Marine Minerals

- Oil and Gas
- Sulfur
- Salt
- Sand and Gravel
- Coral
- Barite
- Deep seabed nodule metals

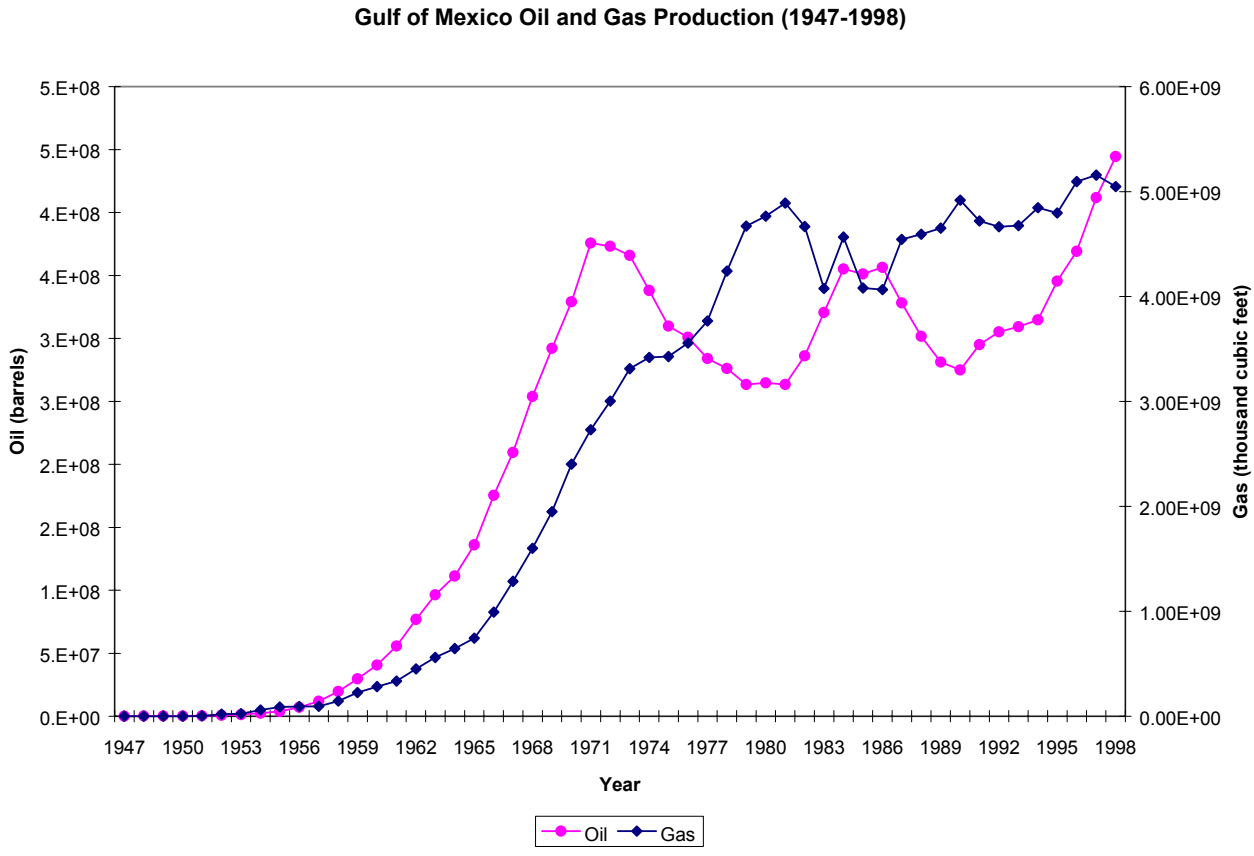
Offshore Oil and Gas

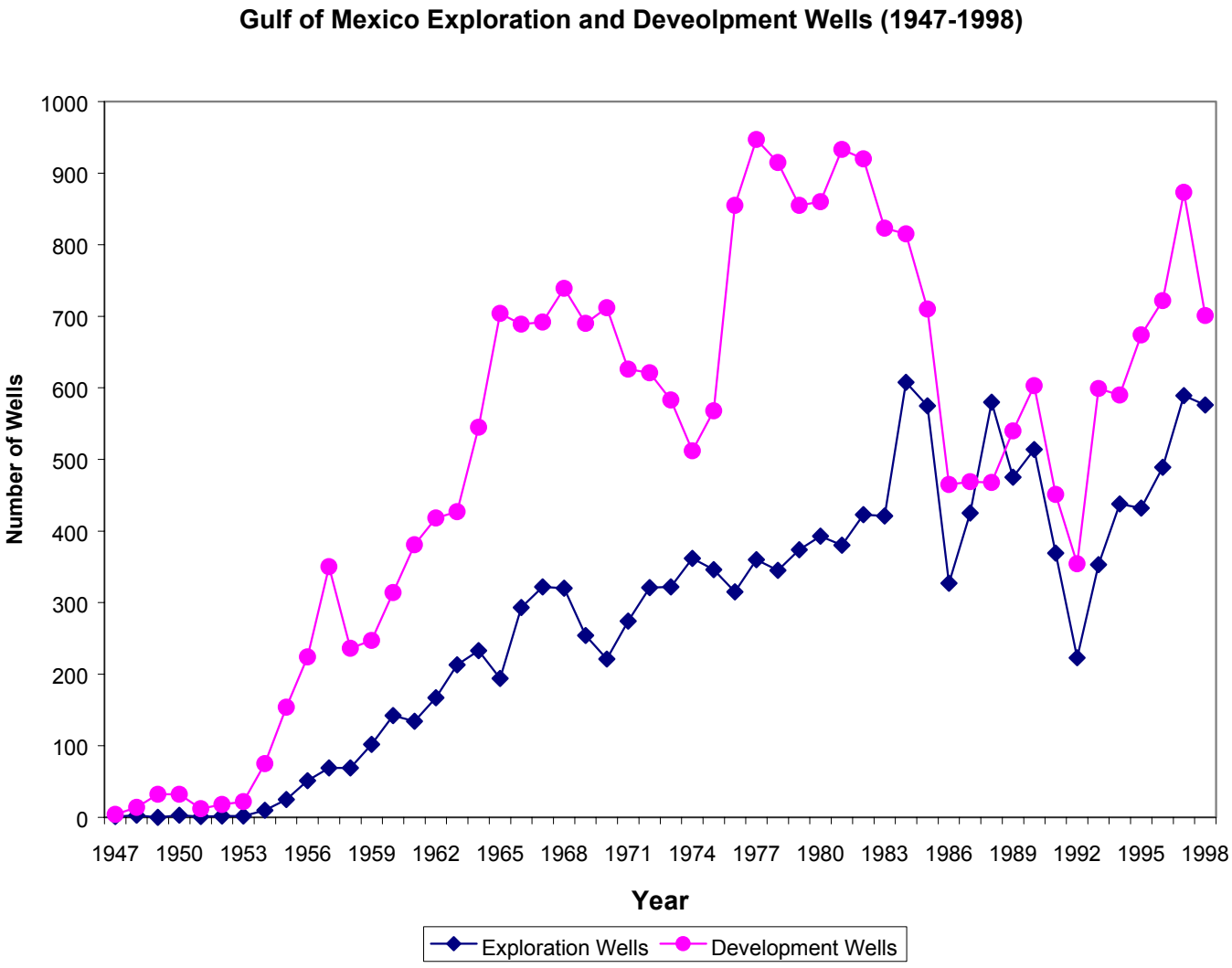
- In 2001, Federal offshore oil and gas production accounted for 26.3 and 24.3 percent of total U.S. production, respectively.

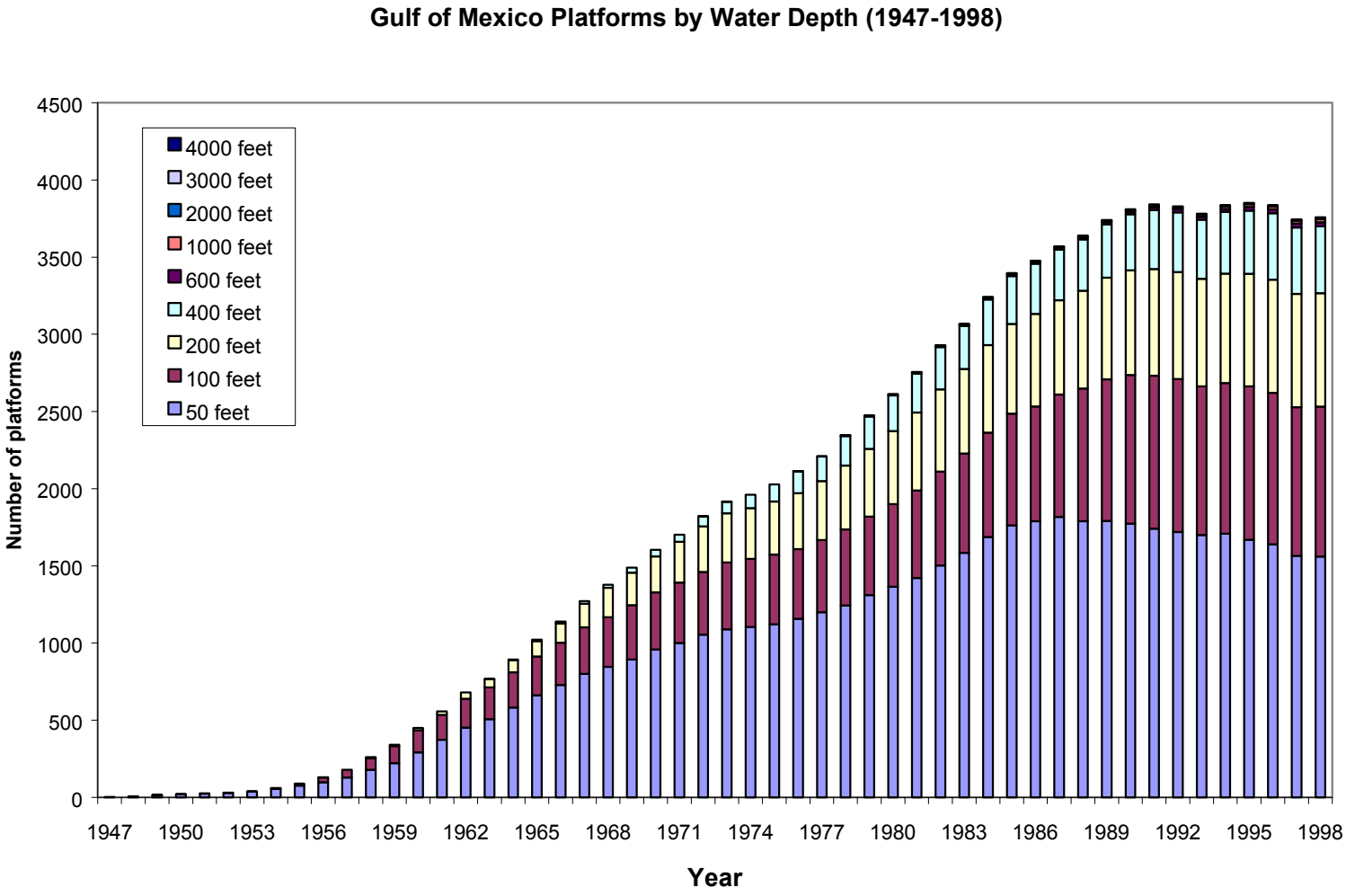
- Oil and gas production in the Gulf of Mexico accounted for 88 and 99 percent of the total U.S. offshore production in 1997, respectively.

- Contrary to earlier predictions of declining production due to resource depletion, the output from the Gulf of Mexico has increased in recent years.

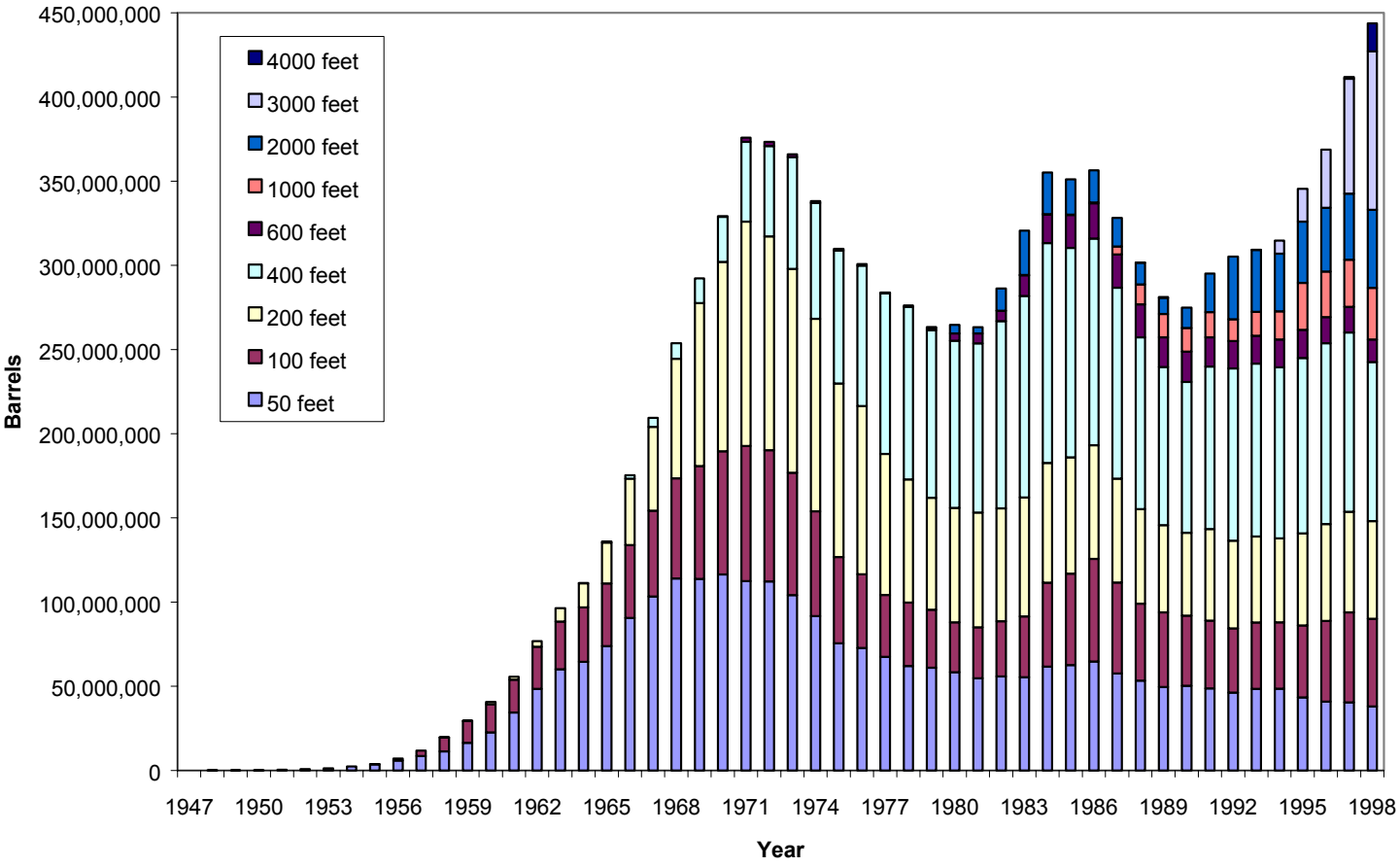
- Technical change in the offshore industry has been remarkable.


Gulf of Mexico Oil and Gas Production (1947-1998)
Oil (barrels)
Gas (thousand cubic feet)
Year
Oil
Gas
5.E+08
5.E+08
4.E+08
4.E+08
3.E+08
3.E+08
2.E+08
2.E+08
1.E+08
5.E+07
0.E+00
6.00E+09
5.00E+09
4.00E+09
3.00E+09
2.00E+09
1.00E+09
0.00E+00
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998


Gulf of Mexico Exploration and Deveolpment Wells (1947-1998)
Number of Wells
1000
900
800
700
600
500
400
300
200
100
0
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
Year
Exploration Wells
Development Wells


Gulf of Mexico Platforms by Water Depth (1947-1998)
4000 feet
3000 feet
2000 feet
1000 feet
600 feet
400 feet
200 feet
100 feet
50 feet
Number of platforms
0
500
1000
1500
2000
2500
3000
3500
4000
4500
1947
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
Year

Gulf of Mexico Oil Production by Water Depth (1947-1998)



Time Line for
Major Technological Achievements
in the Offshore Industry

Technologies	Year
First offshore well drilled in Gulf of Mexico	1938
First OCS exploratory well drilled in Gulf of Mexico	1946
First offshore lease sale	1954
Production from water depths exceeding 100 feet	1955
First drillship	1956
First subsea well drilled	1961
First offshore concrete gravity base structure (Beryl platform)	1975
First fixed platform installed beyond 1,000 feet water depth	1979
First compliant guyed-tower platform in Gulf of Mexico	1983
Production from water depths of 2,000 feet	1984
First horizontal wells drilled offshore	1991
3D seismic data acquisition widely used	1992
First sub-salt discoveries in Gulf of Mexico	1993

Source: MMS

Technical Developments in the Offshore Oil and Gas Industry

- Three-dimensional (3D) seismic technology has been developed since the mid-1980s and has been widely used since 1992. This is a result of the development in computing power and analytical software. 3D seismology provides a better picture of the composition and structure of subsurface rock layers compared with earlier 2D technology.

- Horizontal drilling technology has been developed rapidly since the late 1980s. The technology involves a steerable downhole motor assembly and a "measurement-while-drilling" package. With horizontal drilling technology, drillers are capable of guiding a drillstring that can deviate at all angles from vertical.

- Deep-water technology encompasses two production systems: tension leg platforms (TLPs) and subsea completions.

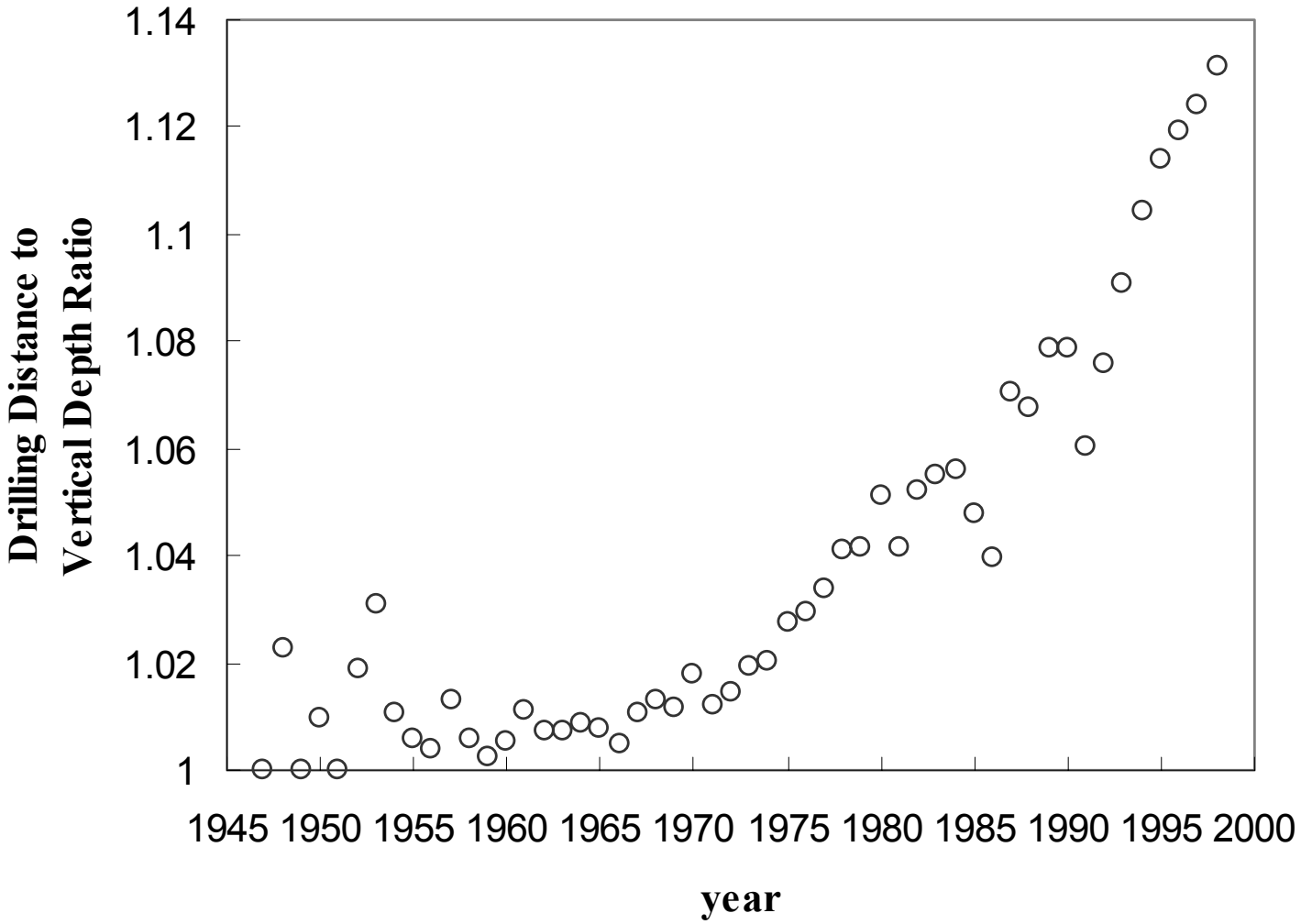
Evolution of Environmental Regulation of Offshore Oil and Gas Exploration and Production

The Minerals Management Service has primary regulatory jurisdiction in the OCS under the Outer Continental Shelf Lands Act of 1953. With the enactment of environmental legislation beginning in the early1970s, several other agencies have acquired limited regulatory jurisdiction in the OCS. The most important of these is the Environmental Protection Agency, which regulates air emissions under the Clean Air Act of 1970 and effluent discharges under the Clean Water Act of 1972. Typically, EPA regulations have taken effect several years later in the Western Gulf of Mexico, where most US offshore oil and gas installations are concentrated, than in other areas of the OCS.

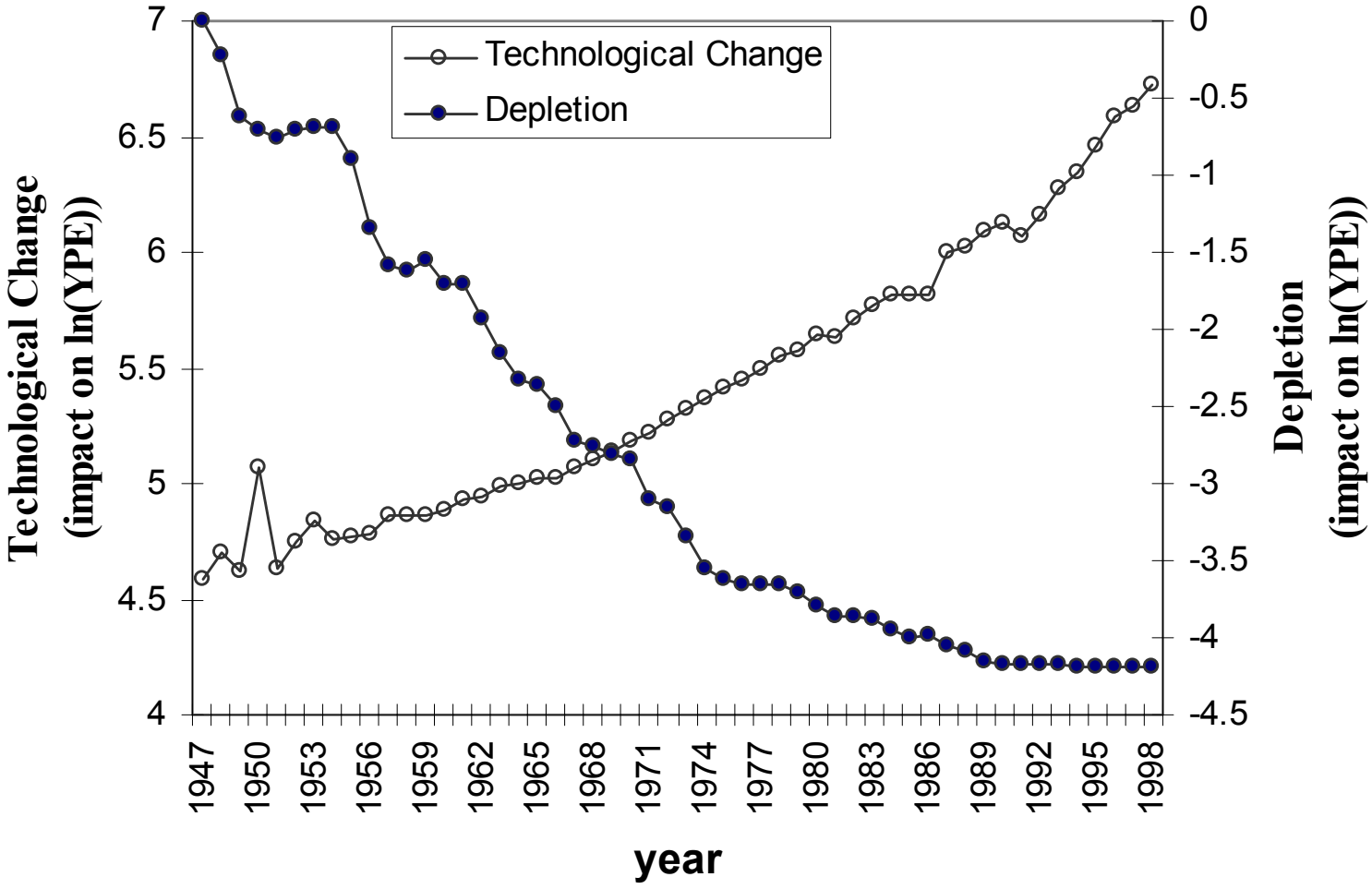
National ambient air quality standards first became applicable to most of the OCS in 1990, when regulatory authority was transferred from the MMS to EPA. The standards became applicable to the Western Gulf of Mexico in 1993, and MMS retains authority in that portion of the OCS for the monitoring and reporting of emissions data for five pollutants (TSP, SO_2, No_x, VOC, CO). MMS consults with EPA to ensure coordination between OCS monitoring and monitoring in adjacent onshore areas.

Under the Clean Water Act, EPA first limited the disposal of free oil in drilling muds and issued effluent discharge standards based on existing technologies in 1975. Standards for toxic and nonconventional pollutants in effluent discharges and drilling muds were added in 1986, along with limits on oil and grease in produced water. In 1993, discharge standards were revised and expanded to cover drilling fluids and cuttings; produced water; deck drainage; treatment, completion and workover fluids; and domestic and sanitary wastes for most of the OCS. These standards were extended to the Western Gulf of Mexico portion of the OCS in 1998-99.

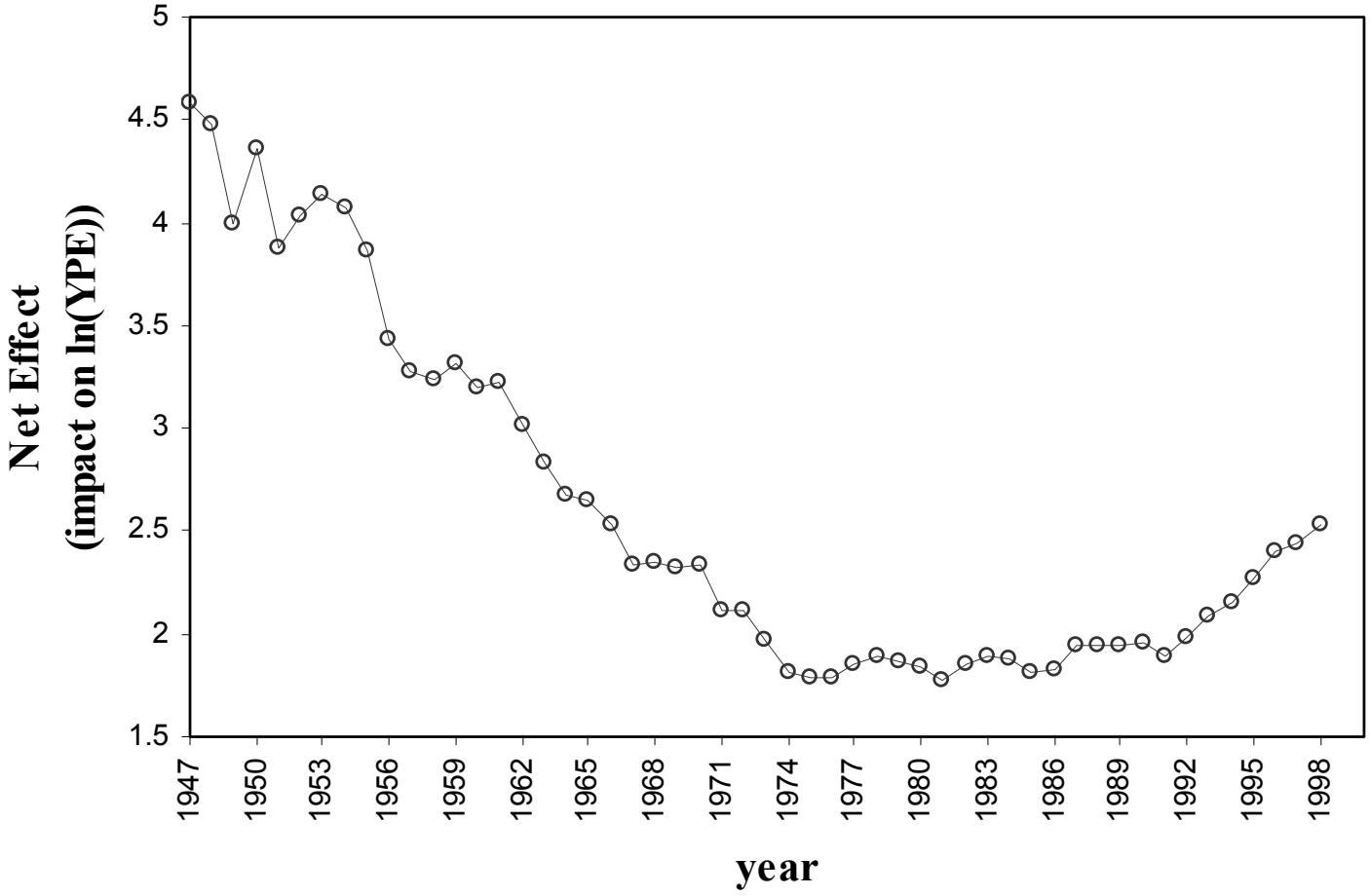
Horizontal and Directional Drilling in the Gulf of Mexico



Technological Change and Depletion
in OCS Oil and Gas Exploration
Gulf of Mexico



Net Effect of Technological Change and Depletion
in OCS Oil and Gas Exploration
Gulf of Mexico



Growth of Total Factor Productivity (TFP)

1976-1995 Average Annual TFP Growth (Percent) in the Gulf of Mexico Offshore Oil and Gas Industry, Adjusted for Water Depth and Field Size

ε_{CS}	0.4	0.6	0.8	1.0	1.2
ε_{CD}					
0.4	5.64	8.56	11.48	14.41	17.33
0.6	5.76	8.68	11.61	14.53	17.45
0.8	5.88	8.81	11.73	14.65	17.58
1.0	6.01	8.93	11.85	14.78	17.70
1.2	6.13	9.05	11.98	14.90	17.82

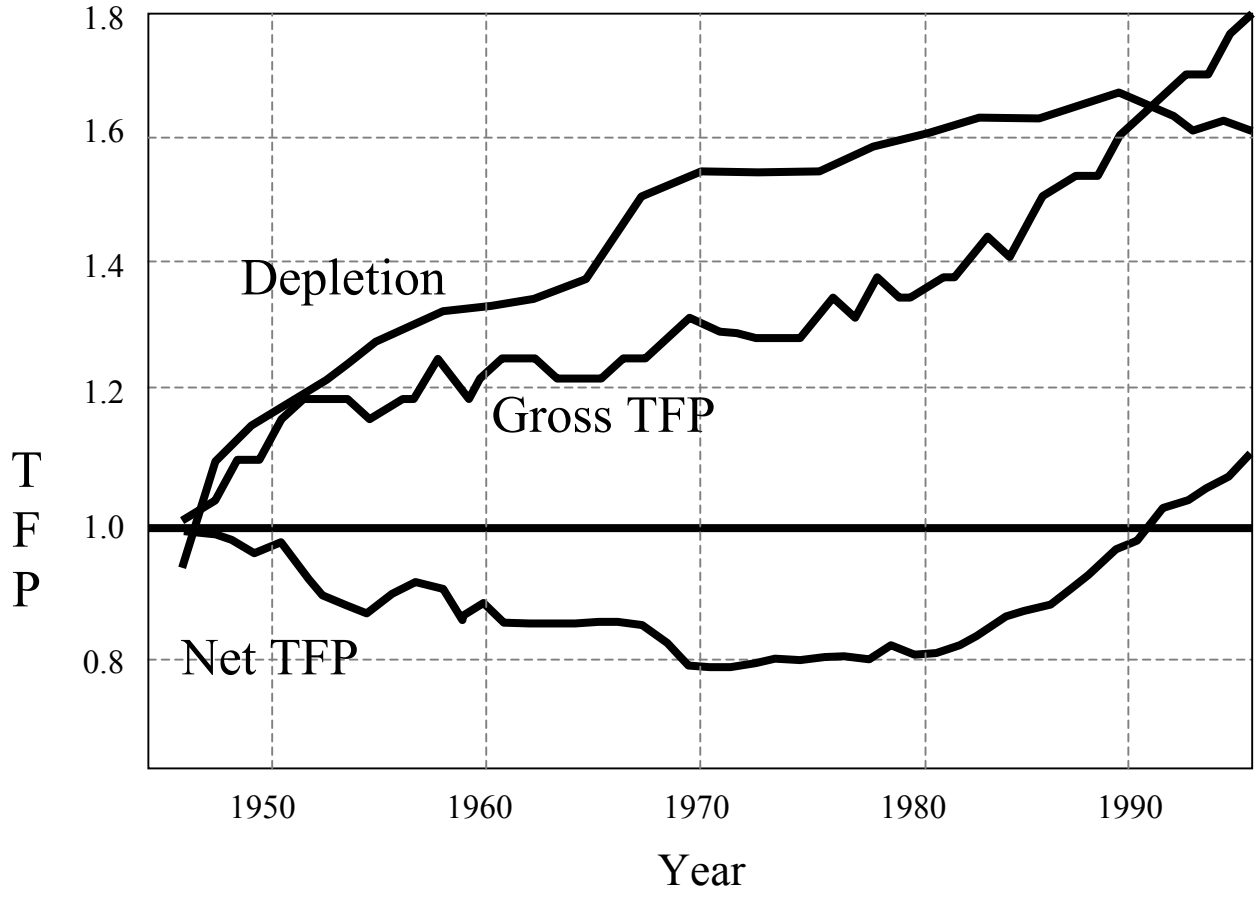
Notes: ε_{CS} is the cost elasticity with respect to field size, and ε_{CD} is the cost elasticity with respect to water depth.

Average Annual TFP Percentage Growth in the Gulf of Mexico Offshore Oil and Gas Industry (1976-1995), Adjusted for Water Depth, Field Size, Environmental Regulation, and Pollution Discharge

ε_{CE}	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
ε_{CQ}										
0.01	16.03	16.09	16.16	16.23	16.30	16.37	16.44	16.50	16.57	16.64
0.02	20.25	20.32	20.39	20.46	20.53	20.60	20.66	20.73	20.80	20.87
0.03	24.48	24.55	24.62	24.69	24.76	24.82	24.89	24.96	25.03	25.10
0.04	28.71	28.78	28.85	28.92	28.98	29.05	29.12	29.19	29.26	29.32
0.05	32.94	33.01	33.08	33.14	33.21	33.28	33.35	33.42	33.49	33.55
0.06	37.17	37.24	37.30	37.37	37.44	37.51	37.58	37.65	37.71	37.78
0.07	41.40	41.47	41.53	41.60	41.67	41.74	41.81	41.87	41.94	42.01
0.08	45.63	45.69	45.76	45.83	45.90	45.97	46.03	46.10	46.17	46.24
0.09	49.85	49.92	49.99	50.06	50.13	50.19	50.26	50.33	50.40	50.47
0.10	54.08	54.15	54.22	54.29	54.35	54.42	54.49	54.56	54.63	54.70

Notes: ε_{CE} is the cost elasticity with respect to environmental regulatory intensity, and ε_{CQ} is the cost elasticity with respect to pollution discharge.

Net TFP, Gross TFP and Depletion
Gulf of Mexico Oil and Gas Industry



Total Factor Productivity
Gulf of Mexico Oil and Gas Industry
Environmental Effect