The Future of Global Downstream Project Activity

Lee Nichols – Editor/Associate Publisher
Hydrocarbon Processing
Gas Processing
Construction Boxscore Database
Detailed and up-to-date information for active construction projects in the refining, gas processing, LNG and petrochemical industries across the globe

www.constructionboxscore.com
1980’s Hair Bands
Global oil demand (MMbpd) from three major industry forecast, 2015-2021.

Global oil demand vs. refinery capacity builds, MMbpd (2015-2021)
New refining project announcements vs new downstream projects (globally), January 2016 – January 2017

Source: Hydrocarbon Processing’s Construction Boxscore Database.
A low-sulfur world

Light distillate consumption (source: BP)

Middle distillate consumption (source: BP)
Petrochemicals

- Global petrochemical sector to see strong growth through the end of the decade
  - However, industry has shifted from bullish to optimistic
- Most significant expansions will be in developing countries in the Asia-Pacific and Middle East regions
- US will see tremendous growth, as well
- Oil-based naphtha crackers making a comeback
  - Ethane remains advantaged feedstock
New petrochemical projects

- As total new project announcements have decreased since 2014, so has new petrochemical project announcements.
- Over the past three years, over 400 new petrochemical projects have been announced.
Active petrochemical projects

Total active petrochemical market share by region, 2016

Breakdown of 2016 petrochemical projects by activity level

Source: Hydrocarbon Processing’s Construction Boxscore Database
New project announcements vs. new gas processing/LNG projects by region, 2014-2016

Source: *Hydrocarbon Processing’s* Construction Boxscore Database.
Announced downstream project investments by region, 2015-2030
Total active projects breakdown

- **Planning**: 40%
- **Study**: 26%
- **FEED**: 18%
- **Engineering**: 9%
- **Under construction**: 7%

Geographical breakdown by region:

- **North America**
  - Canada: Refining (14), Petrochemical (109), Gas processing/LNG (94), Other (35)
  - US: Refining (65), Petrochemical (35), Gas processing/LNG (25), Other (13)

- **Europe**
  - Europe: Refining (125), Petrochemical (101), Gas processing/LNG (30), Other (80)

- **Latin America**
  - Latin America: Refining (104), Petrochemical (66), Gas processing/LNG (42), Other (31)

- **Africa**
  - Africa: Refining (171), Petrochemical (146), Gas processing/LNG (72), Other (48)

- **Middle East**
  - Middle East: Refining (75), Petrochemical (34), Gas processing/LNG (34), Other (28)

- **Asia-Pacific**
  - Asia-Pacific: Refining (275), Petrochemical (198), Gas processing/LNG (102), Other (71)
Total new project announcements by region, 2014-2016.

*Europe includes Eastern Europe, Russia and the CIS
Market share analysis of new projects, 2014-2016

- North America: 4%, 5%, 4%
- South America: 10%, 6%, 6%
- Europe: 15%, 16%, 17%
- Africa: 3%, 6%, 7%
- Asia: 23%, 24%, 34%
- Other regions: 28%, 32%, 21%
Morocco
- LNG Power Project

Nigeria
- DIL project
- Brass Fertilizer
- Eleme Indorama
- NLNG Trains 7 & 8?
- Brass LNG back on?

Egypt
- ERC Mostorod refinery project
- Tahrir Petrochemical Complex
- Sidpec/TCI Sanmar Port Said petchem projects
- MIDOR & Assuit Refinery projects
- FSRU #3 – delayed

Algeria
- Updated Rehab Program
- Three new refineries (Biskra, Hassi-Messaoud, Tiaret)
- Boost in petchem capacity

Mozambique/Tanzania LNG projects

South Africa
- CF2 (not any time soon)
- Project Mthombo? Iran to build?
- Gas to Power program
Asia-Pacific region will lead in distillation capacity additions through 2021
AP will add over 3 MMbpd of distillation capacity over the next 5 yrs
Led by projects in China and India

Source: OPEC World Oil Outlook 2016
Asia-Pacific

- The region will lead in petrochemical demand and production for the foreseeable future
- Fun facts you can share with friends at the dinner table that will make you sound smart:
  - Region represents 1/3 of total global ethylene capacity,
  - Over half of the world’s propylene capacity,
  - Nearly 70% of the world’s methanol capacity
- China/India will be the leaders in petchem capacity
- New petchem projects #s down from 2014
- Region is short on ethylene, especially with closing/consolidation of Japanese naphtha crackers

New petrochemical project announcements in the Asia-Pacific region, 2013-2016.
Asia-Pacific

**INDONESIA**
- Production falling/consumption rising
- $25 B Refinery Development Master Plan
  - Balongan, Cilacap, Dumai, Plaju, Balipapan
- New refineries???
- 35 GW program...got gas, we need it!

**MALAYSIA**
- Economic Transformation Program
  - Pengerang Integrated Petroleum Complex
    - RAPID
  - Bintulu
  - PFLNG 1 and PFLNG 2

**SOUTH KOREA**
- S-Oil’s RUCP and ODC projects
- Expanding petrochemical capacity
- New LNG capacity going online during falling demand
VIETNAM
• Refining/Petrochemical buildout – part of country’s 2020-2025 plan
• Five large-scale projects: Dung Quat expansion, Nghi Son, Vung Ro, Nam Van Phong, Long Son...Nhon Hoi (cancelled)

AUSTRALIA
• LNG liquefaction capacity to reach 66 MMtpy in mid-2017
• LNG exports expected to reach between 52 MMtpy and 60 MMtpy in 2017, and could eclipse 70 MMtpy in 2018
China

<table>
<thead>
<tr>
<th>Company</th>
<th>Project</th>
<th>Capacity, Mbpd</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinopec</td>
<td>Tianjin refinery</td>
<td>240</td>
<td>2020+</td>
</tr>
<tr>
<td>Sinopec</td>
<td>Zhanjiang refinery</td>
<td>300</td>
<td>2019/2020</td>
</tr>
<tr>
<td>Sinopec</td>
<td>Hainan refinery</td>
<td>100</td>
<td>2020+</td>
</tr>
<tr>
<td>Sinopec</td>
<td>Luoyang refinery</td>
<td>160</td>
<td>2020</td>
</tr>
<tr>
<td>CNPC/PetroChina</td>
<td>Huabei refinery</td>
<td>100</td>
<td>2017</td>
</tr>
<tr>
<td>CNPC/PetroChina</td>
<td>Anning refinery</td>
<td>260</td>
<td>2016</td>
</tr>
<tr>
<td>CNPC/PetroChina/PDVSA</td>
<td>Jieyang refinery</td>
<td>400</td>
<td>2021</td>
</tr>
<tr>
<td>PetroChina/Rosneft</td>
<td>Tianjin refinery</td>
<td>200</td>
<td>2020</td>
</tr>
<tr>
<td>CNOOC</td>
<td>Huizhou expansion</td>
<td>200</td>
<td>2017</td>
</tr>
<tr>
<td>Zhejiang Petrochemical</td>
<td>Dayushan Island Complex</td>
<td>400</td>
<td>2020+</td>
</tr>
<tr>
<td>PetroChina/Qatar Petroleum</td>
<td>Taizhou refinery</td>
<td>300</td>
<td>2021+</td>
</tr>
<tr>
<td>Rongsheng Petrochemical Co.</td>
<td>Zhoushan Island refinery</td>
<td>400</td>
<td>2018/2020</td>
</tr>
</tbody>
</table>

Chinese oil demand, 2009-2021. IEA.

China’s monthly net diesel exports, January 2011-April 2016
China - Petrochemicals

- Over $50 B in new petrochemical capacity additions by 2020
- Looking at alternative supply routes: CTO, MTO, PDH, MTP
- Capacity growth:
  - MTO = 5 MMtpy by 2017
  - CTO = 6 MMtpy – 7 MMtpy by 2018
  - PDH = over 10 MMtpy by early 2020s
### India

<table>
<thead>
<tr>
<th>Company</th>
<th>Refining investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hindustan Petroleum Corp.</td>
<td>Investing nearly $8 B to increase refining capacity by two-thirds</td>
</tr>
<tr>
<td>Reliance</td>
<td>Investing over $18 B in refining/petrochemical projects</td>
</tr>
<tr>
<td>Essar Oil</td>
<td>Investing nearly $280 MM in upgrades to Vadinar refinery</td>
</tr>
<tr>
<td>Chennai Petroleum</td>
<td>Study to increase Nagapattinam refinery capacity nine-fold</td>
</tr>
<tr>
<td>Indian Oil Corp.</td>
<td>$600 MM to upgrade Paradip refinery, also $6 B to expand domestic refining capacity by early 2020s</td>
</tr>
<tr>
<td>Bharat Petroleum Corp.</td>
<td>Invested $4 B in Kochi refinery (operating)</td>
</tr>
<tr>
<td>Numaligarh Refinery (BPCL subsidiary)</td>
<td>$3 B Numaligarh refinery expansion project</td>
</tr>
<tr>
<td>IOCL, BPCL, HPCL, Engineers India</td>
<td>Study for $15 B west coast refinery</td>
</tr>
</tbody>
</table>
Total active European projects by region and sector, 2016

Total active European projects by sector

Market share of active projects in the European region
Russia - Refining

- $55 B modernization program to produce higher-quality fuels
- Focuses on upgrading/conversion capacity
- Rosneft and Lukoil led charge on refinery upgrades
- Additional projects underway from GazpromNeft’s Omsk refinery, NeftGaz’s Afipsky refinery, etc.
Commonwealth of Independent States (CIS)

KAZAKHSTAN
- Atyrau refinery modernization, $697 MM, completion 1Q 2017
- Shymkent refinery modernization, $2 B, completion 2017
- Pavlodar refinery modernization, $2 B, completion 2018
- A fourth refinery?
- Atyrau $2-B integrated complex – produce up to 500 Mtpy of PP

AZERBAIJAN
- Oil and Gas Processing and Petrochemicals Complex has restructured
- Heydar Aliyev refinery expansion and upgrade project
- Sumgait petrochemical complex

TURKMENISTAN
- Kiyanly petrochemical complex - $7 B
- Garabogaz fertilizer project - $1.3 B
- Ovdan-Depe GTL project, the country’s second GTL facility

UZBEKISTAN
- Surgil Natural Gas Chemicals ($4 B) project completed in late 2015
- Navoiy ammonia-urea plant (2-Mtpd of ammonia, 1.75 Mtpd of urea)
- Oltin Y’ol GTL plant
- Kandym Gas Processing Plant
Western Europe

- OECD Europe rode the wave of high margins for the past two years, but is it delaying the inevitable?
- EU still suffers from:
  - Surplus processing capacity
  - Competition from ultra-modern refineries
  - Imbalanced product mix
  - Energy efficiency laws/regulations
- Push for renewable and biofuels usage
- Europe 2020 Program (20-20-20)
  - Reduce GHG emissions by 20% from 1990 levels
  - Increase share of renewable energy consumption to 20% of total energy consumption
  - Achieve an increase of 20% in energy efficiency
- Low-sulfur bunker fuels
  - In ECAs – already enacted
  - Non-ECAs – 2020
- Projects focus on: upgrades, more ULSD
  - Ex. ExxonMobil & Shell’s refineries in the Netherlands
  - Total’s “Refining Roadmap” program in France
Middle East total active projects breakdown

- Middle East total active projects breakdown
  - Engineering: 46%
  - FEED: 16%
  - Planning: 16%
  - Study: 5%
  - Other: 17%

Refining capacity additions in OPEC member countries
Saudi Arabia leads the way

- Saudi Arabia continues to develop its refining and petrochemical sector with multiple multi-billion-dollar projects
- Investing heavily in its Transformation Program (Vision 2030)
- Added 800 Mbpd since 2014 with startup of Satorp and Yasref refineries
- Clean fuels project initiative (near-zero sulfur fuels)
- $60 B in petrochemical investment through 2020
- Utilize natural gas for power gen instead of burning oil. Program centers around three large-scale plants: Fadhili, Wasit, Midyan
Saudi Arabia - Petrochemicals

- Petrochemical production build-out is a major initiative of Vision 2030
- Saudi Arabia investing over $60 B in its petchem sector
- Major projects:
  - Rabigh II expansion
  - Sadara complex
  - Jubail MMA/PMMA plants
  - Waad Al Shamal Phosphate
  - Ma’aden ammonia project
  - Saudi Kayan ethylene capacity exp.
  - Sabic oil-to-chemicals?
- Feedstock price reforms:
  - Ethane: $0.75/MMBtu to $1.75 MMBtu
  - Methane: $0.75/MMBtu to $1.25/MMBtu
<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>PROJECT</th>
<th>CAPACITY</th>
<th>COST</th>
<th>COMPLETION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman</td>
<td>Sohar Refinery Improvement Project (SRIP)</td>
<td>60 Mbpd (expansion)</td>
<td>$2 B</td>
<td>1Q 2017</td>
</tr>
<tr>
<td>Oman</td>
<td>Liwa Plastics Project</td>
<td>880 Mtpy (HDPE), 300 Mtpy (PP)</td>
<td>$6.5 B</td>
<td>4Q 2019</td>
</tr>
<tr>
<td>Oman</td>
<td>Duqm Refinery and Petrochemicals Complex</td>
<td>230 Mbpd</td>
<td>$6 B ($9 B if petrochemical complex is built)</td>
<td>2019</td>
</tr>
<tr>
<td>UAE</td>
<td>Jebel Ali Expansion and Upgrade Project</td>
<td>70 Mbpd (expansion)</td>
<td>$1 B</td>
<td>2020</td>
</tr>
<tr>
<td>UAE</td>
<td>Fujairah Refinery</td>
<td>200 Mbpd</td>
<td>$3.5 B</td>
<td>2019</td>
</tr>
<tr>
<td>Turkey</td>
<td>SOCAR Turkey Aegean Refinery (STAR) Project</td>
<td>10 MMtpy</td>
<td>$5.6 B</td>
<td>1Q 2018</td>
</tr>
<tr>
<td>Bahrain</td>
<td>Sitra Refinery expansion</td>
<td>100 Mbpd (expansion)</td>
<td>$5 B</td>
<td>2019</td>
</tr>
<tr>
<td>Qatar</td>
<td>Laffan Refinery 2 (LR2) project</td>
<td>140 Mbpd</td>
<td>$1.5 B</td>
<td>Completed 4Q 2016</td>
</tr>
<tr>
<td>Iraq</td>
<td>Karbala, Missan, Kirkuk (?), Nassiriya (?) refineries</td>
<td>740 Mbpd</td>
<td>$20 B</td>
<td>2020+</td>
</tr>
<tr>
<td>Iraq</td>
<td>Nibras Petrochemical Complex</td>
<td>-</td>
<td>$11 B</td>
<td>Proposed</td>
</tr>
<tr>
<td>Kuwait</td>
<td>CFP and NRP projects</td>
<td>@ 679 Mbpd</td>
<td>$31 B</td>
<td>2020</td>
</tr>
<tr>
<td>Kuwait</td>
<td>Olefins III</td>
<td>1.4 MMtpy</td>
<td>$10 B</td>
<td>2020</td>
</tr>
</tbody>
</table>

- Iran needs foreign investment and construction expertise to carry out ambitious downstream buildout: Boost refining cap from 1.85 MMbpd to 3.2 MMbpd (2025), Triple petchem output to 180 MMtpy (please make the $60 B check out to the Mr. Rouhani, seeking $100 B to rebuild gas industry)
• Oil demand has increased 2 MMbpd (2004-2015), surpassing 7 MMbpd...decelerating presently
• Drop in oil prices have hammered LatAm countries dependent on oil export revenues
• Decreased revenue = little dinero to fund expansions (will rely on imports in the near-term)
• Projects are progressing:
  • Region to add over 400 Mbpd of new refining capacity through 2021
Latin America - Petrochemicals

- Total active petchemical projects = 60
- LatAm needs additional petchem capacity, but the investments are not there
- Large PE deficit (@ 3 MMtpy) and could continue to grow
- US to the rescue?
Brazil

Petrobras’ capital investment plan, 2017-2021

- Fuel sales dropped for a second consecutive year
- Petrobras has vowed to let the markets set the price for refined fuels, NOT government policy
- Catch 22: country needs additional infrastructure, but lacks financial strength to build it
- Ambitious refinery build out is no more, actually looking into selling stakes in refining assets
- Capital budgets have been cut severely over the past several years

Breakdown on Petrobras’ downstream capital investment plan, 2017-2021
The country has a $23 B plan to increase the production of refined fuels and help mitigate refined fuels imports. Refineries involved:

- **Miguel Hidalgo refinery (Tula)** – $5 B reconfiguration/expansion to produce clean fuels
- **Salamanca & Salina Cruz refineries** - $8 B reconfiguration of both refineries, also includes the construction of the first four cogeneration projects to be developed by Pemex Cogeneration Services
- **General Lazaro Cardenas refinery (Minatitlan)** - > $800 MM clean-fuels project
- **Hector R. Lara Sosa refinery (Cadereyta)** – building a ULSD fuel plant, sulfur recovery units, WW, etc.
- **Madero refinery** - $1-B clean-fuels project to add two diesel hydodesulfurization trains & addt’l facilities
- Etileno XXI (pictured)
- $10 B in natural gas pipeline construction to fuel power plants
### Additional notable Latin America projects

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>PROJECT</th>
<th>CAPACITY</th>
<th>COST, US $MM</th>
<th>COMPLETION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peru</td>
<td>Talara Refinery Expansion and Modernization Project</td>
<td>30 Mbpd (expansion)</td>
<td>3,500</td>
<td>2018</td>
</tr>
<tr>
<td>Argentina</td>
<td>Campana refinery expansion project</td>
<td>87 Mbpd (present capacity that will be expanded/upgraded)</td>
<td>1,500</td>
<td>-</td>
</tr>
<tr>
<td>Jamaica</td>
<td>Old Harbor LNG project (FSU will be used in the interim)</td>
<td>138 Mcmd</td>
<td>-</td>
<td>3Q/4Q 2018</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>Aguirre Offshore GasPort</td>
<td>500 MMcfd</td>
<td>-</td>
<td>2Q 2017 the project is massively behind schedule</td>
</tr>
<tr>
<td>Peru</td>
<td>Arequipa Petrochemical Complex</td>
<td>1.2 Mmtpy (PE)</td>
<td>3,500</td>
<td>2021+ no FID has been taken yet</td>
</tr>
<tr>
<td>Trinidad and Tobago</td>
<td>DME complex</td>
<td>1 MMtpy (methanol), 20 Mtpy (DME)</td>
<td>1,000</td>
<td>1Q 2019</td>
</tr>
<tr>
<td>Uruguay</td>
<td>GNL del Plata LNG Regasification Project (FSRU)</td>
<td>10 MMcfd</td>
<td>-</td>
<td>4Q 2016 3Q/4Q 2017</td>
</tr>
<tr>
<td>Jamaica</td>
<td>Kingston refinery upgrade project</td>
<td>-</td>
<td>1,300</td>
<td>-</td>
</tr>
<tr>
<td>Ecuador</td>
<td>Refineria del Pacifico</td>
<td>200 Mbpd</td>
<td>10,000</td>
<td>2020+ finalizing EPC contracts and financing</td>
</tr>
<tr>
<td>Panama</td>
<td>Panama LNG terminal (FSRU)</td>
<td>-</td>
<td>700 +</td>
<td>2019</td>
</tr>
<tr>
<td>Venezuela</td>
<td>Puerto la Cruz refinery expansion</td>
<td>50 Mbpd (x2) deep conversion units, 130 Mbpd vacuum unit, and more</td>
<td>5,600 8,800</td>
<td>2Q/3Q 2018</td>
</tr>
<tr>
<td>Boliva</td>
<td>Bulo ammonia plant, Gran Chaco petrochemical complex</td>
<td>-</td>
<td>2,650</td>
<td>Bulo plant (4Q 2016), Gran Chaco (2020+)</td>
</tr>
<tr>
<td>Aruba</td>
<td>Aruba refinery reactivation project</td>
<td>235 Mbpd</td>
<td>650</td>
<td>2Q 2018</td>
</tr>
<tr>
<td>Curacao</td>
<td>Isla refinery revamp/nat gas terminal</td>
<td>335 Mbpd</td>
<td>5,500</td>
<td>-</td>
</tr>
</tbody>
</table>

- Chile – ENAP will invest $800 MM/yr to 2020 to mitigate energy imports. Program includes the construction of 950 MW to energy grid, modernizing/expanding Concon and Hualpen refineries, adding regas cap at Quintero LNG terminal.
US new/active projects by PADD, 2015-present

US vs. Gulf Coast

- US: 64%
- US Gulf Coast: 36%

PADD 1
- New projects: 9
- Active projects: 17

PADD 2
- New projects: 17
- Active projects: 36

PADD 3
- New projects: 46

PADD 4
- New projects: 7
- Active projects: 15

PADD 5
- New projects: 9
- Active projects: 20
95% of active USGC projects are located in Texas and Louisiana

Nearly 90% of USGC active projects are in the gas processing/LNG or petrochemical industries
New project announcements along the Gulf Coast, 2012

- Gas Processing/LNG Projects
- Petrochemical Projects
- Refining Projects
New project announcements along the Gulf Coast, 2013
New project announcements along the Gulf Coast, 2014
New project announcements along the Gulf Coast, 2015-present
US refining capacity set to increase through 2020

- Surge in light crude refining capacity
- Upgrades to meet Tier 3 fuel regulations
- US refiners: victims of their own success?
- US fuel exports have more than quadrupled over the past 15 yrs.

<table>
<thead>
<tr>
<th>PAD District</th>
<th>Region</th>
<th>Operating refineries</th>
<th>Total refining capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PADD 1</td>
<td>East Coast</td>
<td>9</td>
<td>1.277 MMbpd</td>
</tr>
<tr>
<td>PADD 2</td>
<td>Midwest</td>
<td>27</td>
<td>3.922 MMbpd</td>
</tr>
<tr>
<td>PADD 3</td>
<td>Gulf Coast</td>
<td>57</td>
<td>9.514 MMbpd</td>
</tr>
<tr>
<td>PADD 4</td>
<td>The Rockies</td>
<td>16</td>
<td>679 Mbpd</td>
</tr>
<tr>
<td>PADD 5</td>
<td>West Coast</td>
<td>30</td>
<td>2.924 MMbpd</td>
</tr>
</tbody>
</table>
### US Petrochemical Surge

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Capacity</th>
<th>Derivatives</th>
<th>Startup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dow Chemical</td>
<td>Freeport, TX</td>
<td>1.5 MMtpy</td>
<td>PE, LDPE, EPDM, elastomers</td>
<td>2Q 2017</td>
</tr>
<tr>
<td>Chevron Phillips Chemical</td>
<td>Cedar Bayou, TX</td>
<td>1.5 MMtpy</td>
<td>HDPE, LLDPE</td>
<td>3Q/4Q 2017</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Baytown, TX</td>
<td>1.5 MMtpy</td>
<td>LLDPE</td>
<td>3Q/4Q 2017</td>
</tr>
<tr>
<td>Ingleside Ethylene (Occidental/Mexichem)</td>
<td>Ingleside, TX</td>
<td>544 Mtpy</td>
<td>VCM</td>
<td>1Q 2017</td>
</tr>
<tr>
<td>Formosa Plastics</td>
<td>Point Comfort, TX</td>
<td>1.5 MMtpy</td>
<td>PE, LDPE, MEG</td>
<td>1Q 2017</td>
</tr>
<tr>
<td>Sasol</td>
<td>Lake Charles, LA</td>
<td>1.5 MMtpy</td>
<td>LDPE, LLDPE, EO/EG, specialty alcohol, ethoxylates, etc.</td>
<td>3Q/4Q 2019</td>
</tr>
<tr>
<td>Formosa Plastics</td>
<td>St. James Parish, LA</td>
<td>1 MMtpy-1.5 MMtpy</td>
<td>LDPE, HDPE, EG</td>
<td>2020+</td>
</tr>
<tr>
<td>LACC LLC (Axiall/Lotte)</td>
<td>Lake Charles, LA</td>
<td>1 MMtpy</td>
<td>PE</td>
<td>1Q/2Q 2019</td>
</tr>
<tr>
<td>Shell</td>
<td>Monaca, PA</td>
<td>1.6 MMtpy</td>
<td>HDPE, LLDPE</td>
<td>2020+</td>
</tr>
<tr>
<td>Shintech</td>
<td>Plaquemine Parish, LA</td>
<td>500 Mtpy</td>
<td>PVC, VCM</td>
<td>1Q/2Q 2018</td>
</tr>
<tr>
<td>Total</td>
<td>Port Arthur, TX</td>
<td>1 MMtpy</td>
<td>–</td>
<td>2020+</td>
</tr>
<tr>
<td>Indorama Ventures Olefins (refurbishment)</td>
<td>Lake Charles, LA</td>
<td>370 Mtpy</td>
<td>–</td>
<td>4Q 2017</td>
</tr>
<tr>
<td>PTT/Marubeni</td>
<td>Belmont County, OH</td>
<td>1 MMtpy</td>
<td>EO, HDPE, MEG</td>
<td>2020+</td>
</tr>
<tr>
<td>Williams Olefins</td>
<td>Geismar, LA</td>
<td>850 Mtpy (est.)</td>
<td>–</td>
<td>2020+</td>
</tr>
</tbody>
</table>

Source: Hydrocarbon Processing’s Construction Boxscore Database

- Ethylene expansion projects will add an additional 1 MMtpy of capacity by 2018
- ExxonMobil-SABIC JV? If built, would be the world’s largest ethane cracker
- Total ethane construction CAPEX > $50 B
• Ammonia-urea capacity could top 12 MMtpy by 2019
  • CAPEX > $16 B
• Methanol capacity = 15 MMtpy, could top 30 MMtpy if all projects are built (not likely though)

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Capacity, MMtpy</th>
<th>Cost, US $ MM</th>
<th>Completion date</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCI (Natgasoline)</td>
<td>Beaumont, TX</td>
<td>1.75</td>
<td>1,600</td>
<td>3Q/4Q 2017</td>
</tr>
<tr>
<td>NWIW</td>
<td>Port of Kalama, WA</td>
<td>3.5</td>
<td>1,800</td>
<td>2019</td>
</tr>
<tr>
<td>NWIW</td>
<td>Port Westward, OR</td>
<td>3.5</td>
<td>1,800</td>
<td>2020+</td>
</tr>
<tr>
<td>Celanese</td>
<td>Bishop, TX</td>
<td>1.3</td>
<td>700-800</td>
<td>2020+</td>
</tr>
<tr>
<td>South Louisiana Methanol</td>
<td>St. James Parish, LA</td>
<td>1.825</td>
<td>1,300</td>
<td>2019/2020</td>
</tr>
<tr>
<td>Yuhuang Chemical</td>
<td>St. James Parish, LA</td>
<td>3 (Phase 1&amp;2)</td>
<td>1,850</td>
<td>2018/2020</td>
</tr>
<tr>
<td>Big Lake Fuels</td>
<td>Lake Charles, LA</td>
<td>1.4</td>
<td>1,600</td>
<td>4Q 2019</td>
</tr>
<tr>
<td>Lake Charles Methanol</td>
<td>Lake Charles, LA</td>
<td>1</td>
<td>5,000 (includes pet coke/CCS)</td>
<td>2020</td>
</tr>
</tbody>
</table>
US LNG Export Terminal Projects

- US is the world’s leading gas producer
- Surge in LNG project announcements
- Over 3 dozen LNG export projects have been announced
- Equates to over 330 MMtpy of LNG export capacity
- Total announced CAPEX = nearly $300 B
- Will all these go through... no

Projects:
- Sabine Pass LNG
- Lake Charles LNG Export Co.
- Corpus Christi LNG
- Commonwealth LNG
- Magnolia LNG
- Venture Global LNG
- SCT&É LNG
- Port Arthur LNG
- Texas LNG Brownsville
- Cheniere Mid-Scale LNG?
- Freeport LNG
- Golden Pass LNG
- Next Decade
- EOS LNG
- Barca LNG
- Live Oak LNG
- Rio Grande LNG
- Anova LNG
- Gulf LNG Liquefaction
- Magnolia LNG
- Calcasieu LNG
- Main Pass Energy Hub
- CE FLNG
- Delfin LNG
- SCT&É LNG
- Louisiana LNG Energy
- G2 LNG
- Gulf LNG
- Cameron LNG
- Driftwood LNG
- Plaquemines LNG

Special Projects:
- Jordan Cove LNG
- Oregon LNG
- Alaska LNG
- Dominion Cove Point
- Southern LNG (Elba)
- Strom LNG
- Eagle LNG
- Crowley
- American LNG
- Jordan Cove LNG
- Oregon LNG
### US LNG export capacity due online by 2020

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>No. of liquefaction trains</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabine Pass LNG</td>
<td>Sabine Pass, LA</td>
<td>5</td>
<td>27.5 MMtpy</td>
</tr>
<tr>
<td>Cameron LNG</td>
<td>Hackberry, LA</td>
<td>3</td>
<td>13.5 MMtpy</td>
</tr>
<tr>
<td>Freeport LNG</td>
<td>Freeport, TX</td>
<td>3</td>
<td>13.2 MMtpy</td>
</tr>
<tr>
<td>Cove Point LNG</td>
<td>Lusby, MD</td>
<td>1</td>
<td>5.75 MMtpy</td>
</tr>
<tr>
<td>Corpus Christi LNG</td>
<td>Corpus Christi, TX</td>
<td>2</td>
<td>9 MMtpy</td>
</tr>
</tbody>
</table>

- Second wave of projects could add nearly 30 MMtpy
- Additional trains at Sabine Pass, Freeport, Corpus Christi, Elba Island, Magnolia LNG and Cameron LNG
Canada refining sector and proposed facilities

Canada’s refining capacity equals 2 MMbpd at 16 operating facilities

The $8.5-B, 240 Mbpd Sturgeon refinery being built to process heavy oil from the oil sands

Kitimat Clean & Pacific Energy Future’s proposed heavy oil refinery projects
Canadian LNG

Proposed LNG terminal projects in British Columbia
- Nearly $170 B in announced projects
- 217 MMtpy – 250 MMtpy in LNG export capacity

Proposed LNG terminal projects on Canada’s East Coast
- $24 B in planned projects
- Over 38 MMtpy of LNG export capacity
Thank you for your time!

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