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Legislative Liaison, Communities for Sustainable Monterey County

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CREATIVE ENERGY FOR IMPORTANT ISSUES

Inside the Great Unknown

14 June 2018

The pH Report
Paul Hodges is a trusted adviser to major companies and investors, and serves as a Global Expert with the World Economic Forum. He is a regular speaker at international conferences, and writes regularly for the Financial Times and other leading media. He has been widely recognised for his pioneering work in identifying the impact of ageing BabyBoomers on the economy, and for his foresight in warning of the 2008 financial crisis.

Paul is also non-executive Chairman of NiTech Solutions and a Director of Recycling Technologies. Prior to launching IeC in 2001, Paul worked in senior positions in petrochemicals and chloralkali for Imperial Chemical Industries (ICI) in the UK and USA, and was Executive Director of a $1 billion ICI business.

He is a Member of the Energy Institute and a Freeman of the City of London. He is a graduate of the University of York, and studied with the IMD business school in Switzerland.
“THERE ISN’T ANYBODY WHO KNOWS WHAT IS GOING TO HAPPEN IN THE NEXT 12 MONTHS. WE’VE NEVER BEEN HERE BEFORE. THINGS ARE OUT OF CONTROL. I HAVE NEVER SEEN A SITUATION LIKE IT.”

KEN CLARKE, FORMER UK FINANCE MINISTER, FEBRUARY 2017

- Global outlook – What is the ACC data trying to tell us?
- Oil markets – Do the hedge funds rule the markets?
- US ethylene expansions – Can all the product be sold?
- Sustainability – Are services the key driver for future growth?

Audience Challenge Question

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT

Since October of 2017, which sectors of chemical production have seen growth?

- Plastics
- Coatings
- Agricultural
- Inorganics
- Synthetic Rubber
ACC DATA SHOWS ALL THE MAJOR SECTORS ARE SLOWING

ACC DATA SHOWS ALL THE MAJOR REGIONS ARE ALSO SLOWING
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**Audience Challenge Question**

ANSWER THE QUESTION ON BLUE SCREEN IN ONE MOMENT

What has been the peak price of Brent oil per barrel so far in 2018?

- $55
- $75
- $80
- $90
- $100
BRENT’S ‘STEALTH RALLY’ TOOK PRICES FROM $44/BBL IN JUNE TO $80/BBL PEAK

HEDGE FUND BUYING WAS KEY TO THE RALLY, AND IS NOW REVERSING

“There are large investors in energy, and they don’t care about talking to people who deal with fundamentals. They have no interest in it.” Ed Morse, Oil analyst, Citi
OIL INVENTORIES HAVE “RETURNED” TO THE 5-YEAR AVERAGE – BUT ONLY BECAUSE RECENT LEVELS HAVE BEEN HIGHER

**OECD inventories are still 10% higher than before 2015**

*Source: International Energy Agency*

US OIL PRODUCTION IS RISING, BUT INFRASTRUCTURE DELAYS MEAN MORE OIL IS BEING STORED

*The pH Report*
MOST US BREAKEVEN COSTS HAVE TUMBLED SINCE 2011 TO ~$30/BBL

<table>
<thead>
<tr>
<th>Oil Breakeven Costs by Shale Play in the U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permian wells. First 6 months' cumulative production per lateral foot</td>
</tr>
</tbody>
</table>

**OPERATING COSTS FOR PIONEER AND OTHERS ARE <$10/BBL**

<table>
<thead>
<tr>
<th>Production Costs (per BOE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workovers</td>
</tr>
<tr>
<td>Gathering, Processing</td>
</tr>
<tr>
<td>Production &amp; Valuation Fees</td>
</tr>
<tr>
<td>LOE</td>
</tr>
<tr>
<td>Natural Gas Processing</td>
</tr>
</tbody>
</table>

Q1 2018 compared to Q4 2017:
- Increase in LOE primarily driven by labor costs, fuel and hot oil rates
- Production taxes higher due to increase in oil prices

LOE = LEASE OPERATING EXPENSES
OIL PRICES WILL LIKELY CONTINUE TO RECONNECT WITH NATURAL GAS/COAL AS HEDGE FUNDS SELL OUT

The median oil price has been $23/BBL since 1861.

The pH Report
OIL PRICES AT TODAY’S LEVELS HAVE ALMOST ALWAYS LED TO RECESSIONS IN THE PAST

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- Global outlook – What is the ACC data trying to tell us?
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- US ethylene expansions – Can all the product be sold?
- Sustainability – Are services the key driver for future growth?
For North American ethylene producers, which of the following assumptions are true?

A. Oil will always be $100 per barrel

B. China will continue to grow at double digit rates and maintain a growing demand for petchem

C. Globalization will continue to enable plants to be half-way across the world from their market

D. Plastics will continue to be the material of choice for single-use packaging

NORTH AMERICAN PRODUCERS HAVE EXPANDED ON THE BASIS OF 4 FALSE ASSUMPTIONS

❖ Oil will always be $100/bbl, giving them a feedstock advantage with shale gas

❖ China will always be growing at double-digit rates, and its petchem imports will always grow

❖ Globalisation will continue and so plants can be sited half-way across the world from their market

❖ Plastics will always be the material of choice for single-use packaging applications
US PRODUCERS ARE EXPANDING ETHYLENE CAPACITY BY A THIRD, WITH TWO EXPORT FACILITIES ANNOUNCED

<table>
<thead>
<tr>
<th>ETHYLENE PROJECTS</th>
<th>CAPACITY</th>
<th>TIMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occidental-Mexichem</td>
<td>550 KT/year</td>
<td>Q1 2018</td>
</tr>
<tr>
<td>Ingleside, Texas</td>
<td>(linked to VCM/PVC)</td>
<td></td>
</tr>
<tr>
<td>DowDuPont Chemical</td>
<td>1.5m tonnes/year</td>
<td>Started up</td>
</tr>
<tr>
<td>Freeport, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>1.5m tonnes/year</td>
<td>H1 2018</td>
</tr>
<tr>
<td>Baytown, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChevronPhillips</td>
<td>1.5m tonnes/year</td>
<td>Q2 2018</td>
</tr>
<tr>
<td>Cedar Bayou, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inodorama</td>
<td>440 KT/year</td>
<td>H1 2018</td>
</tr>
<tr>
<td>Lake Charles, Louisiana</td>
<td>(restart of idled unit)</td>
<td>Delayed from 2017</td>
</tr>
<tr>
<td>Shintech</td>
<td>500 KT/year</td>
<td>Q1 2018</td>
</tr>
<tr>
<td>Plaquemine, Louisiana</td>
<td>(linked to VCM/PVC)</td>
<td></td>
</tr>
<tr>
<td>Formosa Plastics</td>
<td>1.25m tonnes/year</td>
<td>H2 2018</td>
</tr>
<tr>
<td>Point Comfort, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sasol</td>
<td>1.5m tonnes/year</td>
<td>H2 2018</td>
</tr>
<tr>
<td>Lake Charles, Louisiana</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lotte-Westlake</td>
<td>1m tonnes/year</td>
<td>2019</td>
</tr>
<tr>
<td>Lake Charles, Louisiana</td>
<td>(with 700 KT/year MEG)</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>9.74m tonnes/year</strong></td>
<td></td>
</tr>
</tbody>
</table>

**The pH Report**

PE CAPACITY IS EXPANDING BY 40% AND MOST WILL HAVE TO BE EXPORTED

"The reality is that the US from a chemical standpoint is a very mature market. We have some demand growth domestically in the US but it's a percentage or two – it’s not strong demand growth," Pryor said, adding that PE hardly grew in the US in a decade. "That is not going to change...The [US] domestic market is what is it and therefore, part of these products, I would argue, most of these products, will have to be exported".

Stephen Pryor, President, ExxonMobil Chemicals, January 2014

<table>
<thead>
<tr>
<th>PE PROJECTS</th>
<th>CAPACITY</th>
<th>TIMING</th>
</tr>
</thead>
<tbody>
<tr>
<td>DowDuPont Chemical</td>
<td>750 KT/year</td>
<td>Started up Q4 2017</td>
</tr>
<tr>
<td>Freeport, Texas</td>
<td>125 KT/year</td>
<td>H2 2018</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>1.3m tonnes/year</td>
<td>Started up Q4 2017</td>
</tr>
<tr>
<td>Baytown, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ChevronPhillips</td>
<td>1m tonnes/year</td>
<td>Started up Q4 2017</td>
</tr>
<tr>
<td>Old Ocean, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INEOS Sasol</td>
<td>470 KT/year</td>
<td>Started up Q4 2017</td>
</tr>
<tr>
<td>La Porte, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sasol</td>
<td>470 KT/year</td>
<td>H2 2018</td>
</tr>
<tr>
<td>Lake Charles, Louisiana</td>
<td>430 KT/year</td>
<td>H1 2019</td>
</tr>
<tr>
<td>Formosa Plastics</td>
<td>800 KT/year</td>
<td>H2 2018</td>
</tr>
<tr>
<td>Point Comfort, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LyondellBasell</td>
<td>500 KT/year</td>
<td>2019</td>
</tr>
<tr>
<td>La Porte, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>5.85m tonnes/year</strong></td>
<td></td>
</tr>
</tbody>
</table>
US NET PE EXPORTS HAVE FALLEN SINCE 2015

THE MIDDLE EAST HAS CAPTURED MOST OF CHINA’S DEMAND GROWTH SINCE 2015
CHINA IS PLANNING 6MT OF NEW PE CAPACITY BY 2022

China aims for a balanced to long position, with surplus exported via Belt & Road Initiative

<table>
<thead>
<tr>
<th>Name of company</th>
<th>New capacity</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zhongtianbechuang Erdos MTO</td>
<td>37.0</td>
<td>LOPE</td>
</tr>
<tr>
<td>Jizhui Noyauran Erdos MTO</td>
<td>25.0</td>
<td>HDPE</td>
</tr>
<tr>
<td>Shenhua Ningmei Chemical</td>
<td>45.0</td>
<td>LLDPE</td>
</tr>
<tr>
<td>CNPC Beizhou</td>
<td>40.0</td>
<td>FDPE</td>
</tr>
<tr>
<td>Shandong Jinzhong MTO</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Yancheng Fuzian</td>
<td>45.0</td>
<td></td>
</tr>
<tr>
<td>Sinopac Zhanjiang</td>
<td>35.0</td>
<td></td>
</tr>
<tr>
<td>Zhejiang Petrochemical</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Sinogem Huanzhou</td>
<td>40.0</td>
<td></td>
</tr>
<tr>
<td>Shaoguan Yuhang (II)</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>Shandong Bintou (I)</td>
<td>20.0</td>
<td></td>
</tr>
<tr>
<td>China Power Investment Erdos</td>
<td>31.0</td>
<td></td>
</tr>
<tr>
<td>China North Panjin Petrochemical</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Sinopac Zhoushan Huangsha</td>
<td>35.0</td>
<td></td>
</tr>
<tr>
<td>Qinghai Kunzige</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Qinghai Domei</td>
<td>30.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47.0</td>
<td>271.0</td>
</tr>
</tbody>
</table>

CONSUMERS AND BRAND OWNERS ARE MOVING AWAY FROM SINGLE-USE PLASTICS

The pH Report

Source: CICCC

The pH Report

Source: BBC Blue Planet 2
SUSTAINABILITY IS REPLACING GLOBALISATION AS A KEY DRIVER FOR POLYMER INDUSTRY PROFITS

PLASTICS HAVE BEEN KEY TO THE PETCHEM BOOM

Source: Production, use, and fate of all plastics ever made, American Association for the Advancement of Science, July 2017
Since 1950, what has been the largest application for plastics?

- Building and Construction
- Packaging
- Textiles
- Electrical/Electronic Materials

Source: Production, use, and fate of all plastics ever made, American Association for the Advancement of Science, July 2017
MORE THAN HALF OF ALL PE IS USED IN PACKAGING,
AND NEARLY 1/3rd OF POLYPROPYLENE

POLYETHYLENE USE IN PACKAGING
MILLION TONNES, %, 2016

<table>
<thead>
<tr>
<th>Application</th>
<th>Tonnage (MT)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Packaging</td>
<td>41</td>
<td>45%</td>
</tr>
<tr>
<td>LLDPE Flexible</td>
<td>33</td>
<td>36%</td>
</tr>
<tr>
<td>HDPE Rigid</td>
<td>8.4</td>
<td>9%</td>
</tr>
<tr>
<td>HDPE Flexible</td>
<td>10</td>
<td>10%</td>
</tr>
</tbody>
</table>

POLYPROPYLENE USE IN PACKAGING
MILLION TONNES, %, 2016

<table>
<thead>
<tr>
<th>Application</th>
<th>Tonnage (MT)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Packaging</td>
<td>48</td>
<td>70%</td>
</tr>
<tr>
<td>Flexible Packaging</td>
<td>14.7</td>
<td>22%</td>
</tr>
<tr>
<td>Rigid Packaging</td>
<td>9.5</td>
<td>9%</td>
</tr>
</tbody>
</table>

SOURCE: ICIS CONSULTING, THE pH REPORT

The world has produced 8.3 billion tonnes of plastic since 1955, and only 9% has been recycled

National Geographic, July 2017

The pH Report
2018 WILL SEE WINNERS AND LOSERS APPEAR

WINNERS
- Ethylene consumers around the world, due to market share battles
- Middle East ethylene/PE producers due to “Belt & Road Initiative” membership
- Chinese ethylene/PE producers as government aims for self-sufficiency

LOSES
- Non-integrated ethylene/PE producers in Europe/Asia as margins are hit
- Non-integrated US ethylene/PE producers as new capacity seeks a domestic home
- European/Asian consumers down all major value chains could be impacted if naphtha-based crackers have to reduce rates or close

SOURCE: THE pH REPORT

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SUSTAINABILITY IS REPLACING GLOBALISATION AS A KEY DRIVER FOR BUSINESS

The pH Report

FUTURE CHEMICAL INDUSTRY GROWTH WILL BE DRIVEN BY SERVICES

The pH Report

SOURCE: THE pH REPORT
NOVEMBER’S SIX KEY QUESTIONS ARE EVEN MORE RELEVANT TODAY

HOW DO WE ENSURE THAT OUR BUSINESS WILL SURVIVE AND PROSPER?

MANAGING RISKS

❖ How will our P&L be impacted by a sustained period of low global GDP growth?

❖ How might trade wars and China’s slowdown impact key customers/supply chains?

❖ What is our contingency plan for a return to major oil/interest rate volatility?

INVESTING TO BUILD THE BUSINESS

❖ How will we compete profitably as sustainability rises up the agenda?

❖ Can we create new service-led offerings to meet emerging market needs?

❖ Can we gain first-mover advantage whilst others hope for “business as usual”?

The pH Report

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William Carroll
Adjunct Professor of Chemistry, Indiana University and Founder, Carroll Applied Science

Paul Hodges
Chairman, InternationsInChem

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