

Energy Optimization Study in a refinery with CHEMCAD

Speaker:

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Source of picture: <http://www1.mdm-online.de> (13.02.2015)

Note: The study was made during my time as head of process department at the company IBH Engineering GmbH which went bankrupt in February 2015.

Actual capacity:	>3,5 Mt/a (442 t/h) of CO
Future capacity:	>4,8 Mt/a (603 t/h) of CO
Production fuels:	motor gasolines (50%) diesel fuel (25%), jet fuel (20%) & fuel oils (5%)

Simulated plants of the refinery

- **C**rude **d**istillation **u**nit (CDU)
- **V**acuum **d**istillation **u**nit (VDU)
- [**F**luid **c**atalytic **c**racking (FCC)]



- 1.Step: Developed a CC-Base-Model of the following main Units
 - CDU, VDU & FCC
- 2.Step: Included the crude oil blends currently refined
- 3.Step: Include detail geometry of all heat exchangers
- 4.Step: Take onside measurements
- 5.Step: Comparison of onside measured values with the results calculated with the CC-models
- 6.Step: Include possible improvements into the CC-models
- 7.Step: Performed sensibility and economical analysis to evaluate the improvements

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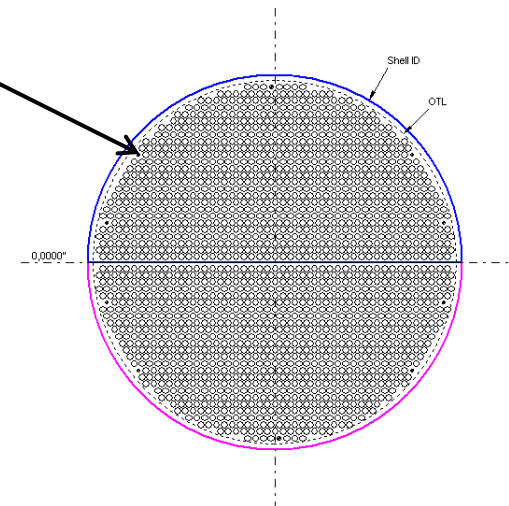
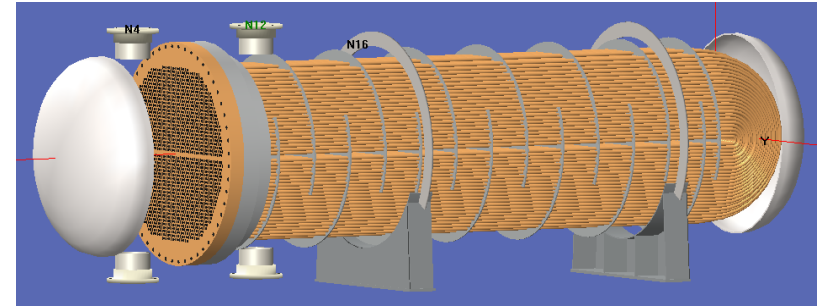
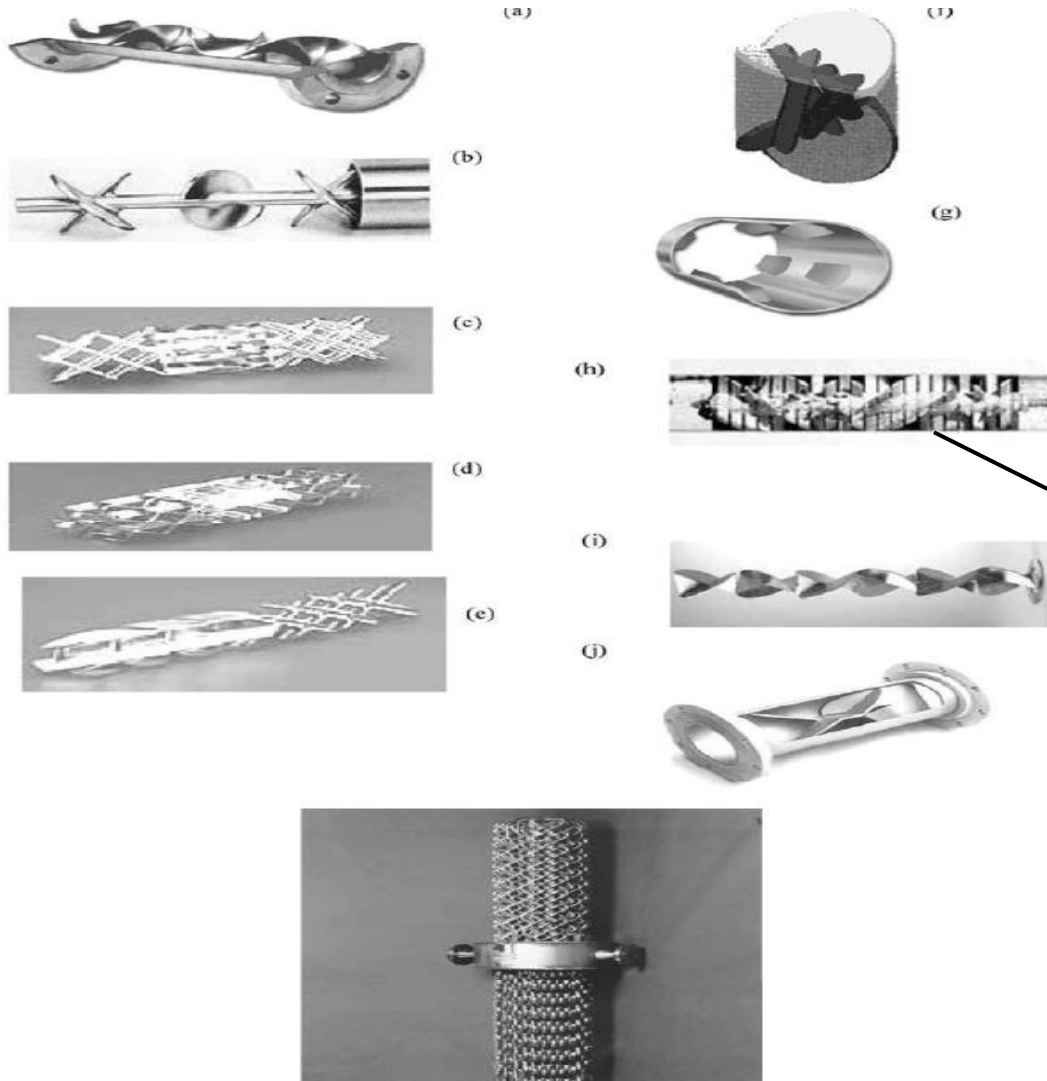


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1. Improvement in CDU

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1. Improvement in CDU

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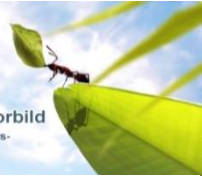
Required Equipment & Work	<ul style="list-style-type: none">- Turbolators for both pre heating trains- New motor for feed pumps- Engineering, onside work
Potential Savings (actual flow)	38.000 EUR/yr.
Potential Savings (future flow)	60.000 EUR/yr.
Cost Estimations	500.000 EUR (±30%)
ROI	less than 9 years

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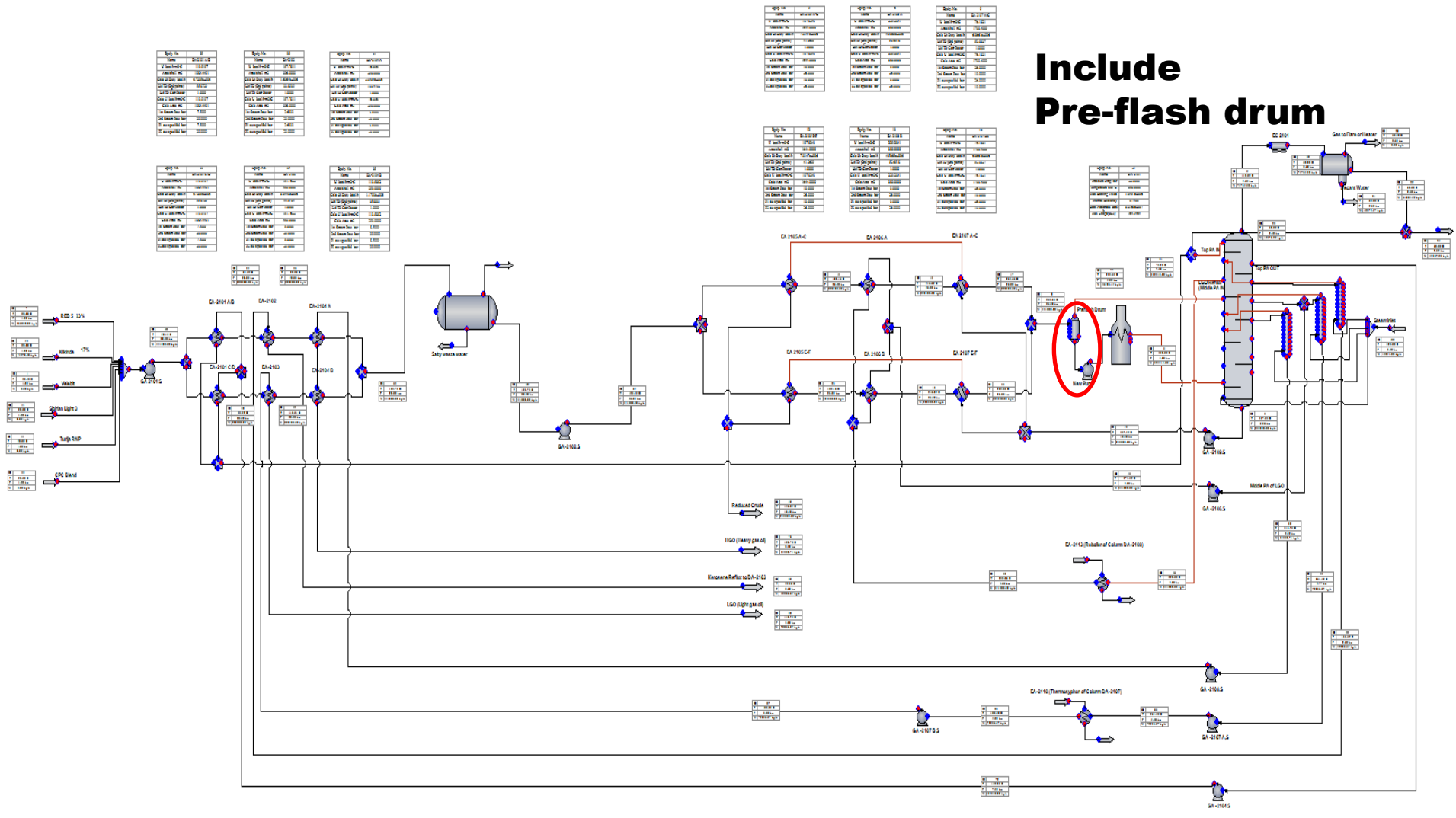
2. Improvement in CDU

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Include Pre-flash drum



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2. Improvement in CDU

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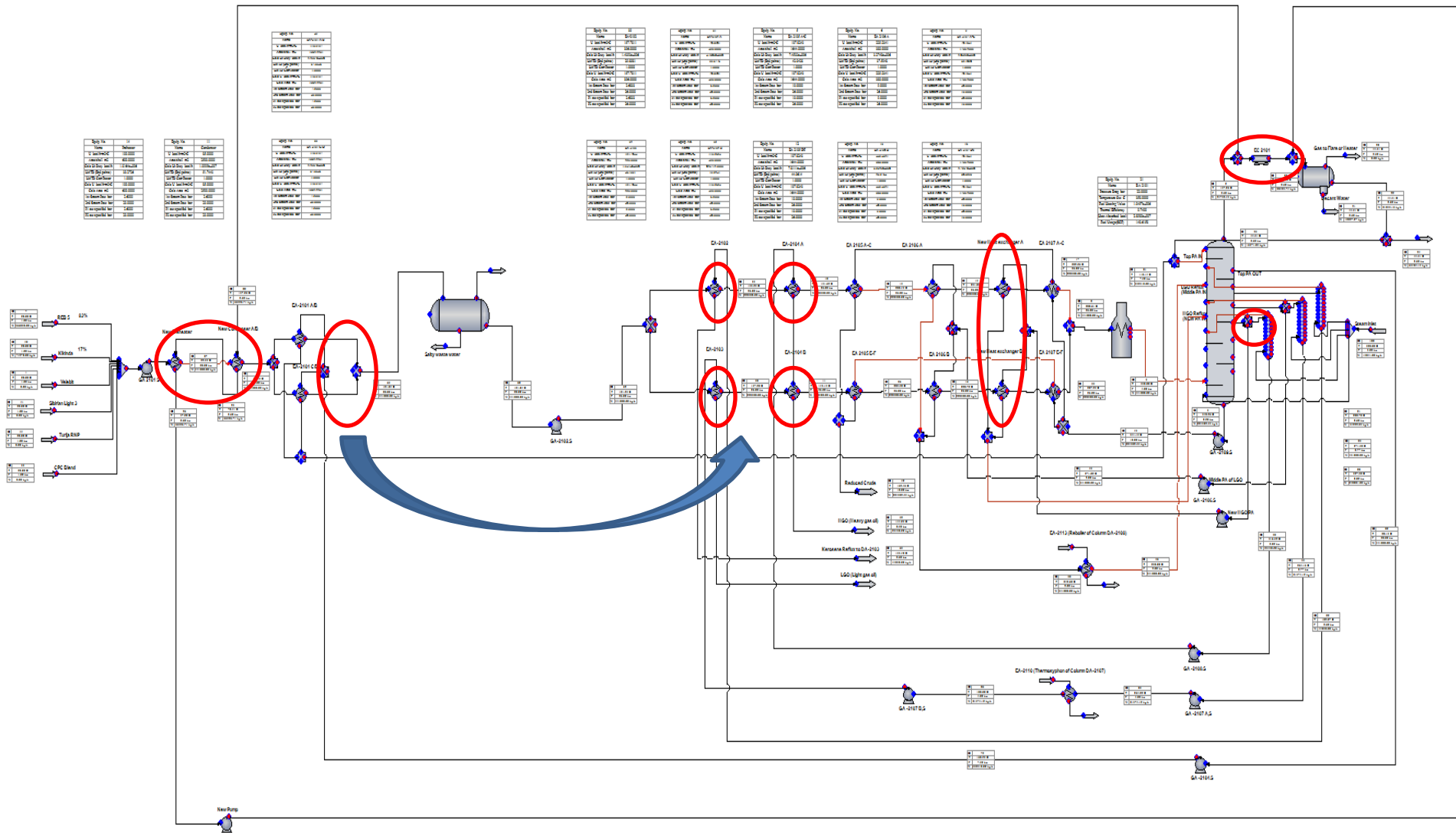
Required equipment & Work	<ul style="list-style-type: none">- New pre-flash drum (8m³, p_{DESIGN}=26bara, approximately)- New pump (400m³/h and p_{OUT}=17bara, approximately)- New nozzle inlet at DA-2101 for the new HGO PA at tray 19- Piping work, valves, onside work, engineering
Potential Savings (actual flow)	1.1 Mio. EUR/yr. (pre-flash at 3 bara)
Potential Savings (future flow)	1.9 Mio. EUR/yr. (pre-flash at 3 bara)
Cost estimations	900,000 EUR (±30%)
ROI	less than 1 year

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3. Improvement in CDU

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3. Improvement in CDU

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Required Equipment & Work

- Splitter upstream EC-2101
- Two new condensers A/B (1300m² each)
- New Heat exchanger (600m²)
- New pump (100m³/h and $p_{OUT}=5\text{bar}$ a, approximately)
- Storage Vessel (7m³, $p_{DESIGN}=3\text{bar}$ a, approximately)
- Mixer downstream EC-2101
- Splitter upstream DA-2106
- New pump (250m³/h and $p_{OUT}=\sim 8\text{bar}$ a, approximately)
- Two new Heat exchanger A/B (700m² each)
- New nozzle at DA-2101 for the new HGO PA at tray 23
- New arrangement of the 1st and 2nd preheating train
- Piping work, valves, onside work, engineering

Potential Savings
(actual flow)

1.6 Mio. EUR/yr.

Potential Savings
(future flow)

3.3 Mio. EUR/yr.

Cost Estimations

9.4 Mio. EUR ($\pm 30\%$)

ROI

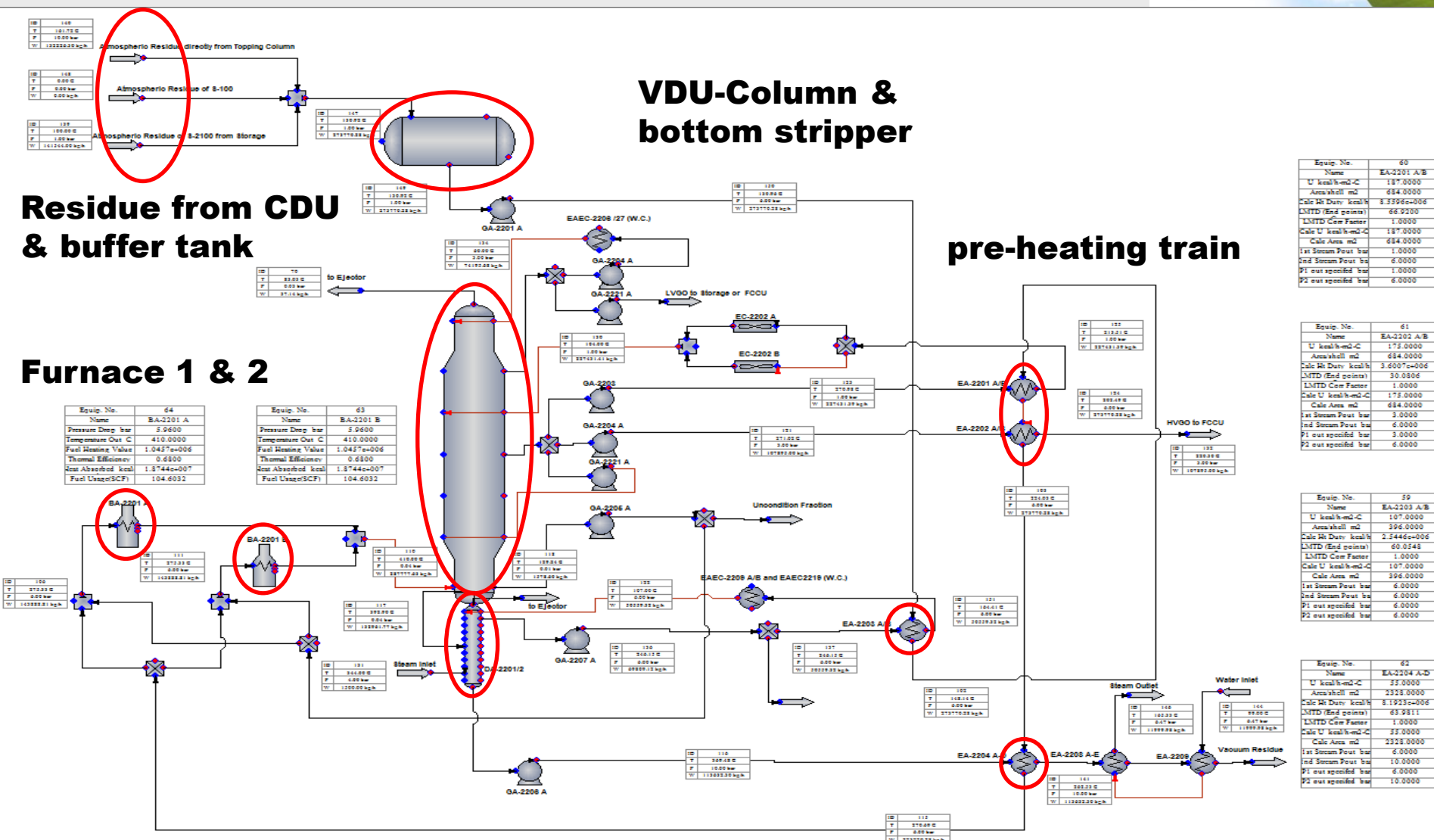
less than 4 years

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VDU (Vacuum distillation unit)

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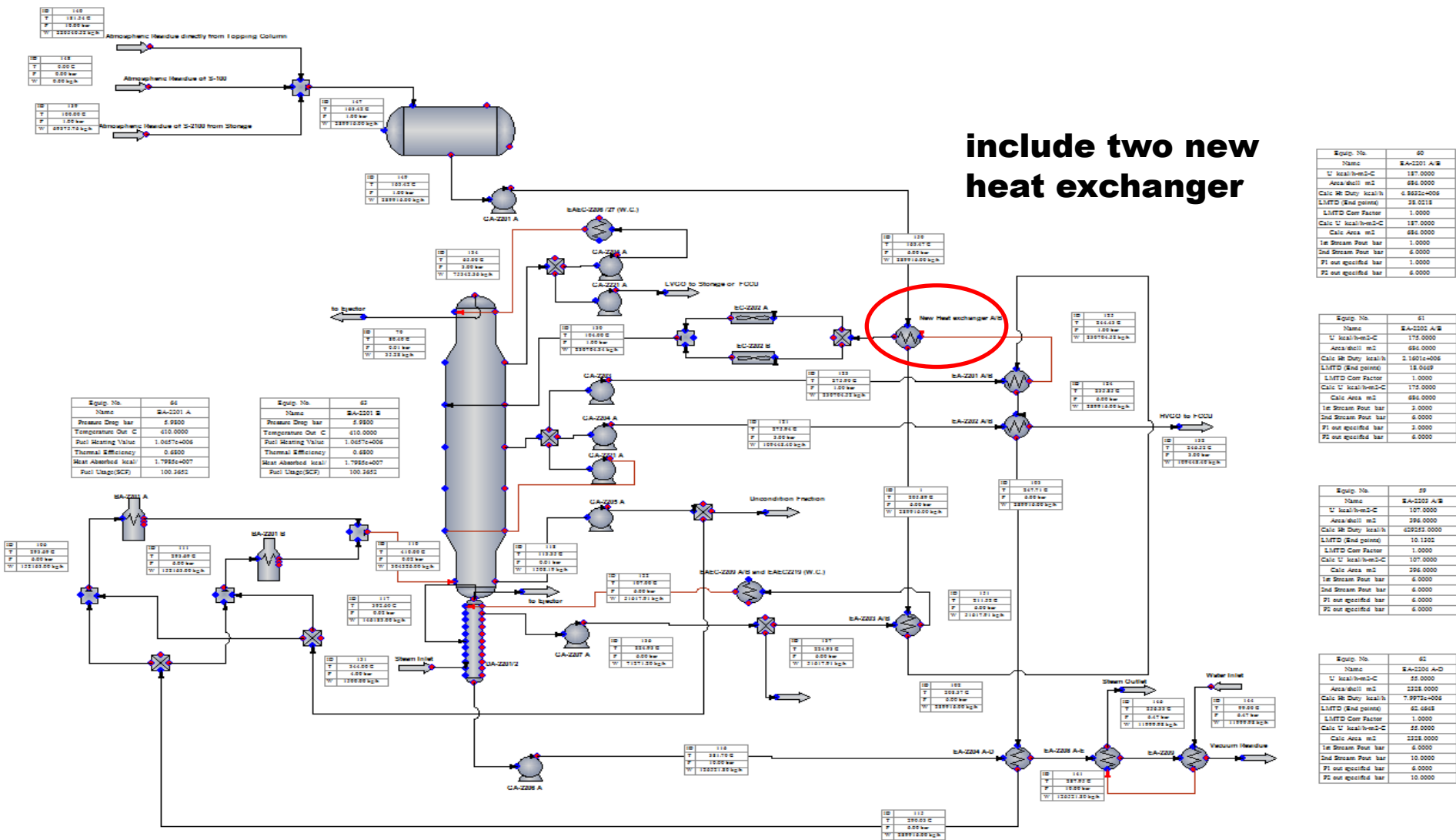


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1. Improvement in VDU

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1. Improvement in VDU

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Required equipment & Work

- Two new Heat exchanger (1000 m² each)
- Piping work, valves, onside work, engineering

Potential Savings (actual flow)

0.95 Mio. EUR/yr.

Potential Savings (future flow)

1.2 Mio. EUR/yr.

Cost estimations

2 Mio. EUR (±30%)

ROI

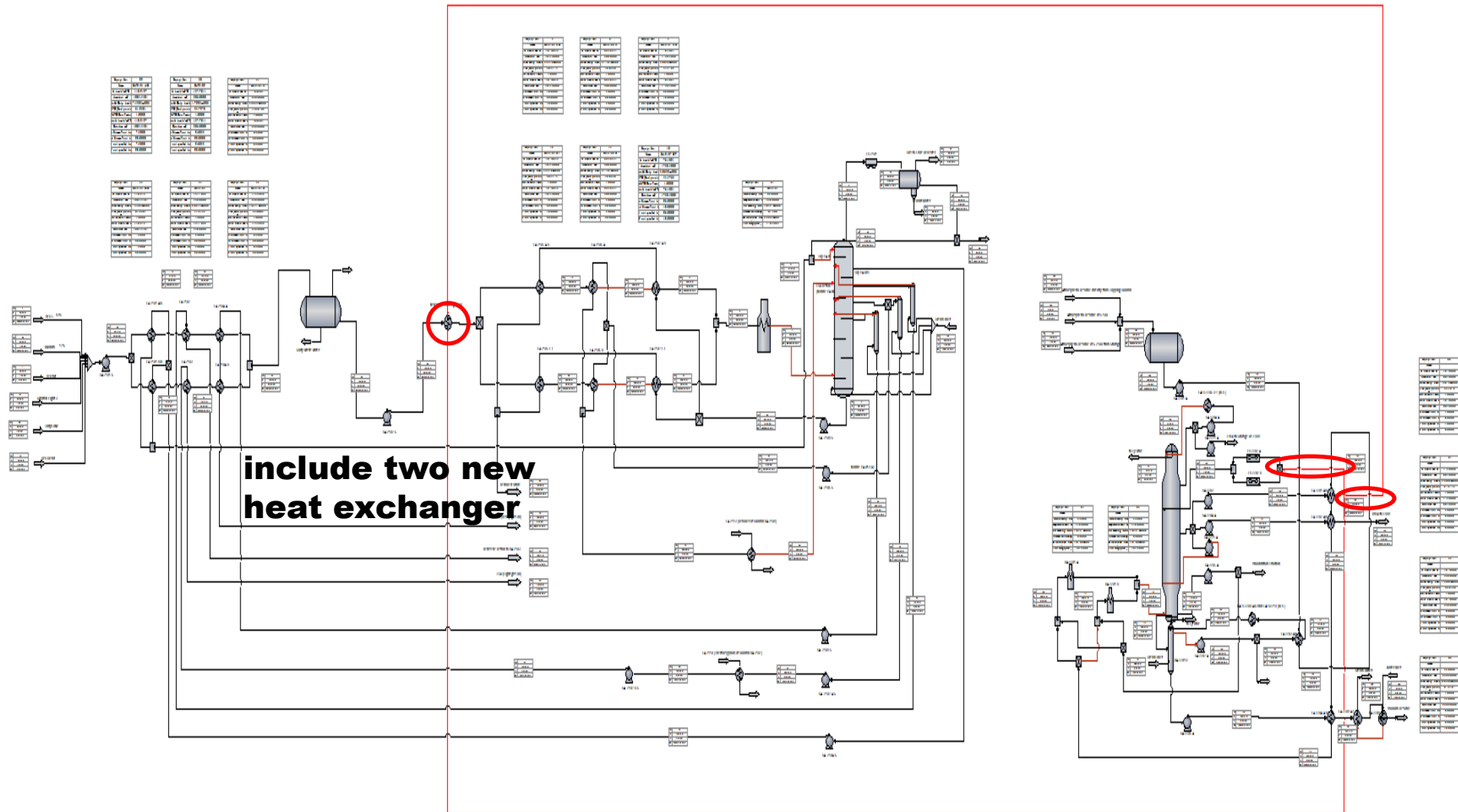
less than 2.5 years

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2. Improvement in VDU

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2. Improvement in VDU

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Required equipment & Work

- Two new heat exchanger (880 m² each)
- New pump (appr. 260 m³/h and p_{OUT}=15bara)
- Piping work, valves, onside work, engineering

Potential Savings (actual flow)

1.2 Mio. EUR/yr.

Potential Savings (future flow)

1.4 Mio. EUR/yr.

Cost estimations

2.0 Mio. EUR (±30%)

ROI

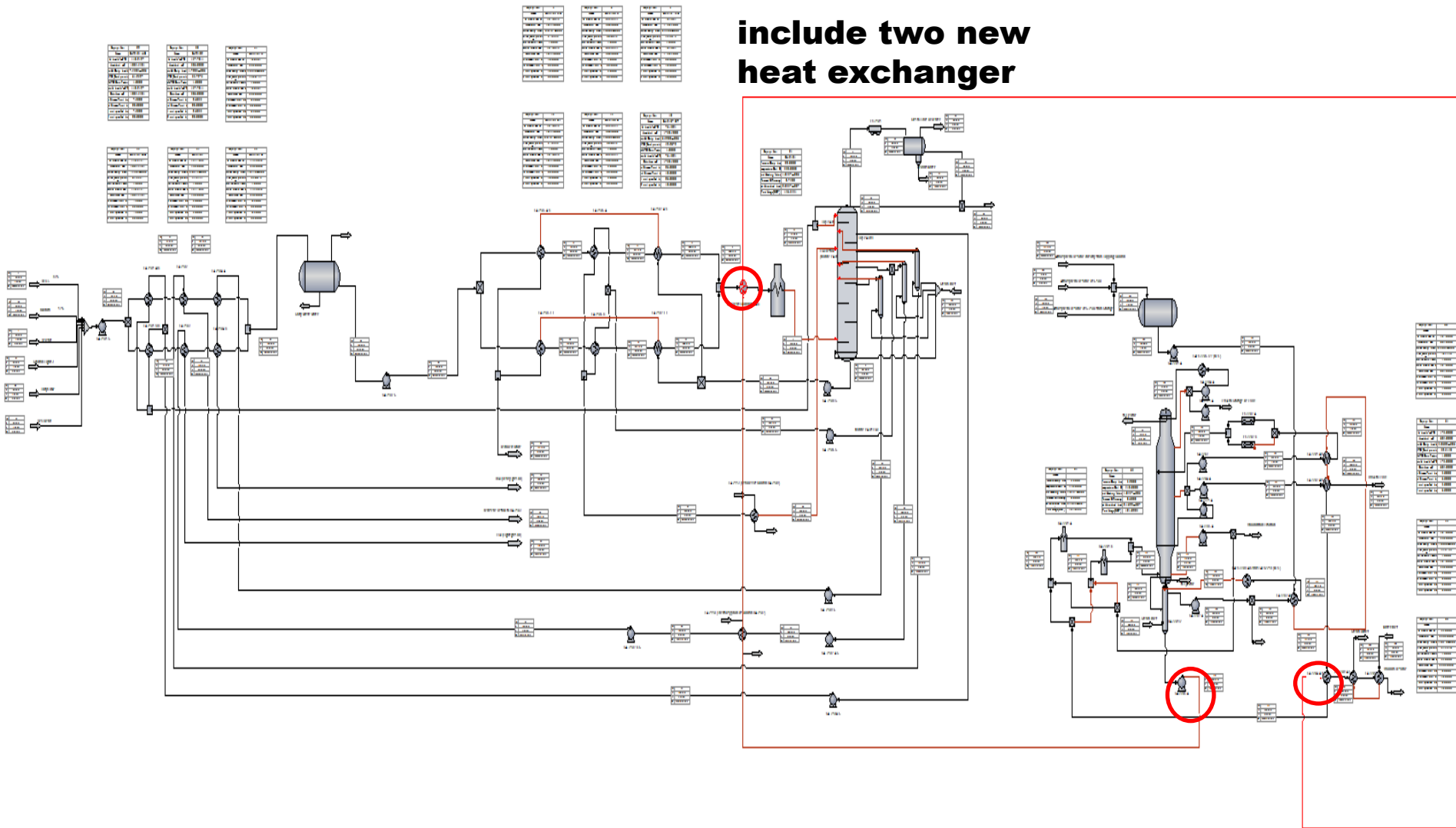
less than 2.5 years

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3. Improvement in VDU

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3. Improvement in VDU

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Required equipment & Work	<ul style="list-style-type: none">- Two new Heat exchanger (700 m² each)- New pump (appr.140 m³/h and p_{OUT}=15 bara)- Piping work, valves, onside work, engineering
Potential Savings (actual flow)	0.37 Mio. EUR/yr.
Potential Savings (future flow)	0.77 Mio. EUR/yr.
Cost estimations	1.6 Mio. EUR (±30%)
ROI	less than 2.5 years

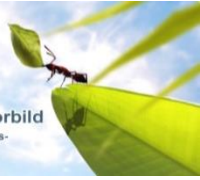
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	PROJECT	Maximum Benefit M€/year
1.	Use the energy at the top of the topping column to preheat the crude oil feed upstream the desalter and add a new HGO PA.	3,0
2.	Use the energy at the top of the topping column to preheat the crude oil feed upstream the desalter	2,4
3.	Include a pre-flash drum upstream the furnace	1,7
4.	Use water ring pumps to replace the steam ejectors	1
5.	Use the HVGO PA after heat exchanger 1 to preheat the feed of S-1 upstream the exchanger 5	0,9
6.	Recover heat from HVGO PA after heat exchanger 1 (shell side) to preheat the S-2 feed upstream the heat exchanger 3	0,8
7.	Use bottom stream of VDU-column to preheat the feed to S-1 downstream the heat exchanger 7	0,3

Optimal project combination: with a benefit of 4,8 M€/year

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1. With CC it was possible to verify the dependencies among the variables regarding the energy balance
2. ChemCad bring trustable output data on its operation units when hydrocarbon fluids have been simulated
3. The deviation of the results given by the CC-models to the onside measured values was less 2%
4. Our new Client accepted CC as Simulation-Tool

THANK YOU FOR YOUR ATTENTION

Please feel free to contact me
after the presentation:

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