A LAYERED APPROACH TO ACHIEVING YOUR PLANT-WIDE OPTIMIZATION GOALS

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Honeywell

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Nic joined Honeywell Process Solutions in 1998 as an APC Engineer. With over 20 years experience in process optimization in different roles with Honeywell and across a wide range of industries, Nic is now a **Technical Solutions Consultant based in Perth Australia.**

Before joining Honeywell, Nic worked as a process engineer with Mobil Refining. Educated at the University of Adelaide, Nic holds a Bachelor of Engineering in Chemical Engineering, is a registered CP Eng with Engineers Australia and is Six Sigma Green Belt certified

AGENDA

- **Industry Challenges in Optimizing Plants**
- **Why Take a Layered Approach?**
  - Multivariable Control
  - Multi-Unit Optimization
  - Site-Wide Optimization

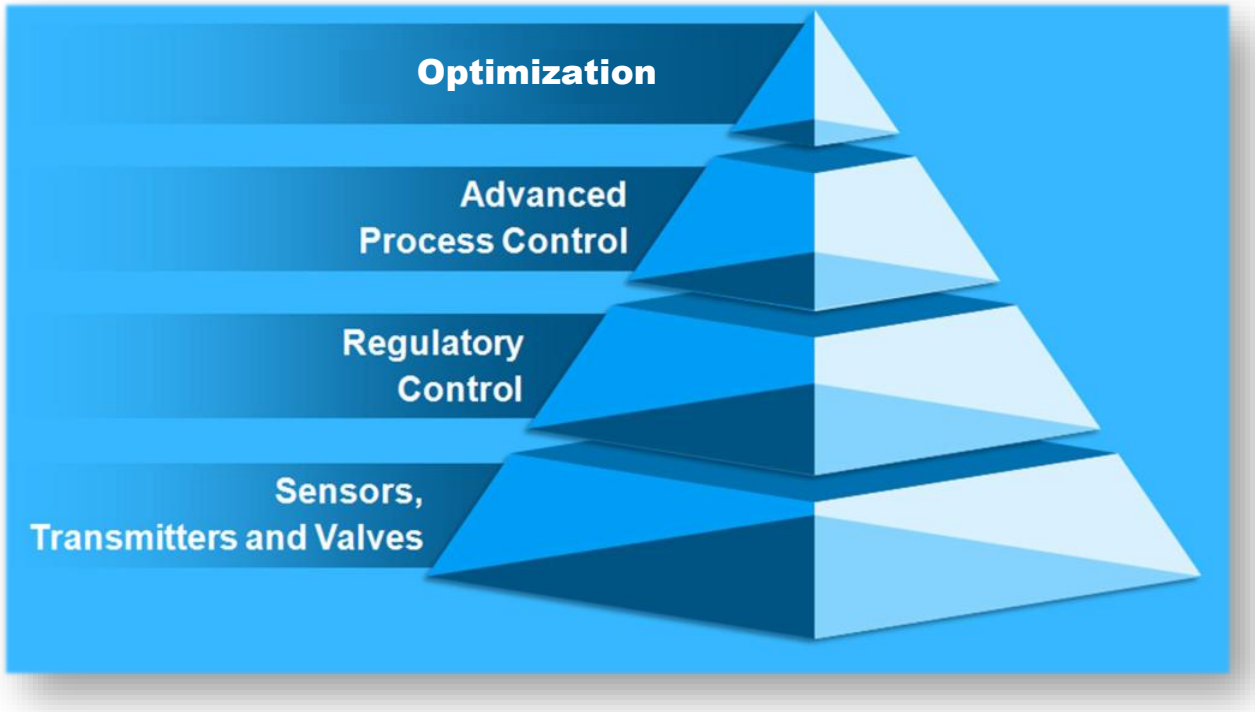
STATE OF PLAY IN INDUSTRY

Operating companies across many industries have been adopting real-time control and optimization technologies over the past 30 years.

The challenges that need to be solved:

- Maximise the utilization of the available assets
- Make the right product mix
  - Meet the customer demand
  - Make the most profitable mix
- Operate at lowest cost

Moving to a site-wide optimization approach allows greater benefits than can be achieved by individual applications



HONEYWELL'S OPTIMIZATION APPROACH

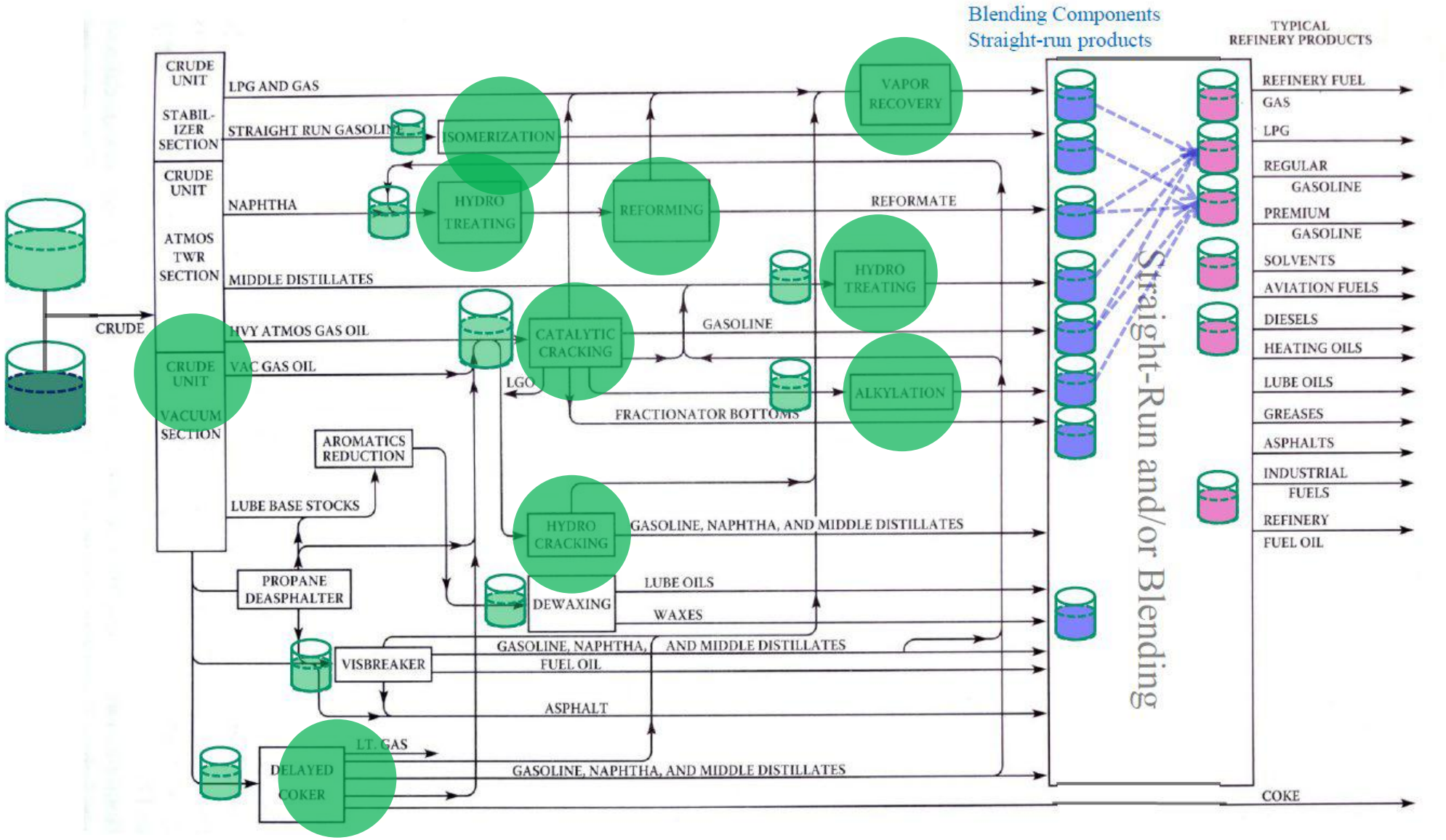
The required level of optimization is based on an assessment of the following criteria:

- Expected Return-On-Investment:
  - Initial investment
  - Maintenance costs (e.g. rigorous models versus data models)
  - Potential Benefits (e.g. tangible and intangible)
  - Complexity of Solution (affects application up-time and maintenance)
- Process Changes (magnitude, frequency, type)
- Process Flexibility (degrees of freedom to adapt to changes)
- Level and Availability of Technical Expertise
  - Implementation Requirements
  - Maintenance Requirements

An optimization solution that provides significant, sustainable benefits, quickly and cost-effectively

APC

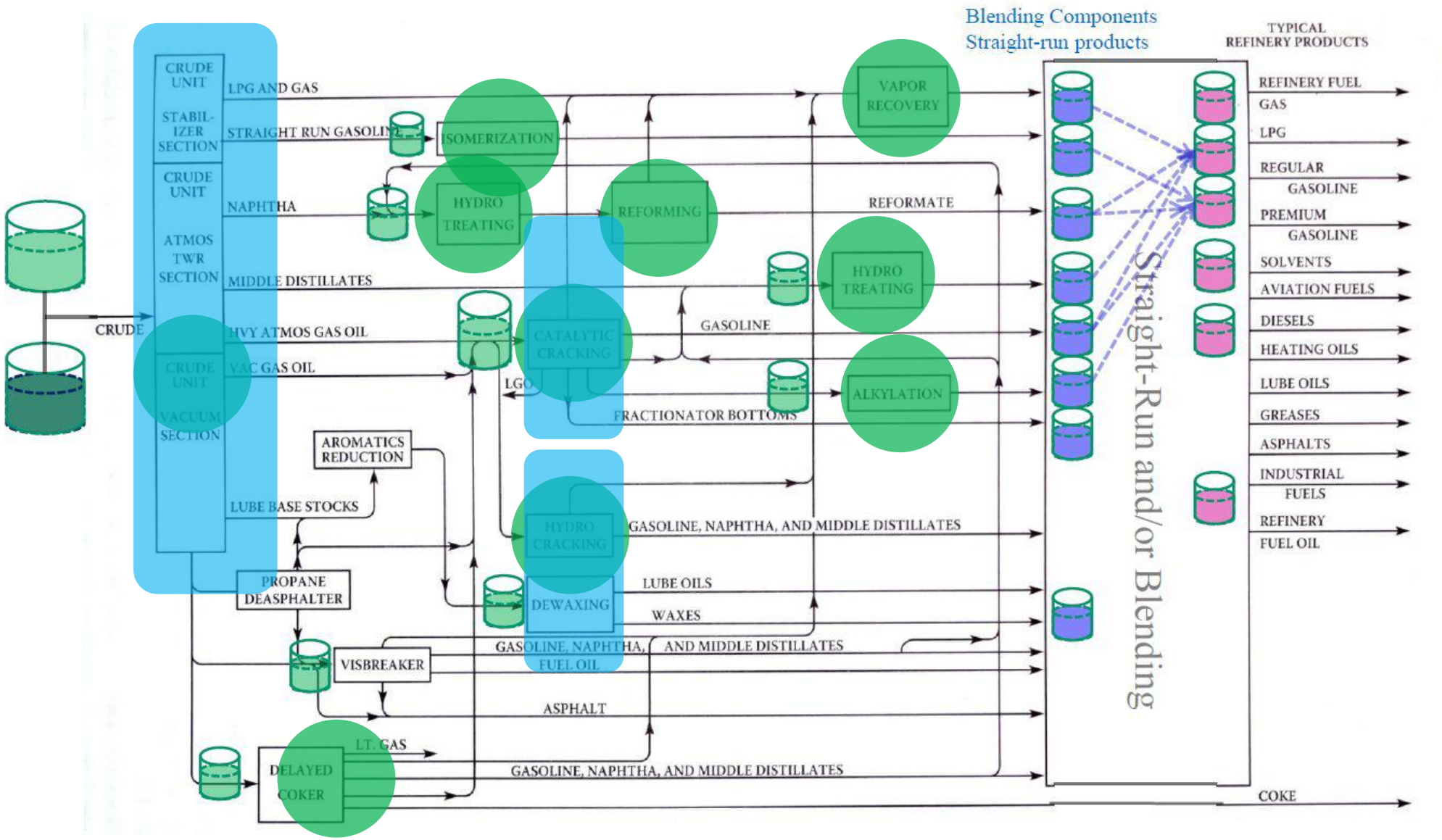
THE PROBLEM OF SCALE



THE PROBLEM OF SCALE

APC

Multi-Unit Optimization

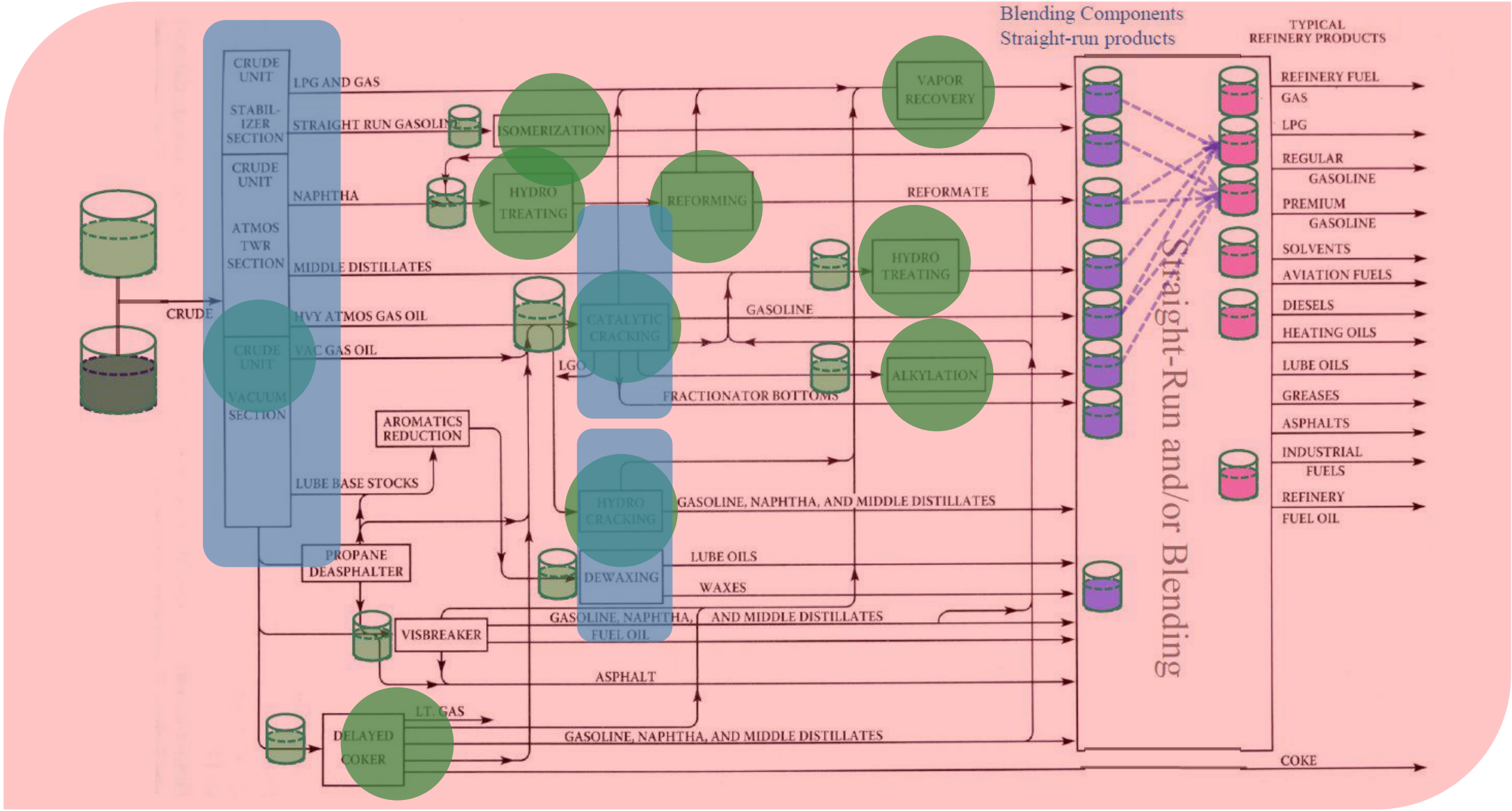


APC

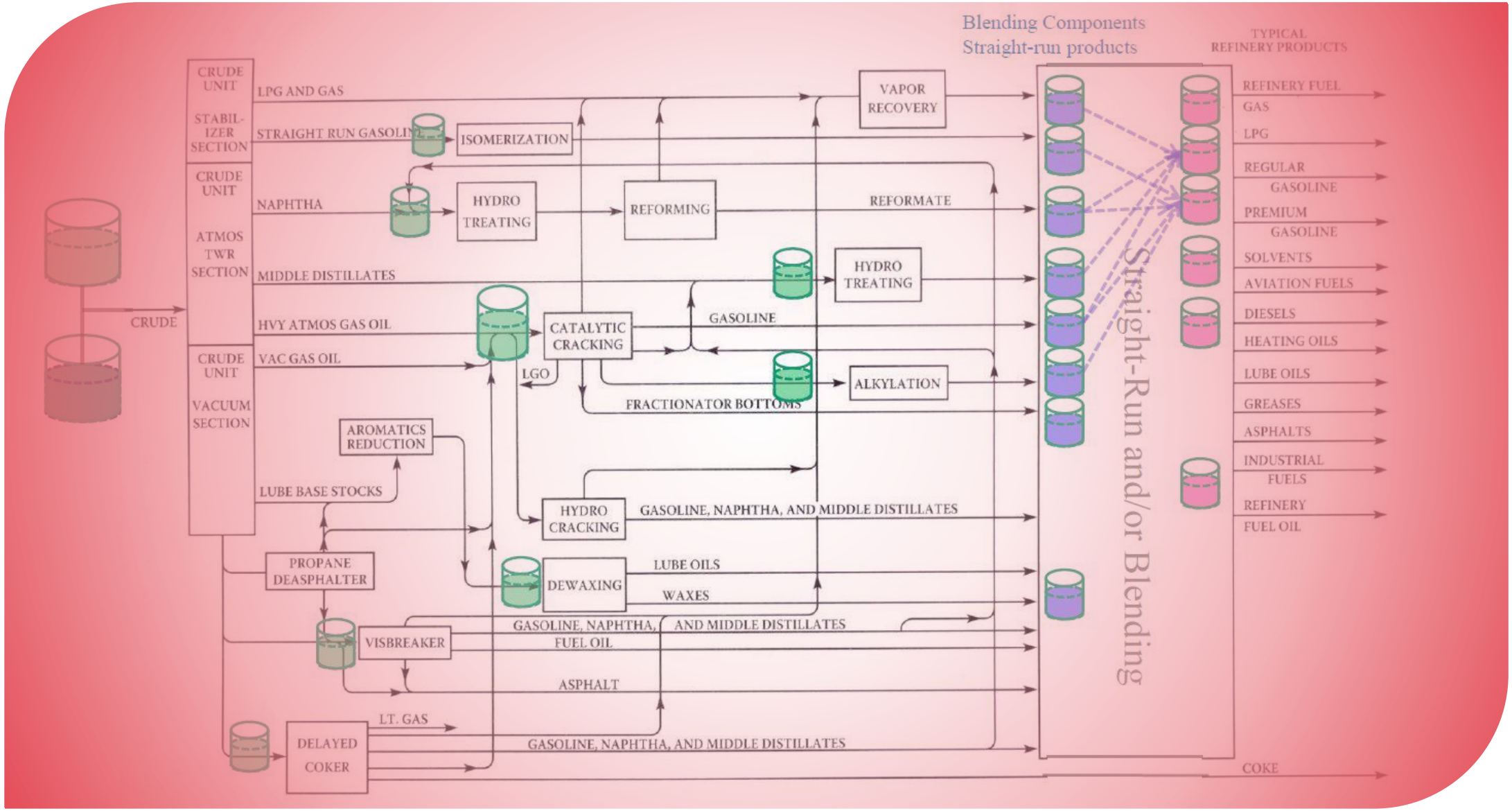
Site-Wide Optimization

Multi-Unit Optimization

THE PROBLEM OF SCALE



THE PROBLEM OF INTEGRATION & CONSTRAINTS



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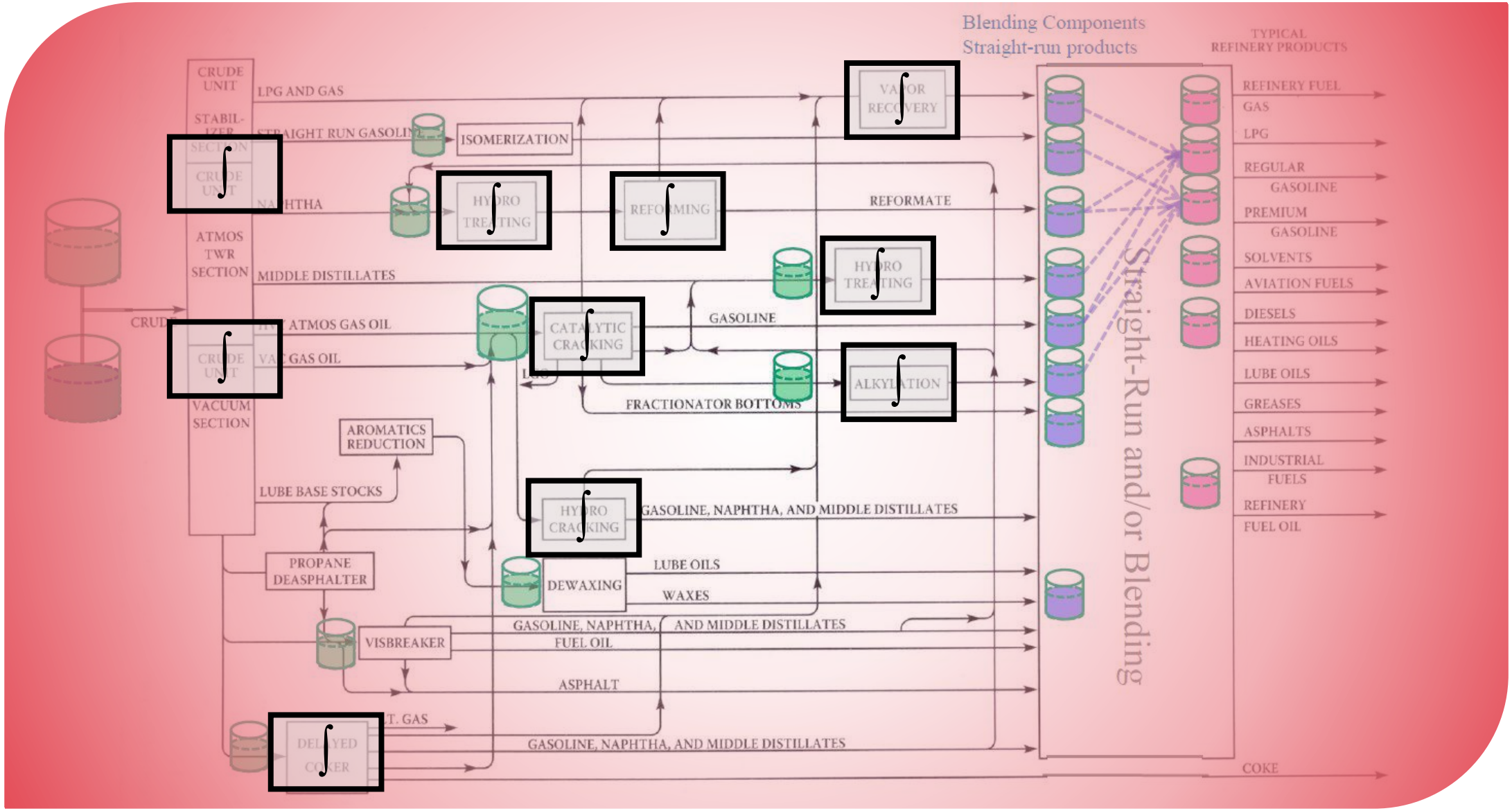

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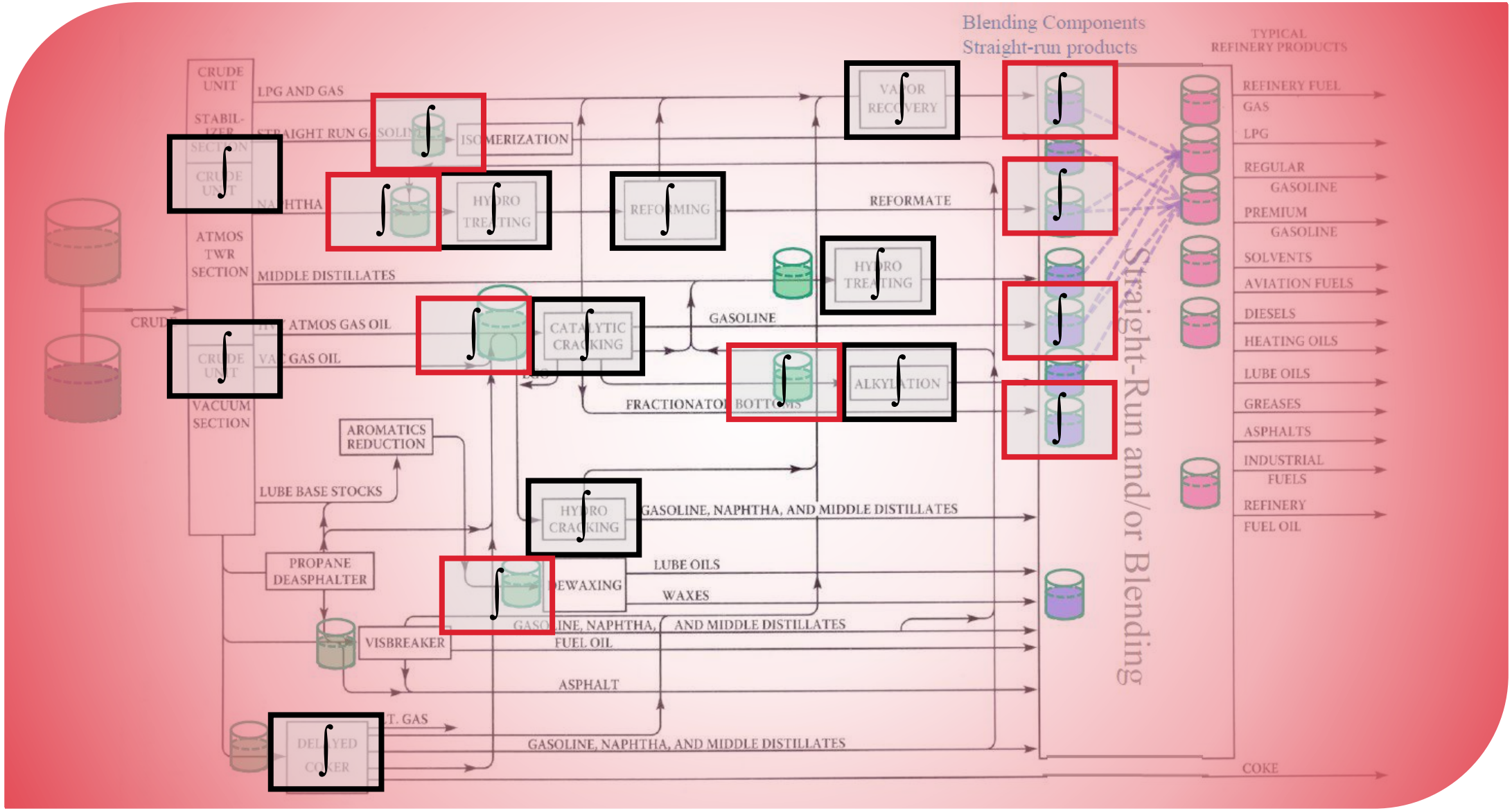

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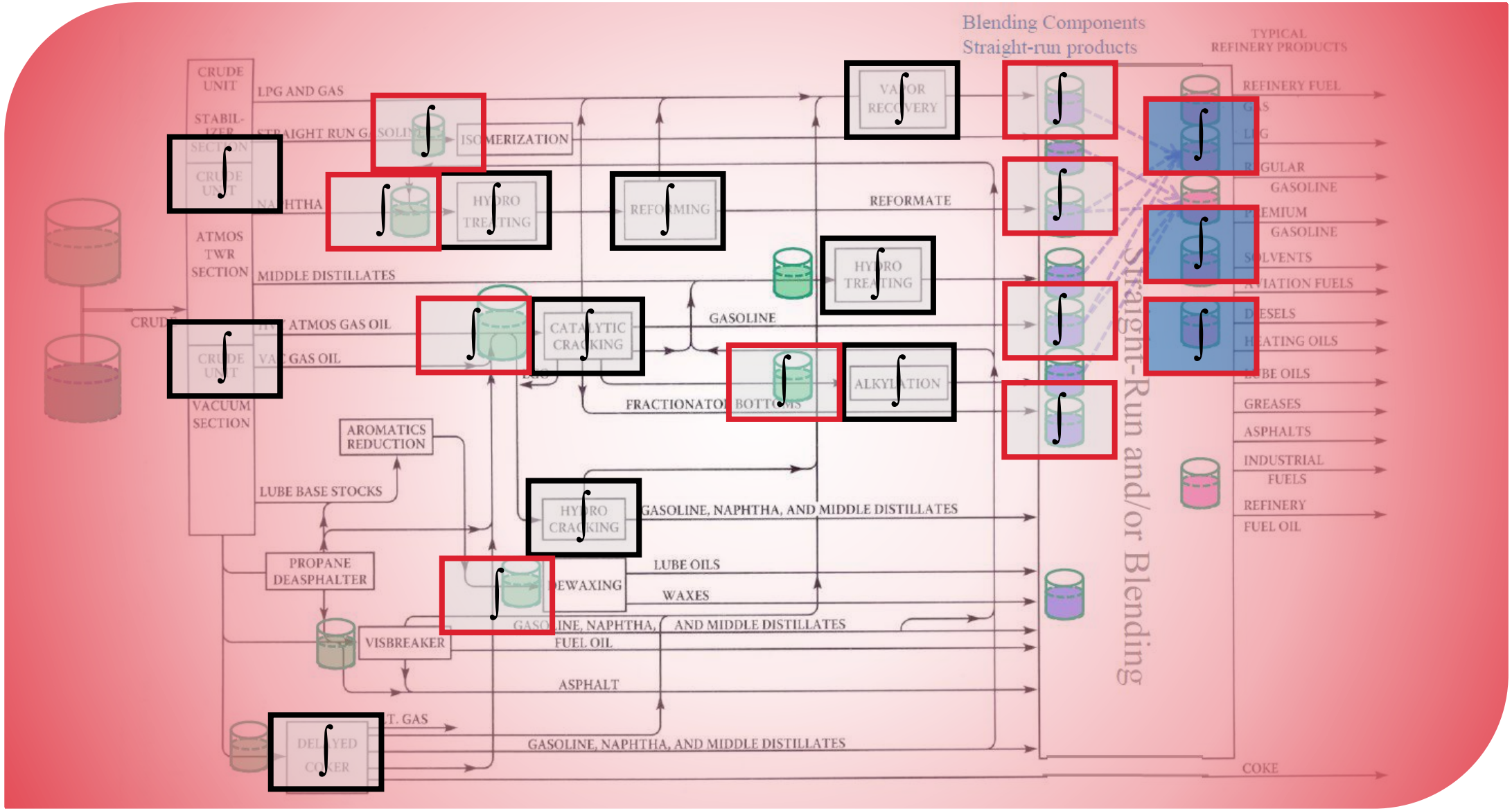

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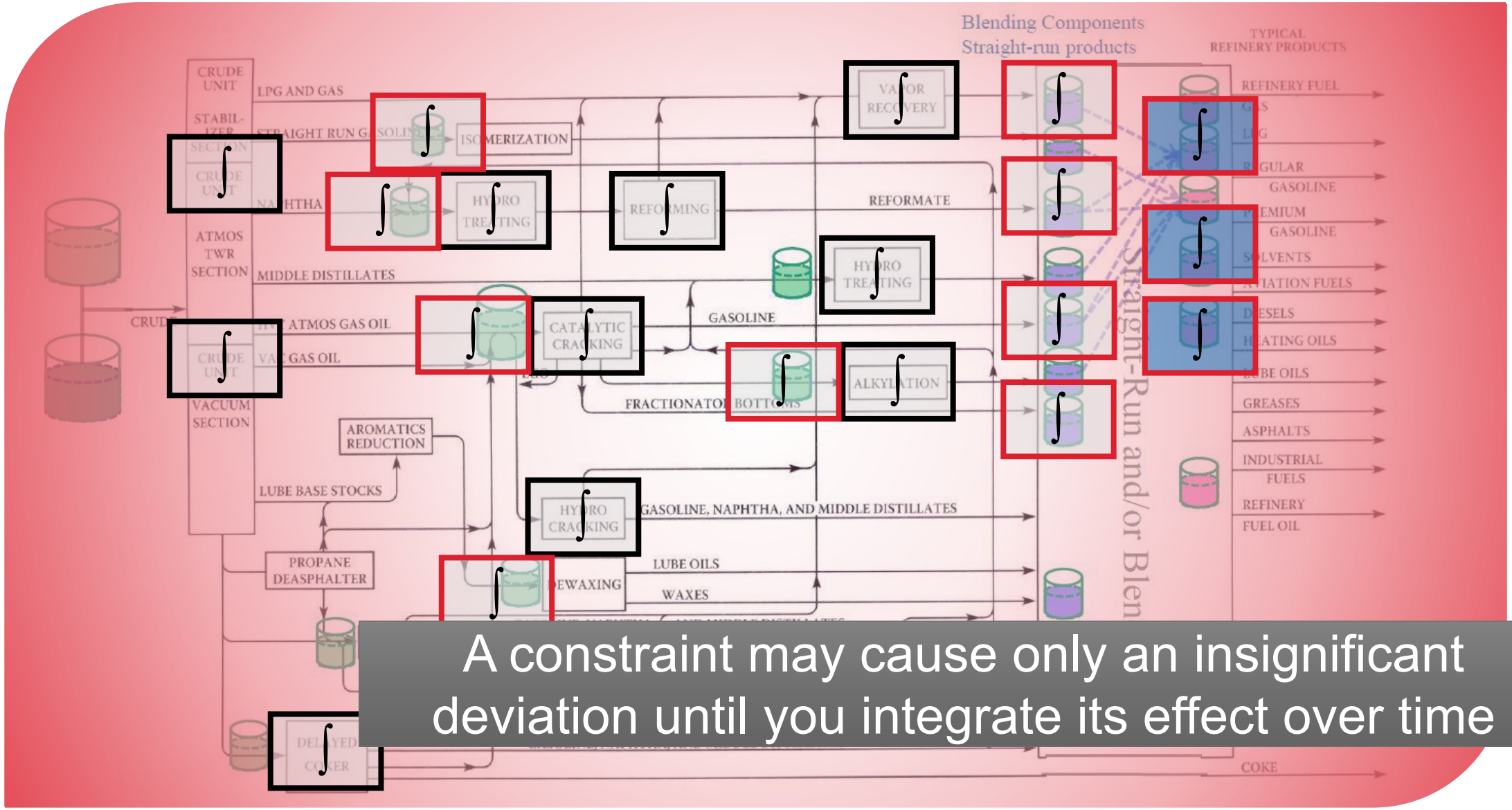


A constraint may cause only an insignificant deviation until you integrate its effect over time

THE ADVANTAGES OF A LAYERED APPROACH

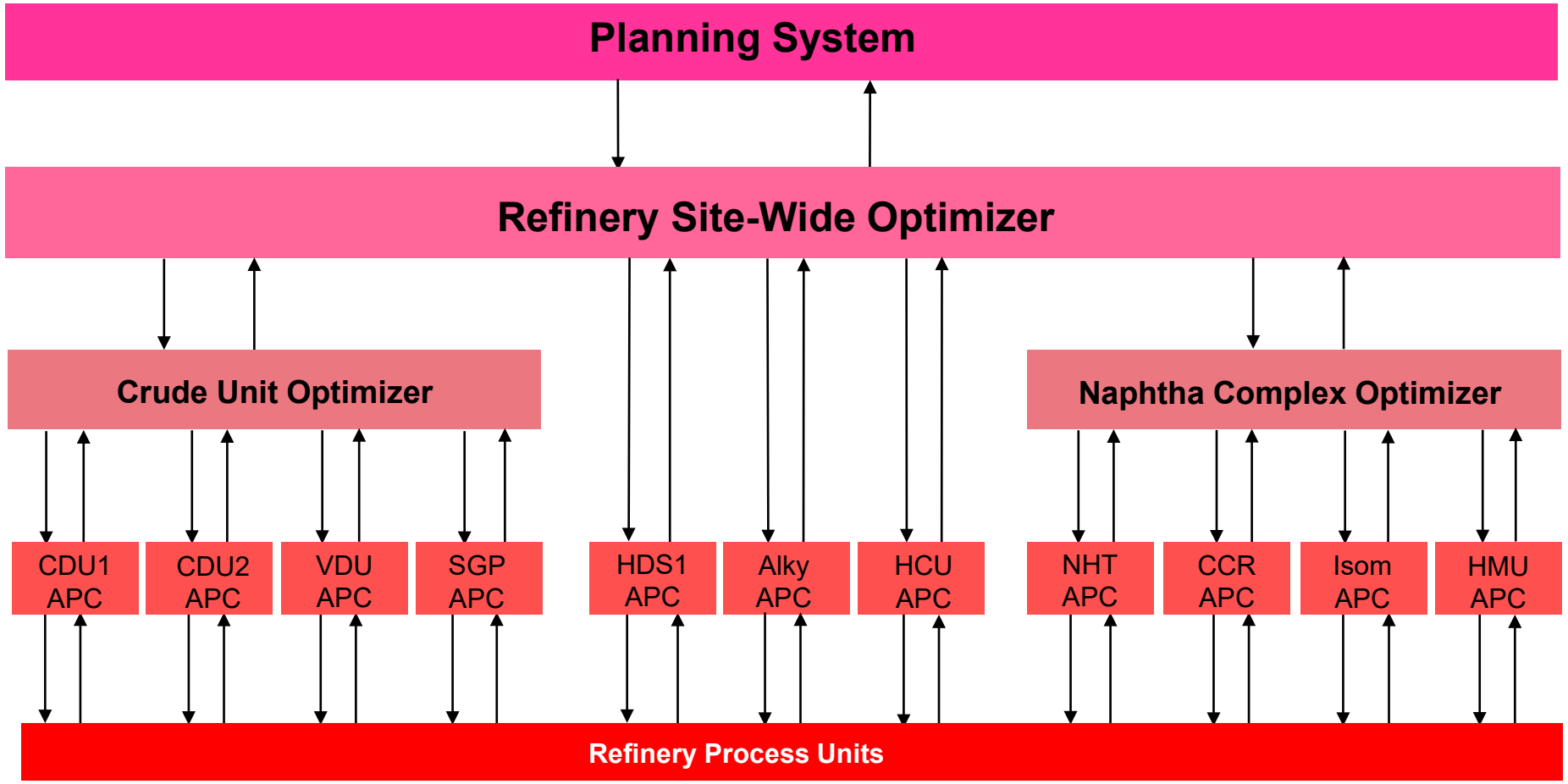
Optimization is not a “one-size-fits-all” approach

Many different technologies (algorithms) exist, each with their pros and cons

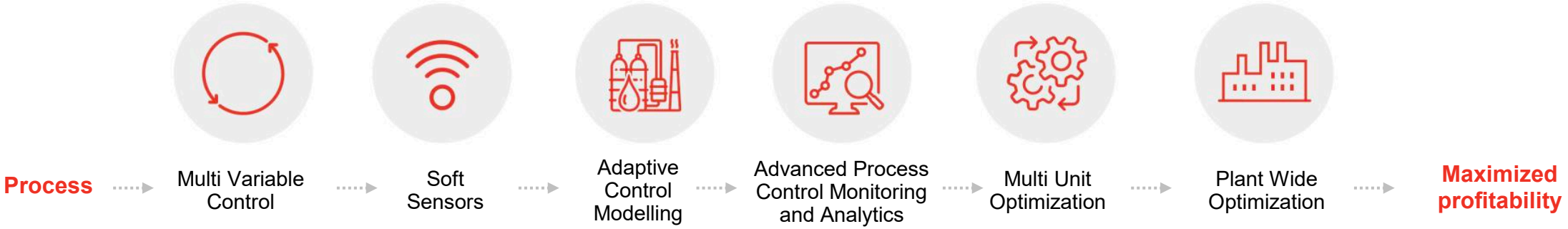
Using a layered approach addresses a number of challenges:

- A multi-technology approach can be used, applying the right technology for the right problem
- A phased approach to implementation can be taken, allowing earlier achievement of benefits
- Optimization of smaller, local problems can be devolved to a lower level optimizer, allowing the optimization to be quickly solved at that level without reliance on a larger, all-encompassing optimization layer
- The approach supports a higher-level plant-wide optimization to manage the challenging dynamics of a wide-area global optimization

BUILDING THE LAYERS

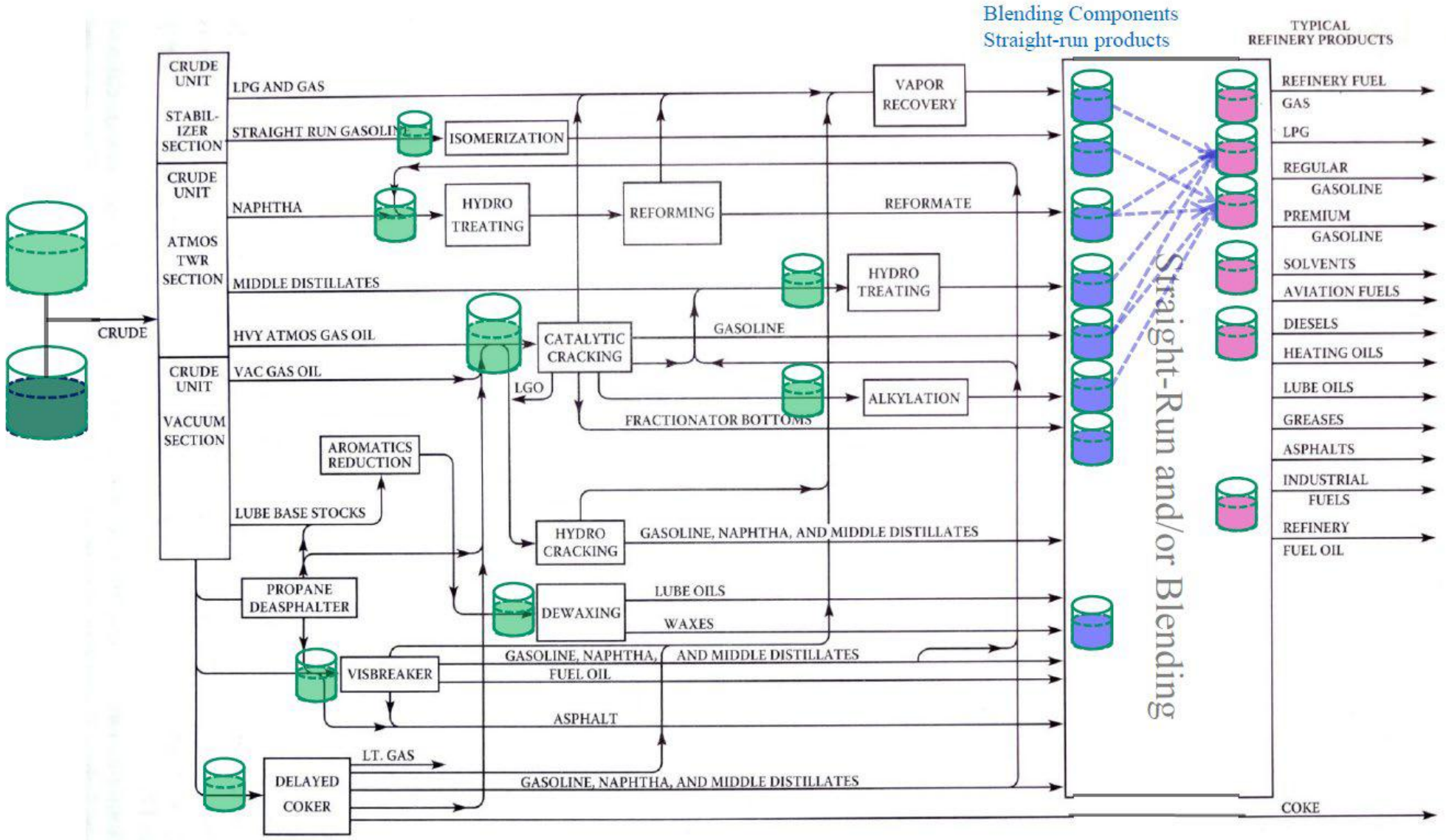


LAYERED OPTIMIZATION IN ONE PRODUCT



Optimize the plant and operate close to the limits	Create soft sensor models and improve the control	Identify accurate models by better step tests	Monitor the unit operation and act based on the gained insights	Dynamically optimize multiple Advanced Process Control applications	Coordinated planning and control at plant level

STARTING WITH ROBUST APC



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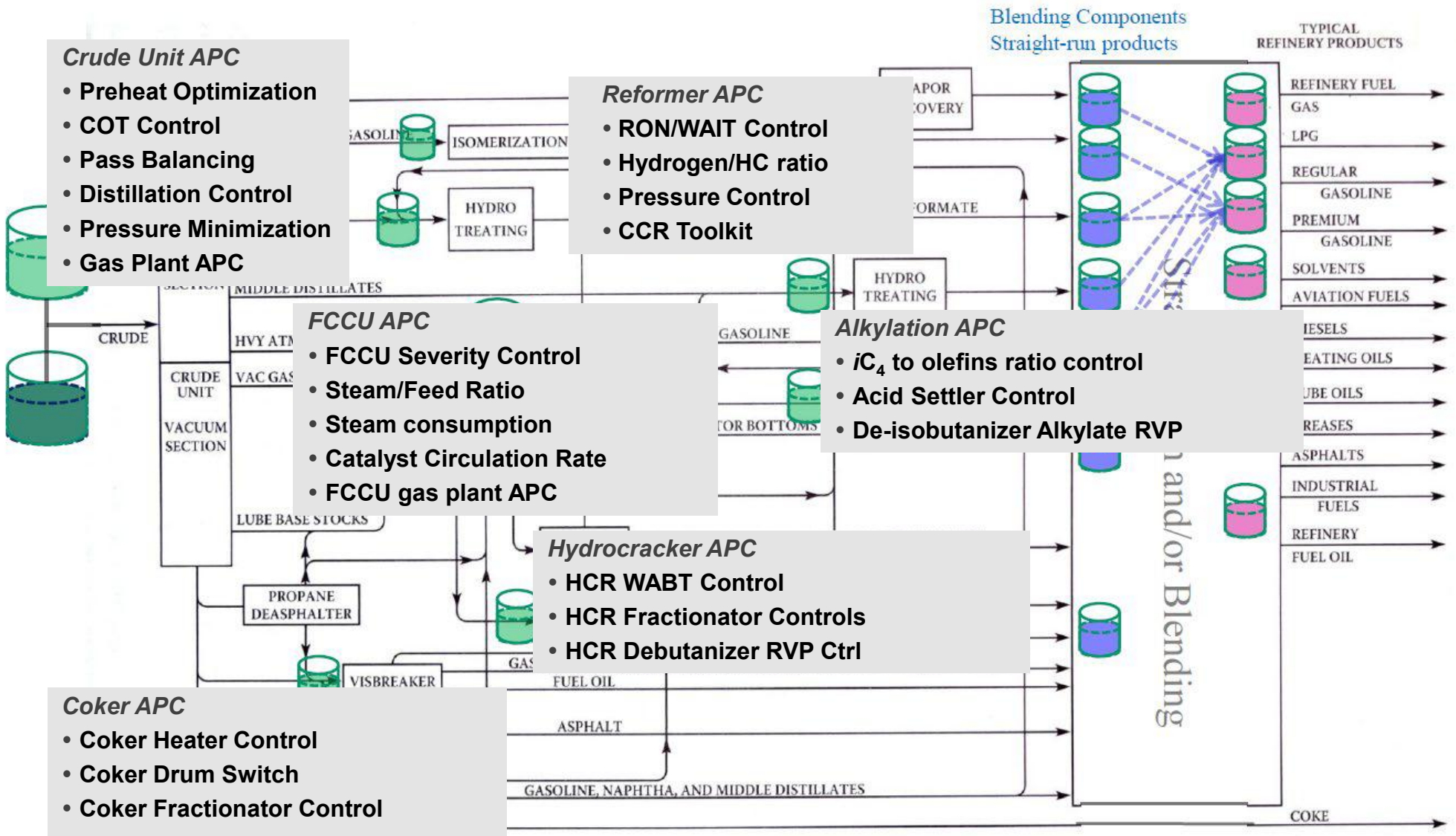


Crude Unit APC
- Preheat Optimization
- COT Control
- Pass Balancing
- Distillation Control
- Pressure Minimization
- Gas Plant APC

Reformer APC
- RON/WAIT Control
- Hydrogen/HC ratio
- Pressure Control
- CCR Toolkit

FCCU APC
- FCCU Severity Control
- Steam/Feed Ratio
- Steam consumption
- Catalyst Circulation Rate
- FCCU gas plant APC

Alkylation APC
- iC_4 to olefins ratio control
- Acid Settler Control
- De-isobutanizer Alkylate RVP

Hydrocracker APC
- HCR WABT Control
- HCR Fractionator Controls
- HCR Debutanizer RVP Ctrl

Coker APC
- Coker Heater Control
- Coker Drum Switch
- Coker Fractionator Control

TANGIBLE APC BENEFITS

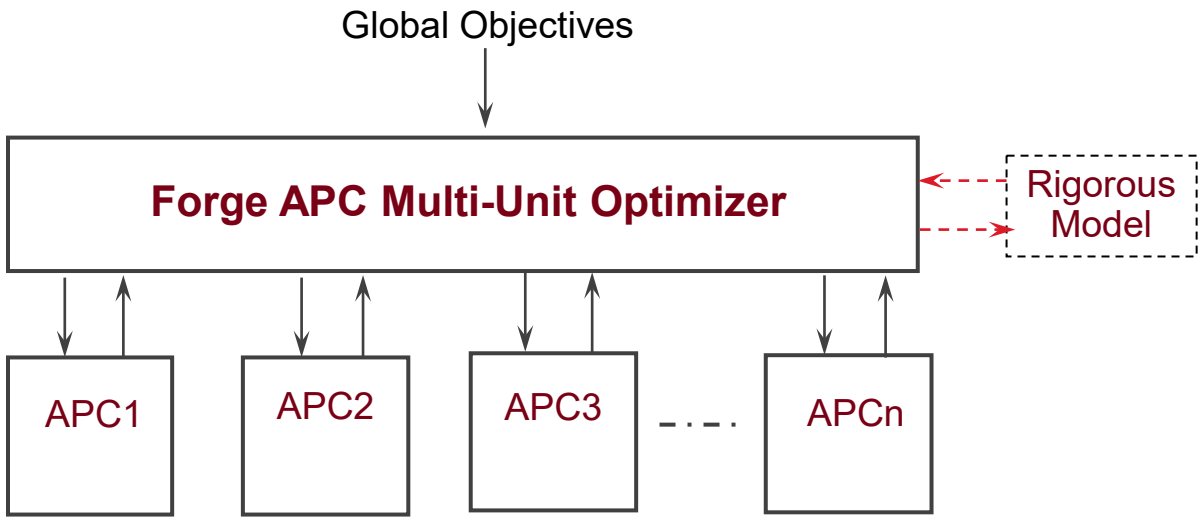
Typical Benefits:

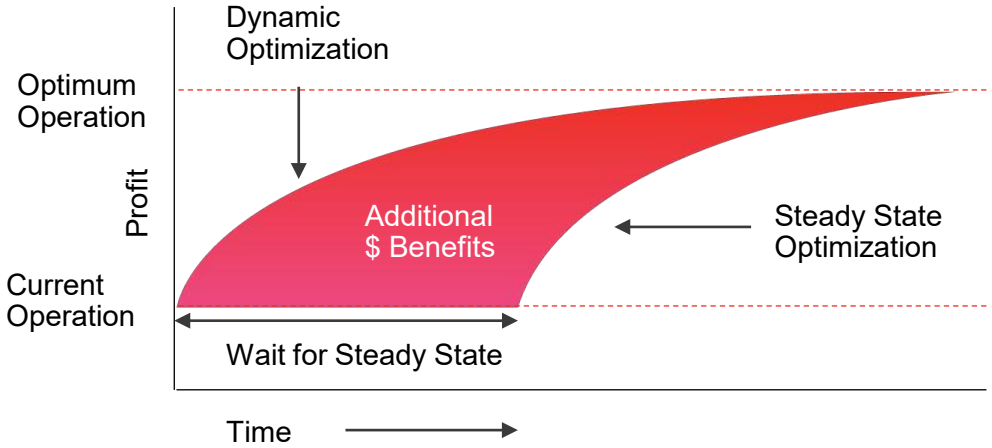
- Increased Throughput
- Improved Yields
- Reduced energy usage
- Decreased Operating Costs
- Improved Quality Consistency
- Increased Operating Flexibility
- Improved Process Stability

Process	Benefit (c/bbl)	Benefit (Yearly US$)
Crude Distillation	5 – 13	2.7 – 7.0M
Coking	15 - 33	2.2 – 4.8M
Hydrocracking	13 - 30	3.3 – 7.6M
Catalytic Cracking	13 - 30	2.4 – 5.4M
Reforming	10 – 26	1.8 – 4.7M
Alkylation	10 – 26	1.1 – 2.8M
Isomerization	3 - 17	0.3 – 1.8M

Significant Benefits Come From Well-implemented APC

MULTI-UNIT OPTIMIZATION SOLUTIONS





- Solves multi-unit optimization dynamically, even when the plant is not at a steady state
- Re-use model investment already in base-level APC
- Streamlined configuration and maintenance

Maximized Profitability

APPLYING RIGOROUS PROCESS SIMULATION

Rigorous Process Simulation offers capability to model complex process behavior

Key Advantages

- Model non-linear process behaviour
- Account for complex unit interactions
- Detailed feed characterisation (eg. crude composition)

Key Disadvantages

- Not always robust in online operation (convergence issues)
- Time consuming to build and maintain
- No additional value if process can be modelled empirically

MOVING TO SITE WIDE OPTIMIZATION

Key Challenge:

How to get the solution layers to stay consistent and reach the global optimum jointly?

Business Planning

Plantwide economics

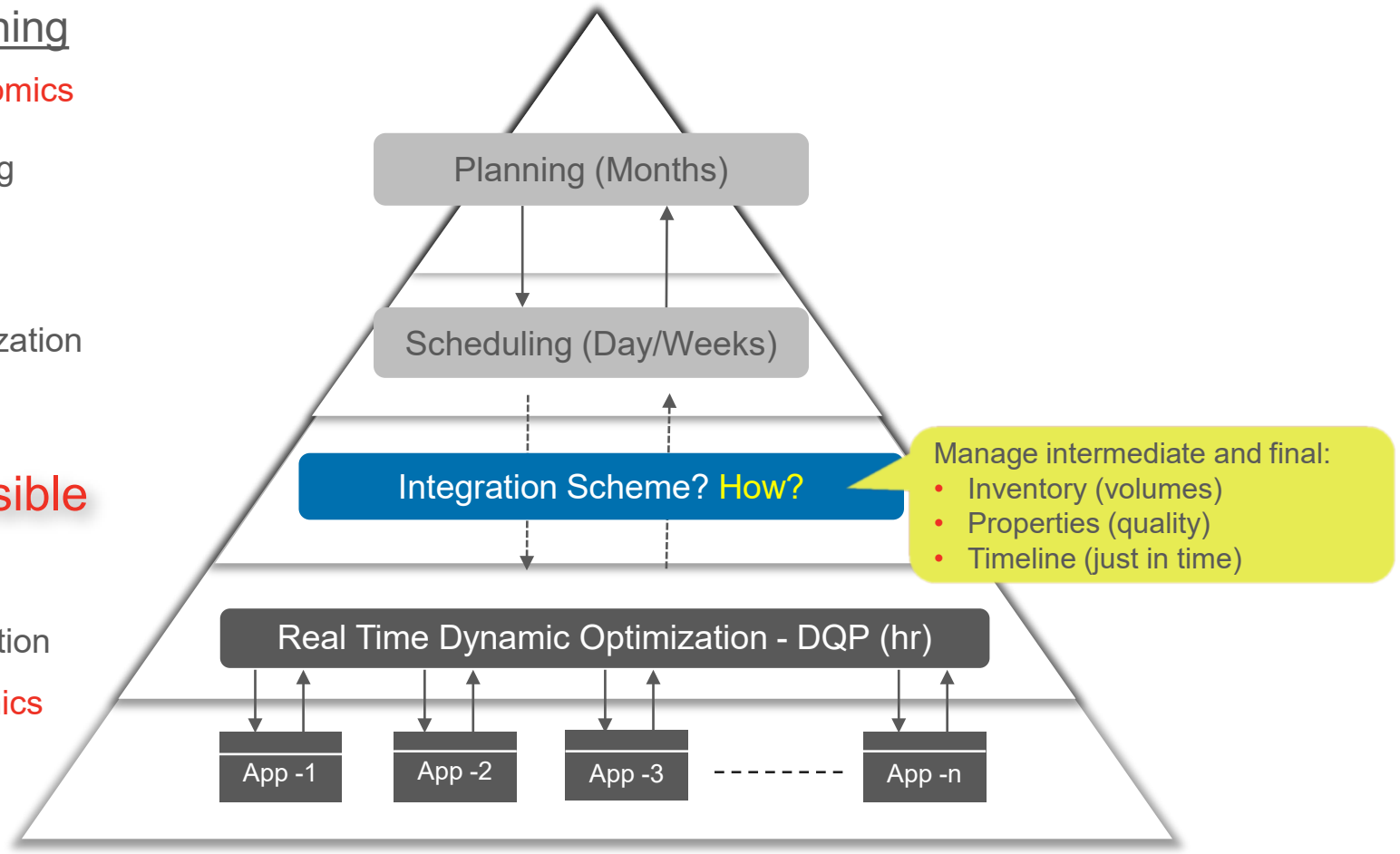
Production Planning

Schedule & Optimization

Optimal feasible

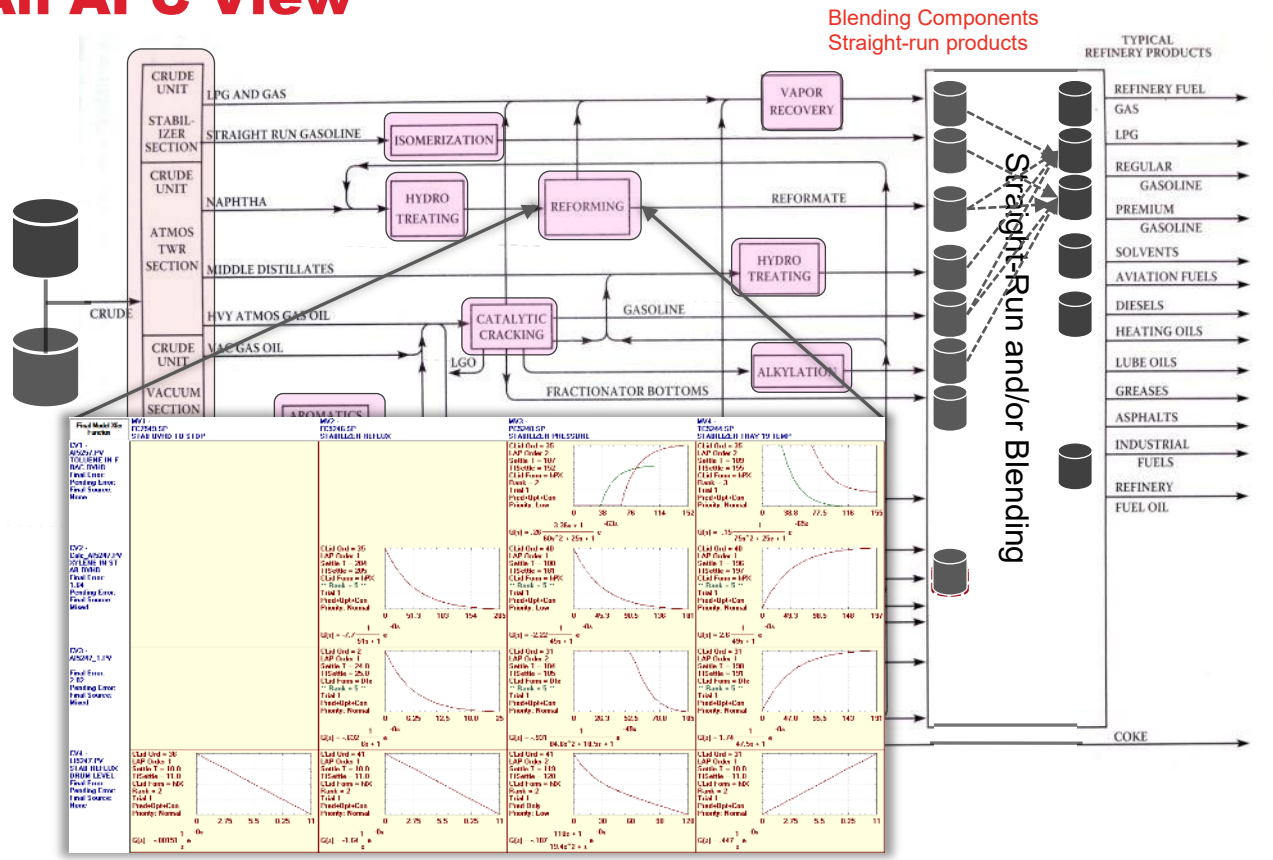
Control & Optimization

Local economics



SITE-WIDE OPTIMIZATION CHALLENGES

Refinery Model – An APC View

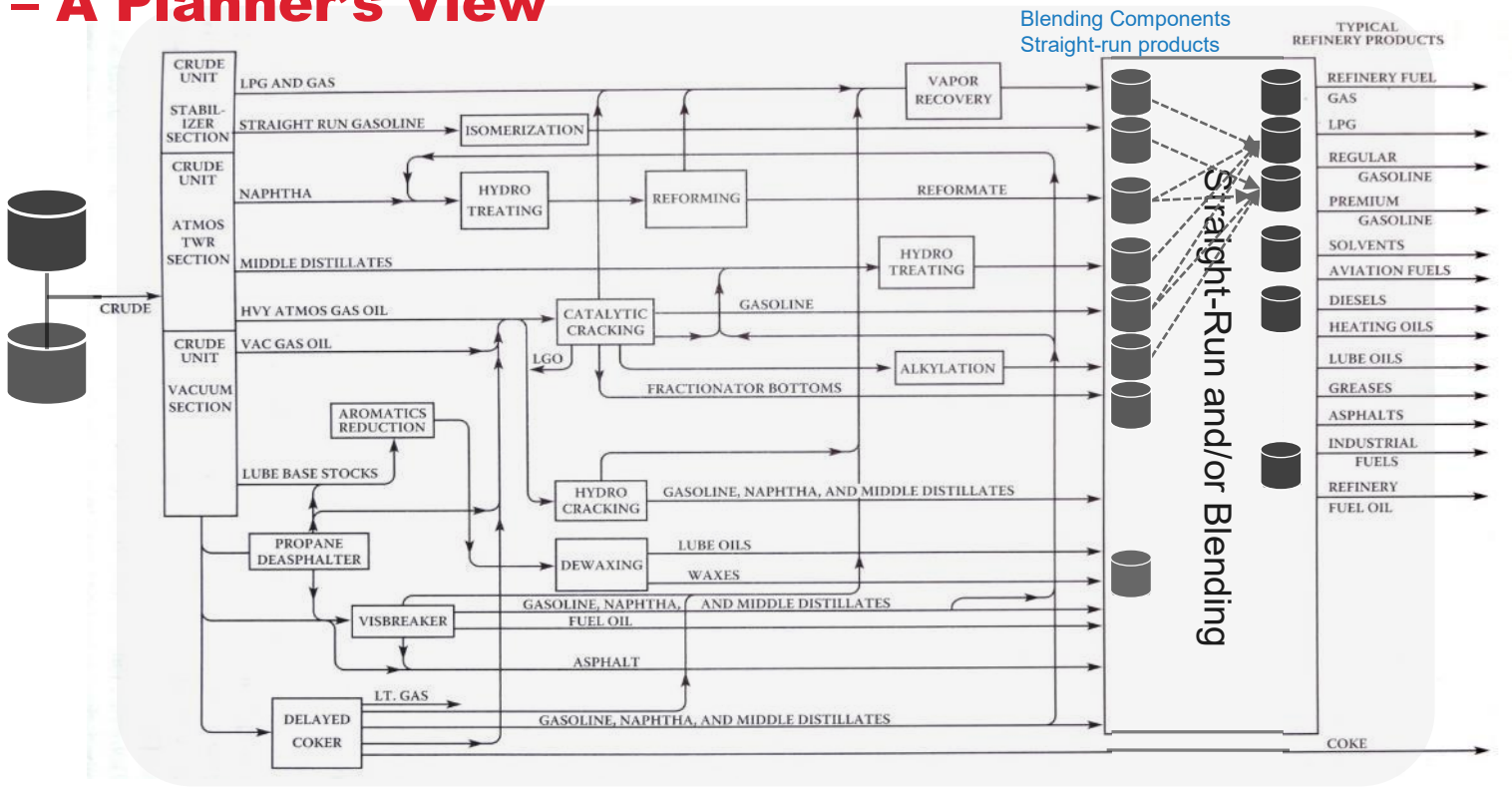


APC model has a greater resolution but limited scope

- It captures essential unit or area operating constraints
- Optimizes unit production to possible detriment of plant

SITE-WIDE OPTIMIZATION CHALLENGES

Refinery Model – A Planner's View



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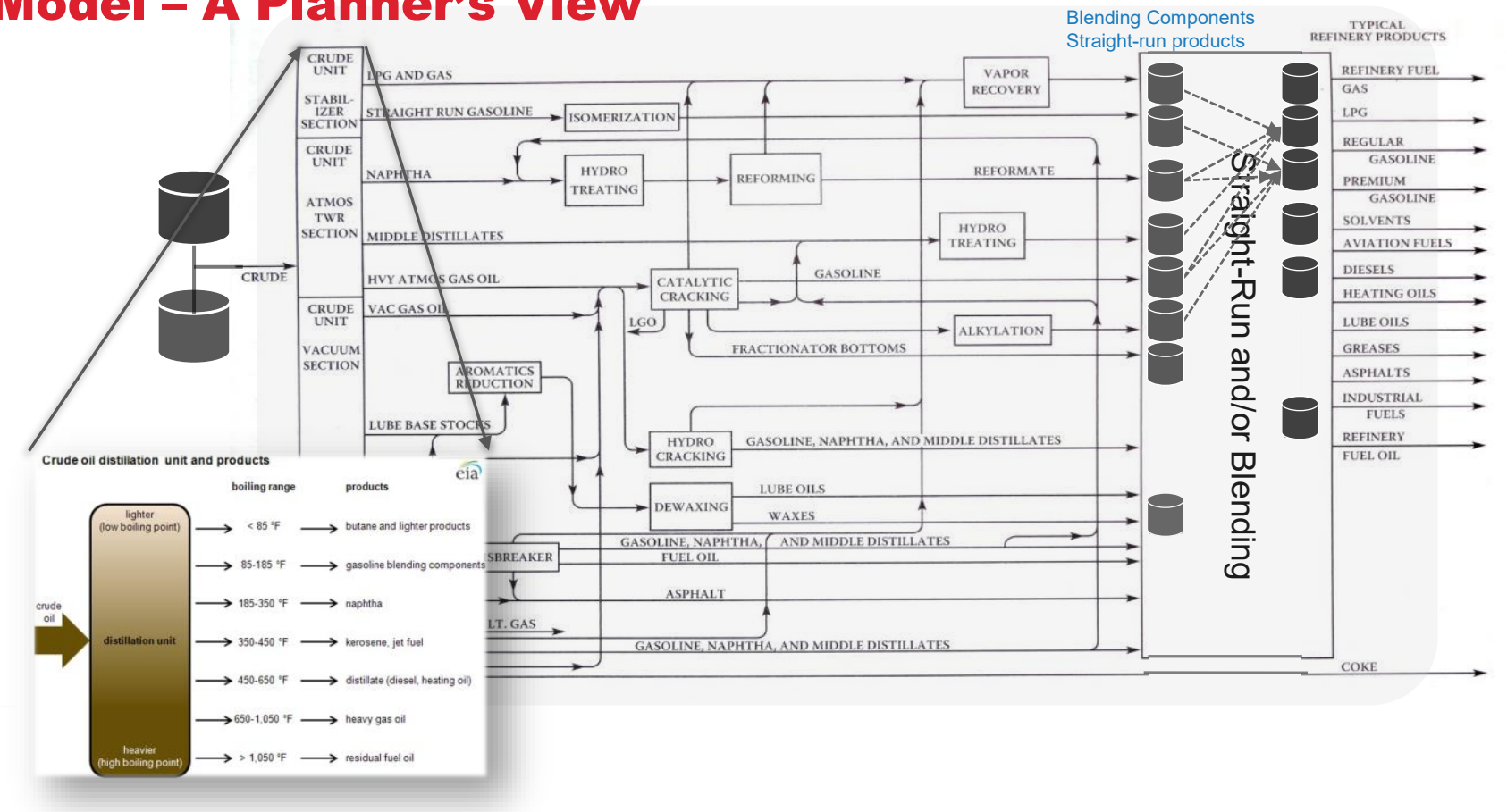

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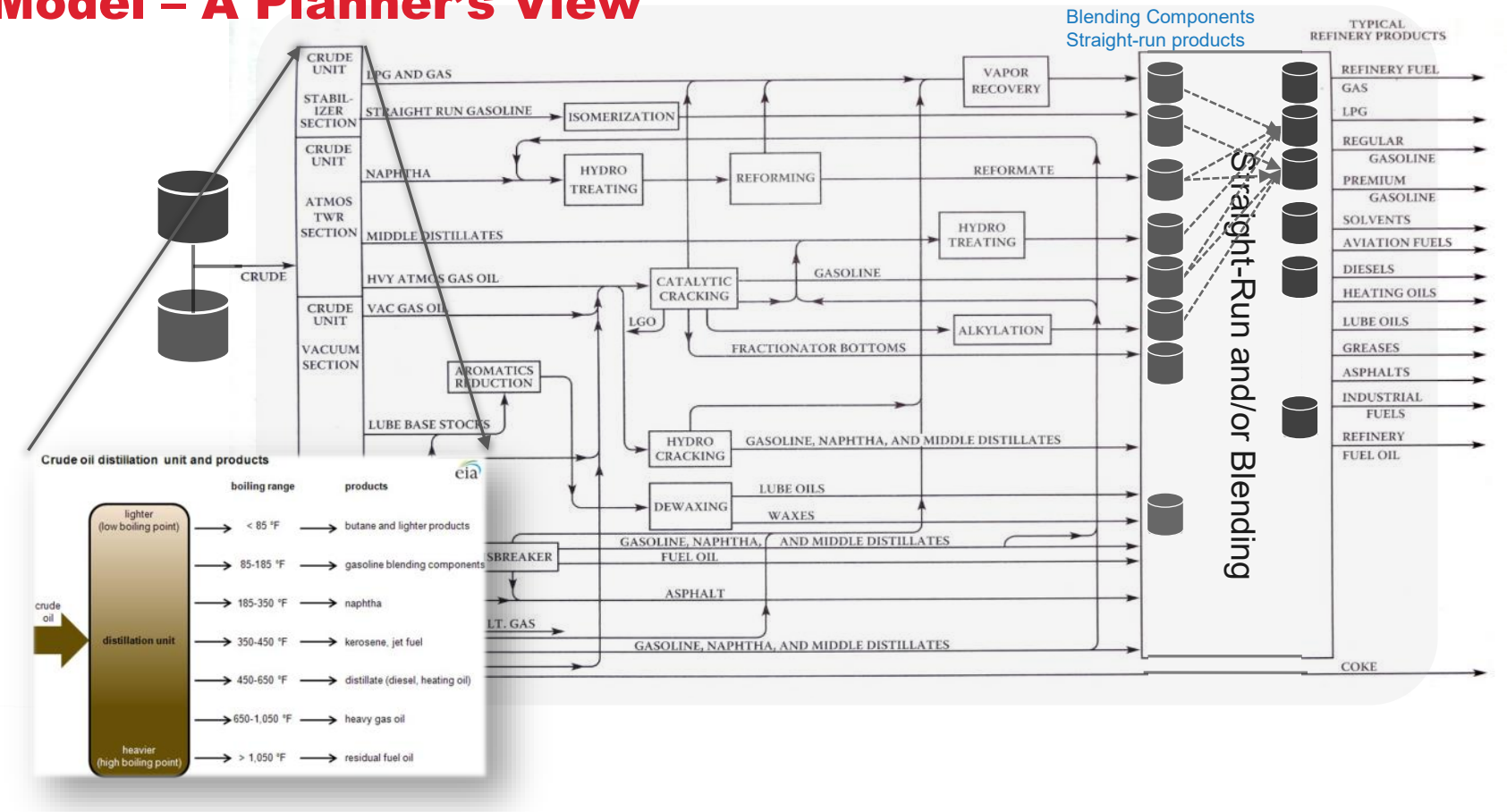

The model has a high level of abstraction

- It captures essential material and energy balances in holistic view of the refinery
- It leaves out many unnecessary or even obscuring details for the economic optimization

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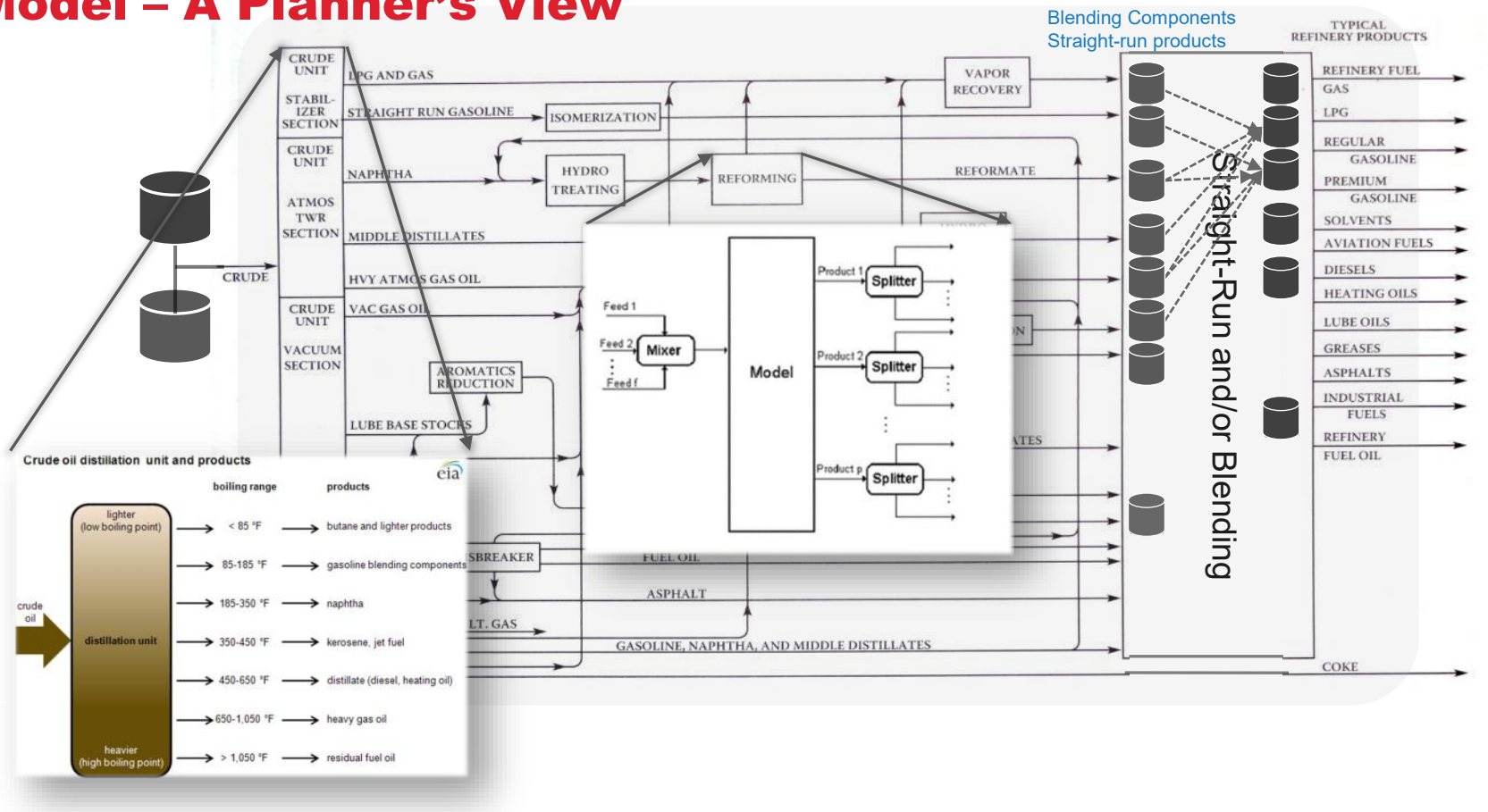

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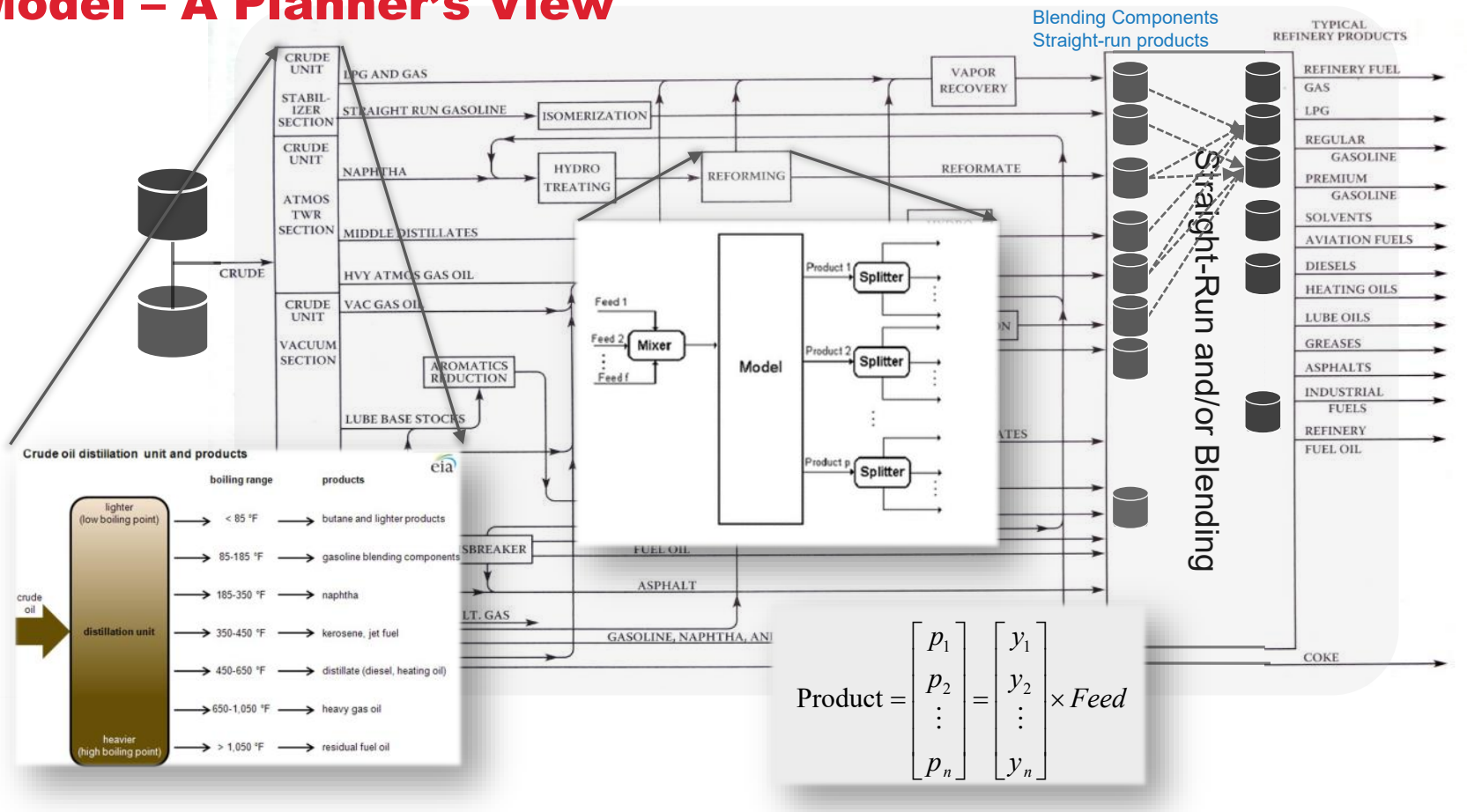

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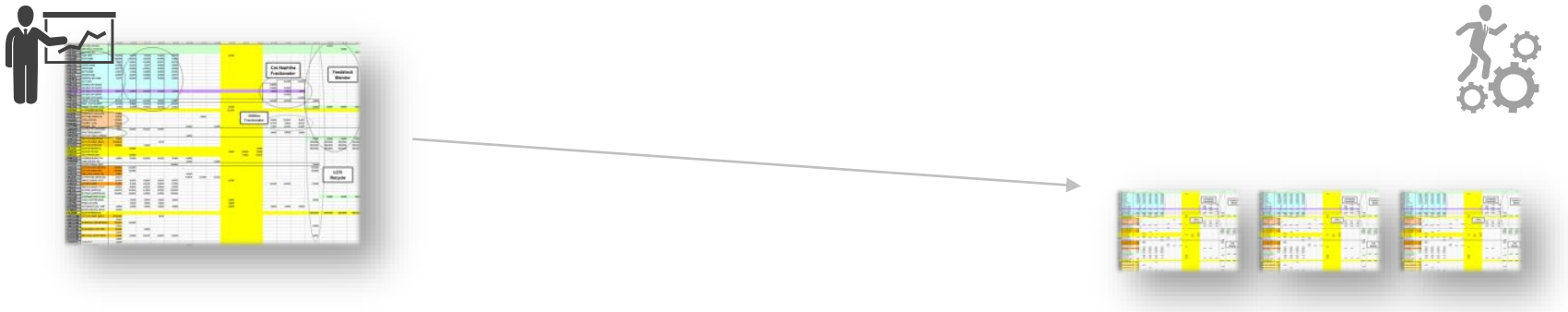
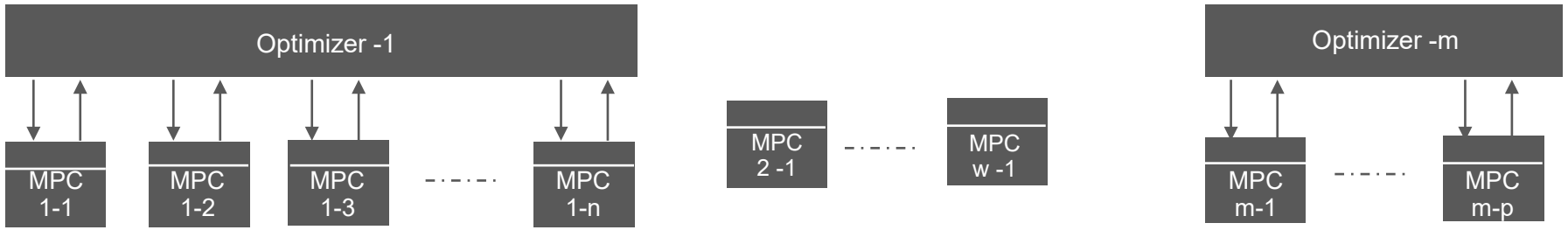
DISCONNECTED PLANNING PROCESSES





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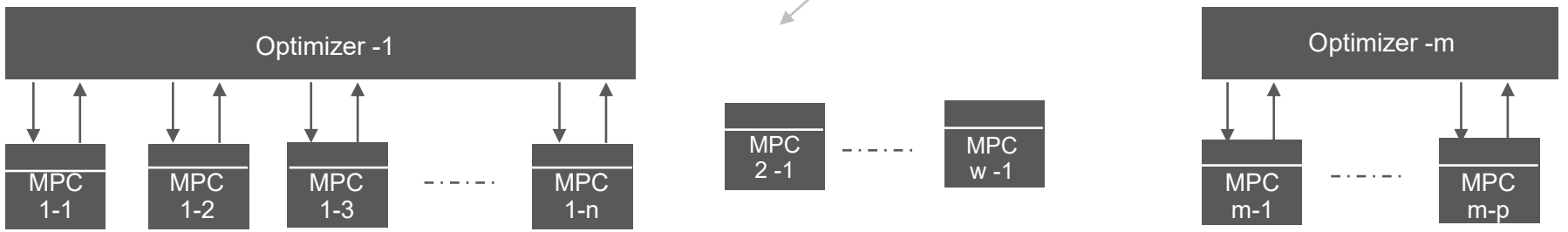
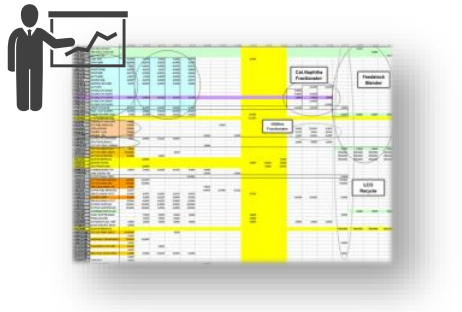
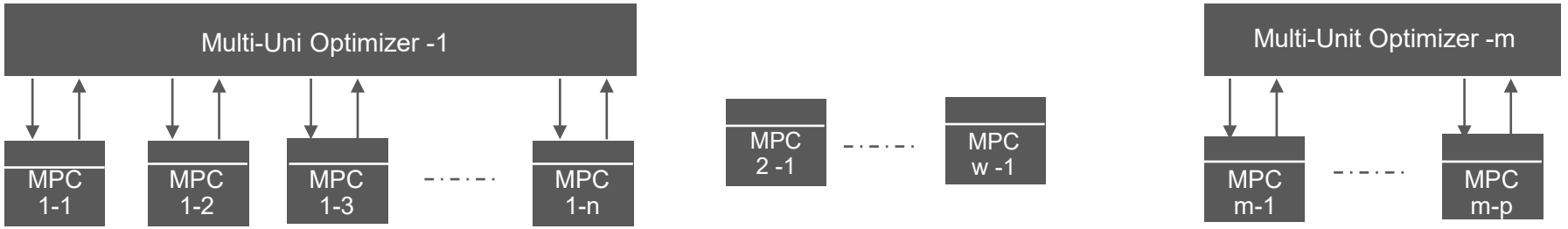


MAKING THE CONNECTION





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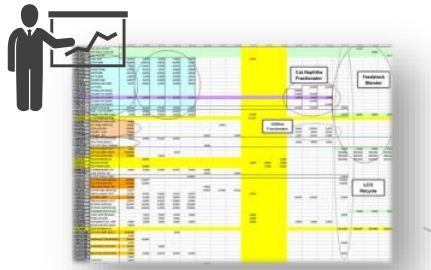

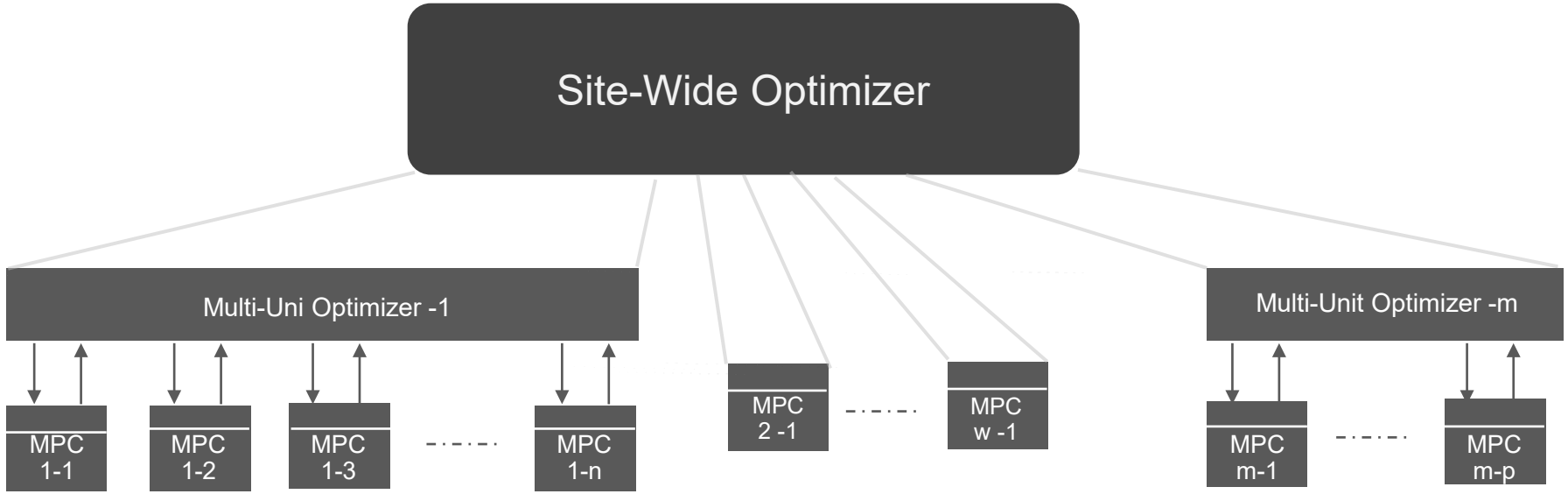

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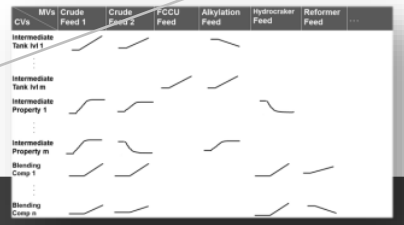


Site-Wide Optimizer

Multi-Uni Optimizer -1

MPC 1-1

MPC 1-2

MPC 1-3

MPC 1-n

MPC 2 -1

MPC w -1

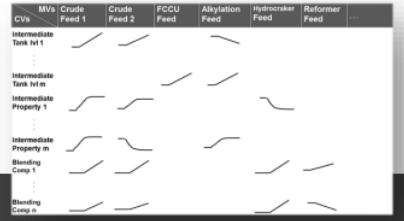
Multi-Unit Optimizer -m

MPC m-1

MPC m-p

MAKING THE CONNECTION

Returned values can include the actual versus predicted yields and proxy limits



Site-Wide Optimizer

Manage intermediate and final:
- Inventory (volumes)
- Properties (quality)
- Timeline (just in time)

Multi-Uni Optimizer -1

Multi-Unit Optimizer -m

MPC 1-1
MPC 1-2
MPC 1-3
MPC 1-n
MPC 2 -1
MPC w -1
MPC m-1
MPC m-p

Manage:
- Unit operation
- Limits
- Constraints

USERS TESTIMONIES

~ SATISFIED CUSTOMERS

"Honeywell was the logical choice because of its extensive refinery APC experience and local engineering capabilities. And it turned out to be the right choice as well. The implementation went smoothly thanks to the methodical project management from pre-test through commissioning. The users find the system easy to understand and simple to maintain"

"The optimizer provides the capability of effectively integrating the hydrogen component of the hydrocracker operation. The integration is natural and seamless and allows us to address the most important requirement of this project"

"Installing an APC controller, or many APC controllers, provides us with the opportunity to save money and energy – which are very important nowadays"

"APC gives valuable online quality information, which helps us adjust downstream unit operations"

"With the Optimizer in operation it was possible to operate the plant at various constraints. Overall operations was able to increase the ethylene production by 3.2% compared to the base case defined at the beginning of the project"

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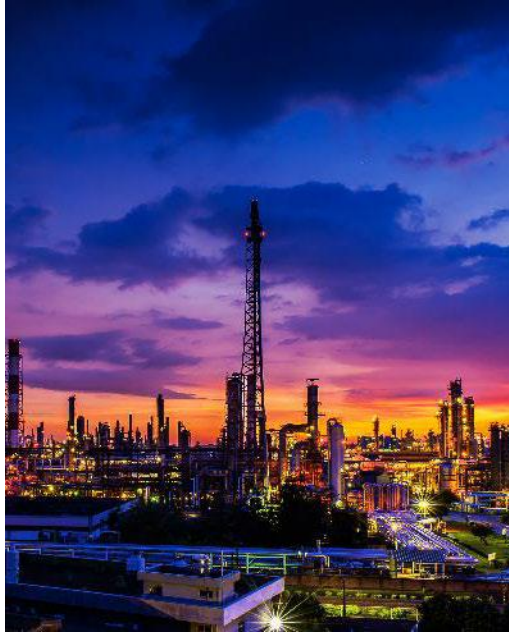
SUMMARY

- Many examples exist of successful optimization
- Optimization introduces particular challenges over and above what APC may face
- A layered optimization approach directly addresses these challenges
- Maximum benefits are derived from solutions that are easy to maintain and implement




THANK YOU

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