

ENERGY SAVINGS IN MISCELLA DISTILLATION



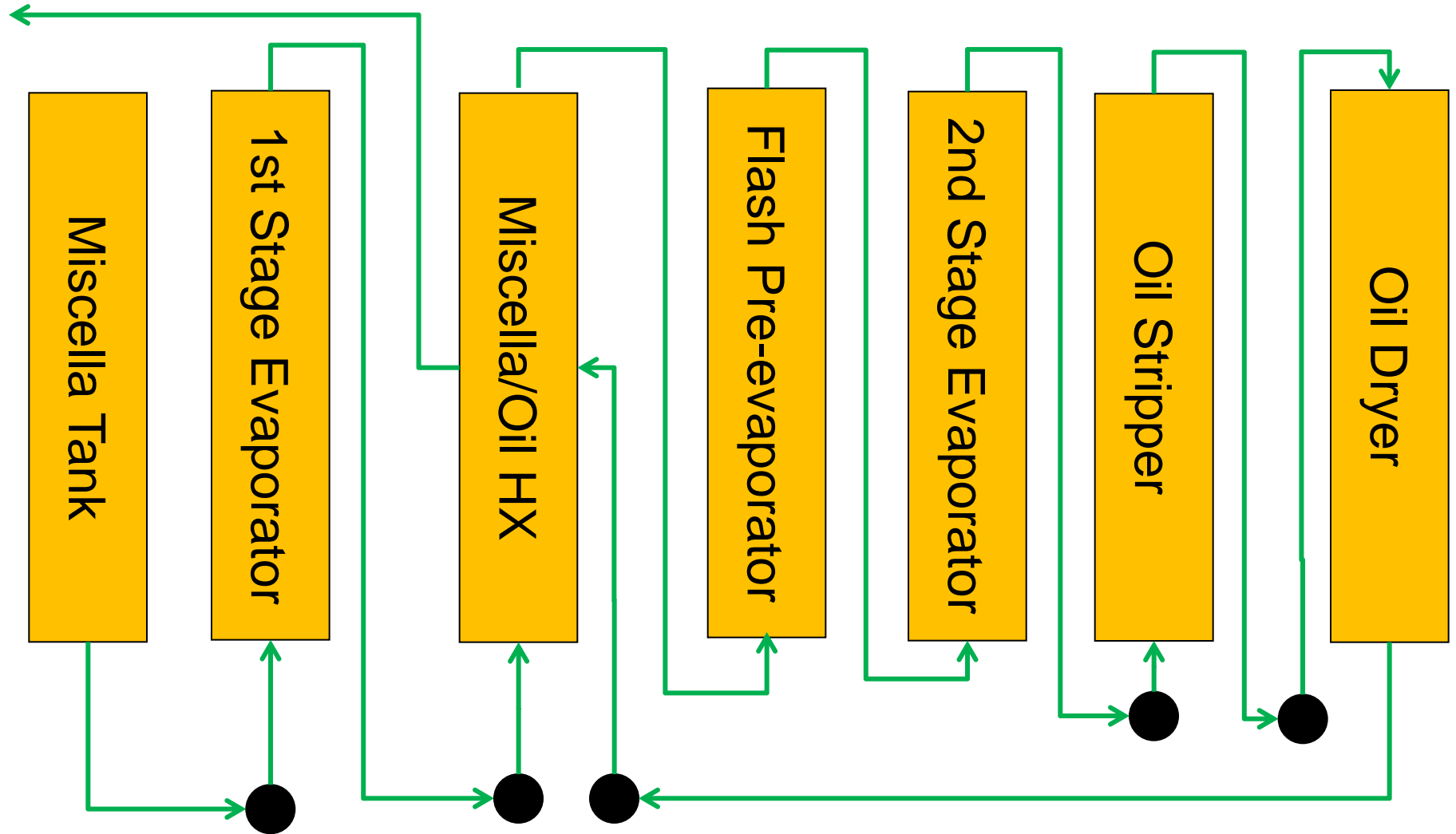
IOMSA Summer Meeting
Nashville, Tennessee
June 2011

Tim Kemper
Desmet Ballestra North America
Atlanta, Georgia, USA

MISCELLA DISTILLATION UNIT PROCESSES



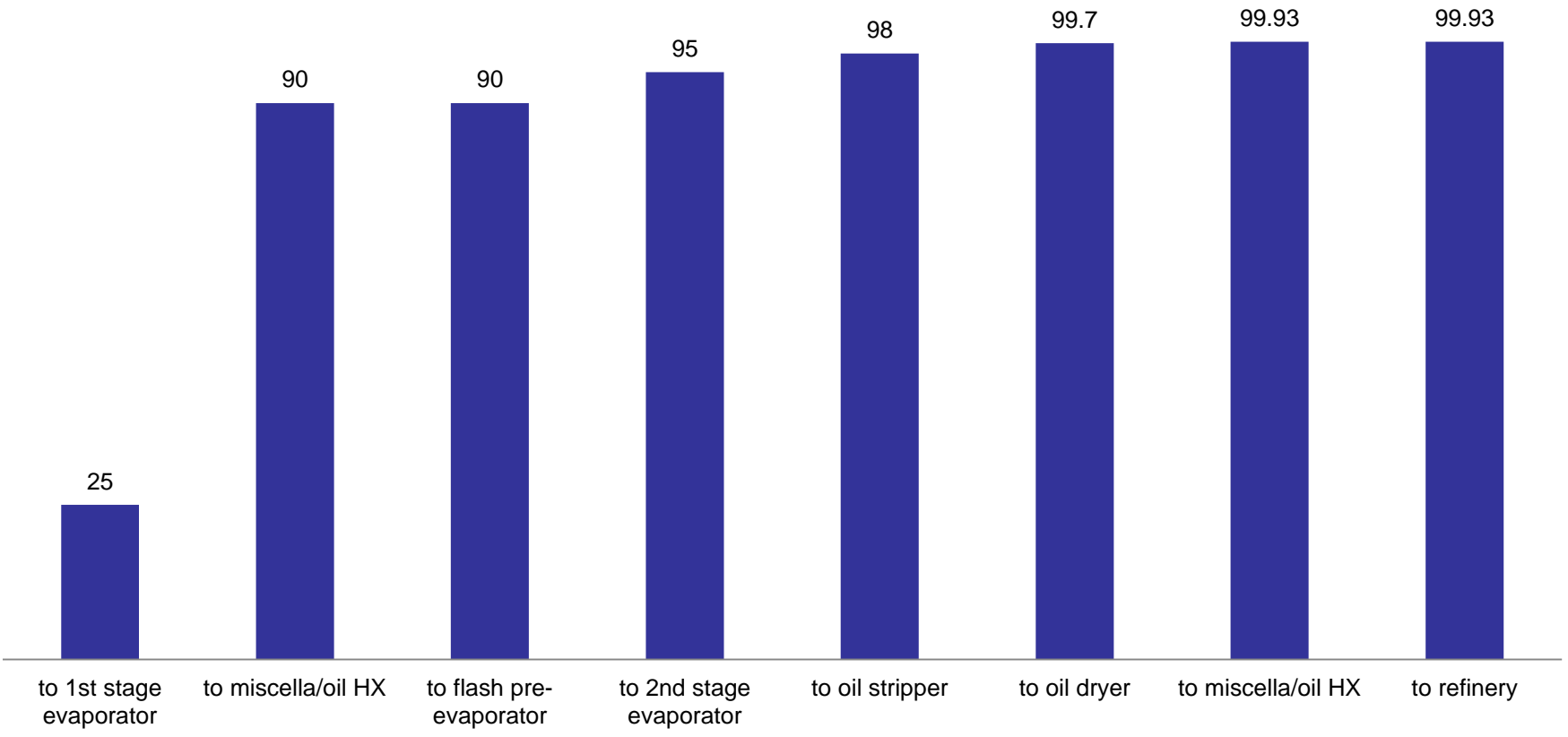
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MISCELLA DISTILLATION OIL CONCENTRATIONS



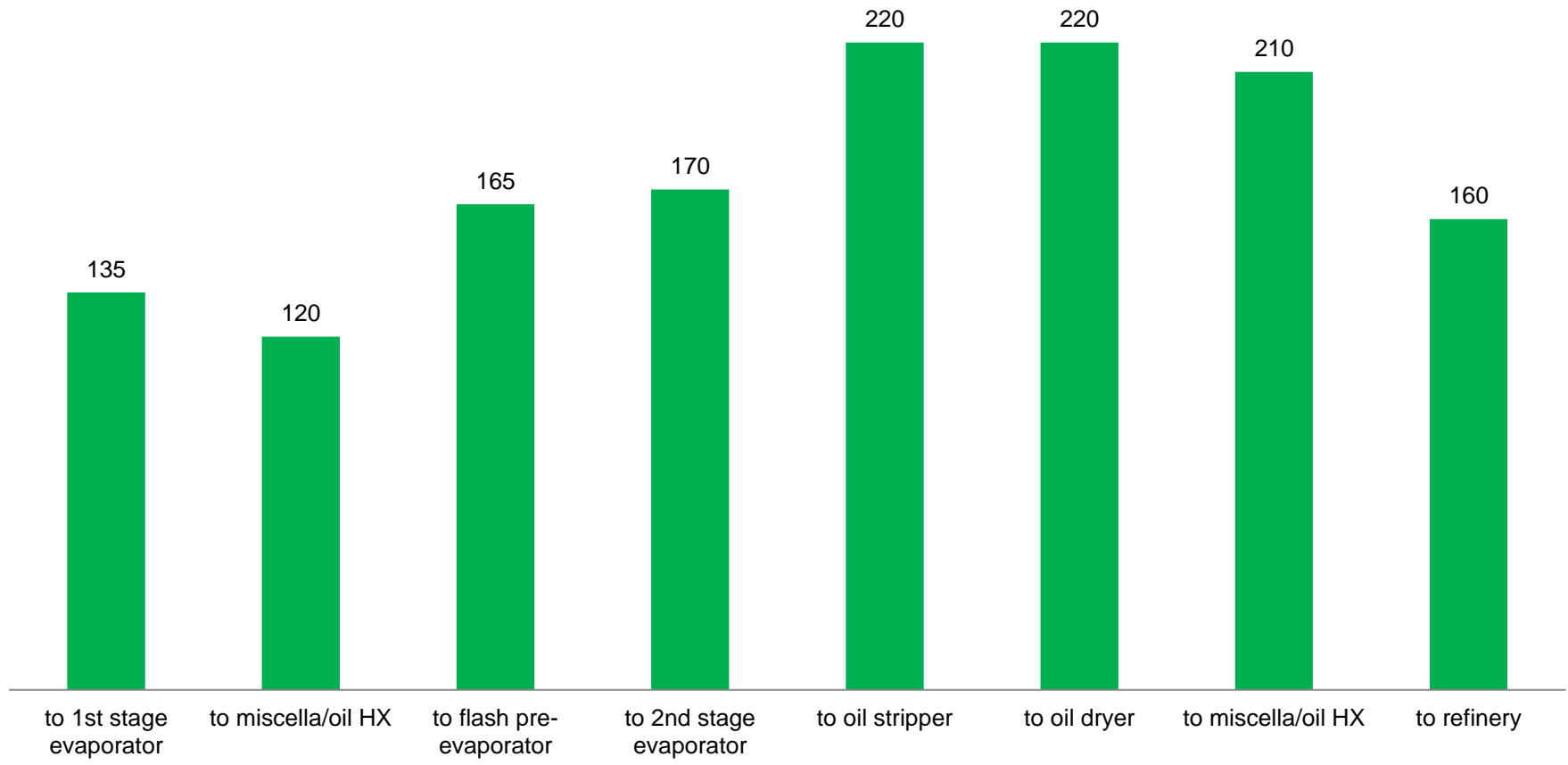
Miscella Concentration Profile



MISCELLA DISTILLATION TEMPERATURES



Miscella Temperature Profile

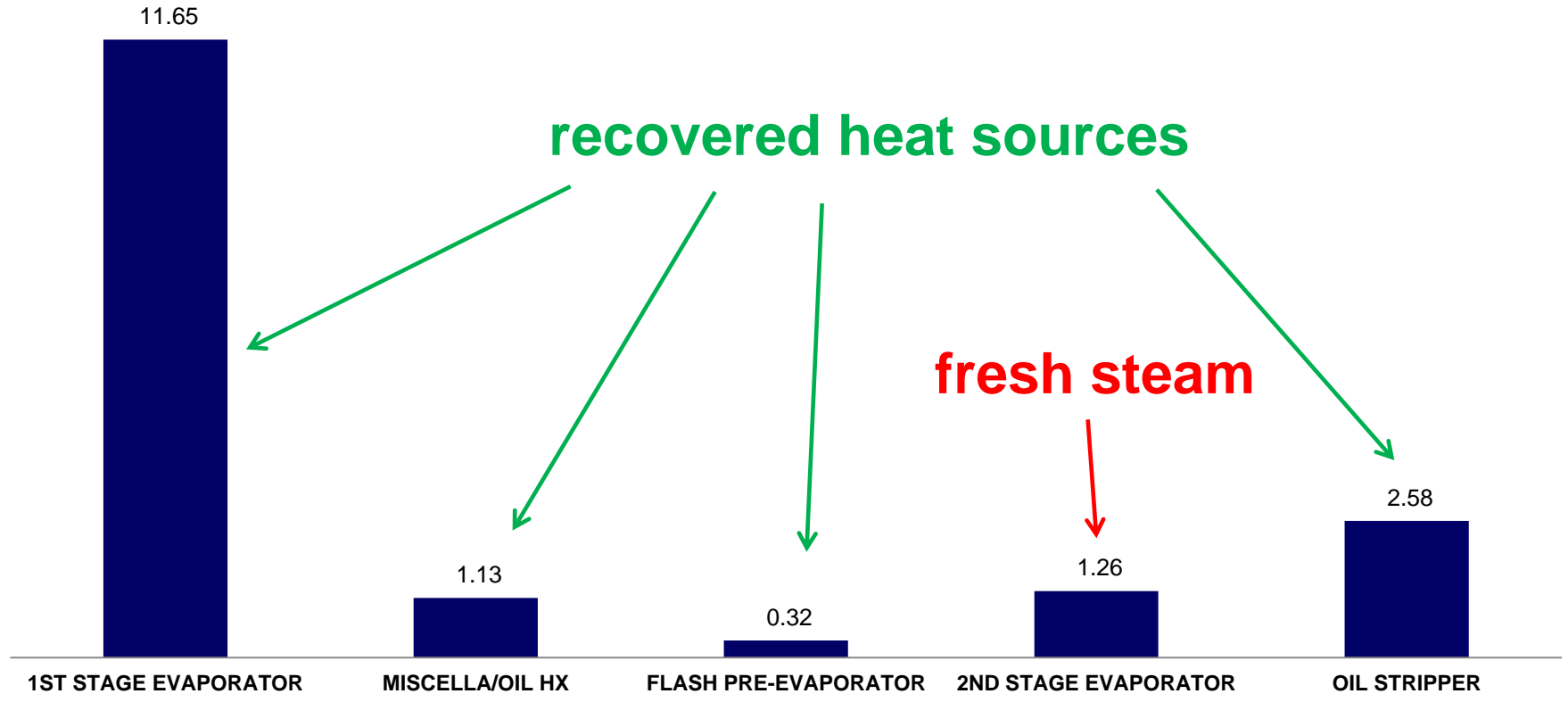


MISCELLA DISTILLATION ENERGY INPUT



Miscella Distillation Energy Input

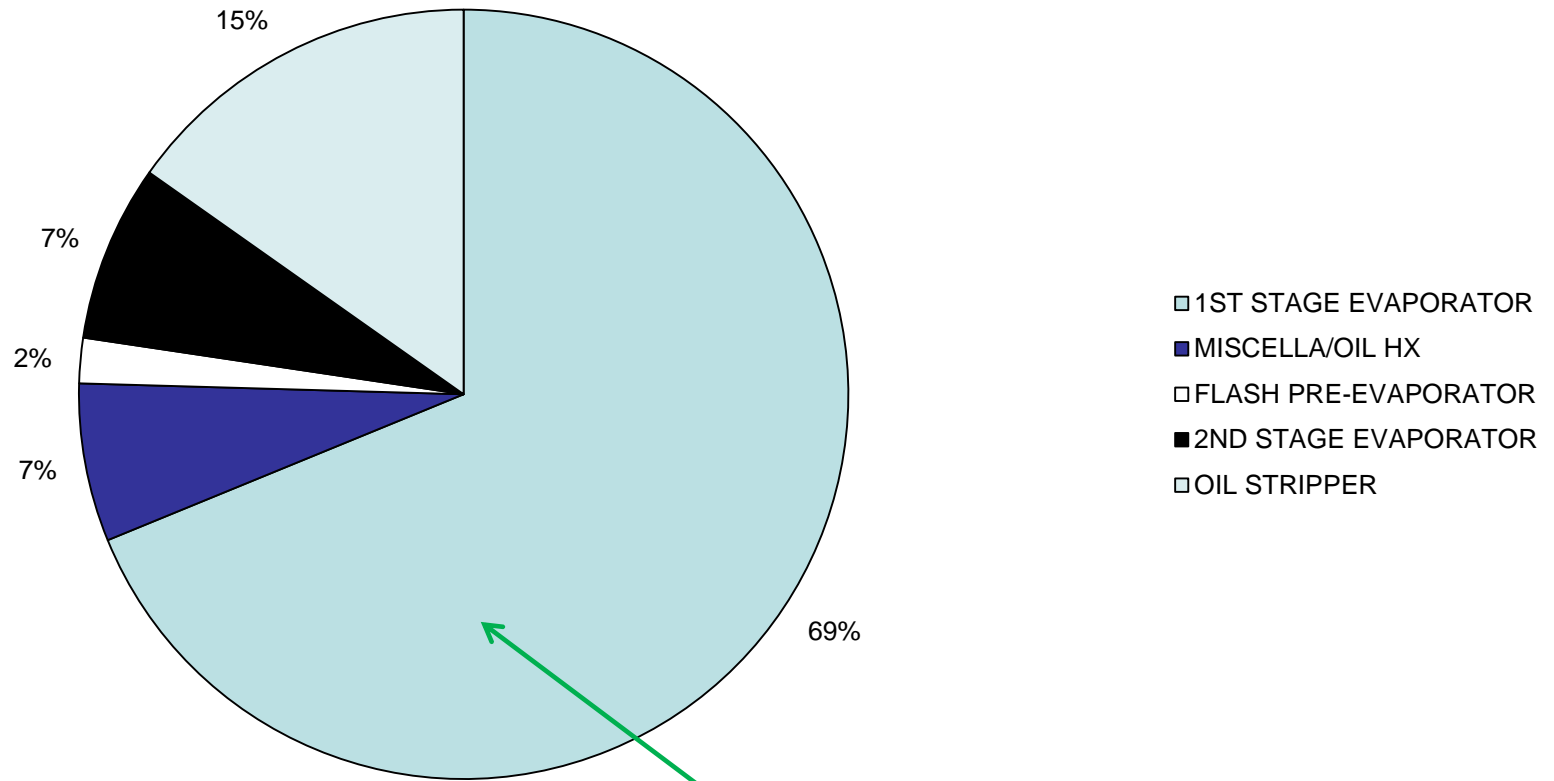
mm BTU / hr (100,000 bpd soy plant)



MISCELLA DISTILLATION ENERGY INPUT



Miscella Distillation Energy Input



1st Stage Evaporator is Key!

OPTIMIZING THE 1ST STAGE EVAPORATOR

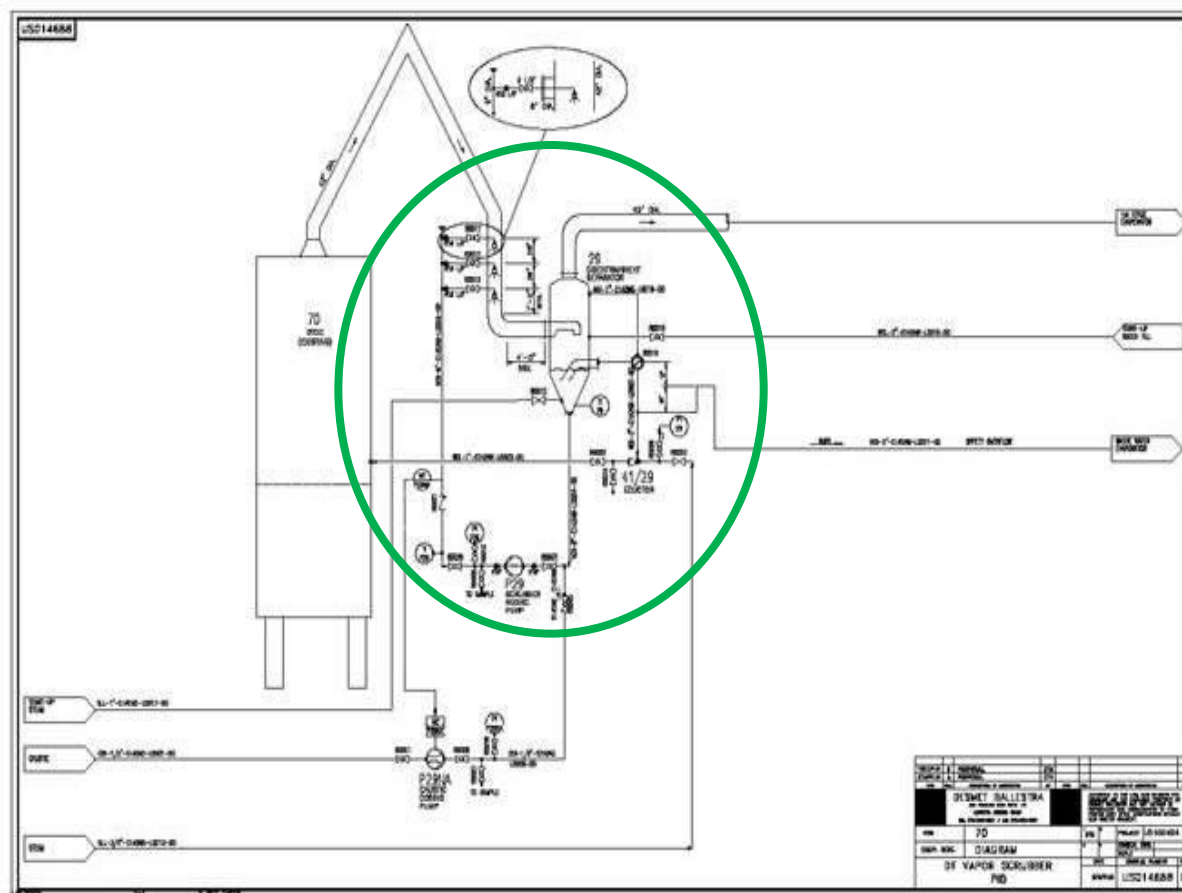


- Optimizing 1st Stage Evaporator heat transfer is key to minimizing distillation energy consumption
- Heat transfer = $Q = U \times A \times \Delta T$
 1. Optimize “U” by keeping the tubes clean
 - minimize tube fouling with a good DT vapor scrubber
 2. Optimize “A” by installing a large tube surface area
 3. Optimize “ ΔT ” by maximizing the vacuum
 - send coolest cooling water to the vacuum condenser
 - minimize vacuum condenser pressure drop
 - only condense hexane vapor in the vacuum condenser

OPTIMIZING THE 1ST STAGE EVAPORATOR



1. Optimize “U” by keeping the tubes clean

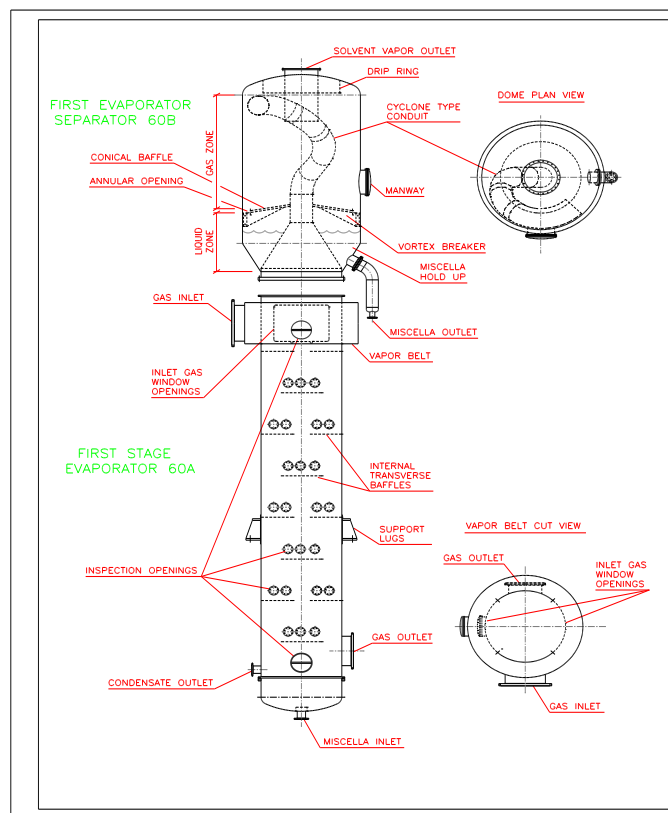


Water-spray type
Vapor Scrubber
to remove meal
fines in DT vapors
to 1st Stage
Evaporator

OPTIMIZING THE 1ST STAGE EVAPORATOR



2. Optimize “A” by installing a large tube surface area



OPTIMIZING THE 1ST STAGE EVAPORATOR



3. Optimize “ ΔT ” by maximizing the vacuum

Impact of Vacuum on 1st Stage Evaporator

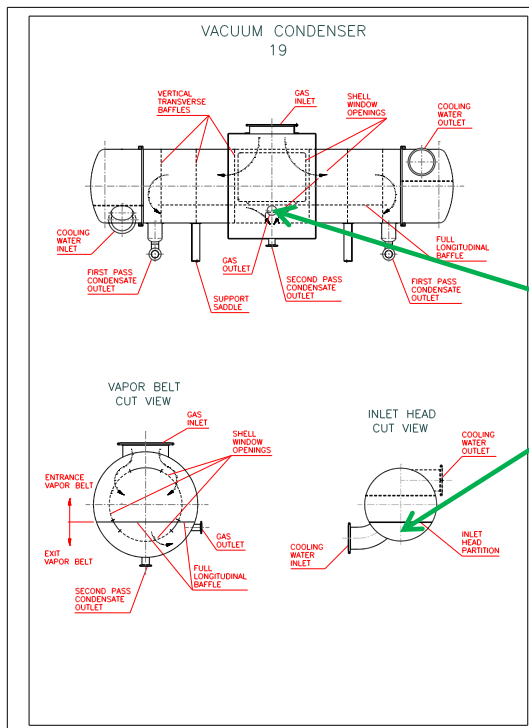
- If vacuum is **15” Hg** on 1st Stage Evaporator, then boiling point of hexane in tubes is **118 F** and DT vapors on shell are 143 F, so **$\Delta T = 25 F$** in evaporator.
- If vacuum is **18” Hg** on 1st Stage Evaporator, then boiling point of hexane in tubes is **106 F** and DT vapors on shell are 143 F, so **$\Delta T = 37 F$** in evaporator.
- This 3” Hg increase in vacuum increases the heat transfer capability by $37/25 = 1.48 = \underline{48\%}$!

OPTIMIZING THE 1ST STAGE EVAPORATOR



3. Optimize “ ΔT ” by maximizing the vacuum

- send coolest cooling water to the vacuum condenser

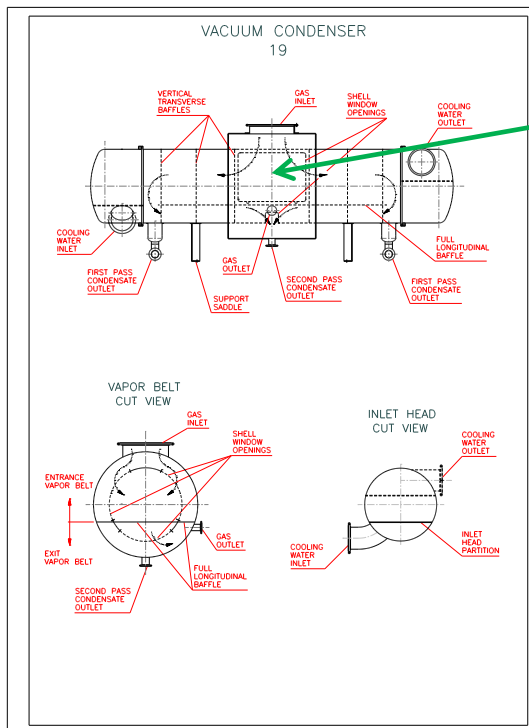


Coollest water near vapor exit

OPTIMIZING THE 1ST STAGE EVAPORATOR



3. Optimize “ ΔT ” by maximizing the vacuum
- minimize vacuum condenser pressure drop



A split flow vacuum vapor condenser reduces pressure drop through the condenser by a factor of 4!

OPTIMIZING THE 1ST STAGE EVAPORATOR



3. Optimize “ ΔT ” by maximizing the vacuum
- only condense hexane vapor in the vacuum condenser

Impact of water in vapors to Vacuum Condenser

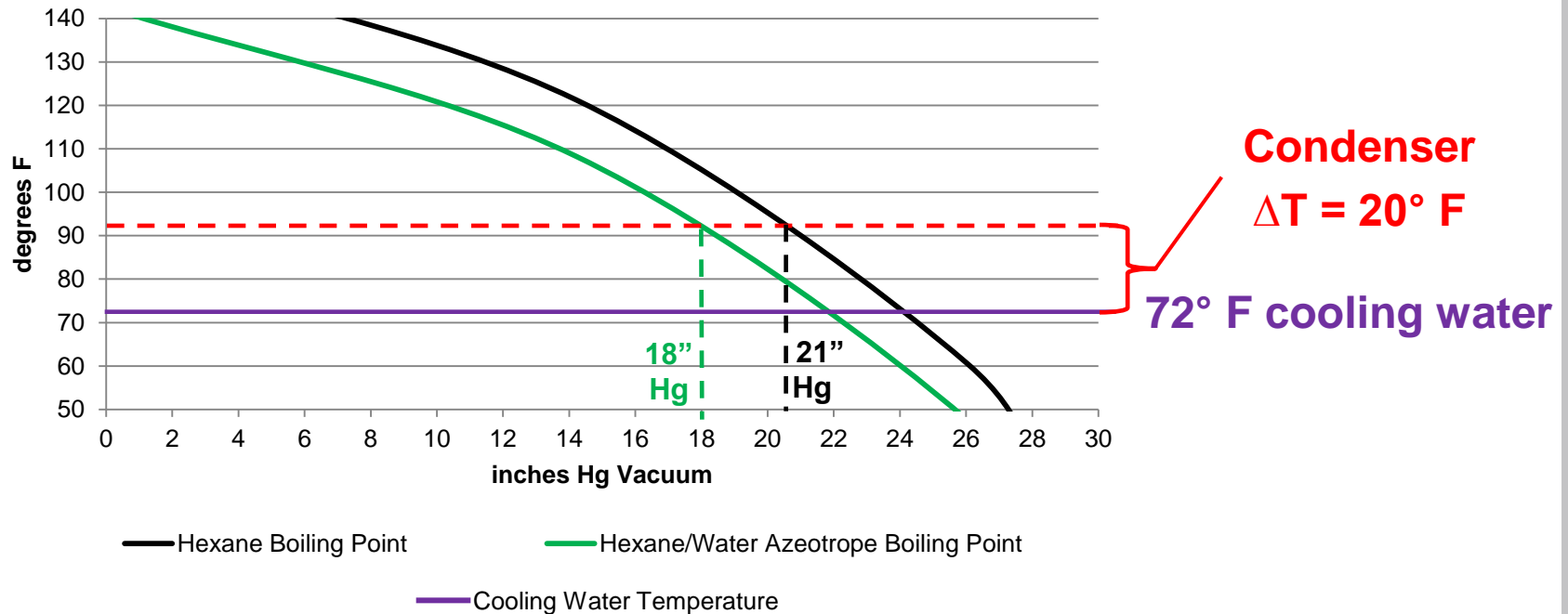
- To achieve 18” Hg vacuum in the 1st Stage Evaporator if there is an azeotropic hexane/water vapor going to the vacuum condenser, **72 F** cooling water is required
- To achieve 18” Hg vacuum in the 1st Stage Evaporator if there is pure hexane vapor going to the vacuum condenser, only **86 F** cooling water is required

OPTIMIZING THE 1ST STAGE EVAPORATOR



3. Optimize “ ΔT ” by maximizing the vacuum - only condense hexane vapor in the vacuum condenser

Impact of Cooling Water Temperature on Vacuum

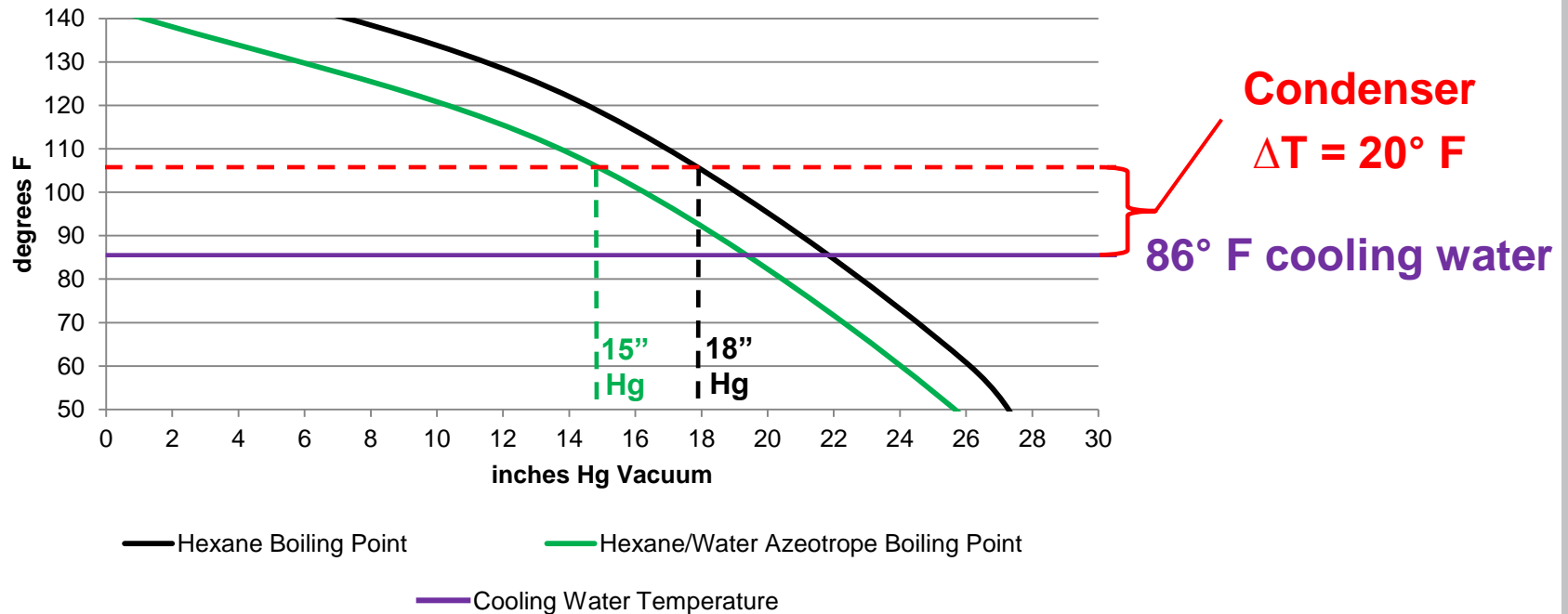


OPTIMIZING THE 1ST STAGE EVAPORATOR



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Impact of Cooling Water Temperature on Vacuum

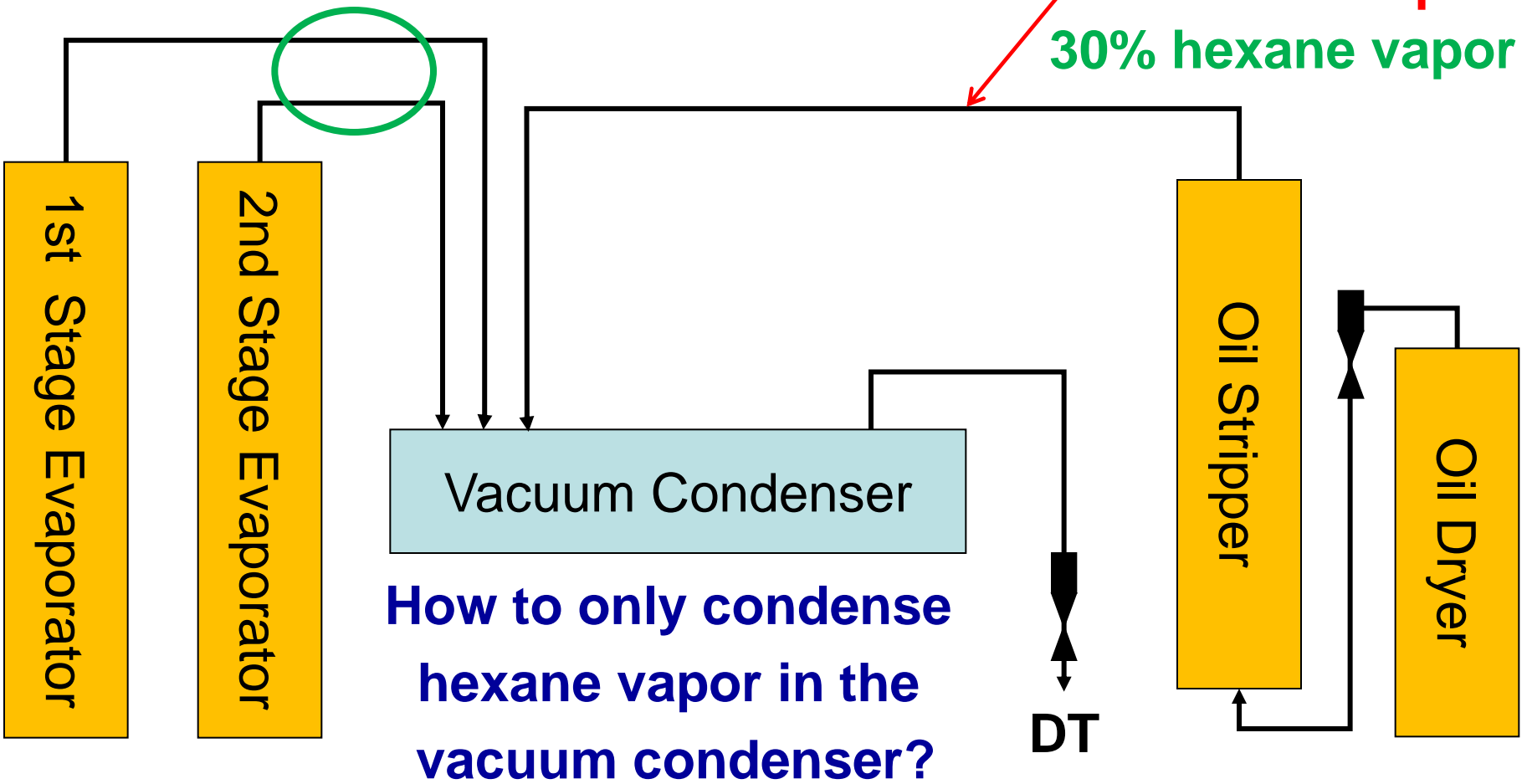


OPTIMIZING THE 1ST STAGE EVAPORATOR

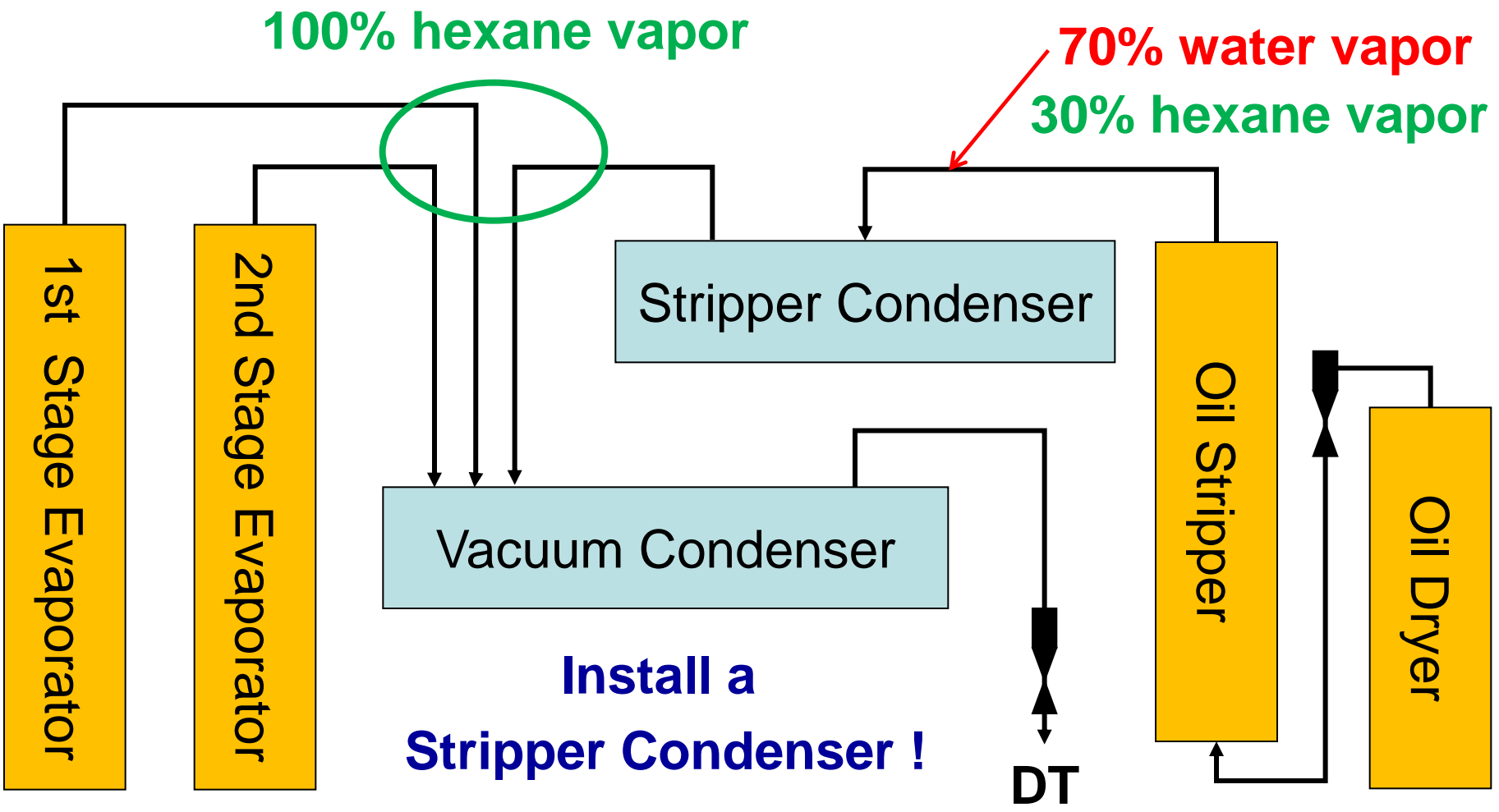


100% hexane vapor

70% water vapor
30% hexane vapor



OPTIMIZING THE 1ST STAGE EVAPORATOR



OPTIMIZING THE 1ST STAGE EVAPORATOR

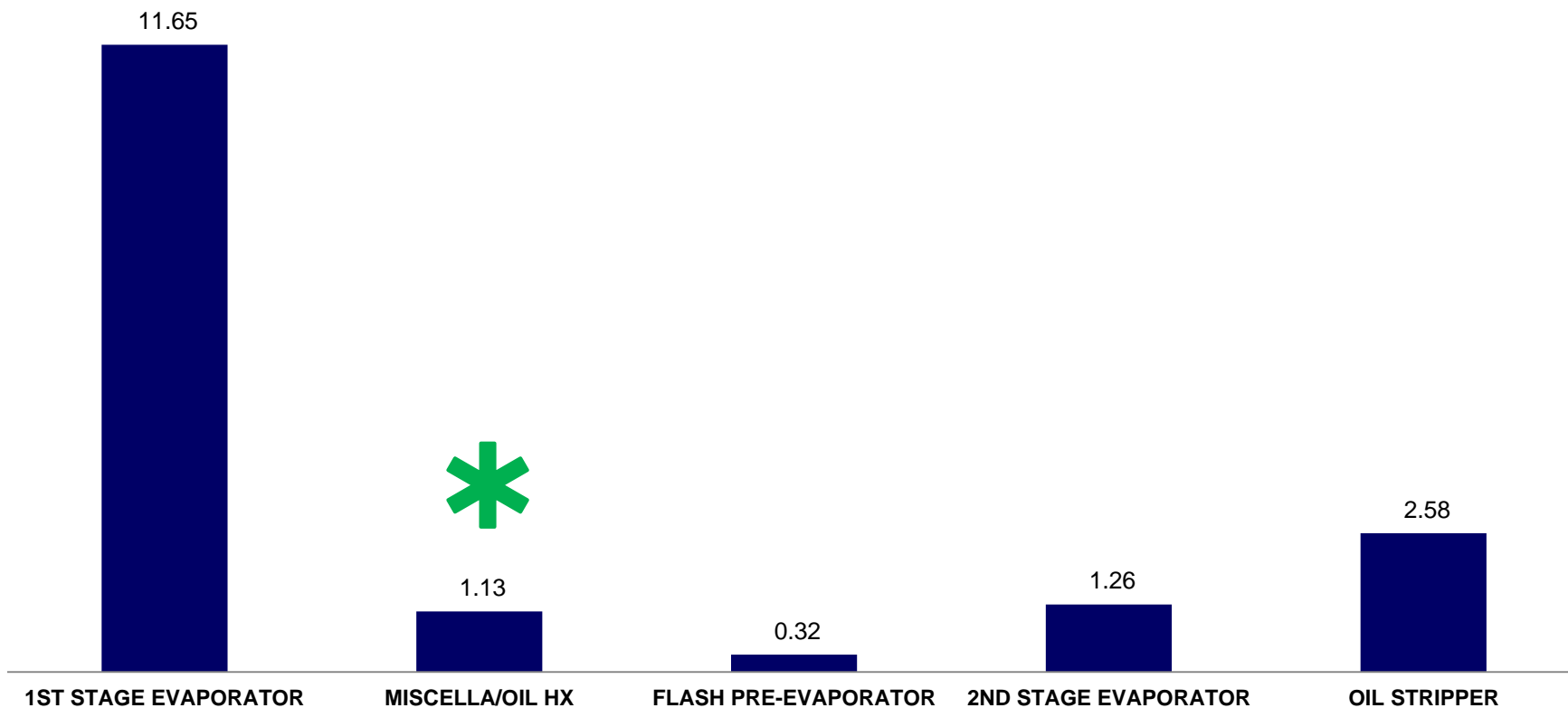


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OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



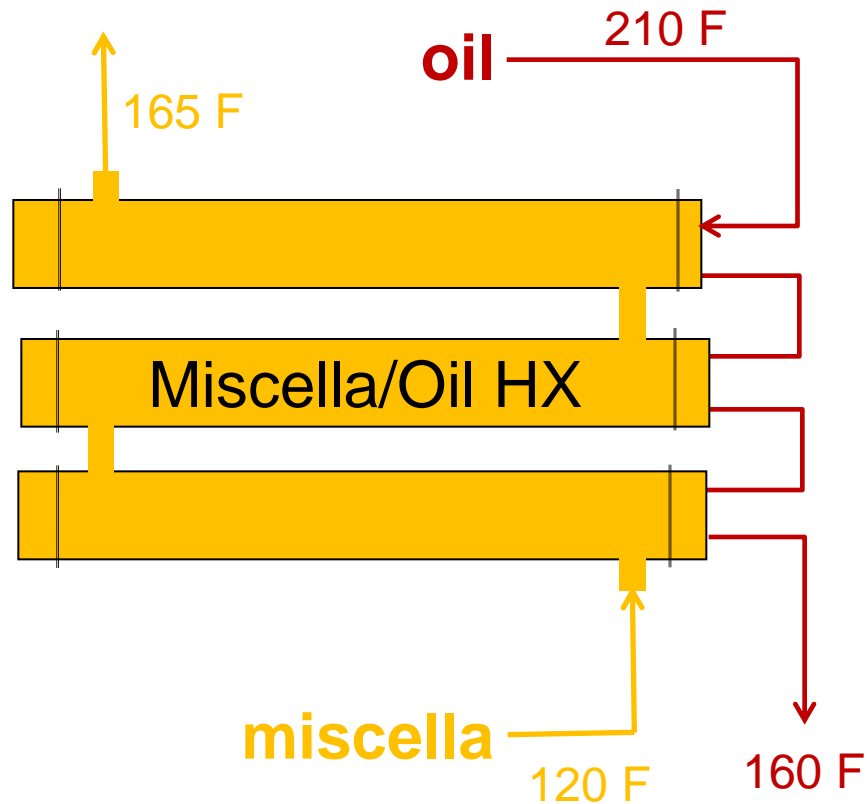
Miscella/Oil Interchanger



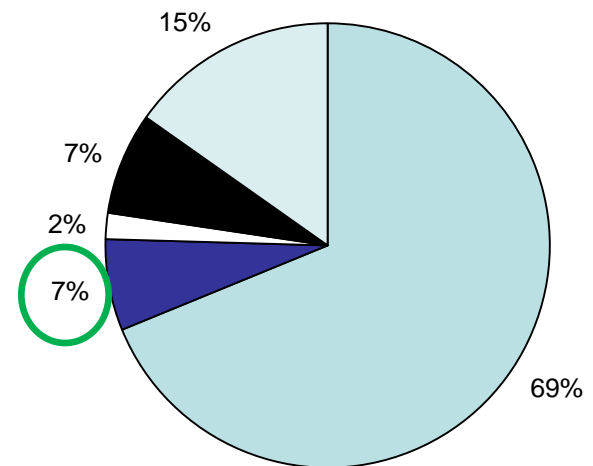
OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



Miscella/Oil Interchanger



Miscella Distillation Energy Input

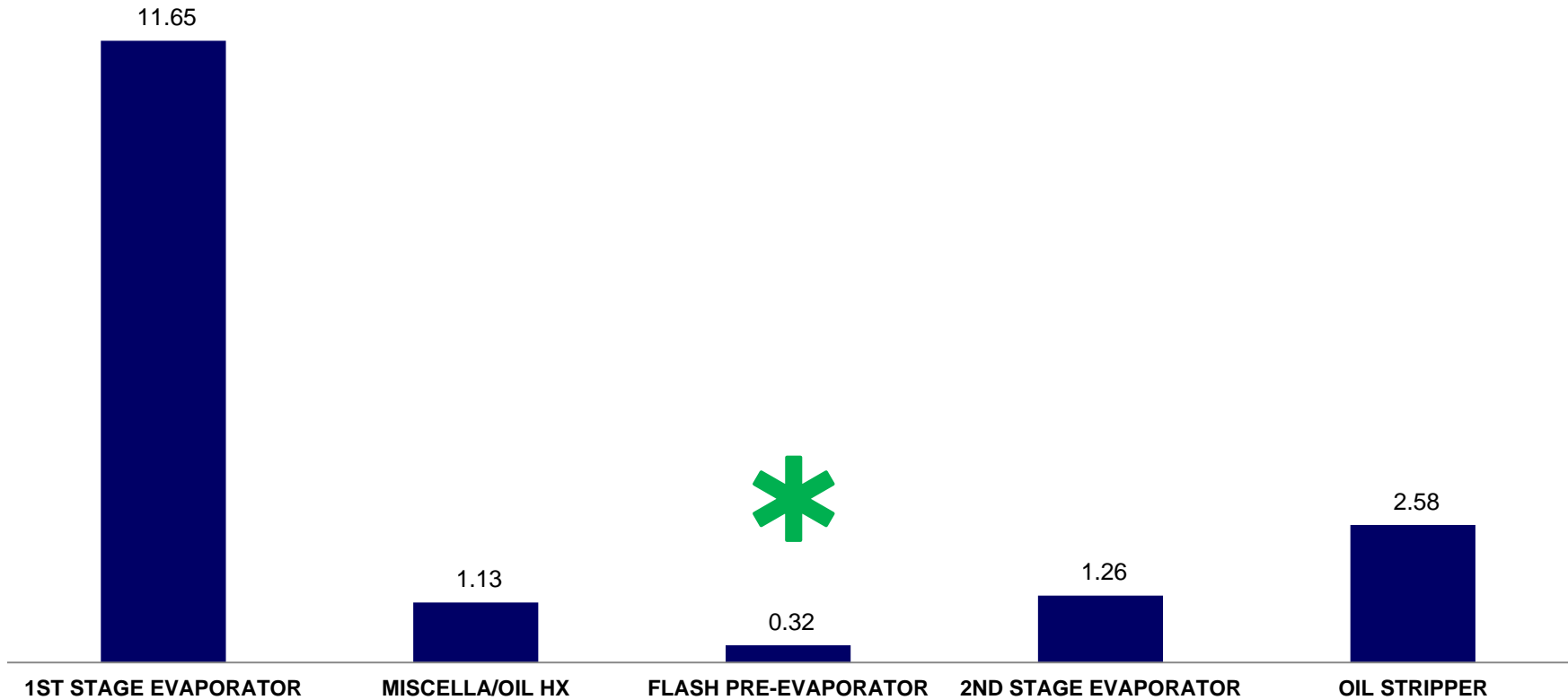


OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION

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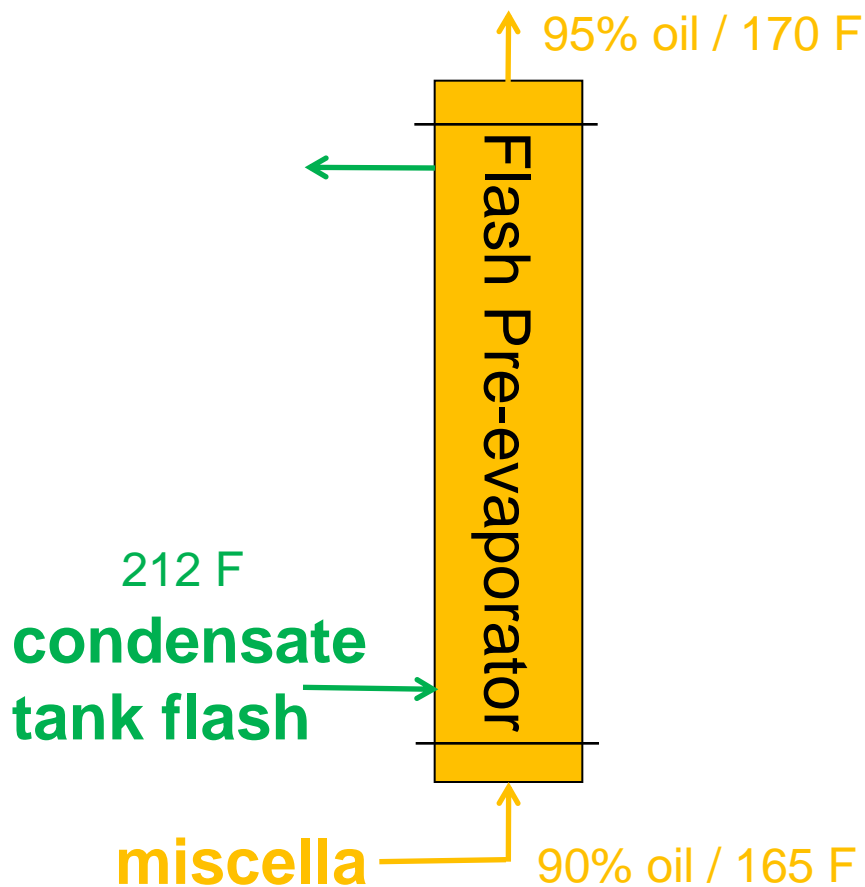
Flash Steam Pre-Evaporator



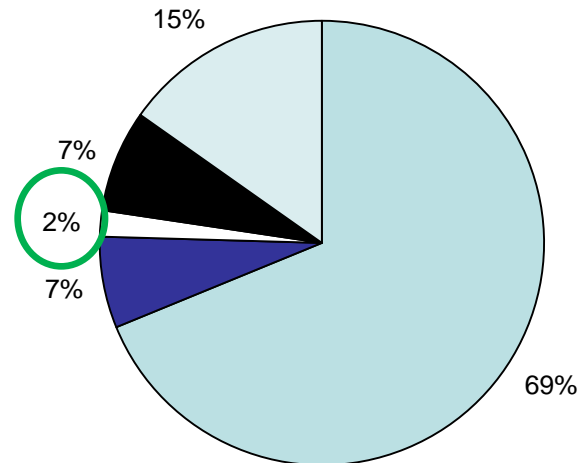
OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



Flash Steam Pre-Evaporator



Miscella Distillation Energy Input

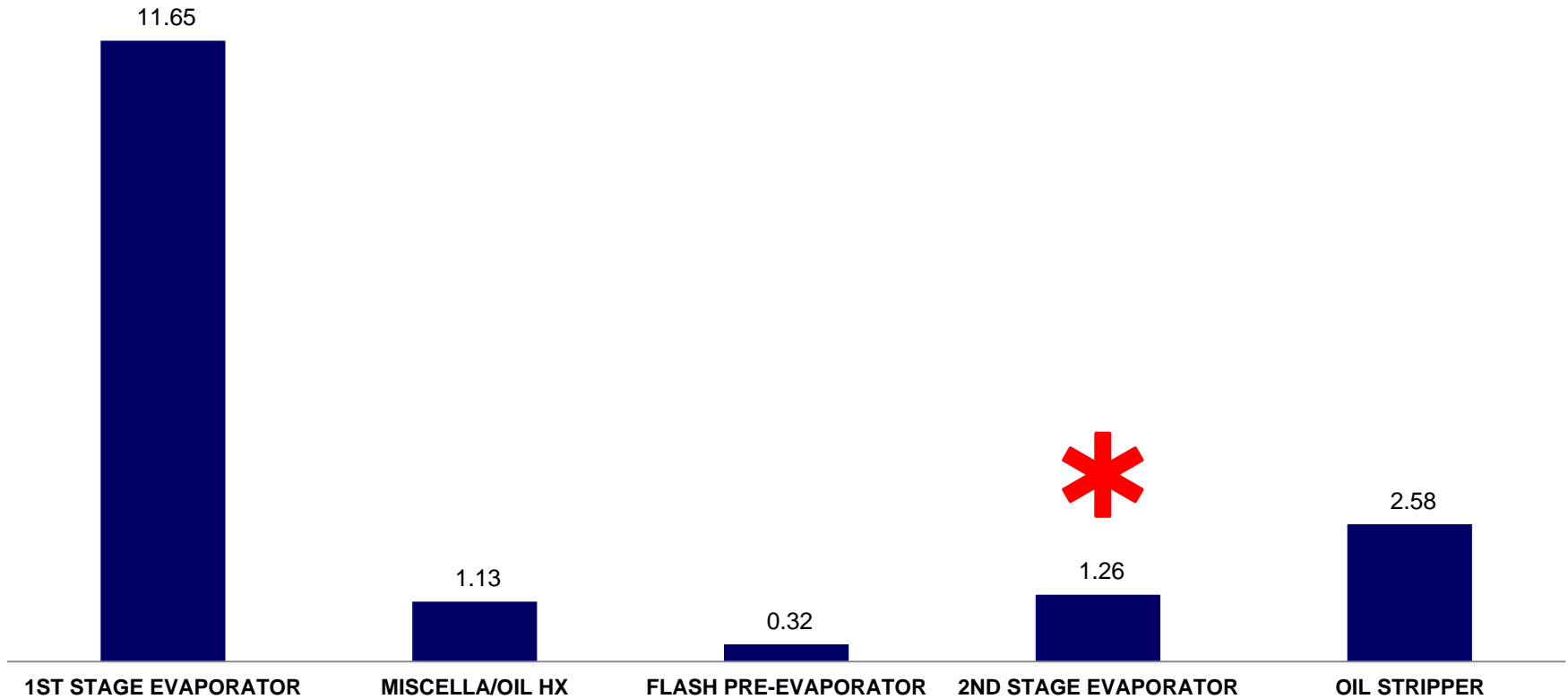


OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



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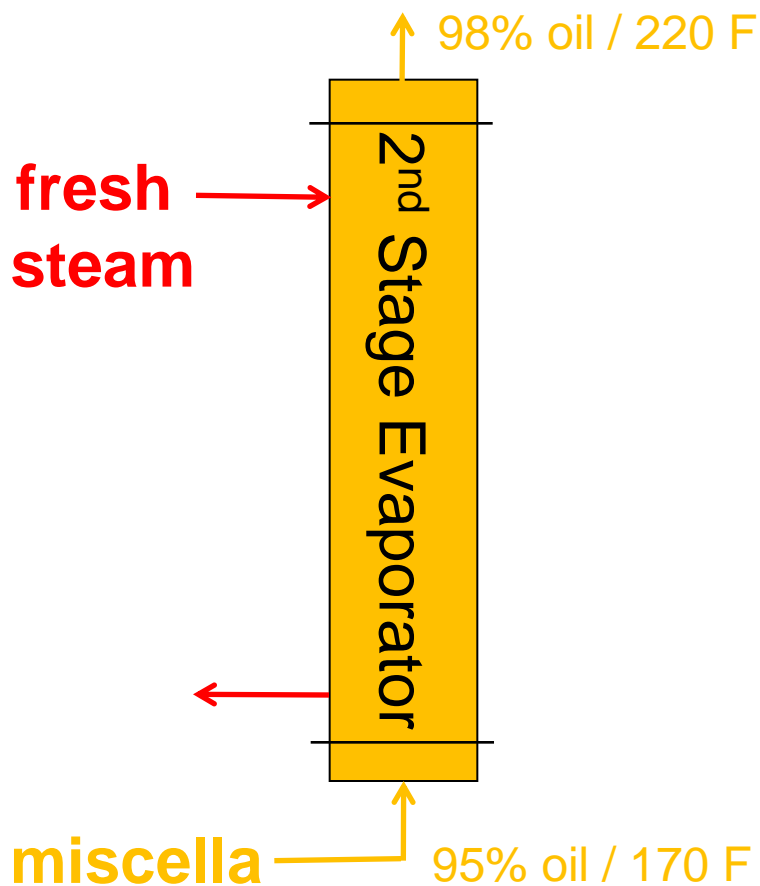
2nd Stage Evaporator



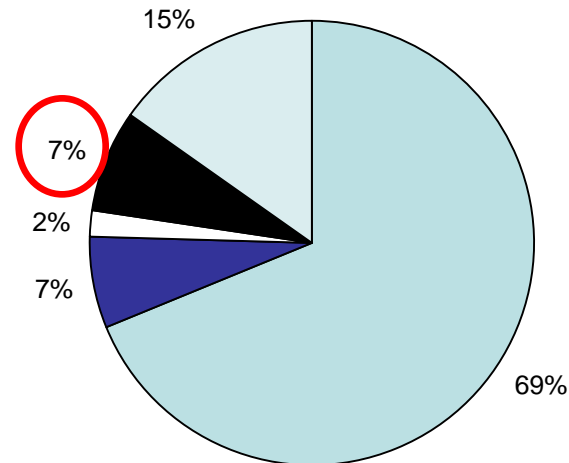
OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



2nd Stage Evaporator



Miscella Distillation Energy Input

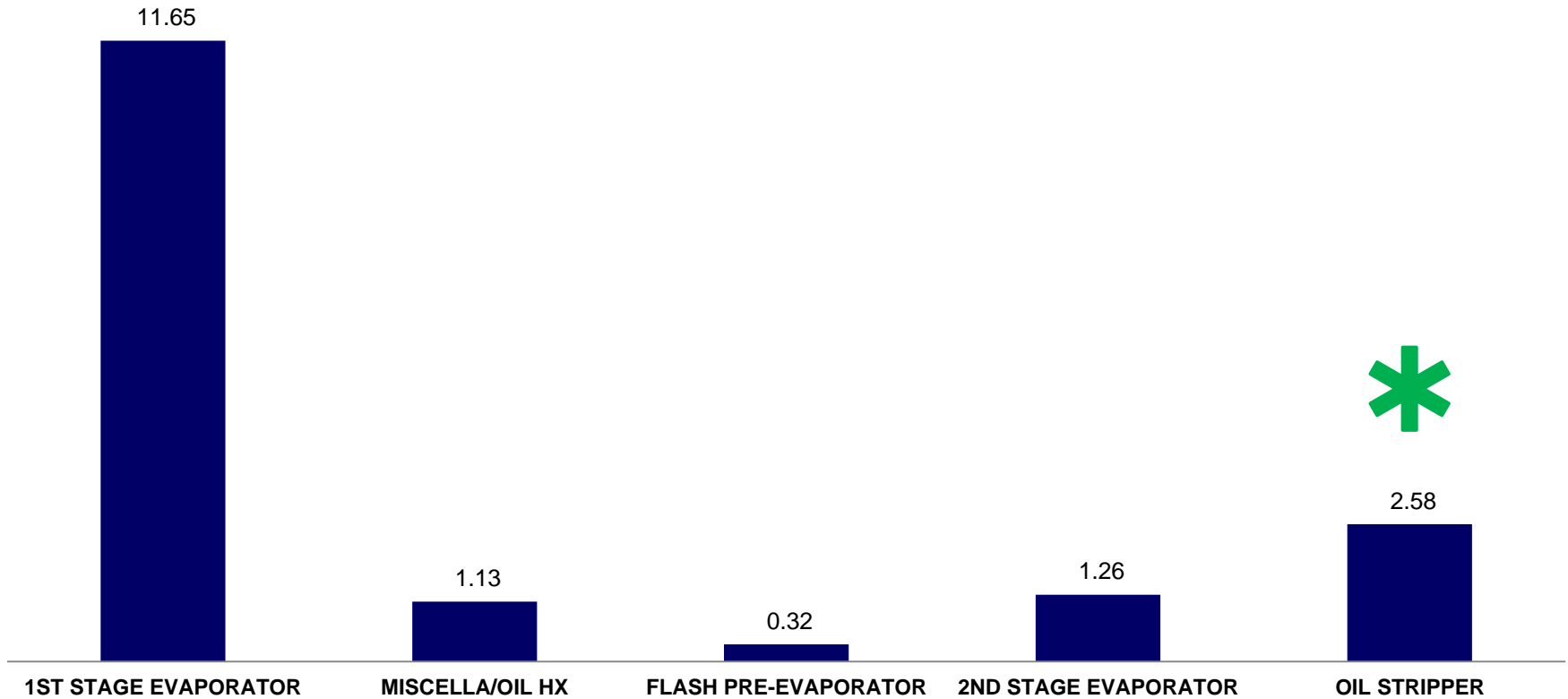


OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION

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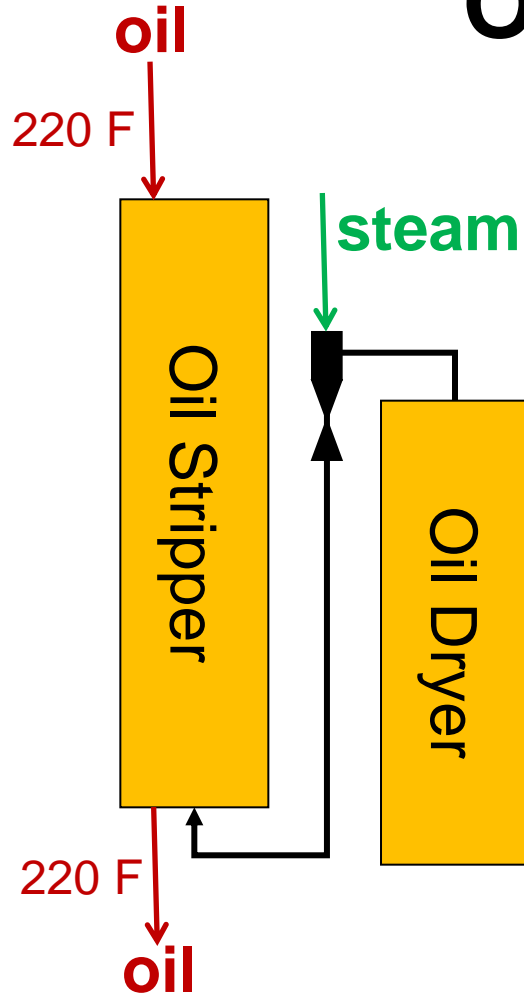
Oil Stripper



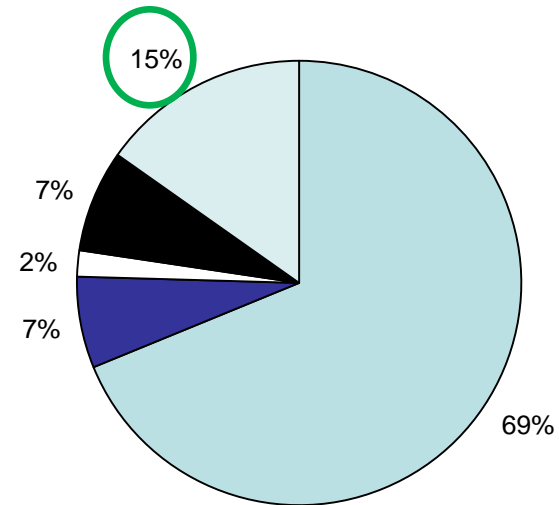
OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



Oil Stripper



Miscella Distillation Energy Input

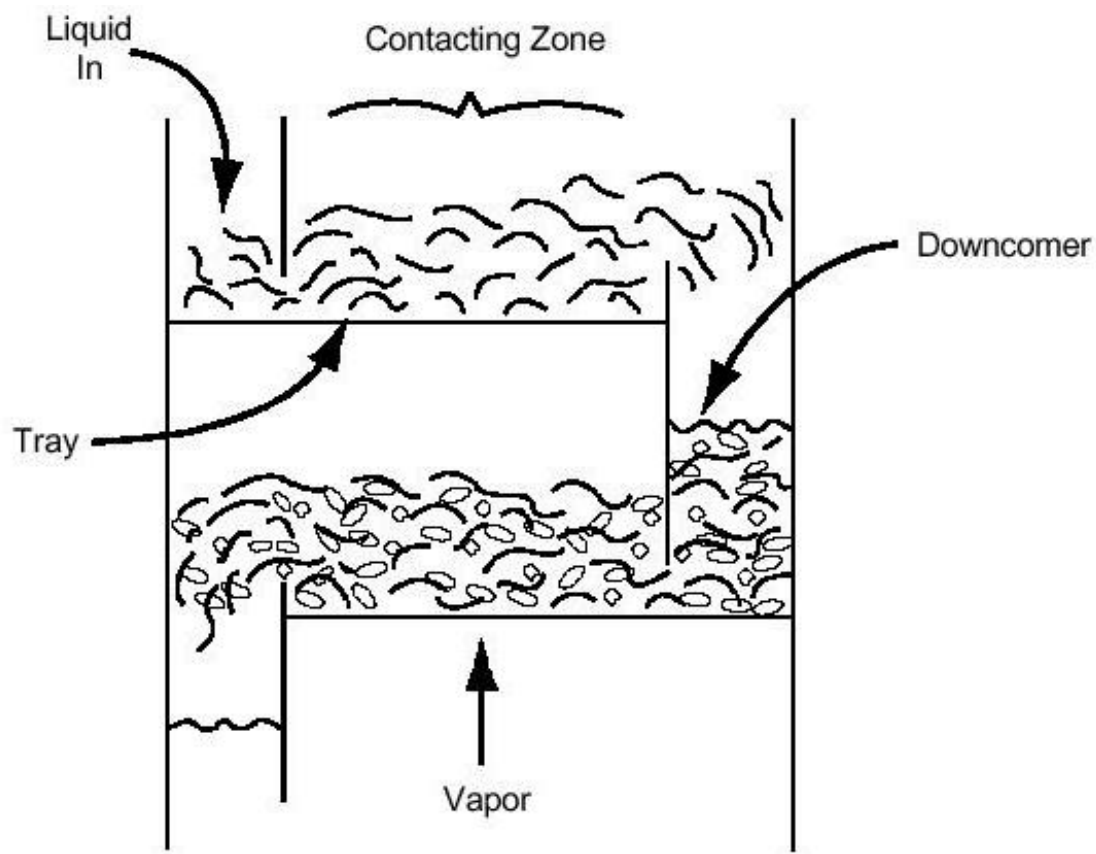
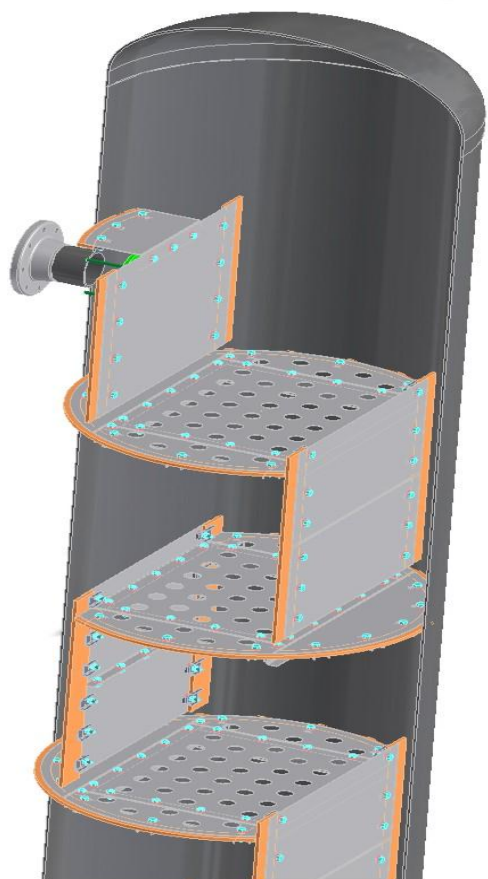


OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION

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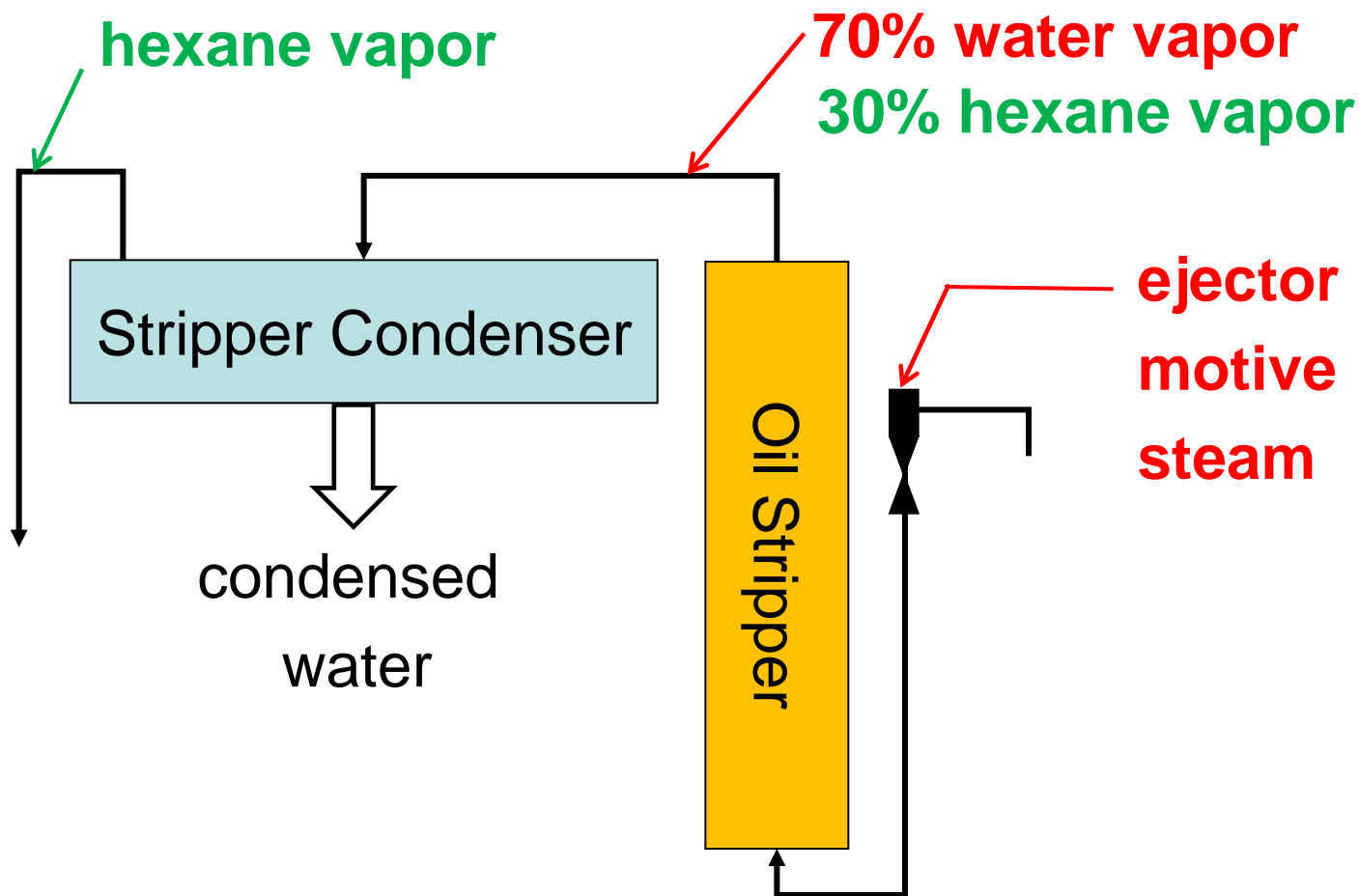


Sieve Tray Oil Stripper





Stripper Condenser Heat Recovery

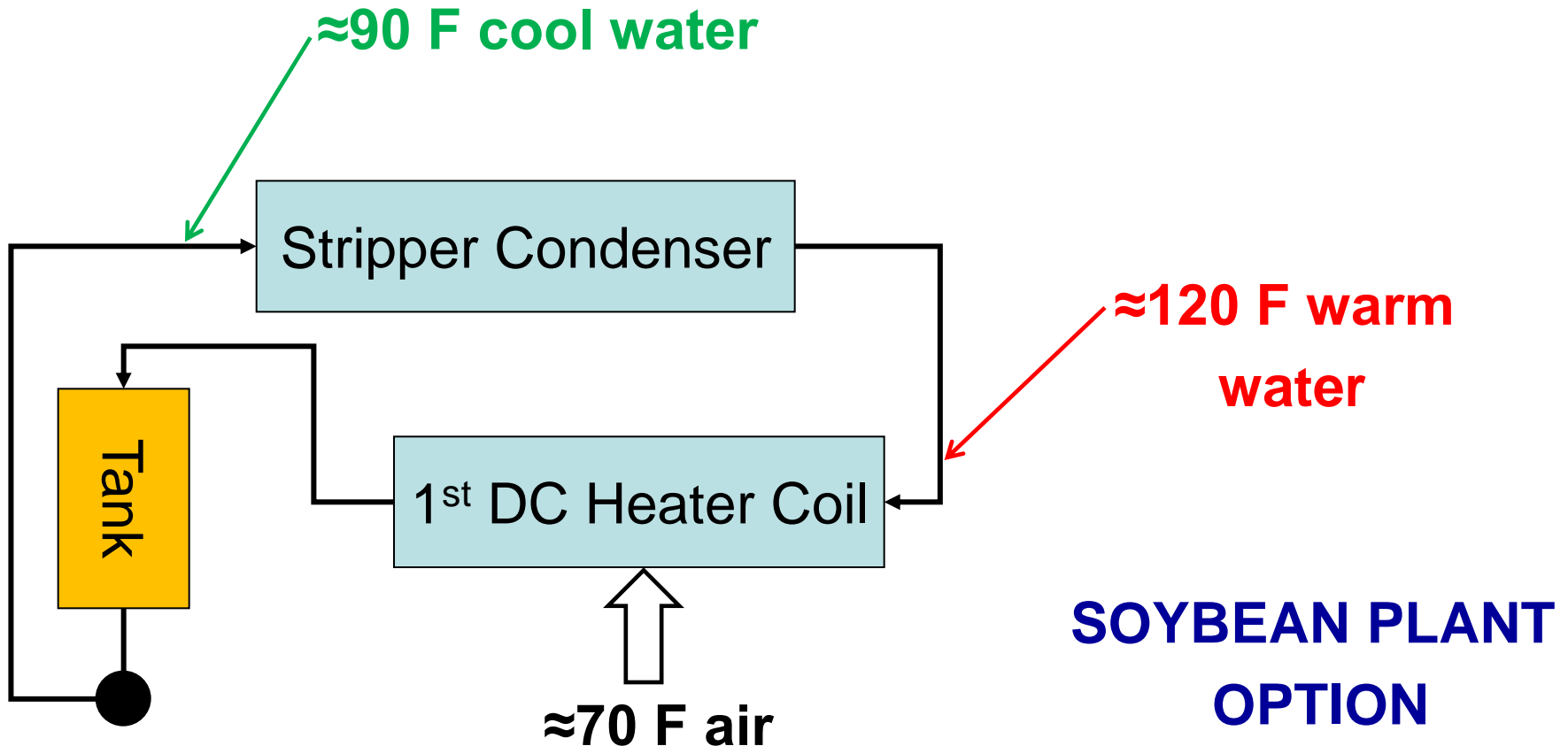


OPTIMIZING DOWNSTREAM MISCELLA DISTILLATION



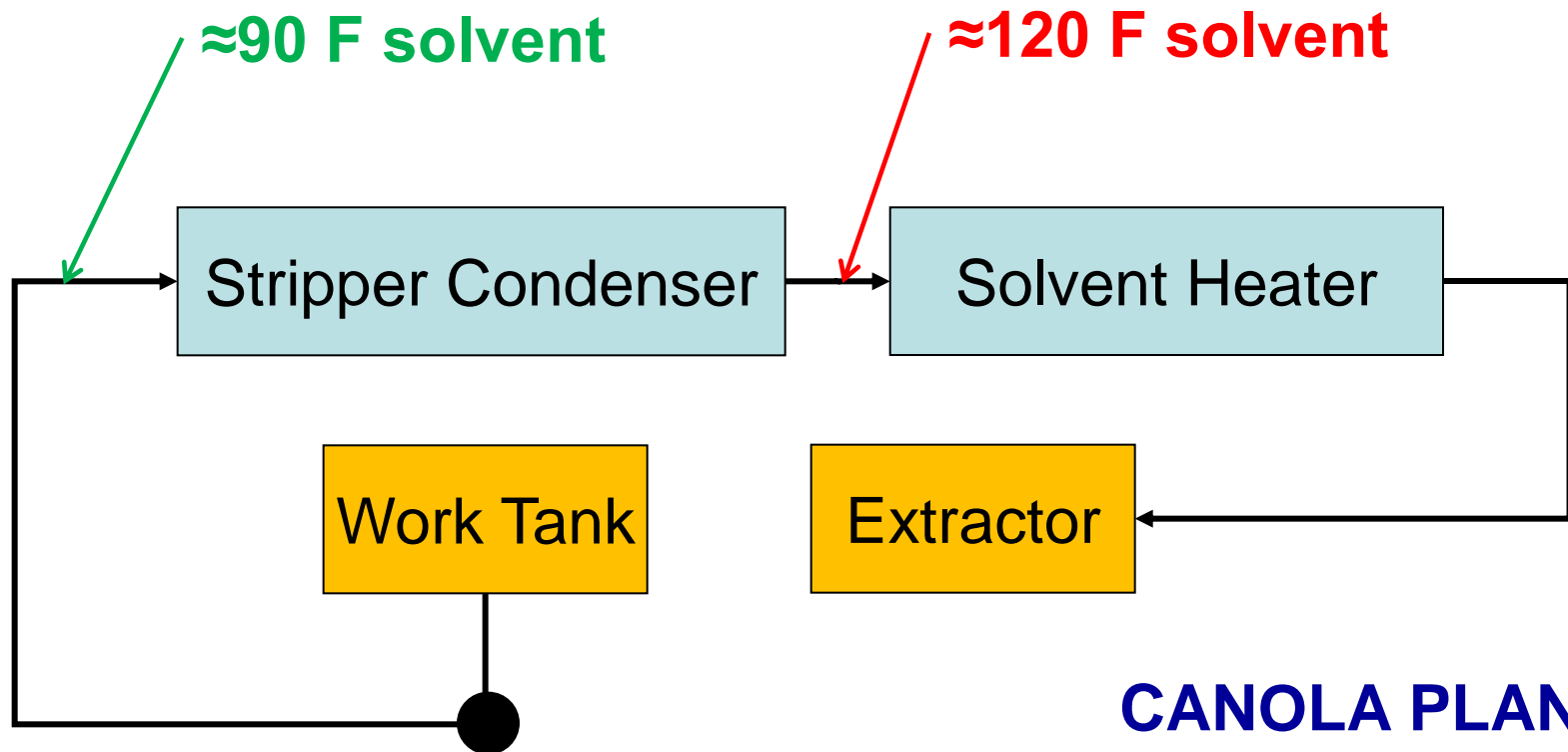
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Stripper Condenser Heat Recovery





Stripper Condenser Heat Recovery



**CANOLA PLANT
OPTION**

ENERGY SAVINGS IN MISCELLA DISTILLATION



Thank You!