Enbridge Ex. 3

ENBRIDGE ENERGY PARTNERS, L.P. AND
ENBRIDGE ENERGY, LIMITED PARTNERSHIP

ILLINOIS COMMERCE COMMISSION

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TESTIMONY OF

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PACIFIC ECONOMICS GROUP, L.L.C

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Section I: Qualifications and Introduction

Q1. Please state your name, business and address.

A1. My name is Charles J. Cicchetti. My address is Pacific Economics Group, 301 North Lake Avenue, Suite 330, Pasadena, California 91101.

Q2. What is your position with Pacific Economics Group?

A2. I am a Co-Founding Member of Pacific Economics Group.

Q3. What are your duties as a member of Pacific Economics Group?

A3. I actively consult with clients on price, costs, environmental, oil, natural gas and electricity market issues, as well as competition and antitrust policies, particularly as those policies relate to regulated industries.

Q4. Do you hold any other positions?

A4. I teach economics and finance at the University of Southern California, where I am semi-retired from my position as the Jeffrey J. Miller Chair in Government, Business, and the Economy.

Q5. What is your educational background?

A5. I attended the United States Air Force Academy, and I received a B.A. degree in Economics from Colorado College in 1965 and a Ph.D. degree in Economics from Rutgers University in 1969. From 1969 to 1972, I engaged in post-doctoral research on energy and environmental matters at Resources for the Future (RFF), a Washington, D.C. think tank.

38

39 **Q6. Please summarize your professional experience.**

40 A6. I served as chief economist for the Environmental Defense Fund from 1972 to
41 1975, and was a faculty member at the University of Wisconsin from 1972 to
42 1985, ultimately earning the title of Professor of Economics and Environmental
43 Studies. From 1975 through 1976, I served as the Director of the Wisconsin
44 Energy Office and as Special Energy Counselor for the Governor. In 1977, I was
45 appointed by the Governor as Chairman of the Public Service Commission of
46 Wisconsin and held that position until 1979, and served as a Commissioner until
47 1980. In 1980, I co-founded the Madison Consulting Group, which was sold to
48 Marsh & McLennan Companies in 1984. In 1984, I was named Senior Vice
49 President of National Economic Research Associates and held that position until
50 1987. From 1987 until 1990, I served as Deputy Director of the Energy and
51 Environmental Policy Center at the John F. Kennedy School of Government at
52 Harvard University, and from 1988 to 1992, I was a Managing Director and
53 ultimately Co-Chairman of the economic and management consulting firm,
54 Putnam, Hayes & Bartlett, Inc. In 1992, I formed Arthur Andersen Economic
55 Consulting, a division of Arthur Andersen, LLP. In late 1996, I left Arthur
56 Andersen to co-found Pacific Economics Group, L.L.C.

57 **Q7. Have you published any papers or articles?**

58 A7. Yes. I have published articles on energy and environmental issues, public utility
59 regulation, competition and antitrust. A complete listing of my publications is
60 included in Exhibit No. 3A, which is appended.

61

62 **Q8. Have you ever given expert testimony in a court or administrative**
63 **proceeding?**

64 A8. Yes. A list of the proceedings in which I have provided expert testimony is also
65 included in Exhibit No. 3A.

66 **Q9. Who retained you for this testimony?**

67 A9. I have been retained by Enbridge Energy Partners, L.P. and through its General
68 Partner, Enbridge Energy Company, Inc. and Enbridge Energy, Limited
69 Partnership (hereinafter collectively referred to as "Enbridge") to provide
70 testimony explaining the benefits to Illinois if the Commission approves
71 Enbridge's Application for a Certificate in Good Standing with respect to its
72 Southern Access Expansion Program and Southern Lights Project.

73 **Q10. What is your understanding of these Enbridge undertakings?**

74 A10. The Southern Access Expansion project will involve construction of two new
75 liquids pipelines in Illinois, located in Boone, DeKalb, LaSalle, Livingston,
76 Grundy, and Will Counties. The majority of the portion of the route for the
77 pipelines located in Illinois would be located within the same right-of-way (See
78 Attachment B to the Application). The Southern Access Expansion would begin
79 at Enbridge Energy's storage terminal in Superior, Wisconsin and carry crude oil
80 through Wisconsin to a point south of Chicago at an existing Enbridge storage
81 facility located near Flanagan, Illinois. This planned 42-inch pipeline is known as
82 the "Stage 2" segment of the Southern Access Expansion Program. "Stage 1"
83 consists of constructing a new line through much of Wisconsin one year prior to

84 Stage 2. The second pipeline would be built concurrently with and complement
85 the Southern Access Expansion. It will transport light liquid hydrocarbons (called
86 diluents) from Illinois-area refineries and other sources through new and existing
87 pipelines in the United States and Canada for delivery in northern Alberta. There,
88 the liquid hydrocarbons would be used to help transport the crude oil from
89 Alberta's oil sands. This project is known as the Southern Lights Project. It will
90 be a 20-inch diameter pipeline and will originate near Manhattan in Will County
91 and cross Grundy County before joining the right-of-way for the new 42-inch
92 crude line in LaSalle County and continuing north through Illinois, Wisconsin,
93 Minnesota, North Dakota, and the Canadian prairie to Alberta, Canada. In this
94 testimony, when I discuss the need for the Southern Access Expansion Program
95 and the Southern Lights Project, I will refer to the projects jointly as the
96 "Expansion Projects."

97 **Q11. How is your testimony organized?**

98 A11. In Section 2, I discuss the world petroleum market and some general policy issues
99 related to the need to add additional crude oil supplies and the need for additional
100 consumer conservation efforts. In particular, I focus on price volatility and
101 security of supply and explain how these issues establish Illinois' need for the
102 Expansion Projects. In Section 3, I quantify the expected values of the benefits
103 that would accrue to Illinois if the Expansion Projects are built. In Section 4, I
104 provide some additional regulatory perspective on the Certificate in Good
105 Standing requested by Enbridge and why that is different than asking for rate-base
106 treatment. Finally, in Section 5, I summarize my conclusions.

107 **Section II. World Petroleum Markets and the Need For the Expansion**

108 **Projects**

109 **Q12. In your opinion, what are the most important policy issues in this**

110 **proceeding?**

111 A12. The most important policy issues are related to crude oil supply and demand. The

112 world needs to add additional crude oil supplies to keep pace with growing world-

113 wide demand. In addition, petroleum consumers need to become more efficient

114 and conserve their energy use. A more subtle concept in understanding the

115 current worldwide oil market is a factor called spare capacity, which is shut-in or

116 operating reserve that can cost effectively be used in times of unexpected or

117 orchestrated changes in production. The world's current and recent level of spare

118 capacity has been very low throughout much of 2006. Some estimate that

119 reduced spare capacity results in a price risk premium of about $10 to $15 per

120 barrel.[1] In order to avoid what we might call the "tyranny of small decisions,"

121 regulators must consider these Supply/Demand fundamentals, as well as the role

122 of spare capacity and its effect on the price consumers can expect to pay at the

123 pump for any inherent price/risk premium on each barrel of oil.

124 **Q13. Can you first explain what you mean by the "tyranny of small decisions?"**

125 A13. Most economists attribute the concept of the "tyranny of small decisions" to

126 Professor Alfred Kahn, who is both an extraordinary academic and a most

[1] See, for example, "Nervous Energy", The Economist, ("'fear premium' of $10-$15 a barrel reflecting the threat of lost supply"), January 7, 2006; Williams, James L.,, Energy Economist, September 8 2006 ($20-$25/bbl supply interruption premium); Deutzia, Tony and Elizabeth Millington, and Rob Sergeant, "Making Sense of America's Oil Needs". National Association of State PIRGs, August 2005, ($4-$13/bbl security risk premium); and Kathuria, Vinish, "Factors Behind the Wild Oil Price Swings", The Hindu, December 27, 2004 ($10/bbl risk premium).

127 distinguished regulator/public servant. Dr. Kahn initially applied this concept to a
128 potential loss of rail service to a small town - - Ithaca, New York. He observed
129 that ridership would not sustain the economic viability of the line and cover the
130 costs of maintaining service, if these costs needed to be recovered in the revenue
131 collected from ticket sales.

132 Dr. Kahn also observed that non-riders, a class that came to be called non-
133 users, might gain value in excess of the option prices they might need to pay to
134 retain the option of the train service in Ithaca, New York. The amount,
135 collectively or in the aggregate, that residents might pay to insure the availability
136 of the train-service option could exceed the amount necessary to retain service.
137 Regardless, there might easily be a "tyranny of small decisions" such that the
138 necessary small decisions are not made to insure service when ticket sales under-
139 recover the cost of service. In such circumstances, service is abandoned despite a
140 greater willingness to pay when insurance payments, that are small per person but
141 large in the aggregate, would easily exceed the losses sustained. This
142 organizational or market failure is called the "Tyranny of Small Decisions."

143 Environmental problems, especially related to the so-called "Tragedy of
144 the Commons," also invoke this same tyranny of small decisions. Here, hunting,
145 fishing, and petroleum production levels are often based upon individual or
146 disaggregate ownership rights. Such management approaches typically sacrifice
147 sustainability and cause a loss of potential economic recovery. Sustainable
148 economic use and development require a holistic approach. Disaggregate

decisions hurt all, thus the "tyranny of small decisions" causes losses known as the "Tragedy of Commons."

Q14. How is that relevant here?

A14. Some might aver that the proposed Expansion Projects would add only 400,000 barrels per day (bpd) to the world's crude oil supply, or less than 0.5 percent of current world demand. This may imply this is a trivial addition to supply and not worth the costs. This reasoning, however, misses the big picture. A beneficial project should not be overlooked or dismissed simply because it adds but a small increment to the world's supply of crude oil. In much the same way, ridership from Ithaca is not the only source of value derived when non-users are considered to be part of the evaluation. The tyranny of small decisions relates to ignoring relatively small additions to the world's supply and focusing on only huge projects. This is a dangerous and fallacious way to view supply. The key to understanding this way of thinking is to consider the current level of spare crude oil production capacity in the world. Every transaction matters, no matter how small. The world's supply situation twenty years hence will depend on today's relatively small projects coming on line and adding incrementally to the world's supply. It is the sum of many small projects and new supplies that will ultimately determine the world's supply/demand balance twenty years from now.

Q15. If the world ignores the concept of Tyranny of Small Decisions, how can we know what the effect will be on the world's petroleum supply twenty years from now?

A15. I can best explain this by using an analogy. Suppose one were to ask a person how much change the person would have in his/her pocket twenty-four hours in the future. The answer to this question is determined by many relatively small transactions. Each of those individual small decisions is ultimately important in the final equation. Eliminating even one of those small transactions would have an effect on the final answer. The same is true for the world's future petroleum supply. Eliminating a relatively small addition such as the Expansion Projects will have an effect on the world's future petroleum supply. The key is to avoid not making a decision that will add to the world's supply because it is a small increment of total supply. For just as each small transaction will affect the amount of change in a person's pocket, so will each of numerous small decisions have on the world's petroleum supply twenty years hence.

Q16. Why is this important?

A16. The Expansion Projects would bring additional non-conventional supplies from Alberta's oil sands (sometimes called tar sands or tight sands) to world markets through Wisconsin and Illinois. These new supplies in Stage 1 will add 180,000 bpd and after completion of Stage 2, the expansion will add another 220,000 bpd, bringing a total of 400,000 bpd to the extremely tight world oil market, which would alleviate some of the current significant decline in spare crude oil production capacity. In addition, refiners and liquids storage operators could rely

193 on this supply and, as a result, make some necessary and important expansions.
194 The key is how Illinois, the nation, and global markets would value these
195 additions. As I explain below, the lack of "Spare Capacity" is the core concern.
196 If the world avoids the tyranny of small decisions, we will get things right.

197 **Q17. What do you mean by the term "Spare Capacity?"**

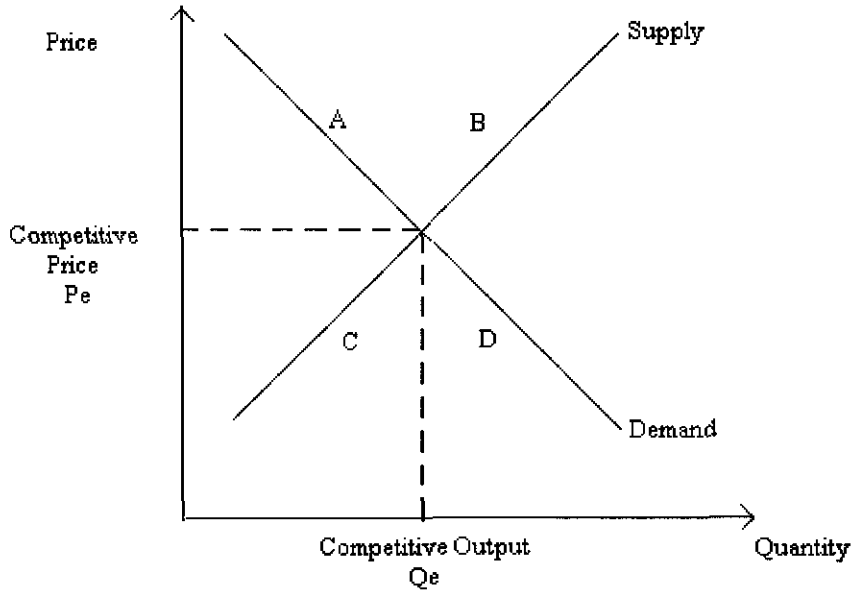
198 A17. At the outset, let me explain that the concept of "Spare Capacity" has several
199 similar, but not identical, definitions. In my testimony, unless I state otherwise, I
200 define Spare Capacity as potential worldwide crude oil capacity that is effectively
201 being "shut in" and not currently in production. This potential petroleum
202 production would have marginal costs below prevailing prices. The petroleum
203 resource is fully proven and production/infrastructure is either in place or
204 relatively available.

205 In effect, I define Spare Capacity as an operating reserve that at times of
206 unexpected or orchestrated outages could be supplied relatively easily and
207 profitably (*i.e.* cost effectively).

208 **Q18. Would you define "Spare Capacity" in terms of economic theory?**

209 A18. Economists use the basic concept of supply and demand to describe most
210 commodity markets such as crude oil. Consider Figure 1.

FIGURE 1
Basic Supply and Demand



Competitive markets reach equilibrium at a competitive price of P_E and competitive quantity Q_e. Excess supply would exist when point B represents the supply offered to a competitive market at a relatively high price. This causes demand to be represented by point A. This is called Excess Supply and prices would fall to P_E. The opposite circumstance is when point C represents the relatively smallish supply offered at a low price. This would lead to Excess Demand, shown at point D, causing prices to increase to P_E.

The basic Supply/Demand relationship is the tool economists use to represent a static or short-term competitive market. Spare Capacity is <u>not</u> the same concept as Excess Supply because some potential crude production is effectively withheld from world crude markets, despite this potential production having marginal costs less than or equal to market prices. Spare Capacity is shut-

224 in and is not crude oil production currently represented in the short-term supply
225 function. Put another way, Spare Capacity is not a component of short-run
226 marginal production cost because, for various reasons, this supply is withheld
227 from the market. Spare Capacity is, however, potentially available as an
228 operating production reserve if the withholding entity, usually a nation, decides to
229 release its Spare Capacity during emergencies or shortages.

230 **Q19. Are there substitutes for Spare Capacity?**

231 A19. A closer factor of substitute for Spare Capacity would be petroleum storage. The
232 relationship is not perfect because there are at least three types of storage. These
233 range from: (1) operational stock in production, transit, or inventory; (2) market
234 hedging and seasonal storage; and (3) strategic petroleum storage. The latter is the
235 most closely akin to the concept of spare capacity. Such storage, which in the
236 United States is called the Strategic Petroleum Reserve (SPR), is mostly justified
237 to reduce the risk of international crises that might curtail or interrupt the flow of
238 crude oil. All product stored, even the gasoline in our automobiles' tanks, would
239 be a potential offset to any such disruption in global crude oil production or
240 supply. However, the amount set aside in importing nations for this purpose, plus
241 the spare production capacity that sits idle in producing nations, are the two
242 factors that would, over a period beyond the first week of any disruption, be the
243 primary means to mitigate the losses from a global shortfall in crude supplies.

244 **Q20. Is Spare Capacity the same as petroleum reserves?**

245 A20. No. Spare Capacity is not the same concept as petroleum reserves. The latter is a
246 long-term factor and represents petroleum that likely could be brought into

247 production (proven reserves) at likely prevailing market prices if additional
248 capital investments are made. When oil prices increase when demand exceeds
249 supply, there are increased incentives and returns expected from additional
250 exploration and production investments. Indeed, a sustained shortfall would
251 likely mean more "rig counts" or wells being drilled, as well as a run-up in the
252 prices paid for new exploratory rigs and wells being drilled. Proven reserves are
253 likely the best source of any expansion when crude oil markets tighten for a
254 sustained period.

255 Spare Capacity is a concept that is more intermediate than this longer term
256 investment response. Spare Capacity means the available wells are known, rigs
257 are in place or readily available, but for operational or other reasons, some
258 potential crude oil production in being shut in (*i.e.* not in current production)
259 despite marginal costs being less than current market prices. Prior to this decade,
260 spare capacity was close to 10 percent of crude production, or about 8 million
261 barrels per day. In more recent years, the level of worldwide spare capacity has
262 fallen precipitously to less than 1 million barrels per day, or about 1 percent of
263 total production.

264 **Q21. What happens if and when Spare Capacity declines?**

265 A21. Natural and man-made events can cause a loss of crude oil production. If there is
266 sufficient Spare Capacity, world crude markets are more likely to recover
267 relatively quickly from a loss of crude oil production with a relatively small or no
268 supply disruption and/or increase in commodity prices. In the past several years,
269 as I explain below, there has been a significant decline in the world's Spare

Capacity of crude oil production capability.

Q22. What can we learn about Lost Production and Spare Capacity using the history of crude oil markets?

A22. Table 1 shows various assessments of periods of lost crude production and the corresponding estimates of the world's availability of Spare Capacity and worldwide crude production. There have been two particularly troublesome periods - - much of the 1970s and the most recent several years. The main exception during the middle roughly twenty years is the period of the Persian Gulf War in 1990/1991.

TABLE 1

Crisis Year	Months[1]	Lost Production 1,000 bpd[1]	Spare Capacity 1,000 bpd[2]	Worldwide Production 1,000 bpd[3]	Percent of Year With Lost Production	Percent of Year Where Lost Production Exceeded Spare Capacity
1970	May-Dec	1,300	4,806	48,061	66.7	0.0
1971	Jan	1,300	3,559	50,844	50.0	0.0
1971	Apr-Aug	600	3,559	50,844	50.0	0.0
1972	n/a	0	3,220	53,666	0.0	0.0
1973	Mar-May	500	2,339	58,463	50.0	25.0
1973	Oct-Dec	4,300	2,339	58,463	50.0	25.0
1974	Jan-Mar	4,300	1,758	58,617	25.0	25.0
1975	n/a	0	3,349	55,824	0.0	0.0
1976	n/a	0	2,416	60,412	0.0	0.0
1977	May	700	2,509	62,713	8.3	0.0
1978	Nov-Dec	5,600	4,433	63,331	16.7	16.7
1979	Jan-Apr	5,600	2,972	66,049	33.3	33.3
1980	Oct-Dec	4,100	4,091	62,946	25.0	25.0
1981	Jan	4,100	5,953	59,533	8.3	0.0
1982	n/a	0	8,594	57,296	0.0	0.0
1983	n/a	0	14,149	56,598	0.0	0.0
1984	n/a	0	13,844	57,683	0.0	0.0
1985	n/a	0	13,218	57,468	0.0	0.0
1986	n/a	0	9,069	60,461	0.0	0.0
1987	n/a	0	9,726	60,785	0.0	0.0
1988	n/a	0	10,106	63,160	0.0	0.0
1989	Apr-Jun	500	4,484	64,051	25.0	0.0
1990	Aug-Dec	4,300	1,309	65,470	41.7	41.7
1991	Jan	4,300	1,959	65,288	8.3	8.3
1992	n/a	0	2,632	65,788	0.0	0.0
1993	n/a	0	2,972	66,046	0.0	0.0
1994	n/a	0	3,356	67,116	0.0	0.0
1995	n/a	0	3,405	68,103	0.0	0.0
1996	n/a	0	3,495	69,895	0.0	0.0
1997	n/a	0	3,247	72,158	0.0	0.0
1998	n/a	0	4,415	73,586	0.0	0.0
1999	Apr-Dec	3,300	5,063	72,333	75.0	0.0
1999	Nov-Dec	1,100	5,063	72,333	75.0	0.0
2000	Jan-Mar	3,300	1,499	74,950	33.3	33.3
2000	Dec	1,600	1,499	74,950	33.3	33.3
2001	Jun-Jul	2,100	2,993	74,828	16.7	0.0
2002	Apr-May	1,800	4,467	74,443	25.0	0.0
2002	Dec	2,600	4,467	74,443	25.0	0.0
2003	Jan-Mar	2,600	1,541	77,054	100.0	100.0
2003	Mar-Dec	2,300	1,541	77,054	100.0	100.0
2004	n/a	0	803	80,260	0.0	0.0
2005	Aug	1,500	803	80,260	8.3	8.3
			Average		17.13%	8.79%
			Average (No High/Low)		15.19%	6.37%

[1] Source: Muse Stancil, "Economic Study for Public Need, Convenience, and Necessity, Table 1, page 6 (January 2006); Hirsch, Robert L., Roger Bezdek, and Robert Wendling; "Peaking of World Oil Production: Impacts, Mitigation, and Risk Management (February 2005); U.S. Department of Energy, Energy Information Service (EIA), "Latest Oil Supply Disruption Information" (2004); EIA, "Global Oil Market and Oil Price Chronologies: 1970-2003," (March 2004); EIA, "Global Oil Supply Disruptions since 1951," (2001); EIA "Annual Energy Review 2002; and EIA, "International Petroleum Monthly (April 2004).

[2] Source: "Nervous Energy", The Economist, Chart 2, page 63, January 7, 2006.

[3] Source: BP Statistical Review of World Energy, page 6 (June 2005). Production for 2005 uses production for 2004.

279

280 In the last two columns of Table 1, I calculate the percentage of a year in
281 which there was Lost Production during a particular event, and more importantly,
282 the percentage of a year in which the estimated Lost Production exceeded the
283 corresponding estimate of Spare Capacity. The conservative estimate is that 6.4%
284 of the past has had a loss of production that exceeded Spare Capacity.[2]

285 With the decline in Spare Capacity, three things have happened. First,
286 each even relatively small potential supply disruption (*e.g.* the loss of about
287 200,000 barrels of Alaskan crude due to pipeline maintenance) causes crude
288 prices to surge. Second, while additional exploration and investments are
289 occurring, so are the growth in demand and a noticeable reduction in supply at
290 existing oil fields. Increasingly, the evidence points to the prospects of future
291 demand growth exceeding new supply from conventional fields and a greater
292 need for more costly investments in substitutes such as tar sands, oil shale, or
293 deep off-shore production. Third, the U.S. dollar has been weakening and hurting
294 U.S. consumers. National security is also undermined as the nation needs to pay
295 greater attention to often unfriendly oil exporting nations in the Middle East,
296 South America, and Asia/Pacific.

297 **Q23. Why is the decline in estimated Spare Capacity important in this**
298 **proceeding?**

299 A23. Recall that crude oil is an international commodity. Two current facts dominate
300 supply and price risk. First, current crude oil production is stretched too thin
301 relative to demand. Second, emerging nations and eastern European growth over

[2] I estimate the conservative case by eliminating one extreme high and one extreme low percentage from the average calculation.

the next two decades are projected to stretch the gap between supply relative to demand even further. Balancing future supply and demand will depend on expanding non-conventional supplies such as the Alberta oil sands. Developing these sources is contingent on new pipelines to transport the crude to market and crude prices sustained at a high-enough level to support continued economic production of crude from the oil sands that have higher recovery costs (but no exploration expenses) than conventional crude oil. Third, petroleum shortages can cause prices to jump. The proposed Expansion Projects potentially would dampen, to some extent, these likely future crude price surges. As explained here, the proposed expansion would help maintain current Canadian exports to Illinois and add about 400,000 bpd of crude exports to the Midwest.

Q24. How can we plan for what the uncertain future holds?

A24. We cannot be certain because the future is uncertain. However, relatively cheap crude oil seems like an outmoded concept. Perhaps the conventional wisdom may once again be proven wrong. This may be too optimistic as world-wide economic growth seems likely because China, India, and other nations have joined the rest of the industrialized world as major economies. Reductions in spare production capacity plus likely increased reliance on non-conventional sources of crude will push prices higher. The optimists see declines from current levels, but there is not much support for scenarios that would cause crude to fall to the $30 per barrel price range, let alone a $20 per barrel range. No one can predict future oil prices with certainty. It is a virtual certainty, however, that any lack of spare crude oil production will add to price volatility and contribute to higher crude oil prices.

Although projections show demand and supply increasing, it is unlikely that future supply growth will outstrip demand, even with improvements in conservation, efficiency, and technology. Most likely, the prior two decades of experience of significant spare capacity in the world's crude oil markets is over, absent some significant economic reversals or recessions that would reduce demand. As demand continues to grow, prices will likely increase if supply cannot keep pace with demand.

Q25. What does the past tell us about the inherent uncertainty in crude oil markets?

A25. Much of the initial post-World War II years could be characterized as having excess crude oil supplies relative to demand. This "spare supply" meant that crude prices were relatively inexpensive and stable. Prior to the 1970s, the nation typically had significant shut-in capacity. This changed dramatically in 1973 in the aftermath of the so-called Yom Kippur War between Israel and its Arab neighbors. When this crisis occurred, the domestic production was virtually at its full potential. Thus, there was little to spare. Similar earlier Middle East conflicts had taken place when there was sufficient shut-in crude production in the United States so that world oil prices remained relatively stable and supplies were not disrupted by these conflicts.

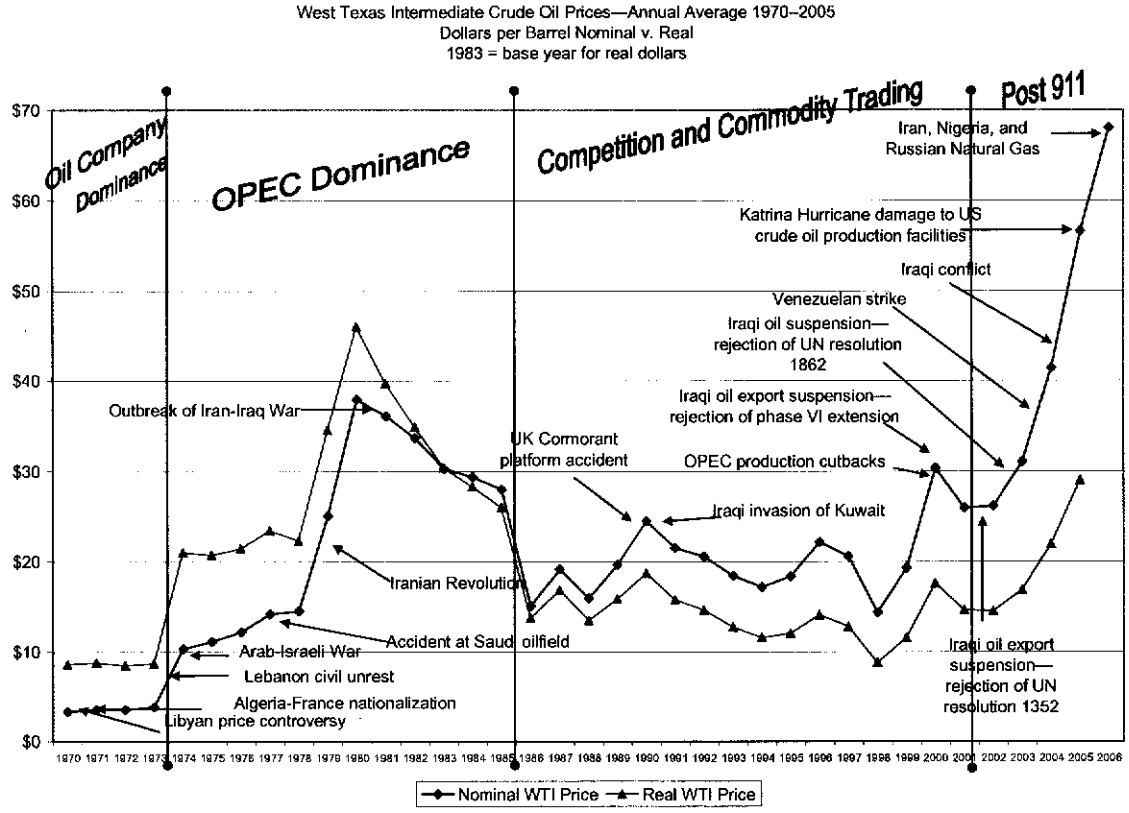
The 1973 Arab-Israeli War was very different because U.S. crude production was effectively at its maximum optimal level. Accordingly, the oil embargo in 1973 resulted in a sharp increase in crude prices, which increased by

about $2 per barrel to $8 per barrel in worldwide markets and to about $4 in domestic crude markets.

Subsequent periods of Lost Production were often called "crises" or "oil shocks" because the price response was often very severe. Generally, prices also fell when demand slackened due to declining macroeconomic conditions in the world (*e.g.*, the U.S. recessions in the late 1990s and post "9/11" in 2001). The swings or volatility increased after 1973 as "Spare Capacity," defined as either the volume or percentage of shut-in crude oil production to total production capability, declined rather sharply. Figure 2 shows the dramatic swings and increased volatility of world crude prices from 1970 to 2005, on an annual basis, in both nominal and real 1983 dollars. Many of the sharp price-increasing events shown in Figure 2 coincided with Lost Production and insufficient Spare Capacity. These events are shown in more detail in Table 1, previously discussed.

360

361 **Figure 2**



362

363 **Q26. Is there any pattern that emerges?**

364 A26. Yes. The pattern that emerges in Figure 2 is that when Lost Production and slack
365 Spare Capacity events are correlated with relatively strong economic conditions,
366 crude oil prices are likely to surge as they did in the late 1970s, late 1990s, and
367 today. Figure 2 also divides the last 36 years into four different phases. In the
368 first phase, prior to the Fall of 1973, the world's crude oil markets were stable.
369 The major oil companies had successfully negotiated concessions to produce oil
370 in most nations outside of North America and the United States had spare
371 capacity and the concomitant ability to restrain market price surges.

372

Q27. Please describe the second phase.

A27. The second phase started with the emergence of OPEC[3], which eventually gained control of spare capacity, mostly with Saudi Arabia having the most influence as to its use or not.

Figure 2 shows domestic prices in the four-dollar range in the early 1970s. World prices were about half that amount because the nation had Mandatory Oil Import Quotas that kept domestic crude prices higher than worldwide prices. This program also gave the nation some shut-in capacity that helped to promote national security.

The 1973 Arab-Israeli War changed all this for several reasons. First, domestic production outside of Alaska had peaked in the early 1970s - - indeed domestic production has fallen from about 11.3 million bpd in 1970 to about 6.8 million bpd in 2005, while demand has increased.[4] See Figures 3 and 4 below, reproduced from the Energy Information Administration's (EIA) Annual Energy Review 2005.[5]

[3] OPEC is the Organization of Petroleum Exporting Countries. Its members include Algeria, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela.
[4] EIA Annual Energy Review 2005 (page 9).
[5] Figures 3 and 4 above appear as Figures 14 and 15 in the EIA's Annual Energy Review 2005.

388

Figure 3. Petroleum Overview

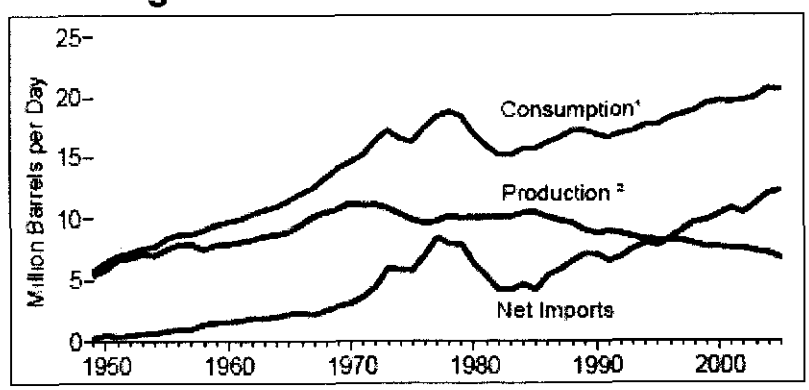


Figure source data

389 [1]Petroleum products supplied used as an approximation for consumption.
390 [2]Crude oil and natural gas plant liquids production. Source: EIA Annual Energy Review 2005.

391

Figure 4. 48 States and Alaskan Crude Oil Production

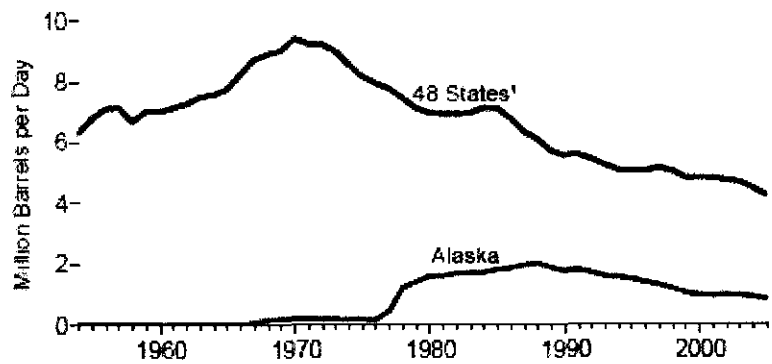


Figure source data

392 [1]United States excluding Alaska and Hawaii. Source: EIA Annual Energy Review 2005

393 **Q28. What can be learned from Figures 3 and 4?**

394 A28. Figure 3 shows that consumption has generally increased since 1950, except for
395 some sizeable drops that coincide with economic recessions, while domestic
396 production peaked at 11.3 million bpd in 1970. In conjunction with this decline in

397 domestic production, net imports have steadily increased since the mid-1980s.
398 Figure 4 shows graphically the steady decrease in production in the 48 lower
399 states, and the drop-off in Alaskan production since the late 1980s. The prices for
400 crude oil in the United States exceeded world prices under the Mandatory Oil
401 Import Quota program that ended in 1973. Some producing states supported
402 these higher domestic crude prices using various conservation and pro-rationing
403 regulations. By the early 1970s, domestic production was generally operating at
404 capacity. Growth in crude could only come from imports, which were restricted
405 for national security reasons. Second, many producing nations outside North
406 America began to take control of oil production and to significantly alter their
407 pre-existing concessions with the major oil companies.

408 These two changes ushered in the second phase shown in Figure 2 where
409 OPEC and producing countries dominated world oil markets. There were two
410 major shocks during this eleven-year period: the Yom Kippur War[6] in 1973 and
411 the Iranian Revolution in 1979. Both crises caused the world crude markets to
412 produce about 5 percent less than demand.[7] Consequently, crude prices surged.
413 Soon after both crises, the world's economies were hit by recessions. While this
414 helped reduce demand, in terms of decreased employment and economic slumps,
415 the "price" paid for curtailing consumption was very high.

416 **Q29. Please describe the third phase.**

417 A29. In the middle to late 1980s, a third phase took hold as the world's crude markets
418 began expanding supply and prices began to soften or decline Here, countries

[6] Sometimes also called the Ramadan or October War.
[7] Even though Saudi Arabia had some extra capacity to sell, it was not enough to prevent crude oil prices from surging.

openly competed to sell their crude. This competition was somewhat new. Trading in crude soon became a commodity-focused market. Historic concessions and long-term contracts between producing nations and major oil companies were replaced by very competitive spot and futures/forward contracts.

The result was a slackening in oil prices as commodity competition increased. OPEC's ability to discipline its member countries also waned. Worldwide economic growth was strong, other than a setback due to the Asian currency crisis. After that slowdown in world demand, the emergence of first China and then India helped to pick up the demand for crude oil. This increase in world demand for crude oil was offset, in part, by increased volumes of Russian crude oil production that entered world markets. This approximately fifteen-year phase was mostly good in terms of prices for the world's needier crude oil consumers.

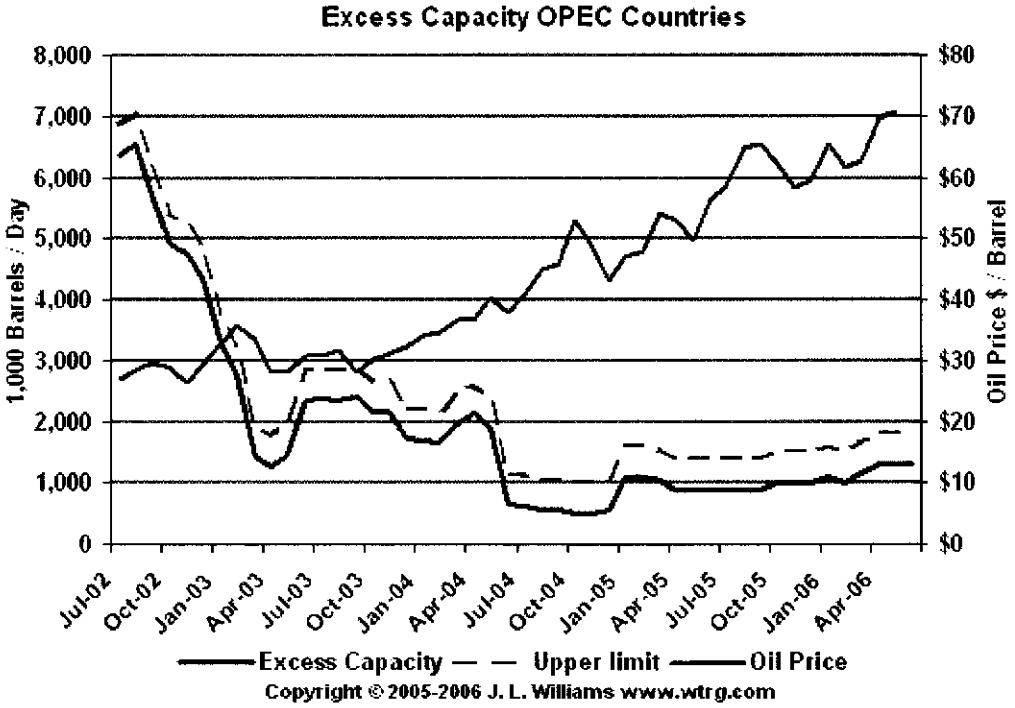
Q30. Please describe the fourth phase.

A30. The fourth phase coincides approximately with "9/11." In the same last five years, there has also been a sharp decline in worldwide spare capacity as Saudi Arabia's stand-by or shut-in production capability has been virtually fully used and world demand continued to expand sharply as China and India modernized, Asian and European economies kicked in, and United States economic growth continued to expand.

In the last five years, each relatively small downward tweak in output or mini-crisis (even a loss of about 200,000 bpd out of about 80,000,000 bpd of worldwide production) has seemingly sent crude oil prices soaring upwards to

new heights. Easing supply and demand seems merely to have slowed upward price movements as new floors or plateaus have formed. A recent issue of the *Energy Economist*[8] includes the following graphic description of these recent five years. Figure 5 reproduced below shows how the decline in spare or excess crude oil production capacity has been highly correlated with rising crude prices.

Figure 5



Excess capacity here refers to "excess production capacity" or "excess supplies" in OPEC.

Q31. Please describe the world crude oil situation as it exists today.

A31. In 2006, real and nominal oil prices have sometimes been about fifteen times their corresponding early 1970s values. Worse, regardless of the precise definition, spare production capacity seems to have become very scarce. Any future severe loss of supply events likely would increase short-term crude prices and add volatility to petroleum markets. There is, thus, considerable prevailing debate

[8] *Energy Economist,* "Oil Prices the Big Picture", October 1, 2006.

about future prices. The future, regardless, is uncertain. The conventional wisdom favors a continuation of high prices for crude and ever more price volatility. This thinking is the direct result of a lack of spare crude production capacity. Nevertheless, official EIA projections have both crude oil supply and demand increasing. No projections support any realistic prospects for future supply expansion to jump significantly ahead of demand growth absent severe worldwide economic recessions. This is despite likely significant improvements in conservation, efficiency, and technology.

Q32. Are there other forces at work that must be recognized?

A32. In addition to the fundamental uncertainty of discovering new supplies, developing new technologies, and building the infrastructure necessary to bring the crude to market, there is a second major force – underlying risks – that must be applied. The history of the past 35 years suggests that there were numerous supply disruptions and other uncertainties that affect worldwide crude oil markets and prices.

Q33. How can you analyze the effect of uncertain future events that would likely cause petroleum prices to change?

A33. There are three factors that seem to matter. The first is the probability or frequency of future crises. This factor is also a matter of duration, such as how many months a future crisis would last. This is very similar to how regulators and engineers think about power outages using a combination of how frequently these outages might occur and how long these outages will last. Regulators and utilities

478 establish planning/reserve criteria to mitigate the adverse consequences of an
479 uncertain future outage.

480 **Q34. What is the second factor?**

481 A34. The second factor is the physical extent of a future disruption or loss in supply.
482 For oil, this would be measured in the barrels per day that would be interrupted
483 when a crisis occurs. Again, this is analogous to how electric companies estimate
484 lost generation or the resulting loss of load during a potential power outage.

485 **Q35. What is the third factor?**

486 A35. The third factor is an assessment of the petroleum market's economic condition
487 when a crisis would occur in the future. For example, are world oil markets
488 already tight and experiencing high prices, or *vice versa*? The corresponding
489 power outage example is that regulators and utilities would also consider
490 seasonality, planned outages, time of day, market prices, and potential other
491 imports and transfers.

492 **Q36. What does the EIA say about oil supply disruptions?**

493 A36. EIA produced a technical document on September 2, 2004 entitled "Rules of
494 Thumb for Oil Supply Disruptions" that is very much in agreement with what is
495 stated here. In this document, EIA discusses future uncertainty, as well as the
496 factors that would either increase or mitigate the consequence of any future
497 supply disruptions. In this analysis, I use the EIA as a guide to formulate the
498 statistical hypotheses based upon the three factors discussed above to first test and
499 then quantify the potential price surges related to potential, albeit uncertain, future
500 oil supply disruptions.

Q37. Other than what we deduce from the graphs and tables you presented, what has been happening to worldwide spare capacity in crude oil production over time?

A37. Table 2 shows the extent to which spare production capacity, which was available to ameliorate past oil crises, has declined. Over the twenty-year period, the world had an average of about 5.8 percent spare or reserve capacity relative to contemporaneous production that could potentially offset some of the adverse price shock consequences of past events that caused a loss of supply. This reserve-like spare capacity fell to an average of just 3.85 percent during the last ten years. And as explained elsewhere in this Testimony, in the last two years this spare capacity has fallen to about 1 percent.

TABLE 2

Spare Capacity Available (Percent Per Year)

	Twenty Year Cycle	**Ten Year Cycle**
Average	5.80%	**3.85%**
Decline Per Year	0.53% (3.0)	0.49% (2.6)

Standard deviations shown in parentheses.

These downward trends are very statistically significant. What matters is the extent to which markets are permitted to work, political opposition to new supplies are held in check, and demand-side reduction policies are supported with political vigor. Low prices in the 1980s and 1990s did not provide much incentive to add production capacity. Current high oil prices, other things equal,

will drive more production capacity increases. Without additional crude supplies or less demand, the world will likely continue to confront rising crude and product prices and a relatively weak degree of spare capacity.

Q38. Can you also express spare capacity in volumetric terms?

A38. Yes. Table 3 shows a similar result in terms of the daily production capability available to offset the Lost Production during crises. During the last twenty years, there was an average of almost 4 million bpd of spare capacity (3.868). This average dropped below 3 million bpd during the last ten years (2.834). In the last two years, it has fallen to less than 1 million bpd.

TABLE 3

Volume of Spare Capacity Available (Millions of Barrels Per Day)

	Twenty Year Cycle	Ten Year Cycle
Mean	3.868 MMB/D	2.834 MMB/D
Decline in Spare Capacity Per Year	0.3 MMB/D (3.5)	0.338 MMB/D (2.4)

Standard deviations shown in parentheses.

The annual decline in the available spare capacity that has been available has been about 300,000 bpd per year over twenty years, and more recently, the annual decline in spare capacity has been about 338,000 bpd per year. These are very statistically significant trends.

Q39. Does demand growth affect Spare Capacity availability?

534 A39. Yes. There are various reasons why a nation may maintain some shut-in or spare
535 capacity. In general, the amount shut in does not generally increase in a particular
536 field or nation over time. Therefore, the volumetric extent of spare capacity is
537 likely fixed unless other nations decide to shut in production (*e.g.* such as an
538 OPEC production agreement might attempt, and seems to be doing).As
539 developing nations begin to expand their demand for petroleum, the percentage of
540 so-called Spare Capacity would, other things equal, decline. Accordingly, Spare
541 Capacity is likely to decline relative to growing worldwide consumption.

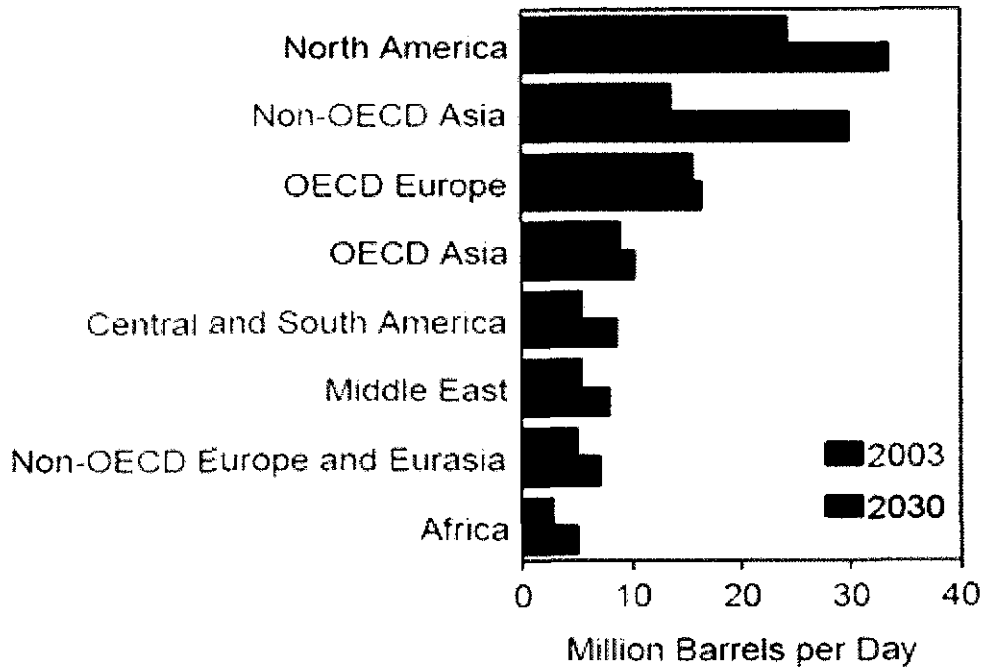
542 **Q40. What are the current forecasts for China's and India's consumption growth**
543 **rates, as well as worldwide?**

544 A40. The EIA[9] projects that economic growth in China, India, and other Asian non-
545 OECD nations will be approximately 5.5 percent per year between 2003 and
546 2030. Further, EIA projects that regional petroleum use will grow by about 3.0
547 percent in those regions between 2003 and 2030. China's and India's
548 consumption is expected to approach that of North America, which is currently
549 the largest consuming region. (See Figure 6 below from the EIA's 2006 IEO at
550 Figure 27). Eastern Europe is also expected to grow much faster than Western
551 Europe. By 2030, EIA projects that world consumption will be about 118 million
552 bpd – up nearly 50 percent from recent current levels pegged at about 80 million
553 bpd.

[9] *Op.Cit.*, International Energy Outlook (IEO).

FIGURE 6

Figure 27. World Oil Consumption by Region and Country Group, 2003 and 2030



Sources: **2003**: Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **2030**: EIA, System for the Analysis of Global Energy Markets (2006).

554

555 **Q41. What does EIA forecast in production increases?**

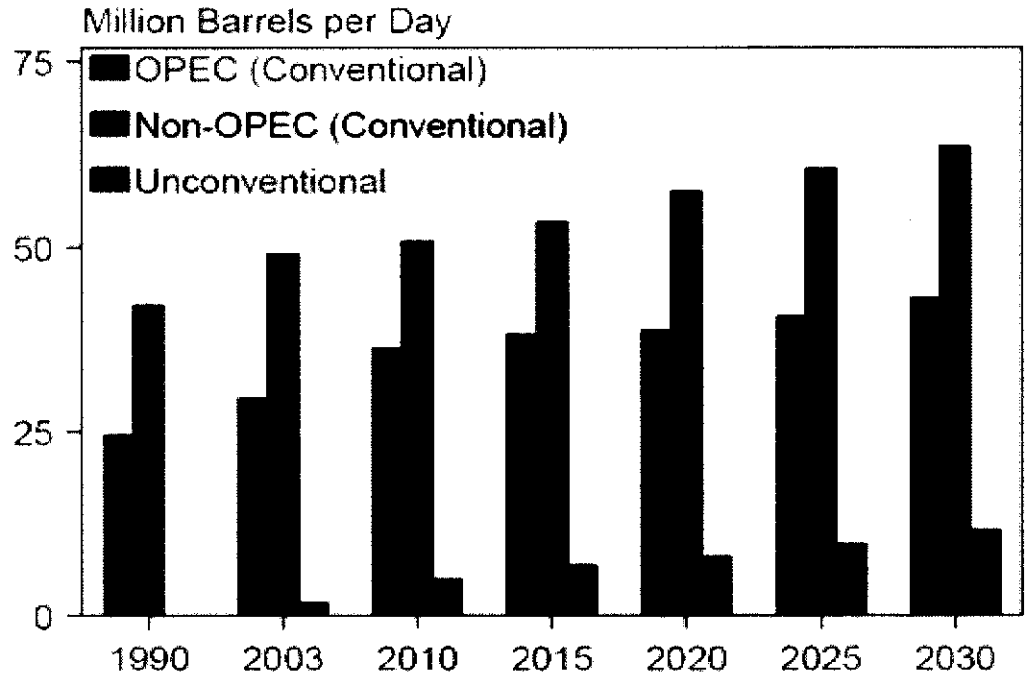
556 A41. EIA projects fairly optimistic increases in production over the next two decades.
557 (See Figure 7 below reproduced from the EIA's 2006 IEO Figure 31, page 30).
558 Combined EIA reference case projections would push 2030 combined worldwide
559 production to 118 million bpd.[10] With projected consumption also at 118 million
560 bpd, even these optimistic production numbers mean that there is no capacity to
561 spare. The 2006 Reference Case simply conforms to EIA's long-standing

[10] EIA International Energy Outlook 2006 (page 26).

562 definition of the Reference Case, which assumes that no additional governmental
563 actions are taken beyond those that are currently in place. EIA also published
564 lower and higher price and quantity scenario.

FIGURE 7

Figure 31. OPEC, Non-OPEC, and Unconventional Oil Production, 1990, 2003, and 2010-2030



Sources: **1990 and 2003**: Energy Information Administration (EIA), Energy Markets and Contingency Information Division. **2010-2030**: EIA, System for the Analysis of Global Energy Markets (2006).

565

566

567 Table 4 shows EIA's reference case for world production of crude from
568 conventional sources. The optimistic view is that the necessary wiggle room of

569 additional supplies will come from non-conventional sources, which EIA puts at
570 about 2.8 million bpd for Alberta oil sands.[11] .

TABLE 4

EIA Reference Case Production
(Millions of Barrels of Crude Oil Per Day)

Year	OPEC	Non-OPEC	Total
1990	24.5	42.1	66.6
2003	30.7	48.9	79.6
2010	37.3	53.4	90.7
2015	39.7	58.6	98.3
2020	40.4	63.7	104.1
2025	42.5	68.2	110.7
2030	45.3	72.6	117.9

Source: EIA, *International Energy Outlook 2006 (June 2006)*, Tables 5 and 6

571

572 The balance of base case projections literally hangs on expanding non-
573 conventional supplies. These non-conventional supplies in Canada depend upon
574 two things: (1) new pipelines to move the incremental supplies of crude oil to
575 refinery markets that are (or become) equipped to handle heavy crude; and 2)
576 sufficient prices that underpin the investment in oil sands projects underway or
577 planned.

578 **Q42. What do you conclude from these production and supply forecasts?**

579 A42. The most sobering realization is that, even with lower-than-current consumption
580 rates, the world will need about 50 percent more crude oil sometime in the 2025
581 to 2030 time frame. World oil prices are surging with the current global demand
582 and supply at "only" about 80 million bpd. The best way to understand why the

[11] EIA International Energy Outlook 2006 (page 32). The EIA's data source for Figure 6 shows a total production number including non-conventional sources that equals 117.9 million bpd. This is the same value that is shown in Table 5, which EIA states represents conventional sources only. Accordingly, something is not quite in balance for the 2030 projections

583 "uncertainty" is so critical is to imagine the scenario where global demand and
584 supply equal about 120 million bpd.[12] The gap between supply and demand must
585 be closed. While demand-management can make some minor contributions, the
586 infrastructure needed to meet our supply needs can only be accomplished project-
587 by-project combined with more aggressive frontal attacks on the demand side to
588 "close the gap."

589 **Q43. How do world crises factor into the equation?**

590 A43. Natural disasters will occur. Regional and other global conflicts are uncertain.
591 When they materialize, they appear to be lumped together for several years. In
592 recent years, the decline in spare worldwide crude oil production capacity has
593 exacerbated any problems related to events that cause a supply loss.

594 Crude oil markets have experienced unplanned or uncertain losses of
595 supply. Table 1, discussed above, shows that over the past 36 years, these loss-of-
596 supply events occur about 17.2 percent of the time and that about half the time, or
597 8.8 percent, the Lost Production exceeded the corresponding volume of Spare
598 Capacity. Eliminating the highest and lowest outliers, the respective probabilities
599 of Lost Production are 15.3 percent and 6.4 percent.

600 The chance or probability of a crisis also seems to vary from decade to
601 decade. The reason for this is that some events that cause a loss of production are
602 man-made (*i.e.* political disputes, terrorist attacks, etc) and some are natural
603 disasters (*i.e.* storms, earthquakes, operational explosions or fires, etc.).

604 The man-made events seem to vary in a non-random manner and, not
605 surprisingly, come lumped together and extend for longer periods of time than do

[12] Both EIA and Muse Stancil foresee future consumption approaching this level.

natural events. Natural events, such as the Gulf hurricanes, are random and less cyclical than the regional or geopolitical conflicts that hit world oil markets in the late 1970s and in the last five post-9/11 years.

Nevertheless, there are several major uncertainties. Past history and economic logic show that the relationship between demand and supply matter. No one can be certain that the spectacular Asian economic expansion led by China, and more recently India, will continue. As I explained, world demand growth matters. Most projections expect a cooling off in the emerging Asian economies growth in petroleum demand. While meaningful, it makes relatively little difference in the fundamental supply and demand coming out of Asia whether that region's demand doubles by 2016 rather than 2019. Further, North American demand continues to grow. More people and more income fuel that growth. The good news is that energy consumption per dollar of GDP production has steadily improved. Few observers in the 1980s imagined the level of U.S. energy efficiency gains per dollar of GDP.[13]

Q44. Don't productivity gains and conservation efforts in the nation ameliorate these effects?

A44. Somewhat. However, despite past productivity gains and seemingly more public support for efficiency and conservation, North American demand for petroleum would seem strong as population increases and the children of recent immigrants blend with society and push out the borders of suburban America. Of course, there could be a second major paradigm shift in energy use in North America

[13] See, for example, DOE/PE00082, "Long-Range Energy Projections to 2010" (July 1988).

where new technologies or increased conservation efforts dampen increased demand. That is, however, why the future remains uncertain on the demand side.

Growth in demand outside of Asia and North America is currently being projected to be relatively slow to moderate. Again, there is uncertainty on the demand side. This is particularly true for Latin America and Africa. No one can predict with certainty what the next two and a half decades will bring to those regions.

Q45. The production forecasts seem to depend on new discoveries of crude oil supplies. How does this affect your analysis?

A45 Because the supply forecasts depend on new discovery, the energy supply side is less amenable to forecasting than is demand. Further, additional infrastructure most likely would be needed to bring newly discovered energy resources to world markets. New exploration, production, and engineering approaches must also find their place in the global petroleum industry. Nevertheless, competitive forces will not necessarily drive global production because some nations have nationalized their crude oil reserves and energy industries. This imbues additional political uncertainty into forecasting supplies. All of these supply side uncertainties must then be compounded to account for the political and national differences that mostly intensify when "liquid gold" has been found and people want to bring it to market.

Q46. What does the EIA forecast?

A46. The EIA presents a Reference Case, a High Case, and a Low Case. In its more likely Reference Case, EIA estimates that global supply may increase about 50

651 percent by 2030, from its current 80 million bpd total.[14] The pending question is
652 "where would the world get an additional 40 million barrels of oil per day?"
653 Currently, conventional western Canadian production is projected to decline. To
654 offset this decline and to meet additional demand, Alberta's oil sands would be an
655 economically attractive choice at today's crude oil prices. There will also be a
656 need for additional pipeline capacity to transport these new non-conventional
657 resources to markets where refineries are located and people live and work.

658 There is a reason most people cannot readily answer the question "where
659 will another 40 million bpd come from?" This is because most new supply
660 sources will be relatively small compared to this presently projected gap. In fact,
661 western Canada's projected future contribution to world energy supplies is
662 relatively large. Nevertheless, finding the remaining 40 million bpd in production
663 areas that may now be inaccessible, unproven, or off-limits will be a challenge
664 facing the oil industry and policy makers.

665 The proposed Enbridge Expansion Projects would take these additional
666 supplies of Alberta crude to Midwest refinery markets. The proposed Enbridge
667 Southern Access Expansion would deliver an additional 400,000 bpd to the
668 Midwest, and therefore, contribute needed supply to total global markets. While
669 this is only about 1 percent of the gap between current supply and a projected
670 increase in demand of about 40,000,000 bpd, the 400,000 bpd pipeline expansion
671 will enhance security of supply and support refinery expansions and upgrades in
672 the Midwest. These 400,000 bpd equals about 40 percent of Illinois' current
673 refinery input.

[14] EIA International Energy Outlook 200 (page 30).

Q47. What do you conclude?

A47. Political and other local opposition to new resource development in many parts of the world are major obstacles that need to be resolved. My first conclusion is that to fuel the growing emerging nations' aspirations and accomplishments, and to sustain continued economic prosperity at home, it is necessary for the nations of the world to close the gap between demand and supply. This conclusion is true whether the world is in the middle or towards the end of the petroleum age.

I would also add three other observations. First, thinking of the Expansion Projects as one percent growth is akin to the "Tyranny of Small Decisions." This should be avoided because if others around the world think about expansions in this same manner, the world would likely pay dearly. Second, the Expansion Projects would enhance tar sand production, which is necessary to maintain current exports to the Midwest and to increase production by at least 400,000 bpd. Third, Canadian petroleum is secure and far less likely to be subject to interruption than crude exports from most of the rest of the world. This would add further security to Illinois and the Midwest.

Q48. So what should be done?

A48. The nation needs to conserve energy and increase efficiency. New supplies are also needed. There would be greater success if we collectively avoid the "tyranny of small decisions." In other words, the nation must avoid any tendency to reject new sources that seem small relative to worldwide needs, such as the 400,000 bpd for the Southern Access Expansion relative to either the 80 million bpd current worldwide use or the 120 million bpd of projected worldwide use. And, to

maintain price stability and security of supply, it is necessary to avoid severe macroeconomic shocks and oil-related crises that disrupt supplies. This is seemingly proving more challenging today than in the past. Finally, we need to be simultaneously developing new technologies and changing consumer behavior.