OIL LIES, DAMN LIES & STATISTICS

Why We Are Confused About Oil "Facts"

*By James M. Day**

Lost in Translation

Mark Twain attributed his often quoted quip, "There are three kinds of lies: lies, damn lies, and statistics," to Benjamin Disraeli. The British prime minister and American literary lion were masters of a different English, nevertheless their clarity was understood on both sides of the Atlantic. Unlike the words of Twain or Disraeli, writing is often the root of confusion and misunderstanding, and the complex world of petroleum law is a prime example of that confusion and misunderstanding. George Ives, Jr., publisher of *Pipeline and Gas Technology*, claimed in a September 2005 editorial that petroleum engineers' technical papers "are well-written, with logical conclusions."[1] He begs to ask the question, however, "Can engineers can write non-technical papers or communicate with those outside engineering?" Ives noted that the magazine's contributing editor, Doyle Stevens, placed the blame on university professors who insist that engineering students take more technical courses and forgo classes aimed at developing writing skills.[2] Yet, that is only a part of the problem.

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Two decades ago, Harvard's Nobel laureate in economics, Wassily Leontif, wrote of his concern about the isolation of academic economists.[3] MIT Professor Emeritus Morris A. Adelman opined in his seminal work, *The Economics of Petroleum Supply*, "[M]any of the questions require dialogue and even co-operation between economists and engineers."[4] Recent papers from academia have proffered collaboration between the sciences and economics because of the preeminence of economic thinking in our capitalistic society. All made excellent cases for an interdisciplinary study of the world's petroleum reserves, a subject of bitter debate today. But (a big *BUT*), interdiscipline studies of petroleum issues must include major contributions from petroleum industry technical and financial professionals and other professions, including lawyers.

Although the U.S. government has shied away from integrated discipline studies, except to pick and choose opinions for political reasons, business depends on interdiscipline analysis for major investment decisions. An excellent petroleum industry example is the multi-billion dollar production sharing contracts with foreign nations. Such investments involve a team of geologists and geophysicists (eternal optimists at finding oil), petroleum engineers (perpetual pessimists, who must produce the oil based on the geologists and geophysicists' "discoveries"), bankers (money men), accountants and tax specialists (number

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crunchers), economists (risk managers), businessmen and politicians (political and business risks), environmentalists and anthropologists (pollution and cultural issues), lawyers (to write understandable contracts), and the company official who makes the final decisions and keeps the mélange working as a team. The success of any major business venture or meaningful study depends upon analysis by diverse professions that can communicate with each other. Without the views of the overlapping fields, neither governments nor industry can solve the complex technical and economic issues.

Sources, Bias & Fudge Factors

How reliable is the information in newspapers, magazines and books and on television? According to Lenburg's *Guide to Research*, "In the mainstream media today, assumptions, inferences, opinions, and editorializing are rampant and confused with fact."[5] As for Internet research, it is a swampland mired with misinformation and propaganda. Self-styled documentaries, exposés and news compound the lack of verifiable data with quotes from "experts." One must look with a jaundiced eye at quotes from amorphous "industry experts" and "government officials" and statements like "intellectuals believe," the latter often connoting the unemployed. No article can be considered reliable unless the reader is made aware of the writer's and source's industry, government, political, and environmental affiliation or bias.

Typically, the media adds anecdotal evidence of an "energy crisis" with comments from an *average* American, like an unemployed single mother with two children, about the price of gasoline hitting $3.00 a gallon. After she complains about price gouging by "oil companies and the Arabs" and sips her bottle of Evian water, the newsman adds that the price of gasoline has soared 50 percent in the last two years. The commentator generally fails to mention whether two years ago OPEC had raised production to lower prices, the nation was suffering from an economic slowdown, or it was discount day at his Chevron station. Perhaps he didn't mention her Evian water cost $10.50 per gallon because Evian spells NAIVE backwards. She was included in the story to gain sympathy, and the reader is not told the causes of gasoline price increases. Except for hard news, newspapers and magazines must be vetted for serious study, reputable scholarly journals being a possible exception.

Professor Adelman also warned: "The student of petroleum economics must take as his guiding motto: *Beware of averages*."[6] Averages can be misleading unless a supporting framework is provided. The average American's income includes Microsoft's Bill Gates and the young man who cooks your Big Mac at McDonald's. If Company A had an oil production increase of 20 percent and Company B's only increased 15 percent, it does not necessarily mean A was more successful. A's production may have increased from 10,000 to 12,000 barrels per day (b/d) and B's production increased from 100,000 to 115,000 b/d, making B's *gross production* more successful. If B's oil was lighter and sweeter, it would earn more because of its value, or if B's production costs were less, B's *net income* could be far greater. Citing a percentile is a meaningless adjective unless supported by the basis.

Writers quote statistics to prove their theories. Even one of our most relied upon sources of financial information, the *Wall Street Journal* (*WSJ*), can be guilty. On September 6, 2005, it reported:

> The refining industry is one of historically meager returns. So poor was business that the number of U.S. refineries has declined to 149 today from 325 in 1981, according to the petrochemical and refiners association. With no new refineries built since 1976, capacity for refining crude oil fell 10% to 16.8 million barrels a day from 18.6 million barrels over the same period.[7]

Maintaining petroleum statistics contains numerous pitfalls.

On September 28, 2005, a *WSJ* editorial on "Refining Capacity" contained a similar paragraph:

> In 1981, there were 325 refineries in the U.S. with a capacity of 18.6 million barrels per day. Today, there are 148, with a capacity of about 17 million barrels though the U.S. demand for gasoline has increased more than 20%. From 1993 to 2002, the average return on investment in the refining industry was 5.5%, or less than half the S&P industrial average of 12.7%.[8]

While I agree with the *WSJ* that U.S. refining capacity is woefully short and we must now import around one million b/d of gasoline, I knew refineries appeared after 1976. Research revealed the Department of Energy's (DOE) Energy Information Administration (EIA) reported 48 refineries were added between 1977 and 1981,[9] although the vast majority, or all, were not new, but taken out of mothballs. The EIA list of 48 refineries added to refining capacity fails to differentiate whether new (grassroots) refineries were built or old refineries were reopened after 1976, which was described by an EIA analyst as a "murky area."

Even if there were no "new" refineries, the *WSJ* failed to mention the reasons for the loss of operating refineries after 1980. Until 1981, the DOE enforced price and allocation controls on crude oil and petroleum products that heavily subsidized small and medium size refineries, most of which were simple distillation plants. Those with a 10,000 b/d capacity or less, derogatorily called "teakettles" or "refiner bias babies," received up to about $1.80 per barrel under the DOE's ill-conceived entitlements program. The entitlements largess was shared by refineries with a capacity of less than 175,000 b/d on a scale inversely proportional to their capacity. Subsidies invited a proliferation of small and inefficient refiners, seven of whom had capacities of less than 1,000 b/d, when the minimum-sized refinery considered to take advantage of technology and economies of scale was 200,000 b/d. Of the 142 refineries closed during the 1980s, 122 had capacities of 30,000 b/d or less, including 77 of 10,000 b/d or less. The vast majority was eventually forced to shut down because they could not compete without the small refiner bias, produce unleaded gasoline, or meet the 1970 Clean Air Act Amendments.

The *WSJ* mixed apples and oranges by blaming the loss of refinery capacity on no new refinery construction since 1976 and a refinery capacity of 18.6 million barrels per day (MMb/d) in 1981 falling 10 percent to 16.8 MMb/d. Refining capacity was only 15.2 MMb/d in 1976, according to the DOE, which means it increased 1.6 MMb/d by 1981, a period when no new refineries were supposed to be constructed, according to the article and editorial. A simple analysis would have disclosed a glut in refining capacity 1981 caused by the inefficient small refineries. The *WSJ* failed to mention that 1976 refinery capacity utilization was 87.6 percent but only 68.6 percent in 1981, compared to the mid-September 2005 capacity utilization of 90.0 percent and mid-September 2004 capacity utilization of 93.1 percent.[10] (A proper comparison requires noting the 2005 percentage was affected by hurricane Katrina's damage to Gulf of Mexico refineries and production.)

Finally, the *WSJ* adds onions to its apples and oranges editorial compost by comparing the average return on investment of 5.5 percent in the refining industry to the Standard and Poor's industrial average of 12.7 percent between 1993 and 2002. Questions: What do 1993 and 2002 have to do with the decline in refining capacity between 1976 or 1981 and 2005? Why did the editor end the comparison in 2002? If he read page A2 of his paper on July 26, 2005 (two months earlier), he would have learned that one of his reporters wrote a succinct reason for the current soaring oil company profits: "high oil prices and fat refining margins."[11]

Why Be Concerned About Minor Differences?

Petroleum is marketed in mind-boggling quantities. The EIA estimated 9,063,000 barrels of gasoline were consumed daily in the U.S. during 2004, which amounts to 380,646,000 gallons. As 2004 was a leap year (i.e., 366 days), Americans consumed an estimated 139,316,436,000 gallons of gasoline.

It is not just a humungous statistic when converted into money. *Did you notice the 9/10 cent at your gasoline station when you last filled up? The 9/10 cent amounted to $3,425,814 a day and totaled $1, 253,847,924 in 2004.* As the late Senator Everett McKinley Dirksen warned, "A billion here, a billion there, and pretty soon you're talking big money."

Responses to inquiries how and why the "9/10 cent" practice developed were unvarying. The DOE, API, and *Oil & Gas Journal* answers were that the practice was similar to the retail pricing practice of not charging a round number, such as $1.95 instead of $2.00.

Barrels, Gallons, Liters, Tons & Tonnes Confusion

Oilmen have dealt in barrels since Colonel Edwin L. Drake drilled America's first oil well in 1859. Barrels were ideal containers, but came in various sizes and the United States had no barrel standards. The sudden huge demand for barrels drove their cost higher than the value of oil they were containing. With purchasers demanding a standard oil barrel, Pennsylvania coopers looked to British standards established under King Edward IV in 1482 and selected the 35-imperial gallon herring barrel over the 36-gallon beer barrel, 32-gallon ale barrel and 31½-gallon wine barrel. (Pay no attention to a joke of the era that the herring barrel was selected over the beer barrel because it might create a beer shortage or make beer taste bad.) In 1866, the Pennsylvania Oil Regions Petroleum Producers Association adopted the herring barrel that eventually became accepted in international trade.

The oil industry no longer depends on barrels to transport petroleum, but the 42-American gallon barrel remains the standard international measurement for crude oil production and petroleum products in wholesale commerce. Retail sales are

marketed in gallons and motor oil is sold it quarts in the United States, one of the few nations not committed to the metric system (Système International d'Unités). The British have also been slow in fully adopting the metric system, as have Liberia and Bangladesh. There are numerous occasions when confusion between the systems resulted in costly errors. Most infamous was the loss of the Mars Climate Orbiter in 1999 caused by the National Aeronautics and Space Administration's use of the metric system and Lockheed Martin Astronautics designing the software for the Orbiter's thruster engine in pounds, rather than Newtons, sending it crashing into the surface of Mars.

Writers often refer to either barrels or gallons to sway opinion. Oilmen measured the *Exxon Valdez* oil spill in Alaska's Prince William Sound at 260,000 barrels and the media and environmentalists claimed the spill was 11 million gallons. Doesn't "millions" sound worse than "thousands"? The world's worst oil spill occurred in 1978 when the *Amoco Cadiz* ran aground on the French coast and broke apart, spilling its entire cargo. Over six times greater than the *Exxon Valdez*, Amoco listed the spill at 219,617 long tons of Arabian and Iranian light crude, which doesn't sound as bad as 1,640,540 barrels or 68.9 million gallons.

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Americans are not the only ones confused. Outside the United States, gasoline and diesel oil are marketed in liters (3.7854 liters/gallon). In the 1980s, Shell (Dutch/British) bid to supply diesel fuel to the American Samoa Government (ASG) and erred in converting the volume to gallons, resulting in Shell substantially underbidding the other suppliers and losing money on the contract. When Shell attempted to rescind its bid, as counsel for the ASG, I merely recited a basic legal maxim: *One is presumed to know the law of a nation and the customs of an industry.*

Petroleum expands under heat and contracts at low temperatures. As a result, there are standard temperatures and pressures used in the sale of petroleum. Crude oil and petroleum products are sold at 60° Fahrenheit (15° or 15.6° Celsius) and 14.65 psi pressure (101.325 kpa), except in less developed countries without temperature correcting meters and several major producing nations. American Samoa's average temperature of 84° Fahrenheit resulted in a supplier illegally overcharging the Samoan consumers approximately $360,000

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during a three year period because it failed to install temperature correcting meters.

Maintaining petroleum statistics contains numerous pitfalls. The *Energy Statistics Manual* ("*Manual*") of the Paris-based International Energy Agency (IEA), established in 1974 under the framework of the Organization for Economic Co-operation and Development (OECD), recognizes that oil is measured in barrels in commerce. Nevertheless, it requires its reports to be converted to thousand metric tonnes. As the OECD includes only 30 member nations, the rest of the world is not bound by its 193-page *Manual*. As a result, non-OECD nations often submit reports not always within the precise dictates of the *Manual*. To add to the inconsistencies, the *Manual* requires natural gas liquids be included in crude oil, although many nations do not, including the U.S. and most Middle Eastern producers.

Misunderstandings distort petroleum reserves and production statistics and infect press reporting. I cannot count the times I have read "ton" when the correct term should have been "tonne." A "short ton" of 2,000 lbs. is used in the United States and a "long ton" of 2,240 lbs. is *generally* used in Great Britain. A ship's capacity, including oil tankers, is measured in "deadweight tons" in long tons, which also refers to 100 cubic feet capacity. A British Petroleum (BP) official, after unloading a cargo of petroleum on American soil, reflected whimsically that he calculated the tonnage tax in long tons rather than a "damn American short ton." A "tonne" is the metric tonne (MT) of 2,204.6 lbs, slightly over 10 percent more than the American short ton. As the weight of crude oil and petroleum products varies in relation to its °API gravity, converting barrels to tonnage constitutes another potential cause of error, as shown in the following:

Description °API	Short Tons	Metric Tonnes	Long Tons
Heavy crude 26	6.36	7.02	7.13
Light crude 34	6.69	7.37	7.49
Gasoline 55	7.54	8.31	8.44

An oil industry rule of thumb used to "guesstimate" the number of barrels is 7.3 or 7.33 barrels per metric tonne (bbl/MT). The IEA uses an estimate of 7.37 barrels. However, average estimates can be misleading, as shown by two crude oils from Sumatra: Minas is 35.2 °API and contains 7.38 bbl/MT and Duri is 26.5 °API and is only 6.75 bbl/MT, a difference of 9.33% per barrel.

The IEA prefers to state the specific gravity of petroleum compared to water. As the density of water is 1 gram/cubic meter, it records a petroleum's specific gravity as a percentage of water, contrary to commercial practices that utilize API degrees. The IEA admits the system developed by the American Petroleum Institute (API) is universally followed. Several years ago, I discovered that several Former Soviet Union petroleum engineers had never heard of the practice, nor were familiar with the method to compute (API gravity from specific gravity, which is relatively simple.[12] The IEA Manual adds to the confusion by requiring petroleum be converted to "metric tons." In spite of its dictates, the IEA has to refer to API degrees when referring to light and heavy crude oils because it is universally used in international commerce.

The IEA and EIA classify crudes "generally greater" than 38 (API as light and those less than 22 (API as heavy. Neither is realistic. Notwithstanding the IEA and EIA bureaucracies, there are no standards recognized by the petroleum industry or national oil companies throughout the world. Bob Tippee, editor of the Oil & Gas Journal, writes, "In general, heavy crudes have API gravities below 25°; mediums have API gravities of 25–32°; lights have API gravities higher than that."[13] Norman J. Hyne, noted petroleum author and professor of Petroleum Geology at the University of Tulsa, agrees heavy crude is below 25°API, but opines that light crudes are 35°API and above.[14] Both views are accepted in the petroleum industry. Crude oils are labeled by the suppliers, as witnessed by the listing of crude oils in the OPEC basket of crudes for pricing: Saudi Light 34 °API, Nigeria Bonny Light 37 °API, and Venezuela Tia Juana Light 31 °API. Light crude oils can be refined into more gasoline and other high value products, resulting in a higher price. Tia Juana Light should be rated medium, but most Venezuelan crude is heavy gunk, and "light" is a Venezuelan sales pitch.

Aberrations & Perversions

Oil and gas statistics are often perverted by "barrels of oil equivalent" (boe). A common practice is to combine the oil and gas reserves and production based on the *approximate averages* of the heat value of oil and gas on a British thermal unit (Btu) ratio of one barrel of oil being equivalent to six cubic feet of natural gas, expressed as 6:1. Rule of thumb averages are misleading. Crude oil and gas vary in Btu value. Most companies calculate the boe by *actual* Btu values; for example, 5.75:1, which would increase the gas boe by 4 percent above the *averages*. If one utilizes the *average* crude oil and *average* natural gas at the wellhead, the ratio would be closer to 5.6:1. The Society of Petroleum Engineers recommends a reasonable approximation be based on 35°

API oil, where the gas is dry at the point of sale, which results in a conversion factor of 5.8:1.

The Btu ratio or thermal content is only one factor in determining the characteristics and value of oil and gas. "Paper" natural gas is traded on the New York Mercantile Exchange (NYMEX) at per one million Btu, theoretically accounting for space heating and boiler use. However, the Btu value of natural gas is not necessarily a useful basis for measuring a value to all purchasers, such as the chemical industry, nor is it a proper measure for all petroleum products. Moreover, according to Professors Adelman and Watkins, thermal conversion is an "economic fiction."[15] Their relative market values are controlling and subject to change. What matter are the volumes of the oil and gas and their market value on a specific date.

Petroleum marketing and government regulation require precise measurements based on standard tests developed by the American Society for Testing Materials and other scientific organizations. Contracts for the purchase of petroleum include dozens of specific tests for impurities, stability and performance, such has Btu content, flash point, pour point, sulfur and octane, to mention a few. As different tests may produce varying results, contracting parties and government regulations designate specific test procedures. After the passage of the Natural Gas Policy Act of 1978 (NGPA), the issue was raised whether the "wet" or "dry" method was required under the NGPA to measure the Btu content of natural gas, which was decided in *Interstate Natural Gas Assoc. of America v. Federal Energy Regulatory Coms* in 1983.[16] The Federal Energy Regulatory Commission (FERC) issued a regulation changing from the wet to the dry method at the first sale at the wellhead, which had been used by FERC and the its

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predecessor agency, the Federal Power Commission, under the Natural Gas Act of 1938 for fifteen years and was a long-time industry standard. The court ruled FERC's dry method would raise the wellhead price 0.07% above the maximum ceiling prices set by Congress per one million Btu (MMBtu) under the NGPA and was contrary to the intent of Congress. Refunds resulting during the five years of FERC's inept and confusing rulemaking and litigation exceeded $1 billion.

Natural gas is traded on the NYMEX and primarily sold based on heat content. Pure methane in 1,000 cubic feet (Mcf) amounts to 1,009, 1,012 or 1,031 MMBtu, depending on the test utilized. This requires that parties to gas sales contracts to agree on a specific Btu value and test, because the gas Btu value varies, depending on the methane, ethane propane, butane and non-hydrocarbon (e.g. carbon dioxide) content of the gas. Wellhead sales based on volume per Mcf leaves room for arbitrage, depending on the Btu value. For example, if a natural gas is purchased on a Mcf basis then sold on a Btu basis, there often is a substantial total price difference. **BLB**

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1 George Ives, Jr. Pipeline & Gas Technology, Sept. 2005, at 3

2 *Id.*

3 Wassily Leontif, *Academic Economics*, 217 *Science* 104-07 (1982).

4 Morris A. Adelman, The Economics Of Petroleum Supply 19 (Massachusetts Institute of Technology 1993).

5 Jeff Lenburg, Guide To Research 50 (Checkmark Books 2005).

6 Adelman, Economics, *supra* note 4 at 305.

7 Herrick, et. al, *Oil Industry Embarks on Recovery*, Wall Street Journal, Sep. 6, 2005, at A2.

8 *Refining Incapacity*, Wall Street Journal, Sep. 28, 2005, at A16.

9 DOE/EIA. *The U.S. Petroleum Refining Industry in the 1980*'s. Table B1 Refineries Shutdown Between 1980 and 1990, by Year and Complexity. 1990, at 57-60.

10 *Industry Scoreboard*, Oil And Gas Journal at 6, Sep. 26, 2005.

11 Bhushan Bahree, *Oil Profits May Be Peaking — High Energy Prices Drive Earnings, but Some See Turn in 2006*, Wall Street Journal, July 26, 2005, at A2.

12 °API = (141.5 ((x) – 131.5 where x = specific gravity at 60°F) - 131.5. [Water = 10°sAPI.]

13 Bob Tipee, Where's The Shortage? A Nontechnical Guide To Petroleum Economics 80 (PennWell 1993) (emphasis added).

14 Norman J. Hyne, Petroleum Geology, Exploration, Drilling, And Production 4 (2d ed. PennWell 2001).

15 Morris A. Adelman & G.C Watkins. *Costs of Aggregate Hydrocarbon Reserve Additions: Oil Equivalence of Gas and its Unit Cost*, The Energy Journal, Jun 1. 2004.

16 716 F.2d 1 (D.C. Cir. 1983), *cert. denied*, 104 S.Ct. 1616 (1984).