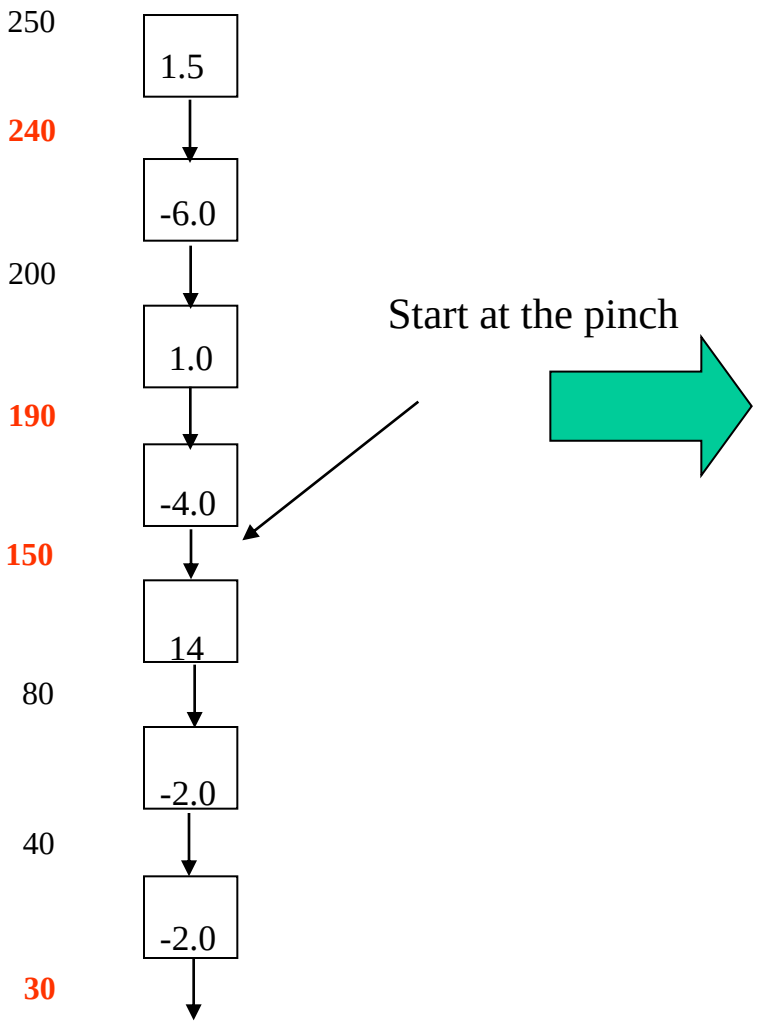
PART 2

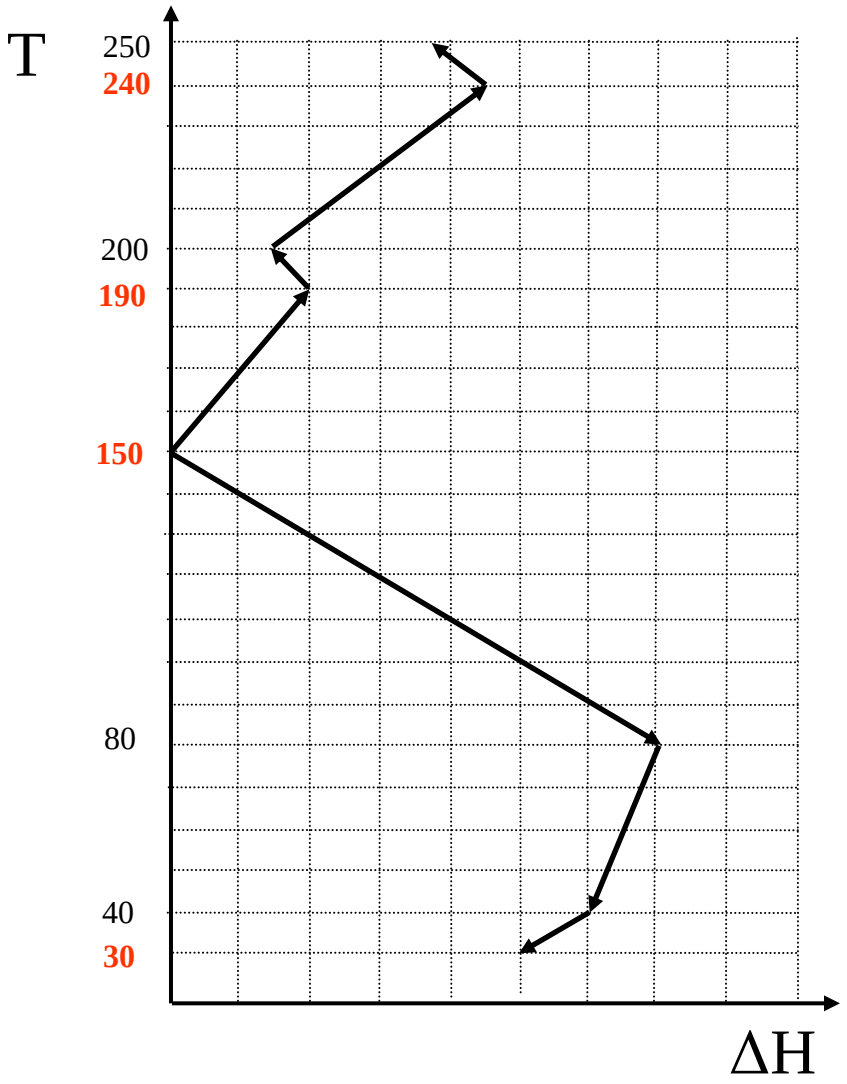
UTILITY PLACEMENT AND INTEGRATION WITH POWER

UTILITY PLACEMENT

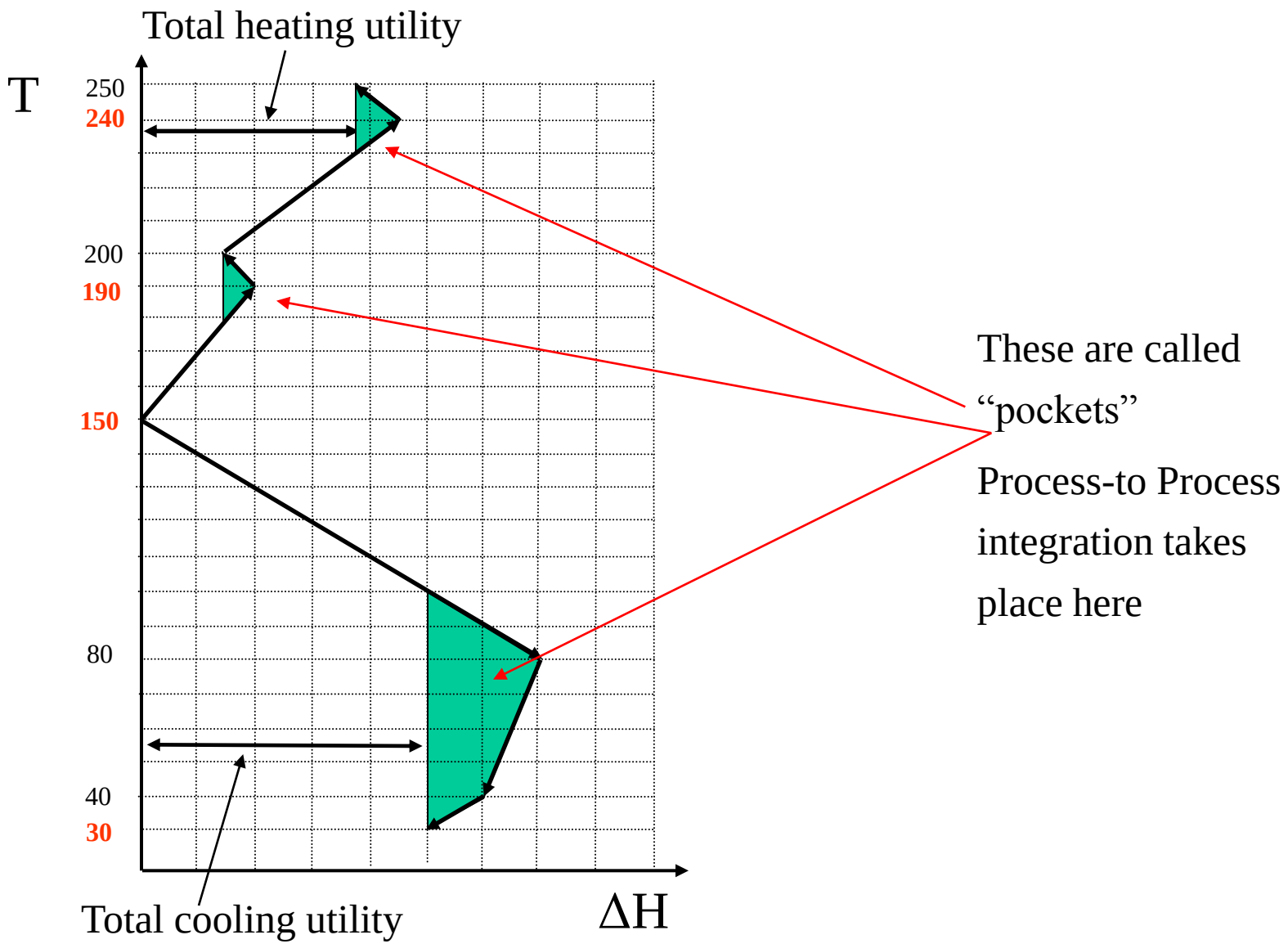
We now introduce the GRAND COMPOSITE CURVE, which will be useful to analyze the placement of utilities.



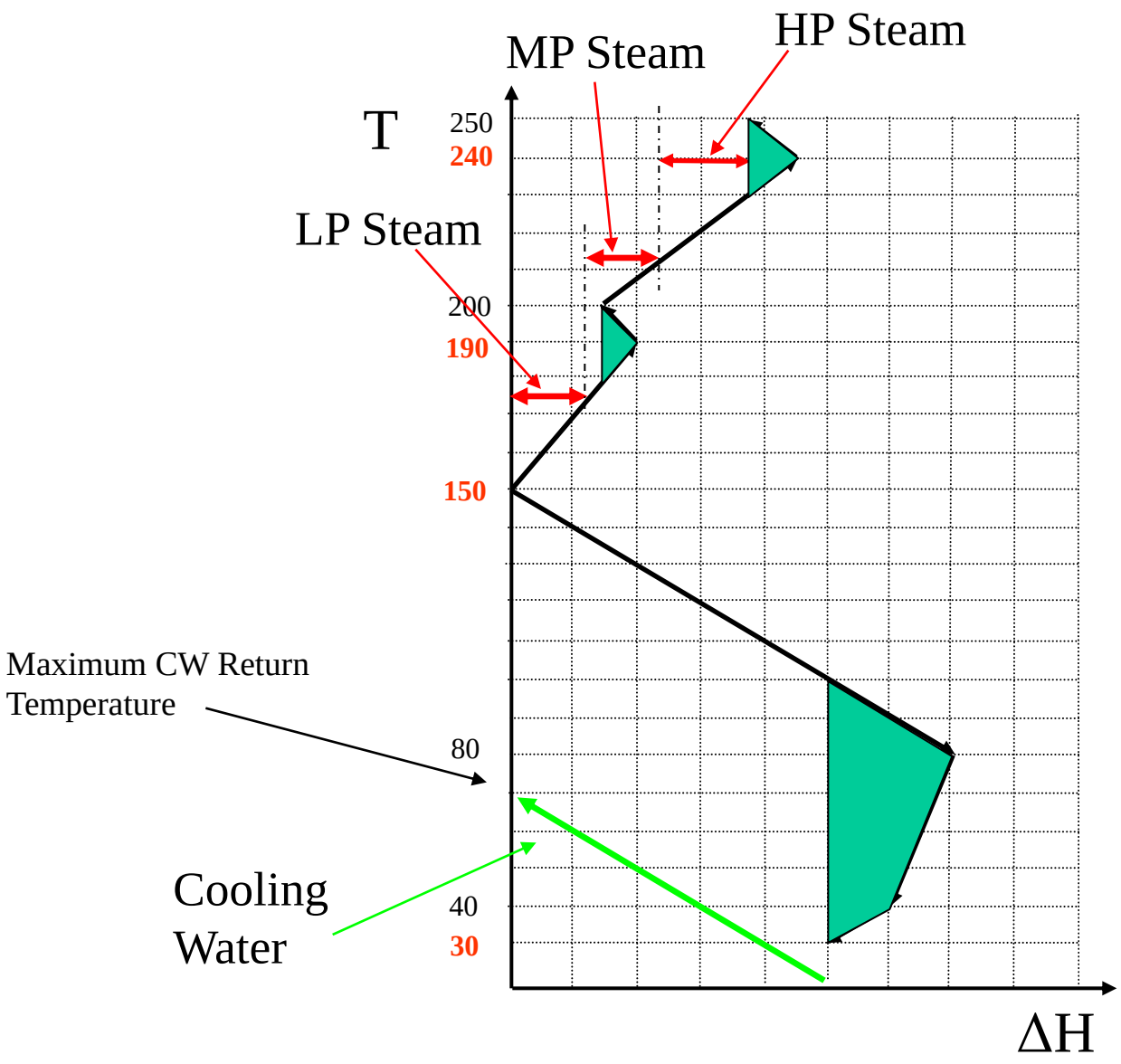
Start at the pinch



GRAND COMPOSITE CURVE

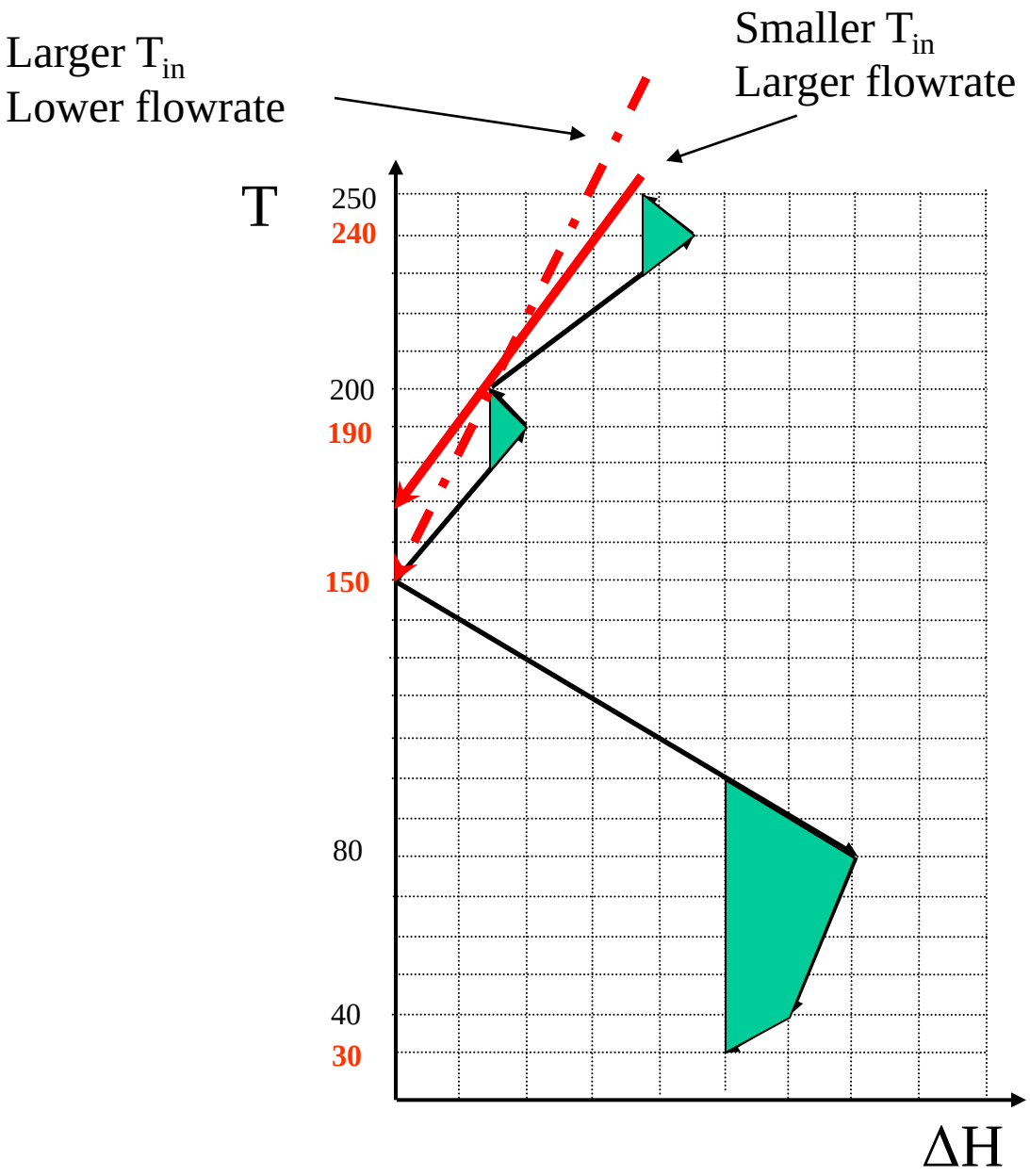


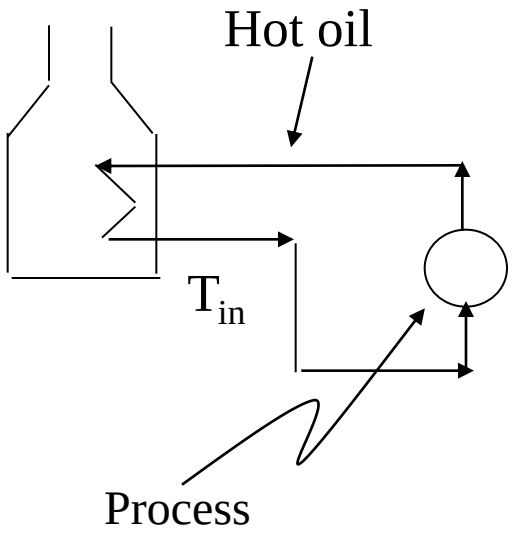
UTILITY PLACEMENT



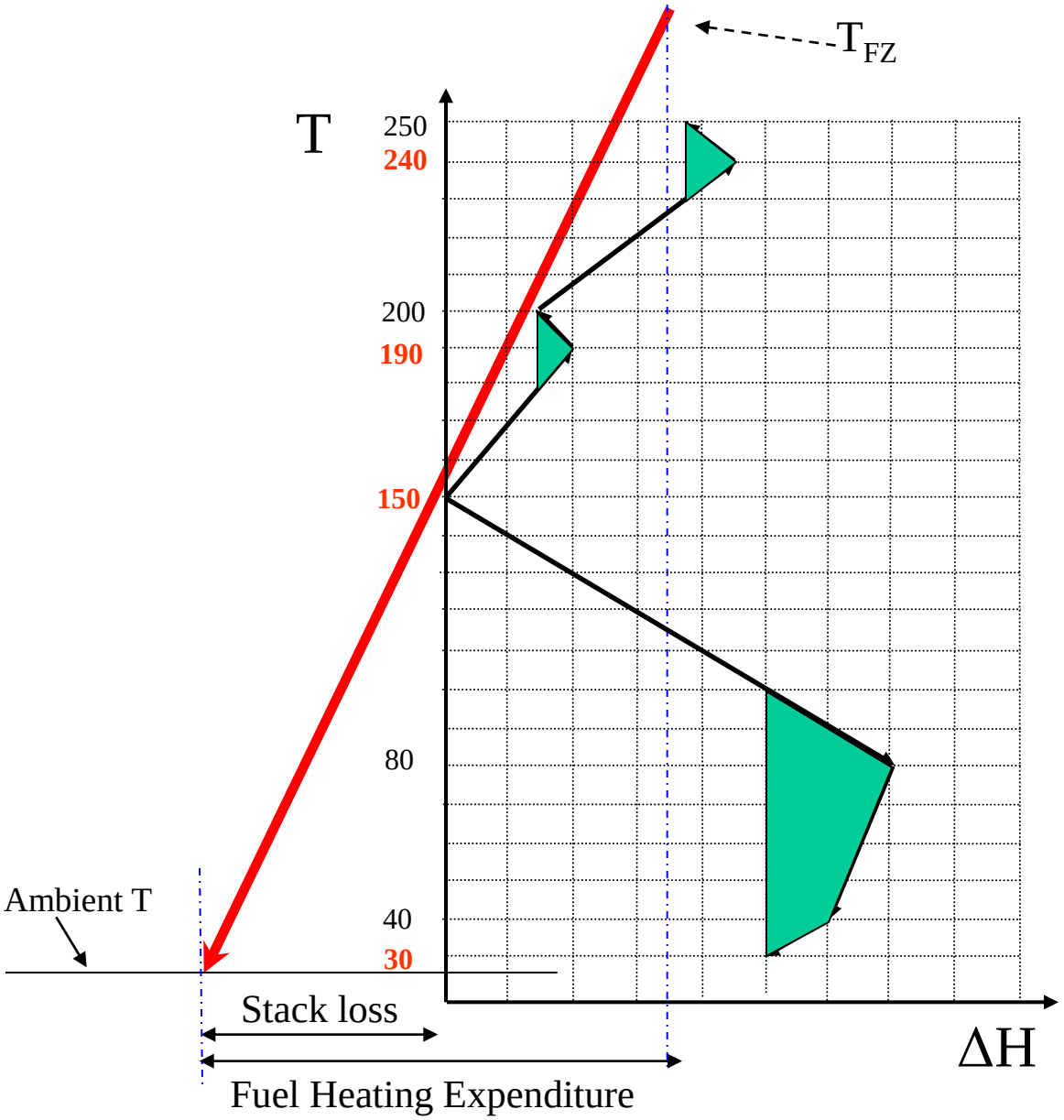
Cooling Water line should not cross the Grand Composite Curve

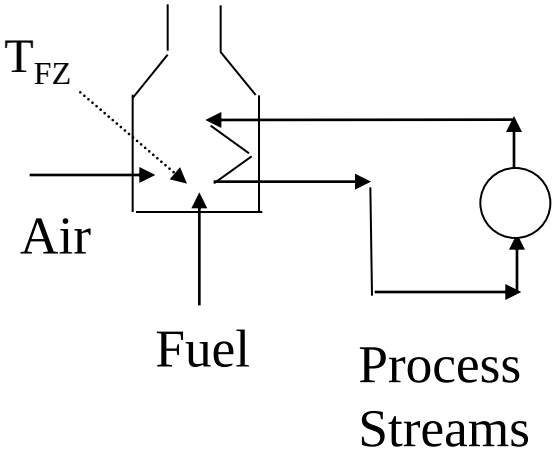
HOT OIL PLACEMENT



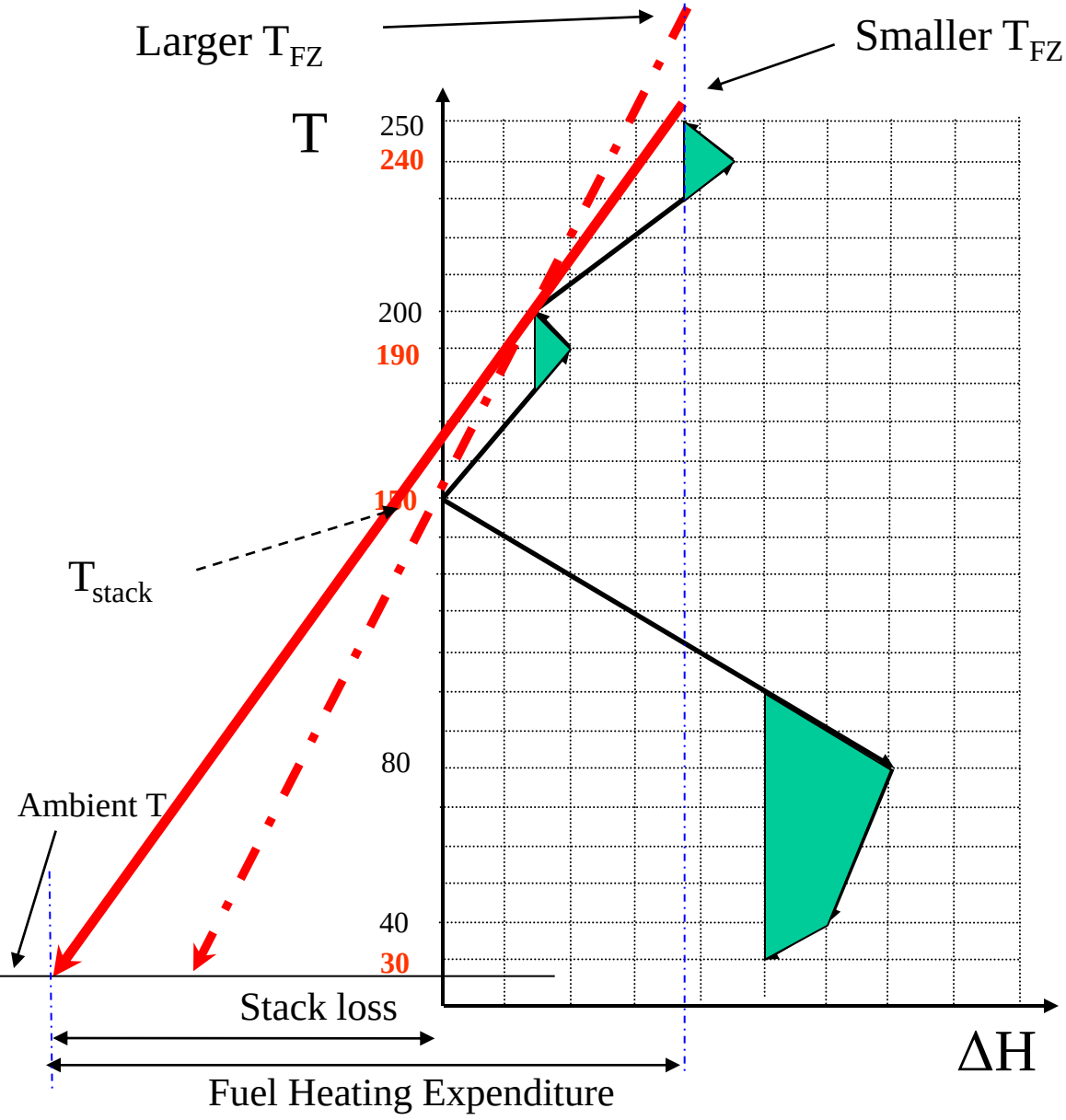


FURNACE PLACEMENT

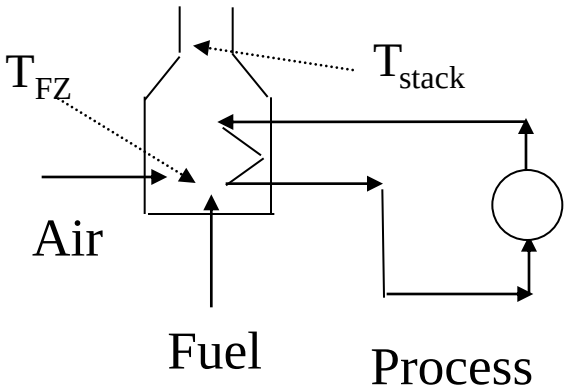




FURNACE PLACEMENT

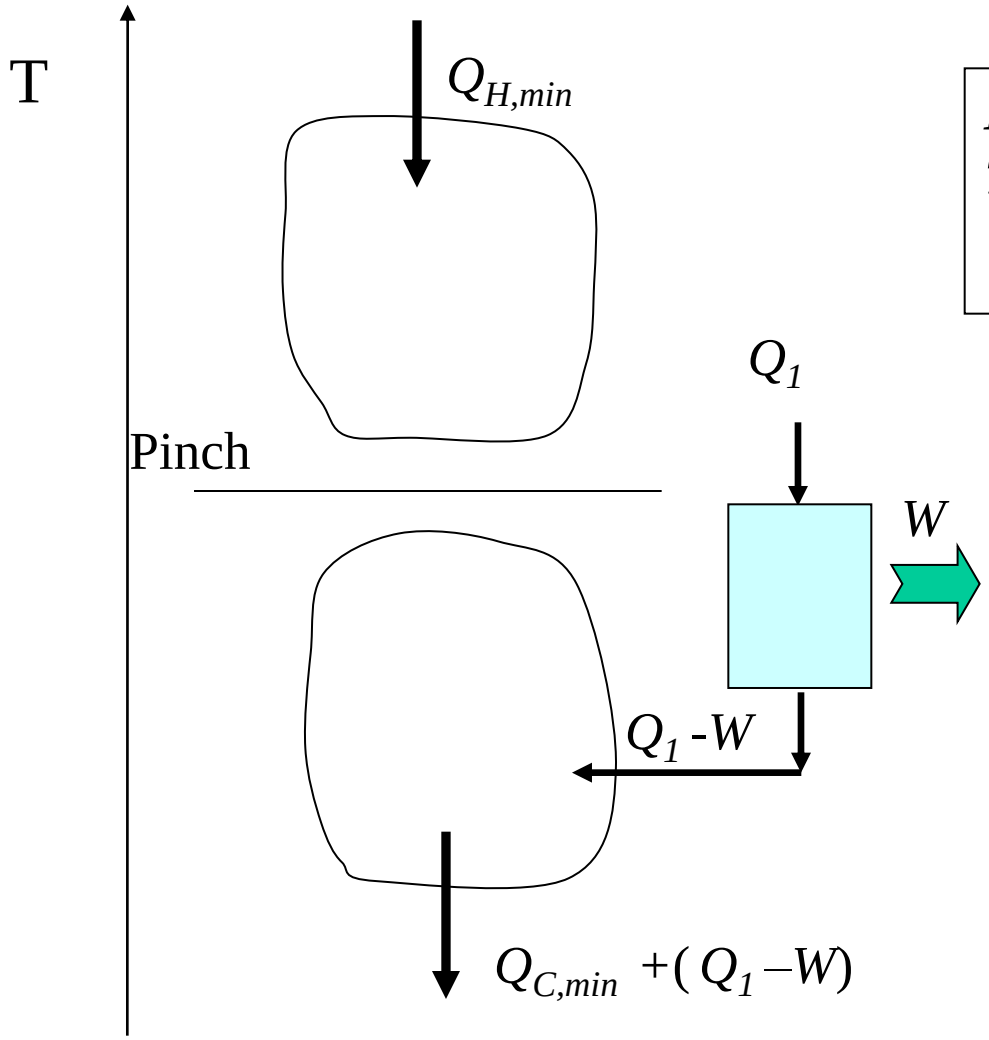


Smaller T_{FZ} increases Fuel Heating Expenditure!!!!!!!



COMBINED HEAT AND POWER

Use of Steam Turbine exhaust below the pinch



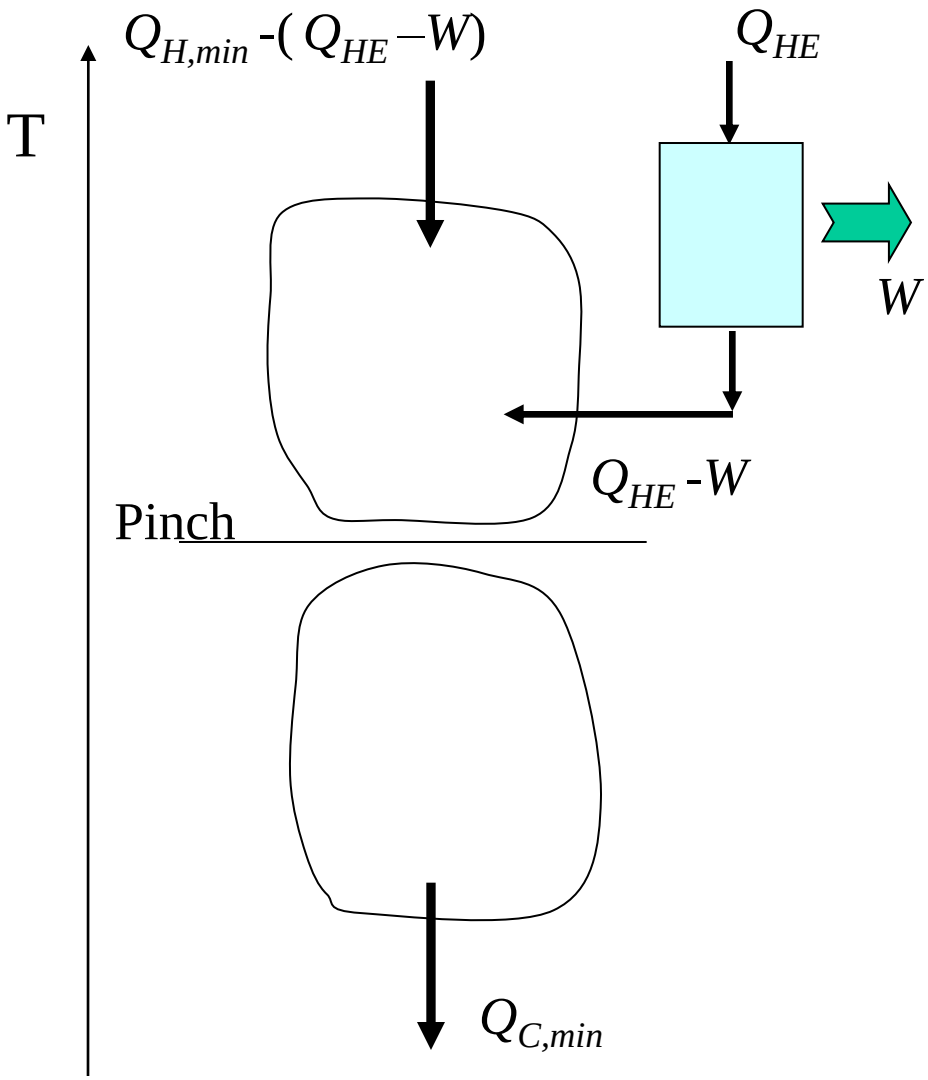
INTEGRATED SYSTEM TOTAL ENERGY INTAKE

$Q_{H,,min} + Q_1$

Note that in this case there is no gain. The heat engine can be arranged separately and the utility usage will not change.

COMBINED HEAT AND POWER

Use of Steam Turbine exhaust above the pinch



INTEGRATED SYSTEM TOTAL ENERGY INTAKE

$Q_{H,,min} + W$

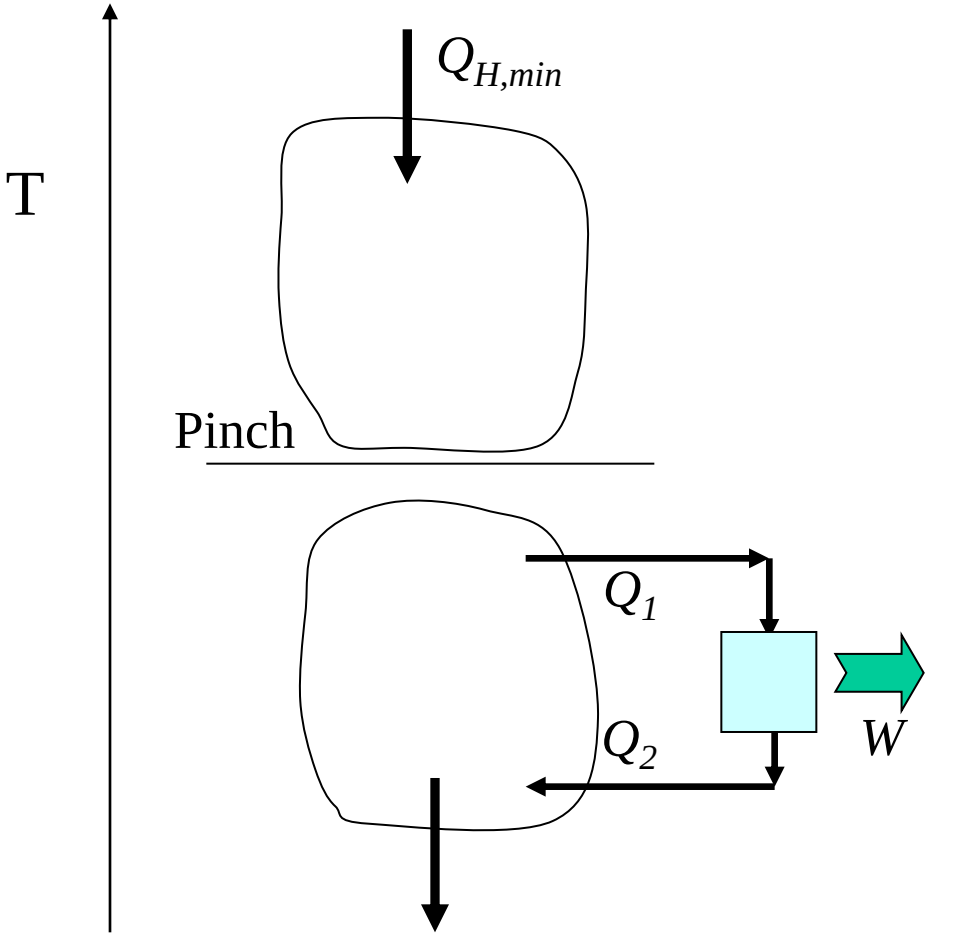
Note that in this case there is gain

SEPARATE SYSTEMS TOTAL ENERGY INTAKE

$Q_{H,,min} + Q_{HE}$

COMBINED HEAT AND POWER

Heat Engine Placement below the pinch.



$$Q_{C,min} + (Q_2 - Q_1) = Q_{C,min} - W$$

INTEGRATED SYSTEM TOTAL ENERGY INTAKE

$Q_{H,,min}$

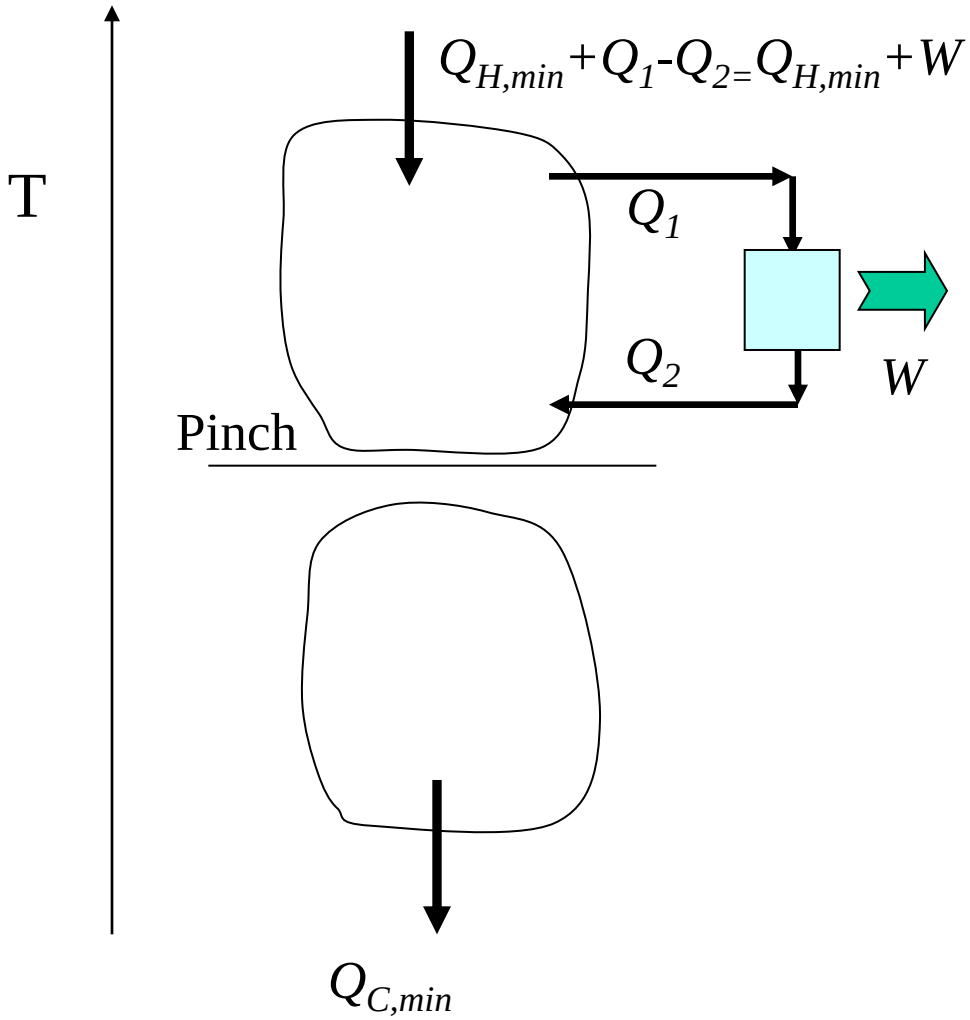
SEPARATE SYSTEMS TOTAL ENERGY INTAKE

$Q_{H,,min} + Q_1$

In this case there is a reduction of W in cooling utility. Both produce W.

COMBINED HEAT AND POWER

Heat Engine Placement above the pinch.



INTEGRATED SYSTEM TOTAL ENERGY INTAKE

$Q_{H,,min}+W$

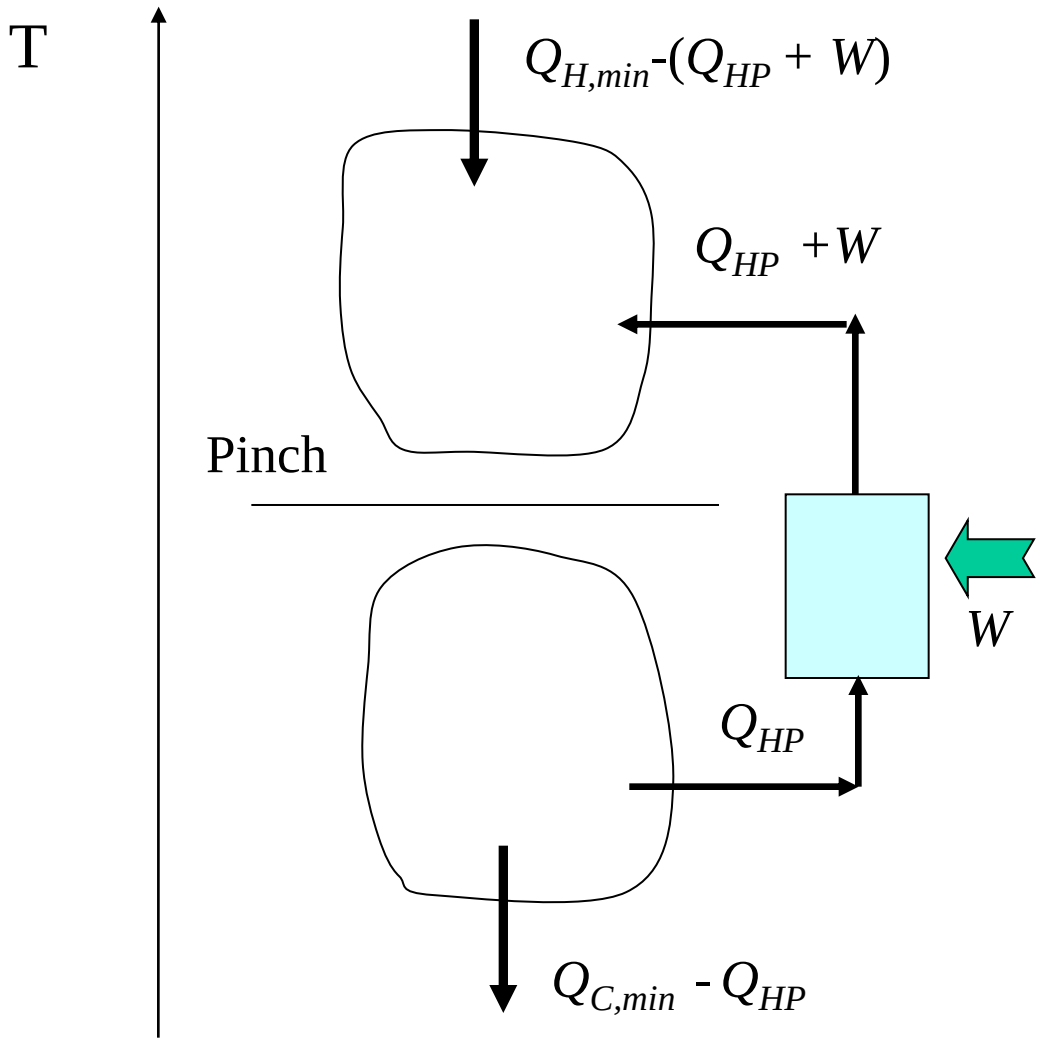
SEPARATE SYSTEMS TOTAL ENERGY INTAKE

$Q_{H,,min}+Q_1$

Both produce W.

COMBINED HEAT AND POWER

Heat Pump Placement across the pinch.



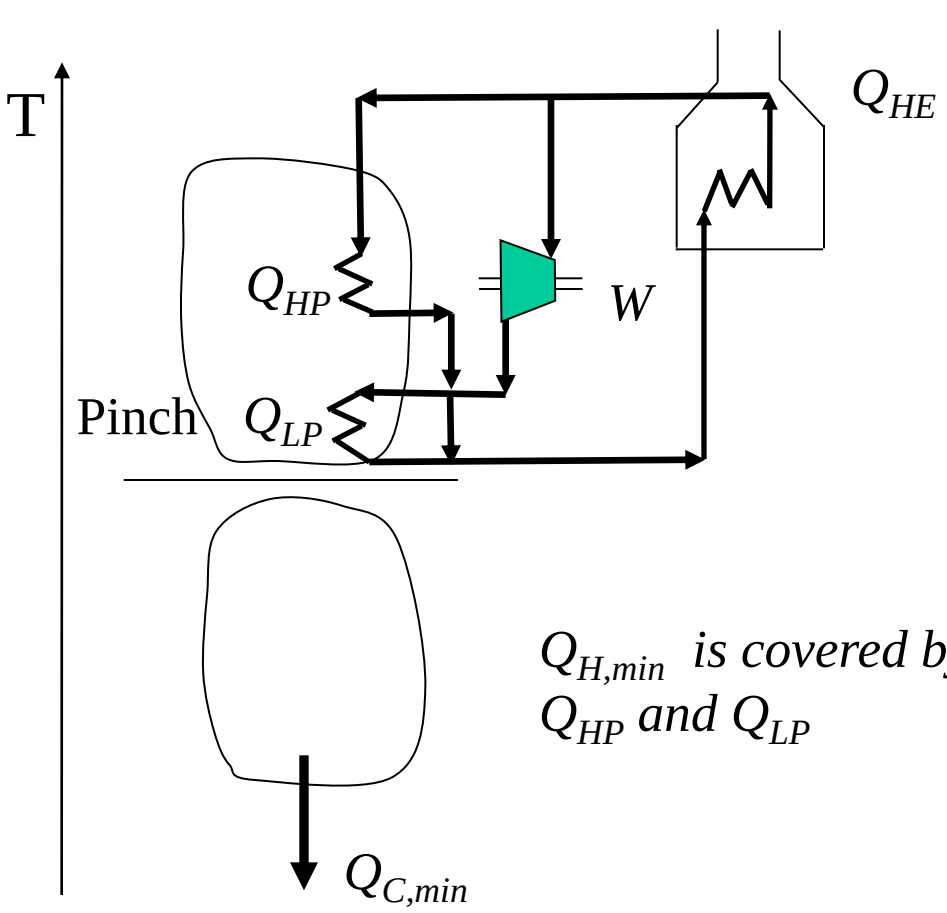
TOTAL ENERGY INTAKE

$Q_{H,min}$-Q_{HP}

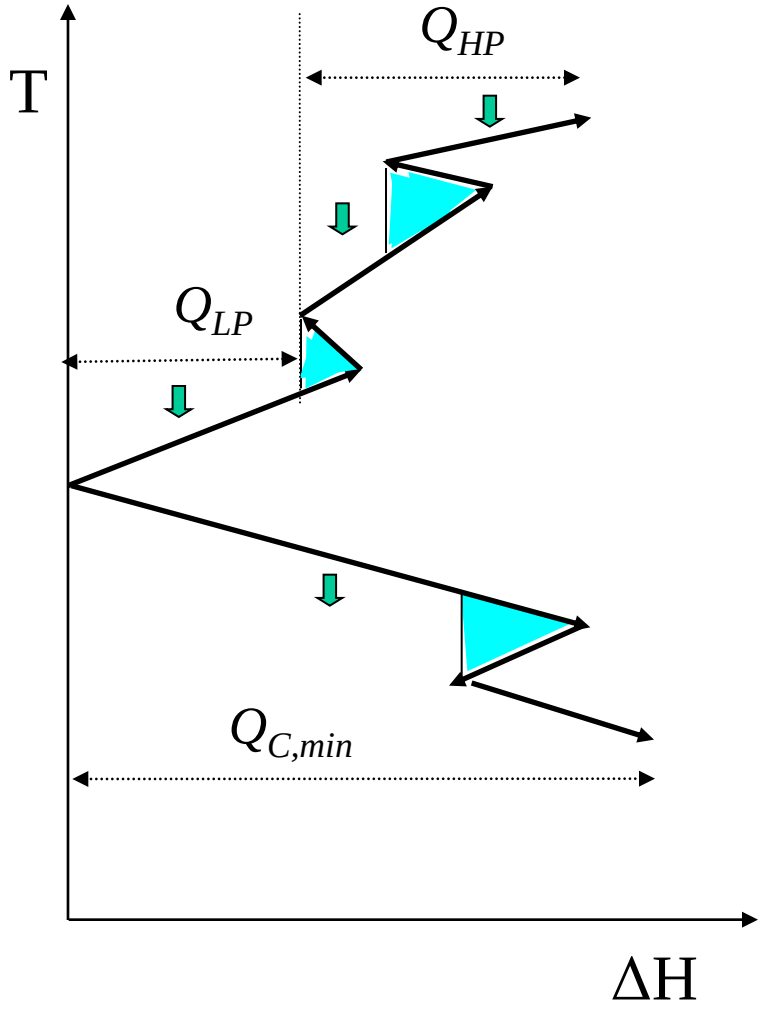
A net reduction of Q_{HP}

COMBINED HEAT AND POWER

Utility Placement



$Q_{H,min}$ *is covered by* Q_{HP} *and* Q_{LP}



COMBINED HEAT AND POWER

Gas Turbine Placement

INTEGRATED SYSTEM
TOTAL ENERGY INTAKE

$Q_{H,min} + W + Q_{LOSS}$

SEPARATE SYSTEMS
TOTAL ENERGY INTAKE

$Q_{H,min} + Q_F$