Global Refining Perspectives

Capacity Outlook
Demand/Utilization
Valuation

Prepared for

November 2017
Introduction: Aegis Energy Advisors Corp.

A BOUTIQUE ENERGY INVESTMENT BANK PROVIDING STRATEGIC ADVISORY SERVICES TO THE REFINING SEGMENT OF THE ENERGY INDUSTRY

- Established in 1994 and headquartered in New York City
- Founder & president has more than 40 years advising on strategy and M&A
  - Former managing director and head of the energy mergers and acquisitions practice at First Boston (1985 to 1991) and head of the global energy group at Salomon Brothers (1991 to 1994)
  - Key executive managers with extensive commercial and engineering experience
- Focused on the formulation and implementation of strategies and transactions enabling our clients to maximize value
  - Valuations
  - Acquisitions
  - Mergers
  - Divestitures
- Conceived to combine the transactions experience and capabilities of a traditional investment bank with the technical, analytical and commercial expertise of an energy industry consultant

Strategic & Financial

Commercial

Operational

THE INTERSECTION OF INSIGHTS REQUIRED TO RESPOND TO STRATEGIC ISSUES IN THE 21ST CENTURY

Aegis Energy Advisors, November 2017
Discussion Topics

- **Anticipated Refining Capacity Additions**
  - How much capacity is expected to be added where and by whom?
  - How reliable are these estimates?

- **Demand/Utilization**
  - What is the expected profile of future refined product demand?
  - How will that demand translate into utilization of the available refining infrastructure to meet that demand?

- **Valuation**
  - What determines the value of a refinery in an M&A transaction?
Projected Refinery Capacity Additions
World Refining Capacity Additions – All Projects, Net: 1990 – 2022E

- Determining global refining capacity additions
  - Inconsistent reporting
  - Much information anecdotal
  - Not all projects are credible
- Data must be compiled and risk-adjusted

World Refining Capacity Additions - All Projects, Net

- Capacity Additions: 2017 to 2022
- Number of projects: 243
- Announced additions: 25.4 mmbpd
- Risk-adjusted additions: 7.9 mmbpd

Projections: Projected ALL PROJECTS, NET OF CLOSURES Additions from Aegis Refining Database

Historical: Actual Net Capacity Additions from BP Statistical Review of World Energy – 2017

Additions Are Not Spread Equally Across the Globe

- Very little new capacity expected in the OEDC
- Net closures shown for 2017 largely due to planned closures of CDUs in Japan to comply with government mandates to raise the complexity of the country’s refining infrastructure

The vast majority of capacity additions are expected in the non-OECD
- Principally China, India and the Middle East

Wide difference between announced capacity and risk adjusted capacity
World Refining Capacity Additions: 2017E – 2022E

- 243 Refinery Projects at various all stages of development (grassroots, expansions, upgrades)
  - Aegis estimates “Unrisked Refining Capacity Additions”: Net ~25.4 mmbpd

- Vs. IEA’s projects
  - Difference between projects in common due mainly to timing
  - The remaining difference is in the projects which Aegis tracts that do not appear in the IEA’s database
  - No apparent risk adjusting by the IEA other than by projects selected for inclusion

- 900 mm bpd net difference in capacity estimates

ALL PROJECTS (ALL PHASES): 2017 - 2022

<table>
<thead>
<tr>
<th></th>
<th>Aegis Energy (in common with IEA)</th>
<th>Aegis Energy (only)</th>
<th>SubTotal - Aegis Energy</th>
<th>IEA</th>
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Reference: Aegis Energy Advisors (10.30.17), Company Reports, IEA 2017 MTOMR

- Only 49 Refinery Projects (20% of All Projects) are in the Construction & Completion stage
  - Aegis estimates “Unrisked (announced) Refining Capacity Additions”: Gross ~4.6 mmbpd, Net ~3.6 mmbpd
  - Aegis estimates “Risk-Adjusted Refining Capacity Additions”: Gross ~4.1 mmbpd, Net ~3.1 mmbpd

- Vs. IEA’s 27 projects in the same category
  - Projects in common almost identical in terms of risked and unrisked capacity
    - Most capacity coming on stream within two years, so project risking is low
  - Main difference is in projects in Aegis database that are not in the IEA’s
    - An additional mmpbd of capacity

### CONSTRUCTION & COMPLETIONS: 2017 - 2022

<table>
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<tr>
<th>Capacity (mbpd)</th>
<th>Total Projects</th>
<th>Announced Capacity</th>
<th>Risk-Adjusted Capacity</th>
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</table>

Reference: Aegis Energy Advisors (10.30.17), Company Reports, IEA 2017 MTOMR
World Refining Capacity Additions – Announced: 2017E – 2022E

- Majority of capacity currently under construction is scheduled to come on stream in the next three years
  - Much of the capacity scheduled for completion in 2017 is already on stream
- Closures reflect announced closures only
  - Majority of closures in 2017 in Japan in response to a government mandate
  - Much of the remainder are shut-downs in connection with replacement capacity

World Refining Capacity Additions – Builds versus Closures, Announced

- Risk adjusting significantly reduces total additions
- Risking does not change the amount of capacity under construction so much as the timing of its completion
- Risking changes closures only to the extent the companion projects are risked

Risk Adjusting

- Because so much evidence is anecdotal, project announcements and subsequent reporting are subject to interpretation
  - Recognized international media sources are generally more reliable than local media that may be subject to local political or other influences
  - Reporters are not engineers and may not always understand what they are being told

- Two levels of adjustment
  - Engineering stage
    - Pre-FEED – conceptualization and feasibility studies
    - FEED – front-end engineering and preparation of FID
    - EPC – engineering, procurement and construction design
    - Construction – physical construction activities
      - Excludes “groundbreaking” ceremonies, which may be more symbolic than real
    - Completion – start-up and commissioning
    - Cancel – highly unlikely to proceed or be funded
  - Broader, qualitative measures
    - Ownership / sponsorship
      - Location / Free market economy
      - Credit ratings
      - Refining experience
      - Overall credibility
    - Project specifics
      - Grassroots or expansion
      - Relative project costs
      - Financing

- Risk adjusting might change the timing of a project, the probability-adjusted capacity or both
**Risk Adjusting Example: Project Cost Estimates**

- **Project cost estimates can vary considerably**
  - If a project’s cost is unrealistically low, the project is likely to be canceled when the “real” cost is discovered (usually at FEED)
  - If too high, unlikely project will proceed as it will be uneconomic to build (IRR too low)

- **Expansion exception**
  - Expansions are often part of a broader upgrade, in which case the project’s cost may appear unrealistically high relative to the associated increase in capacity

![Average Project Cost / Announced Planned Capacity (US$ / bpd)](chart)

Reference: Aegis Energy Advisors (10.30.17)
Risk Adjusting: A Tale of Five Projects

- Results of risk adjusting for five separate projects
  - Geographically diverse
  - At various stages of completion
  - All to be completed in the next five years
  - With sponsorship of varying degrees of credibility

- 1.9 mmbpd of unrisked capacity vs. 1.0 mmbpd of risked capacity

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<td>2017</td>
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<td>30%</td>
<td>9%</td>
<td>-</td>
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Total | 1,865 | 960 |
SOCAR’s STAR Aegean Refinery

04 October 2017: Azernews - The construction of the Star oil refinery of the Azerbaijani state oil company SOCAR, the largest project finance transaction in Turkey, is completed by 95 percent.

- Long timeframe to complete; delays due mostly to efforts to arrange acceptable financing

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Aegis Energy Advisors, November 2017
Kuwait National Petroleum Co.’s Al-Zour Refinery

- A new 618 mbpd refinery, Al-Zour to replace an aging 200 mbpd facility, Al-Shuaiba
- Originally initiated in 2006 but cancelled in 2007 upon initial cost estimate
- Project deferred and reactivated several times over ten years due to costs and political controversy
- Reapproved in 2014
- Today construction has recently begun

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<td>2017</td>
<td>Closure</td>
<td>100%</td>
<td>100%</td>
<td>(200)</td>
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Aegis Energy Advisors, November 2017
Zhejiang Petrochemical’s Zhoushan, China Refinery

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<td>2016</td>
<td>2017?</td>
<td>2021</td>
<td>2022</td>
<td>Construction</td>
<td>90%</td>
</tr>
</tbody>
</table>

JULY 10, 2017: BEIJING (Reuters) - Zhejiang Petrochemical started construction on Monday of the first phase of its oil refining and petrochemical complex on the island of Zhoushan, near Shanghai, in Zhejiang province...

14 September 2016 ICIS News: SINGAPORE (ICIS) - China’s Zhejiang Rongsheng is building a joint venture refinery-petrochemical complex in Zhoushan, with the first phase due to start up in late 2018... Construction remains at an early stage, the sources said.
MRPL’s Mangalore Refinery Expansion Project

- Mangalore Refinery and Petrochemicals Ltd (MRPL) a subsidiary of ONGC
- Financially strong, credible sponsor
- Expansion far more likely to be completed on schedule than a grassroots project
- Land acquisition for expansion can be highly politicized
- If foregoing assumptions are incorrect, impact on totals is not material

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Land acquisition for expansion can be highly politicized

If foregoing assumptions are incorrect, impact on totals is not material
Dangote Industries’ Lekki, Nigeria Refinery

- A company with no refining experience building the one of the largest refineries in the world
- Cost estimate likely too low for this location: limited refinery construction services and infrastructure
- Sponsor simultaneously developing a fertilizer plant at the site, which may be what is currently under active construction
- Not all financing in place
- Will probably be completed eventually but difficult to say when

June 6, 2016: @CNNMoney - At the refinery’s planned oceanfront location, construction is underway. Pipes have been laid and a massive dredging operation has commenced, but the outline of a refinery has yet to emerge.

August 27, 2017 Vanguard - A recent visit to the site of the plant in Lagos showed that progress has been made in many areas. For instance, the sand filling of the site has been completed. Work was ongoing in piling, targeted at preparing the ground for foundation laying. The construction of harbour that would enhance import and export of various items was ongoing.
Refinery Demand & Utilization

Translating Projected GDP Growth to Refined Product Demand
Global real GDP is expected to grow at a CAGR of nearly 3% from now until 2040
The basis for global refined product demand

Reference: EIA 2017 IEO – Reference Case;
Global standards of living are expected to continue to rise (GDP per capita)
Global energy efficiency continues to improve (Refined product demand per unit GDP)
OECD Energy Intensity

- Standards of living and energy intensity are not equally spread across the globe
- OECD standards of living are high and improving
- Energy efficiency of the OECD economies continues to improve
Non-OECD standards of living are high and improving
Energy efficiency of the OECD economies continues to improve – at a much faster rate than in the OECD

World Liquids Demand: 1990 – 2040E

- **World CAGR (2017E– 2040E) = 0.60%**
- **Non-OECD CAGR (2017E– 2040E) = 1.22%**
- **OECD CAGR (2017E– 2040E) = -0.20%**

Reference: EIA 2017 IEO – Reference Case
Refinery Utilization

- **Refining Throughput:**
  - Historical “Refining Throughput” data from the BP Statistical Review of World Energy

  ![Total Liquids Supply Diagram]

  - Less: Natural Gas Liquids (NGLs)
  - Less: Refinery Processing Gains
  - Less: Liquids from Renewables
  - Less: Other Liquids

  **Crude & Condensates Supply (Input to Refinery)**

- **Refining Capacity (per Calendar Day):**
  - Historical data from the BP Statistical Review of World Energy
  - Projections based on Aegis Global Refinery Capacity Database
    - Unrisked (Announced) and Risk-Adjusted based on a variety of specific economic & technical factors

- **Projected Refining Utilization:**
  - Refining Utilization (%) = Refining Throughput / Refining Capacity

- Refining Crude & Condensate Utilization (%) = Throughput / Capacity (per Calendar Day)
- Utilization based on capacity that is currently under construction: at historical levels
- Utilization based on all announced plans (Risk Adjusted): below historical levels
  - Some of the planned projects may never be built
  - Some existing capacity may be shut down

Reference: Aegis Energy Advisors (10.30.17); Company Reports, EIA 2017 IEO; BP Statistical Review of World Energy – 2017
- Projections: Aegis Risk-Adjusted Refining Capacity Additions, Net of Closures; Throughputs from EIA 2017 IEO (Crude & Condensate Supply)
- Historical data: BP Statistical Review of World Energy – 2017
OECD Europe Refining Utilization: 2005 – 2022E

- In the absence of additional refinery closures European refinery utilization is projected to weaken
  - Assumes all demand met from internally produced refined product
  - Would be exacerbated by product imports from the Middle East or Asia or even North America

Reference: Aegis Energy Advisors (10.30.17); Company Reports, EIA 2017 IEO; BP Statistical Review of World Energy - 2017,
Asia Pacific Refining Utilization: 2005 – 2022E

- Refining Crude & Condensate Utilization (%) = Throughput / Capacity (per Calendar Day)
  - Projections:
    - Aegis Risk-Adjusted Refining Capacity Additions, Net of Closures
    - Throughputs from EIA 2017 IEO (Crude & Condensate Supply)
    - Historical data: BP Statistical Review of World Energy – 2017

Reference: Aegis Energy Advisors (10.30.17); Company Reports, EIA 2017 IEO; BP Statistical Review of World Energy - 2017
**Cost to Supply: NW Europe vs. US**

- **Cost to Supply (CTS) = (Feedstock Cost + Op Costs – Co-product Credits) / (Gasoline + Distillate Yield)**
  - Adjusted for freight to a particular market
  - A refinery’s CTS is a proxy for its position on the supply curve

- **The chart below shows a comparison of several “typical” refineries over the past decade**
  - NW Europe Lt Sweet FCC: 200 mbpd Brent cracking refinery
  - NW Europe Med Sour FCC: 200 mad Urals cracking refinery
  - USEC Lt Sweet FCC: 200 mad Bonny Light / Bakken cracking refinery
  - USGC Lt Sweet FCC: 100 mbpd LLS cracking refinery

- **Over the past decade, the competitive positioning of the NW European refineries in their local market has deteriorated relative to external sources of supply**

![Cost to Supply NW Europe Chart](image-url)
Cost to Supply: NW Europe 2007 vs 2013

- In 2007 only the largest, most complex US capacity could profitably supply product to NW Europe
  - Large-scale, USGC full conversion refineries, underpinned by wide light-heavy differentials
  - Virtually no US volumes moved eastward

- By 2014, the competitive stature of USGC and USEC refining had improved materially
  - Supported by advantaged light crude supplies, lower natural gas prices and high utilization rates
  - USGC full conversion refineries have not fared better as light-heavy differentials have contracted
Cost to Supply: NY Harbor 2007 vs 2013

- The evolution of the competitive landscape in NY Harbor stands in contrast with NW Europe
- In 2007, European refiners found a ready market in the USEC
  - US PADD I received approximately 974 mbpd of imported gasoline and blendstock, largely from Europe and the Caribbean
- By 2014, much of NW Europe’s refining capacity was challenged to access the NY Harbor market economically
  - Exacerbated by surging US refinery production and stagnant demand
The widening disparity between US and European natural gas prices has been a key driver of the diminished competitive standing of Europe’s refining sector
- Since mid-year 2010, benchmark average natural gas prices have been about 250% higher in Europe than in the US
- Translates directly into increased energy costs and increased hydrogen costs
- **Cash Margin (estimated)** = Gross Margin – Variable Cash Costs – Fixed Costs
- **Gradual tail**: $2.50/bbl margin change over last 25% of capacity
  - Principally refineries with little or no resid or VGO conversion
- **Limited exposure to light-heavy crude differentials**
  - Predominance of light sweet North Sea grades
  - Sour processing capability is a key differentiator
- **Even during “peak” margin years, marginal capacity remains “marginal”**
  - Low distillate yields
  - Material resid production

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**Graph:**

- **Group Average**: $3.75/bbl
- **Mid 50% Average**: $3.70/bbl
- **Tail 15% Average**: $0.30/bbl
NW Europe Marginal Barrel Analysis: 2013 Cash Margin Curve

- **Significant contraction in throughput “compresses” supply curve**
  - Shutdowns (e.g., Wilhelmshaven, Coryton, Shell Harburg) and capacity reductions (e.g., Gonfreville)
  - More competitive import supply continues to make significant inroads

- **Stronger competitors remain but impact on industry cost structure is muted**
  - Decreased utilization among remaining sites leads to higher fixed costs per barrel
  - Cost pressures exacerbated by higher natural gas prices
  - Cash margin curve is approximately $3.15/bbl lower than in 2007
  - Less differentiation among remaining peers
  - Most simple refineries have negative cash flow or have exited the market

![Graph showing the cash margin curve with data points at $0.60/bbl, $0.30/bbl, and ($3.10/bbl)](image-url)

**Group Average:** $0.60/bbl
**Mid 50% Average:** $0.30/bbl
**Tail 15% Average:** ($3.10/bbl)

**Cumulative Feedstock Run, mbpd**

**Demand-side pressure from stagnant market**

**Supply-side pressure from competitive imports**
Refinery M&A Valuation
Refining M&A Transactions: Comparable Transaction Metrics

- IRRs are the basis on which refineries are valued in M&A transactions: not multiples of capacity or EBITDA
- Even refineries that seem roughly comparable can have very different metrics
  - Example: Carson, TX City and Chalmette are all larger, complex facilities but with very different transaction multiples
  - But with very similar IRRs

<table>
<thead>
<tr>
<th>Location</th>
<th>Buyer</th>
<th>Seller</th>
<th>Date</th>
<th>Capacity (bpd)</th>
<th>Repl. Cost ($ mil.)</th>
<th>Sale Price ($ mil.)</th>
<th>EBITDA</th>
<th>% Complexity</th>
<th>$ per bbl</th>
<th>$ per barrel</th>
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<td>North Pole</td>
<td>Flint Hills</td>
<td>Williams</td>
<td>Mar-04</td>
<td>220,000</td>
<td>1.1</td>
<td>300</td>
<td>891</td>
<td>810</td>
<td>65%</td>
<td>3.3x</td>
<td>15%</td>
</tr>
<tr>
<td>Delaware City, DE</td>
<td>Premcor</td>
<td>Motiva</td>
<td>Mar-04</td>
<td>175,000</td>
<td>12.3</td>
<td>1,810</td>
<td>2,286</td>
<td>186</td>
<td>22%</td>
<td>3.1x</td>
<td>13%</td>
</tr>
<tr>
<td>Limassol, Cyprus</td>
<td>Valero</td>
<td>Premcor</td>
<td>Apr-05</td>
<td>787,000</td>
<td>10.2</td>
<td>7,840</td>
<td>9,665</td>
<td>952</td>
<td>97%</td>
<td>5.4x</td>
<td>9%</td>
</tr>
<tr>
<td>Tulsa, OK</td>
<td>Holly</td>
<td>Sunoco</td>
<td>Jun-09</td>
<td>85,000</td>
<td>10.4</td>
<td>1,354</td>
<td>765</td>
<td>74</td>
<td>5%</td>
<td>1.1x</td>
<td>17%</td>
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<tr>
<td>Tulsa, OK</td>
<td>Holly</td>
<td>Sinclair</td>
<td>Dec-09</td>
<td>75,000</td>
<td>8.0</td>
<td>1,273</td>
<td>1,713</td>
<td>215</td>
<td>10%</td>
<td>1.7x</td>
<td>15%</td>
</tr>
<tr>
<td>Delaware City, DE</td>
<td>PBF Energy</td>
<td>Valero</td>
<td>Jun-10</td>
<td>190,000</td>
<td>12.0</td>
<td>3,970</td>
<td>2,048</td>
<td>163</td>
<td>11%</td>
<td>2.4x</td>
<td>15%</td>
</tr>
<tr>
<td>Paulsboro, NJ</td>
<td>PBF Energy</td>
<td>Valero</td>
<td>Oct-16</td>
<td>160,000</td>
<td>12.6</td>
<td>3,216</td>
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<td>277</td>
<td>13%</td>
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<td>13%</td>
</tr>
<tr>
<td>St Paul Park, MN</td>
<td>Northern Tier</td>
<td>Marathon</td>
<td>Dec-10</td>
<td>84,000</td>
<td>9.7</td>
<td>1,689</td>
<td>6,114</td>
<td>766</td>
<td>19%</td>
<td>1.3x</td>
<td>13%</td>
</tr>
<tr>
<td>Toledo, OH</td>
<td>PBF Energy</td>
<td>Sunoco</td>
<td>Dec-10</td>
<td>175,000</td>
<td>10.5</td>
<td>2,920</td>
<td>2,236</td>
<td>218</td>
<td>14%</td>
<td>2.7x</td>
<td>14%</td>
</tr>
<tr>
<td>Pembroke, UK</td>
<td>Valero</td>
<td>Chevron</td>
<td>Mar-11</td>
<td>220,000</td>
<td>9.7</td>
<td>3,679</td>
<td>2,182</td>
<td>225</td>
<td>13%</td>
<td>2.4x</td>
<td>14%</td>
</tr>
<tr>
<td>Stanley, OK</td>
<td>Essar</td>
<td>Shell</td>
<td>Mar-11</td>
<td>227,000</td>
<td>7.2</td>
<td>3,260</td>
<td>1,287</td>
<td>178</td>
<td>11%</td>
<td>2.4x</td>
<td>14%</td>
</tr>
<tr>
<td>Superior, WI</td>
<td>Calumet</td>
<td>Murphy</td>
<td>Jul-11</td>
<td>35,000</td>
<td>8.0</td>
<td>1,098</td>
<td>6,114</td>
<td>766</td>
<td>19%</td>
<td>1.3x</td>
<td>13%</td>
</tr>
<tr>
<td>Meraux, LA</td>
<td>Valero</td>
<td>Murphy</td>
<td>Sep-11</td>
<td>125,000</td>
<td>10.6</td>
<td>2,059</td>
<td>2,160</td>
<td>204</td>
<td>13%</td>
<td>2.3x</td>
<td>14%</td>
</tr>
<tr>
<td>Wynnewood, OK</td>
<td>CVR Energy</td>
<td>Gary</td>
<td>Nov-11</td>
<td>70,000</td>
<td>9.3</td>
<td>1,649</td>
<td>7,500</td>
<td>810</td>
<td>32%</td>
<td>1.6x</td>
<td>15%</td>
</tr>
<tr>
<td>Carson, CA</td>
<td>Tesoro</td>
<td>BP</td>
<td>Aug-12</td>
<td>266,000</td>
<td>13.1</td>
<td>7,081</td>
<td>4,417</td>
<td>337</td>
<td>17%</td>
<td>2.6x</td>
<td>14%</td>
</tr>
<tr>
<td>Great Falls, MT</td>
<td>Calumet</td>
<td>Connerchar</td>
<td>Aug-12</td>
<td>10,500</td>
<td>8.7</td>
<td>733</td>
<td>11,429</td>
<td>1,320</td>
<td>16%</td>
<td>2.6x</td>
<td>14%</td>
</tr>
<tr>
<td>Texas City, TX</td>
<td>Marathon</td>
<td>BP</td>
<td>Oct-13</td>
<td>475,000</td>
<td>12.6</td>
<td>8,302</td>
<td>6,697</td>
<td>1,446</td>
<td>30%</td>
<td>2.3x</td>
<td>15%</td>
</tr>
<tr>
<td>San Antonio, TX</td>
<td>Calumet</td>
<td>NuStar</td>
<td>Jan-13</td>
<td>14,500</td>
<td>4.8</td>
<td>333</td>
<td>1,106</td>
<td>232</td>
<td>6%</td>
<td>1.7x</td>
<td>15%</td>
</tr>
<tr>
<td>Kapaoli, HI</td>
<td>Par Petroleum</td>
<td>Tesoro</td>
<td>Jun-13</td>
<td>94,000</td>
<td>4.8</td>
<td>1,606</td>
<td>1,228</td>
<td>98</td>
<td>6%</td>
<td>1.5x</td>
<td>15%</td>
</tr>
<tr>
<td>Chalmette, LA</td>
<td>PBF Energy</td>
<td>XOM PDVSI</td>
<td>Jun-15</td>
<td>189,000</td>
<td>12.5</td>
<td>3,706</td>
<td>2,471</td>
<td>233</td>
<td>9%</td>
<td>1.5x</td>
<td>N/A</td>
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<tr>
<td>Torrance, CA</td>
<td>PBF Energy</td>
<td>ExxonMobil</td>
<td>Sep-15</td>
<td>155,000</td>
<td>14.9</td>
<td>5,850</td>
<td>9,667</td>
<td>1,465</td>
<td>34%</td>
<td>5.8x</td>
<td>9%</td>
</tr>
</tbody>
</table>

Aegis Energy Advisors, November 2017

Golden Era
### Comparables Analysis: Implied Values for a Hypothetical Refinery

- The values implied for hypothetical refinery (right table) based on the transaction metrics from refinery divestitures (left table)
  - Wide dispersion of implied values based on static metrics and EBITDA multiples
  - Much tighter dispersion around IRRs

- Assuming Carson & TX City are comparables, hypothetical refinery would be worth as little as $342 million or as much as $1.1 billion

<table>
<thead>
<tr>
<th>Transaction</th>
<th>TRANSACTION METRICS</th>
<th>MATRIX OF IMPLIED VALUES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ per Barrel</td>
<td>$ per bbl Complexity</td>
</tr>
<tr>
<td>Krotz Springs, LA</td>
<td>6,065</td>
<td>963</td>
</tr>
<tr>
<td>Tulsa, OK</td>
<td>765</td>
<td>74</td>
</tr>
<tr>
<td>Tulsa, OK</td>
<td>1,713</td>
<td>215</td>
</tr>
<tr>
<td>Delaware City, DE</td>
<td>895</td>
<td>75</td>
</tr>
<tr>
<td>Paulsboro, NJ</td>
<td>2,048</td>
<td>163</td>
</tr>
<tr>
<td>St Paul Park, MN</td>
<td>2,690</td>
<td>277</td>
</tr>
<tr>
<td>Toledo, OH</td>
<td>2,286</td>
<td>218</td>
</tr>
<tr>
<td>Pembroke, UK</td>
<td>2,182</td>
<td>225</td>
</tr>
<tr>
<td>Stanlow, UK</td>
<td>1,287</td>
<td>178</td>
</tr>
<tr>
<td>Superior, WI</td>
<td>6,114</td>
<td>766</td>
</tr>
<tr>
<td>Meraux, LA</td>
<td>2,160</td>
<td>204</td>
</tr>
<tr>
<td>Wynnewood, OK</td>
<td>7,500</td>
<td>810</td>
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<tr>
<td>Carson, CA</td>
<td>4,417</td>
<td>337</td>
</tr>
<tr>
<td>Great Falls, MT</td>
<td>11,429</td>
<td>1,320</td>
</tr>
<tr>
<td>Texas City, TX</td>
<td>1,438</td>
<td>114</td>
</tr>
<tr>
<td>San Antonio, TX</td>
<td>6,897</td>
<td>1,446</td>
</tr>
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<td>Kapolei, HI</td>
<td>1,106</td>
<td>232</td>
</tr>
<tr>
<td>Chalmette, LA</td>
<td>1,228</td>
<td>98</td>
</tr>
<tr>
<td>Torrance, CA</td>
<td>3,471</td>
<td>233</td>
</tr>
<tr>
<td>Superior, WI</td>
<td>9,667</td>
<td>1,465</td>
</tr>
<tr>
<td><strong>Averages</strong></td>
<td><strong>3329</strong></td>
<td><strong>407</strong></td>
</tr>
</tbody>
</table>
Refining M&A Transaction IRRs

- Transaction IRR’s are remarkably consistent throughout different margin environments
  - “Golden Era” was characterized by high margin expectations and low IRRs
    - A period when a shortfall in global refining capacity was anticipated
    - Buyers paid premiums for refineries as platforms for needed expansion
  - Since then margins have been more normal (lower) and the acquisition IRRs higher
    - **Global refining capacity anticipated to be sufficient to meet expected refined product demand**

- By current transaction metrics as estimated by Aegis, Superior is an outlier
  - Implies Husky justified its lower transaction IRR with synergies and capital avoidance
# Fair Market Value

- **Three broad determinates of Fair Market Value under a DCF valuation**
  - Operating assumptions
  - Margin Forecast
  - Discount Rate

**Operating Assumptions**
- Based on current demonstrated performance
- Presumed to be least susceptible to disagreement among buyers and sellers
- Some latitude to select within ranges of performance
- Values more sensitive to some operating variables than others

**Discount Rate**
- M&A discount rates are determinable but highly dependent on asset quality and location
- In general, M&A discount rates are higher than R&M company WACCs
  - Must be higher than buyer WACCs for transactions to be accretive
  - Reflects the higher risks associated with unfamiliar assets with uncertain performance characteristics
  - Exception: “Golden Era” (2004 through 2007) when buyers were valuing refineries at their WACCs in order to acquire platforms for expansion in a capacity constrained world
    - M&A discount returned to normal levels following the financial crisis of 2008

**Margin Projections**
- Most susceptible to disagreement between the parties
- Wide diversity of opinions on future margins within the energy industry
- Syndicated research firms a traditional source of price and margin projections
  - Differences based on differing assumptions regarding global economic growth, geopolitical environment, government regulation and energy supply and demand fundamentals
  - While a widely-used source of price projections, syndicated research firms are not the arbiters of asset valuation
**Executive Summary: Sensitivity Analysis**

- The market assumptions such as crack spreads and crude oil differentials are the most impactful sensitivities
  - There also appears to be a high level of uncertainty and/or lack of consensus view among experts regarding what these assumptions should be
  - The likely range for the other assumptions are more narrowly defined

**Sensitivity Impact of Changes to Key Assumptions**

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Sensitivity Change</th>
<th>Uncertainty of Consensus</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLS321</td>
<td>+/- $2/bbl</td>
<td>High</td>
</tr>
<tr>
<td>LLS-Maya</td>
<td>+/- $3/bbl</td>
<td>High</td>
</tr>
<tr>
<td>Discounting</td>
<td>+/- 200 bp</td>
<td>Modest</td>
</tr>
<tr>
<td>Throughput</td>
<td>+/- 2% Utilization</td>
<td>Modest</td>
</tr>
<tr>
<td>Fixed Opex</td>
<td>+/- 5%</td>
<td>Low</td>
</tr>
<tr>
<td>Capex</td>
<td>+/- 10%</td>
<td>Low</td>
</tr>
<tr>
<td>Inflation</td>
<td>+/- 0.5%</td>
<td>Modest</td>
</tr>
<tr>
<td>Inventory Carry</td>
<td>+/- 100 bp</td>
<td>Low</td>
</tr>
</tbody>
</table>
Sensitivity Analysis: Alternative Forecasts

- A comparison of Aegis projections with recent forecasts of commonly-used syndicated market research firms suggest material differences in outlook
  - Direct bearing on the implied value of Hypothetical refinery
  - Aegis value is comparable to that implied by refinery’s business plan; other values diverge materially

For Firms A & B valuation analysis assumes the same operating, cost and DCF assumptions.
- Only changes are price assumptions

Business Plan value assumes CFFO & Capex assumption provided by Owner
- Aegis discounting
- Stepped-up depreciation

$\text{1/3 ULSD}^1 + 2/3 87-\text{Conv} - \text{LLS (Nominal)}$

**Comparative Valuations, $\text{mm}$**

---

\(^1\)50ppm road diesel prior to 2007, ULSD thereafter
Aegis Margin Projection

- **A market-based projection**
  - A forward crack excluding the effects of financial market transactions
  - Assumes the futures market is distorted by financial hedging and speculative investing
  - Proprietary methodology developed over 20 years of observing and advising on downstream M&A
  - Validated by testing against other market indicators
    - M&A transaction values
    - Equity research
    - Public market valuation
  - **Key: Not an opinion but rather what the broader commercial market appears to expecting**
Valuation Methodology: Margin Expectations (Nominal)

- The evolution of Aegis’ market-based margin expectations projection since 2006
- Changes over time as expectations about the future change
- Reliable indicator of refinery market value at any given point in time
  - Not a predictor of future value
  - Expectations can and do change often and dramatically

---

Graph showing the evolution of margin expectations from 2006 to 2017, with data points indicating changes over time.
Summary

- **Capacity Additions**
  - A lot of announced capacity, Most of which will not be built
  - Majority expected in China, India and the Middle East
  - Even planned capacity by credible sponsors could be subject to deferral or cancellation if the outlook is for falling utilization

- **Refined Product Demand and Projected Refinery Utilization**
  - A product of GDP growth, the energy intensity of the world’s economies and population growth
  - Refined product demand is expected to grow, but at a slower rate than historically due to improvements in energy efficiency

- **M&A Valuation**
  - Refinery M&A values are determined by the current market’s embedded expectations for margins
  - The challenge is to derive what those expectations are
  - Do that correctly, then you will know something no one else in the market knows
Thank You

Strategic & Financial

Commercial

Operational

THE INTERSECTION OF INSIGHTS REQUIRED TO RESPOND TO STRATEGIC ISSUES IN THE 21ST CENTURY