Cycle

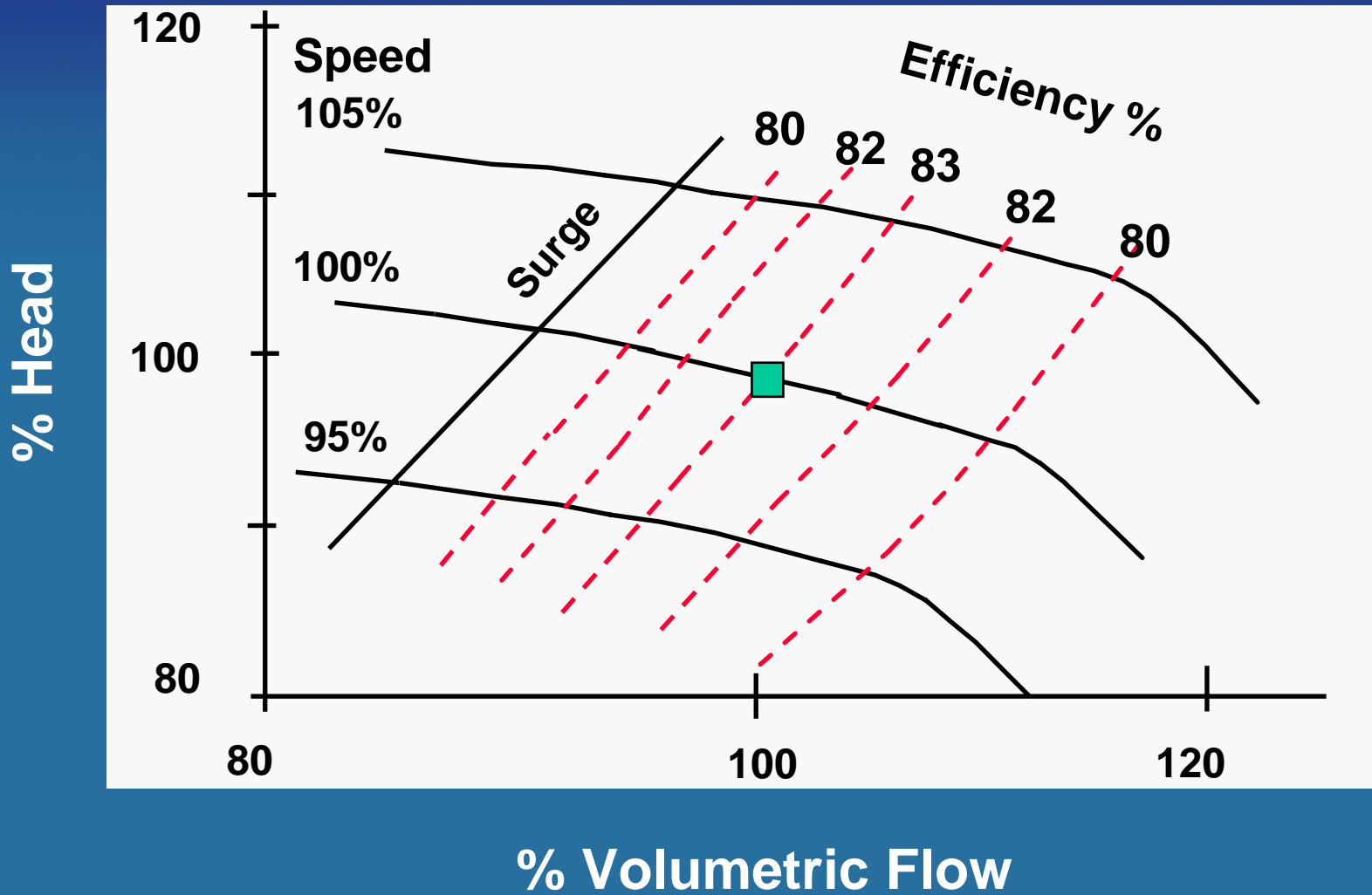


Lost Work Components

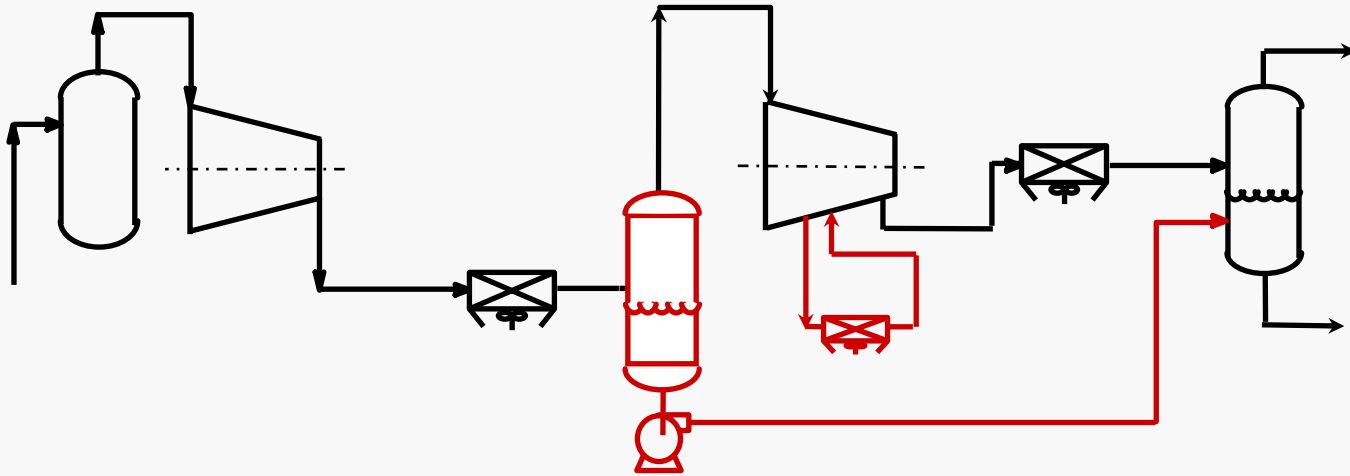
Lost Work, % Total Work
(Increasing Power ↑)



Compressor Performance Curve



Interstage Cooling/Condensing Issues

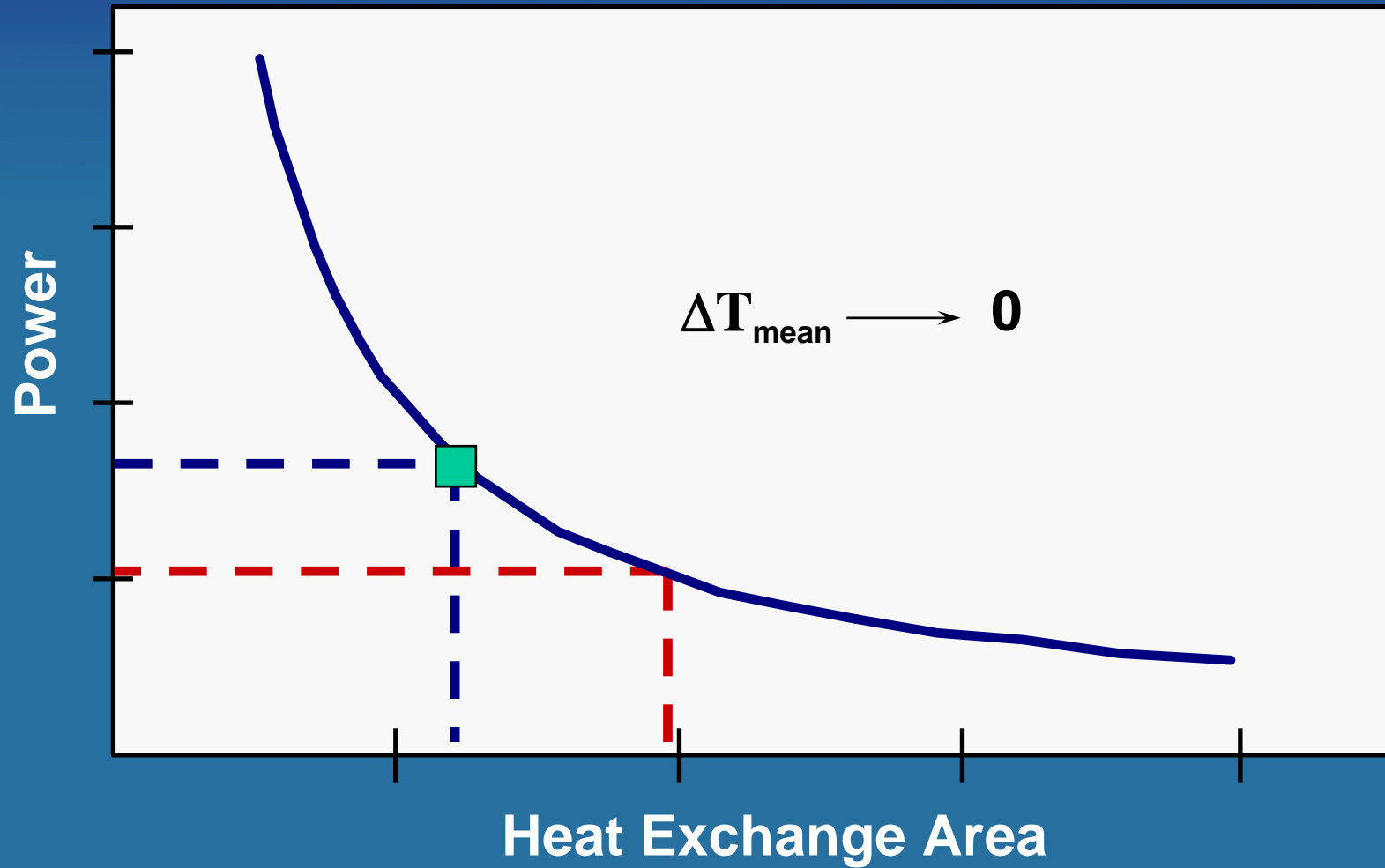


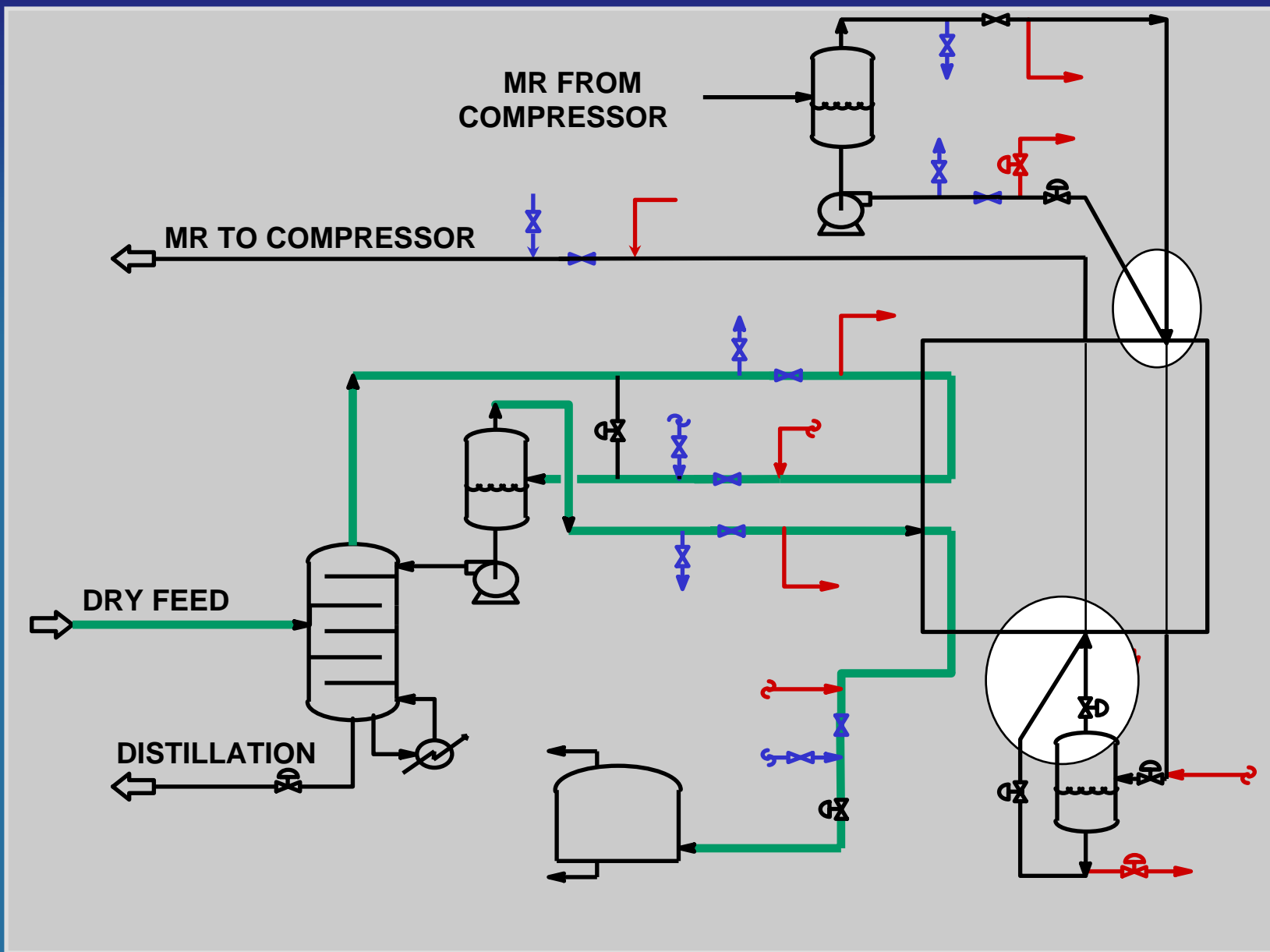
**Interstage Cooling - More Isothermal
Compression**

Cp/Cv Ratio N2-1.4; C1-1.3; MR-1.2; C3-1.1

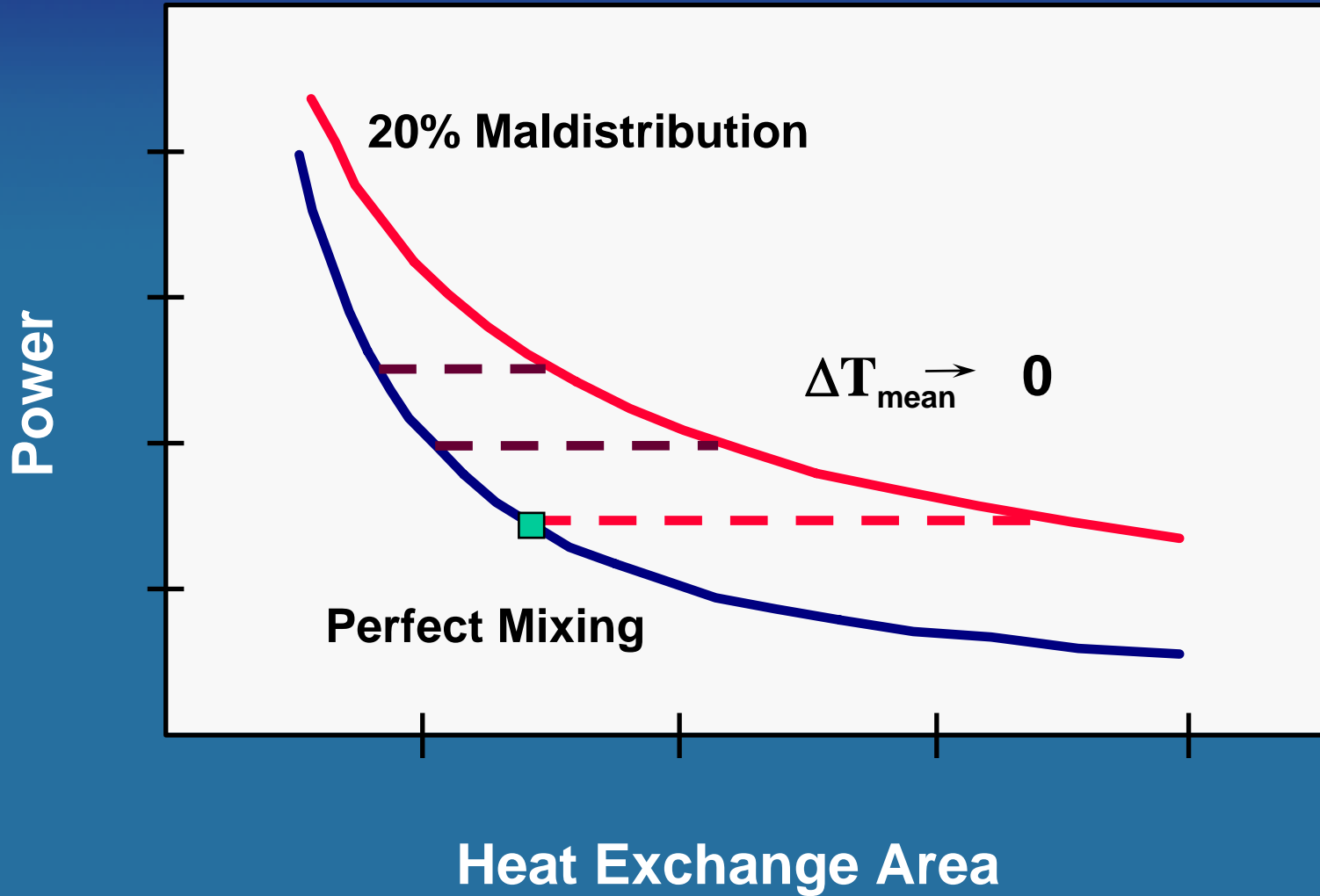
**Interstage Condensing - Converts
Compression to Pump Power**

Power - Area Tradeoff

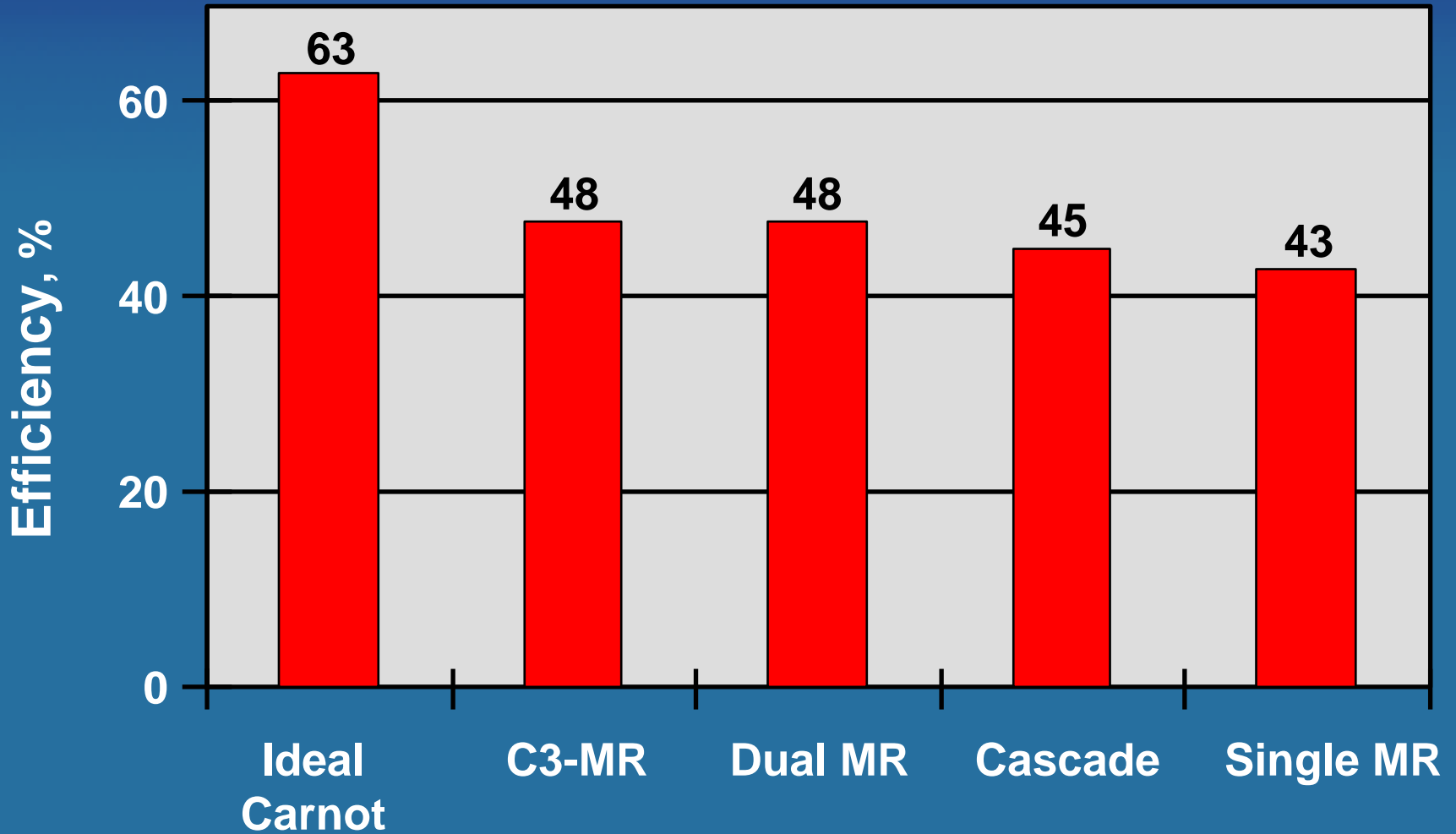




Maldistribution



Cycle Efficiency Comparison



- Thermodynamic fundamentals
- Sound engineering practices
- Defined evaluation criteria

Will produce a meaningful
LNG Liquefaction Cycle
Efficiency Analysis

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