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Houston, TX, USA
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PROCESS Industries

CHS


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# Online Tool for Preheating Train Monitoring

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# CHS Refinery, Laurel, Montana

**Where it Fits in CHS**
- One of 2 CHS-owned refineries (Laurel, MT & McPherson, KS)
- Part of an end-to-end energy network: refineries, pipelines, terminals, transportation
- Supports farmer-owned cooperative model with reliable fuels supply

**Core Operating Facts**
- 65,000 BPD crude throughput
- Built: 1930 | Acquired by CHS: 1943
- 281 acres | ~377 employees
- Crude supplied via pipeline

**Major Processing Capabilities**
- 2 CDU units, Delayed Coker, Hydoprocessing, FCC, Alky, and Sulfur Recovery

**Distribution & Reach**
- 86% pipeline, 7% rail, 7% truck
- Feeds Cenex® branded fuels network across the U.S.
- On-site & terminal blending for Premium Diesel products

# Inprocess in Brief

**Since 2006 helping the processing industries in solving design and operational issues by applying process simulation**

our **core business** is Process Simulation

enthusiastic about **sharing our knowledge** with our clients

**all technologies** (process simulator and control system)

| | | |
|---|---|---|
| 2006<br>est. in Barcelona by domain experts | Projects in 65 countries<br>worldwide footprint | 160+/120+<br>Employees/process simulation engineers |
| 600+<br>executed projects | >110<br>OTS Projects | 500+<br>training courses |

**Inprocess Solutions & Services**

Engineering Studies

Engineers Training

Operators Training

Process Digital Twins

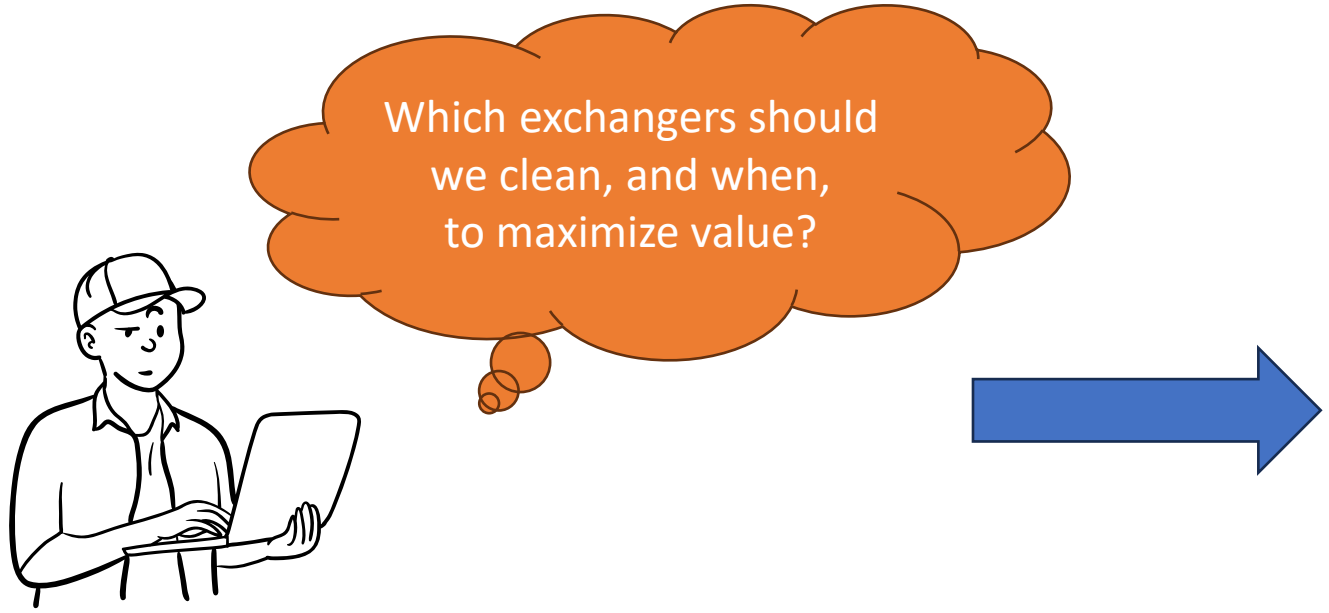
# 1. Context

# The challenge

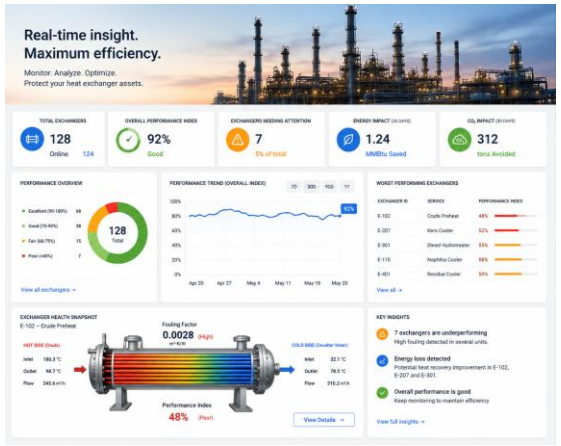
## The challenge:

Fouling → Thermal efficiency ↓ → Fuel requirements ↑ → Cost & emissions ↑

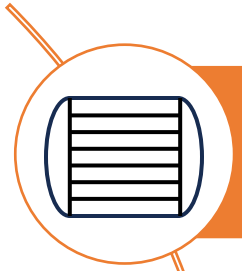
- Cleaning must be planned carefully to reduce downtime (~½ day per Heat Exchanger)




ONLINE MONITORING TOOL



# Study objectives



Identify exchangers with greatest impact of fouling on performance using Aspen EDR in Aspen HYSYS.

Prioritize cleaning scope to reduce outage time and cost.

Implement an online monitoring tool integrated with real-time plant data to flag degradation vs thresholds.

Enable dynamic updates to cleaning strategy to reduce energy use, downtime, and emissions.

# 2. Approach

# Project phases

## PROOF OF CONCEPT

**Phase I: Offline fouling assessment**

- EDR model development
- Fouling study offline
- Determining fouling mechanism due to mode switching

**Phase II: Online real-time monitoring tool**

- Connectivity of the model with plant data.
- Design of HMI

## FULL DEPLOYMENT

Phase III: **Development** of larger plant model

Deployment of full integrated plant model with plant data

# Phase I: Offline fouling assessment

# Phase I: Network fouling assessment

Offline assessment using Aspen EDR within Aspen HYSYS
- Historic Plant data (flowrates, temperatures, and pressures)

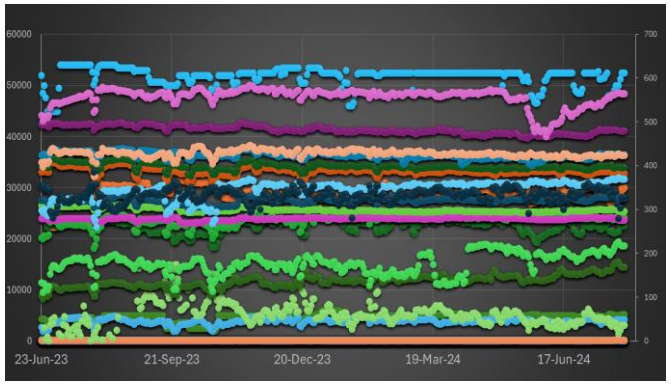
Evaluate fouling degree and trends across the entire preheat network
- Determine the difference in fouling due to mode swinging (coker to asphalt)
- Development of surrogate models to predict fouling rate

Identify exchangers with greatest impact on efficiency and cost
- Deprioritize exchangers that refoul quickly after cleaning

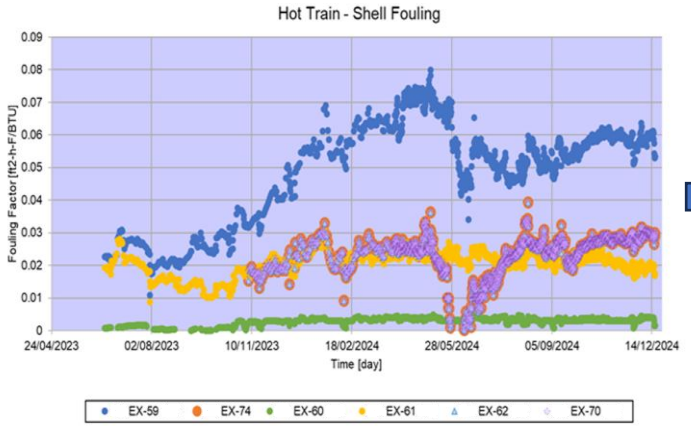
Definition of KPIs for phase II

# Offline Fouling Analysis

## HISTORIC PLANT DATA (T, P, Ḟ)



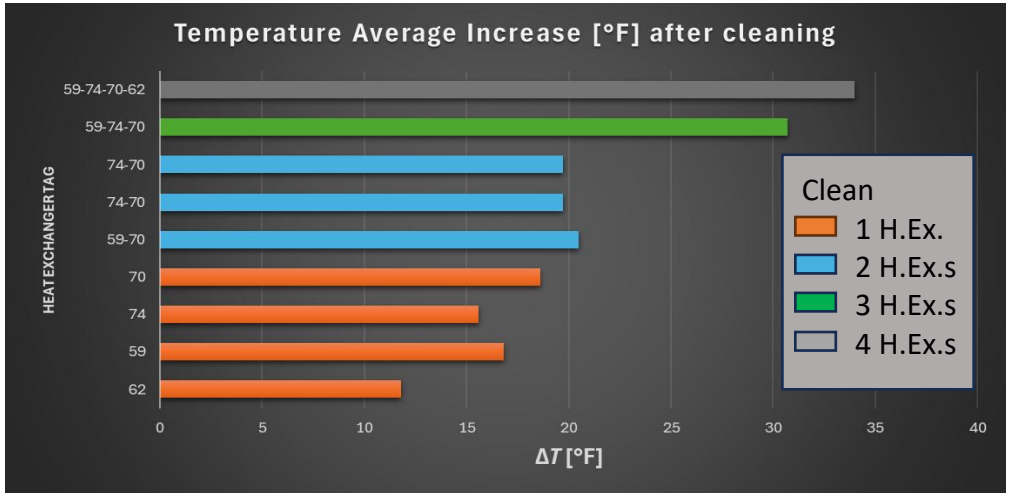

## FOULING ANALYSIS




## Fouling rate surrogate model

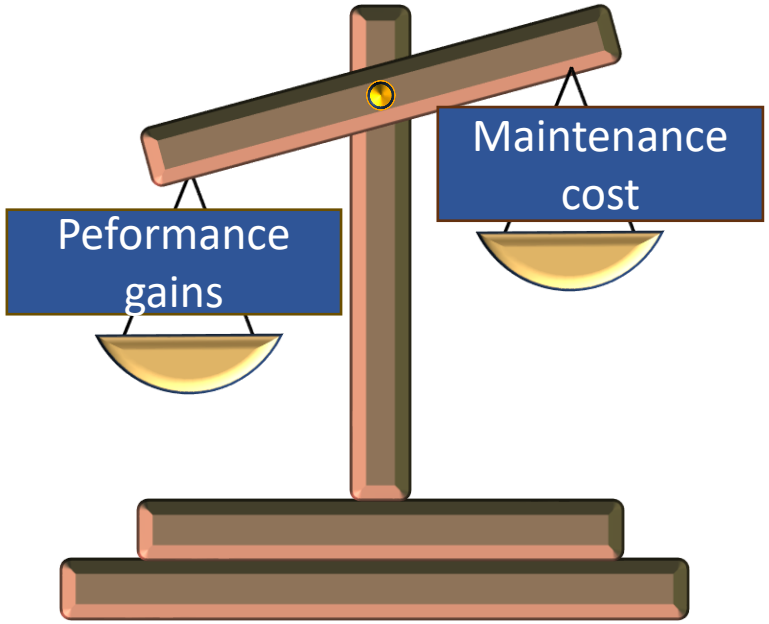
$$\hat{f}(x) = \sum_{j=1}^{m} \beta_j g_j(x) + Z(x)$$

## WHAT-IF SCENARIOS



# Phase I: Shutdown cleaning schedule optimizer

- Select the right exchangers to maximize benefit during shutdowns
- Each exchanger cleaning typically
  - Requires ≥ 0.5 day work
  - Cleaning can exceed $100k
- Result: reduced maintenance time/cost while maximizing performance gains

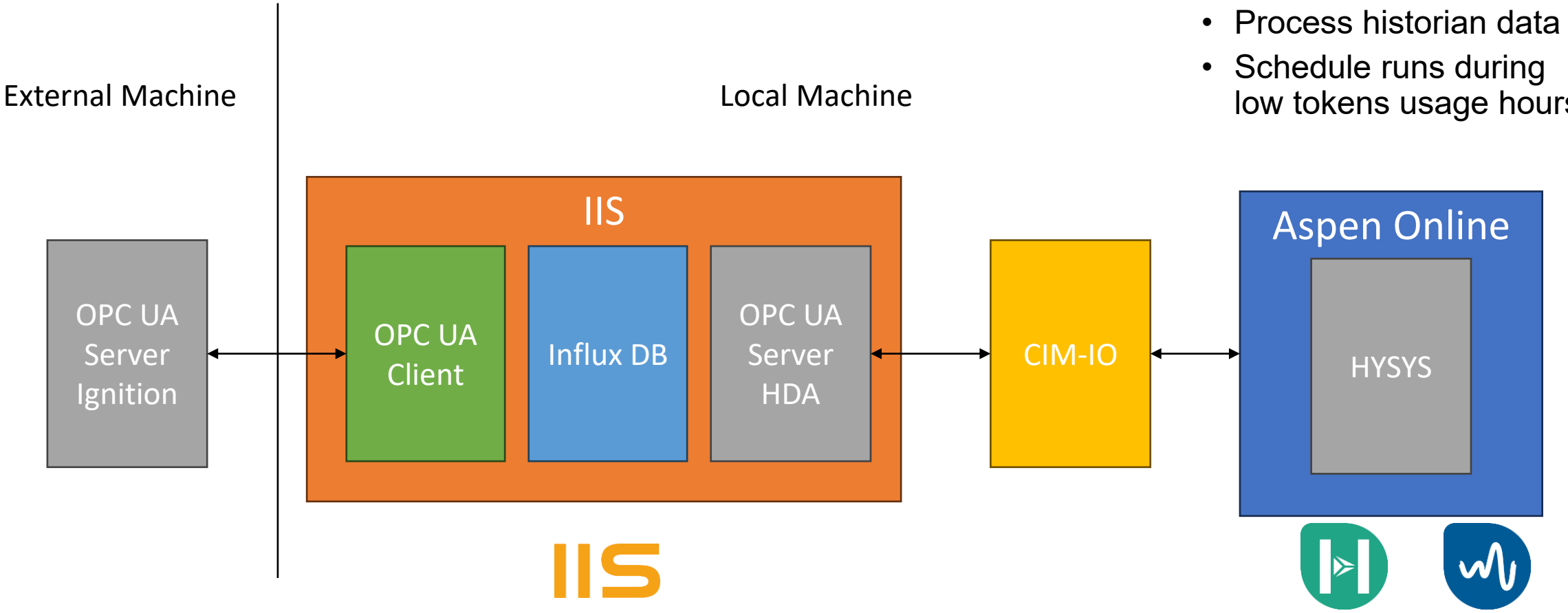


# Phase II: Development of online tool

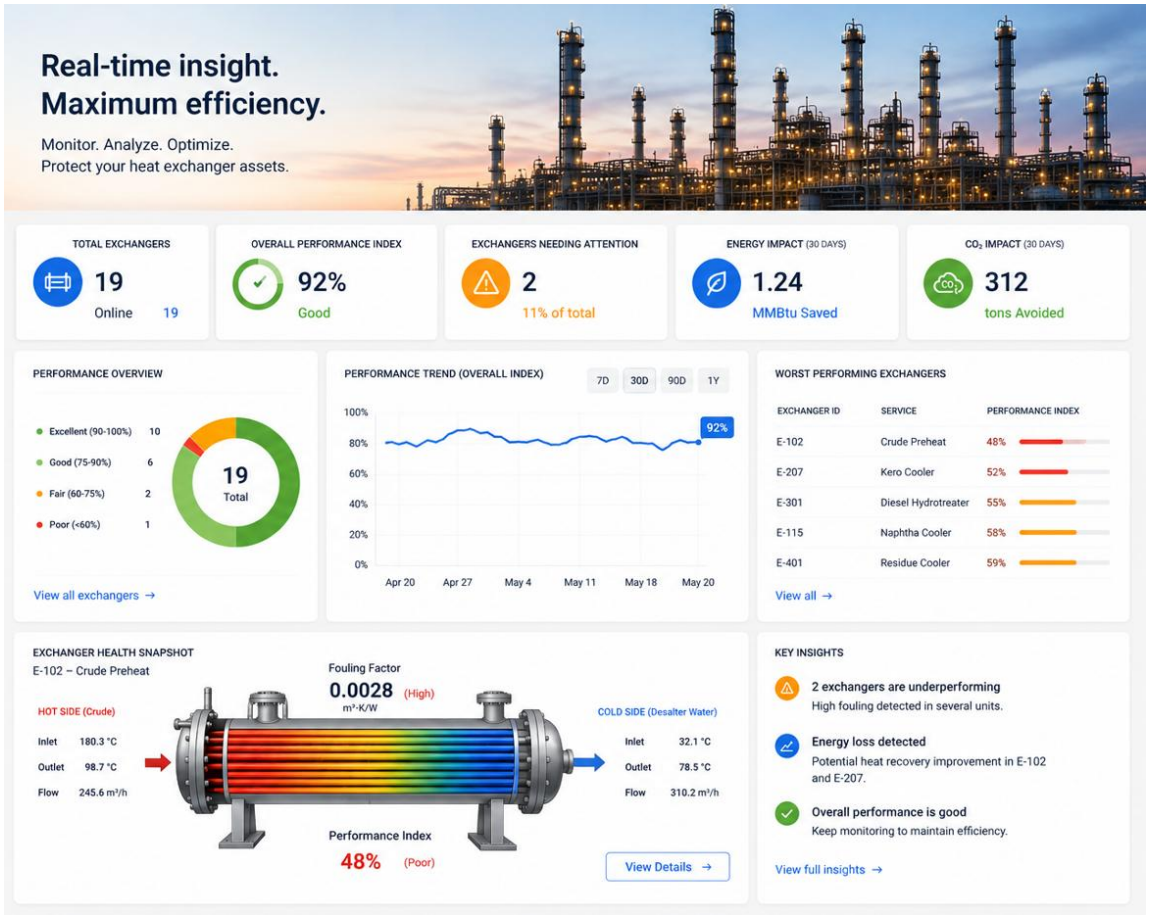
# Phase 2: real-time monitoring tool

**Advantages:**

- Process historian data
- Schedule runs during low tokens usage hours



# Online Tool – HMI in Dashboard




- Overall performance value
- Exchangers needing attention
- Energy and emission impact
- Exchanger health: DT, DP, duty and fouling

*Note: the values shown here do not represent real CHS plant data to comply with NDAs*

# Phase III: Full model implementation

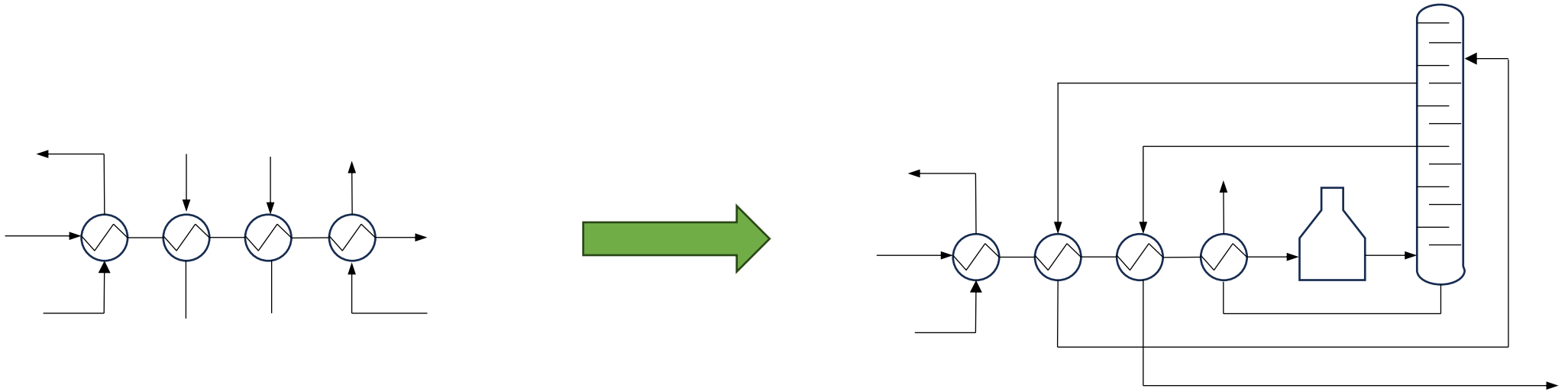
(Future work)

# Phase III – model development

Phase I and II consists of a preheating train model where compositions are kept constants.

It does not capture impact of the fluid properties changes in the heat exchange performance.

A full unit integrated model is been developed.



Preheating train model

Unit integrated model

# Conclusions

- **Combining Aspen HYSYS + Aspen EDR with real-time data enables continuous HX performance monitoring**
- **Data-driven cleaning selection reduces downtime and operational cost**
- **The same framework supports energy efficiency and emissions reduction**
- **Next steps:**
  - Full model integration
  - Embed into maintenance planning workflows

# Thank you!
# Q&A

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