A Review of *Oil Production Capacity Expansion*
Costs for the Persian Gulf
by

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Abstract

The U.S. Energy Information Agency has recently published a report prepared by Petroconsultants, Inc. that addresses the cost of expanding crude oil production capacity in the Persian Gulf. A study on this subject is much needed in view of the dwindling supply of data on such costs from this region; however, this report does not provide any data and does little more than present the consultants' assumptions. Where those assumptions can be checked against plausible extrapolations of costs elsewhere, the investment per well is too high and productivity per well is too low. The result is an overstatement of the needed investment per unit of output.

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This report was prepared for EIA by Petroconsultants Inc (PC). Many government and private bodies had expressed a wish for "foreign energy supply information." Data on Persian Gulf costs have indeed dwindled in the last 20 years, and a serious attempt should be made to provide some.

However, the report contains no information, only the consultants' assumptions, of which a few can be compared with publicly available data. They show the estimates are much too high, in some areas by a factor of more than five.

If estimators do not disclose data and methods, there is no way to see and correct mistakes. A similar 1986 PC report "based on reserves" forecast that a non-OPEC production decline was "imminent and unstoppable...well before [1990]." [OGJ 1986] In fact, there has been a strong continuing *increase*. This whopper, still un-examined and unexplained, does not inspire confidence.

The problem is set by an EIA projection (the "high" in Tables 2 and 7). It has oil production capacity in six Persian Gulf nations rising from 20.7 million barrels daily (mbd) in 1994 to 36.6 mbd in 2010, a net increase of 15.9 mbd. The interim output is 158 billion barrels, which equates to 433 mbd.

The resulting capacity loss, which is ignored in the PC report, depends on the aggregate Persian Gulf decline rate. Assume alternatively a 3 percent or a 9 percent decline rate. The capacity loss is alternatively 13 mbd or 39 mbd. Either way, replacement exceeds the net growth. Added to the 16 mbd net increase, we need either 29 or 55 mbd in total.

Instead of trying to estimate the likely range of decline rates, the report makes estimates from Gulf "reserves." They note (p. 2) that the Gulf reserves-to-production ratio (R/P) is about 83, uneconomically high. They use a rule of thumb of R/P=20 to estimate developed reserves. This choice is arbitrary. A commonly used rule of thumb is 15. In the USA, the average is 9, varying widely among States and subdivisions. The UK R/P is lower.

An R/P ratio is an economic response to physical parameters. Both factors vary everywhere. PC have not justified detailed calculation from an assumed R/P.

But there is an additional and fatal flaw in doing this for the Persian Gulf. We know little about how the reserves are estimated, and how biased for bargaining or political purposes. Persian Gulf published reserve numbers are too imprecise and often untrustworthy to permit any calculation of developed or undeveloped reserves. Reckoning costs from reserves compounds the error.

Elsewhere PC have called Persian Gulf reserve increases "political" and overstated. [Campbell 1995] Their strictures of 1995, and earlier, discredit the method they use in 1996. One need not go nearly as far as they did then to reject what they do now.

PC do not say what reserve concept they are using. Developed reserves, calculated from data in the form of Tables B1-B8, have a precise definition, generated by capacity and production. Since operating costs are mostly fixed, and output declines approximately at a constant percent per year, the unit operating cost rises until it equals the price. At this "economic limit," production stops. Then the reserve equals the cumulative output from start to "economic limit." Since the main variables are inter-related, it is often possible to piece out some missing ones. [Adelman 1989]

PC do not use this concept. Indeed, they violate it. In Table B7, "low case," output is assumed to decline at 25 percent per year. Using their estimate of "peak production operating expense per barrel," it follows that halfway through Year 10, the economic limit is reached because fixed plus variable operating expenses exceed the assumed price of $17. But cumulative output at 9.5 years since the peak is only 65 percent of what they call "field size." If we add half a peak year as an allowance for pre-peak output, we have still produced only 74 percent of the field. Thus the reserve is not what is economic to produce, but something else, one-third larger, never explained.

Consider now the estimated investment per well. We are not told how it was reckoned, but we can do a limited reality check by comparing it with USA data for onshore wells of the same depth. (Offshore, drilling depth effects are swamped by depth of water, by economies of scale in slots per platform, and recently the spread of subsea completions.)

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Table I. Comparison of Estimated Investment Per Well

AREA	Well Depth (th ft)	J.A.S. Drilling Cost/Well (th $)	INVESTMENT PER WELL Estimated from J.A.S. (th $)	Estimated by Petroconsultants (th $)	RATIO
IRAN:Zagros Tertiary	2.5	118	441	1920	4.4
	6.0	244	913	3160	3.5
	12.5	1234	4614	5520	1.2
IRAN:Zagros Mesozoic	2.5	118	441	2040	4.6
	6.0	244	913	3310	3.6
	12.5	1234	4614	7550	1.6
IRAQ:Zagros Tertiary	3.5	147	551	3150	5.7
	4.0	159	596	2460	4.1
	6.5	275	1028	3100	3.0
IRAQ:Zagros Mesozoic	3.5	147	550	3150	5.7
	4.0	159	595	2460	4.1
	6.5	275	1029	3100	3.0
IRAQ:Arabian Mesozoic	6.5	275	1029	2720	2.6
	10.0	767	2867	4370	1.5
	11.0	987	3691	5640	1.5
ABU DHABI: Arabian Mesozoic	5.0	207	772	3080	4.0
	7.5	409	1529	2990	2.0
	10.0	767	2869	4350	1.5

Sources:
J.A.S., Joint Association Survey of Drilling Costs 1993. Linear interpolation within depth class.
Estimation of cost excess outside USA, and of non-drilling expenses, see [Adelman 1995].

Table I shows the USA drilling cost per well at each depth given in the PC report. This is raised by 70 percent to allow for non-drilling cost, and then multiplied by 2.2 to allow for the higher costs outside the USA, with its dense service-supply network. The allowance may be excessive. It is much higher than a similar one made by DOE. [Adelman 1995, p. 236] Yet the PC estimates are up to several times as high. Until the discrepancy is explained, it must be called a gross overstatement.

We turn now to output per well. Table II compares the PC assumptions of average well

Table II. Middle East Well Productivity 1994

	Petroconsultants	National Average
Iran	1682	4111
Iraq (1989)	1372	7275
Abu Dhabi	1603	1693

	Petroconsultants	National Average
"Middle East offshore"	2553	NA
Average "mid case"	1494	NA
Average "high"	2245	NA
Kuwait	NA	2616
Saudi Arabia	NA	5811

Sources:

Petroconsultants, Appendix B. "Information from the eight plays used is assumed to be representative of the countries addressed here." (p. 2)

World Oil, August 1995; daily output divided by total wells.

productivity with average output per well in 1994 (or 1989 for Iraq). The national averages are higher, yet they are too low. They include all operating wells, most of them declining for years. Hence they understate the output of newly drilled wells. The PC down-bias in well productivity is even greater than Table II would suggest.

There is an independent reality check. Table III takes the net capacity increase in several

Table III. Middle East Well Productivity: New Wells

	Saudi Arabia	Iran	UAE
Net capacity increase, 1990-94, mbd	2.45	0.7	0
Aggregate output, 1991-94, mbd	39.2	17.0	11.2
Loss of capacity, mbd			
at 3% decline	1.176	0.51	0.336
at 9% decline	3.528	1.53	1.008
Total capacity additions			
at 3% decline	3.626	1.21	0.336
at 9% decline	5.978	2.23	1.008
Oil Wells drilled 1991-94	567	218	240
Capacity per well			
at 3% decline	6391	5547	1400
at 9% decline	10536	10222	4200

Sources:

Capacity, Petroleum Intelligence Weekly (compare also Centre for Global Energy Studies, bimonthly reports).

Output, same sources.

Oil wells drilled, World Oil. NB: In some years, oil wells are not shown separately. If so, they are estimated from the previous years' ratio of oil wells to all wells.

Persian Gulf countries, from end-1990 to end-1994, and adds to it either 3 percent or 9 percent of

the intervening cumulative output. The total capacity increment is then divided by the number of oil wells drilled in the various countries. As we would expect, even with the assumed low 3 percent decline rate, the average new well produces more than the average of all wells old and new. With higher decline rates, estimated productivity of the new wells is much greater. But 9 percent is the *lowest* of the 24 decline rates assumed by PC for the eight specimen plays in Appendix B. If we take the PC decline rates seriously, Persian Gulf new-well productivity is many times their estimates.

Both of these errors-- too high an investment per well, and too low a productivity per well-- impart the same bias: overstating the needed investment per unit of output. This report at best is based on unsupported estimates for an unrepresentative sample. The information gap remains, all the worse for the pretense that it has been even partly closed.

References

[Adelman 1989] Adelman, M. A. "Offshore Norwegian Development Costs Calculated from Project Data," *Energy Exploration & Exploitation*, Vol. 7, no. 1, 1989, pp. 51-62.

[Adelman 1995] Adelman, M. A. *The Genie Out of the Bottle: World Oil Since 1970* (Cambridge, Mass., MIT Press, 1995).

[Campbell 1995] C. J. Campbell, "Proving the Unprovable", *Petroleum Economist*, May, pp. 27-30.

[OGJ 1986] *Oil & Gas Journal*, October 20, 1986, p. 22.