COMPREHENSIVE ASSESSMENT OF STEAM CRACKERS FOR ENERGY INTENSITY IMPROVEMENT

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CONTENTS

1. Motive for Improving Energy Intensity
2. Energy Assessment Scope & Methodology
3. Gap Analysis & Opportunity Identification
4. Strategy to Pursue Fuel Gas Savings
   ▪ Case studies
   ▪ Energy Saving projects
5. SABIC Sustainability Performance
MOTIVES FOR ENERGY INTENSITY IMPROVEMENTS

- Comply to Government Regulations
  - Saudi Energy Efficiency Program

- Increasing Cost Margin / Profit

- Improving Sustainability Index

- Non Availability of Fuel for Expansions
STEAM CRACKER ENERGY ASSESSMENT SCOPE

Crackers & Utilities formed Core of the Assessment in SABIC Integrated Petrochemical Complex

Measures for optimized Energy Consumption

- **Optimization** of process sequence
- **Maximization** of equipment efficiencies
- **Reduction** of dilution steam ratio
- Increased suction pressure CGC
- Increased ethane **conversion**
- Boiler feed water preheating
- Reduced min. temperature differences
- **Minimization** of pressure drops
- Optimization of **heat integration**

Comprehensive Assessment of Petrochemical Complex Provides Opportunities for Energy Saving by Integration of multiple Units
CRACKER ENERGY ASSESSMENT PROCESS

Energy Assessment Methodology

1. Understand Process Performance
   - Site Data, Process Experience & Expertise
     - Benchmark & Gap Analysis
     - Process & Utilities Review

2. Identify Process Gaps
   - Operational Gap Analysis
   - Detailed Pinch Analysis
   - Total Site Analysis
   - Yield / Energy Trade off

3. Develop & Evaluate Opportunities
   - Affiliates + Project Team
     - Project Review
     - Project Development
     - Road Map

Utility System Modelling / Process Modelling / Pinch Analysis

Evaluation Tools

50 Brainstorm Ideas
30 Screened Ideas
15 Road Map Projects

Comprehensive Assessment of Cracker & Utilities for Opportunity Identification, Development and Implementation
ENERGY GAP DISTRIBUTION FOR CRACKER PLANT

Categorization of Energy Gaps in Process would help in Focusing on Improvements in specific areas that results in High Impact
OPPORTUNITY SPREAD FOR >10 PLANTS

Investment Linked Opportunities do Exist
However very few are Economically Feasible due to low fuel cost scenario
# STEAM CRACKER ENERGY SAVING OPPORTUNITIES

<table>
<thead>
<tr>
<th>Process Optimization</th>
<th>Process Intensification</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ Fired Heater Optimization</td>
<td>❑ Anticoking Coils</td>
</tr>
<tr>
<td>❑ Steam Header Balance</td>
<td>❑ High Emissivity Coatings</td>
</tr>
<tr>
<td>❑ Cond. / Extr. Optimization</td>
<td>❑ Swirl Flow Tubes</td>
</tr>
<tr>
<td>❑ Column Targeting</td>
<td>❑ Heat Pumps</td>
</tr>
<tr>
<td>❑ Heat Integration</td>
<td></td>
</tr>
<tr>
<td>❑ Fouling Control / Mitigation</td>
<td></td>
</tr>
</tbody>
</table>

Opportunities do exist to improve energy intensity of plants, but “Is it economical considering fuel cost in oil rich economies?”
STRATEGIES TO PURSUE ENERGY SAVING OPPORTUNITIES

How to Justify Energy Savings if the Marginal Cost for Fuel Savings is low - 1.75 $/MMBTU?

- What’s really Impacted
- What process are affected if there is low Fuel
- What can I do if I get some additional Fuel
- Improving Sustainability helps in Improving Brand Value

Redefining Marginal Fuel Cost will Improve Investment linked Energy Saving Opportunity
REDEFINING MARGINAL FUEL COST: RECOVERY OF VALUABLE COMPONENTS FROM FUEL

- Fuel Grid Integration with adjacent refineries / chemical plants
- Export / Recovery of High Value Chemicals e.g., H₂ / Propane
- Every Kj of energy saved in cracker is evaluated against additional revenue by either selling H₂ to refineries or recovering valuable paraffin's from offgas

**CASE 1: Export of H₂ from Fuel Stream**

- Cracker
- Fuel Gas (Methane)
- Propane (Makeup Fuel, equivalent to H₂)
- Refinery

**Case 2: Recovery of Paraffin's**

- Plant ‘X’
- Site Boilers
- Cracker

**Energy Saved ➔ Reduced Import of Expensive Fuel**

**Energy Saved ➔ Recovery of Valuable Chemicals (H₂)**
OPERATION FLEXIBILITY (EXAMPLE CRACKER OPERATION)

**Low Fuel**
- Adhering to quota will require Cracker to increase cracking severity
- Increasing severity decreases the selectivity to HVC
- This has negative impact on plant economics

**Additional Fuel**
- Any Fuel gas saved provides opportunity to operate cracker at desired severity (high HVC)
- Operating at lower conversion
- Fuel gas saved → Marginal cost of additional HVC produced

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Energy Saved → Improving Operation Flexibility → Prod. of High Value Chemicals
INCREASING CATALYST SELECTIVITY

- Current Catalyst has low selectivity, part of feed is burnt and the energy is converted to Steam. Steam thus produced is used in the process elsewhere.

- High selective catalyst provides better production & minimizes reactant requirement.

- Steam Savings in other parts of the complex provides an opportunity to implement high selective catalyst.

**Energy Saved → Opportunity for High Selective Catalyst**
**Low reactant consumption → Higher Productivity**

*Enhancements in EO/EG Manufacturing technology White paper*
OPTIMIZATION OF FIRED HEATERS

- Gross Energy Consumption ~ 97%
- Net Energy Consumption ~ 45%

**SABIC Experience**
- More than 150+ High Capacity Fired heaters
- Furnaces from all ages, 1980s to 2010s
- Thermal Efficiency: 88% - 94%

**Old Furnace**
- Stack O2
- Stack Temp.
- Casing Losses
- Burner Maintenance

**New Furnace**
- Stack O2

Comprehensive assessment helps in identifying specific issues, developing tailor fit solutions for increasing throughput & decreasing energy intensity.
SHAFT WORK OPTIMIZATION

Shaft Work, often overlooked, provides the largest Opportunity for Energy Saving in New and Old petrochemical Complex
HEAT INTEGRATION OPPORTUNITIES IN OLEFINS

Modern day Plants are heat integrated within their ISBL. Opportunities arises by integrating with adjoining plants.

Typical Pinch Opportunities

- Rerouting Stream
- Addition of New exchangers
- Increasing Area in Existing exchangers
- Replacing MPS with LPS
- Shift cryogenic utility levels from C2R to C3R

All Heat Integration opportunities needs investments & have low impact. Most of these are economically infeasible due to low Fuel Cost
SUSTAINABILITY STRATEGY

- Corporate Sustainability KPI’s
- Special Sr. Management sponsored programs in every affiliates /subsidiaries
- Continuous monitoring and reporting system to ensuring sustaining the benefits

SABIC Sustainability Targets

2010
Base Year

25%

2025
Assessment Year

Energy Saved = Achieving SABIC’s Sustainability Goals (KPI’s)
Improving Brand Value; Meeting Regulatory Targets ; Social Responsibilities
**SABIC SUSTAINABILITY PERFORMANCE 2017**

**OPERATIONAL KPI PERFORMANCE**

- **9.3%** \(\downarrow\) GHG EMISSIONS INTENSITY
- **7.6%** \(\downarrow\) ENERGY INTENSITY
- **8.8%** \(\downarrow\) WATER INTENSITY
- **35.2%** \(\downarrow\) MATERIAL-LOSS INTENSITY
- **43%** \(\downarrow\) REDUCTION IN FLARING EMISSIONS\(^{(1)}\)
- **3.5 mmt** \(\downarrow\) TOTAL CURRENT CO\(_2\) UTILIZATION