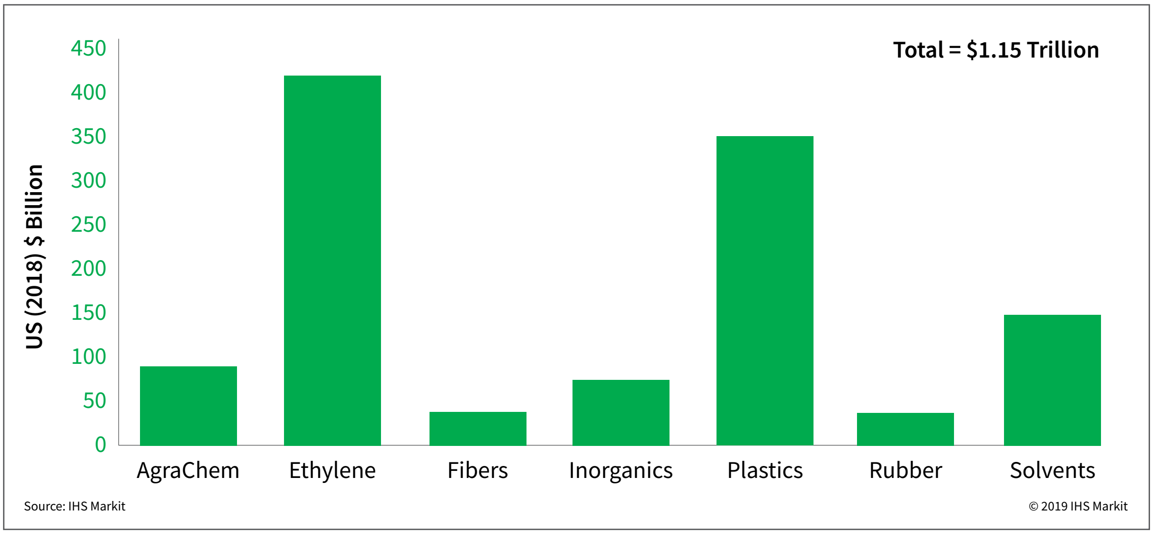
IHS Markit®

Capital Deployment

A look inside our technology & economic analyses from the 2019 – 2016 Process and Economics Program (PEP)

*Featured reports in this document are a part of a continuing technology and economics PEP offering on Capital Deployment

IHS Markit expects about 1 trillion dollars to be spent on new investment in the chemical industry globally, between now and 2030.



Over the past two decades, the focus behind investment selection decisions have changed, owing to the technology and commercial state-of-there industry. In mid-2005, the emphasis was on advantaged feedstocks and then it was about state-of-the industry technology development and the selection of process technology to enable the use of the abundant and low-priced (advantaged) feedstocks. In the past 5 years regional competitiveness has had increasing importance in capital deployment decisions. Specifically, country macroeconomic dynamics including labor-related cost inflation, shortage of skilled labor in developed countries and construction-related technical advances in developing countries have caused relative capital construction variations across the globe.

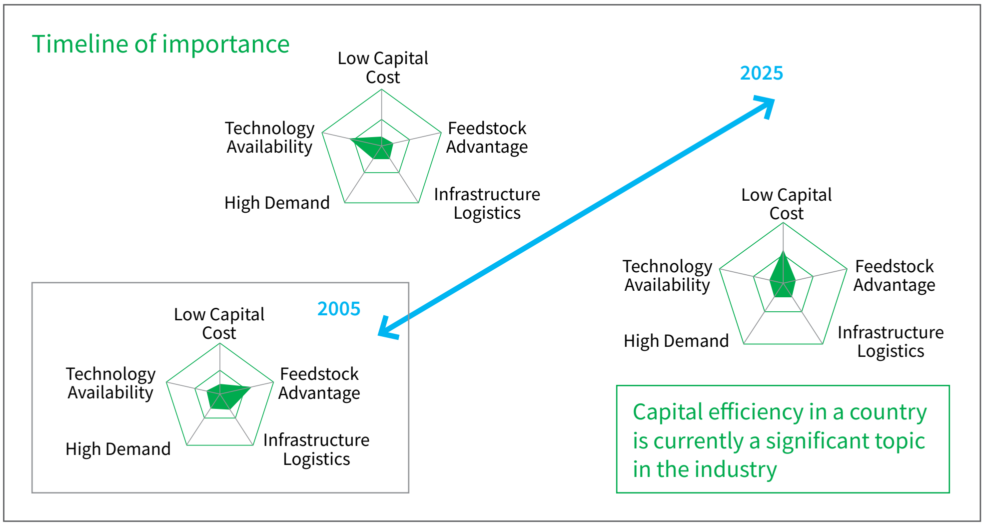
For example:

- ✓ China has evolved to a very competitive capital cost position with a location factor below 0.6 relative to the USGC due to efficient construction methods, good skilled labor productivity, low labor costs and, extensive domestic equipment manufacturing capabilities
- ✓ Employing offshore procurement and off-shoring strategies during EPC implementation, can drive the location factor in KSA to <0.9 versus the more traditional >1.15 relative to the USGC.

The implication is that project development and capital appropriation decisions are being more and more complex because of:

- Increasing capital intensity (cost per ton of constructed capacity) against very dynamic country investment costs on an absolute and relative basis
- Long plant lives in an everchanging business, environment needs as well as emerging disruptive technology change the “technical world order”
- An overall scarcity of capital available to stakeholders and owners

Along these lines, and with scrutiny on capital investment, we have published within IHS Markit’s Process Economics Program (PEP), several reports on the cost data, methodology and analytics that we have used in the development of PEP's equipment and total capital cost estimates over 1800 process technologies evaluated in our published reports.



The Process Economics Program (PEP)

PEP provides in-depth, independent technical and economic evaluation of both commercial and emerging technologies for the chemical, biochemical, and refining industries. For 56 years, PEP has and continues to analyze the impact of changes in processes, feedstocks energy prices, and government regulations on chemical and fuel production economics for our clients

Benefits

New technologies can either offer an opportunity or pose a threat. Prompt and thorough analyses of new developments are crucial to making the proper decision—whether you are exploiting a proprietary technology or responding rapidly to a competitor's move. PEP reduces the time and costs associated with collecting and interpreting the voluminous information needed to assess new technologies.

Clients make use of PEP's independent analyses—which draw on our experts' industry experience in process design, cost estimation, and R&D planning—to make informed decisions. Complementing that expertise are the program's extensive databases and ongoing contacts with chemical companies worldwide.

IHS Markit creates content with our Chemical Engineers & Chemists….

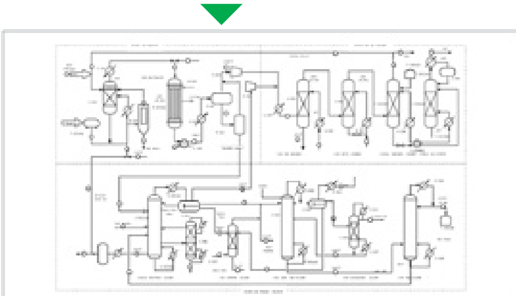
….and want our customers to be able to use it "all"

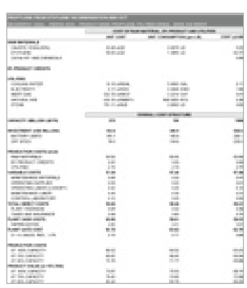
Our Analytics are "bottom-up". We develop:

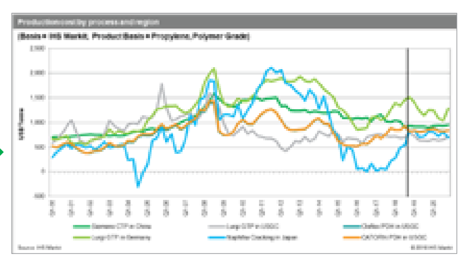
- Design Basis
- Process Flow Diagrams
- Heat and Material Balance
- Equipment One-Line Specs

We develop:

- Detailed **Capital Investment and Operating Cost** Estimates for each product
- Using our Propriety Cost Estimating Software (PEPCOST)







Recent IHS Markit PEP Reports and Reviews relating to capital investment cost and deployment

Dynamic Location Factors PEP Review: 2019-12 (May 2019)

Abstract

In our continuous discussions with clients around the world, a topic of frequent interest and priority is the variation between construction cost levels in different locations ("Location Factor"). In general, much of the relative cost fluctuation can be attributed to wide swings in global currency exchange rates and, in some regions, improving skilled labor productivities, local labor rates and project development procurement strategies.

To help our customers understand the fundamentals of location factors, we conducted primary market research and developed a location factor model and methodology that reflects IHS Markit macroeconomics and the country-specific costs needed to develop relative location factors for the construction of petrochemical, chemical and refinery plants. The results and methodology were published in our Location Factor PEP Report RP 204C (December 2016) described below. In this 2019 PEP Review (like 2016 Report 204C), we include geographical coverage of 12 locations:

1. Brazil
2. Canada (Alberta)
3. China (coastal)
4. Germany
5. India
6. Japan
7. Poland
8. Russia (Surgut, Western Siberia)
9. Singapore
10. Saudi Arabia
11. South Korea
12. United States (Gulf Coast)

Any geography can be set to 1.0 as the basis country. Note that the base case shows location factor subcomponents relative to the US Gulf Coast and are on a third quarter 2016 basis.

An important user experience of the PEP Review 2019–12 Location Factor Model is enhanced functionality for customers, who can now:

- Estimate a 10-year forward view of location factors.
- Set and/or view scenario conditions (e.g., “test” alternate labor and equipment EPC business models/approaches).
- Input the user’s own time series of macroeconomics and cost data.

Location Factors PEP Report: 204C (December 2016)

Abstract

In discussions with our clients in recent years, one of the topics that they bring up most frequently has been the rapid change in relative construction cost levels between different locations. Much of this cost fluctuation can be attributed to recent wide swings of exchange rates for most global currencies. In this report, we update our location factors calculation methodology to reflect new data sources that are available now that IHS has merged with Markit. We also expand our coverage to 11 locations—Canada (Alberta), Brazil, Germany, Poland, Russia (Surgut, Western Siberia), China (coastal), India, Japan, Korea, Singapore, and Saudi Arabia. All of the location factors are relative to the US Gulf Coast and are on a third quarter 2016 basis.

While our base case examines petrochemicals, we also provide separate factors for refining and polymers processes for all of the locations. In addition to the location factors, we have also prepared the corresponding chemical process industry (CPI) sector-specific purchasing power parities. We have developed historical time series for all of the location factors and purchasing power parities. In addition, we have prepared historical time series for many of our data sets. These include worldwide CPI skilled construction labor, engineering, and project management wage rates. Also presented are historical time series for local major equipment price levels, and for steel, electric, and civils bulk materials.

Estimation of Project Cost beyond EPC Construction Costs PEP Review: 2017-15 (February 2018)

Abstract

PEP has traditionally provided cost estimates that are limited to EPC (engineering, procurement, and construction) costs and contain a minimum of presupposition. We assume, for example, instantaneous construction and do not include the cost of land. This is deliberate—we want a client who intends to use our estimates in a more formal analysis not to have to back out numerous IHS- generated assumptions.

Total owner's cost goes beyond this, however, and contains significant "other costs" that are required "from concept to commercialization." Clients have from time to time asked us for guidance in identifying and then quantifying these additional cost burdens. These costs can be capital costs or noncapital costs, and they open our consideration beyond the physical boundaries of the plant to include infrastructure requirements that are necessary for the plant to be made operational.

This report details our analysis of significant project development costs, from concept to commercialization, which includes but is not limited to EPC costs. Since every construction project is unique, we present these costs as a range of the percentage of the EPC capital cost estimate. In this way, the client can use the PEPCOST EPC estimate as a starting point, and then build up their own estimate. We present our estimates of the likely ranges of investment required for product definition and development, permitting, and cost activities prior to the final investment decision. We also examine infrastructure costs both just outside the plant gate and remote from the plant. We identify and quantify those EPC costs beyond the typical PEPCOST estimate. Finally, we quantify financial costs during construction as well as requirements for working capital;

Battery Limits Cost Estimation PEP Report: 145C (January 2017)

Abstract

The Process Economics Program (PEP) provides a wide range of plant investment and economic estimates for process technology in the chemical, polymer, and refinery industries. These conceptual designs and economic assessments depend on reasonable estimates of costs for the process equipment used in each design. To accomplish this, PEP must periodically address the methods used to estimate such costs, which in turn involves an assessment of the correlation methods of each equipment type. New equipment types should also be added at such times, the enhance the breadth of the equipment classes covered, as well as to update existing types to account for changes in the equipment manufacturing industry and address new data and expand limits.

This report updates the algorithms and correlations used to estimate battery limits capital costs built into PEP's costing method (PEPCOST) and adds a number of new equipment types that previously required manual entry of hand calculations because PEPCOST did not previously include estimation methods for them. A total of nearly 3,500 new or updated correlations are included, counting equipment costs, setting labor, material costs, and labor requirements for each bulk installation component (piping, civil, structural steel, instrumentation, electrical, insulation, and paint). The results of this effort are applicable to the chemical, petrochemicals, oil refining, and specialty chemical industries. Food and pharmaceutical industries are less applicable because most process equipment in those areas require built-in "clean-in-place" or "sterilize-in-place" features, for which the process industries noted previously do not need.

The goal of this project has been to upgrade and enhance PEP's ability to prepare cost estimation data for the preparation of AACE Class 3 estimates with minimum design engineering effort.

Accounting for Carbon Emission Cost in Chemical Production Economics PEP Review: 2017-12 (October 2017)

Abstract

With the signing of the Paris Climate Agreement in December 2015, pressure is mounting for all 197 countries that signed the agreement to reduce global greenhouse gasses (GHGs) emissions. In particular, the 135 countries that submitted NDCs (nationally determined contributions) need to develop a credible plan and adopt a workable mechanism, such as a carbon trading system (CTS), to meet their reduction targets by 2030. The chemical industry, being one of the most energy-intensive industries, will certainly be a major target for emission reduction.

This review investigates how to account for carbon emission cost in the chemical production economics and assesses its impact on the competing processes and regions, including:

- Ammonia production from coal and natural gas in China and from natural gas in the USGC
- Urea production from ammonia in the USGC and China
- Integrated ammonia-urea production from natural gas in the USGC and from coal in China
- Ethylene production by wide-range naphtha steam cracking in the USGC, Germany, and China; ethane steam cracking in the USGC; and coal-to-olefins (CTO) in China
- Chlor-alkali production by membrane cell technology in the USGC, Germany, and China
- Bio-isoprene production from glucose in the USGC

A template is provided for each process/region in a Microsoft Excel interactive file that uses a reference process in the PEP database, so that the impact of adding carbon emission cost to the variable cost, cash cost, and net production, etc., can be seen with a few mouse clicks. Our clients can enter their own raw material and utility prices and unit consumption, and specify their own carbon emission intensity, carbon emission benchmark (allowance), and carbon emission cost to develop customized production economics, should the client's numbers deviate from those in the PEP database.

Ammonia is selected since there is a proposed methodology on how to set an emission benchmark (allowance) in China. Urea is chosen to represent a process that consumes CO2 as a major raw material. Integrated ammonia-urea processes are examined to see if including carbon emission cost in the production economics will alter an ammonia or urea producer's decision to integrate or operate as a stand-alone plant. Ethylene is selected since it is the highest commodity chemical, and it can be produced from ethane, naphtha, and coal, each emitting a very different amount of CO2. Chlor-alkali is chosen to represent a process with high electricity consumption. Bio-isoprene is selected to represent a biomass-based process.

We also provide a summary of the status of global greenhouse gas (GHG) emissions in major regions, with emphasis on the chemical industry; a review of current emission trading systems in major regions and recent carbon emission prices; and an example of how to set carbon emission benchmarks (allowances).

Visit us at

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About IHS Markit

IHS Markit (Nasdaq: INFO) is a world leader in critical information, analytics and solutions for the major industries and markets that drive economies worldwide. The company delivers next-generation information, analytics and solutions to customers in business, finance and government, improving their operational efficiency and providing deep insights that lead to well-informed, confident decisions. IHS Markit has more than 50,000 key business and government customers, including 80 percent of the Fortune Global 500 and the world's leading financial institutions. Headquartered in London, IHS Markit is committed to sustainable, profitable growth.

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