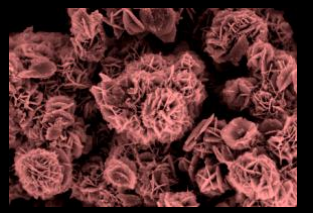




Chemical Engineering

Inspiring Potential · Generating Futures

UNIVERSITI TEKNOLOGI PETRONAS

CDB 4313Z – HEAT INTEGRATION

PROCESS INTEGRATION I

APPROPRIATE PLACEMENT OF HEAT ENGINE AND HEAT PUMPS

ZULFAN ADI PUTRA, PDENG

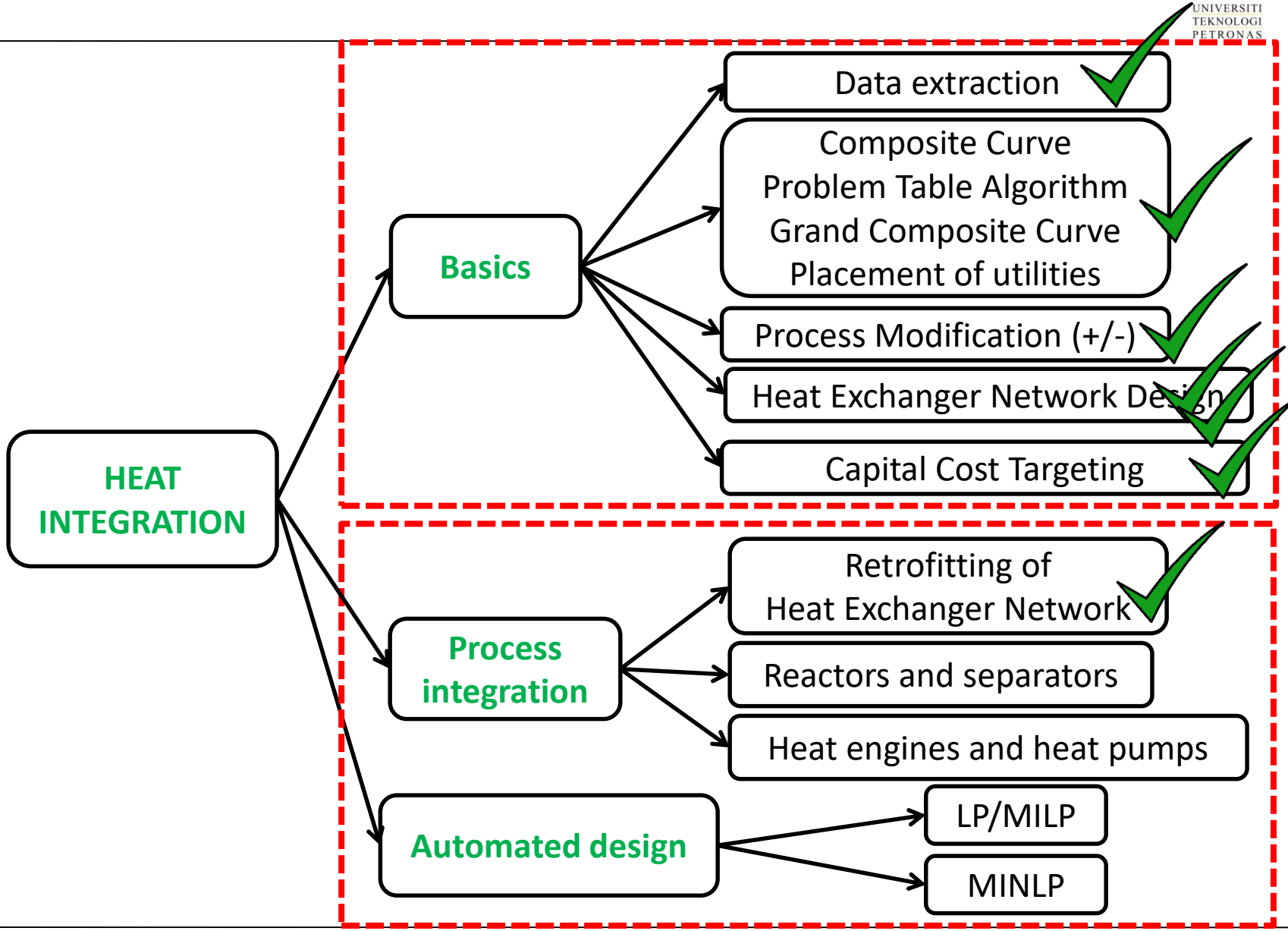
OFFICE: 05-03-08
TELP: 05 368 7562
EMAIL: zulfan.adiputra@utp.edu.my

Discussion time: Friday 15.00 – 17.00

Chemical Engineering
Inspiring Potential · Generating Futures

COURSE OVERVIEW

UNIVERSITI TEKNOLOGI PETRONAS



Chemical Engineering
Inspiring Potential · Generating Futures

COURSE LEARNING OUTCOMES

UNIVERSITI TEKNOLOGI PETRONAS

At the end of this course, students shall be able to:

1. Perform **targeting exercise** to determine the minimum utility requirements and maximum heat recovery possible for a process using composite curve or problem table algorithm

2. **Design heat exchanger network** for achieving maximum energy recovery or minimum total cost using pinch analysis technique

3. **Apply pinch analysis software** to perform heat integration and heat exchanger network design that is cost competitive and taking into account of sustainability factors

4. Analyze the **potential for heat and power integration** of a process and the possible implementation options, and to screen the options using cost effective strategy

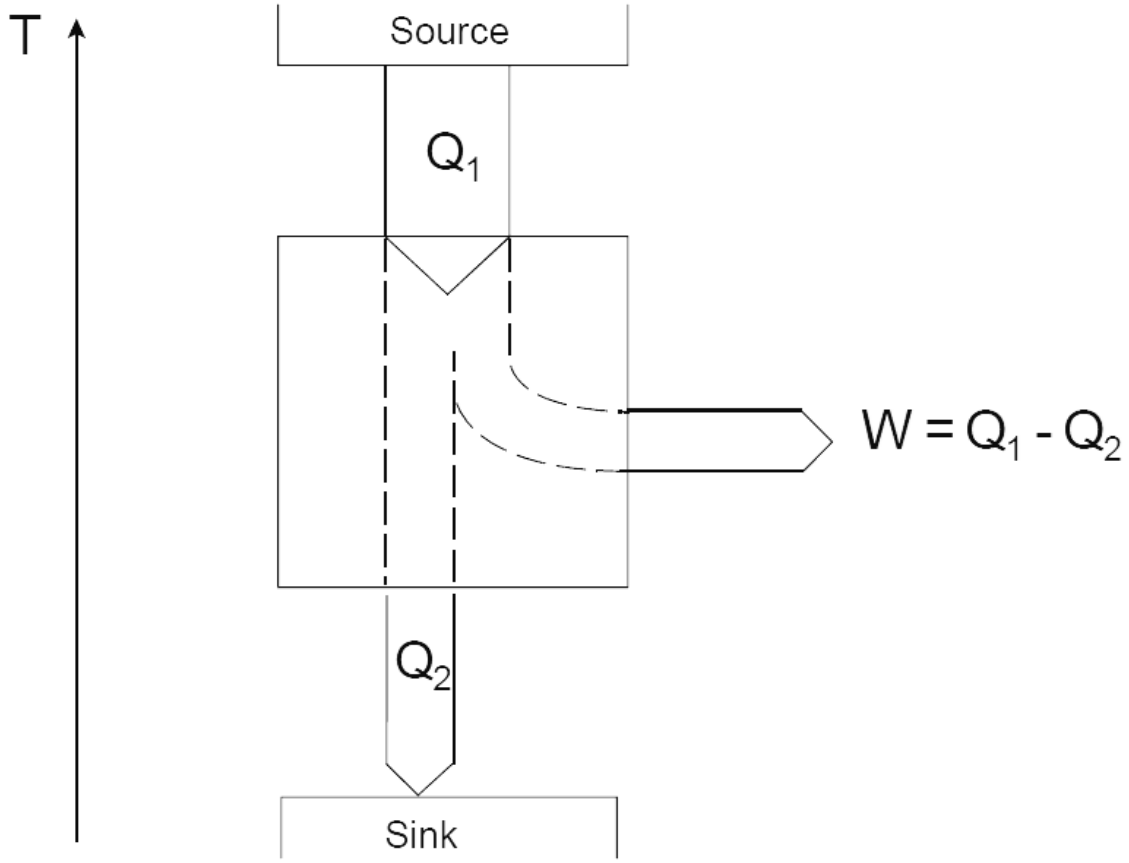
5. Perform **correct data extraction** from process flowsheet for the purpose of performing pinch analysis

Chemical Engineering
Inspiring Potential • Generating Futures

HEAT ENGINE

UNIVERSITI TEKNOLOGI PETRONAS

Heat engine → an engine that convert heat into work,
e.g. gas turbine, steam power plant



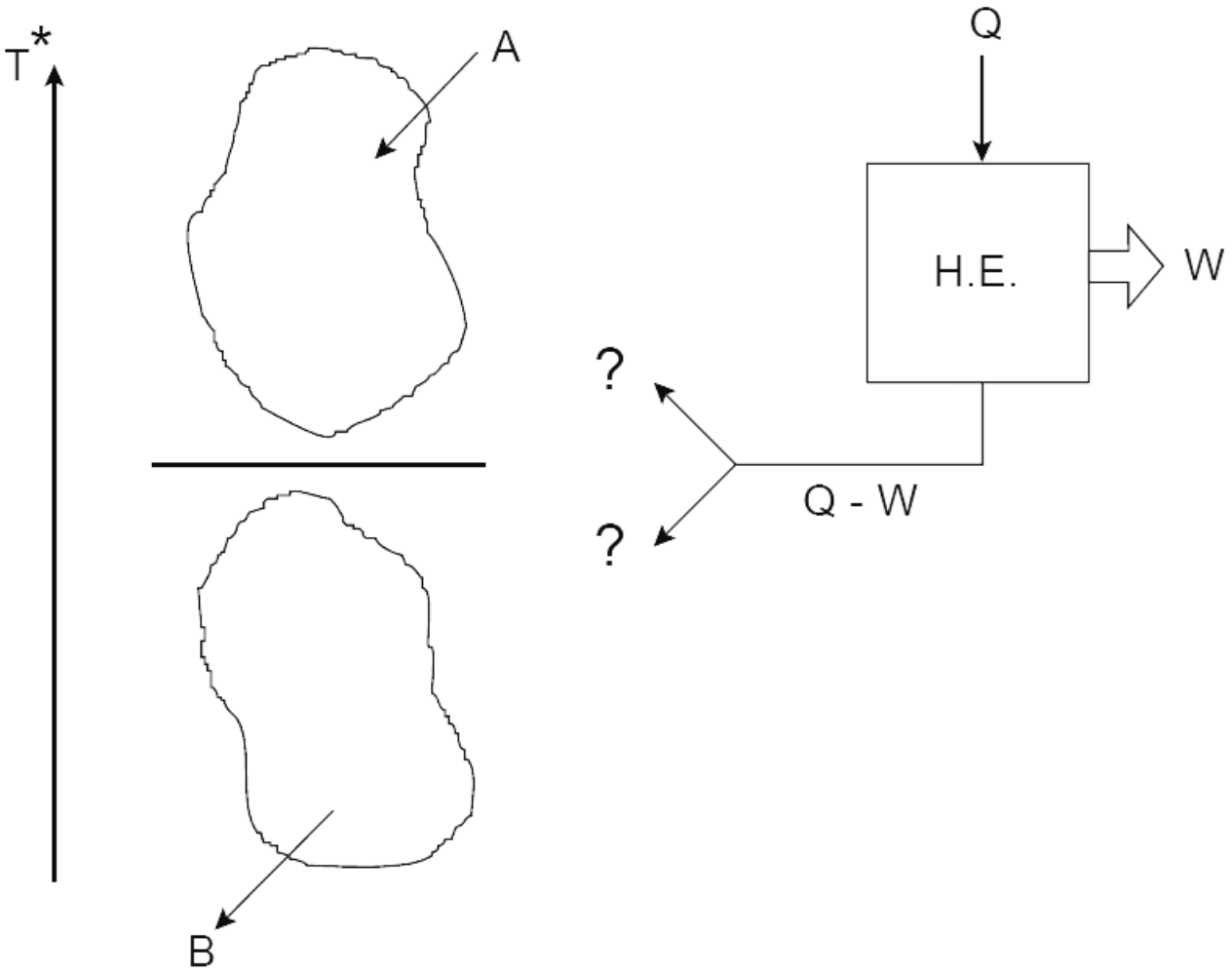
Chemical Engineering
Inspiring Potential · Generating Futures

GE GAS TURBINE

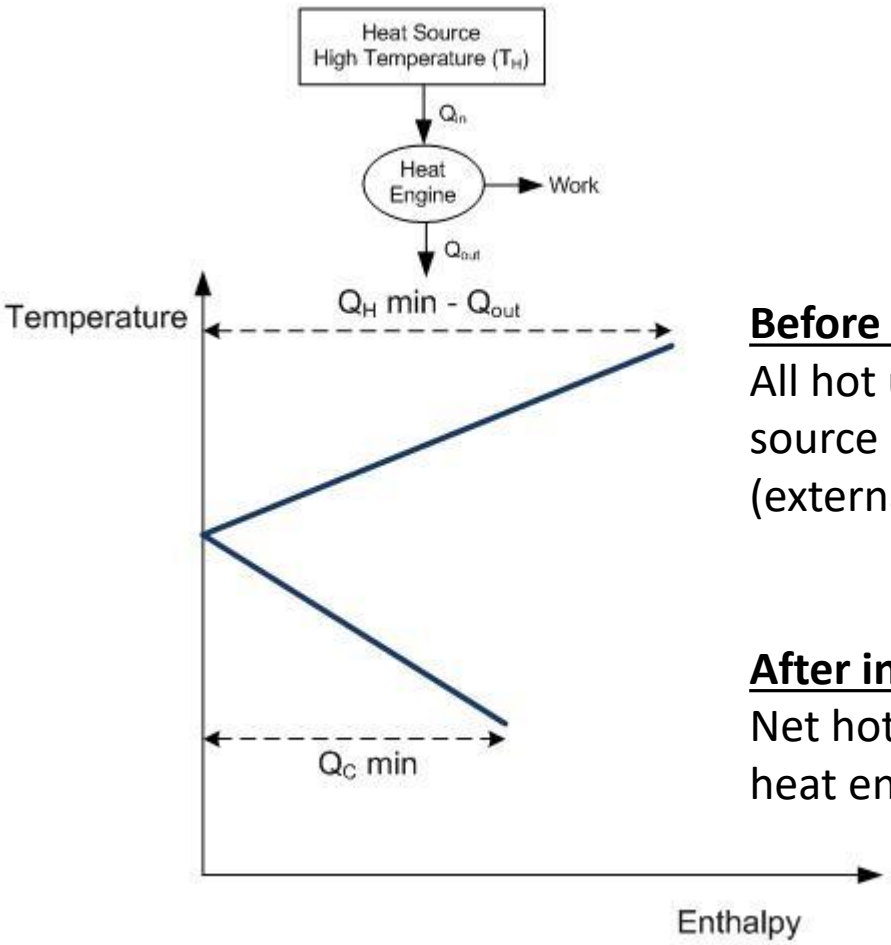
UNIVERSITI TEKNOLOGI PETRONAS

BRAINSTORM:

HOW SHOULD WE INTEGRATE HEAT ENGINE?



ABOVE PINCH?



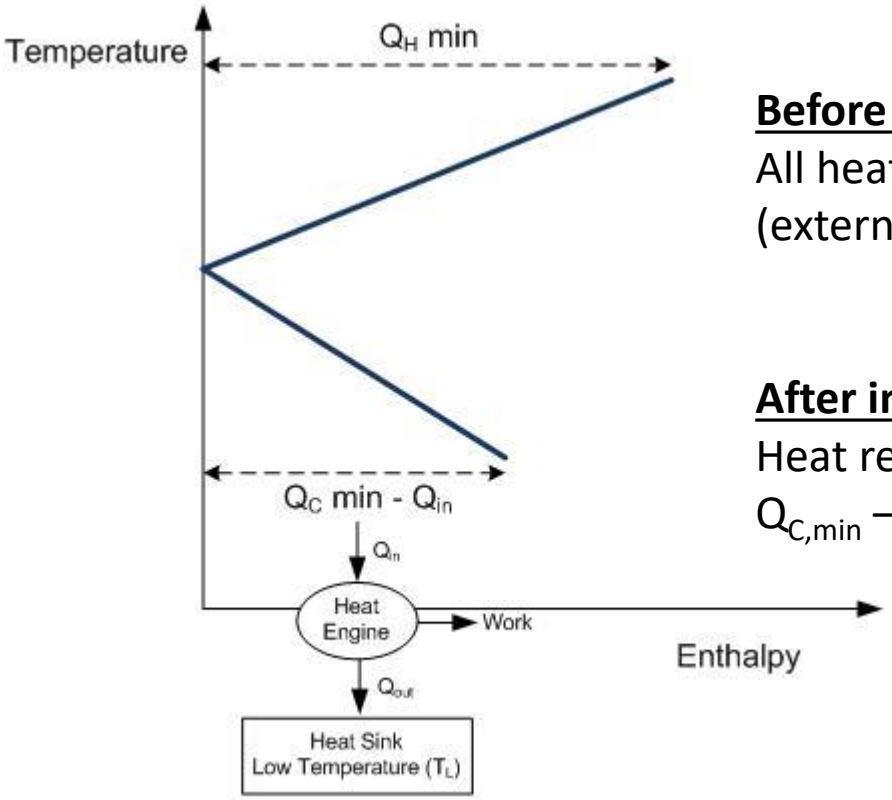
Before integration:

All hot utility ($Q_{H,min}$) is taken from external source
(external hot utility)

After integration:

Net hot utility = $Q_{H,min}$ – waste heat from heat engine

BELOW PINCH?



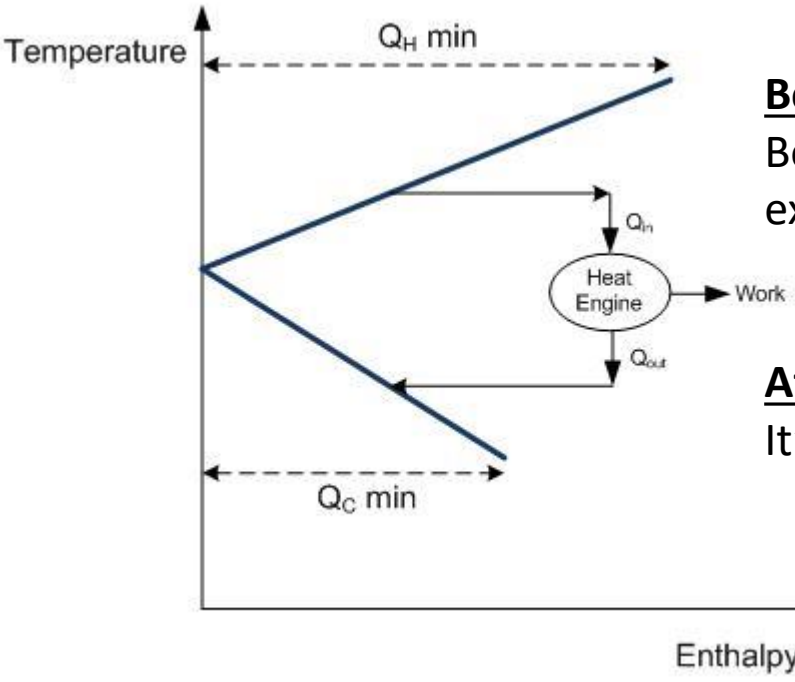
Before integration:

All heat ($Q_{C,min}$) is removed to cooling water (external cold utility)

After integration:

Heat removed to cooling water = $Q_{C,min}$ – waste heat from heat engine

ACROSS PINCH?



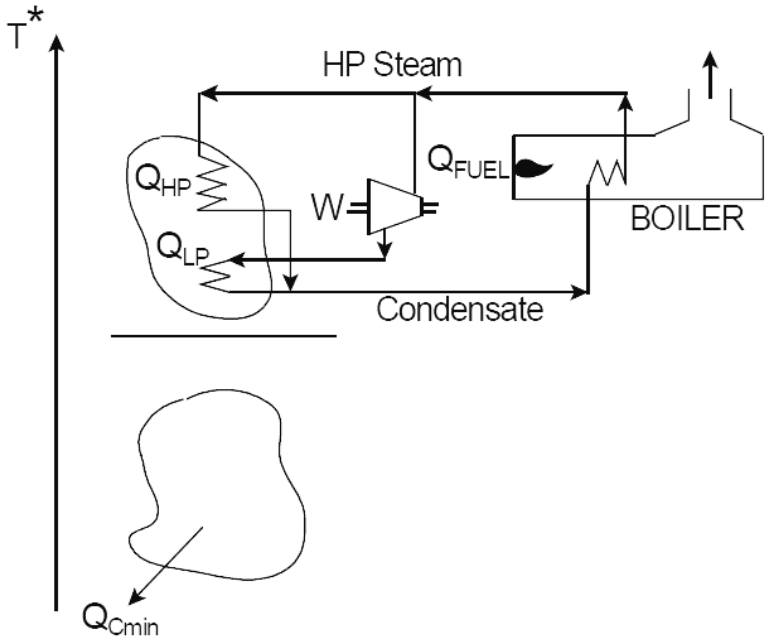
Before integration:

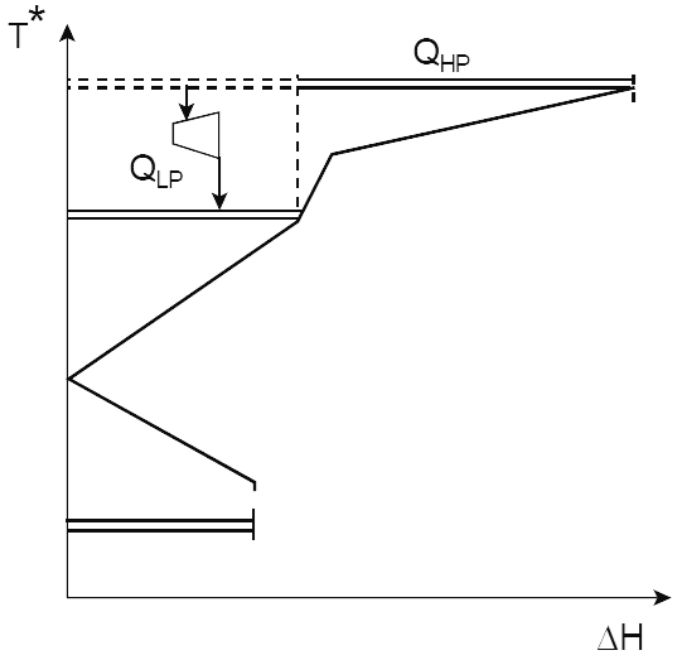
Both hot and cold utilities are taken from external source

After integration:

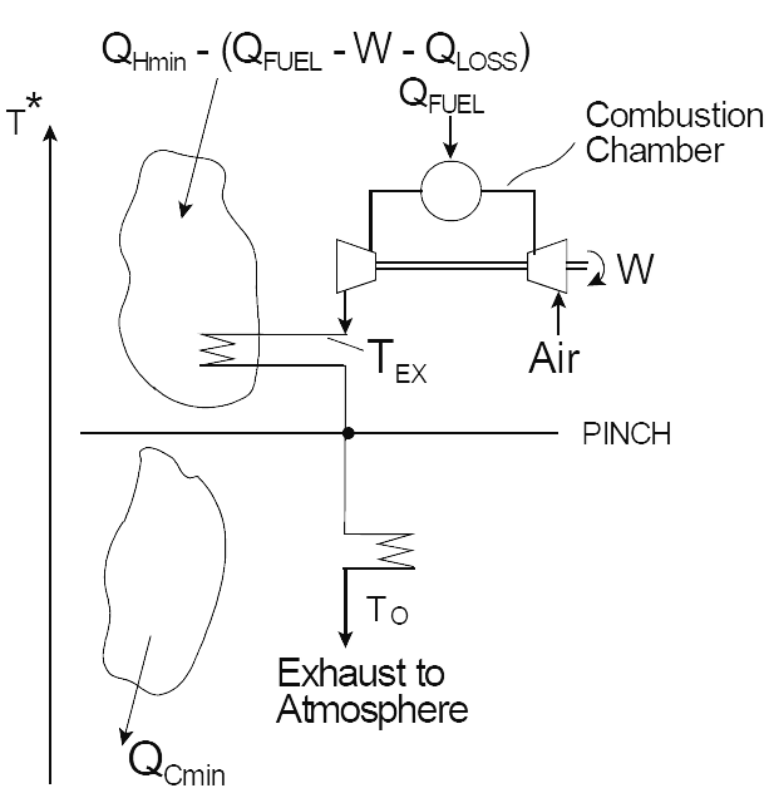
It's still the same

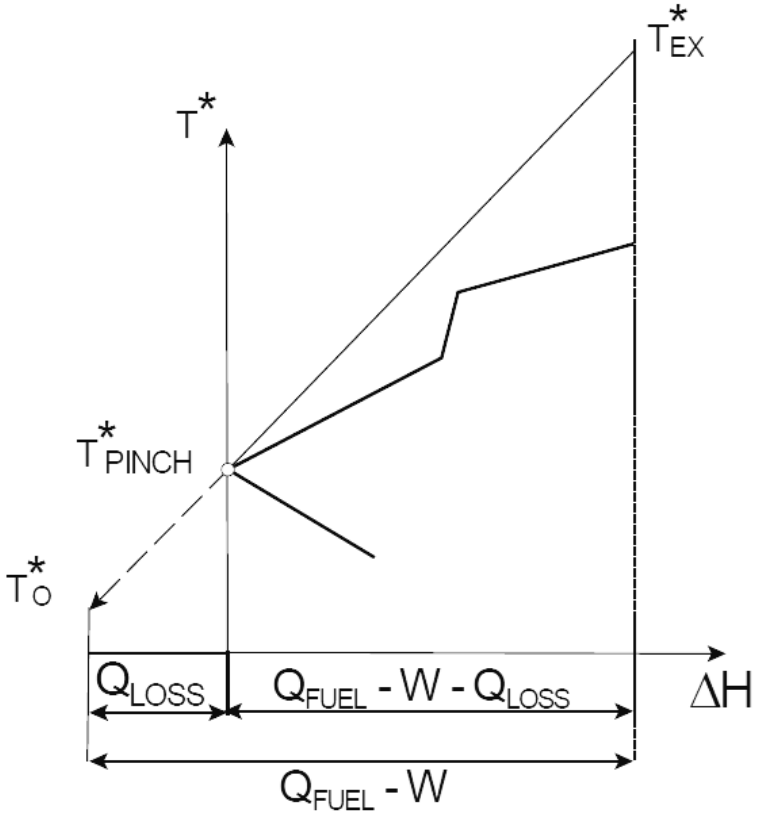
STEAM TURBINE INTEGRATION





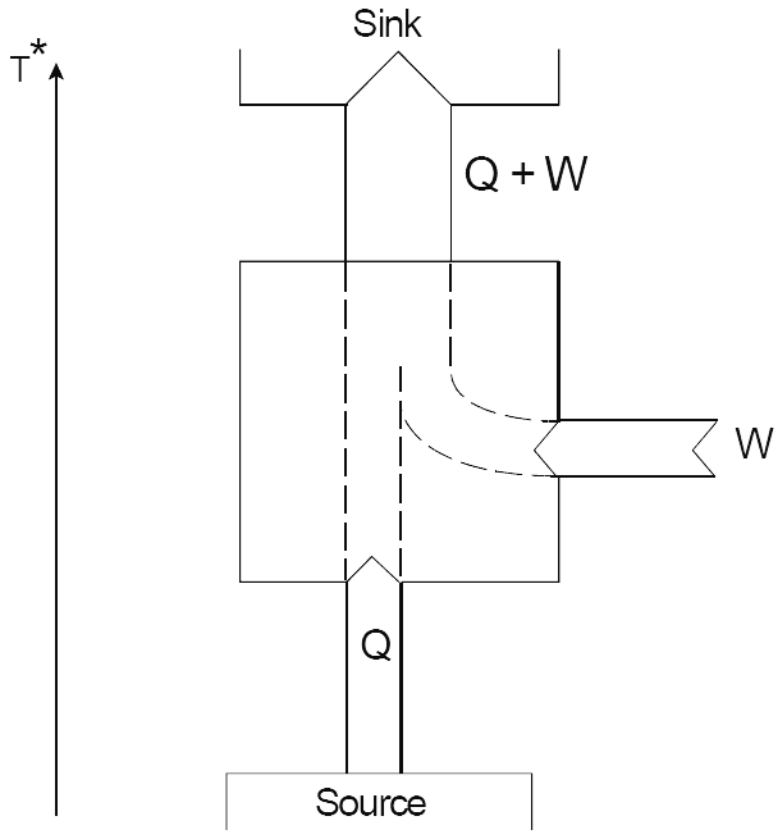
GAS TURBINE INTEGRATION





HEAT PUMP

Heat pump → an engine that convert work into heat,
an engine that pumps heat from a lower temp to a higher temp
e.g. refrigeration



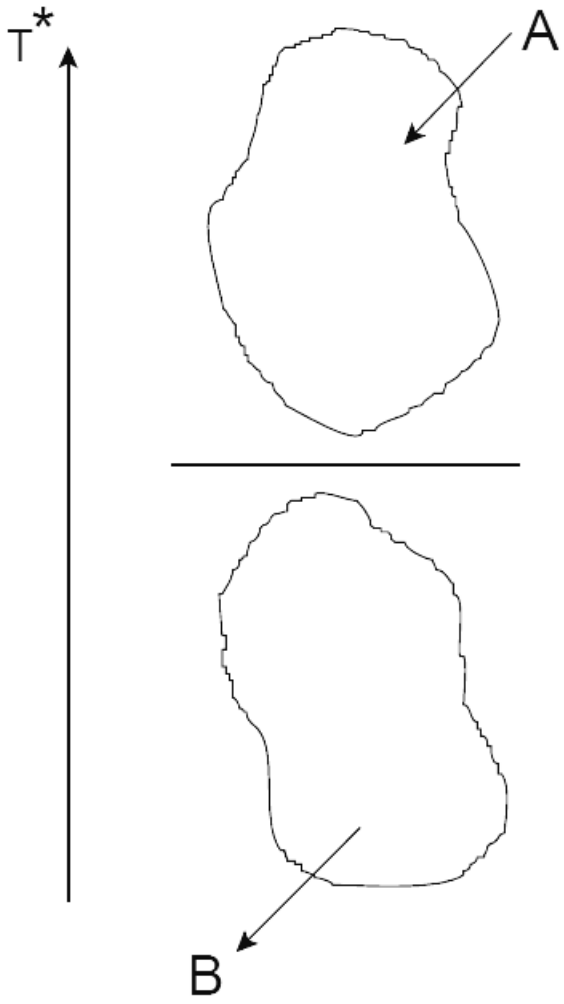
Chemical Engineering
Inspiring Potential • Generating Futures

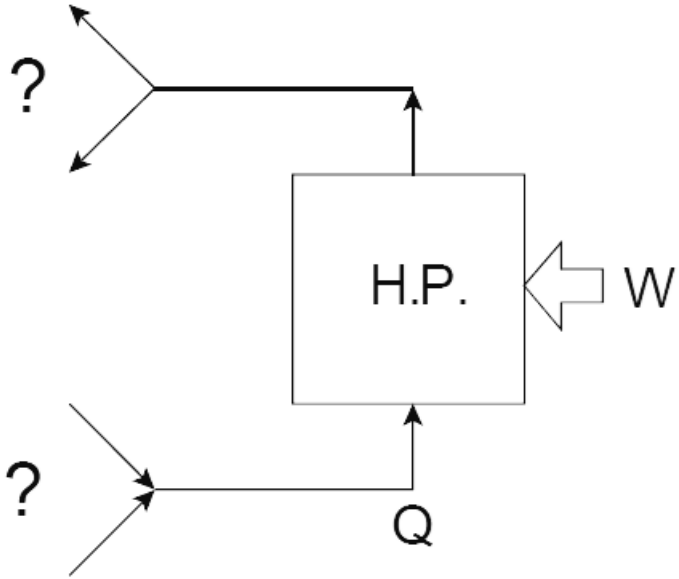
Chemical Engineering
Inspiring Potential • Generating Futures

UNIVERSITI TEKNOLOGI PETRONAS

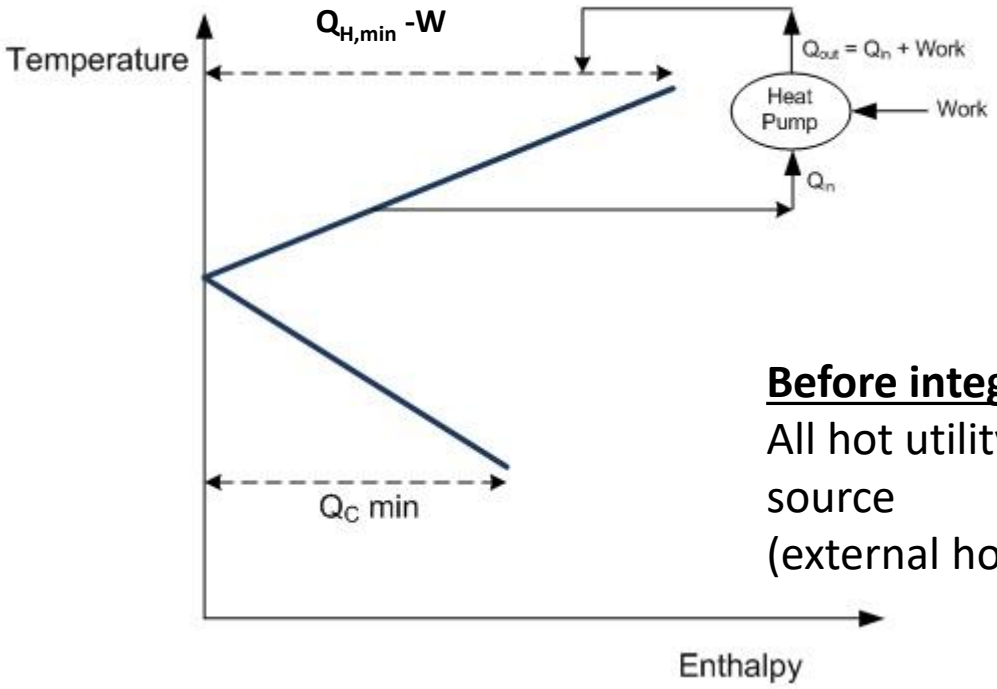
BRAINSTORM:

HOW SHOULD WE INTEGRATE HEAT PUMP?





ABOVE PINCH?



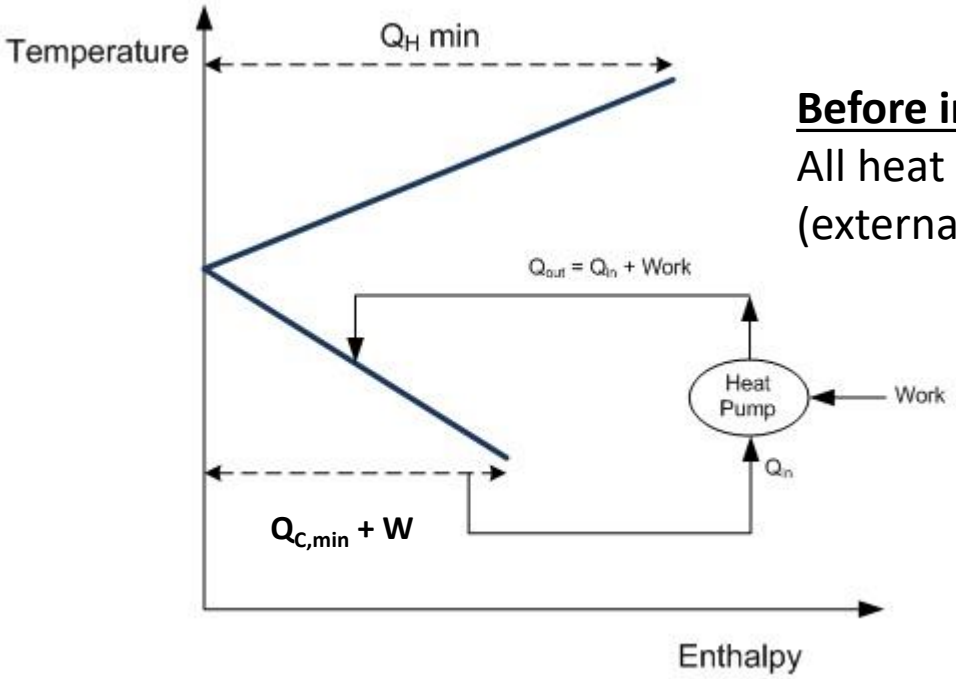
Before integration:

All hot utility ($Q_{H,min}$) is taken from external source
(external hot utility)

After integration:

Net hot utility = $Q_{H,min}$ – Work

BELOW PINCH?



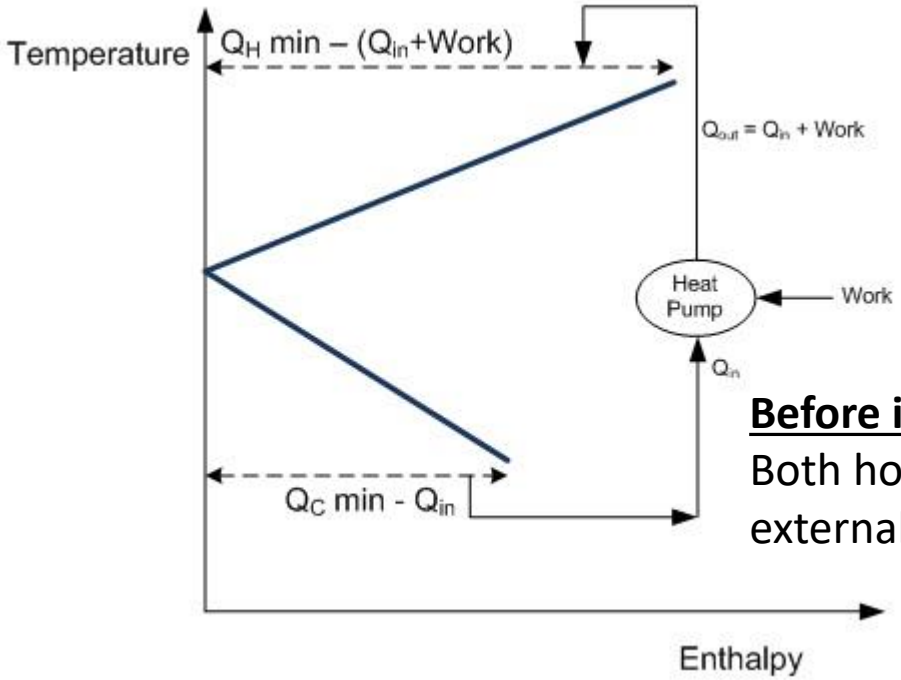
Before integration:

All heat ($Q_{C,min}$) is removed to cooling water (external cold utility)

After integration:

Heat removed to cooling water = $Q_{C,min}$ + Work

ACROSS PINCH?



Before integration:

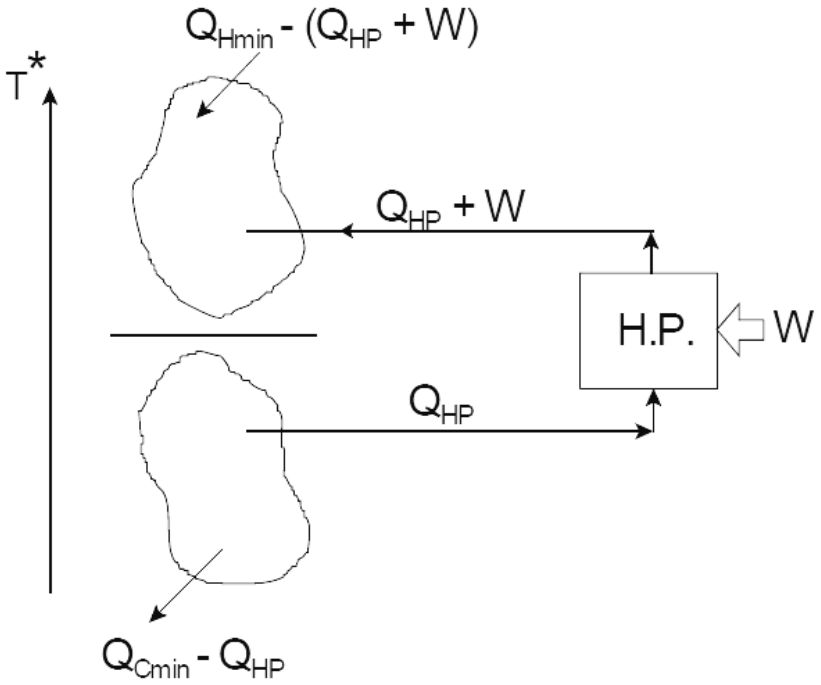
Both hot and cold utilities are taken from external source

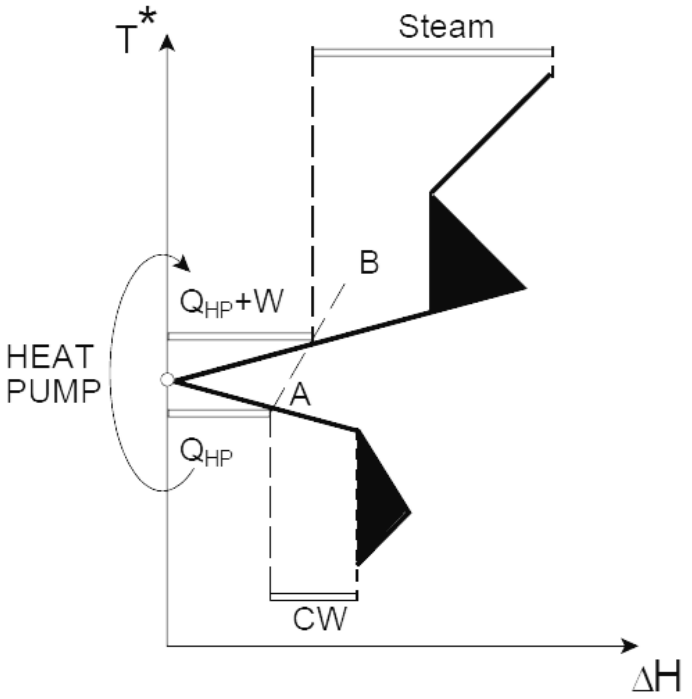
After integration:

Heat to cold utility is taken/pumped to supply heat as a hot utility.

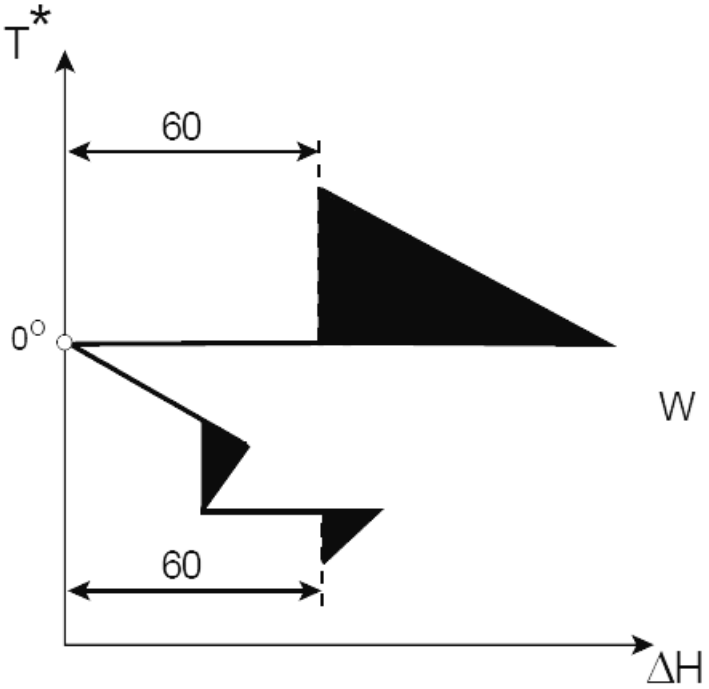
It reduces both hot and cold utilities.

HEAT PUMP INTEGRATION

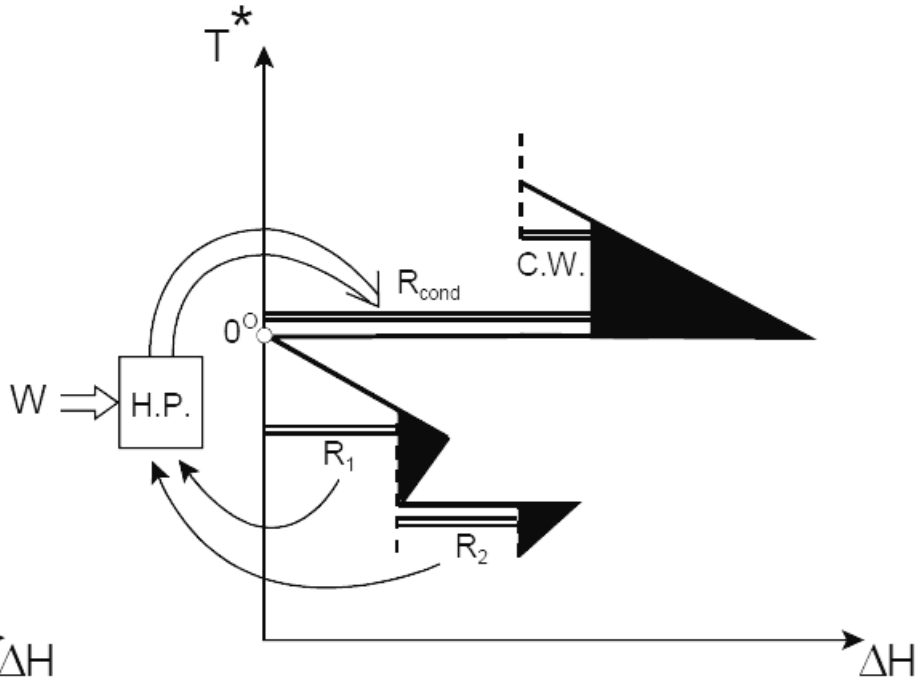




REFRIGERATION

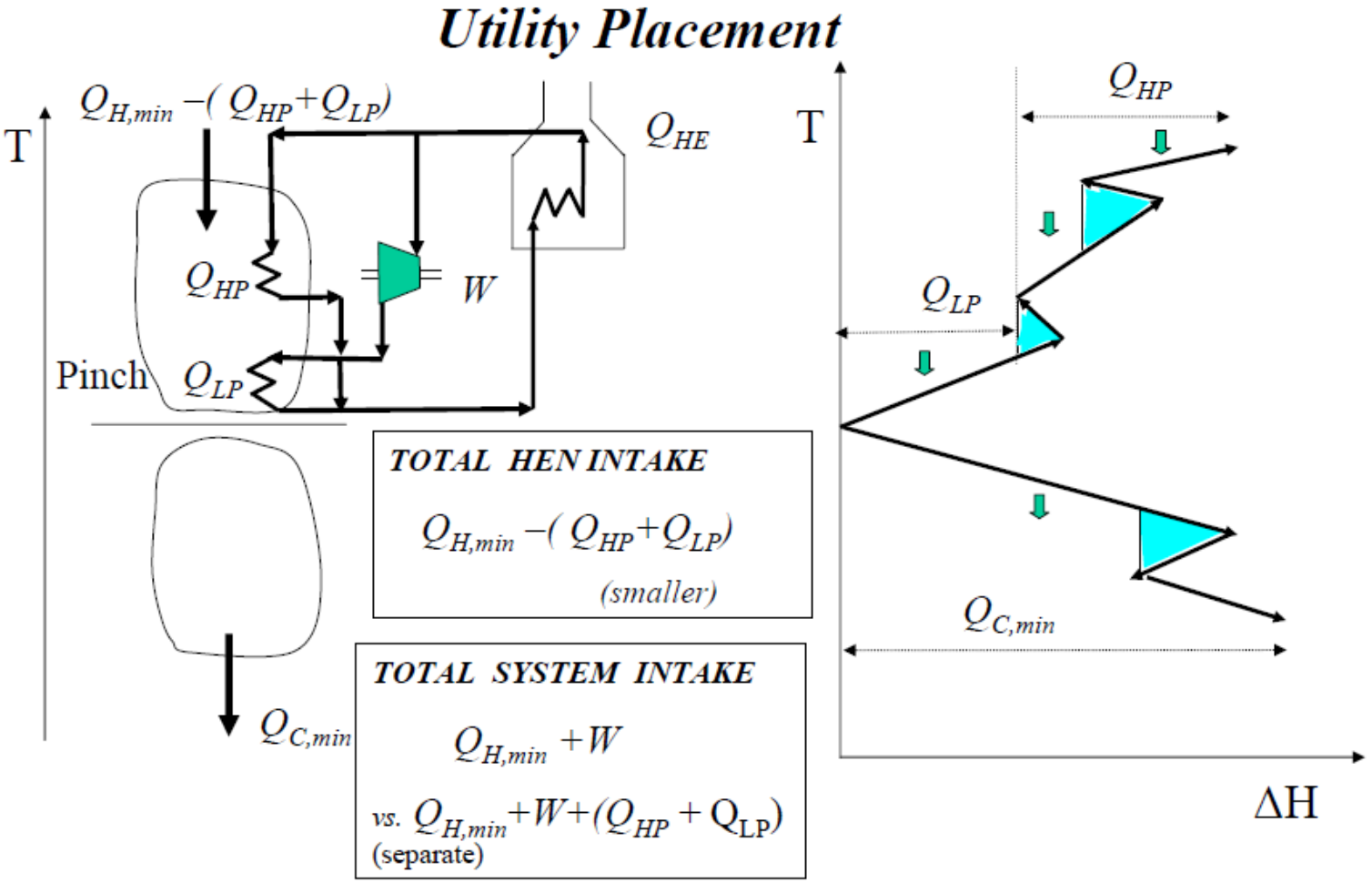


Process grand composite curve

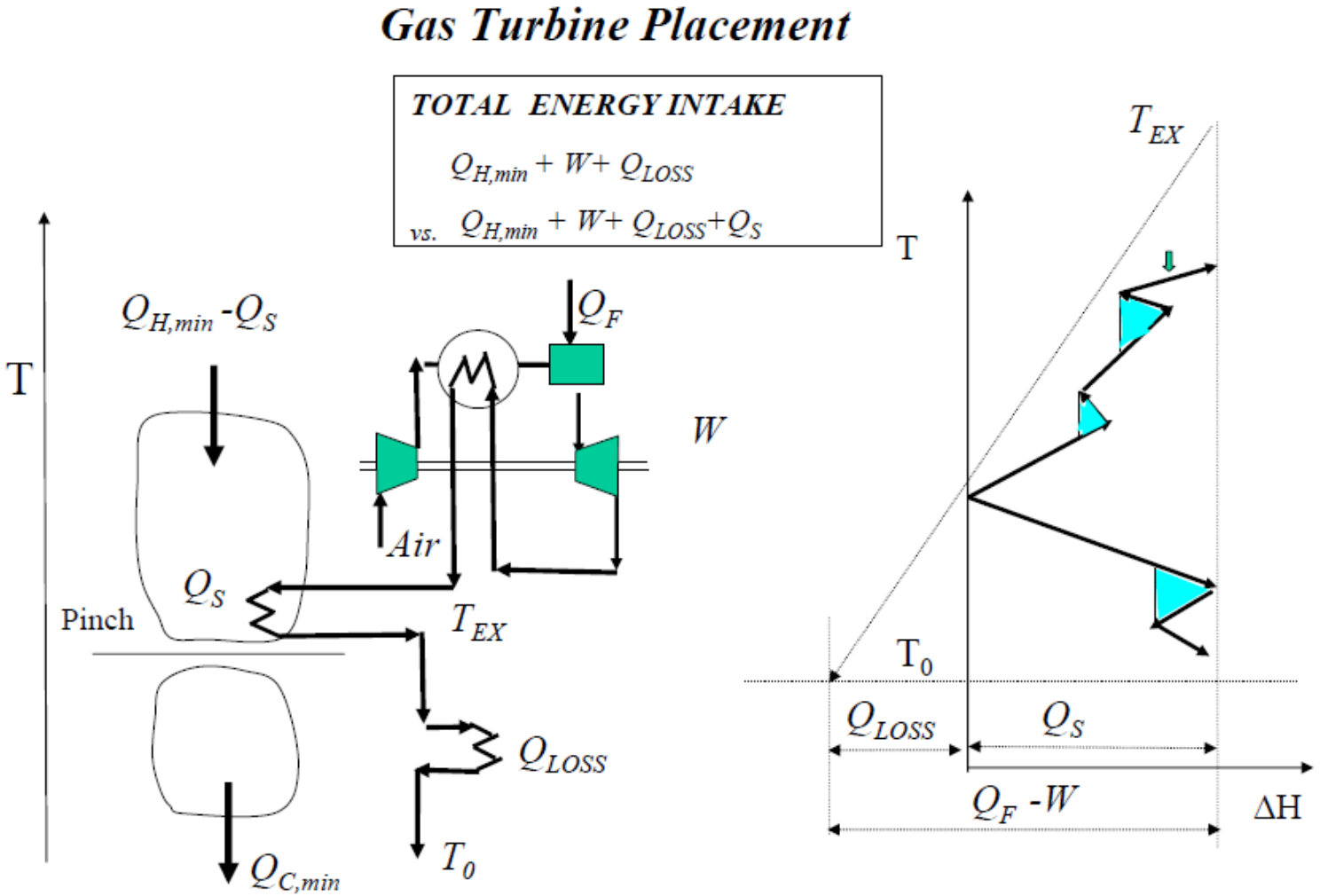


With refrigeration/rejection levels placed

COMBINED HEAT AND POWER



GAS TURBINE REPLACEMENT



Chemical Engineering
Inspiring Potential • Generating Futures

GROUP WORK

UNIVERSITI TEKNOLOGI PETRONAS

From your case,
Please discuss and identify locations of
heat engines and/or heat pumps.

Please specify the reduction of hot and/or cold utilities
from utilizing the heat engines and/or heat pumps

Chemical Engineering
Inspiring Potential·Generating Futures

COURSE OVERVIEW

UNIVERSITI TEKNOLOGI PETRONAS