
# Ethylene Business Planning and Scheduling

May 30, 2010

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# Objectives Of Workshop – Discussion Agenda

1. *To review and highlight opportunities for improvement* in CLIENT's current business optimization systems, process and practices
2. *To derive high-level estimates of the benefits*
3. *To evaluate* the proposed Ethylene Planning and Scheduling *solution* from The Quaker Group.
4. *A proposal leading to the implementation* of a software / advisory solution at the target CLIENT.

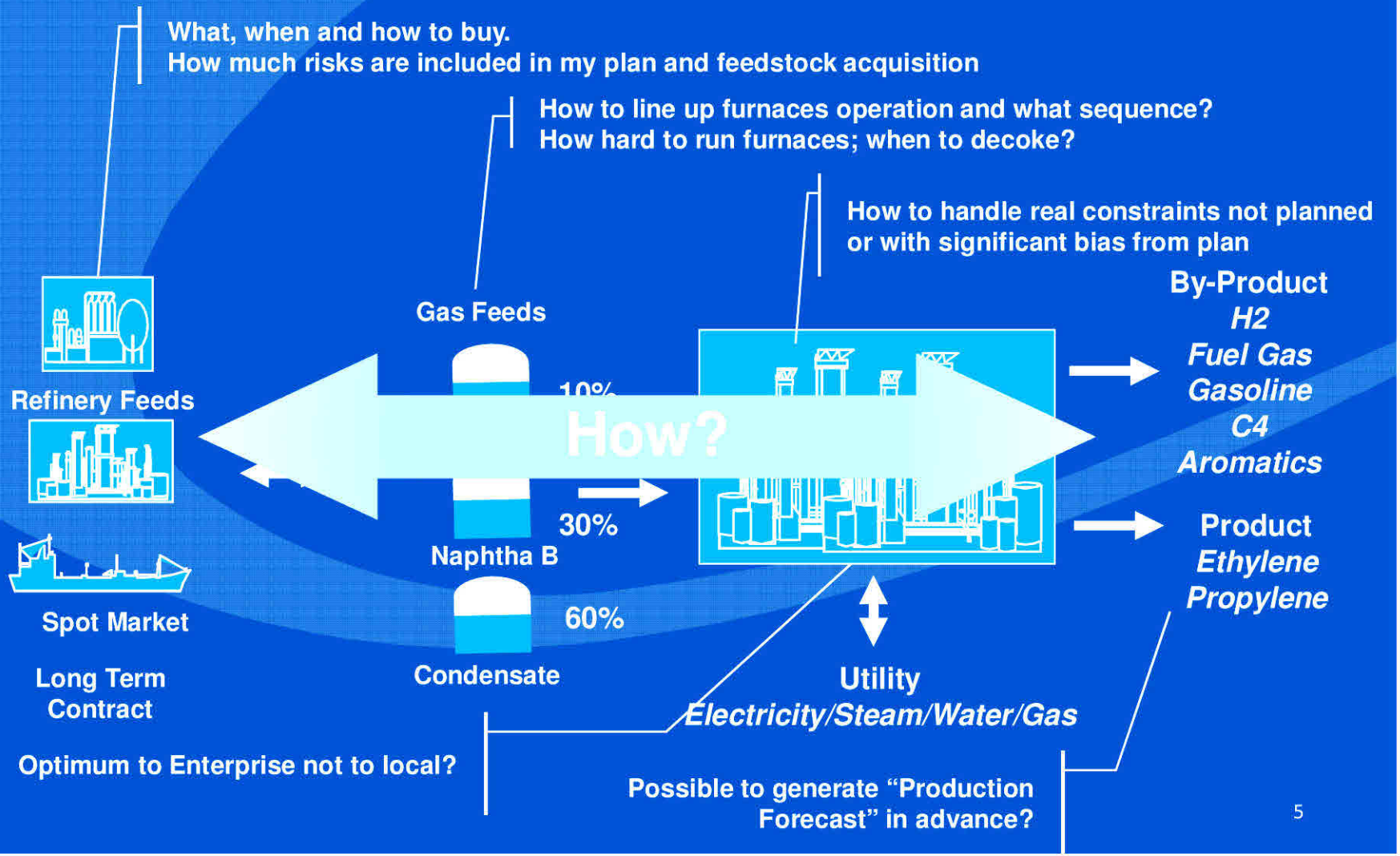
# Agenda

- Introduction
- Benefits Analysis
- Solution
- Forward Plan

# Planning & Scheduling Opportunities & Benefits

# Ethylene Business Optimization

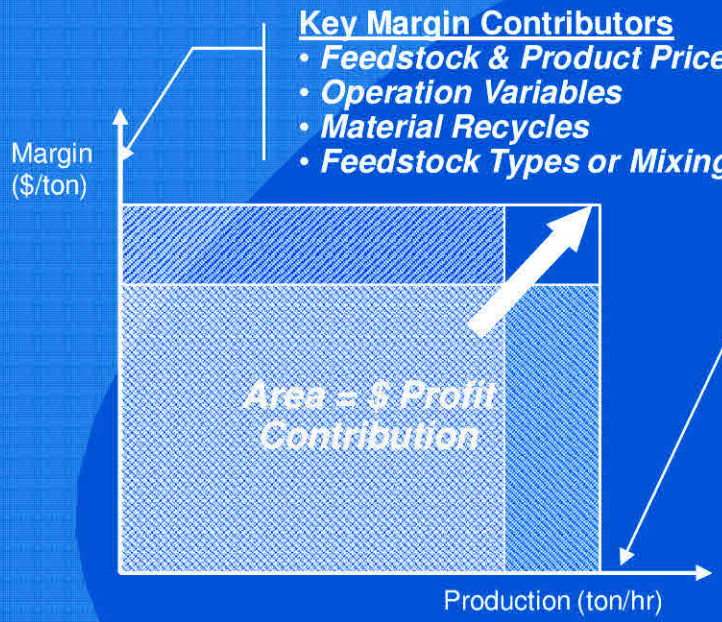
How to Maximize Margins within Manufacturing, Logistics, Working Capital and Risk Constraints with 'step-out' technology . . .



# Key Drivers

- Reduce Working Capital
  - Reduce Inventories
- Increase Profit Contribution
  - Reduce penalties (demurrage)
  - Increase margin ($/ton ethylene)
  - Increase production (ton ethylene)

# Increase Profit Contribution




**Key Production Contributors**

- *Process Constraints*
- *Down Stream Constraints*
- *Inventory / Logistics (in/out-bound)*

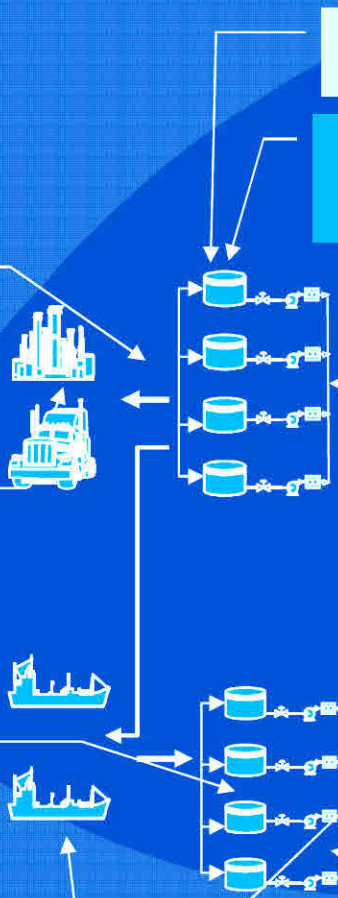
$$\text{Net Improved Profit Contribution} = \sum \left[ \text{Improvement in Margin Contribution \& Production Contribution} \right] + \text{Penalty Cost Reduction}$$

# Potential Improvement Area
# Ethylene Margin & Throughput

# Major Factors to Profitability

*Throughput Contributor*

*Margin Contributor*



*Product Prices*

High Product Inventories

*Delays in Product Selling & Shipping*

Low Internal Product Demand -> Run down constraints

*Feedstocks:*
*-Prices*
*-Compositions*
*-Blends*

*Feed Rate*

Delays in Feedstock Acquisition & Supply

*Material Balance Closure*

*Plant Design*
*Plant 1 vs. Plant 2*

*Operation Conditions:*
*COT / SOR / COP*

Furnace Bottlenecks & Availability

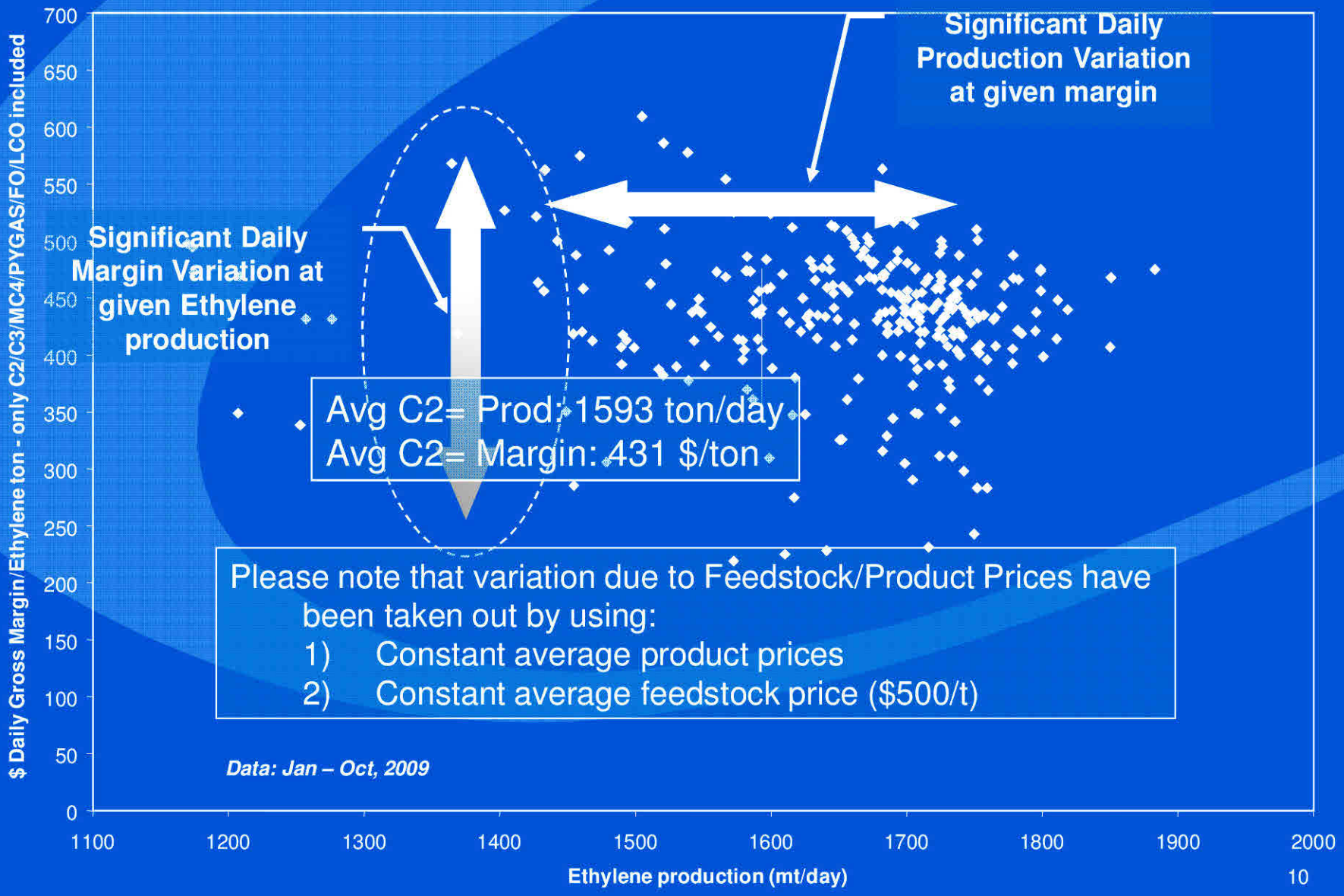
Recovery Section Bottlenecks & Plant Problems

*Furnace Loading & Level of Coking*

Low Feedstock Inventory

*Material Recycles*

# Daily Ethylene Margin & Production



# Barriers to Improvement

Many Degrees of Freedom
- Operating Conditions (x two plants)
- Feedstock types & blends (x two plants)
- When to take furnaces off-line for Decoking or Maintenance
- Alternatives for streams which can be recycled: store, sell, use as fuel gas
- Loading between Plant 1 and Plant 2 (plus inter-unit stream transfers?)
- Commercial: when, what, how much to buy and sell at what price?

Every Day is Different
- Different external constraints, feed availability, inventory situations, etc.
- Little time to analyze
- If there are too many & frequent plan changes, it may be difficult for the implementation to stay in synch

Complex Constraints & Trade-offs
- What we decide today, affects what we can do, cannot do and have to do tomorrow (eg i) taking a furnace out for decoking today, ii) if we use Feed A today, we may have only Feed B tomorrow, iii) cumulative constraints (like coking & inventories)
- Everything is integrated – cannot make an optimum plan by considering each issue/decision in isolation

Several departments involved in making and implementing decisions (Commercial, Logistics, Manufacturing, Planning)

# Simple Linear Regression Model

- **Developed simple (linear), statistical correlation of Margin as a function of all 4 variables (COT, SOR, Feed Rate & Mass balance) based on actual data:**

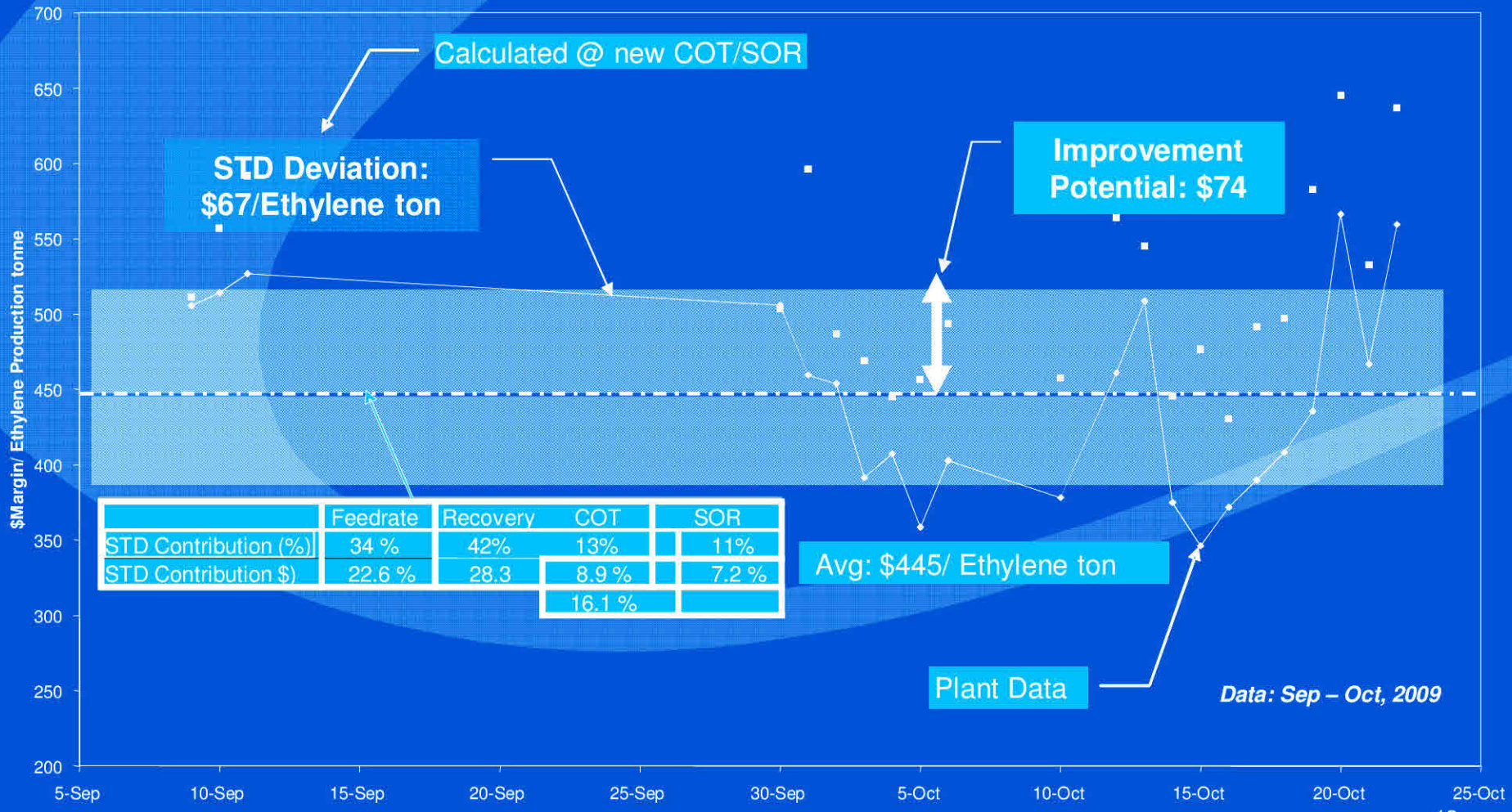
- ***Ethylene Margin = A + B * (COT) + C * (SOR) + D * (Feed Rate) + E * (Mass Balance)***

- Please Note:
  - The statistical model used for the benefits analysis is *not the same as the models in our ethylene scheduling product;* our scheduling product are rigorous (fundamental) models; they also consider all important variables;
  - We have checked and confirmed that the coefficients of the simple models used for this benefits analysis are *consistent with the trends in rigorous yield models* (ie movements are in the same direction and the size of the movements is similar)
  - As long as we stay *within the limited operating range of the data* the regression model is based on (Feedstocks & within COT/SOR range), *it has predictive capabilities*

# Potential Margin Improvement

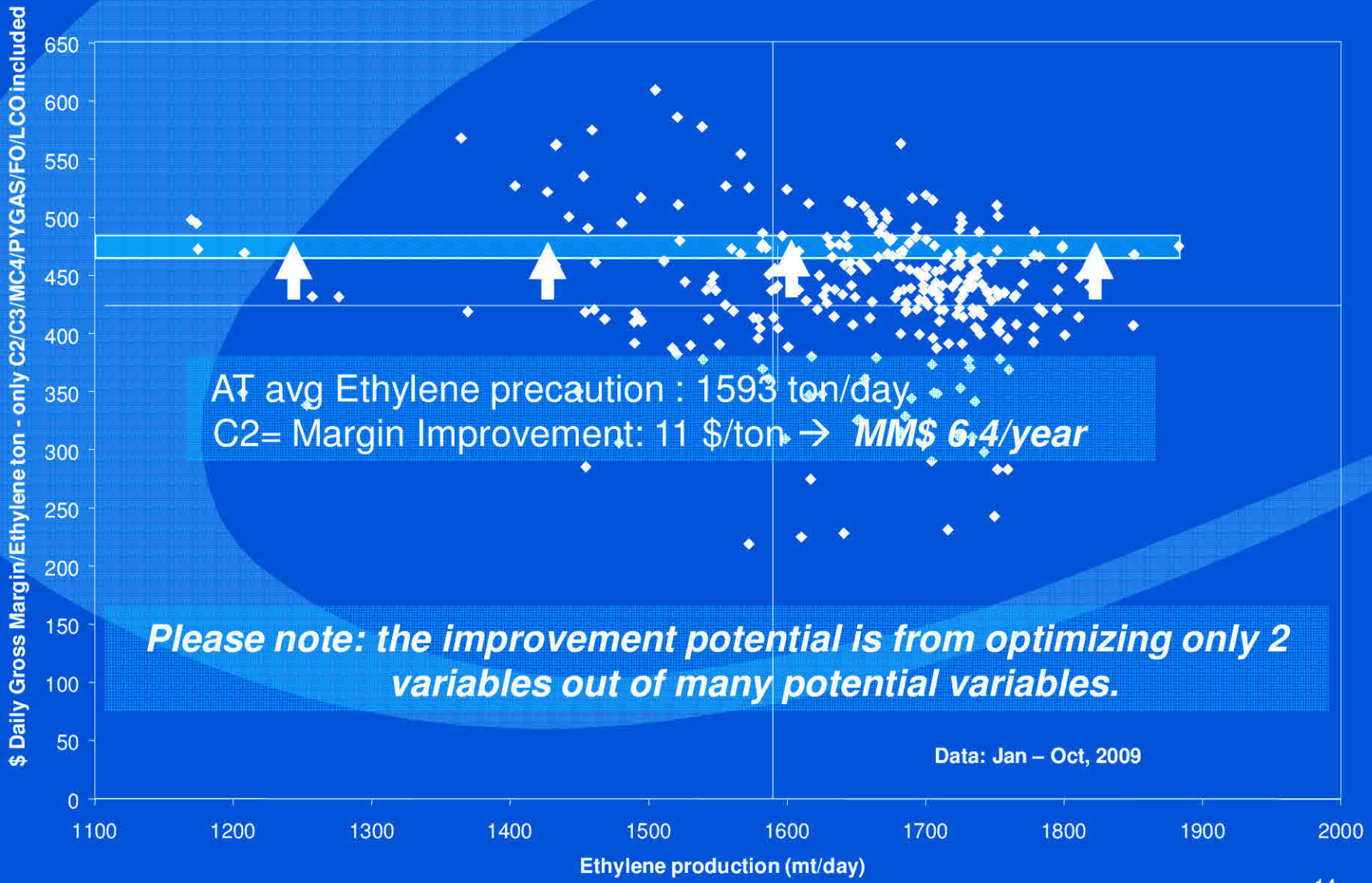
Assume the achievable can not be more than 70% of STD Deviation contribution

→ Improvement Potential = $11/Ethylene mt

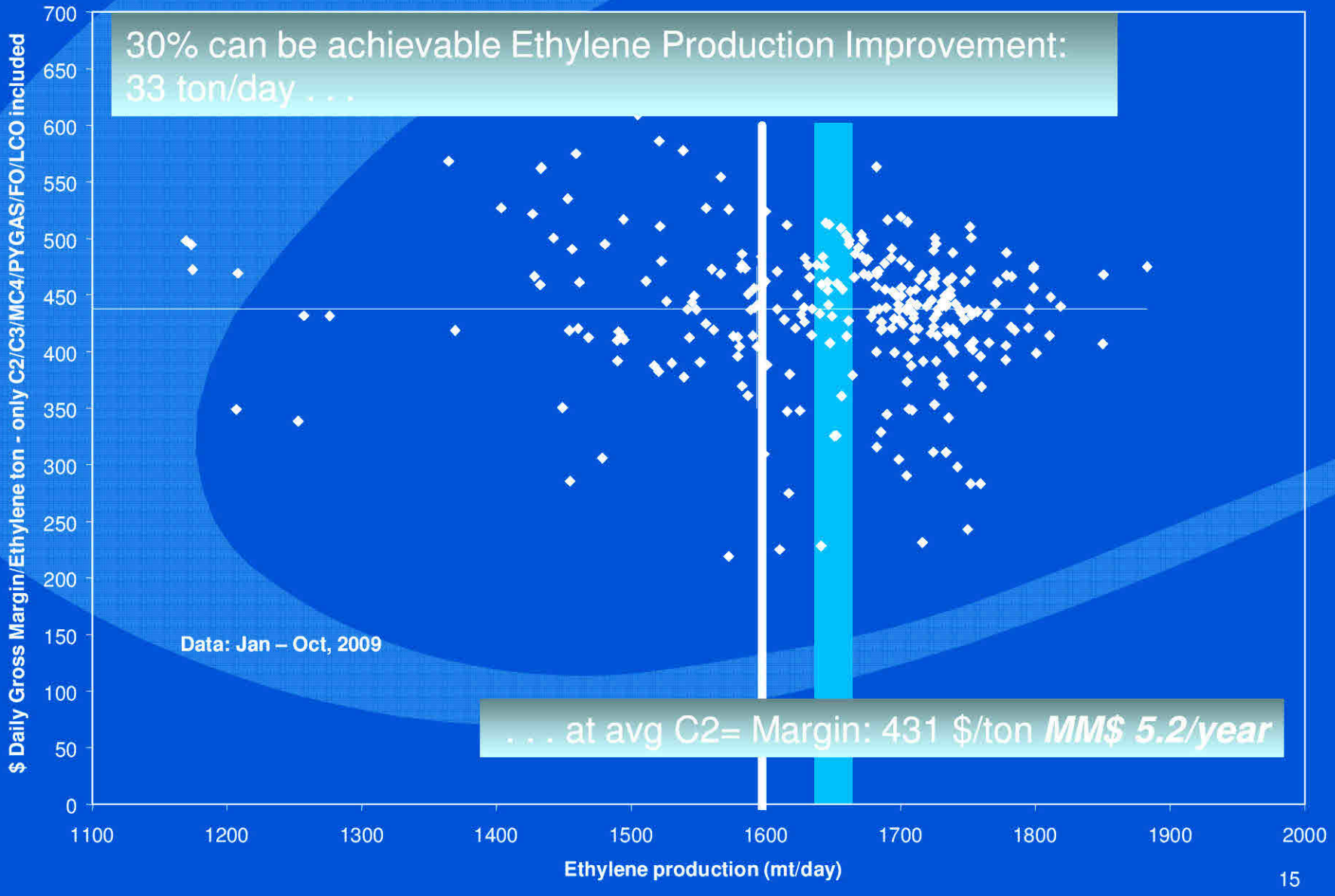



| | Feedrate | Recovery | COT | SOR |
|---|---|---|---|---|
| STD Contribution (%) | 34 % | 42% | 13% | 11% |
| STD Contribution $) | 22.6 % | 28.3 | 8.9 % | 7.2 % |
| | | | 16.1 % | |

# Extrapolating Unit Margin Benefit Potential



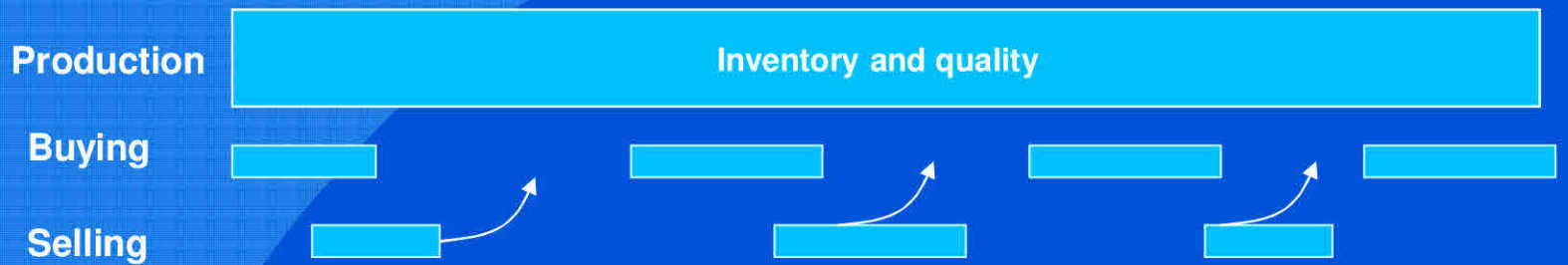
# Ethylene Production Benefit Potential



# Potential Improvement Area
# Logistics Penalty – Demurrage Cost

# Demurrage Cost

## Suggested Capability / Improvement

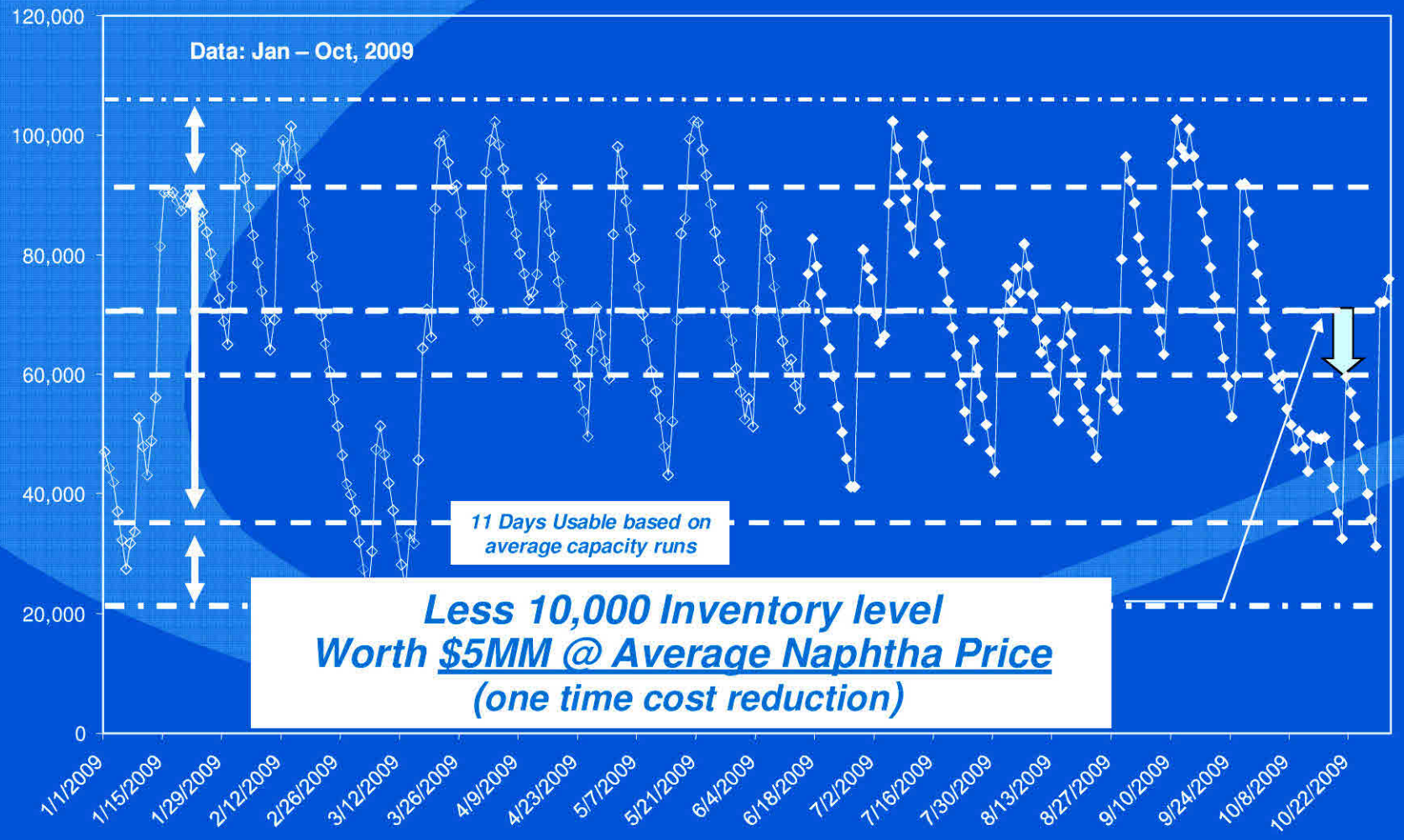



- *Suggested Capabilities*
  - Readiness and visibility of all required information (present & future)
  - Analysis of all relevant "trade-offs"
  - Communication on time showing Value / Drivers across all stakeholders.
- *Potential benefits*
  - Naptha Demurrage: avoid incidences due to C4 ($265,000/year)
  - C4 Demurrage: avoid incidences due to Naphtha and Operation ($245,000/year)
  - Total Penalty Reduction around $0.5MM/year

# Potential Improvement Area
# Feedstock Inventory

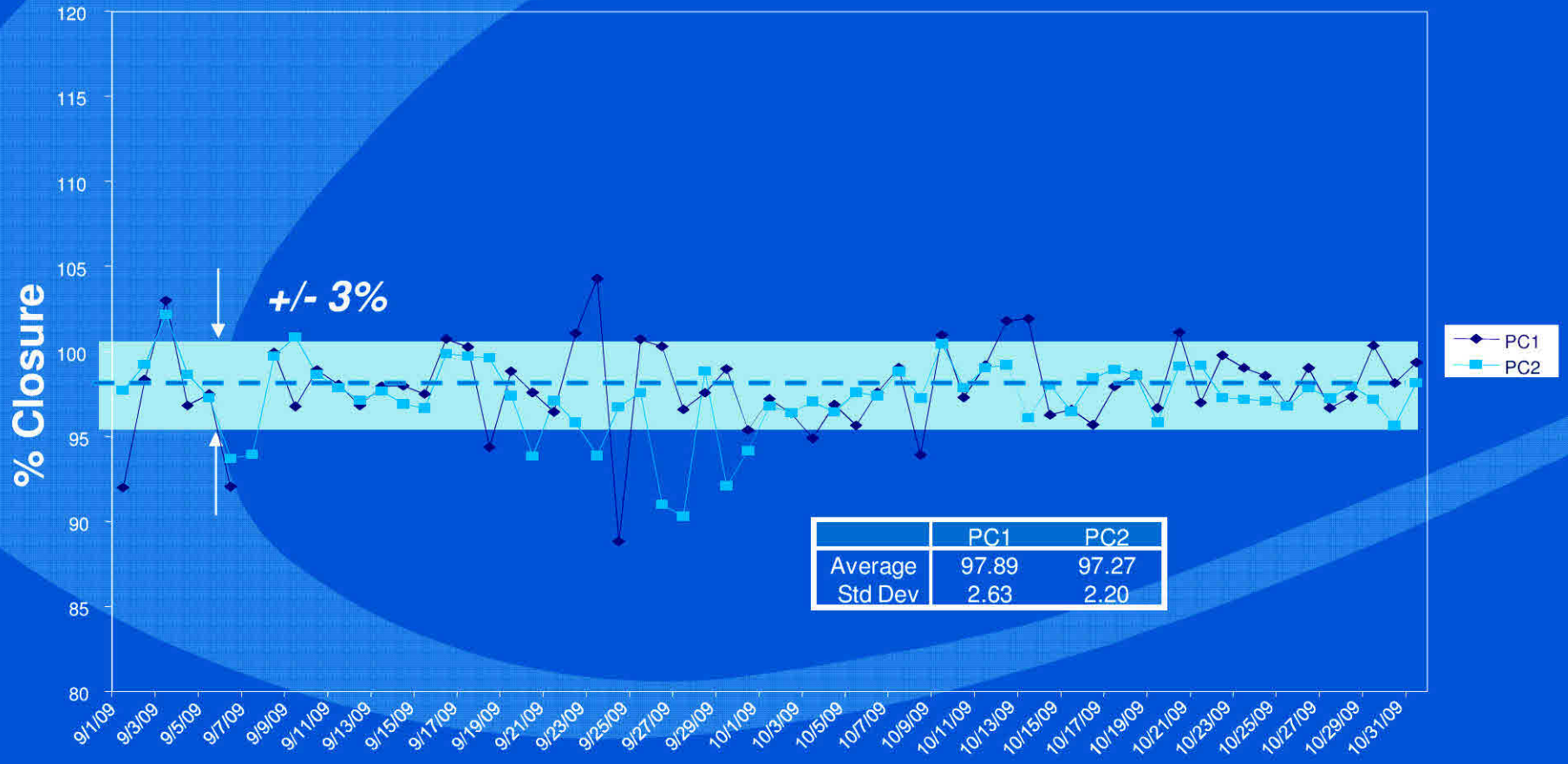
# Naphtha Inventory Management

## Naphtha Inventory



# Data Consistency

# Material Balance Closure: Data Consistency




| | PC1 | PC2 |
|---|---|---|
| Average | 97.89 | 97.27 |
| Std Dev | 2.63 | 2.20 |

*Data: Sep - Oct, 2009*

# Planning & Scheduling Improvement Potential - Summary

# Ethylene Business Optimization

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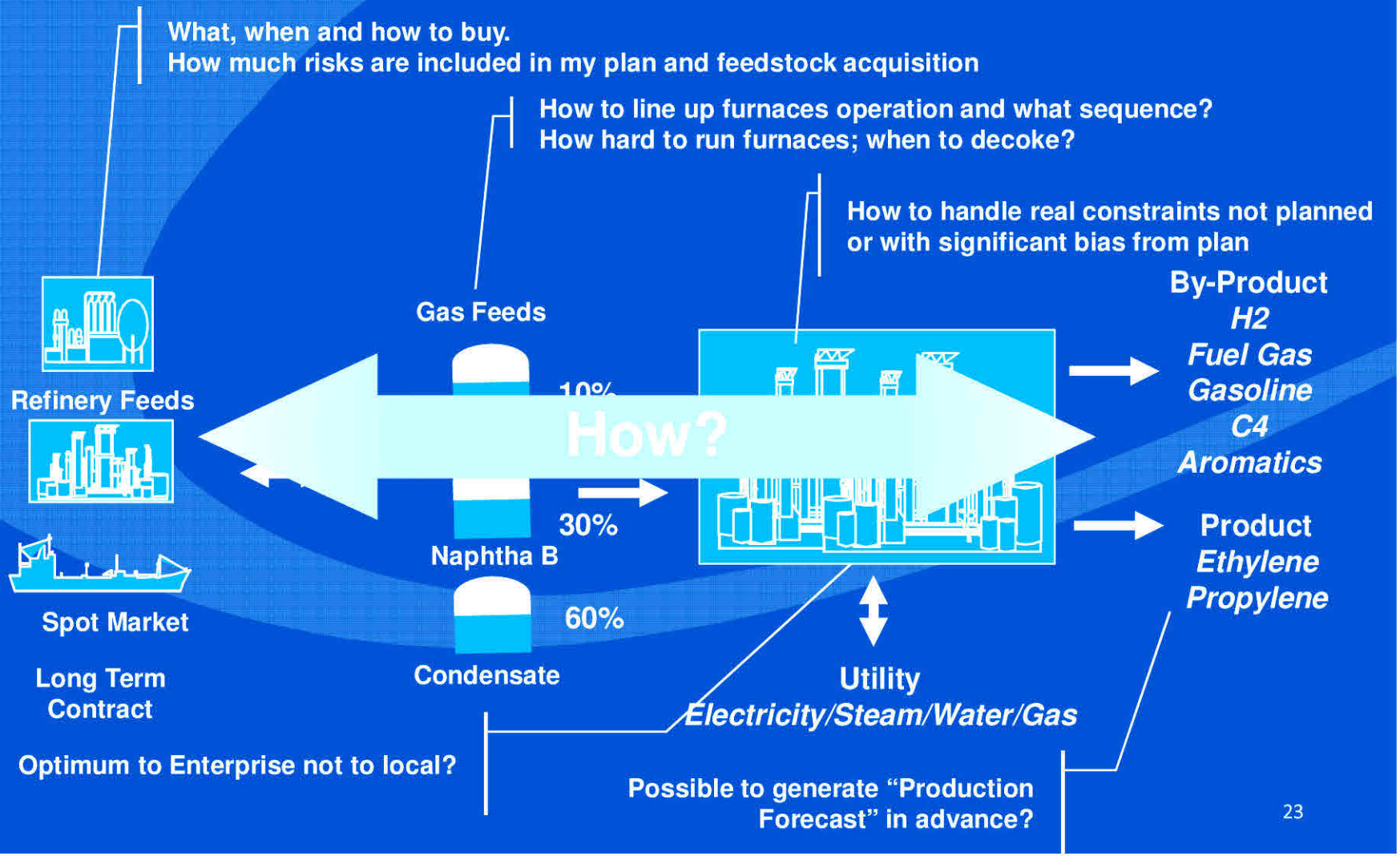
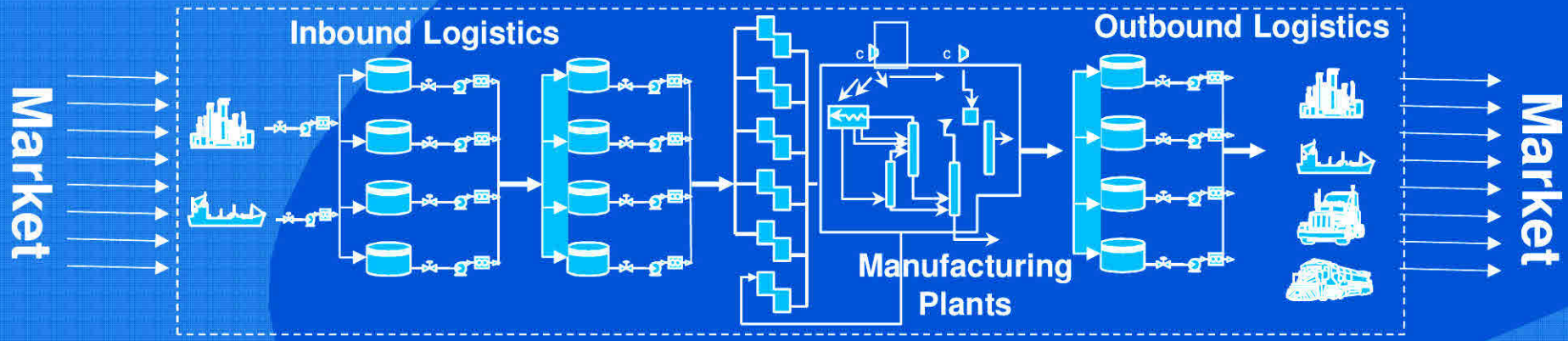


# Quaker Group's Ethylene Scheduling Solution – Ethylene Optimizer (EO)

Constraint Oriented Reasoning (COR) provides an . . .




- **Visualize in real-time all relevant data, information and plans**
- **Model accurately** the true **manufacturing complexity variability**
- **Collaboratively evaluate scenarios, optimize conflicting KPIs**.
- **Reconcile plan vs actual performance gap**
- **React quickly to changes**

. . .optimization dimension not available before now

# Summary of Improvement Potential

**Net Improved Profit Contribution**

$$= \sum \left[ \text{Improvement in Margin Contribution \& Production Contribution} \right] + \textit{Penalty Cost Reduction}$$

$$= \sum \left[ \begin{array}{c} \textit{MM\$ 6.4} \\ \textit{MM\$ 5.2} \\ \hline \textit{Total: MM\$ 11.6} \end{array} \right] + \textit{MM\$ 0.5}$$

$$= \textit{Total: MM\$ 12.1 +} + \textit{MM\$ 5 (one time cost reduction)}$$

***Please note: The Quaker Group is confident that the actual achievable potential is larger than this number if larger number of degree of freedom are taken into account***