

# Refining & Petrochemicals Integration

## *Business Drivers & Enabling Technologies*

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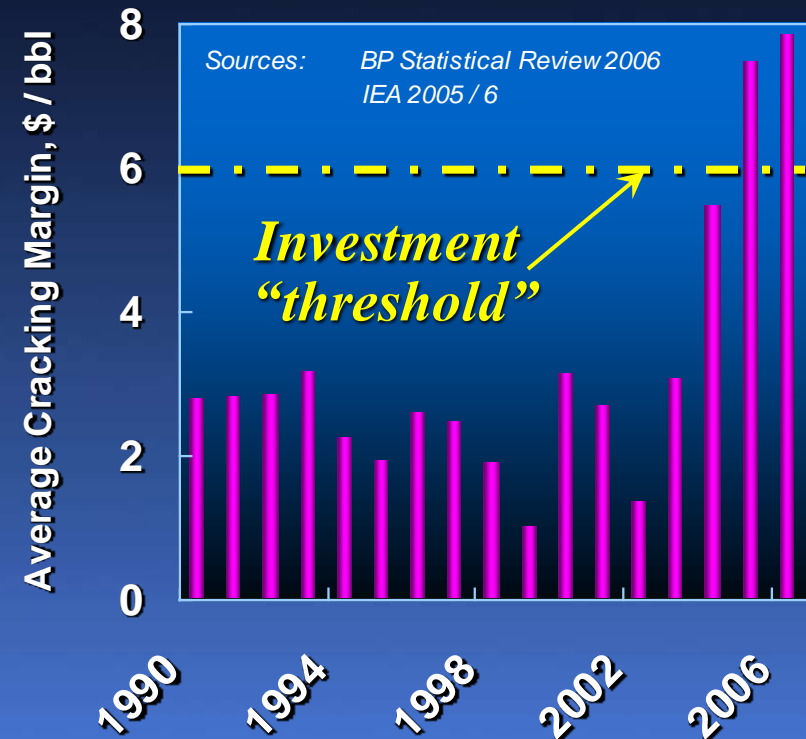
# Refining & Petrochemicals Integration

## *Business Drivers & Enabling Technologies*

- Refining & petrochemicals markets
- Investment strategies
- Enabling technologies
- Concluding remarks



# Refining Situation

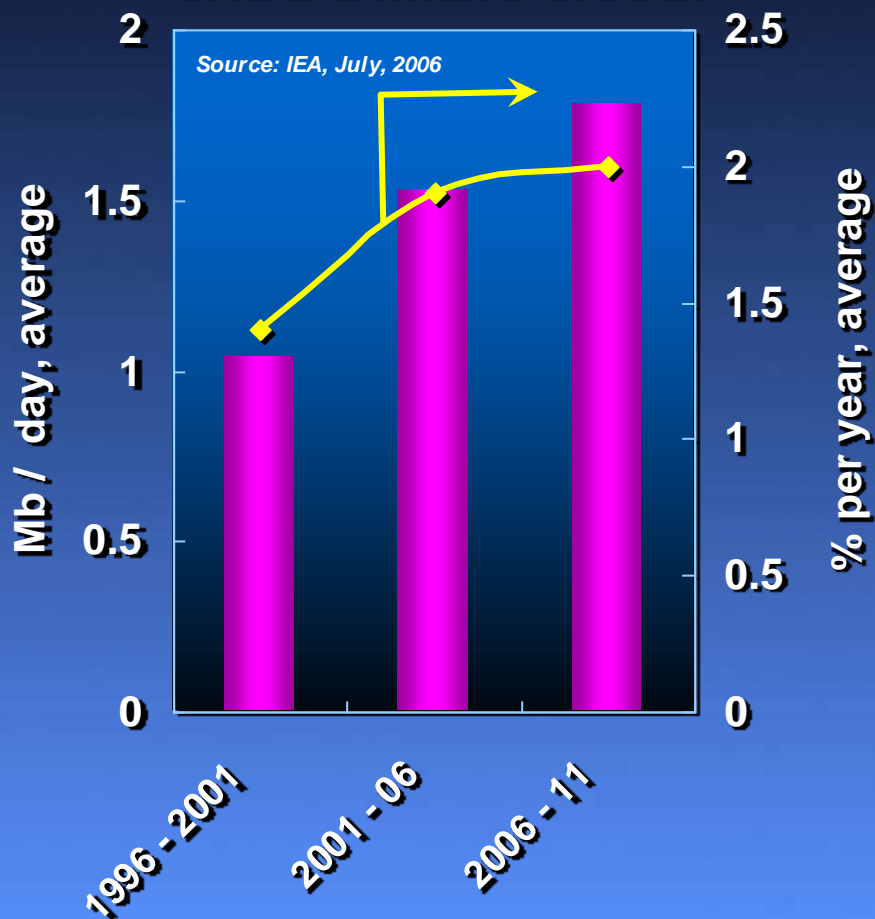


- Refining utilisation significantly higher in 2004 - 06
- Margins currently above re-investment "threshold"

***Refining investments potentially attractive***

# Refining Investment Imperative

## Global Demand Growth



- ~ 1.5 Mb / d incremental refined fuels annually
  - ~ 45% in M. East + China
  - Clean transport fuel growth
- Refining investments essential
  - Capacity
  - Conversion
  - Upgrading

**\$30 – 40  
billion  
per year**

***Substantial investments essential***



- Escalating fabrication and construction costs affecting investment returns

**New 200 kb/d  
Cracking refinery**

**\$4bn investment**

**10% Internal Rate  
of Return**

**~ \$6+/bbl average margin  
for 20+ years required**

***Investment Risk Remains Challenging***

- **Feedstock and product flexibility**
  - “Opportunity” feedstocks
  - Optimal upgrading & conversion
  - Maximize value addition
  - Prosper from cyclical markets
- **Operational efficiency**
  - Economies of scale
  - Energy
  - Control & optimization

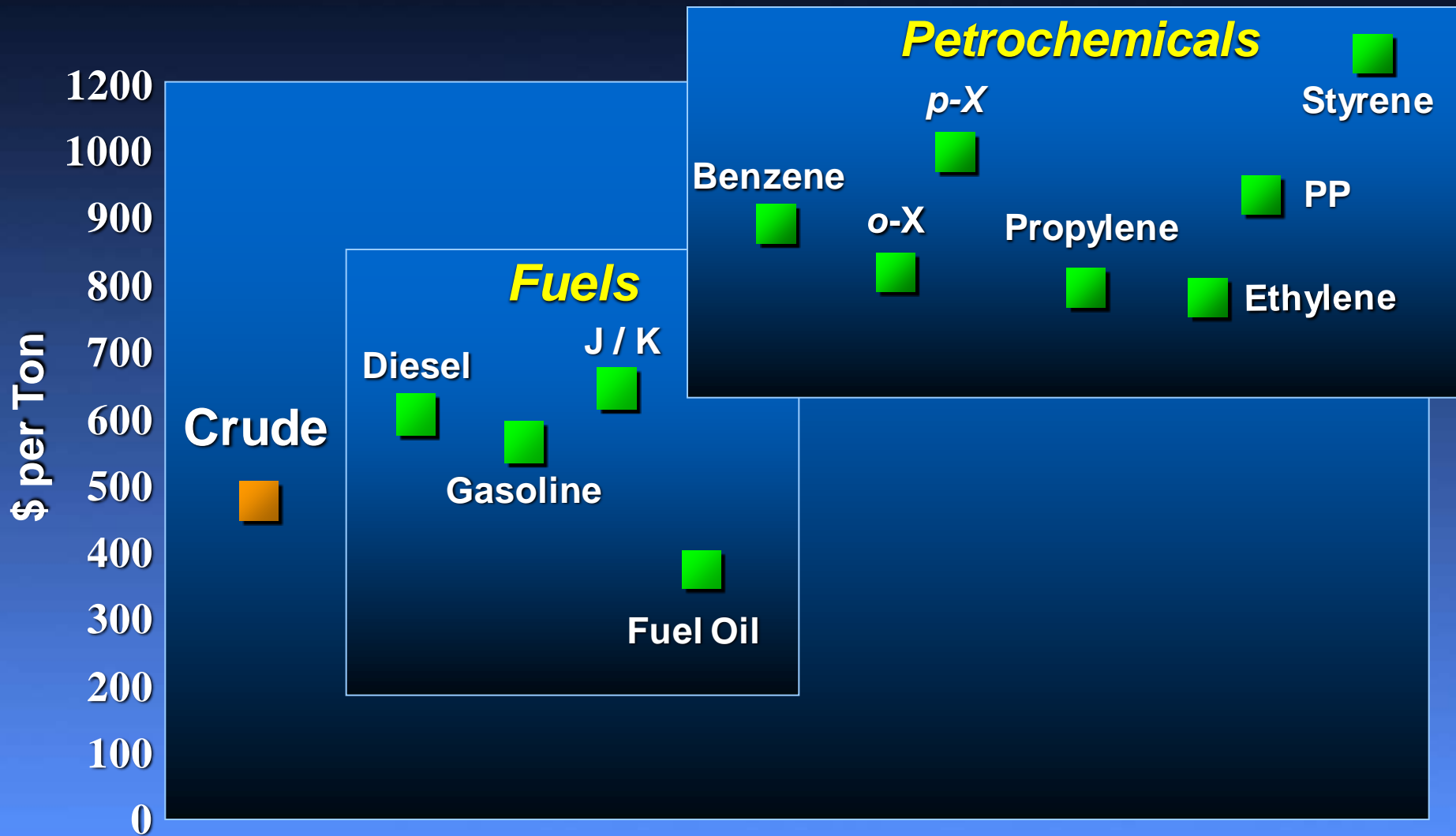
**Leading-Edge  
Technology**

***Flexibility, Efficiency, Integration***

# Advantages Of Integration

- **Integrated refinery and petrochemical operations minimize costs and optimize product distribution**
- **Optimized integration of hydrocarbon processes, energy, hydrogen, and water**
- **Feedstock flexibility to capitalize on available low cost crude oils and intermediates**
- **Supply chain optimization provides faster delivery of products**

# Adding Value to Crude



**Petrochemicals Can Add Significant Value**

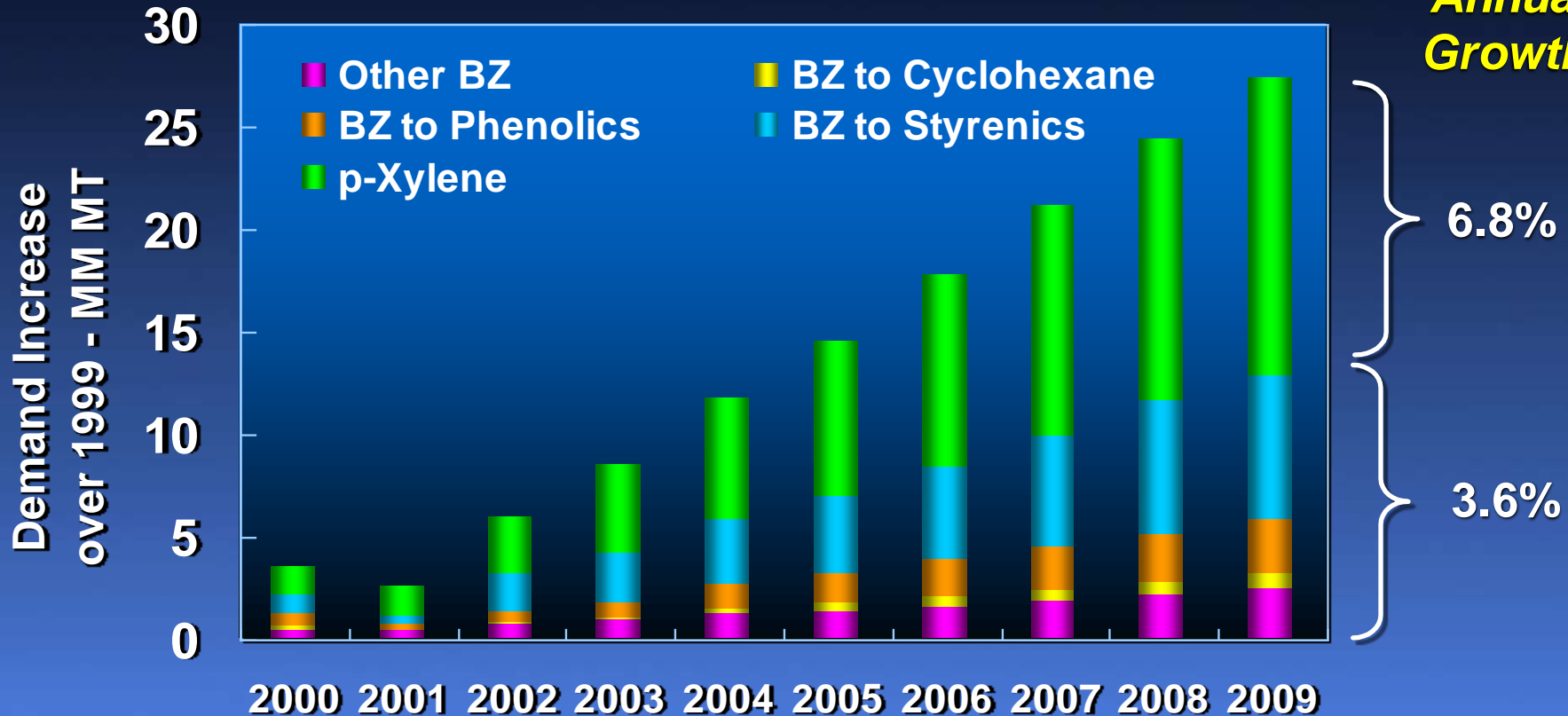


# Aromatics Markets

**Annual Growth**

6.8%

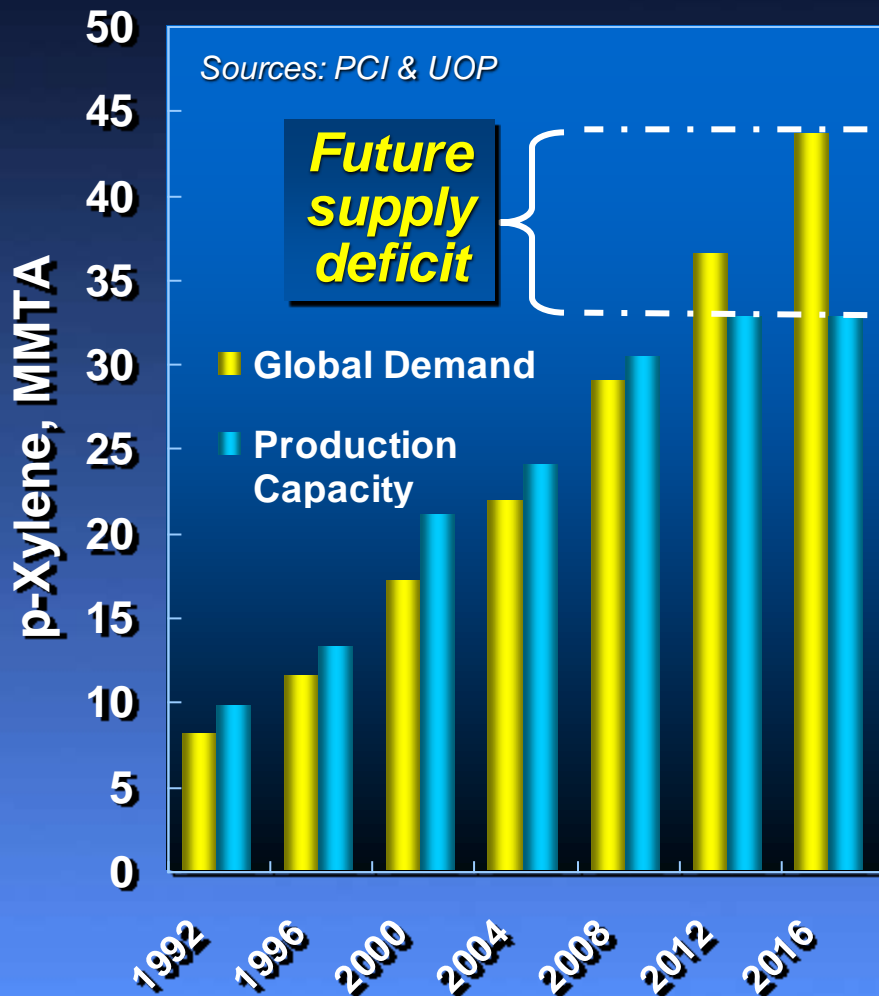
3.6%



Sources: CMAI & UOP

**Strong Aromatics & Derivatives Growth**

# p-Xylene Capacity & Demand (Committed Projects Only)

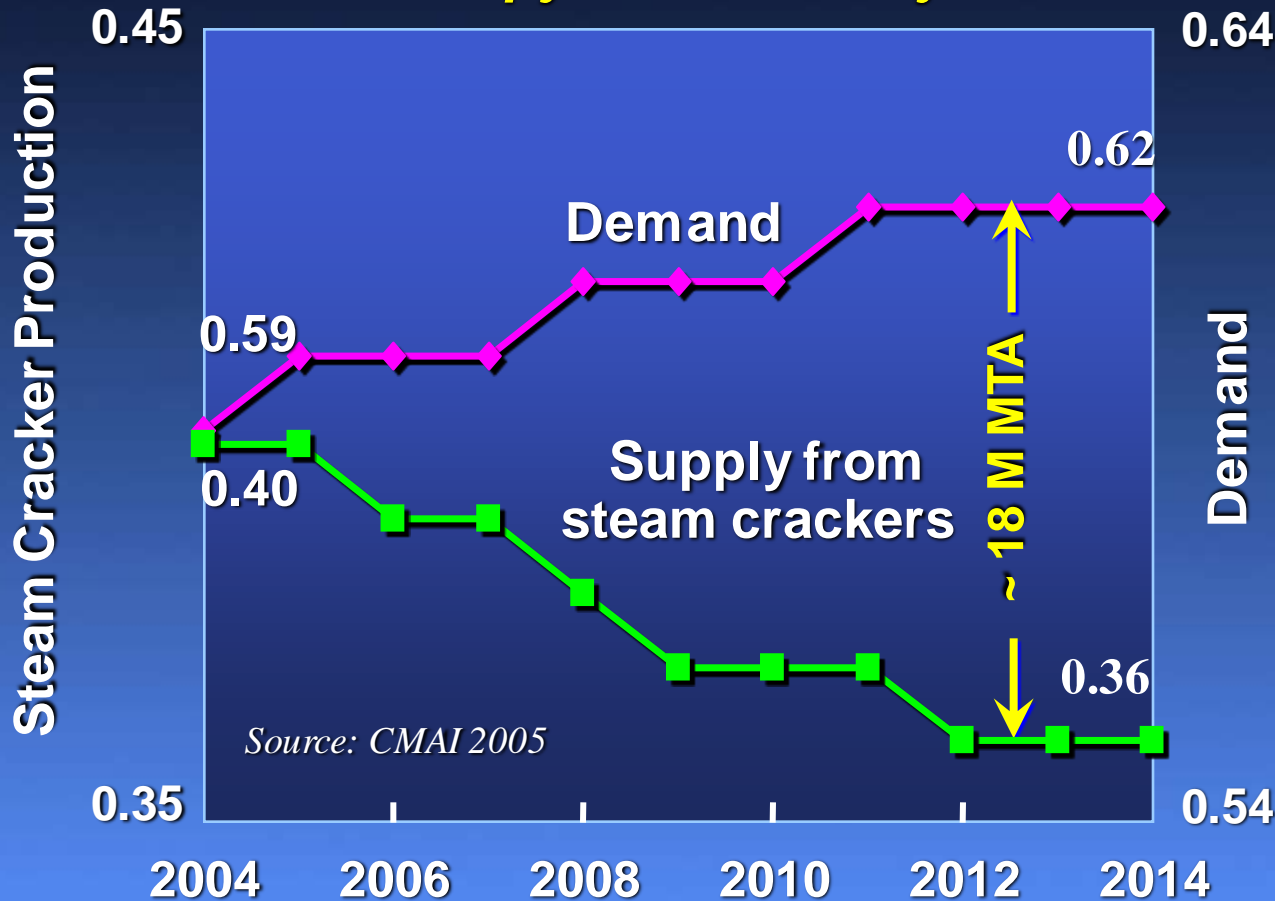


- Refineries are main source of xylenes supply
- Future p-X demand growth expected to average 1.8M MTA/Yr

**3 To 4 World Scale p-X Complexes Annually**

# Propylene Market

## MT Propylene / MT Ethylene



**Propylene demand increasing faster than supply from conventional sources**

**Growing Demand For "On-Purpose" Propylene**

# BTX & Olefins: Integration Potential

- Strong growth potential
- Attractive value addition
- Assured feedstock supply
  - Potential for low cost & “distressed” refinery intermediates
- High value return streams to refinery, e.g., hydrogen, high octane gasoline

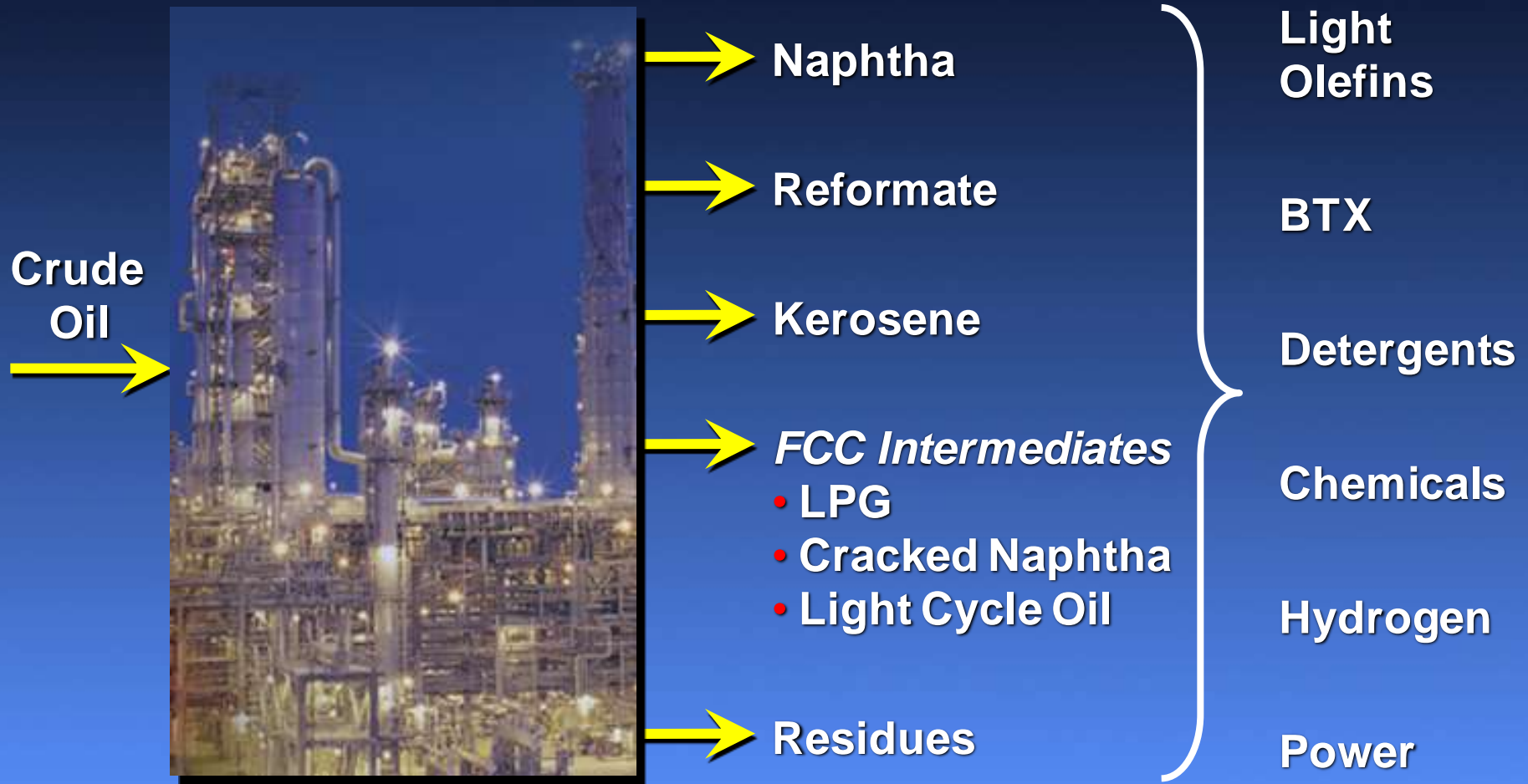
*Refining*

+

*Petrochemicals*

***Potential To Raise Returns & Mitigate Risk***

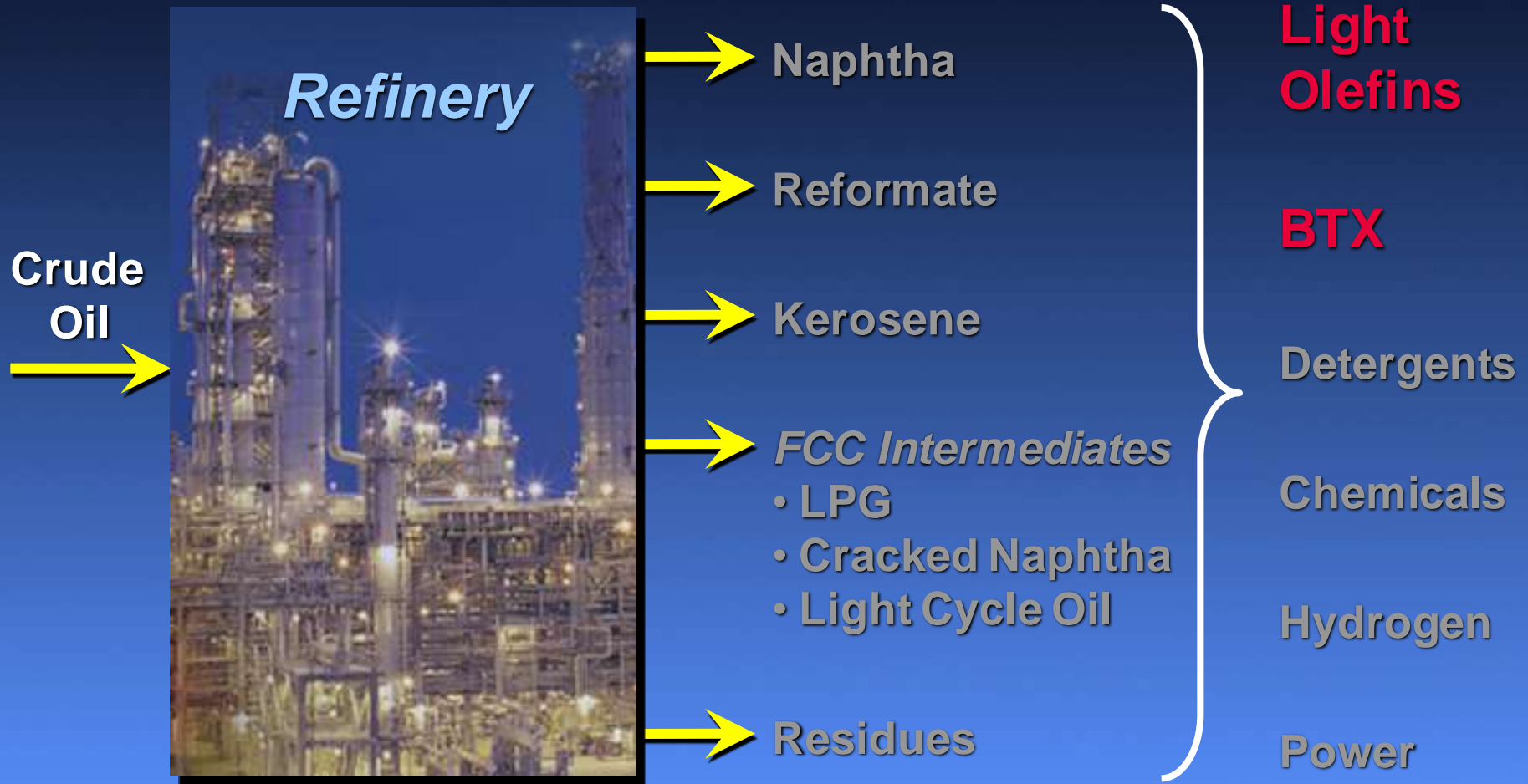
# Integration Strategies



***Technology Provides Link***

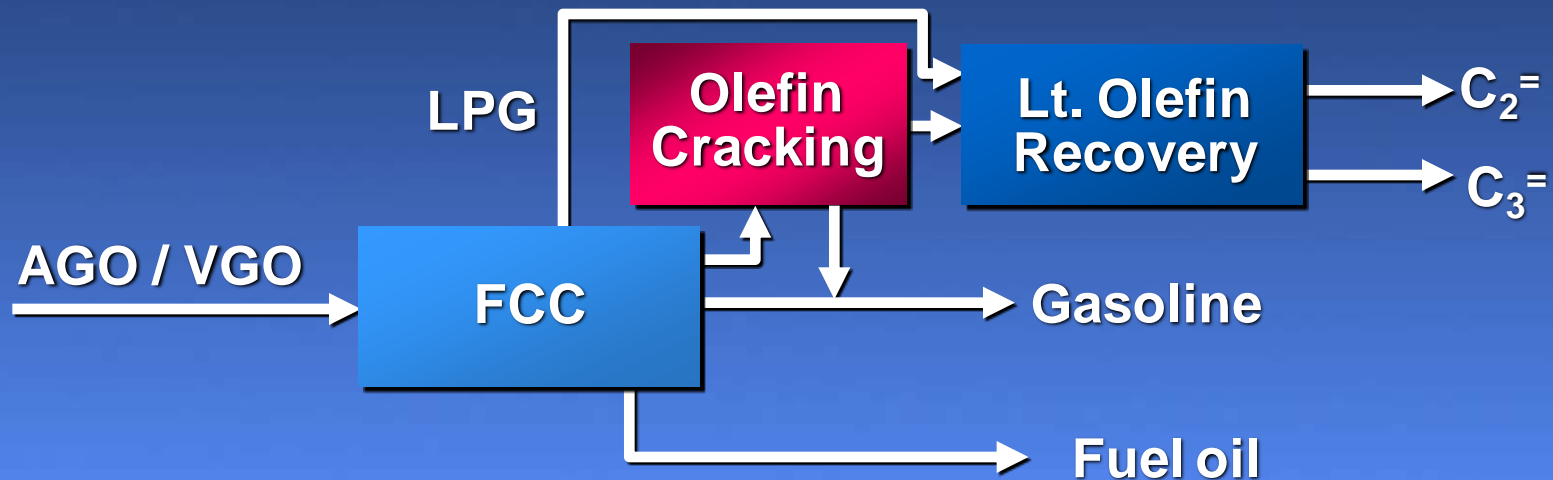
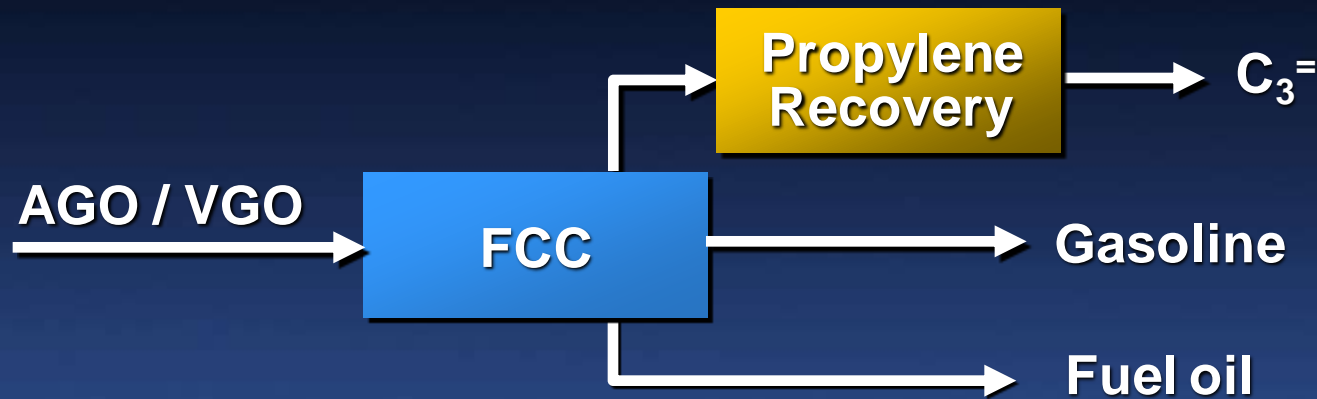


# Integration Strategies



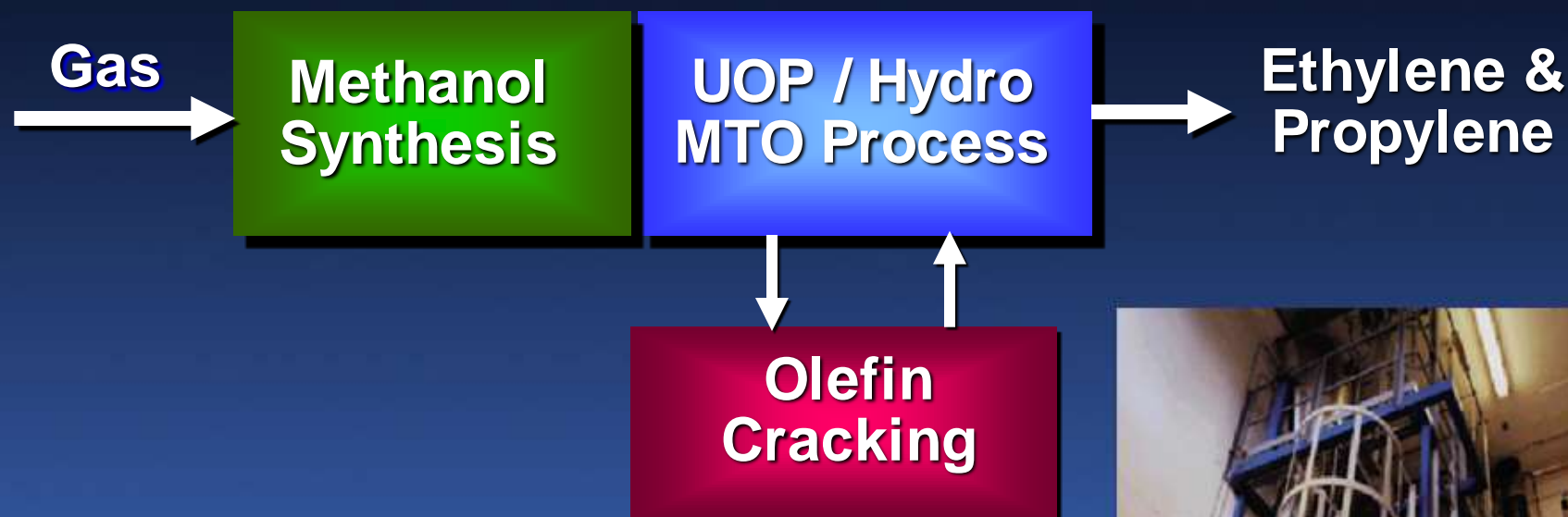
***Technology Provides Link***

# Refinery – Light Olefins Integration



*Olefin Cracking: Developed by Total Petrochemicals & UOP  
Doubles Propylene Production & Reduces C<sub>4</sub>/C<sub>5</sub> Olefins*

# Olefin Cracking Enhances Gas To Olefins



- 20% increase in light olefin yields
- Nearly 80% reduction in C<sub>4</sub>+ by-products
- 2:1 propylene/ethylene production ratio

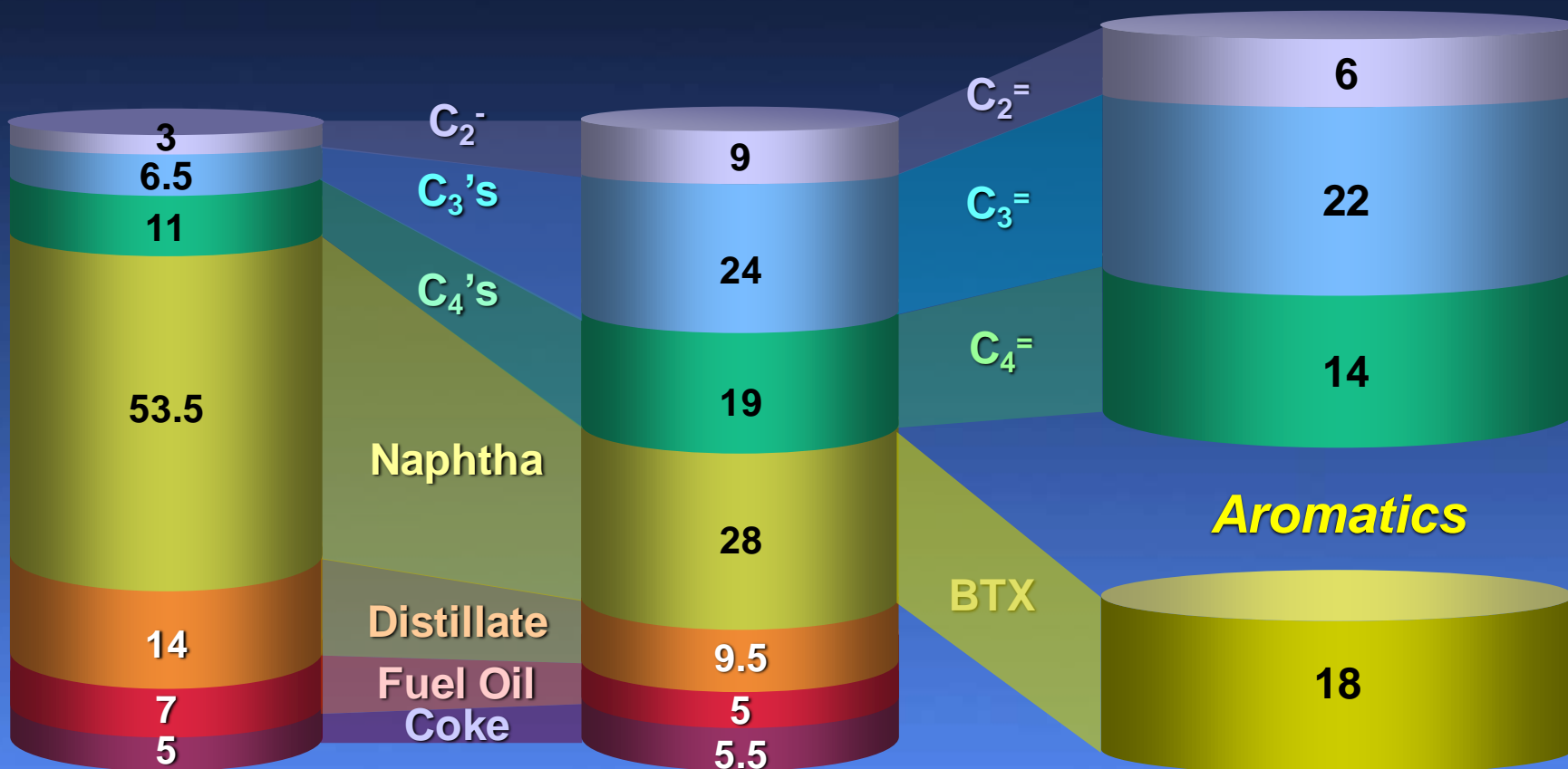


# PetroFCC™ Process: BTX + Olefins

## Traditional FCC

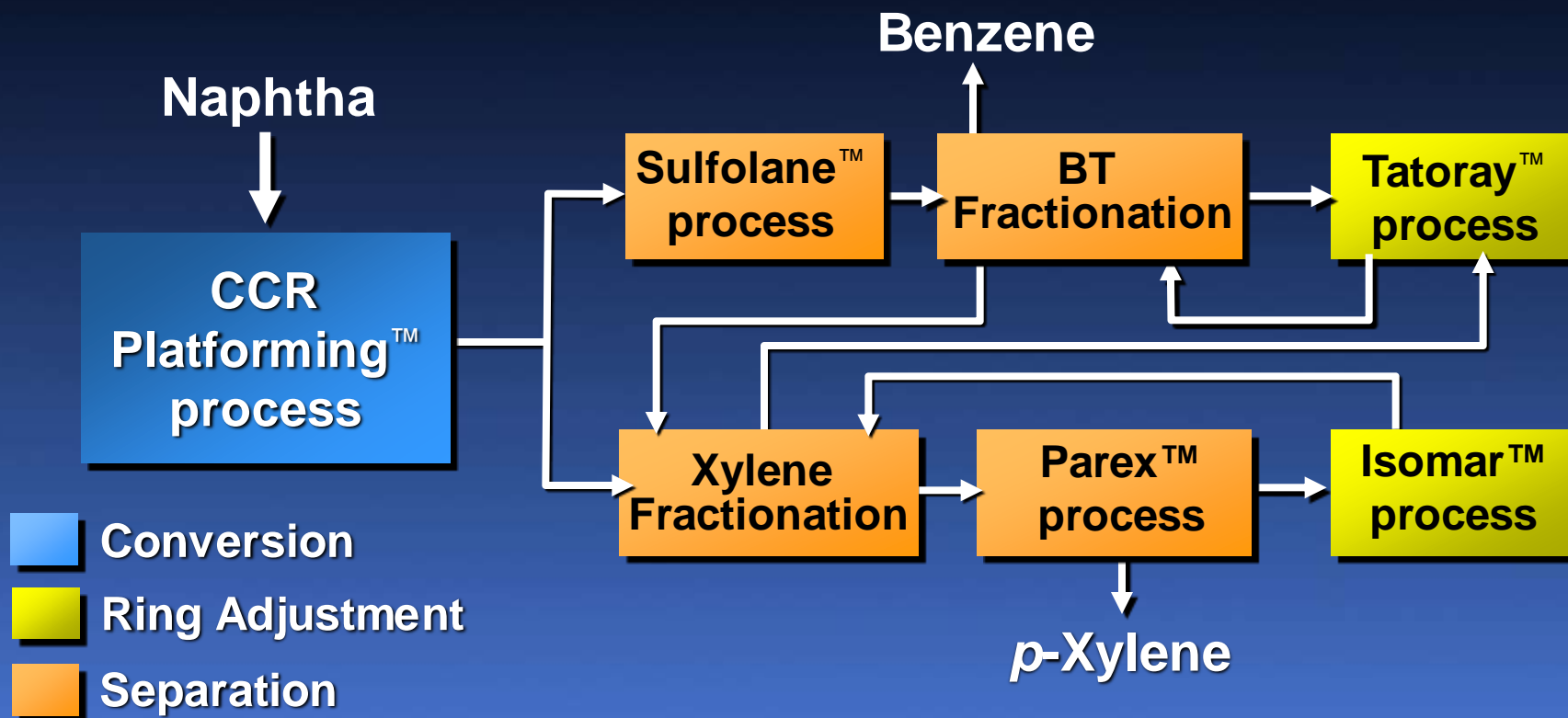
## PetroFCC Process

## Light Olefins



**The "Petrochemicals Refinery" Enabler**

# Aromatics Processing



- Proven performance track record
- State of the art technology – continuous innovation
- Cost effective designs; high on-stream efficiency

**90% of p-X capacity since 1970 uses Parex process**



# BTX Innovation: LCO-X™ Process

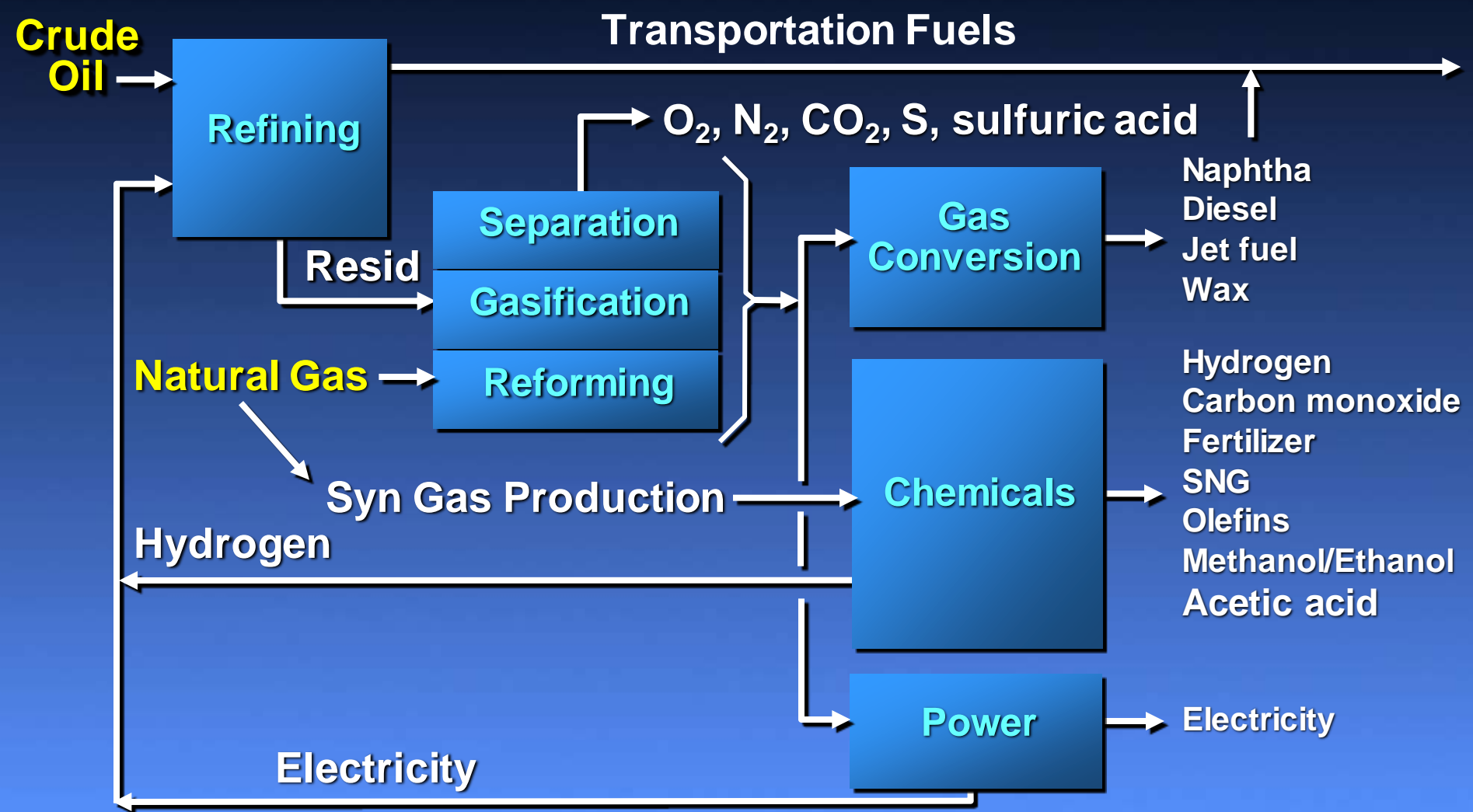
- **FCC light cycle oil (LCO)**
  - Distillate range intermediate product
  - High sulfur, high density, highly aromatic
  - Difficult to blend to clean transport fuel

*Low value as fuel blendstock*
- **High content of multi-ring aromatics**
  - Unlock benzene and xylenes

*Low cost, high value BTX feedstock*
- **LCO-X process for converting LCO to BTX recently announced**

***\$0.75/Bbl crude increase in operating margin***

# A Future Scenario



**Technology Developments Key To Deeper Integration**

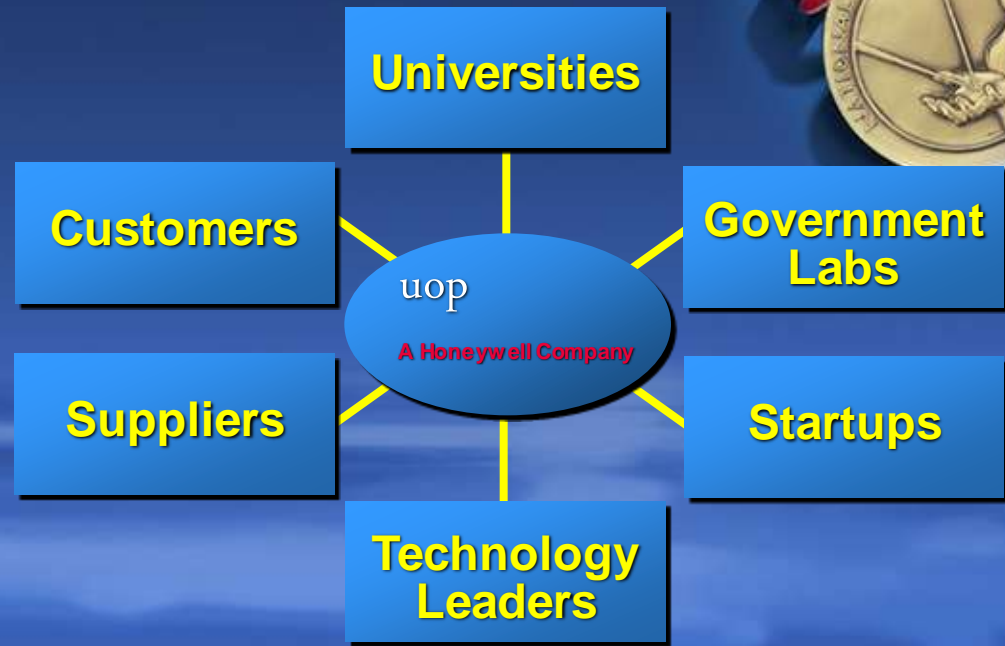
# Innovation, Research, Development

- **UOP Awarded National Medal of Technology in 2005**  
“...over 85 years of sustained technical leadership and innovation for the worldwide petroleum refining and petrochemical industries.....benefited quality of life throughout the world.”

Ref: National Medal of Technology Award to UOP, 2005



- **Broaden the knowledge base**
- **Leverage academic and industrial experts**
- **Keys to success:**
  - Collaboration / alliances
  - Commercialize



***Technology Imperative – A Key Enabler***

- **Strong growth of refining and petrochemicals markets, healthy margins**
  - Investment in additional capacity essential
- **Integrating petrochemicals with refining can mitigate investment risk**
- **Continuing technology innovation key enabler for successful integration**

***Thank You***