Pinch Point Technology
- examples of application

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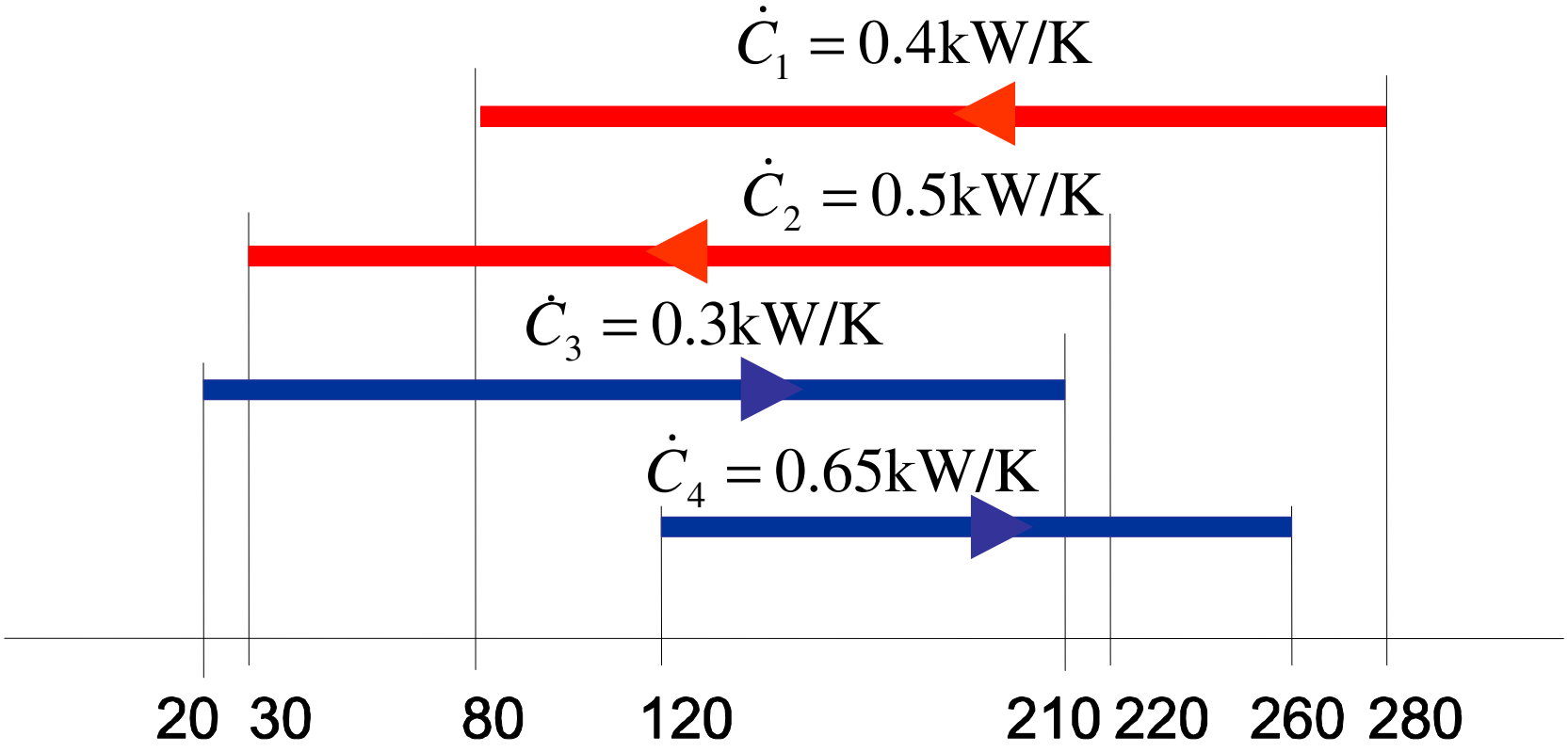
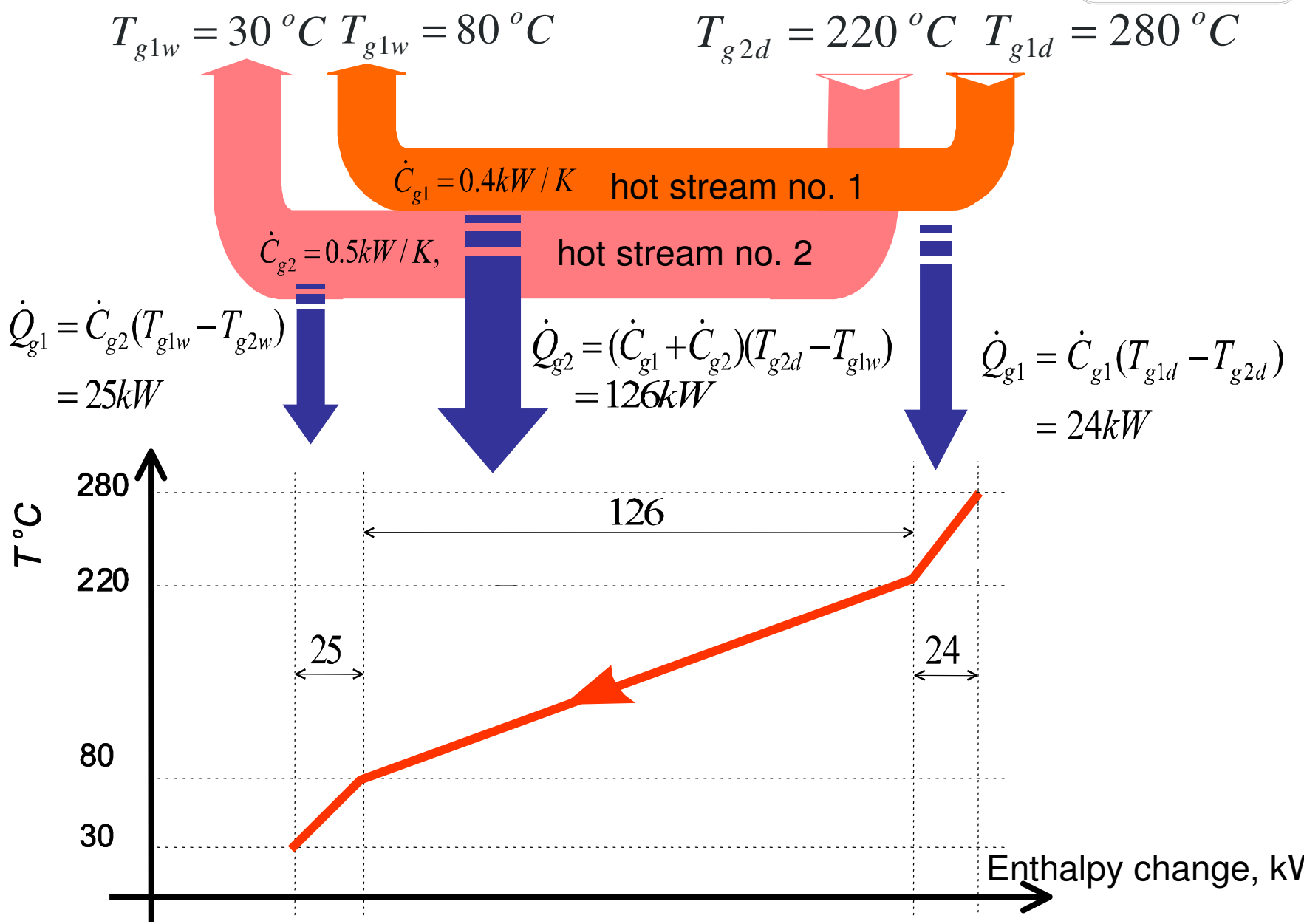
Example 1

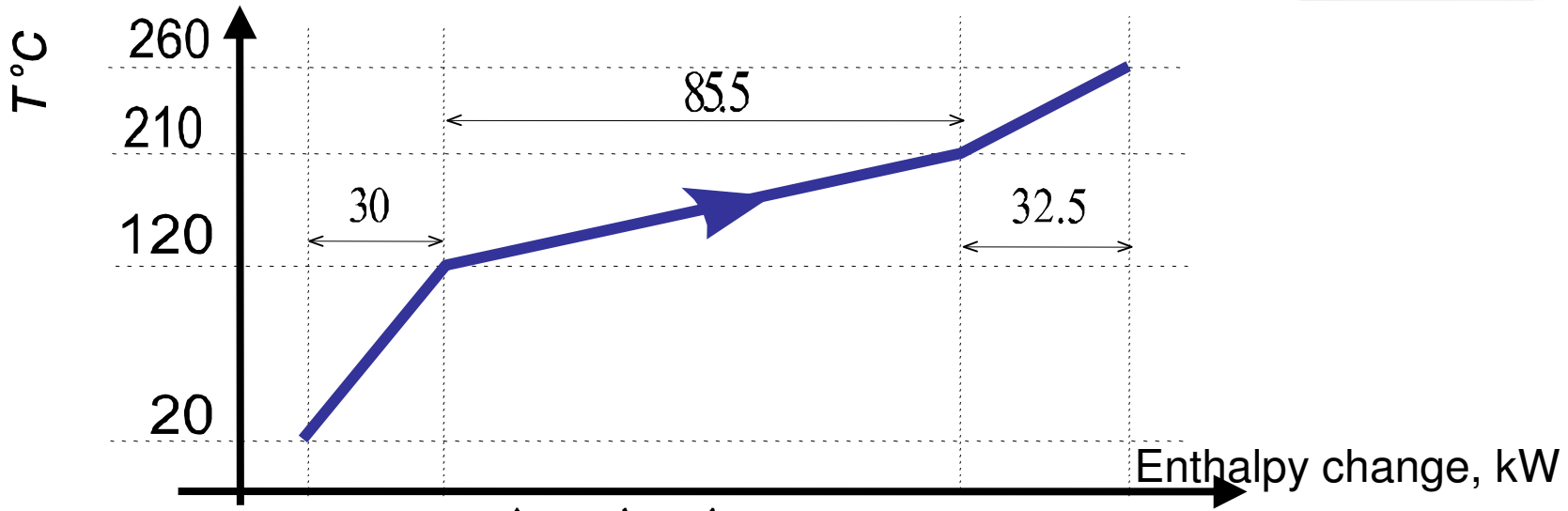
Case study:



Hot composite curve



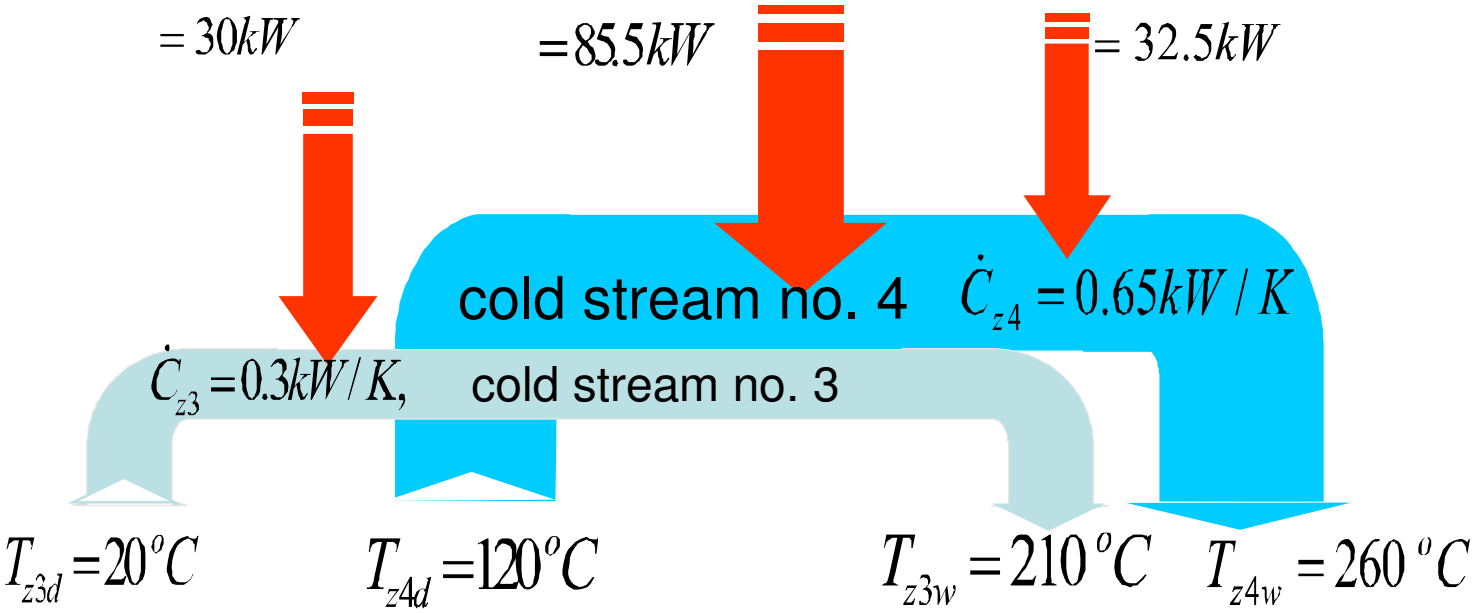
Cold composite curve



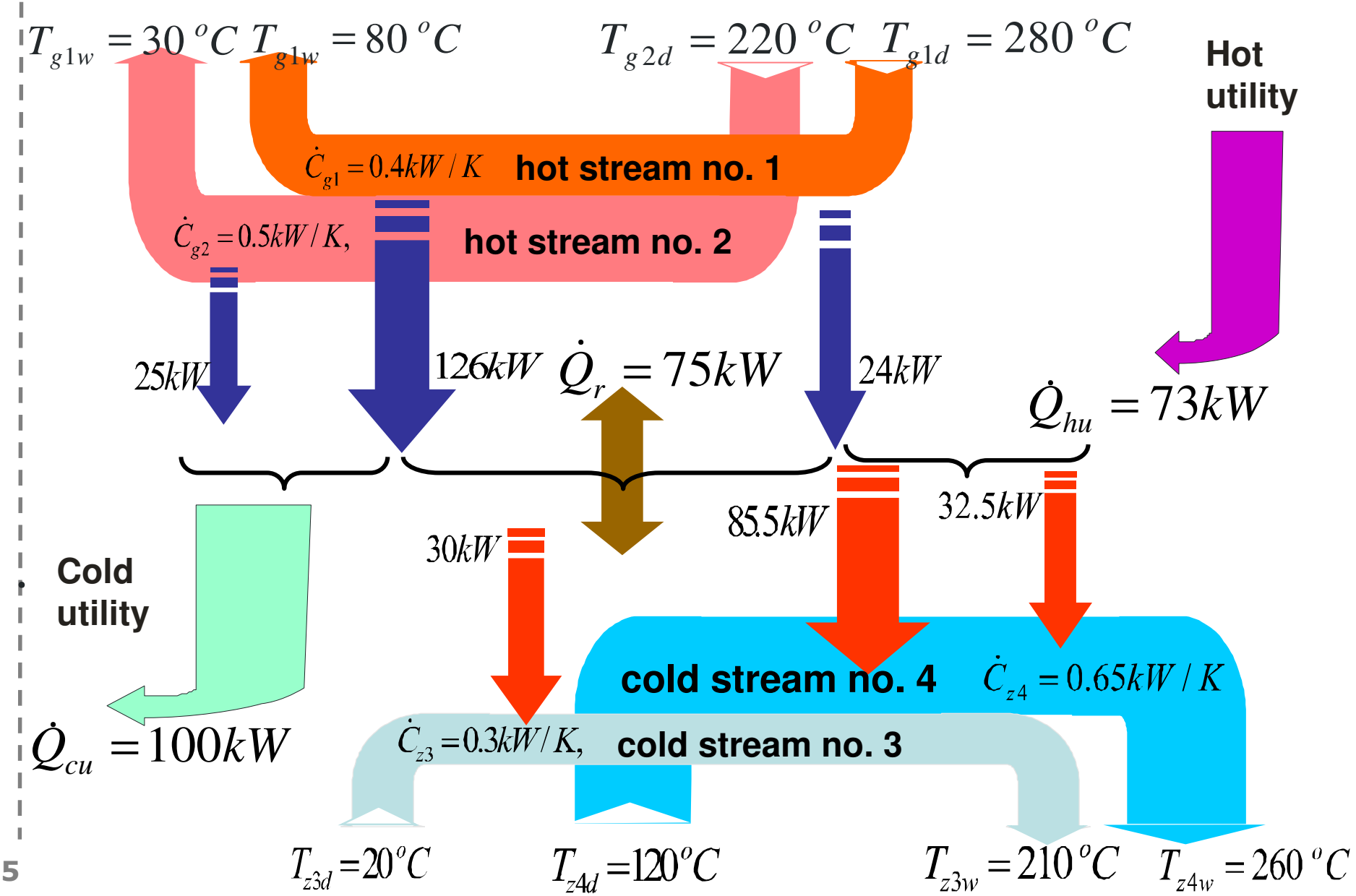
$\dot{Q}_{z1} = \dot{C}_{z3}(T_{z4d} - T_{z3d}) = 30kW$

$\dot{Q}_{z2} = (\dot{C}_{z3} + \dot{C}_{z4})(T_{z3w} - T_{z4d}) = 85.5kW$

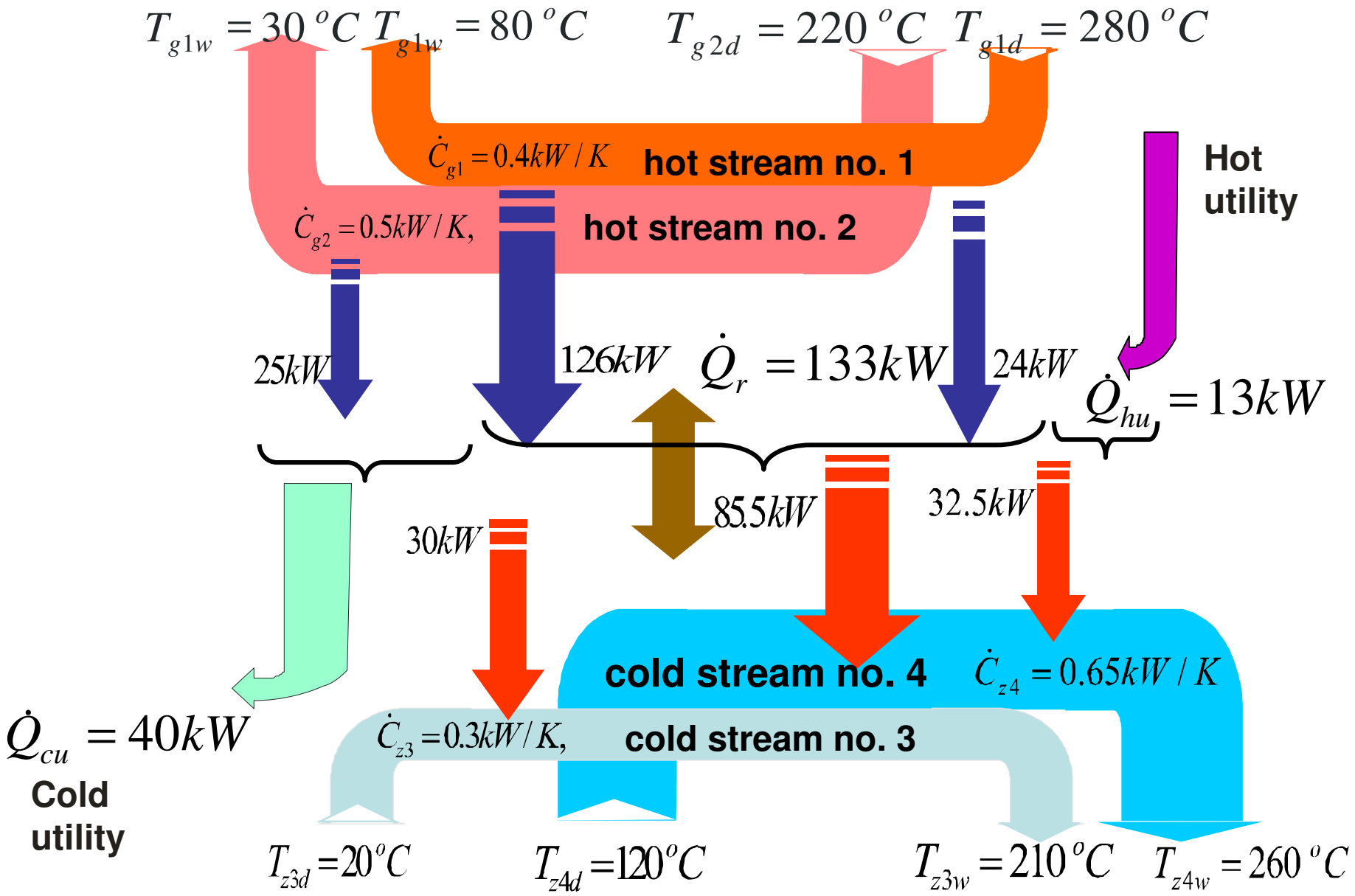
$\dot{Q}_{q1} = \dot{C}_{z4}(T_{z4w} - T_{z3w}) = 32.5kW$



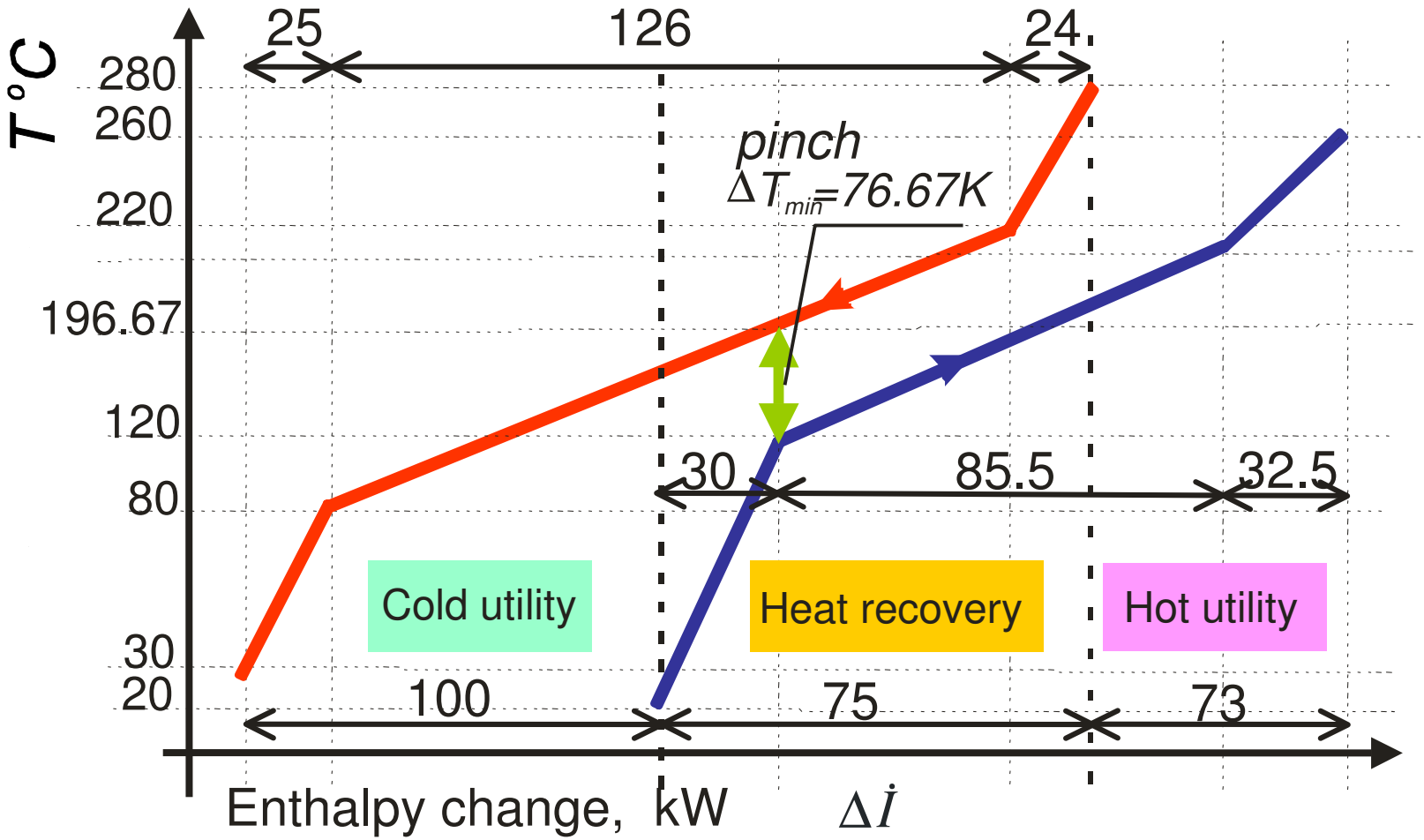
Composite curves



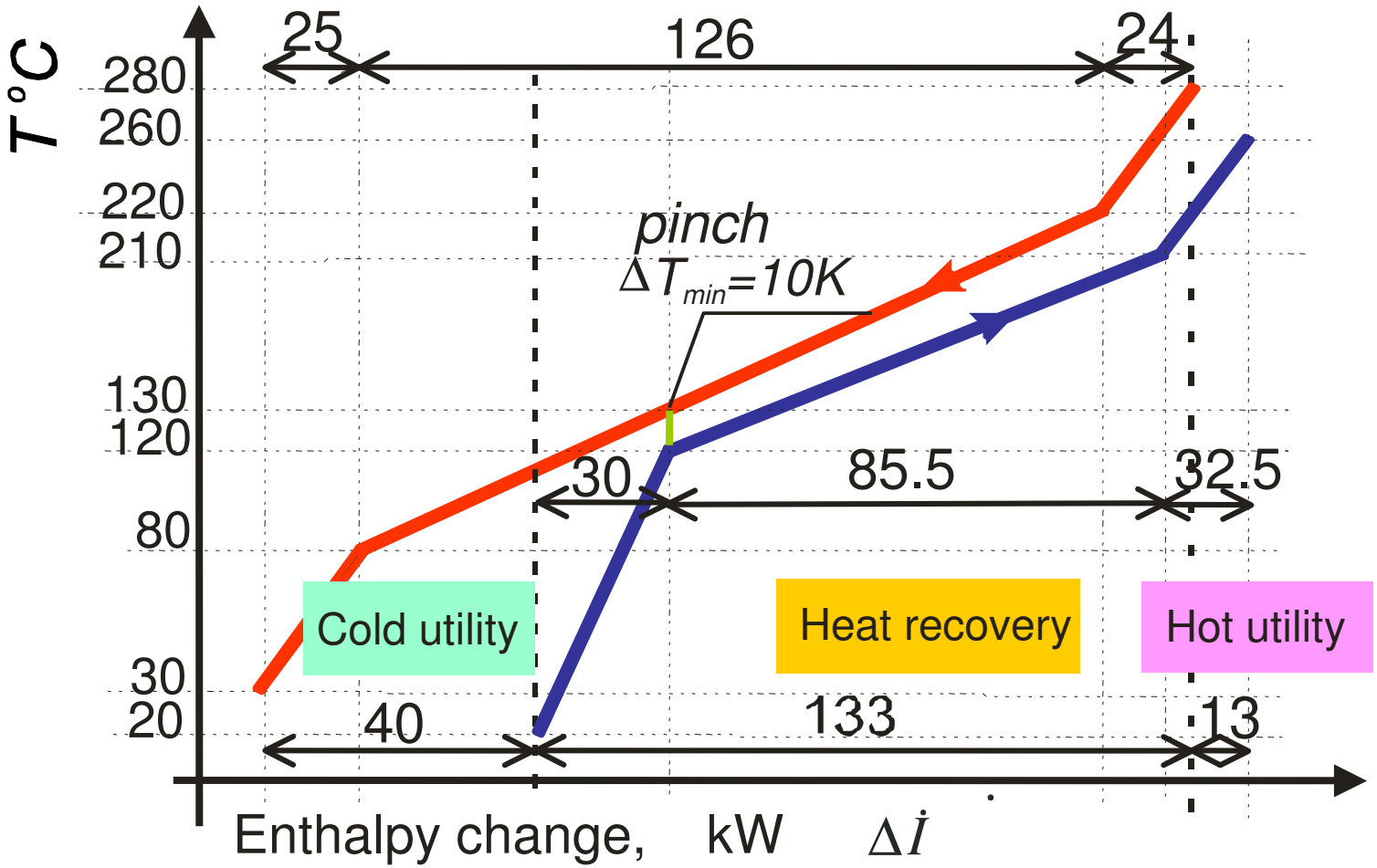
Composite curves



Composite curves

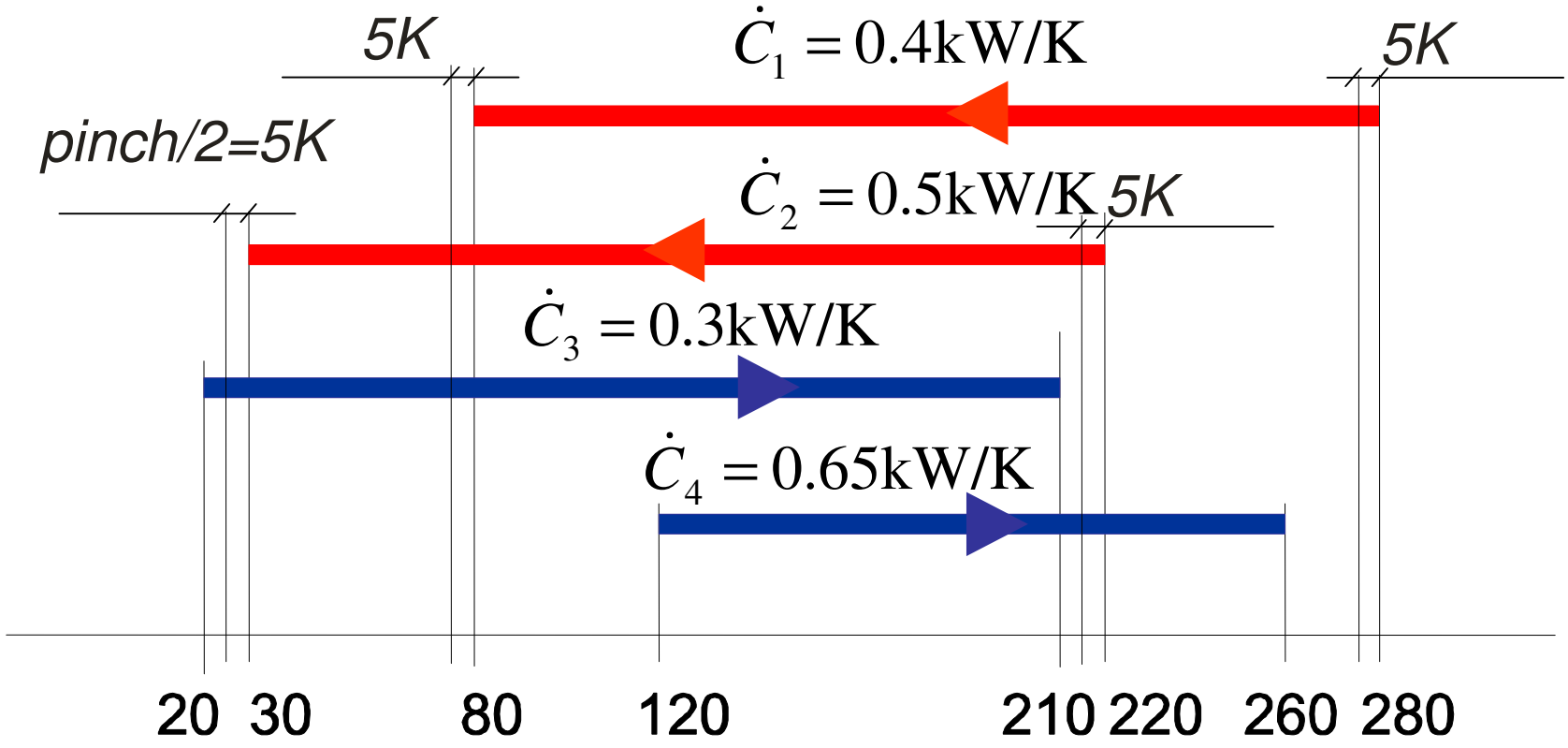


Composite curves



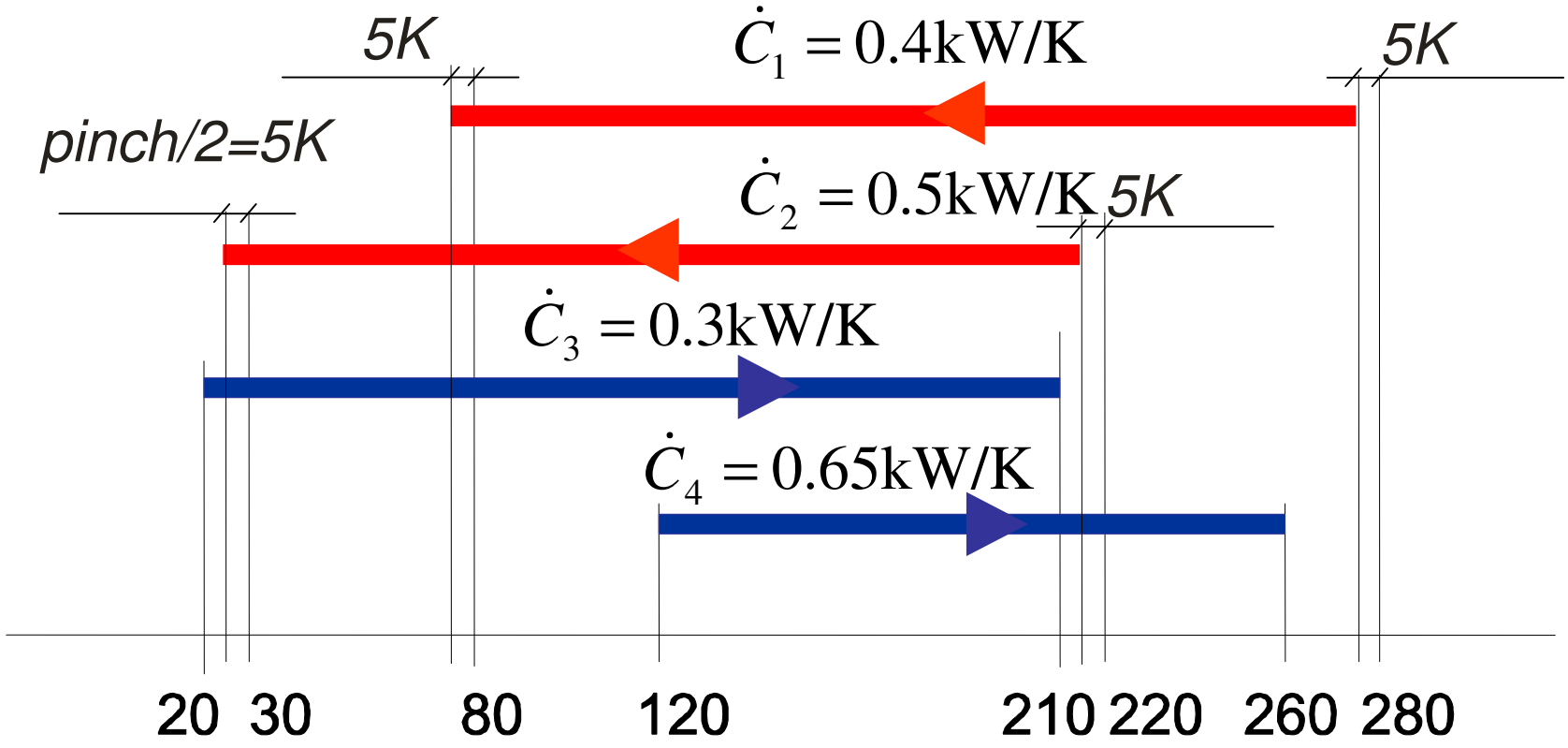
Grand composite curve

for assumed pinch=10K



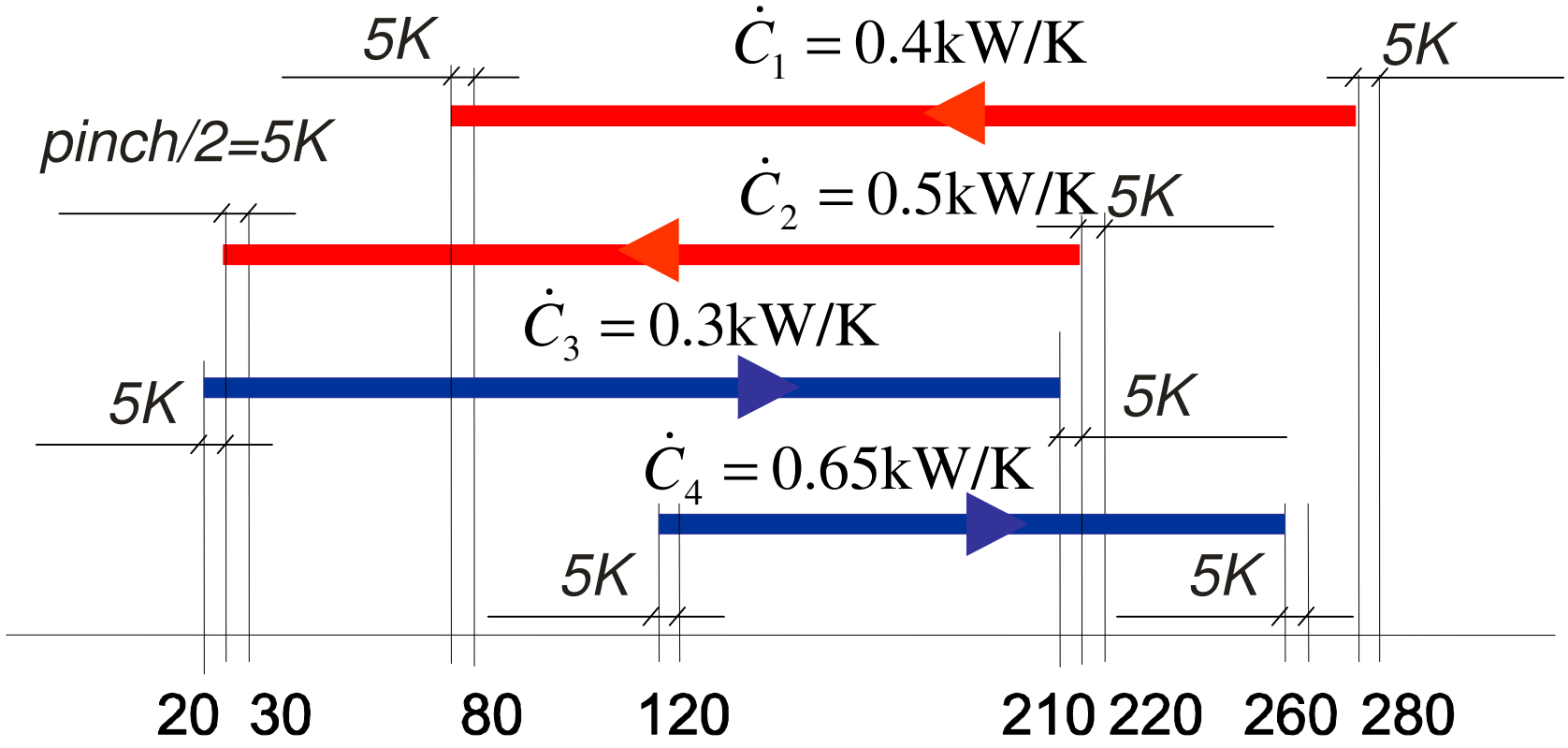
Grand composite curve

for assumed pinch=10K



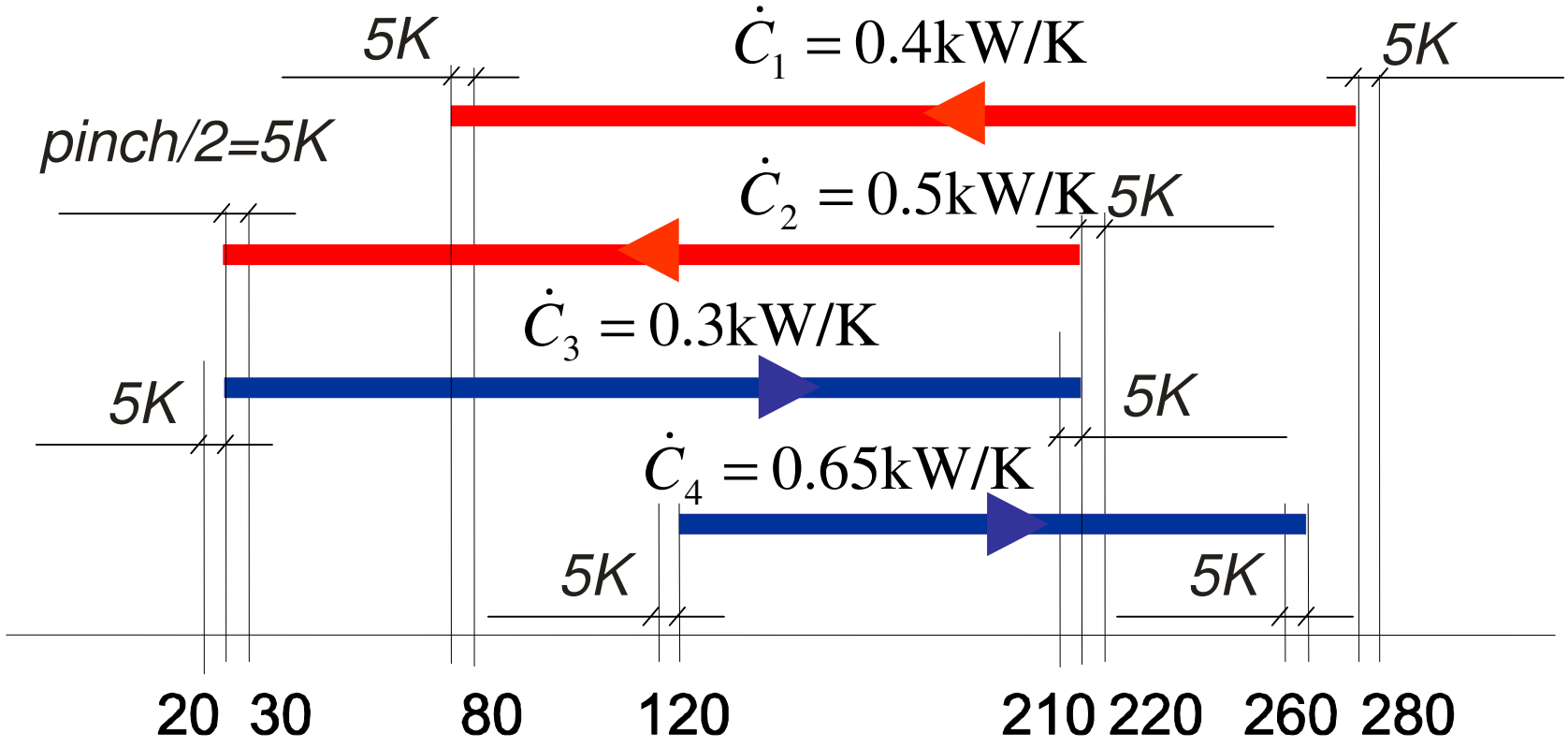
Grand composite curve

for assumed pinch=10K



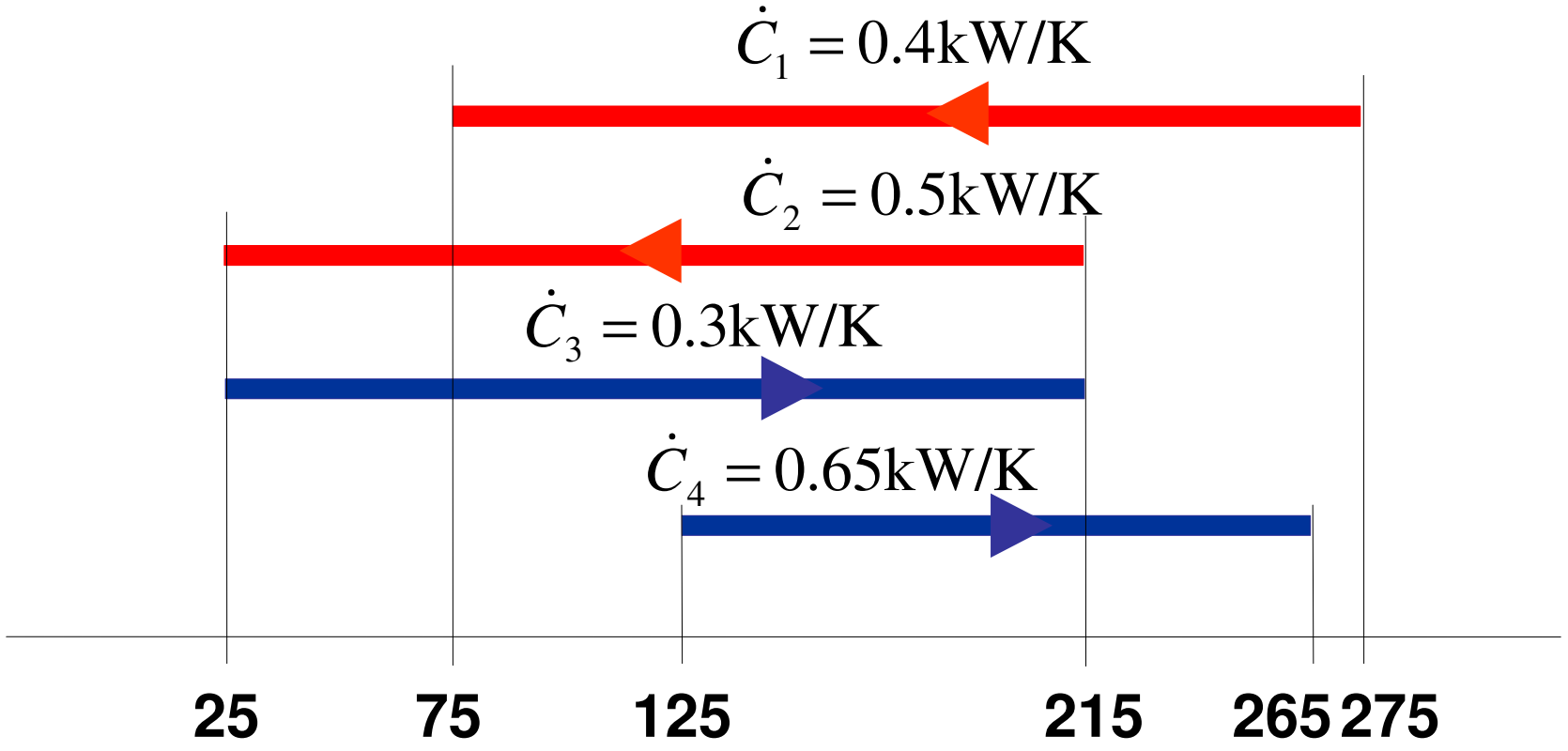
Grand composite curve

for assumed pinch=10K

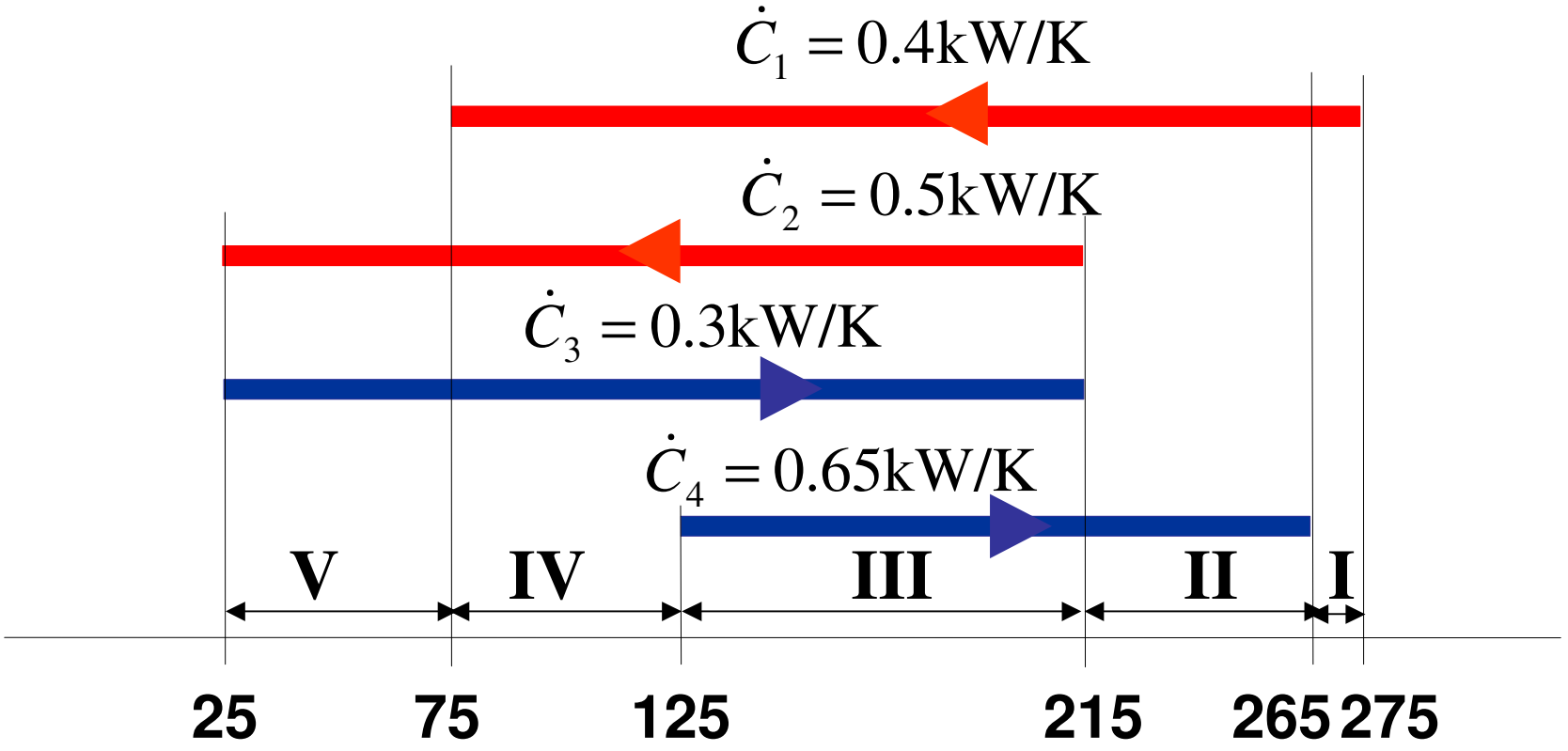


Temperature ^{0}C

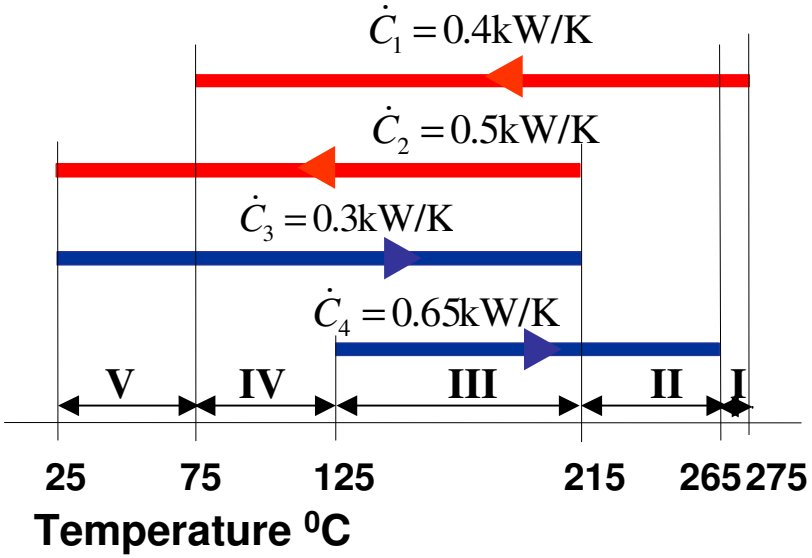
Grand composite curve



Grand composite curve

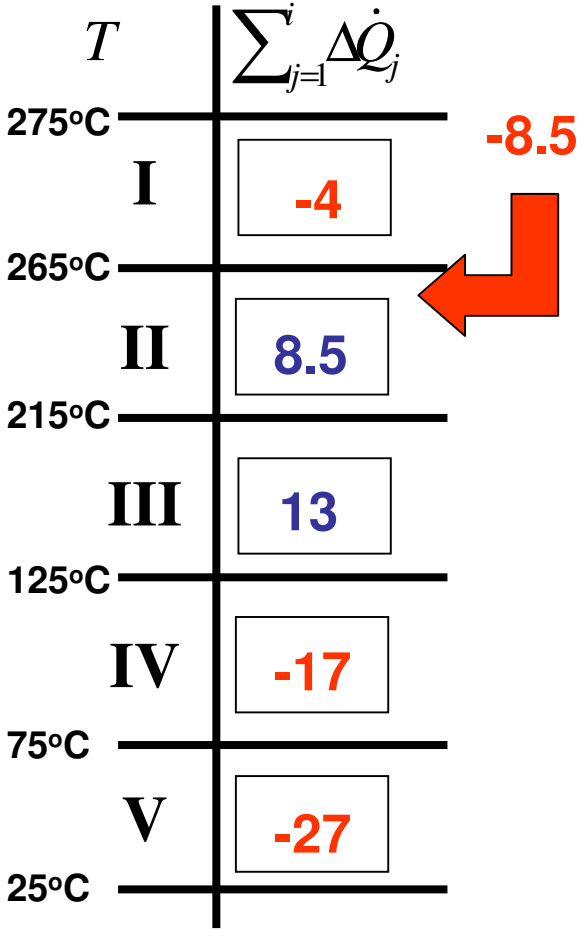


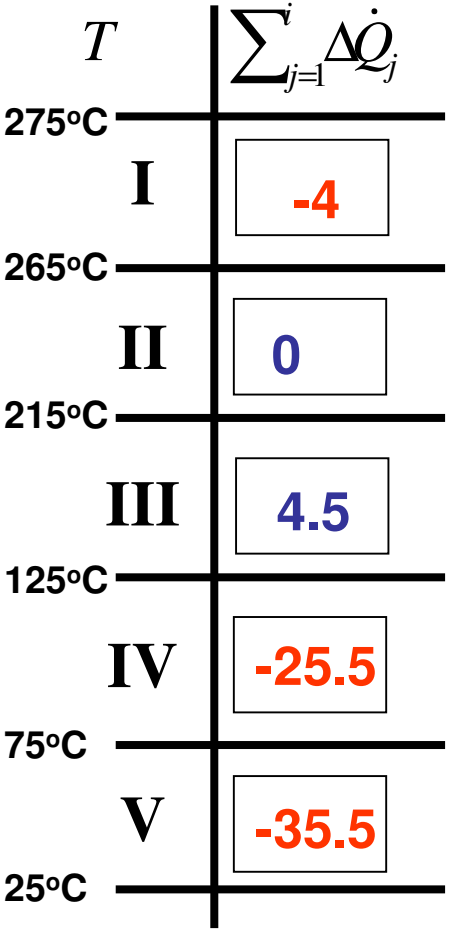
Grand composite curve



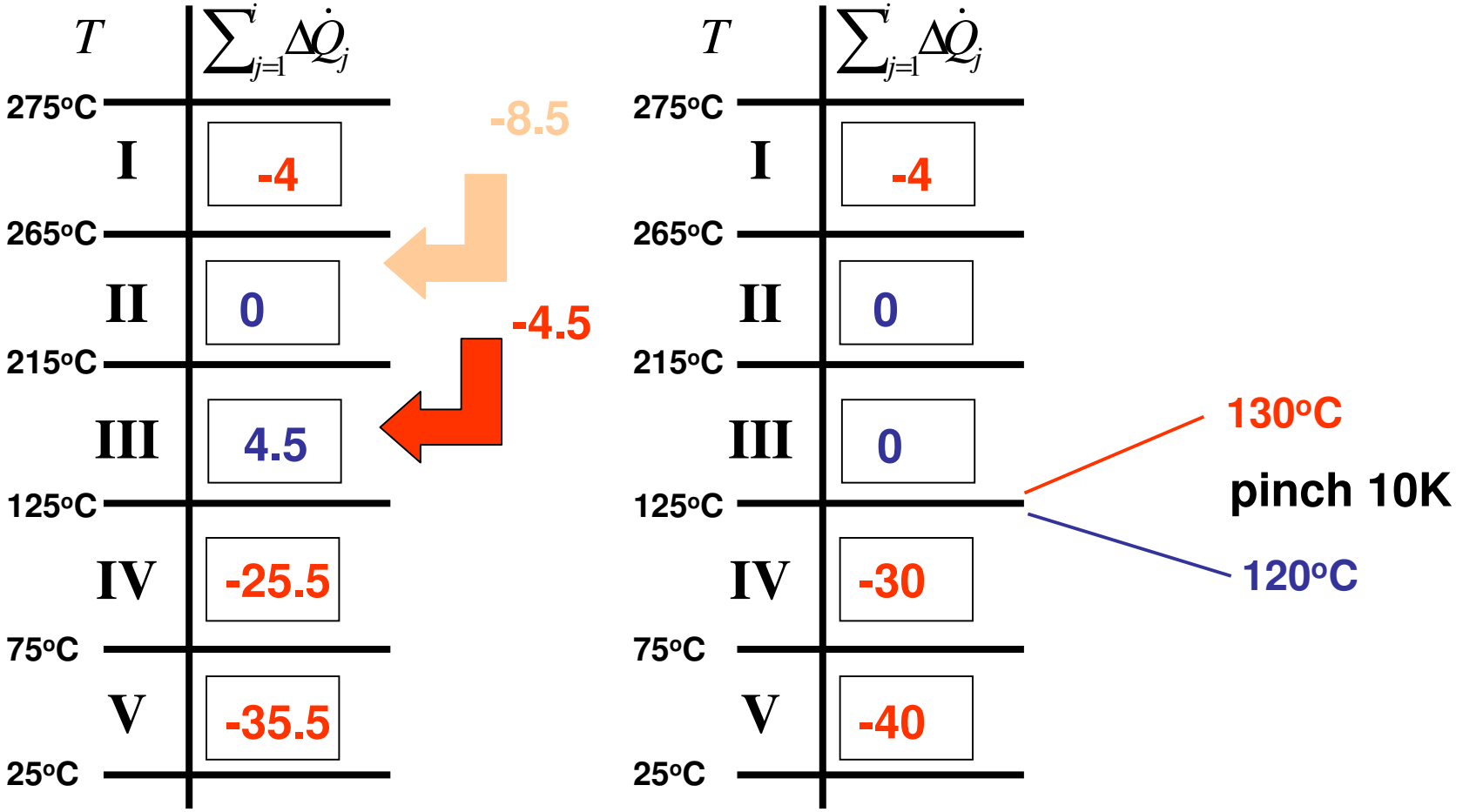
	$\sum_z \dot{C}_z - \sum_g \dot{C}_g$	ΔT_i	$\Delta \dot{Q}_i$	$\sum_{j=1}^{i} \Delta \dot{Q}_j$
I	-0.40	10	-4	-4
II	+0.25	50	12.5	8.5
III	+0.05	90	4.5	13
IV	-0.60	50	-30	-17
V	-0.20	50	-10	-27

Grand composite curve

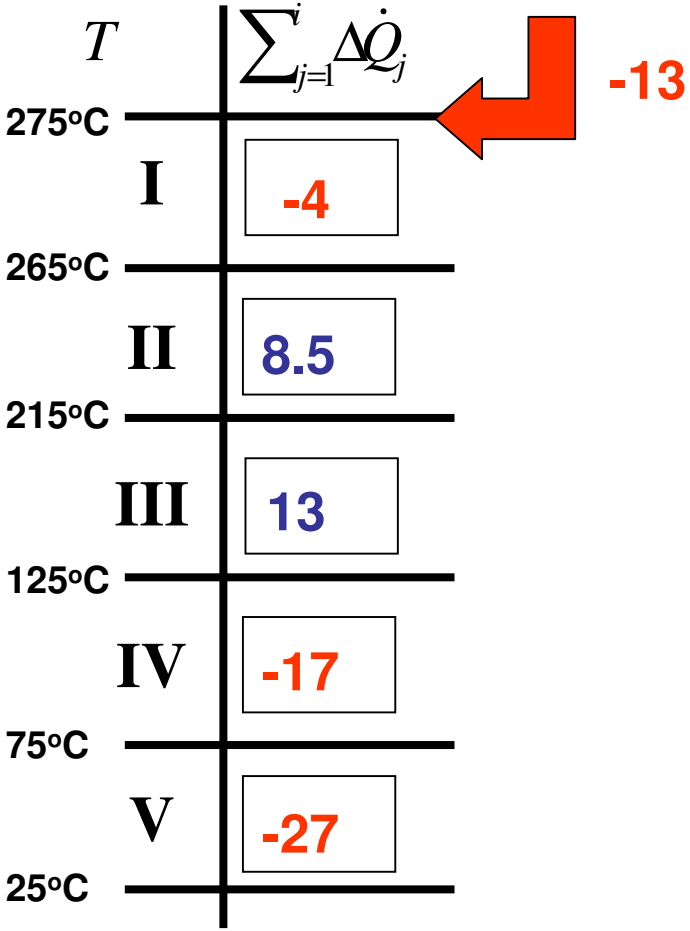


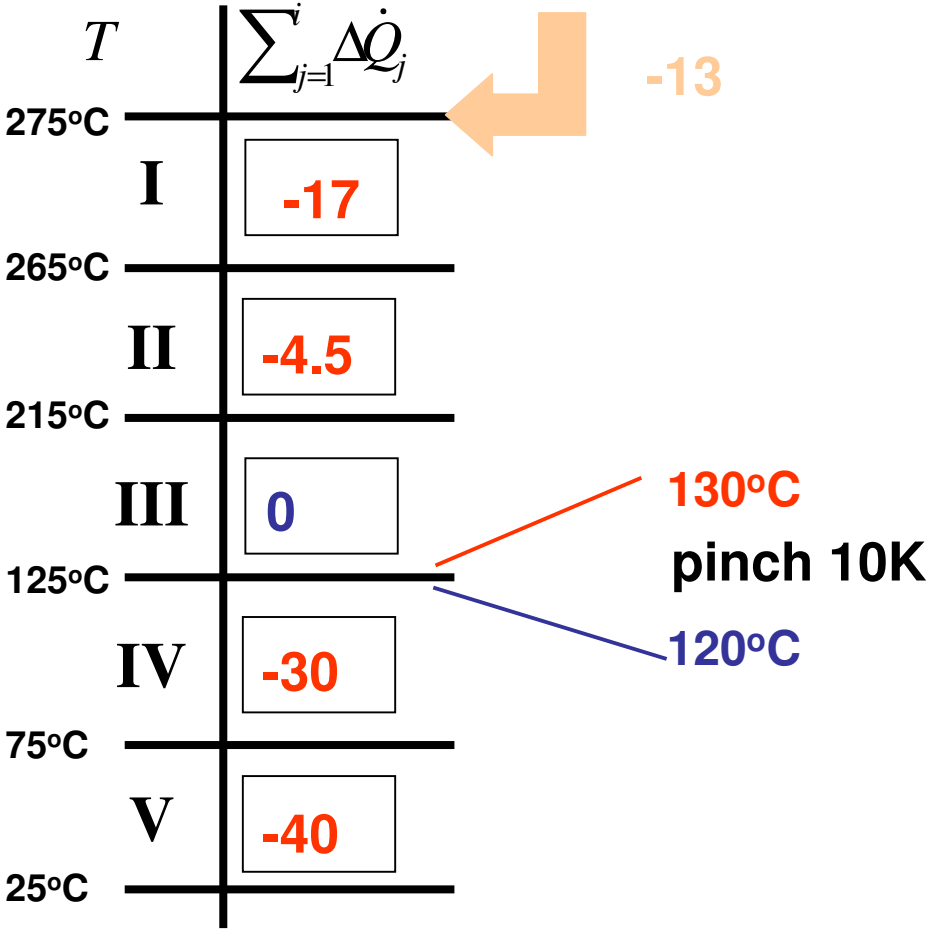


Grand composite curve

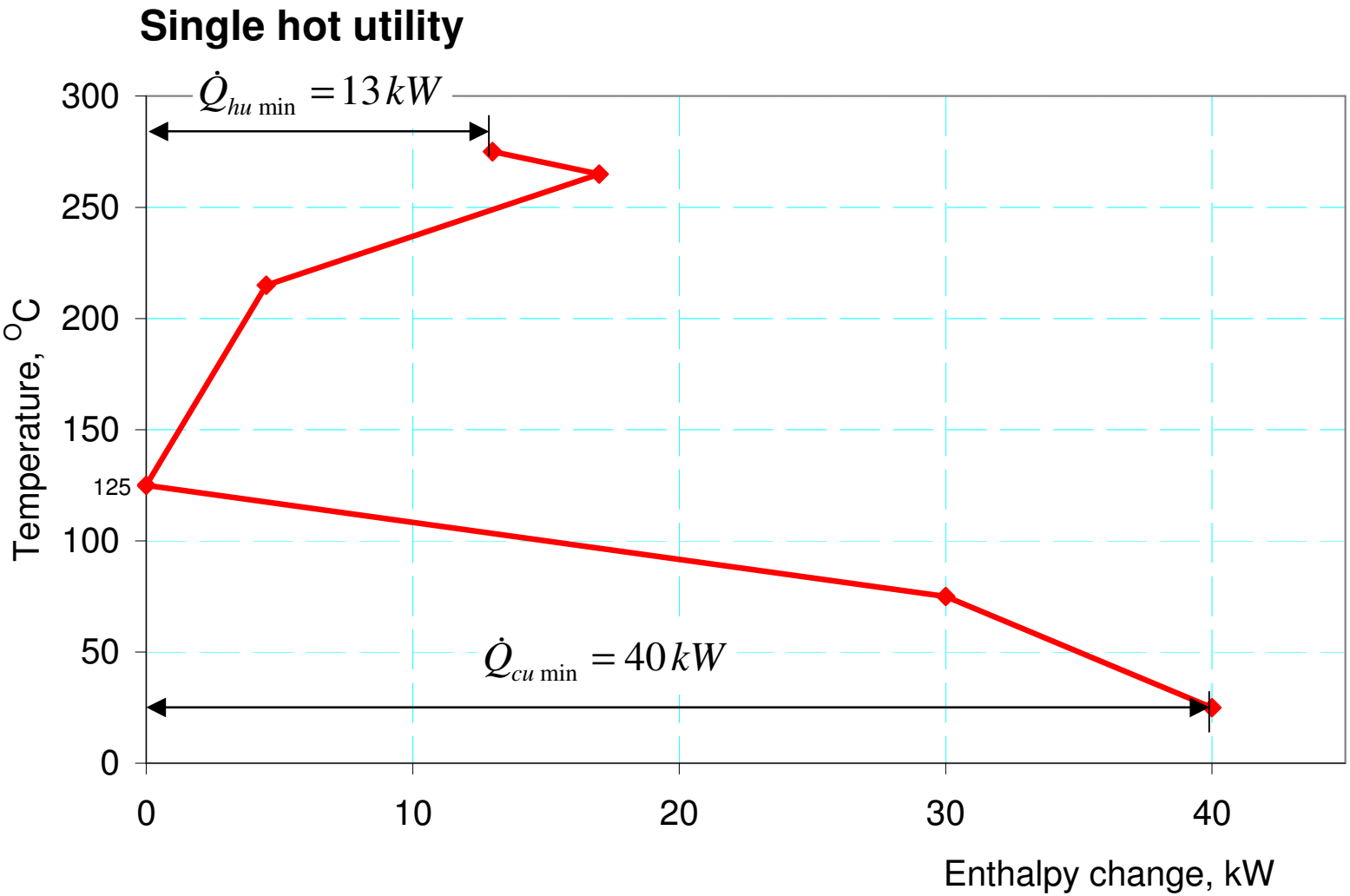


Grand composite curve



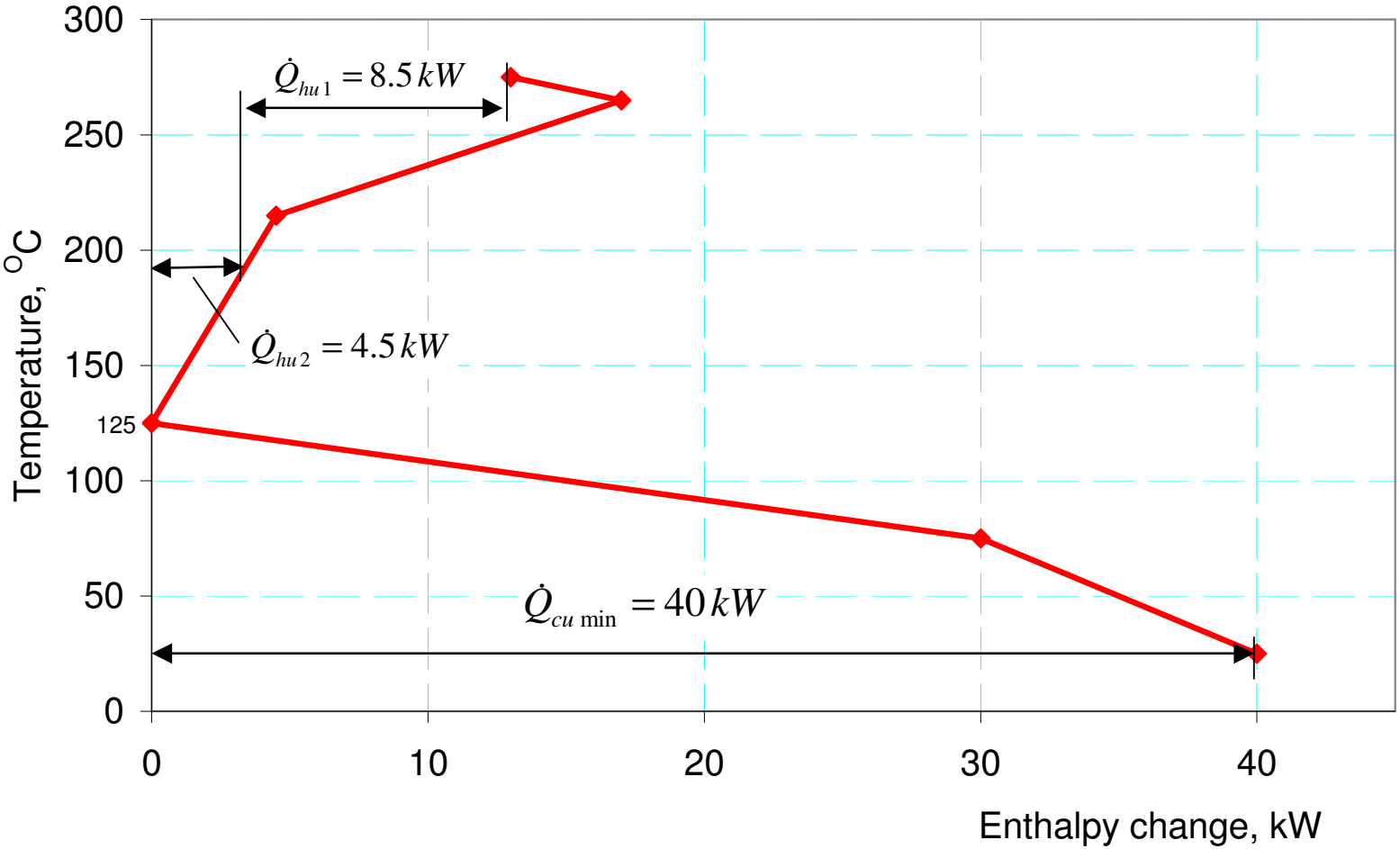


Grand composite curve



Grand composite curve

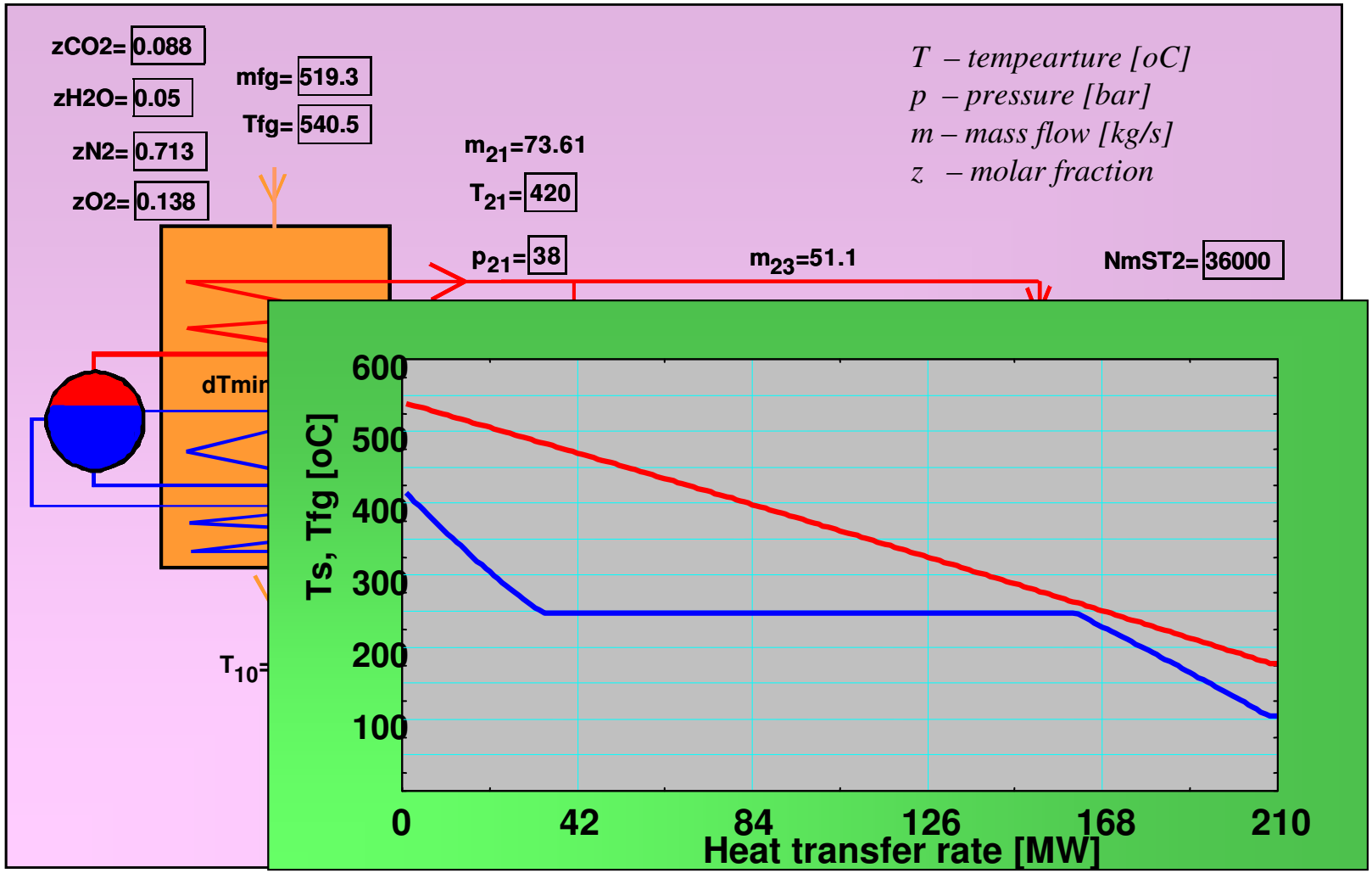
Multiple hot utilities – reduction of exergy losses



Example 2

Optimization of Heat Recovery Steam Generators

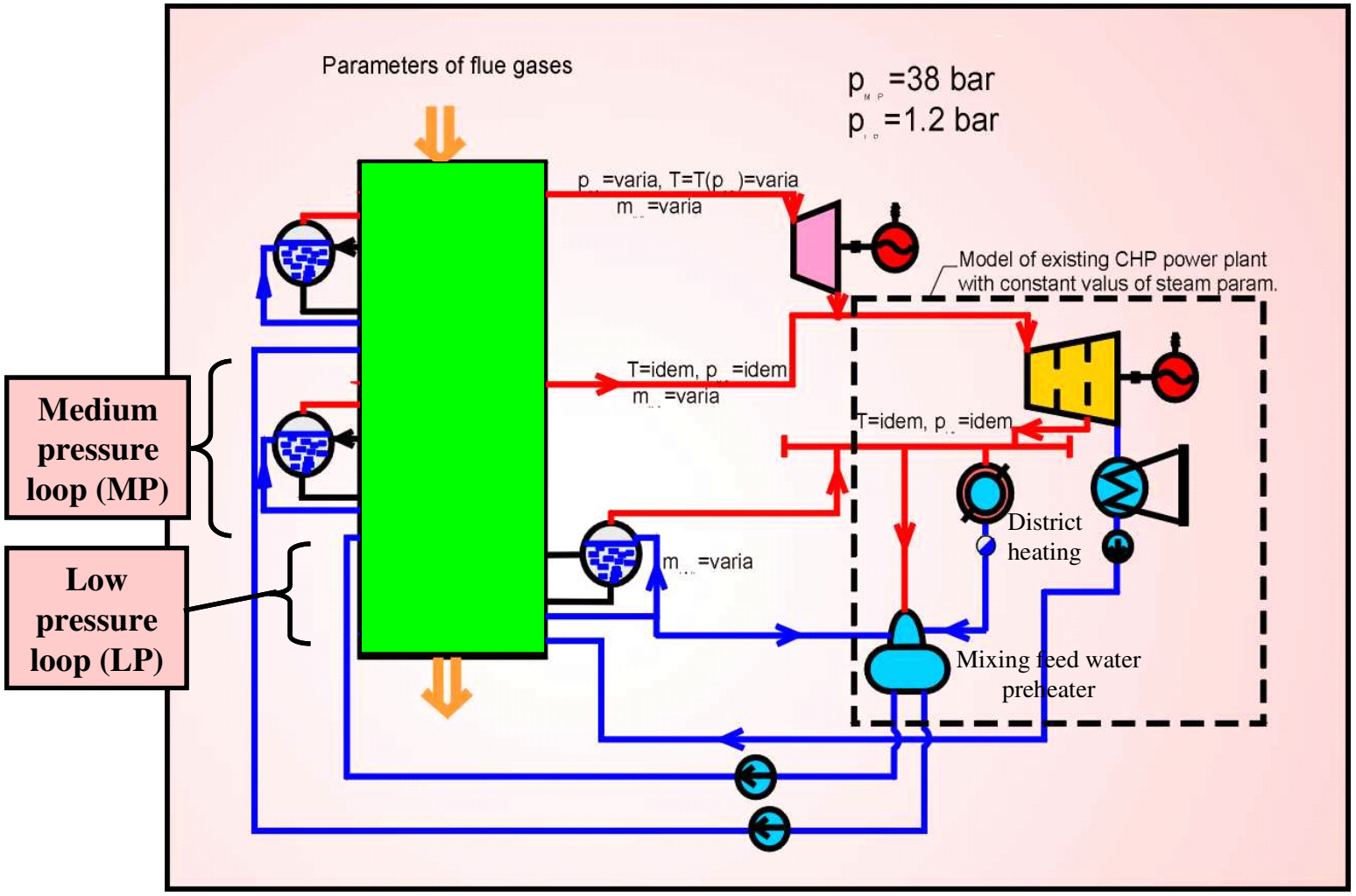
- single pressure – no need for pinch analysis



Example 2

Optimization of Heat Recovery Steam Generators

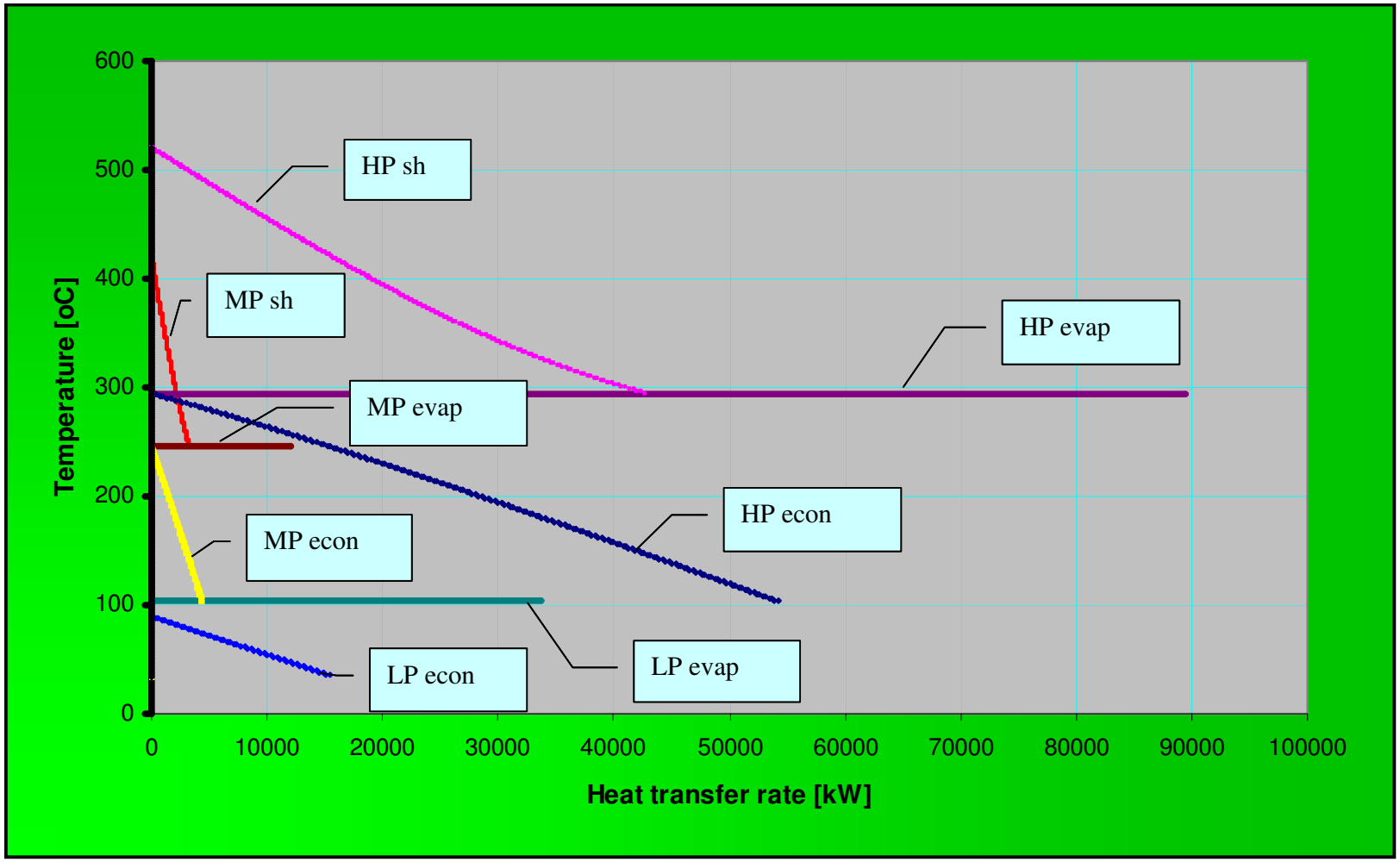
- multi pressure - pinch analysis possible



Example 2

Optimization of Heat Recovery Steam Generators

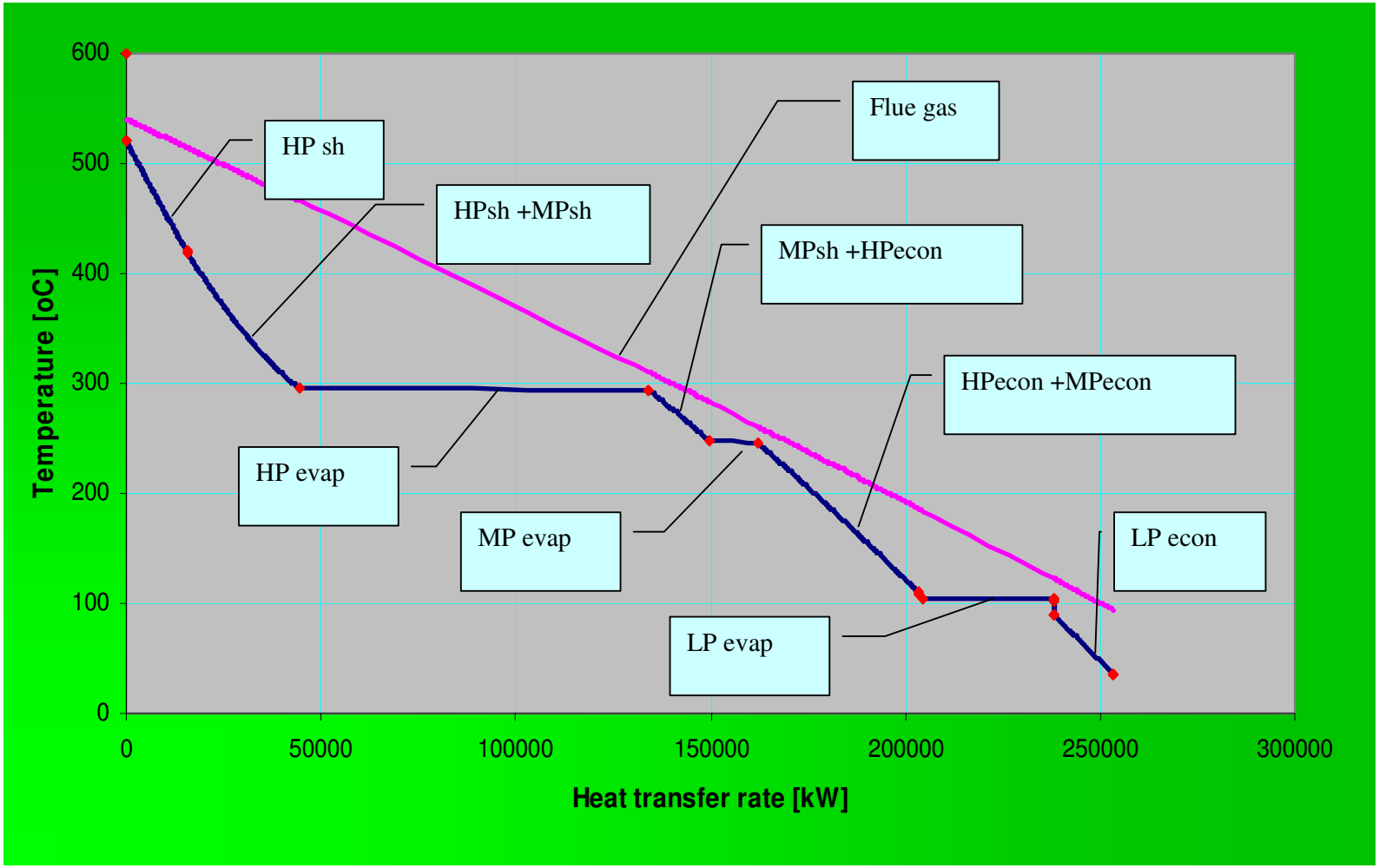
- component streams for cold composite curve



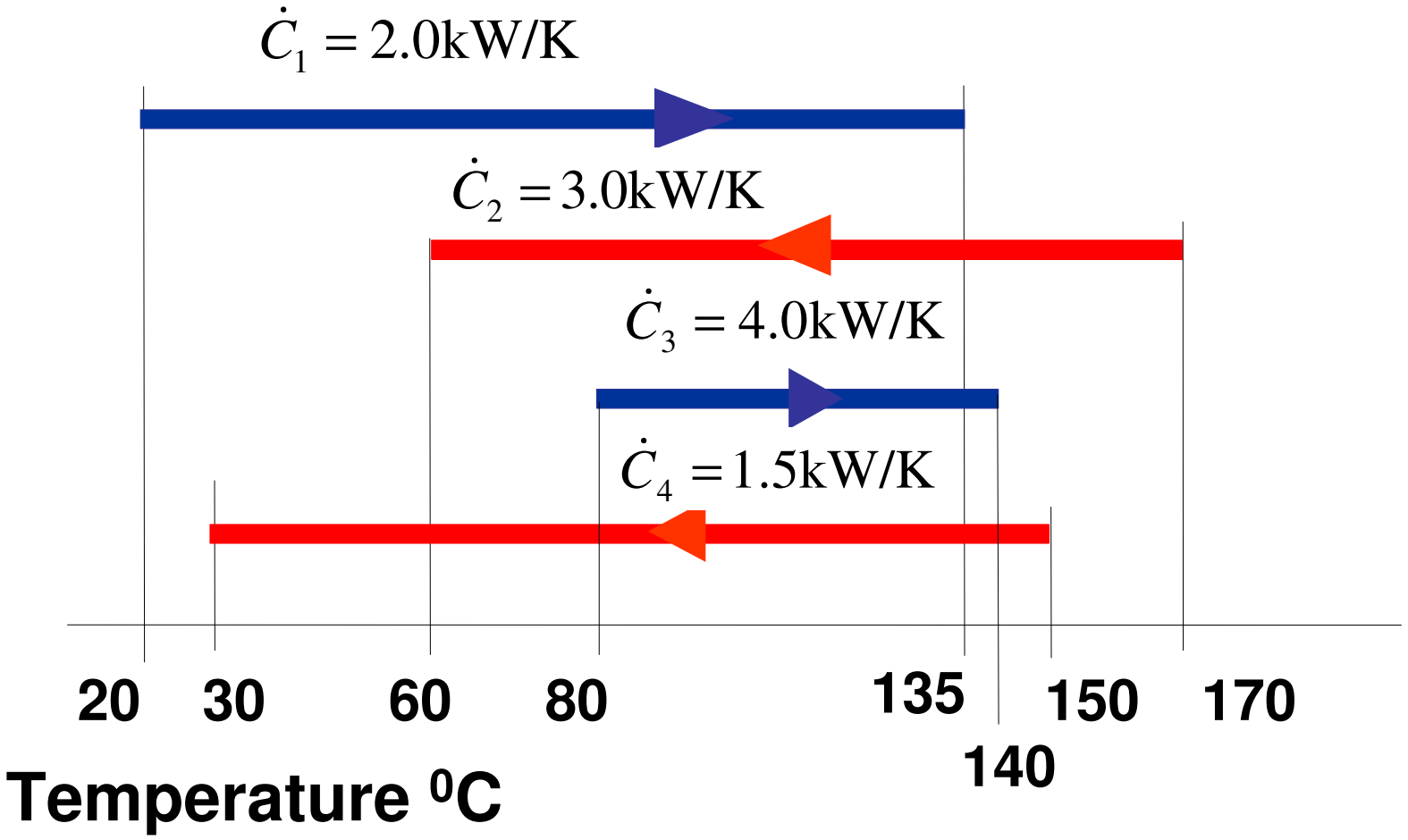
Example 2

Optimization of Heat Recovery Steam Generators

- composite curves

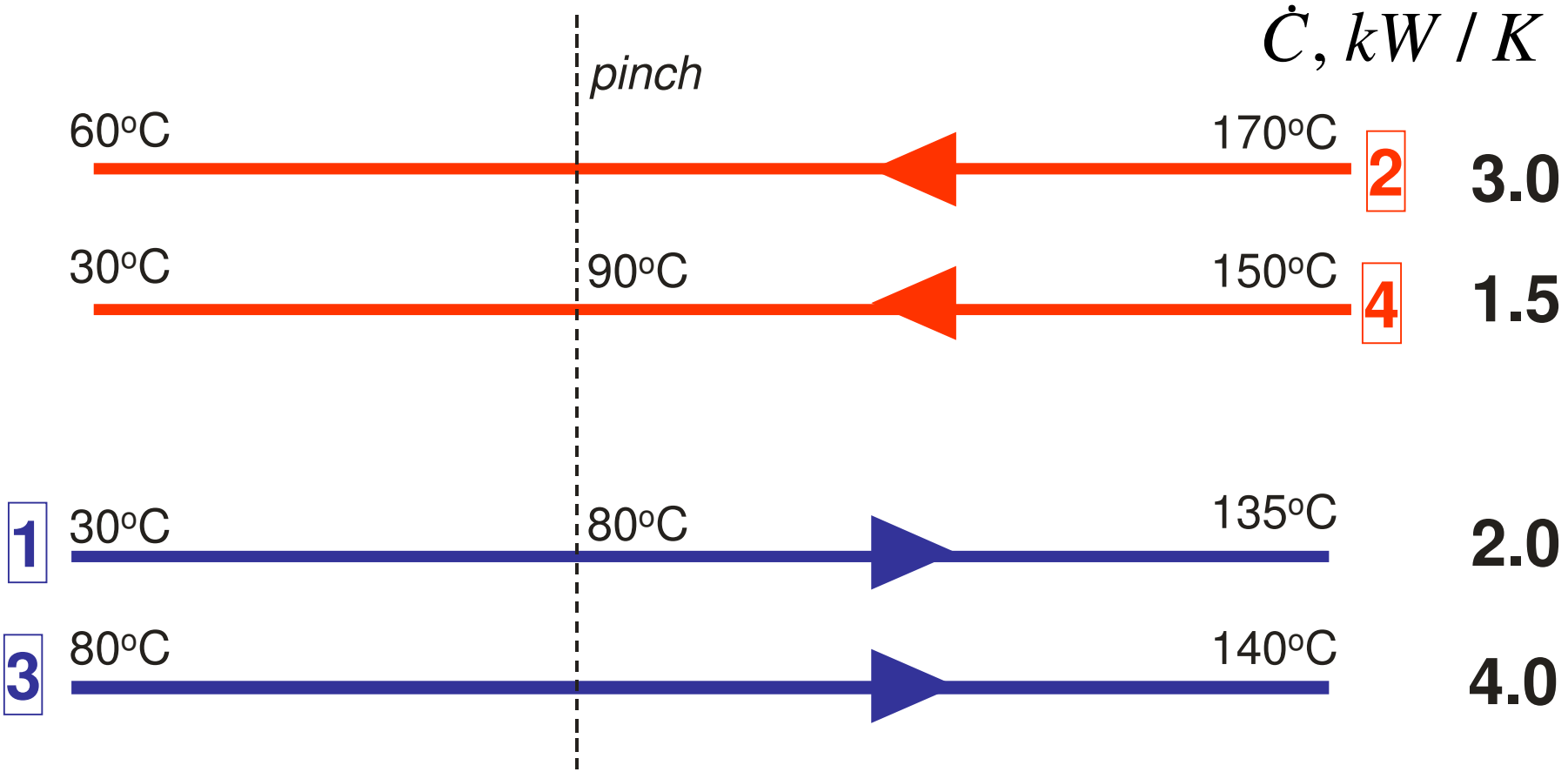


Example 3
Heat Exchanger Network Design



Heat Exchanger Network Design

Case study:



Heat Exchanger Network Design

Pinch method ensures maximal heat regeneration.

The economic optimum could be however not at pinch method solution.

The designs with smaller number of heat exchangers can be preferred economically.

Heat Exchanger Network Design

Many final solutions are possible.

Following advices should be considered to follow Pinch Method principles:

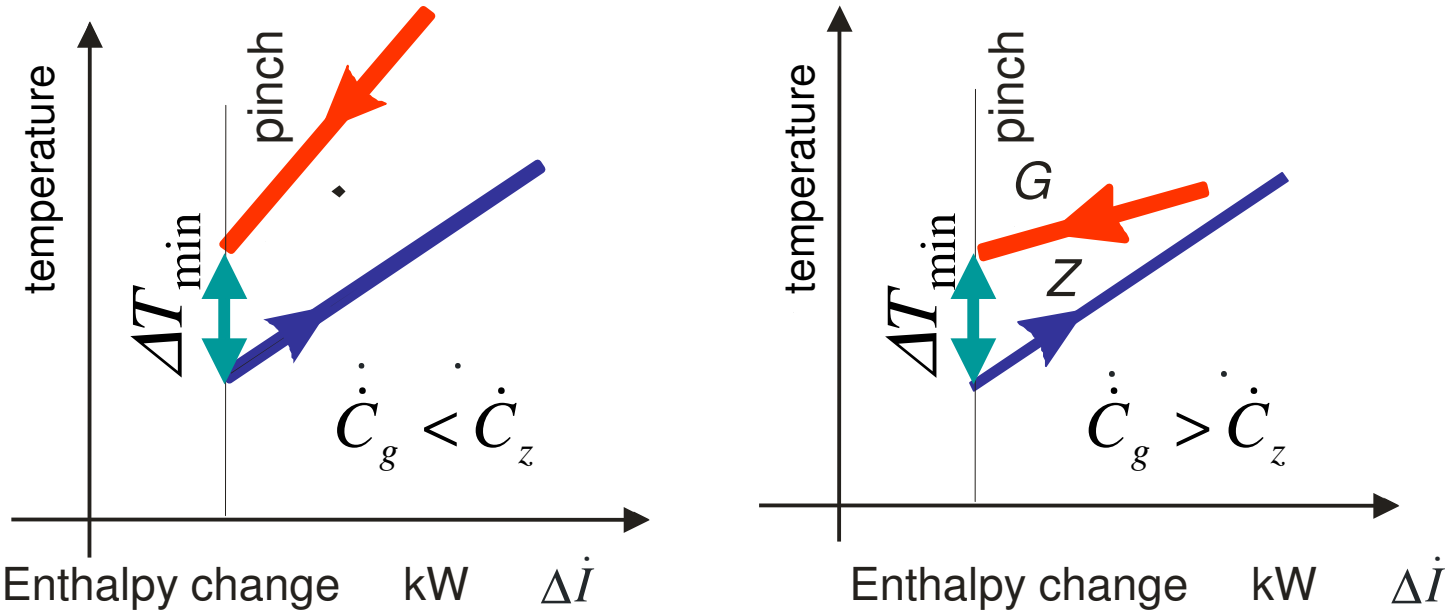
- ✓ do not use hot utility below pinch as well as cold utility above pinch
- ✓ do not use extremely low and high temperature differences
- ✓ combine hot and cold streams of similar heat flux capacities
- ✓ maximize heat exchanger capacities
- ✓ temperature differences in heat exchangers should be equal or higher than at pinch point

Heat Exchanger Network Design

Above the pinch point

- combined streams should fulfill following relation:

$$\dot{C}_g \leq \dot{C}_z$$

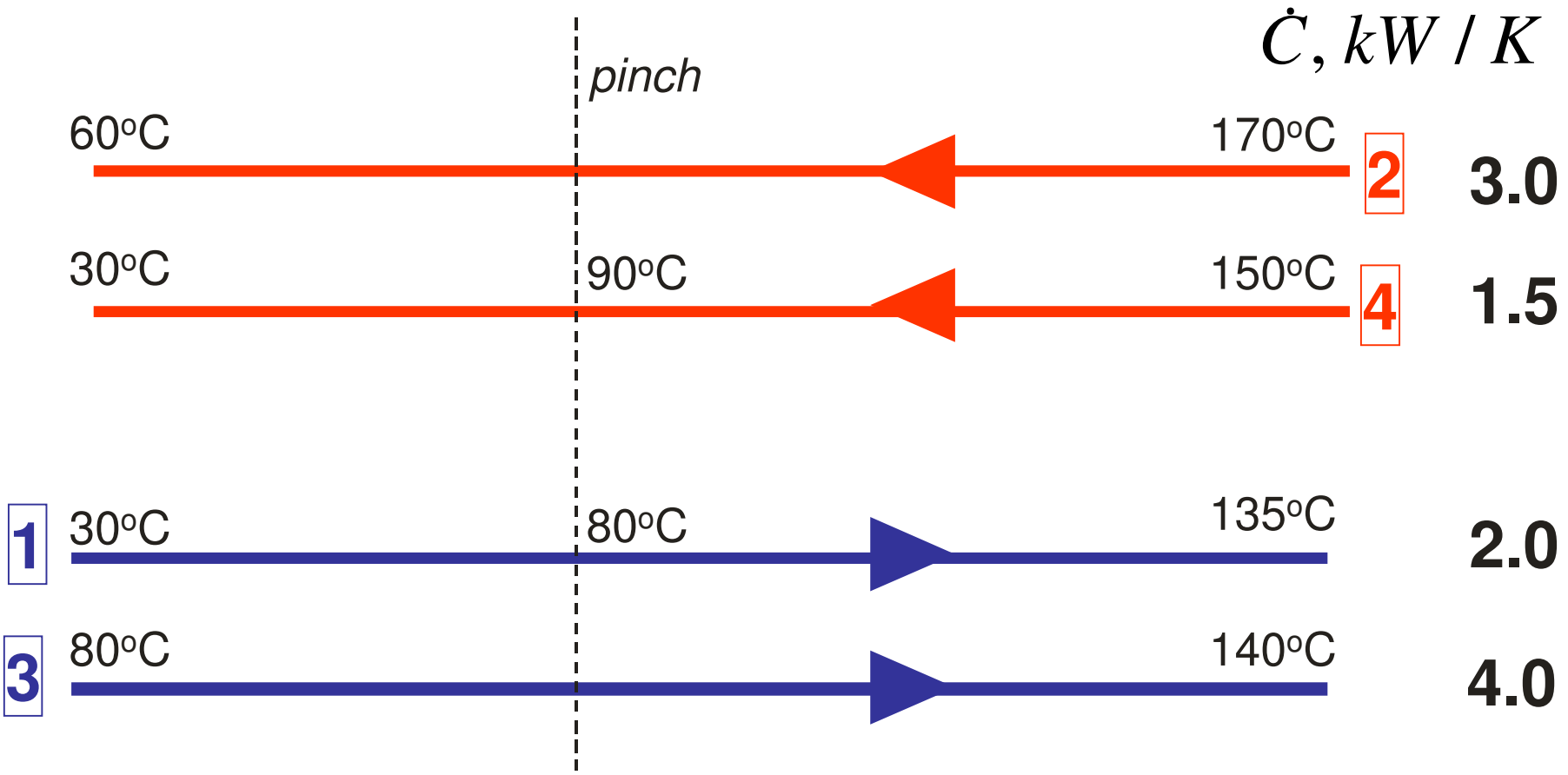


Below the pinch point

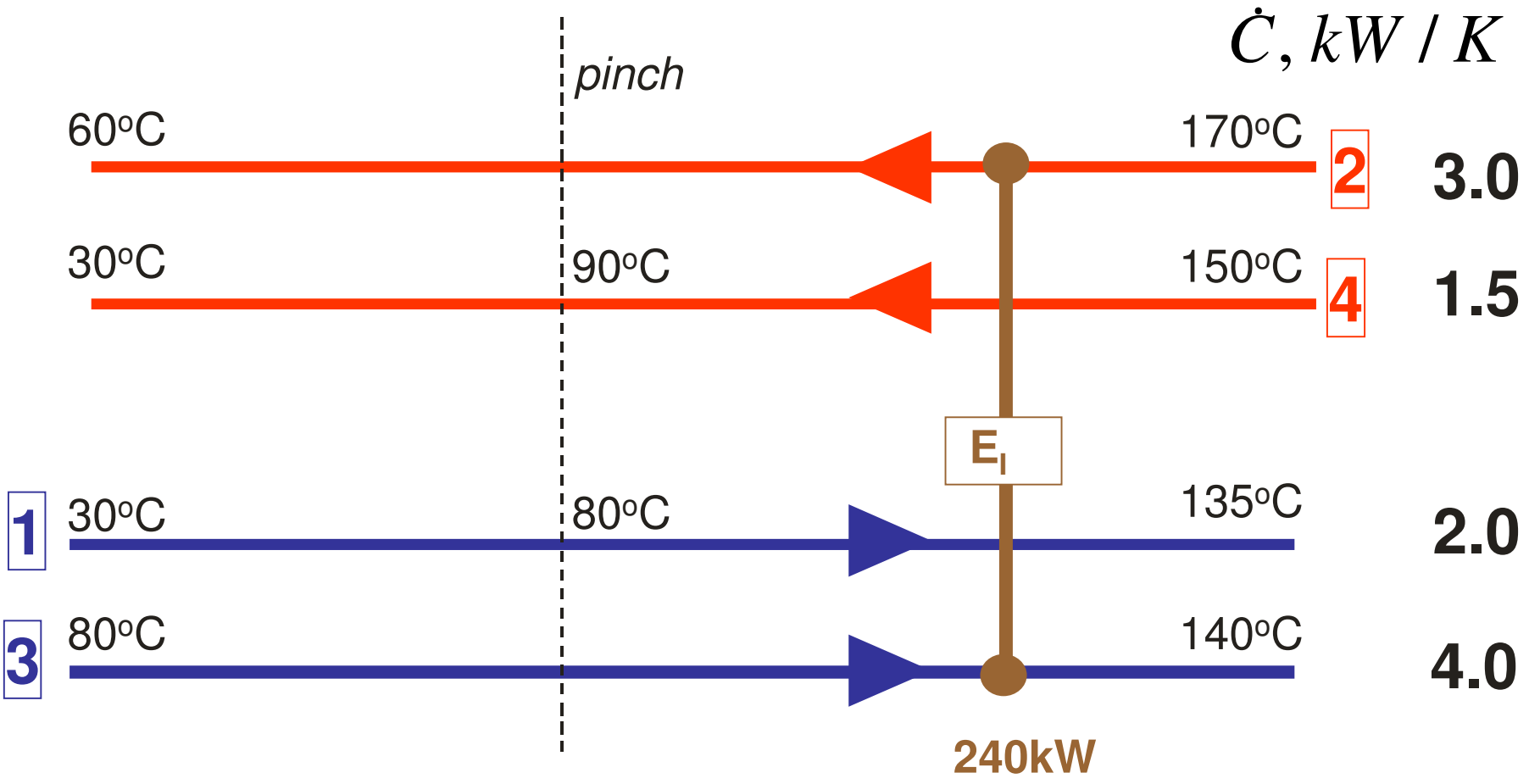
- combined streams should fulfill following relation:

$$\dot{C}_g \geq \dot{C}_z$$

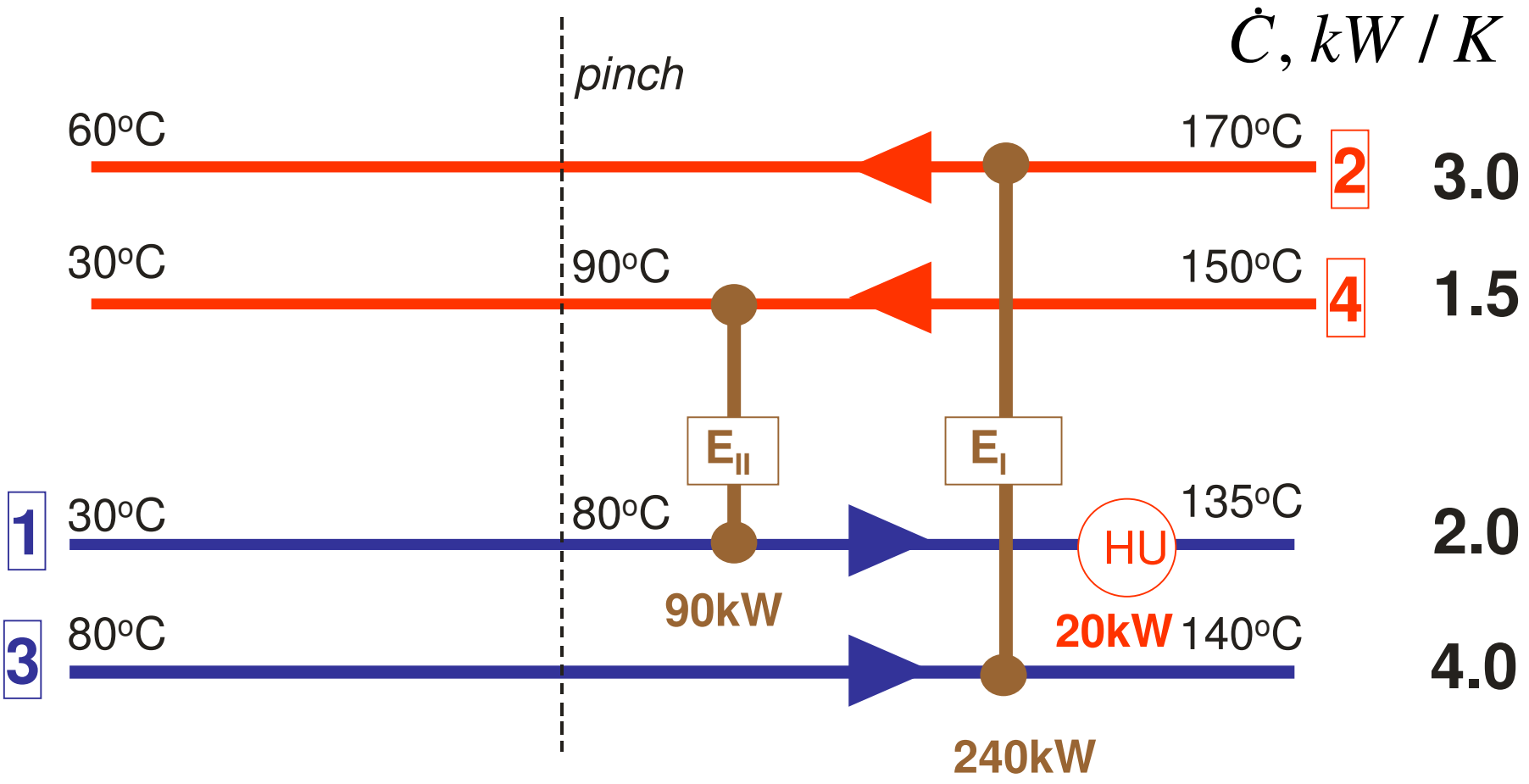
Heat Exchanger Network Design



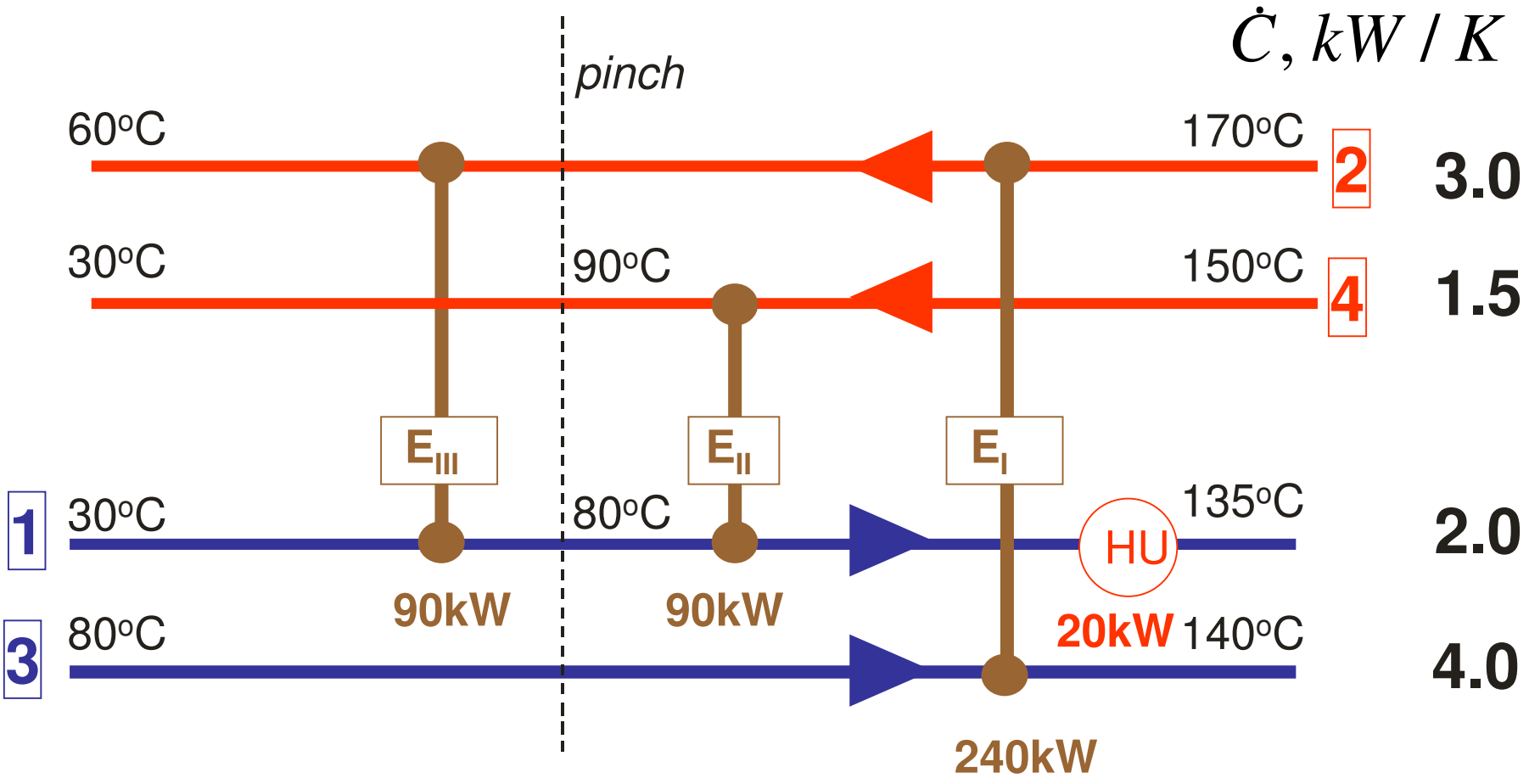
Heat Exchanger Network Design



Heat Exchanger Network Design

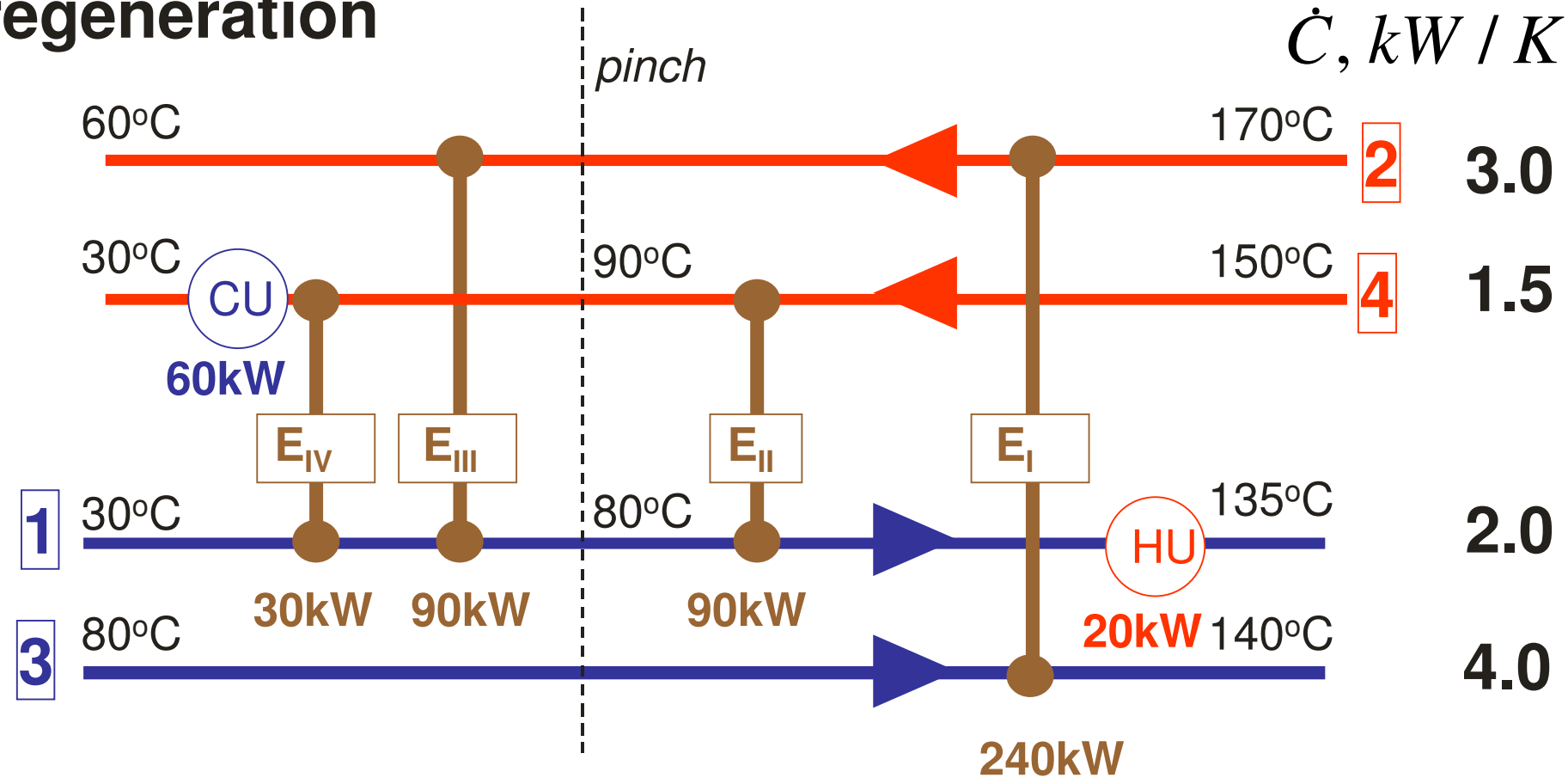


Heat Exchanger Network Design



Heat Exchanger Network Design

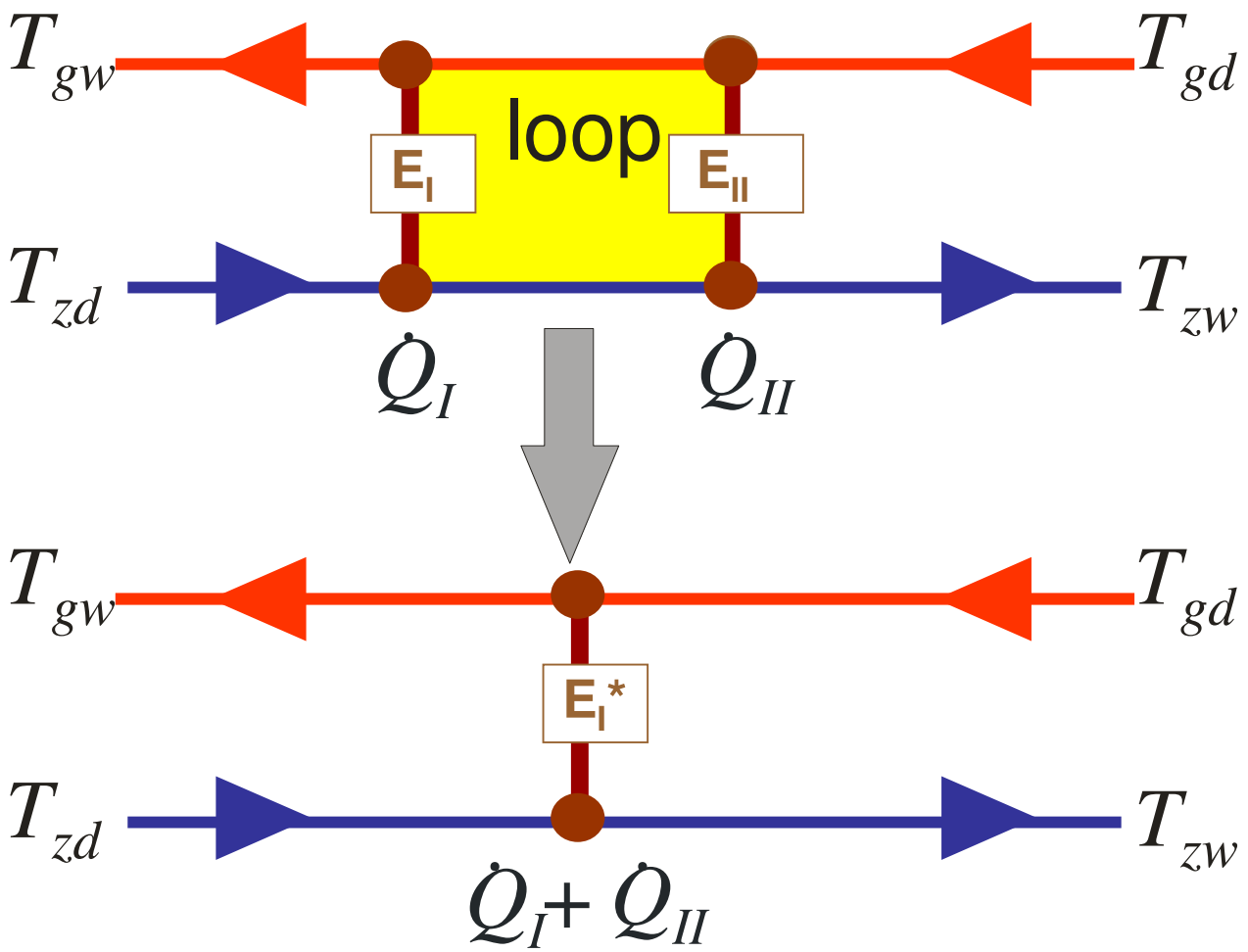
The network with maximal heat regeneration



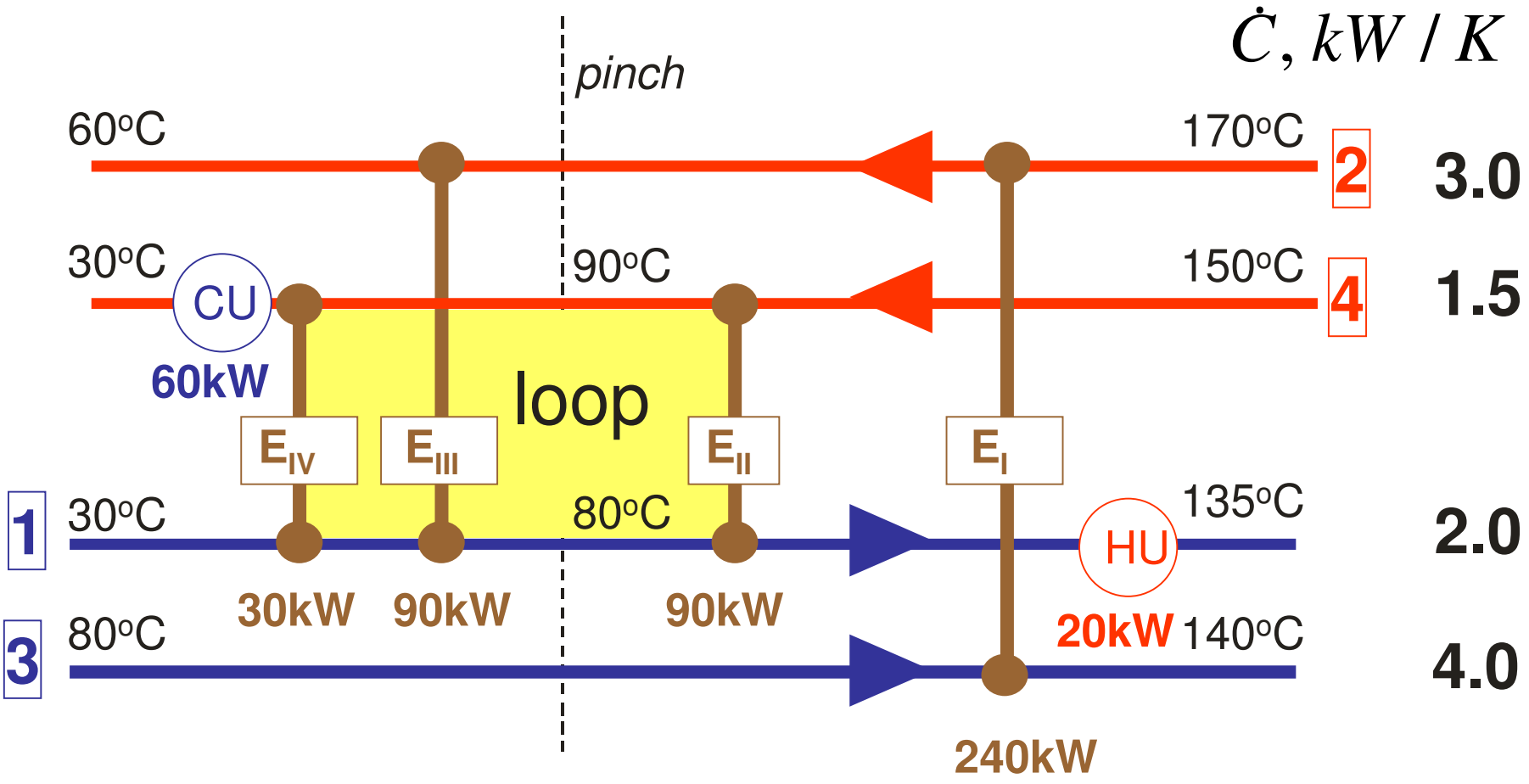
The operating cost is minimized but the capital cost may be not.

Heat Exchanger Network Design

Two heat exchangers can be reduced to one unit.



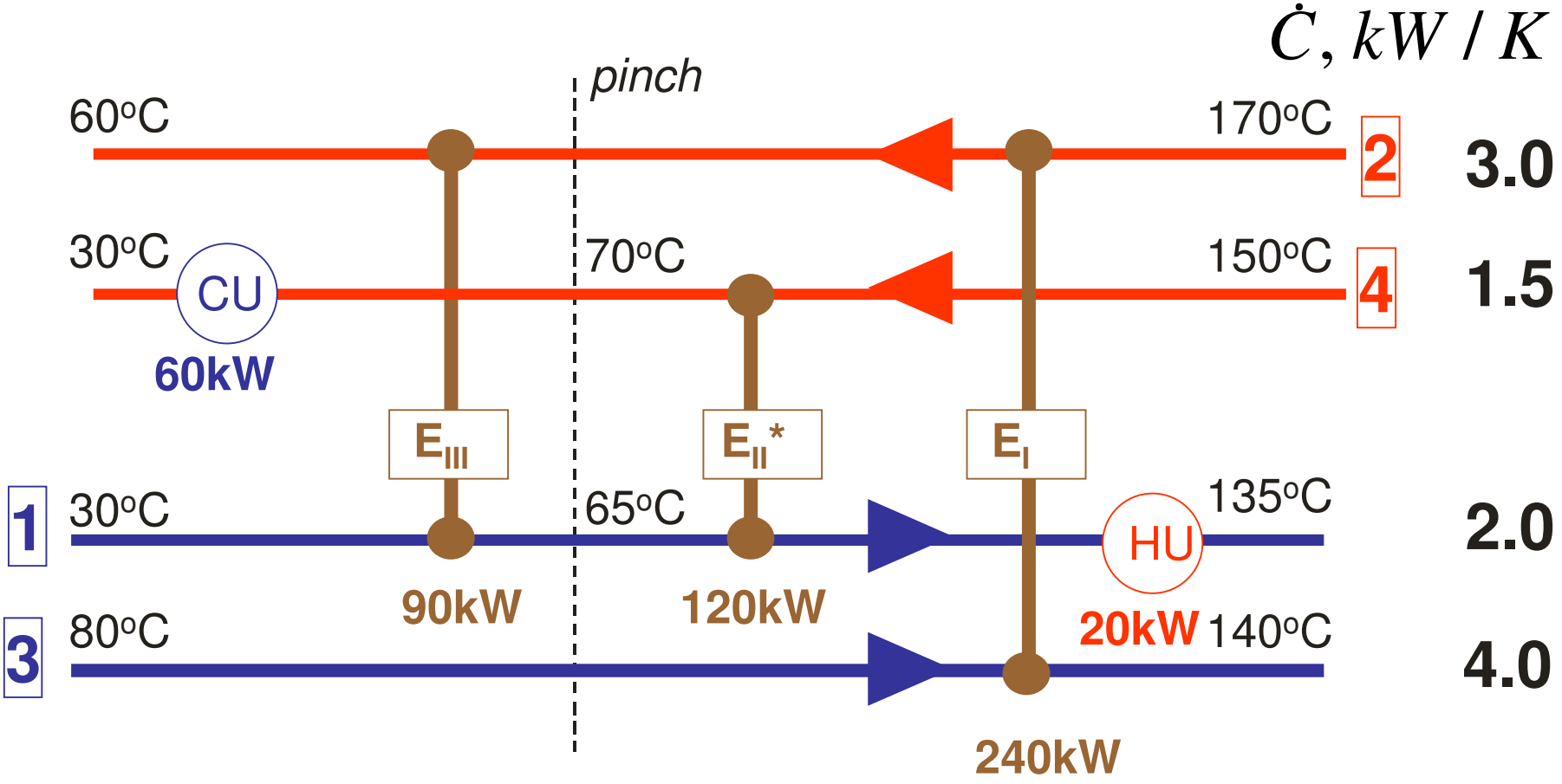
Heat Exchanger Network Design



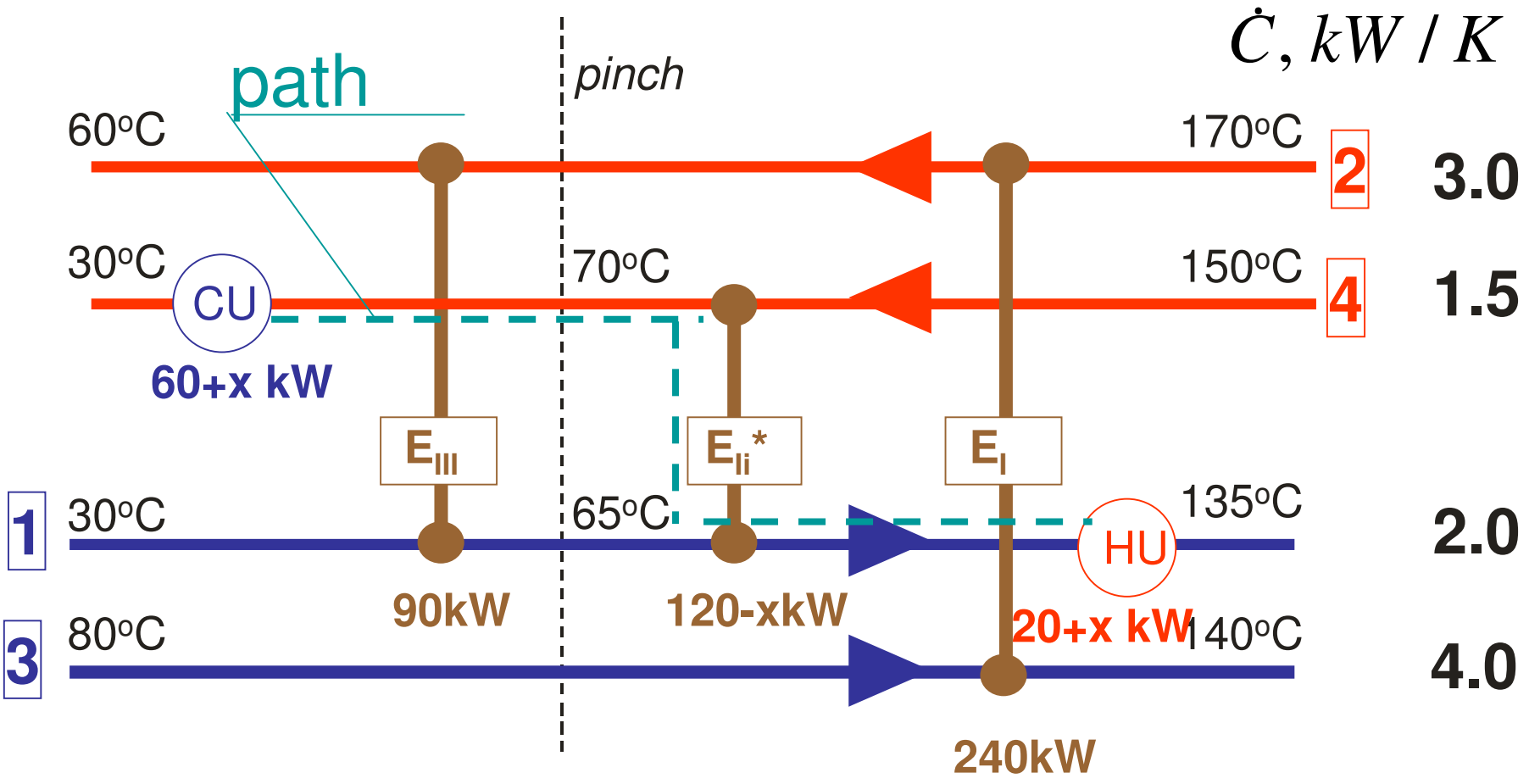
Heat Exchanger Network Design

ΔT_{min} **decreased by 5K.**

- higher heat exchange area but still maximal heat recovery



Heat Exchanger Network Design



Heat Exchanger Network Design

ΔT_{min} again 10K.