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Geopolitics and Energy

Key Trends: 2000-2020

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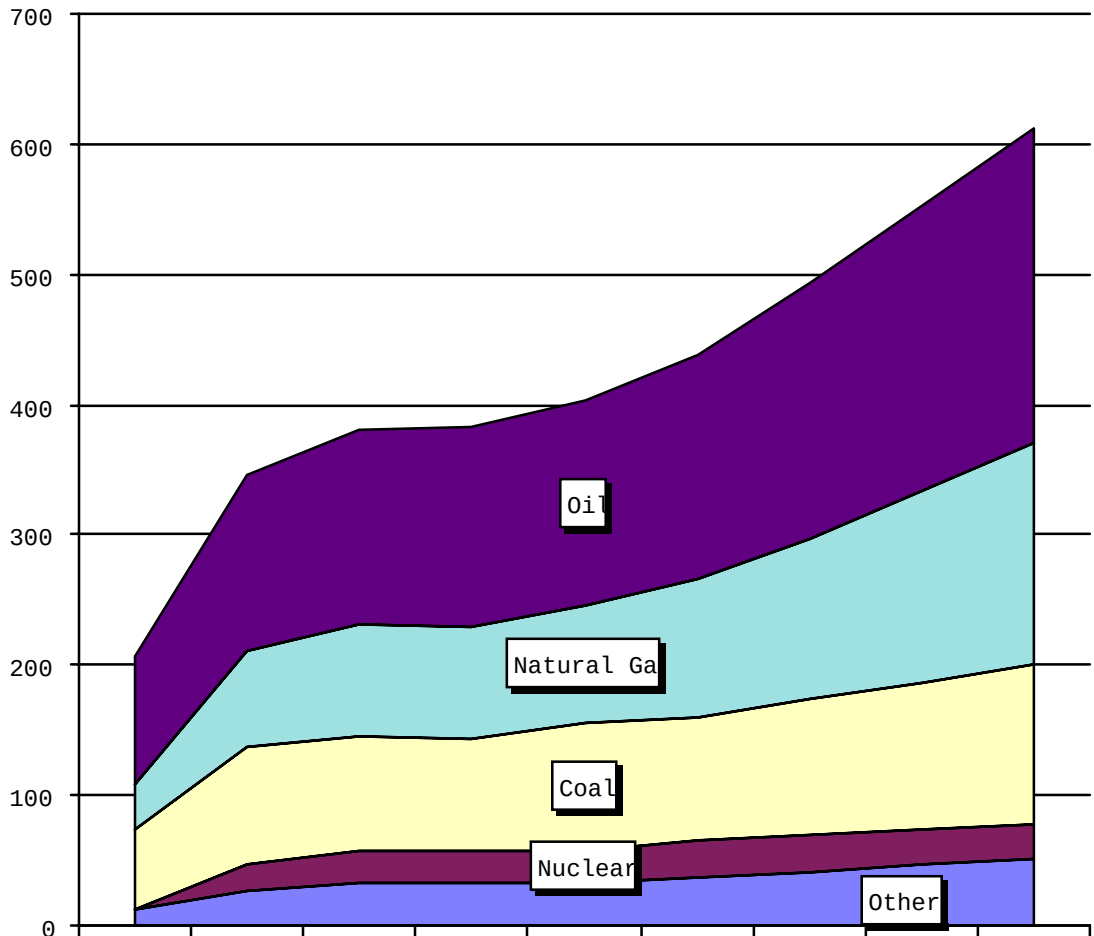
Market, Environmental, and Regulatory - Driven Geopolitical Risks

- **Massive Rises in Asian Demand**
  - **Up from 73.8 Quads in 1990 to 98.9 Quads in 2000.**
  - **Rise to 197.1 Quads in 2020**
  - **Oil alone up from 28.5 Quads in 1990 to 41.6 Quads in 2000. Rise to 76.7 Quads in 2020.**
  - **Gas alone up from 5.7 Quads in 1990 to 10.28 Quads in 2000. Rise to 28.3 Quads in 2020.**
- **Environmental and Regulatory: Kyoto, Coal Use, Nuclear Power**
  - **Carbon emissions increase from 5,827 million metric tons in 1990, and 6,097 million metric tons in 2000, to 9,850 in 2020.**
  - **Rise is over 100% in developing world (2,158 million metric tons in 2000 to 4,592 in 2020).**
  - **DOE/IEA studies indicate Kyoto could affect at least 25% of world energy supply.**
  - **Coal use in developing world increases from 321 Quads in 1990, and 36.32 Quads in 2000 to 71.1 Quads in 2020**
  - **Nuclear worldwide shifts from 20.4 Quads in 1990, and 25.3 Quads in 2000 to 28.0 Quads in 2020.**
- **Investment and Production Capacity**
  - **Worldwide demand means funding increase from 381.9 Quads in 2000 to 611.5 Quads in 2020 (+60%)**
  - **Oil rises from 152.2 to 241.8 Quads (+49%)**
  - **Gas Rises from 86.9 to 168.6 Quads (+92%)**
- **Developing world demand means funding increase from 137.6 Quads in 2000 to 272.1 Quads in 2020 (+94%)**

Rising World Energy Demand By Type of Primary Fuel: 1970-2020

(Quadrillion BTU)

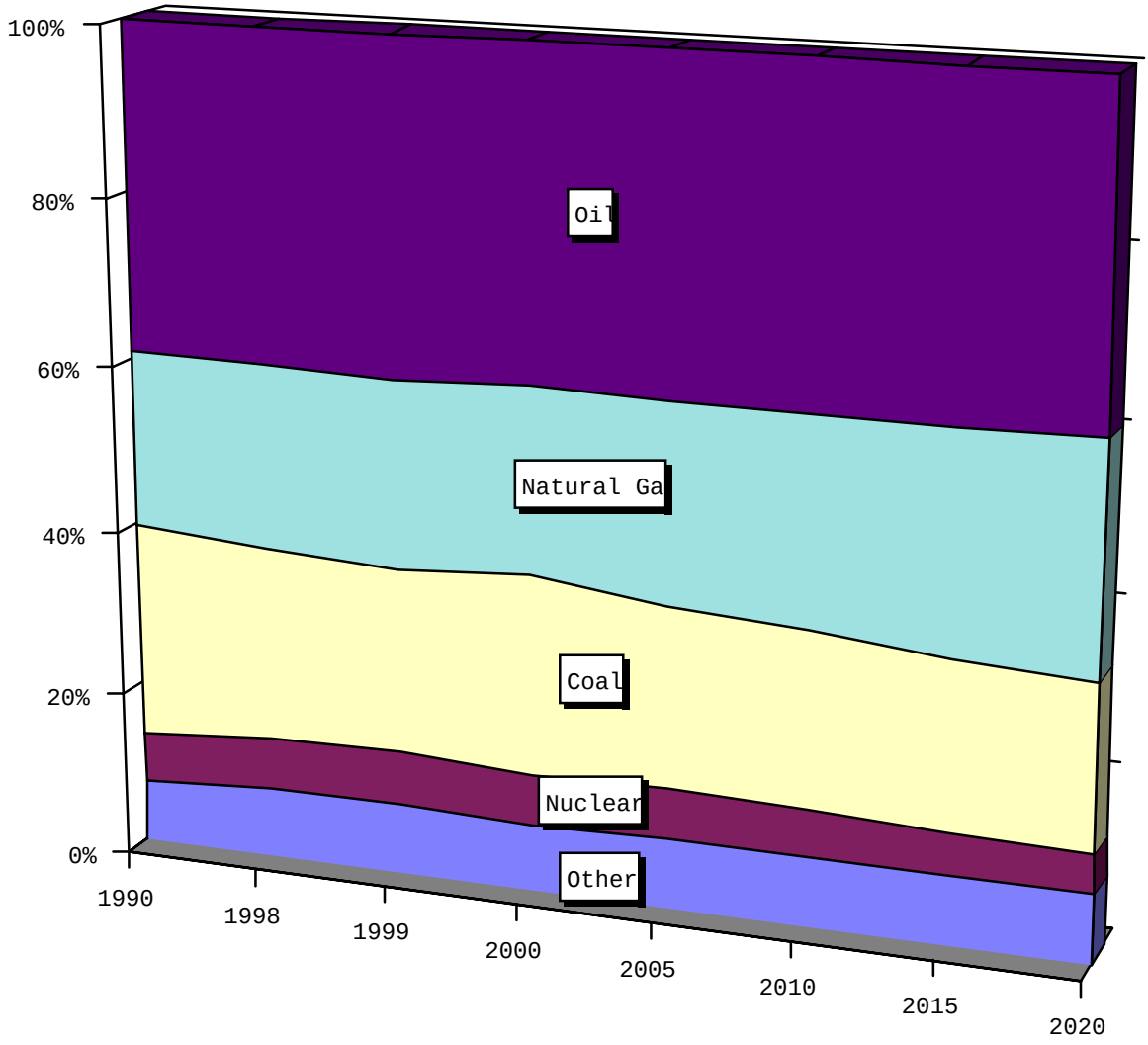


	1970	1990	1998	1999	2000	2005	2010	2015	2020
Oil	97.8	134.9	149.8	152.2	157.7	173.4	195.4	219	241.8
Natural Ga	36.1	74.5	84.5	86.9	90.1	105.2	123.4	145.8	168.6
Coal	59.7	90	89.9	84.8	97.7	95.6	104.7	112.8	122.3
Nuclear	0.9	20.4	24.4	25.3	24.5	26.9	27.5	27.7	28
Other	12.2	26.3	32	32.7	32.7	37.6	41.6	46.4	50.7

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484 (99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484 (00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), p. 181.

Share of World Consumption By Type of Primary Fuel Show Rise in Gas and Decline in Coal: 1970-2020

(Quadrillion BTU)



Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484 (99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484 (00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), p. 181.

Strategic Influence and Energy: Who Has the World's Energy Reserves?

(Percent of Proven World Reserves)
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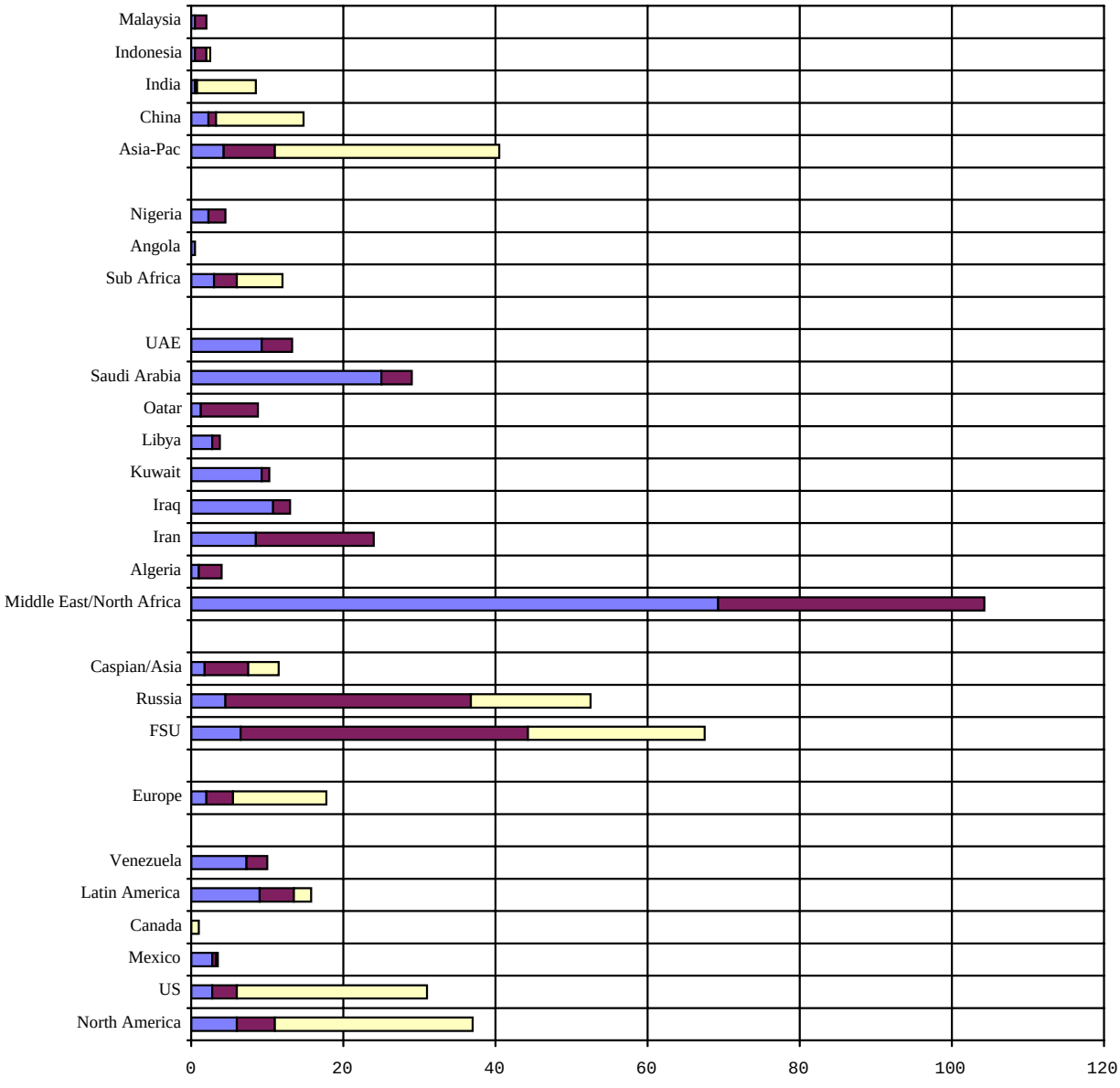
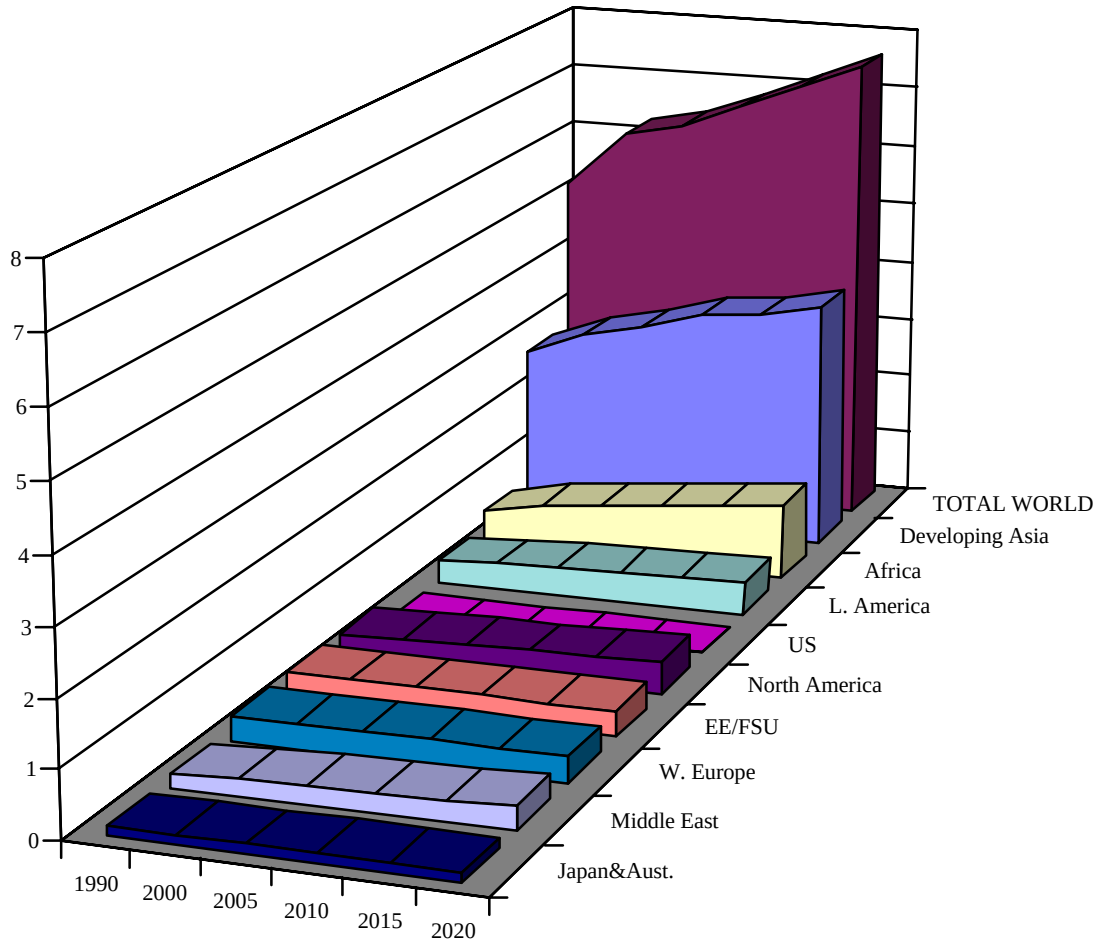


	North A	US	Mexico	Canada	Lat in A	Venezu		Europe		FSU	Russia	Caspian/		Middle	Algeria	Iran	Iraq	Kuwait	Libya	Oatar	SaudiAr	UAE		Sub Af	Angola	Nigeria		Asia-Pa	China	India	Indonesi	Malaysia
Coal	26	25	0.1	0.9	2.2			12		23	16	4		0.1										6.2				30	12	7.6	0.5	
Gas	4.9	3.2	0.6		4.6	2.8		3.5		38	32	5.7		35	3	15	2.1	1	0.9	7.4	4	4		2.8		2.3		6.8	0.9	0.4	1.4	1.5
Oil	6.1	2.8	2.7		9	7.3		1.9		6.4	4.6	1.8		69	0.9	8.6	11	9.2	2.8	1.3	25	9.3		3.1	0.5	2.2		4.2	2.3	0.4	0.5	0.4

Source: BP Statistical Review of World Energy, June 2001.

The New World of Energy Consumers: Population Growth by Region

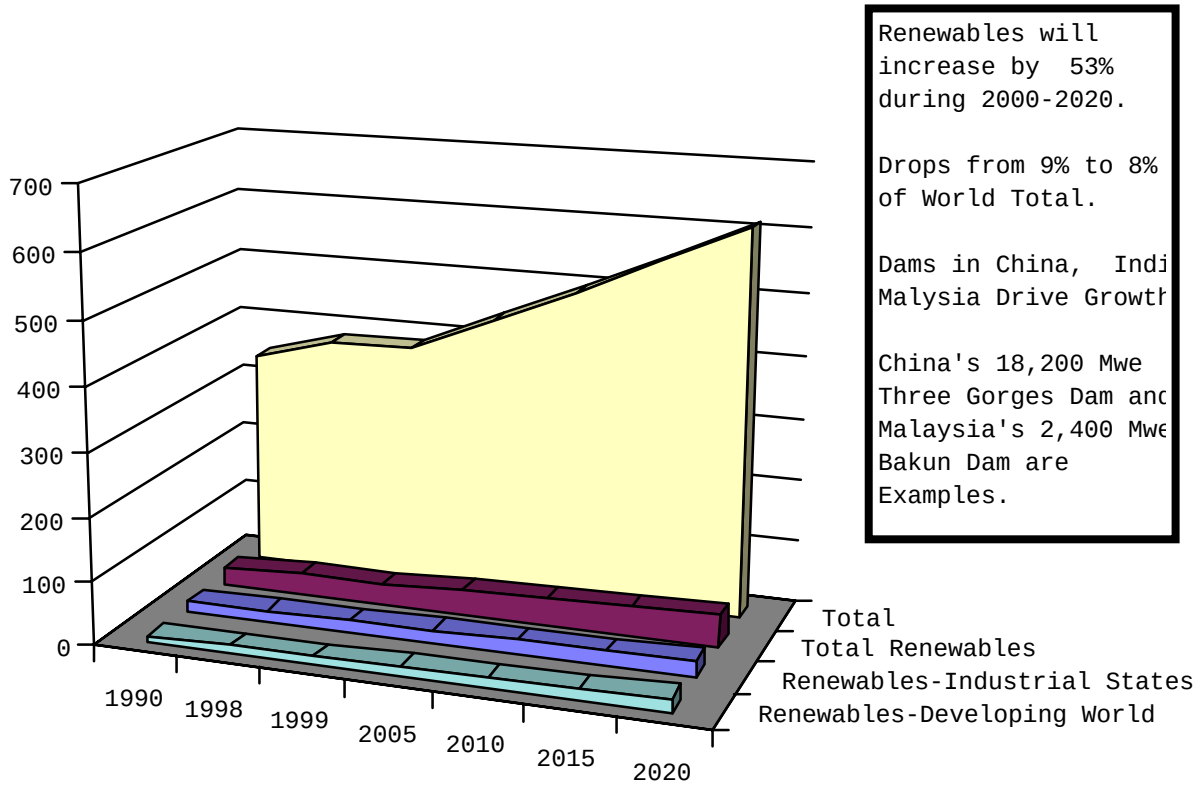
(Population in Billions)



	1990	2000	2005	2010	2015	2020
Japan&Aust.	0.15	0.15	0.16	0.16	0.16	0.16
Middle East	0.19	0.24	0.27	0.3	0.33	0.36
W. Europe	0.38	0.39	0.39	0.39	0.39	0.39
EE/FSU	0.41	0.41	0.41	0.4	0.39	0.39
North America	0.37	0.4	0.43	0.45	0.47	0.49
US	*0.26	*0.27	*0.28	*0.30	*0.31	*0.33
L. America	0.35	0.4	0.45	0.48	0.51	0.53
Africa	0.6	0.8	0.9	1	1.1	1.2
Developing Asia	2.8	3.2	3.4	3.7	3.8	4
TOTAL WORLD	5.3	6.2	6.4	6.8	7.2	7.6

Renewables are Not Projected to Solve the World's Energy Problems and Most Growth Occurs in Massive, Environmentally Suspect Projects, in the Developing World Like the Three Gorges Dam in China: 1970-2020

(Quadrillion BTU)

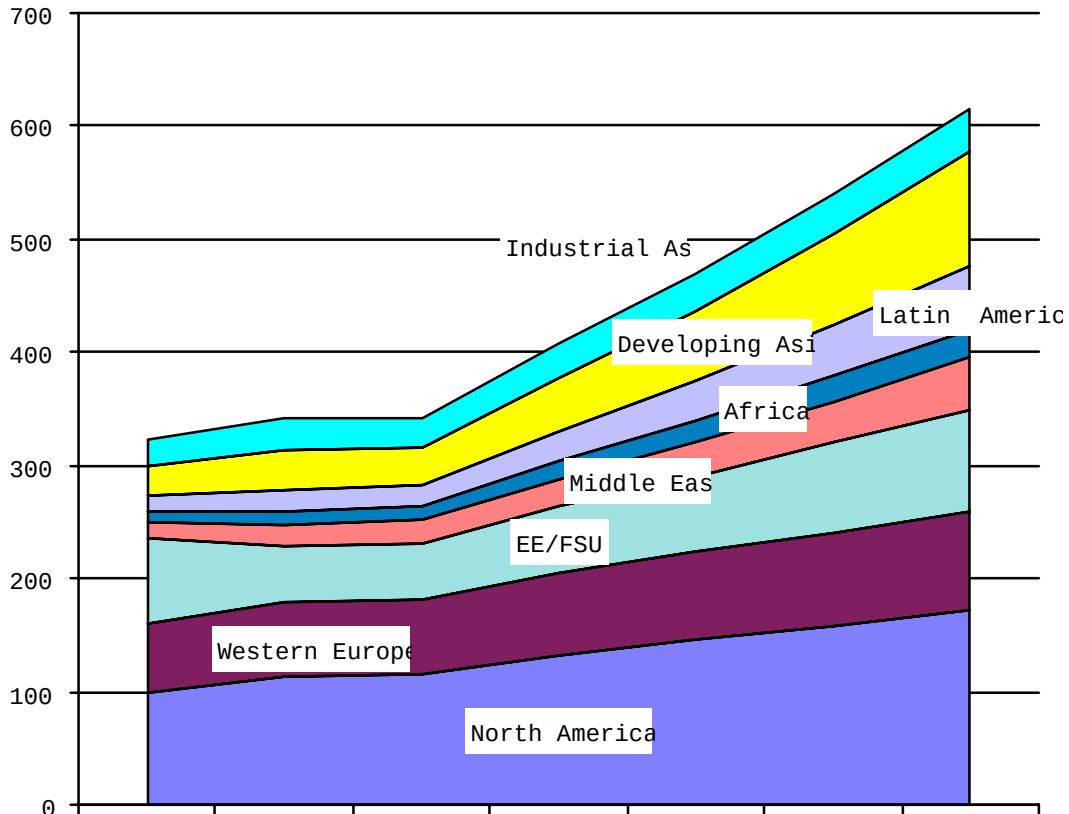


	1990	1998	1999	2005	2010	2015	2020
Renewables-Developing World	8	11.1	11.5	14.1	16.1	18.9	21.4
Renewables-Industrial States	15.6	17.9	18.6	21	23	24.9	26.9
Total Renewables	26.5	32	33.1	37.6	41.6	46.4	50.7
Total	346.2	379.7	381.9	438.6	492.6	551.7	611.5

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 179 &187.

World Energy Demand By Region Shows Broad Growth Dominated by Asia and North America: 1990-2020

(Quadrillion BTU)

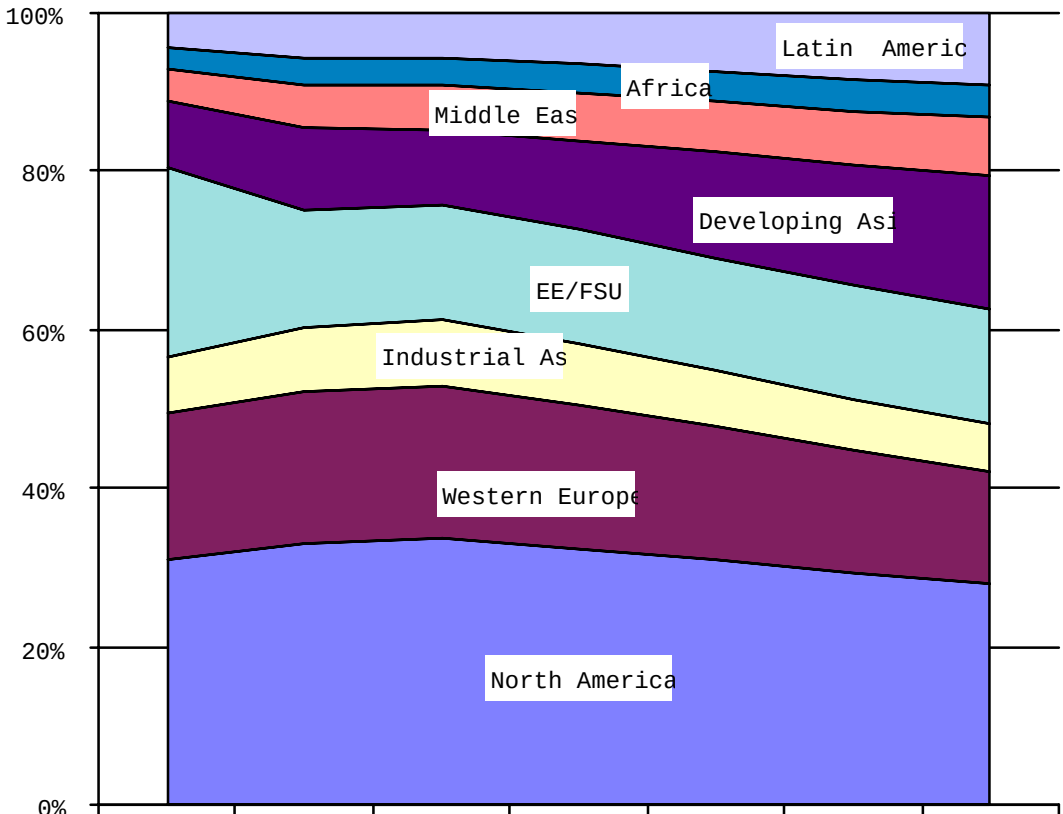


	1990	1998	1999	2005	2010	2015	2020
Industrial Asia	22.8	27.6	27.9	31	32.9	35	37.1
Developing Asi	27	35.3	31.9	45.7	61.5	80.6	102.8
Latin America	13.7	19.4	19.8	26.5	34.5	44.7	55
Africa	9.3	11.6	11.8	15.3	18	21.8	25.6
Middle East	13.1	19.1	19.3	23.8	30.2	37.3	45.9
EE/FSU	76.3	50.6	50.4	59.1	67.3	78.9	89.8
Western Europe	59.8	65.8	66	73.8	78.2	82.5	88
North America	100.1	112.7	115.7	131.9	145.4	158.2	171.2

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

Developing World Dominates Shift in Distribution of World Energy Demand By Region: 1990-2020

(Quadrillion BTU)



	1990	1998	1999	2005	2010	2015	2020
Latin America	13.7	19.4	19.8	26.5	34.5	44.7	55
Africa	9.3	11.6	11.8	15.3	18	21.8	25.6
Middle East	13.1	19.1	19.3	23.8	30.2	37.3	45.9
Developing Asi	27	35.3	31.9	45.7	61.5	80.6	102.8
EE/FSU	76.3	50.6	50.4	59.1	67.3	78.9	89.8
Industrial Asi	22.8	27.6	27.9	31	32.9	35	37.1
Western Europe	59.8	65.8	66	73.8	78.2	82.5	88
North America	100.1	112.7	115.7	131.9	145.4	158.2	171.2

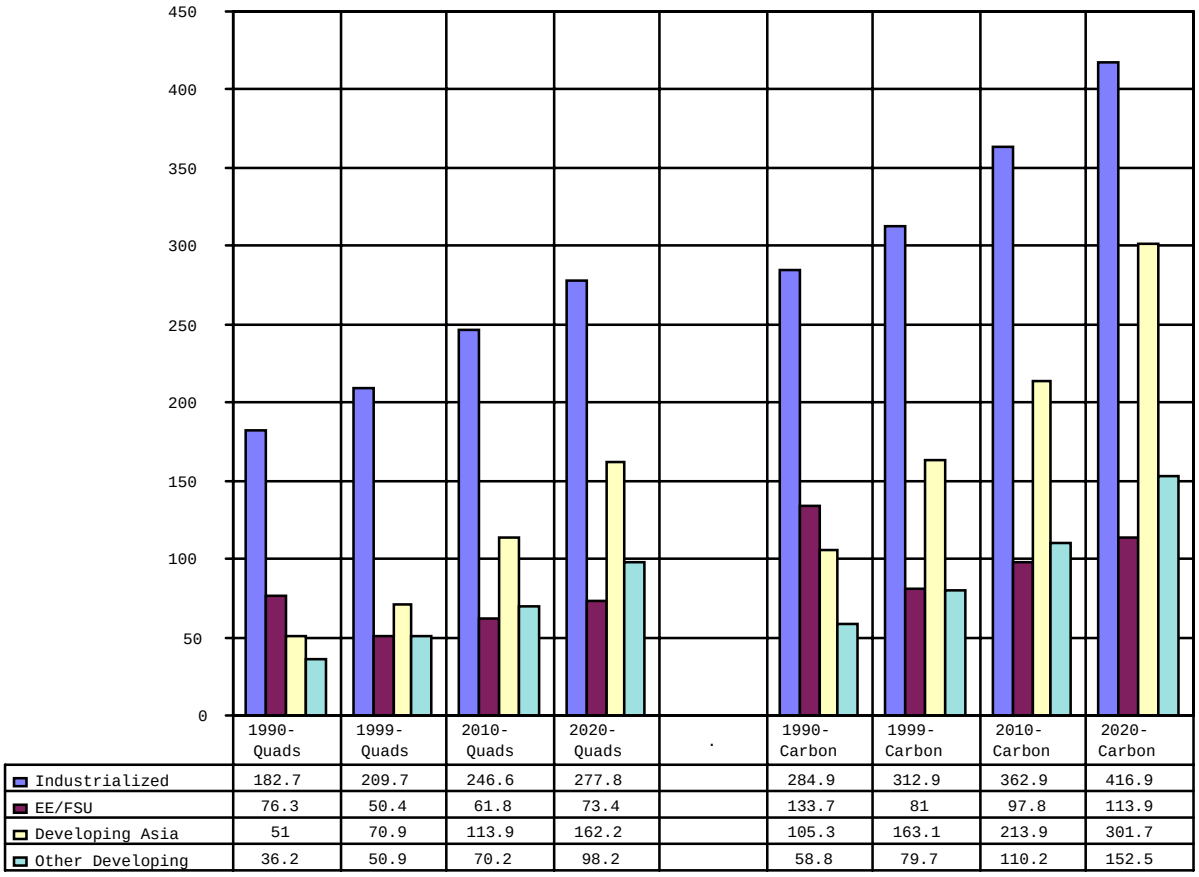
Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

Shifts in Major Environmental Factors

- **Total CO2 Emissions Rise from 6.1 billion metric tons in 1999 to 7.9 billion in 2010 and 9.9 Billion in 2020.**
- **Developing Countries Account for 77% of the Rise Between 1990 and 2010 and 72% of the Rise Between 1990 and 2020.**
- **Carbon Intensity Does Improve Along with Energy Intensity**
- **Developing World -- Driven by Asia -- Rapidly Catching Up with Industrialized World in Terms of Total Emissions.**
    - **Developing World Rises from 1,641 million metric tons in 1990 to 2,158 million in 2000, 3,241 in 2010 and 4,542 in 2020. (+111% from 2000-2020.)**
    - **Developing Asia Rises from 1,053 million metric tons in 1990 to 1,361 million in 2000, 2,139 in 2010 and 3,017 in 2020. (+116% from 2000-2020.)**
    - **Chinese and India Drive emissions Through Increased Use of Coal, Nuclear, Oil, and Gas.**
    - **Environmental Trade-offs By Region Become Unworkable.**
- **Industrial World Rises from 2,849 million metric tons in 1990 to 3,129 million in 2000, 3,692 in 2010 and 4,169 in 2020. (+33% from 2000-2020.)**
    - **US Rises from 1,352 million metric tons in 1990 to 1,767 million in 2000, 2,171 in 2010 and 2,515 in 2020. (+42% from 2000-2020.)**
    - **US Annual Growth Rate during 2000-2020 is 1.7% versus 0.9% for Europe and Japan (Mexico is 4.0%)**
- **Transition from Coal to Gas Reduces Emission Growth but Even Gas Emissions Become Massive.**
- **Transportation Emissions from Oil nearly double from use of 33 MMBD in 1990 to 65MMBD in 2020.**
    - **Emissions rise 3.8% per year in Developing World (4.9% in Asia) versus 2.9% in EE/FSU and 1.7% in Industrial World (2.1% in North America.)**

Environmental Uncertainties and Demand: Increases in Global Consumption of Energy versus Increase in Environmental Impacts

(Energy Consumption in Quads vs. Carbon Emissions In Millions of Metric Tons Divided by 10, EIA Reference Case)



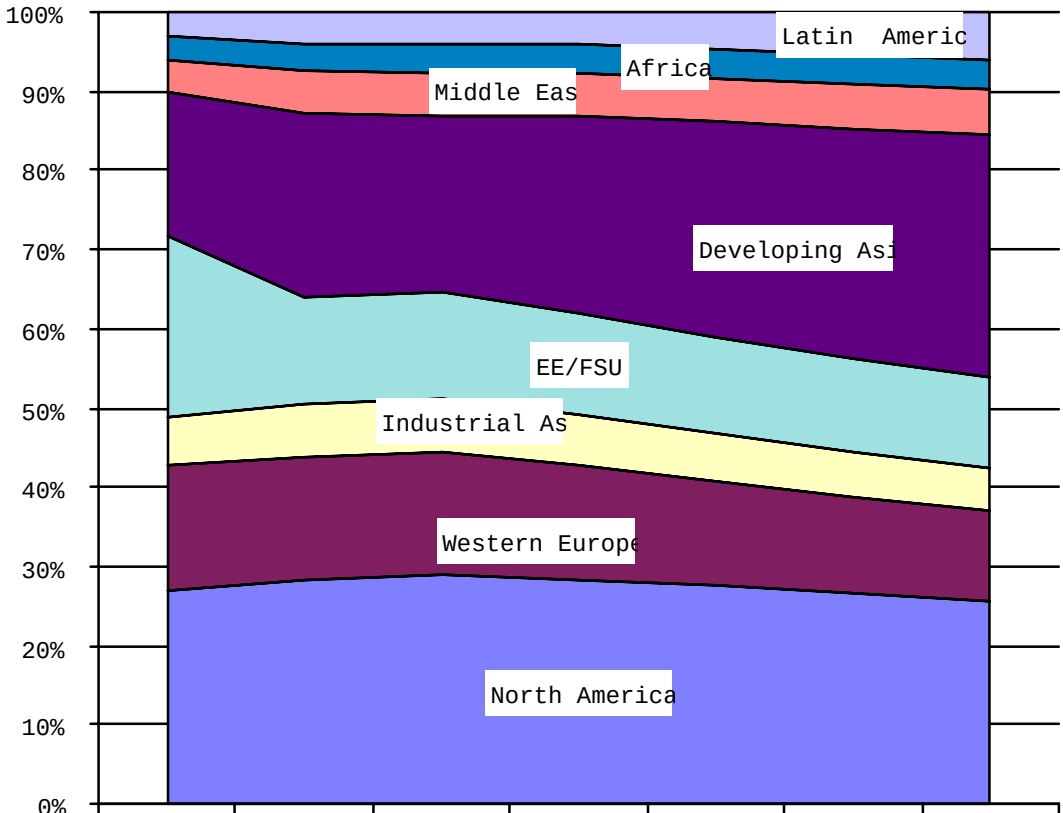
	1990-Quads	1999-Quads	2010-Quads	2020-Quads		1990-Carbon	1999-Carbon	2010-Carbon	2020-Carbon
Industrialized	182.7	209.7	246.6	277.8		284.9	312.9	362.9	416.9
EE/FSU	76.3	50.4	61.8	73.4		133.7	81	97.8	113.9
Developing Asia	51	70.9	113.9	162.2		105.3	163.1	213.9	301.7
Other Developing	36.2	50.9	70.2	98.2		58.8	79.7	110.2	152.5

Total Annex 1	242.3	246.9	289.1	326.0		2765	3028	3527	3939
(US)	84.2	97.0	115.6	130.9		1352	1517	1835	2088
Total Developing	87.2	121.8	184.1	260.3		1641	2158	3241	4542
Total World	346.2	381.9	492.6	611.5		5827	6097	7910	9850

Source: Adapted by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2002, pp. 179, 189.

Distribution of Energy CO2 Emissions By Region: 1990-2020

(Millions of Metric tons Equivalent)

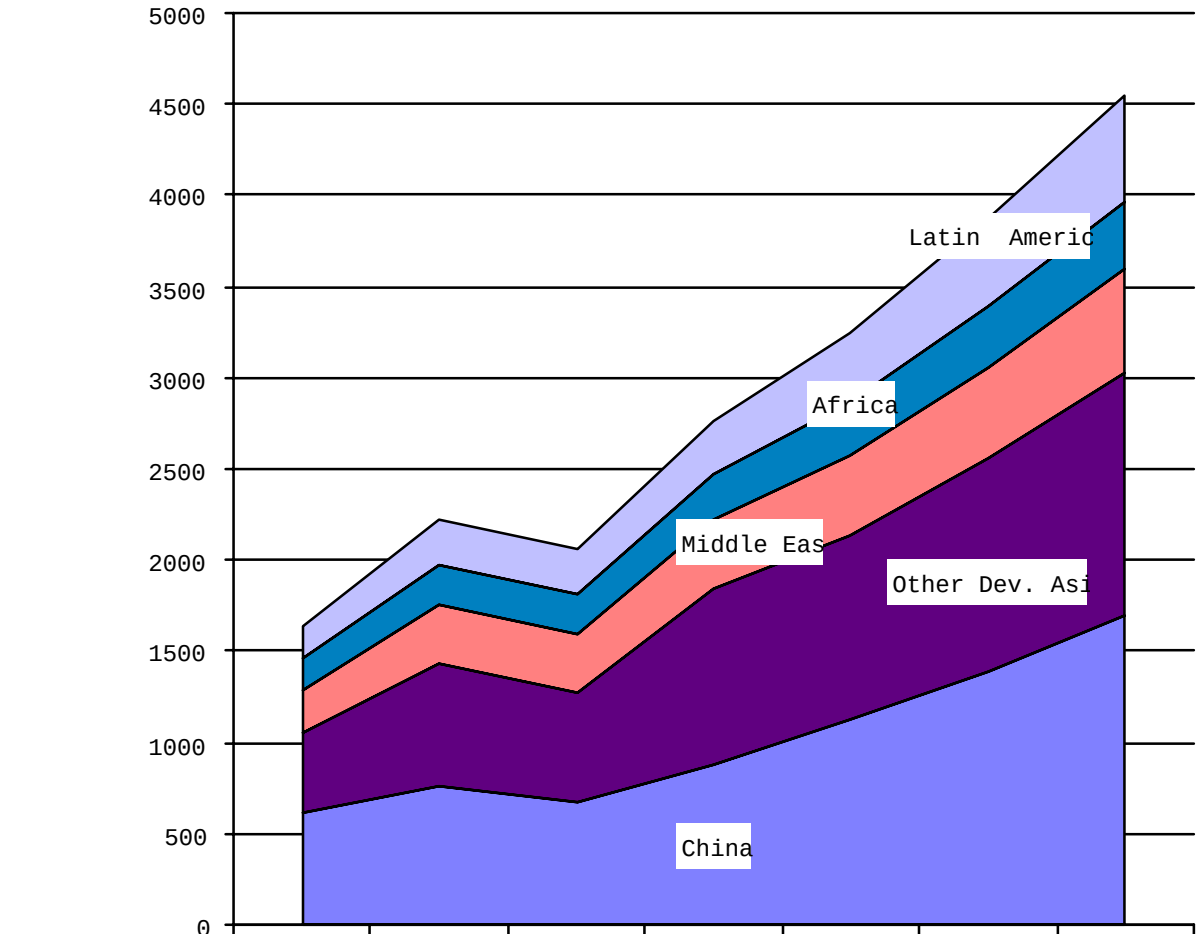


	1990	1998	1999	2005	2010	2015	2020
Latin America	178	246	249	290	377	484	595
Africa	179	216	218	256	287	327	365
Middle East	231	325	330	372	439	501	566
Developing Asi	1053	1435	1361	1748	2139	2558	3017
EE/FSU	1337	816	810	907	978	1068	1139
Industrial Asi	357	412	422	451	475	496	518
Western Europe	930	947	940	1008	1045	1086	1136
North America	1562	1742	1767	1986	2171	2346	2515

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

Distribution of Energy CO2 Emissions in the Non-Kyoto World: 1990-2020

(Millions of Metric tons Equivalent)

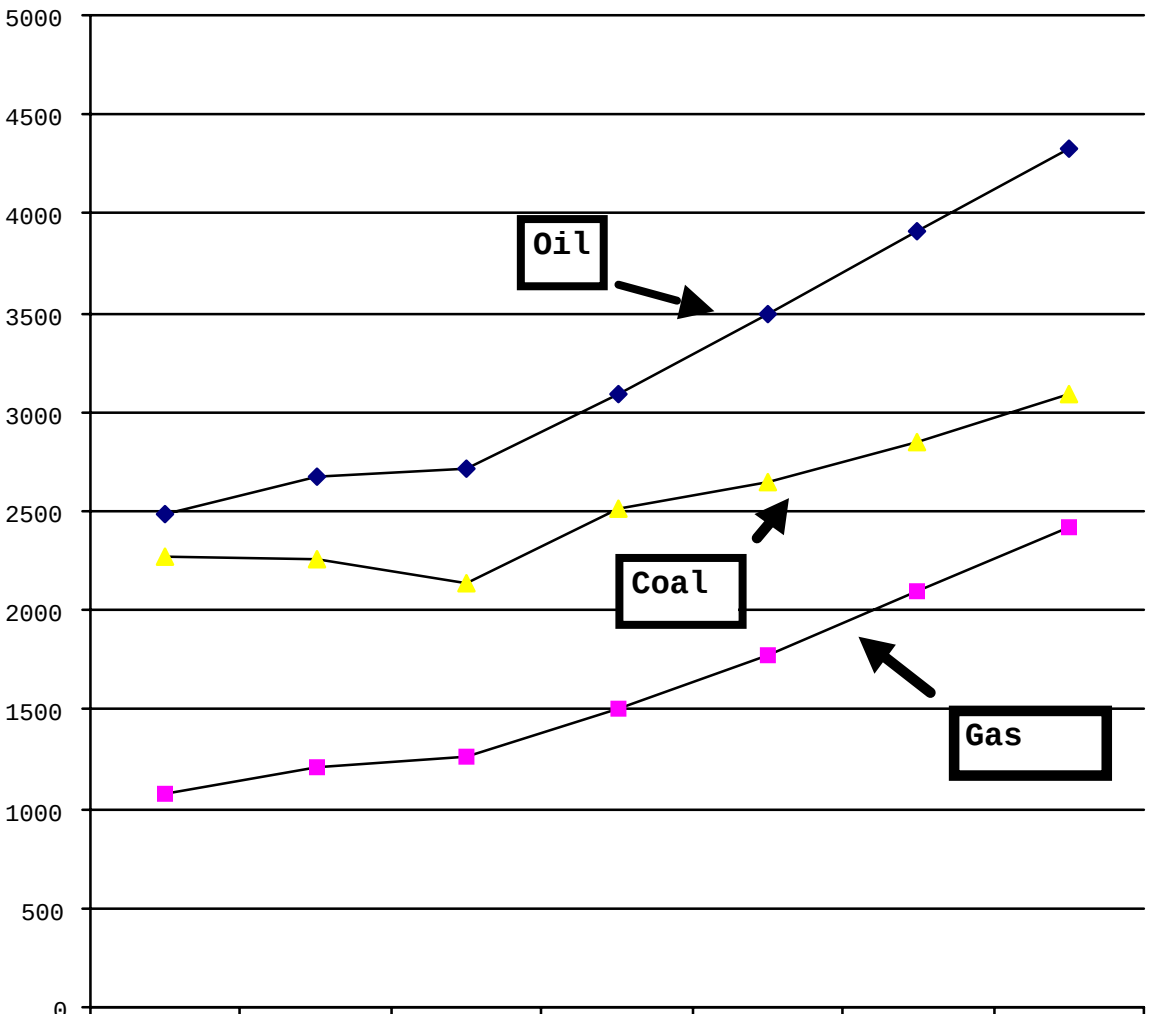


	1990	1998	1999	2005	2010	2015	2020
Latin America	178	246	249	290	377	484	595
Africa	179	216	218	256	287	327	365
Middle East	231	325	330	372	439	501	566
Other Dev. Asi	436	670	597	967	1012	1165	1335
China	617	765	669	881	1127	1393	1692

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

Distribution of Energy CO2 Emissions by type of Fuel: 1990-2020

(Millions of Metric tons Equivalent)

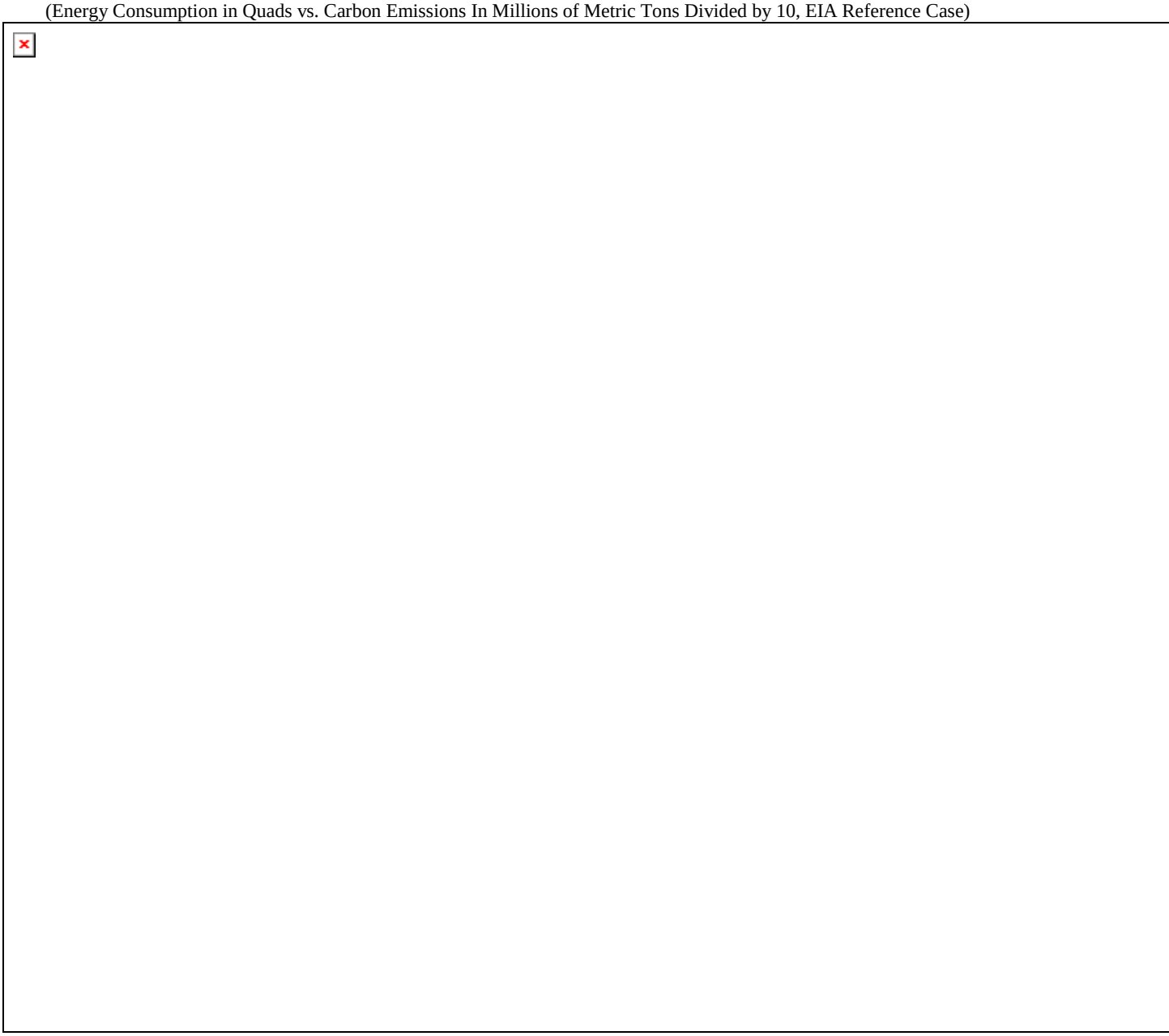


	1990	1998	1999	2005	2010	2015	2020
Oil	2482	2673	2712	3090	3488	3916	4332
Gas	1072	1216	1257	1512	1774	2096	2425
Coal	2274	2254	2137	2517	2648	2854	3094

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

The US Share of Global Energy and Pollution

(Energy Consumption in Quads vs. Carbon Emissions In Millions of Metric Tons Divided by 10, EIA Reference Case)



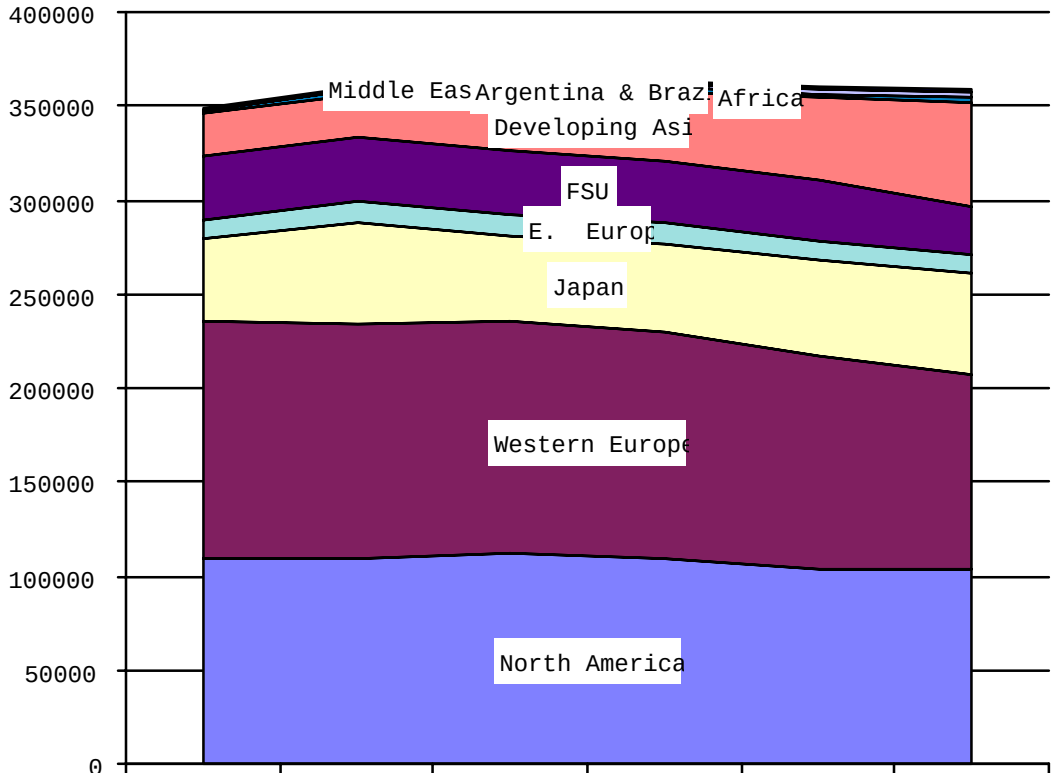
Source: Adapted by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2002, pp. 179, 189.

Electricity and Shifts in Nuclear Energy

- **Total share of electricity generation drops from 16% of world output in 2000 to 12% in 2020. Coal drops from 36% to 32%. Oil goes from 9.5% to 9.4%. Renewables Stay at 20%.**
  - **Increase in Quads Use from 2000-2020 is 47% for Oil, 31% for Coal, 11% for nuclear, and 56% for Renewables.**
  - **Developing Countries Increase Consumption by 4.2% Annually from 2000-2020. (China by 5.5%) Industrial World by 1.9%**
- **Key Shift is Gas Use:**
  - **From, 28.0 Quads in 2000 to 60.8 Quads in 2020: More than 100% Increase.**
  - **Goes from 18% of All Generation in 1990 and 2000, to 26% in 2020.**
- **Nuclear Generation Rises from 350 Gigawatts in 2000 to 359 Gigawatts in 2020.**
  - **438 plants in 30 countries in 2000: 104 in US, 59 in France, 53 in Japan.**
  - **Asia will add 32 Gigawatts by 2020, with 14 Gigawatts being Added By China.**
  - **33 reactors under construction in world, half in Asia.**
  - **China = 8, South Korea = 4, and India and Taiwan = 2 each.**
- **EE/FUS will drop from 44 Gigawatts in 2000 to 37 Gigawatts in 2020.**
  - **25 of 59 reactors now operating pose significant safety risk.**
  - **6 of 15 RMBK (Chernobyl) plants are "first generation."**
- **87,756 tons of nuclear waste fuel now in storage versus storage capacity of 147,8868 tons.**

The Future of Nuclear Energy: 1999-2020

(Megawatts)

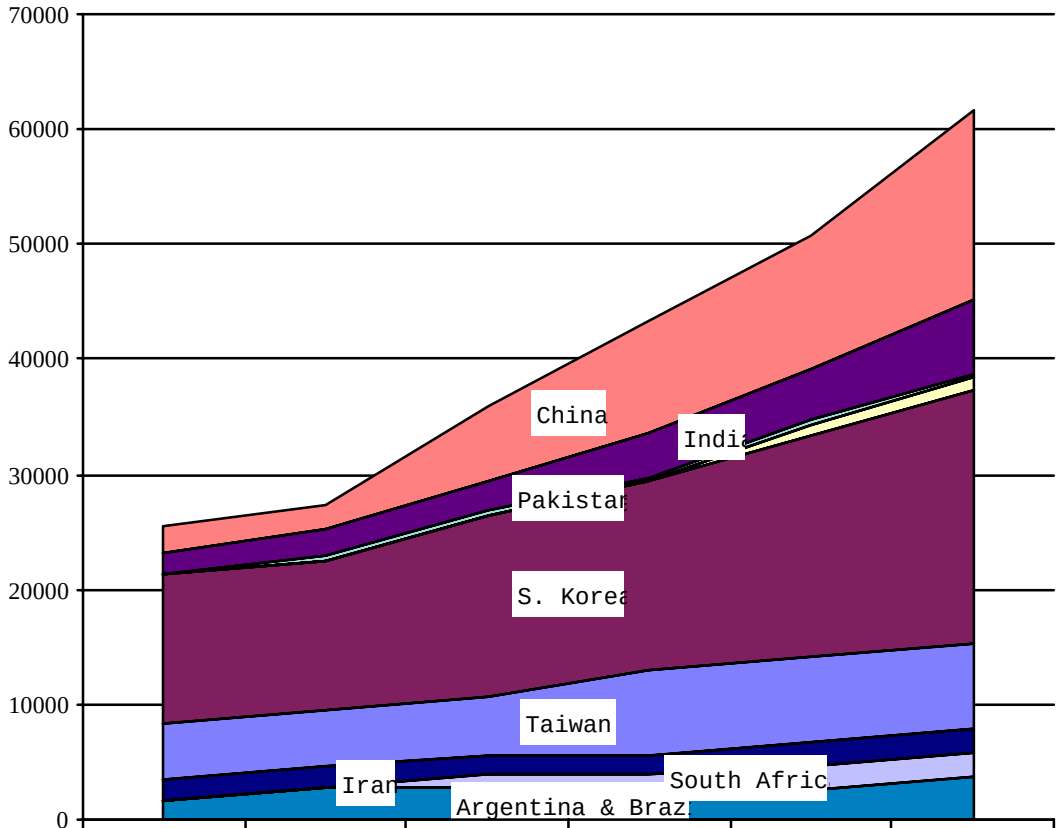


	1999	2000	2005	2010	2015	2020
Africa	1842	1800	1800	1800	1930	2060
Middle East	0	0	1073	1073	2146	2146
Argentina & Brazi	1561	2790	2790	2790	2544	3684
Developing Asia	22063	22777	30259	37663	44099	54447
FSU	34704	33796	34511	32543	31471	26004
E. Europe	10605	10675	11692	10060	10060	10710
Japan	43961	53961	44389	47793	50837	53406
Western Europe	125991	125726	123397	120191	113778	103989
North America	108776	108867	112656	109298	103791	102981

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

It's Great to Proliferate!
Nuclear Energy – Where the Growth May Be: 1999-2020

(Megawatts)



	1999	2000	2005	2010	2015	2020
China	2167	2177	6597	9597	11587	16607
India	1887	2301	2503	3973	4423	6451
Pakistan	125	425	425	425	300	300
N. Korea	0	0	0	0	950	950
S. Korea	12990	12990	15850	16245	19425	22125
Taiwan	4884	4884	4884	7414	7414	7414
South Africa	1842	1800	1800	1800	1930	2060
Iran	0	0	1073	1073	2146	2146
Argentina & Brazil	1561	2790	2790	2790	2544	3684

Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

Internal Security/Stability Driven Risks

- **Russia**
  - **5.9 MMBD of oil production capacity in 2000 (7.3%); 5.6-7.0 MMBD in 2010 (5.9-7.4%)**
  - **Major gas exporter – 33% of World Reserves**
- **Caspian States 1.1 MMBD in 2000; 2.4 MMBD in 2010? MMBD in 2020. 16-32 billion barrels proven, 163-186 billion barrels possible. Possible North Sea sized field, but 85% are potential reserves and not proven.**
  - **Major gas exporter. 2.9 Tcf/year in 2000. 236-337 Tcf "Proven," 328 Tcf more possible.**
- **Gulf States 21.7 MMBD in 2000 (28%); 42.9 MMBD in 2020 (35%)**
  - **Major gas exporter – 32.8% of world reserves**
- **West Africa – Nigeria (continuing unrest in Niger Delta area and Angola (30 year civil war)**
  - **5.1 MMBD in 2000 (6.3%); 8.6 MMBD in 2020 (7.7%)**
- **Latin America – Venezuela**
  - **3.1 MMBD in 2000 (4%); 5.4 MMBD in 2020 (4.5%)**

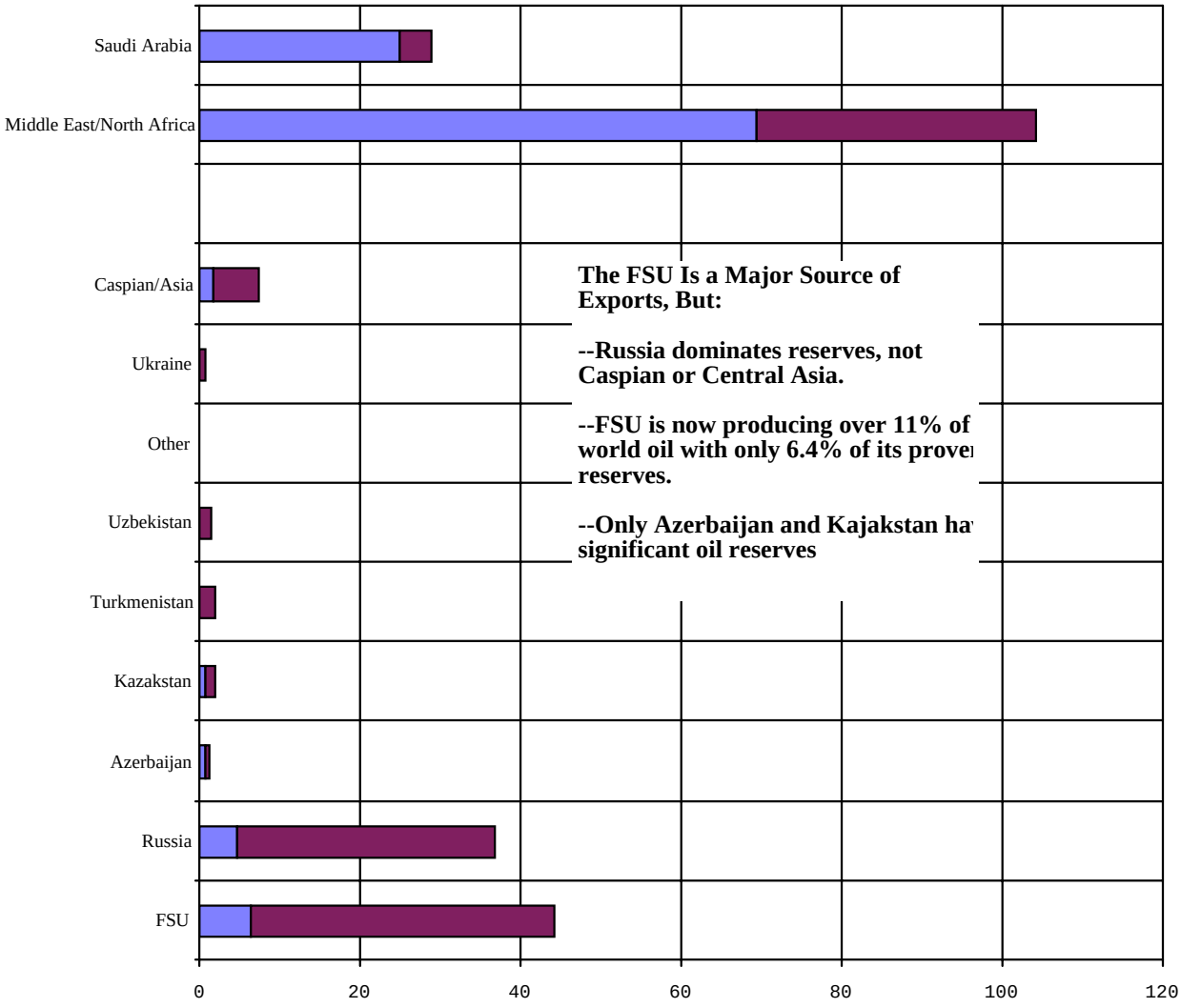
Conflict & Tension-Driven Risks

- **Caspian Energy Supply**
  - **Pipelines and Investment**
  - **New Great Game**
- **New Oil Embargo: 2nd Intifada**
  - **Iraq and Iran have threatened so far, Saudi Arabia has rejected.**
- **Gulf Energy Supply – Iran and Iraq**
  - **6.8 MMBD in 2000 (9.3%); 11.7 MMBD in 2020 (9%)**
  - **Investment and Containment**
  - **War – Civil Conflict**
- **Algeria (civil war) and Libya (growing unrest)**
  - **Civil conflict/Sanctions**
  - **2.9 MMBD in 2000 (3.7%); 5.7 MMBD in 2020 (4.7%)**
- **Gas Pipelines: Russia-Europe-China-India**
- **Massive increase in oil shipments, largely by sea: 42.4 MMBD in 2000, 70.9 MMBD in 2020 (+67%). Gas also increasing.**
- **Proliferation**
  - **Algeria, Libya, Egypt, Israel, Syria, Iran, and Iraq**
  - **WMD vs. smart weapons and mines.**

- **Strait of Hormuz/Gulf: Up from 30% of world oil production capacity in 2000 to 38% in 2020. Oil exports up from 14.8 MMBD to 33.5 MMBD (+126%)**

The Limits to the Export Impact of the FSU

(Percent of Proven World Reserves)



	FSU	Russia	Azerbaijan	Kazakstan	Turkmenistan	Uzbekistan	Other	Ukraine	Caspian/ Asia		Middle East/North Africa	Saudi Arabia
Gas	37.8	32.1	0.6	1.2	1.9	1.3	0.05	0.7	5.7		35	4
Oil	6.4	4.6	0.7	0.8	0.1	0.1	0.1	-	1.8		69.3	25

Source: BP Statistical Review of World Energy, June 2001.

The "China Syndrome"

- **Only 2.3% of world's oil reserves, 0.9% of world's gas; but 11.6% of world's coal. Population is about 21% of world total.**

- **Only country whose strategic writings focus on global competition for energy; Sees US Navy and dependence on Middle East as major strategic threat.**

- **EIA projects that:**

    - **Oil consumption rises from 2.3 MMBD in 1990 and 4.3 MMBD in 2000, to 10.5 MMBD in 2020 (+4.3% annually during 2000-2020.**

    - **Gas consumption rises from 3.0 TCF in 1990 and 0.9 TCF in 2000, to 6.4 TCF in 2020 (+10.1% annually during 2000-2020. Want to raise gas from 3% of energy use in 2000 to 10+% in 2020.**

    - **Nuclear generating capacity rises from 2,177 MWE in 2000 to 16,607 in 2020. Total electricity consumption rises from 1,084 billion KwH to 3,349. (5.5% annual rise.) Hydroelectricity and renewables rise from 2.3 Quads to 6.6 Quads (5.1% annual increase.)**

    - **Environmental problems restrain coal use. But, coal consumption rises from 1,124 million short tons in 1990 and 1,075 MST in 2000, to 2,562 MST in 2020 (+4.3% annually during 2000-2020.**

    - **Carbon emissions still rise from 669 million metric tons of carbon equivalent in 2000 to 1,692 in 2020 -- an annual rise of 4.5% The highest rate of increase in the world.**

- **Trying to guarantee supply through strategic oil and gas pipelines from Russia and Central Asia. Seeking oil and gas pipeline and supply deals with Russia. Discuss Central Asian pipeline.**

- **Wants to build own$18 billion east-west gas pipeline from Tarim Basin in Xinjiang to Shanghai in spite of low reserves.**

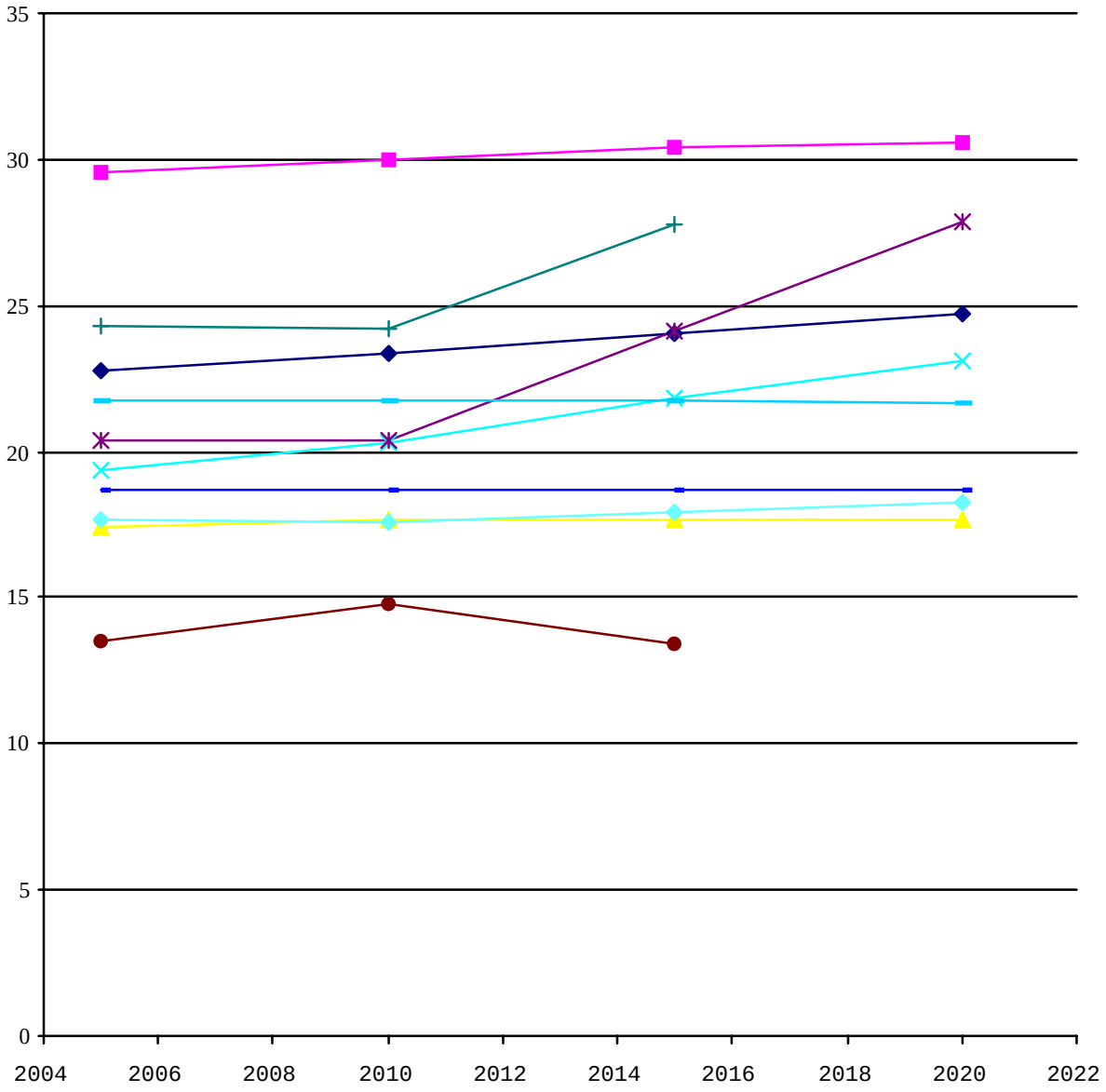
- **Some hope of more reserves in Ordos Basin in Northwest China and offshore in Bohai Sea east of Tianjin.**

- **Buying interests in Indonesian, Australian and Qatari gas.**

- **China National Petroleum buying interests in oil deals in Azerbaijan, Kazakhstan, Indonesia, Iran, Iraq, Peru, Sudan, and Venezuela.**

The Oil Market Crystal Ball: Price Projections

($2000 per barrel for average landed imports to US)



Source: EIA, International Energy Outlook, 1999, DOE/EIA-0484(99), pp. 142-143. EIA, International Energy Outlook, 2000, DOE/EIA-0484(00), p. 173. EIA, International Energy Outlook, 2002, DOE/EIA-0484(02), p. 181.

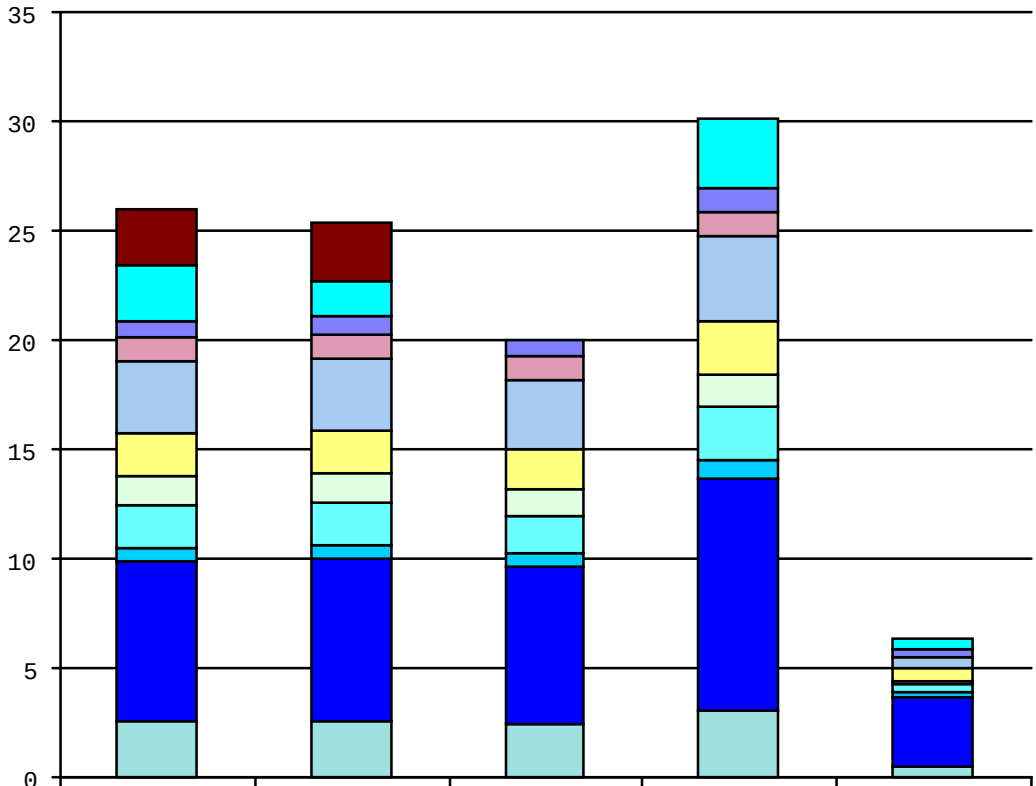
The Market is Only Part of the Story: Impact of Oil Disruptions

In 1974 the United States experienced its most significant supply interruption with the cutoff of about 18 million barrels per day, or about 55 percent of the world export market. During that disruption, the world oil price tripled, from about $4 a barrel to about $12 a barrel. In 1990, the Iraqi invasion of Kuwait meant the loss of 4.3 million barrels of oil production per day, or about 13 percent of the world export market. This led to a doubling in the world oil price from July to October 1990, from about $16.50 to about $33 a barrel.

Date of Disruption	Duration in Months	Average Gross Shortfall in MMBD	Reason for Disruption
3/51-10/54	44	0.7	Nationalization of Iranian oil fields
11/56-3/57	4	2.0	Suez War
12/66-3/67	3	0.7	Syrian Transit Fee Dispute
6/67-8/67	2	2.0	Six Day War
5/70-1/71	9	1.3	Libyan price controversy; damage to Tapline
4/71-8/71	5	0.6	French-Algerian nationalization struggle
3/73-5/73	2	0.5	Lebanon unrest, pipeline damage
10/73-3/74	6	2.6	October War; Arab oil embargo
4/76-5/76	2	0.3	Civil war in Lebanon; disruption of Iraqi exports
5/77	1	0.7	Damage to Saudi oil field
11/78-4/79	6	3.5	Iranian revolution
10/80-12/80	3	3.3	Outbreak of Iran-Iraq War
8/90-10/90	3	4.6	Iraqi invasion of Kuwait/Desert Storm

The Oil Embargo Game: 2Q 2002

(In MMBD)



	1Q 2002	2Q 2002	1/01/02 OPEC Quota	Production Capacity	2Q Surplus Capacity
Total OPEC	*27.8	*27.4	-	-	-
Other Liquids	2.6	2.7	-	-	-
Total OPEC Crude	*25.2	*24.7	-	*32.0-32.5	*7.3-7.8
Iraq	2.5	1.6	-	3.1	0.53
Total OPEC 10	*22.7	*23.0	*27.7	*29.0-29.5	*5.9-6.4
Algeria	0.78	0.8	0.69	1.1	0.3
Indonesia	1.1	1.1	1.1	1.2	0.08
Iran	3.3	3.4	3.2	3.9	0.48
Kuwait	1.9	1.9	1.8	2.4	0.53
Libya	1.3	1.3	1.2	1.5	0.2
Nigeria	2	2	1.8	2.4	0.35
Qatar	0.6	0.6	0.6	0.9	0.3
Saudi Arabia	7.3	7.4	7.1	10.5	3.1
Venezuela	2.6	2.6	2.5	3.1	0.5

Source: EIA, "OPEC", http://www.eia.doe.gov/emeu/cabs/opec2.html, June 7, 2002

US Dependence on Oil Imports

- **Domestic US production of crude oil and NGL has dropped from 11.0 MMBD in 1973 to 10.2 MMBD in 1980, 9.0 MMBD in 1990, and 8.1 MMBD in 2000-2002.**
- **The US averaged 11.87 MMBD worth of imports in 2001, with 9.33 MBD of crude oil and 2.54 MMBD of product.**
- **During 2001, about 48% of U.S. crude oil imports came from the Western Hemisphere (19% from South America, 15% from Mexico, 14% from Canada), while 30% came from the Persian Gulf region (18% from Saudi Arabia, 9% from Iraq, 3% from Kuwait)**
- **EIA estimates that total U.S. gross oil imports are projected to increase from 11.5 million barrels per day in 2000 to 17.7 million in 2020**
- ***Net Import Dependence is far higher*:**
  - ***US export markets depend on other nations' ability to import energy*.**
  - ***US imports have a high energy content -- often easing environmental pressures as well.***
  - ***The US is obligated to share energy as part of the agreements setting up the International Energy Agency*.**

Source: DOE/EIA, Annual Energy Outlook, 2002, p. 60.

The Changing Character of US Imports

- **Crude oil accounts for most of the expected increase in imports through 2005, whereas imports of petroleum products make up a larger share of the increase after 2005.**
- **Product imports are projected to increase more rapidly as U.S. production stabilizes, because U.S. refineries lack the capacity to process much larger quantities of imported crude oil.**
- **OPEC is expected to account for less than 50 percent of total projected U.S. petroleum imports through most of the forecast.**
- **The OPEC share is expected to increase gradually to 50 percent in 2020, and the Persian Gulf share of U.S. imports from OPEC is projected to range between 48 and 51 percent consistently throughout the forecast.**
- **Crude oil imports from the North Sea are projected to increase slightly through 2010, then to decline gradually as North Sea production ebbs.**
- **Significant imports of petroleum from Canada and Mexico are expected to continue, and West Coast refiners are expected to import crude oil from the Far East to replace the declining production of Alaskan crude oil.**
- **Imports of light products are expected to nearly triple by 2020, to 4.5 million barrels per day. Most of the projected increase is from refiners in the Caribbean Basin and the Middle East, where refining capacity is expected to expand significantly.**
- **Vigorous growth in demand for lighter petroleum products in developing countries means that U.S. refiners are likely to import smaller volumes of light, low-sulfur crude oils.**

Source: DOE/EIA, Annual Energy Outlook, 2002, p. 60.

Macroeconomics of Oil Disruptions: EIA Estimate

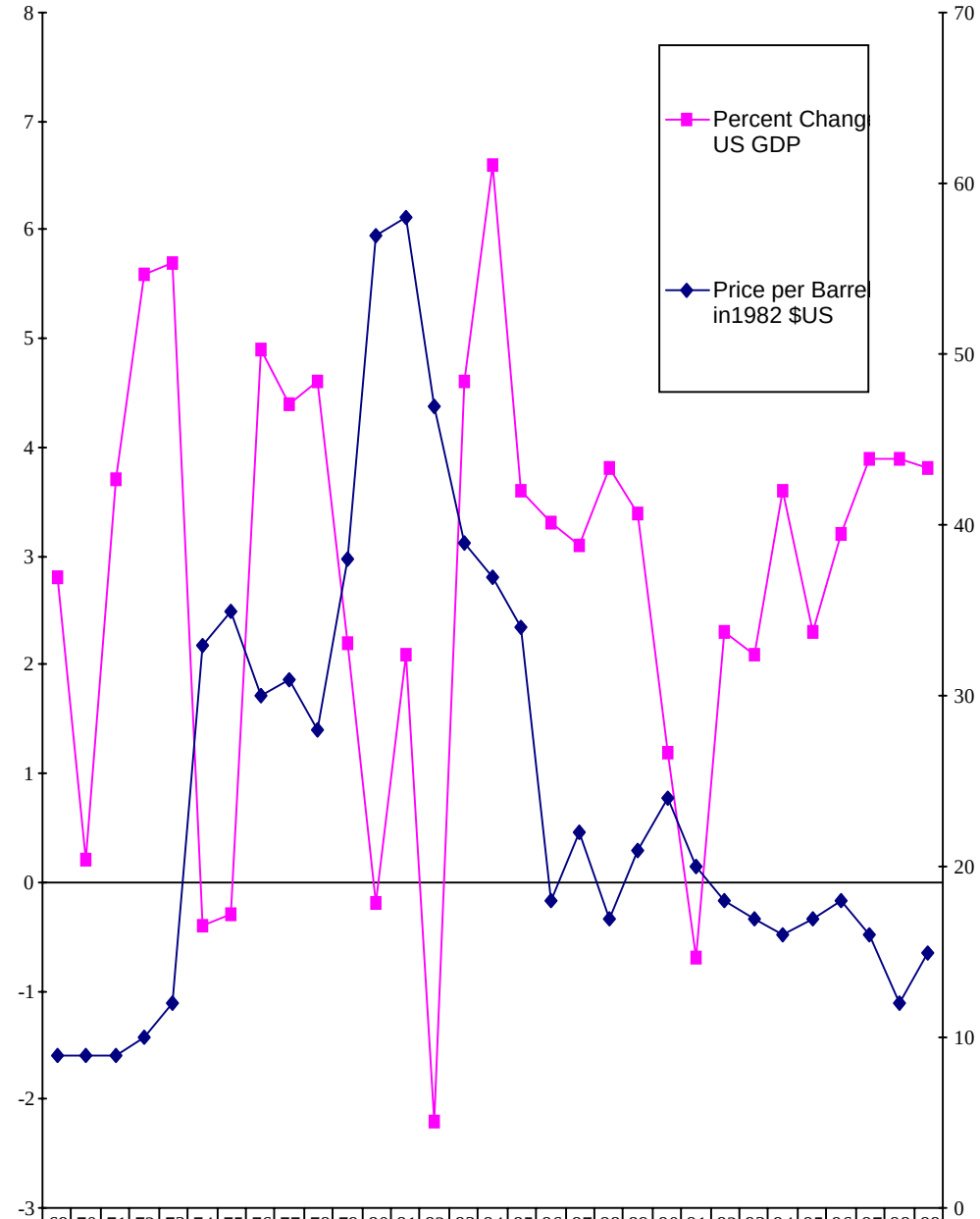
- **Disruptions and World Oil Prices**:
  - For every one million barrel per day (1 MMBD) of oil disrupted, world oil prices could increase by $3-5 per barrel.
- **EIA has analyzed two hypothetical but somewhat dated cases.**
  - The first assumed that the price of oil stays constant at $11 per barrel through 1999 and 2000.
  - The second reflected world oil prices rising from $11 in the first quarter to $22 by the third quarter of 1999 and remaining at that level through 2000. The table below highlights impacts on the economy.
- **Impacts of the World Oil Price Rising from $11 to $22 per Barrel**

	First Year	Second Year
Increase in CPI Inflation	+0.50 percentage	+0.75 percentage points
Loss in GDP Growth	-0.50 percentage point	-1.00 percentage points

- **In the higher price contingency:**
  - In the first year, CPI Inflation is higher by an additional 0.5 percentage points, reflecting higher prices for oil and other energy commodities. In the following year, higher prices paid for energy will cycle through the economy and create additional inflationary pressure and CPI inflation is higher by approximately 0.75 percentage points.
  - GDP growth is also affected. In the first year, the growth rate of GDP under the high world oil price case is approximately 0.5 percentage points lower, and the next year, the reduction in growth is approximately a full percentage point.
- **Is there a threshold for concern about the rise in oil prices?** On average, world oil prices have been around $20 (in constant 1998 dollars) since 1986. However, in 1990 prices rose beyond $30 dollars and the growth rate of the economy fell below 2 percent in 1990 and became negative in 1991. A sustained world oil price of $30 would result in additional inflationary pressure, perhaps as much as 0.5 additional percentage points, and an additional loss in GDP growth on the order of 0.5 percentage points.
- **Volatility matters for all consumers and producers in the economy**. Business firms, both energy and non-energy, make investment decisions based on expectations about prices. If the decision is made in the expectation of low (or high) energy prices, and the oil market varies sharply, firms may make inappropriate investment and general business decisions. Even those firms that expect volatility may be adversely affected by simply putting off a decision until the market is more stable. Consumer purchases of housing and consumer durables, such as autos and appliances, are also affected by instability in energy markets. The economy would most likely be better off with stable energy prices,
- **Source: Adapted from an EIA risk analysis.**

The Art of Dubious Correlation: Oil Prices versus US Economic Growth

(Percent Change in US GNPx10 versus $ per Barrel in real 1982 $US))

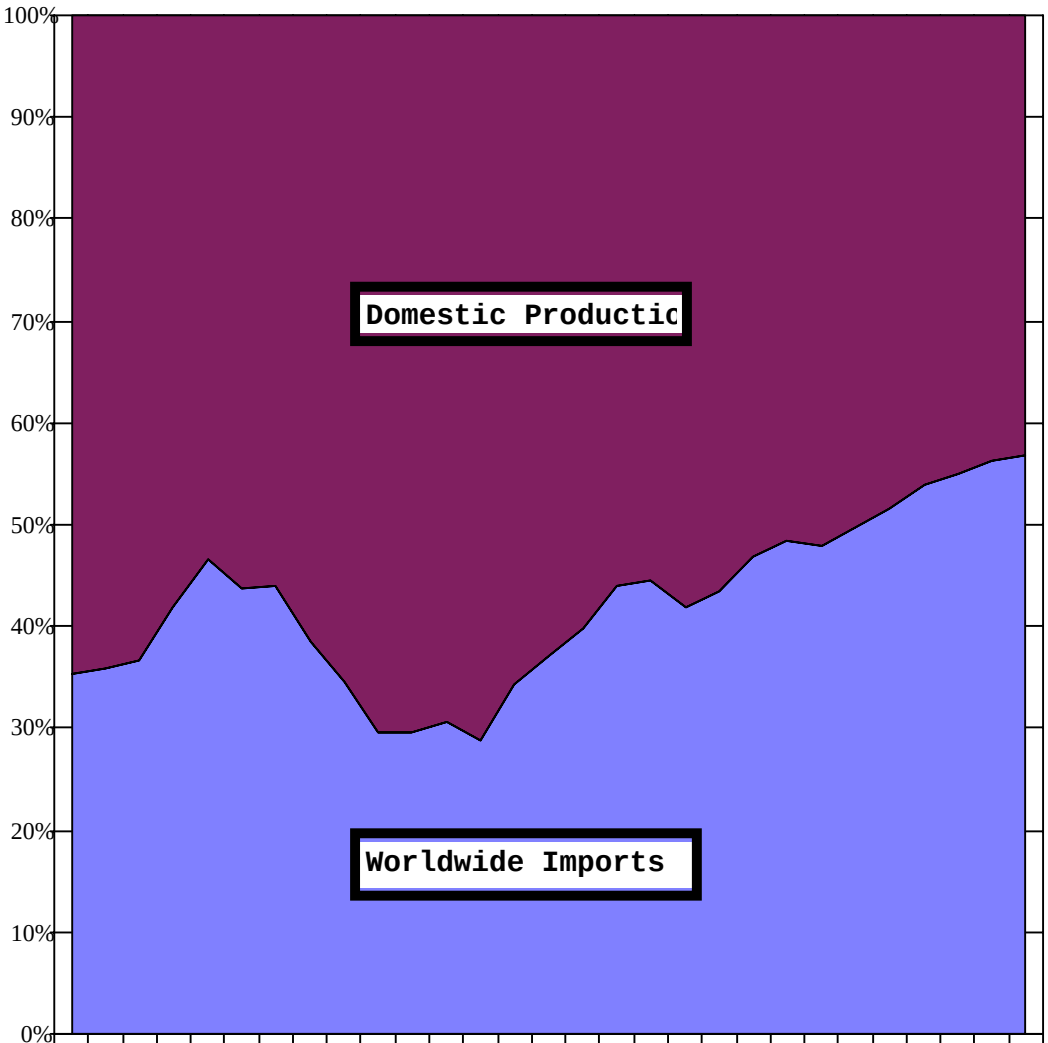


	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Percent Change in US GDP	2.8	0.2	3.7	5.6	5.7	-0	-0	4.9	4.4	4.6	2.2	-0	2.1	-2	4.6	6.6	3.6	3.3	3.1	3.8	3.4	1.2	-1	2.3	2.1	3.6	2.3	3.2	3.9	3.9	3.8
Price per Barrel in1982 $	9	9	9	10	12	33	35	30	31	28	38	57	58	47	39	37	34	18	22	17	21	24	20	18	17	16	17	18	16	12	15

Source: Estimated by Anthony H. Cordesman from www.eia.doe.gov/emeu/security/gdwop.gif

US Total Net Crude Oil and Petroleum Product Imports as a Share of Total Consumption: 1973-2002

(In MMBD)



	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	2001
Domestic Production	11	11	10	9.8	9.9	10	10	10	10	10	10	11	11	10	10	9.8	9.2	9	9.2	9	8.6	8.6	8.6	8.6	8.6	8.4	8.1	8.1	8.1
Net Imports	6	5.9	5.8	7.1	8.6	8	8	6.4	5.4	4.3	4.3	4.7	4.3	5.4	5.9	6.5	7.2	7.2	6.6	6.9	7.6	8.1	7.9	8.5	9.2	9.8	9.9	10	11

Source: Adapted by Anthony H. Cordesman from EIA, Monthly Energy Review, March 1999, pp. 15, and www.eia.doe.gov/emeu/mer/txt/mer3-1a, accessed June 20, 2002..

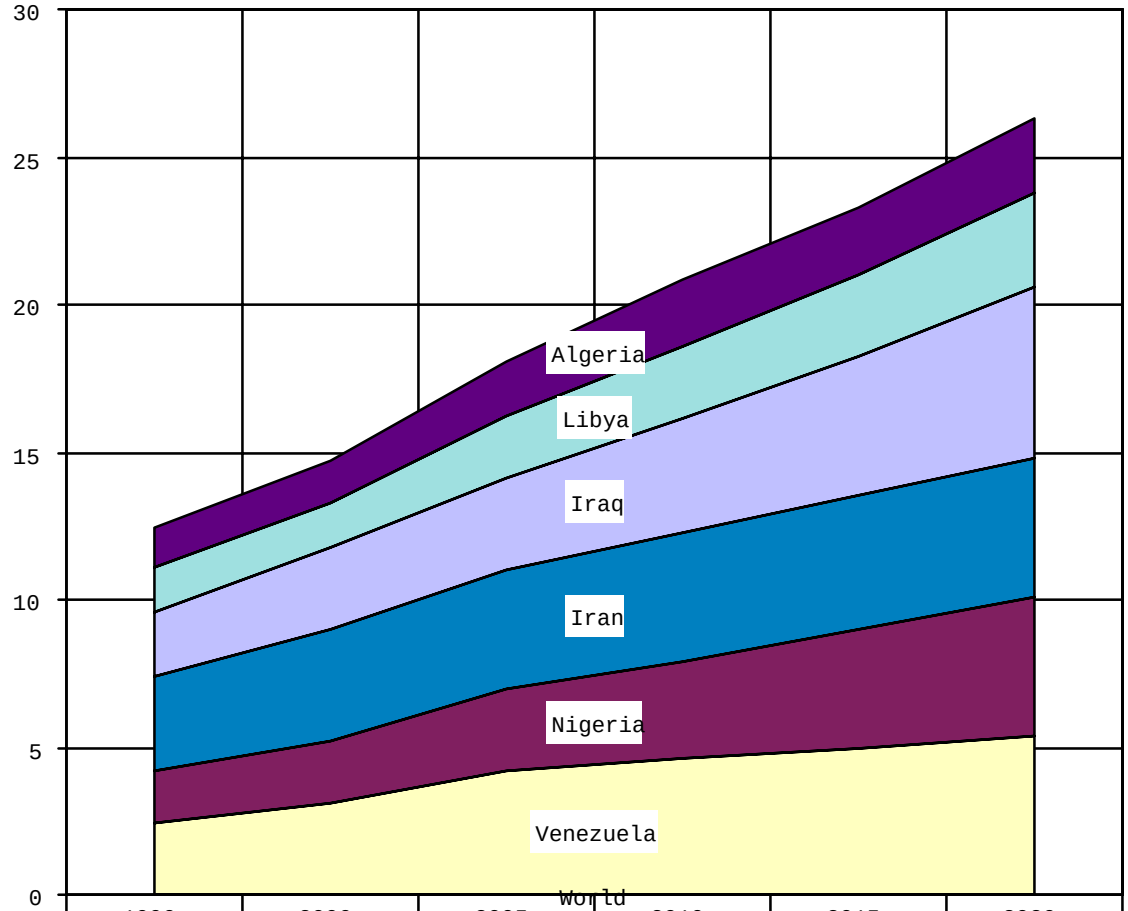
The Future of the World Oil Market

- **In the reference case, projected prices fall initially (through 2002) and then rise by about 0.9 percent per year, reaching $24.68 in 2020 (all prices in 2000 dollars.**
- **In nominal dollars, the reference case price is expected to exceed $42 in 2020.**
- **Total worldwide demand for oil is expected to reach almost 119 million barrels per day by 2020.**
- **Developing countries in Asia show the largest projected growth in demand, averaging 3.8 percent per year.**
- **OPEC—primarily the Persian Gulf nations—is expected to be the principal source of**
- **marginal supply to meet increases in demand. The projected increase in OPEC production capacity in the reference case is consistent with announced**
- **plans for OPEC capacity expansion By 2020, OPEC production is projected to be over 57 million barrels per day (almost twice its 2000 production) in the reference case, 45 million in the high price case, and 67 million in the low price case**
- **Forecasts of total world demand for oil range from about 125 million barrels per day in the low price case to about 115 million barrels per day in the high price case.**
- **The expansion of productive capacity will require major capital investments, which could depend on the availability and acceptability of foreign investments. Iraq is assumed to continue selling oil only at sanction-allowed volumes through 2002.**
- **Iraq has indicated a desire to expand its production capacity aggressively, to about 6 million barrels per day, once the sanctions are lifted. Recent discoveries offshore of Nigeria, as well as Venezuela's aggressive capacity expansion plans, will more than accommodate increasing demand in the absence of Iraq's full return to the oil market.**
- **Non-OPEC supply is projected to reach 61 million barrels per day by 2020.**
- **The growth and diversity in non-OPEC oil supply have shown surprising resilience. Countries that are expected to register production increases over the next decade include North Sea producers, Australia, Canada, and Mexico. In Latin America, Colombia, Brazil, and Argentina. Deepwater projects off the coast of western Africa and in the South China Sea will start producing significant volumes of oil early in this decade.**
- **In addition, much of the increase in non-OPEC supply over the next decade is expected to come from the former Soviet Union,**

Source: DOE/EIA, Annual Energy Outlook, 2002, p. 58-60.

Production Capacity of "High Risk" Oil Producers: 1990-2020

(EIA Reference Case in MMBD)

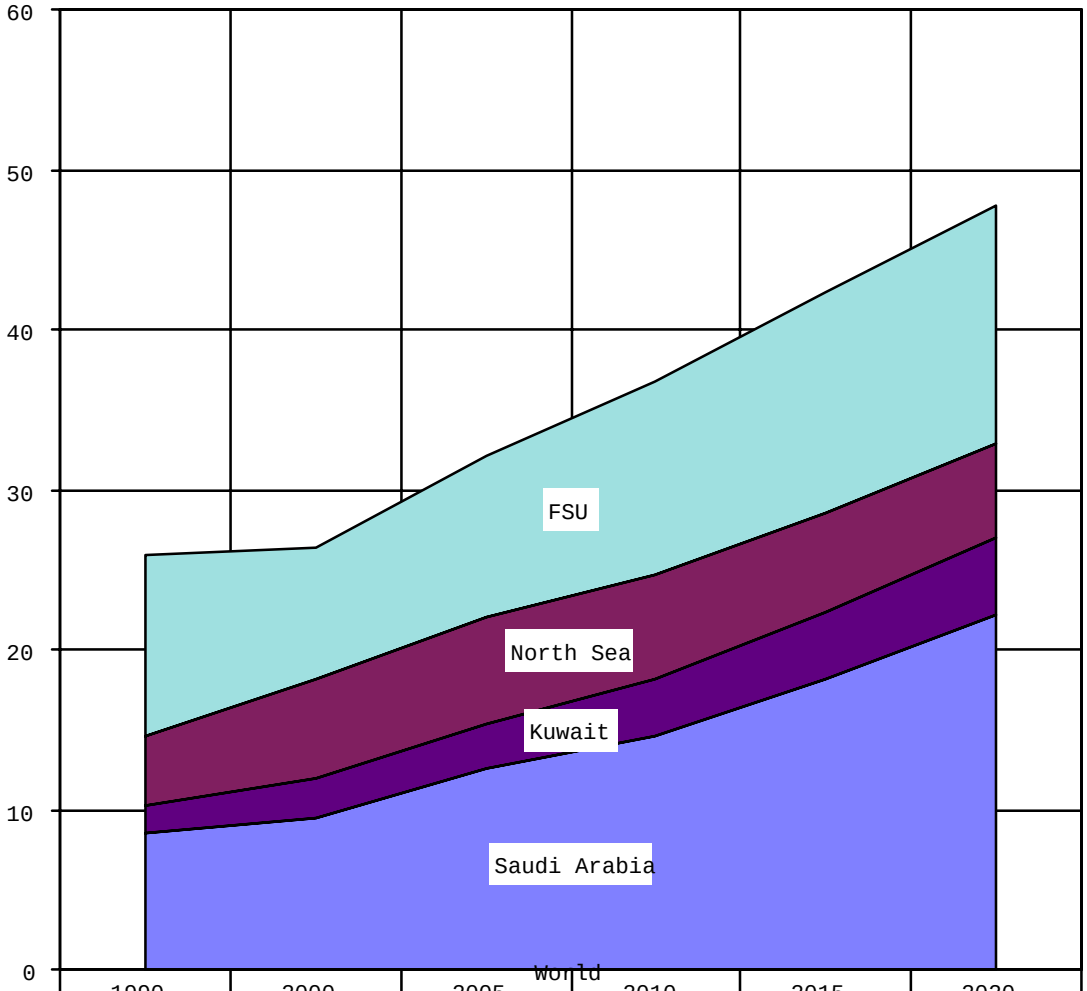


	1990	2000	2005	2010	2015	2020
Algeria	1.3	1.4	1.9	2.2	2.3	2.5
Libya	1.5	1.5	2.1	2.5	2.8	3.2
Iraq	2.2	2.8	3.1	3.8	4.7	5.8
Iran	3.2	3.8	4	4.4	4.5	4.7
Nigeria	1.8	2.1	2.8	3.3	4	4.7
Venezuela	2.4	3.1	4.2	4.6	5	5.4
World	*69.4	*77.4	*88.0	*98.4	*109.8	*121.3

Source: Estimated by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2001, p. 239.

Production Capacity of "Potential Risk" Oil Producers: 1990-2020

(EIA Reference Case in MMBD)

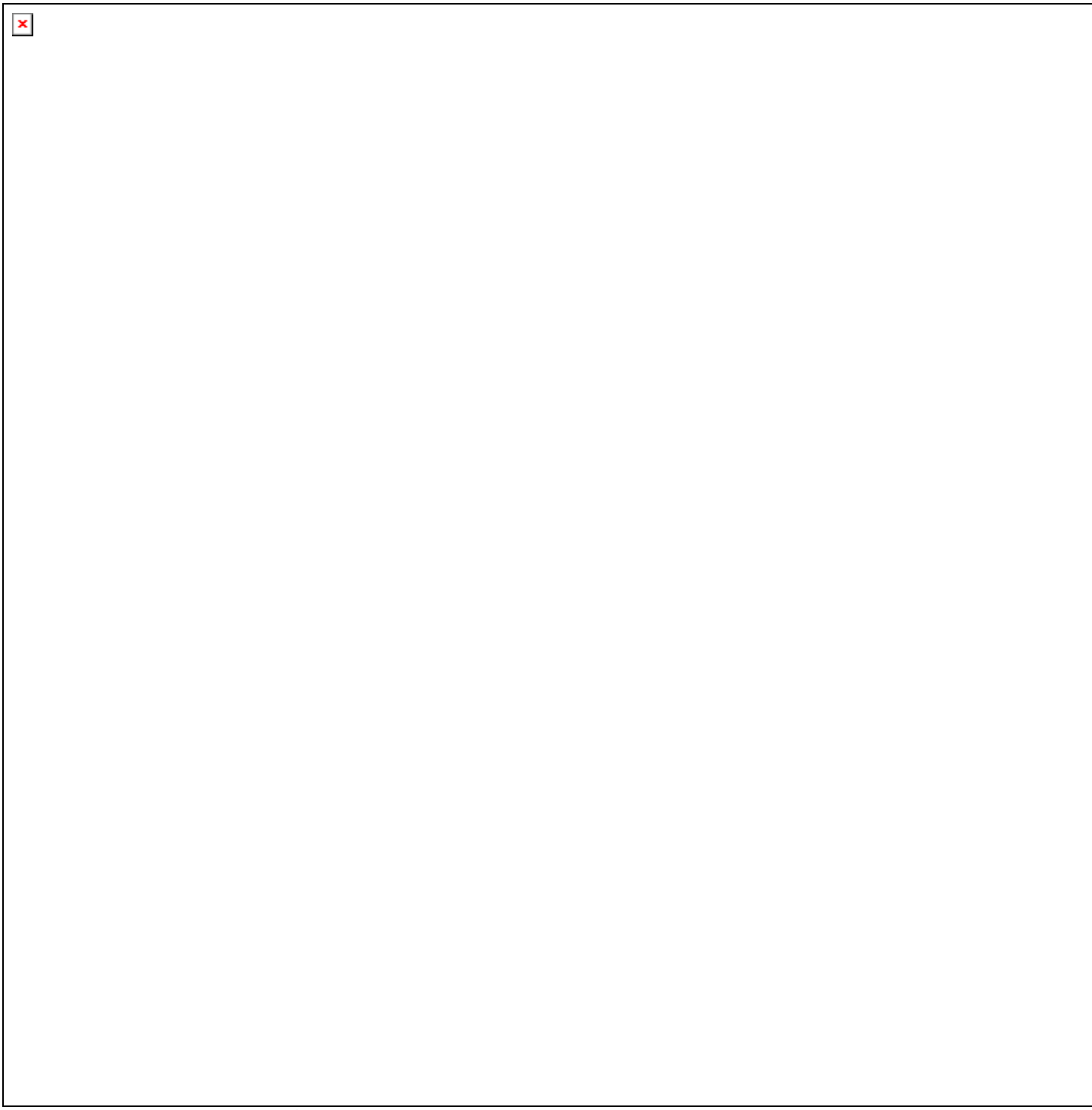


	1990	2000	2005	2010	2015	2020
FSU	11.4	8.1	10.1	12.1	13.8	14.9
North Sea	4.2	6.3	6.7	6.5	6.2	6
Kuwait	1.7	2.5	2.8	3.5	4.1	4.8
Saudi Arabia	8.6	9.4	12.5	14.6	18.2	22.1
World	*69.4	*77.4	*88.0	*98.4	*109.8	*121.3

Source: Estimated by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2001, p. 239.

Where the Oil Is: Proven and Speculative

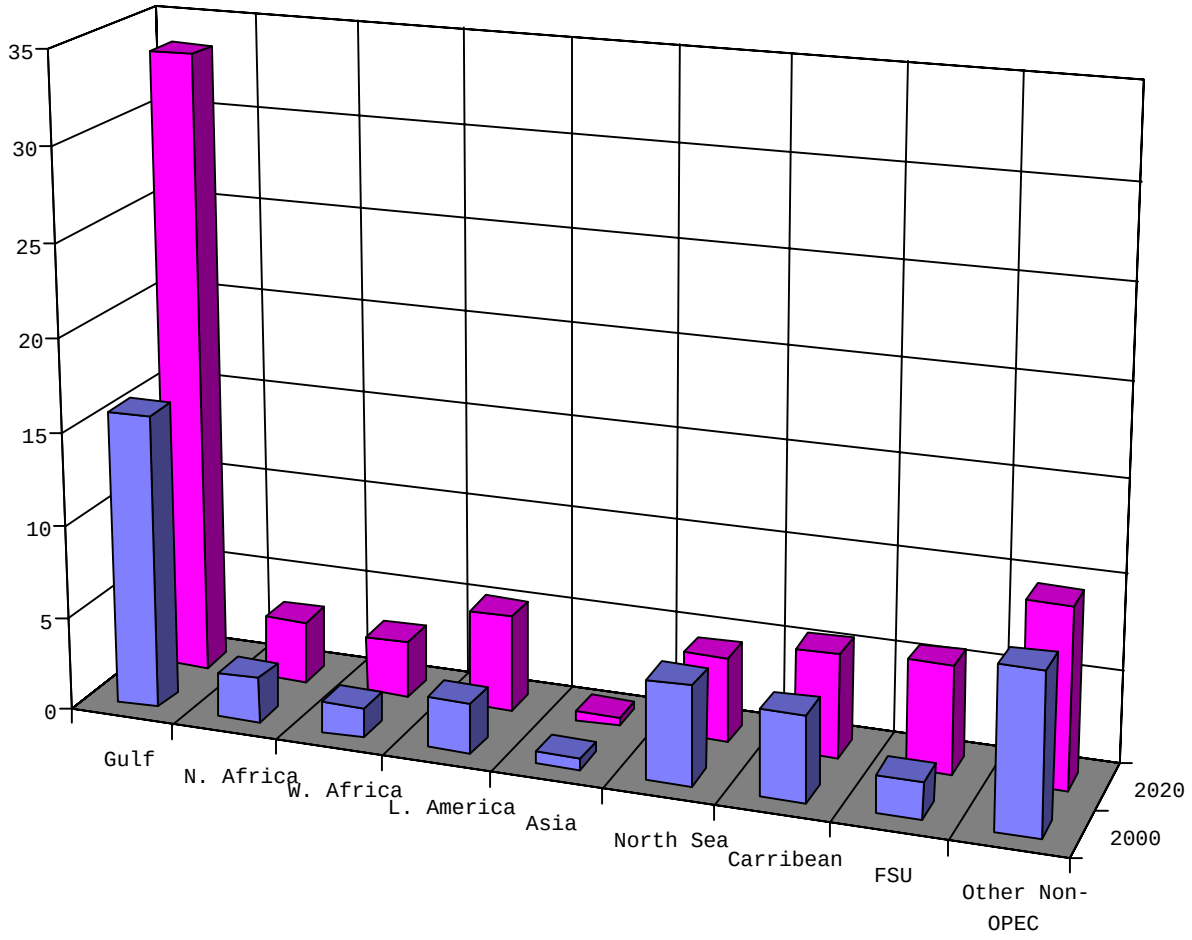
(Billions of Barrels)



Source: Adapted by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2002, p. 38

Where the Oil Comes From: Worldwide Petroleum Exports by Source: 2000 versus 2020

(in MMBD)



	Gulf	N. Afric	W. Afric	L. Americ	Asia	North Se	Carribear	FSU	Other Nor OPEC
2000	15.8	2.4	1.6	2.7	0.6	5.3	4.6	2	8.5
2020	33.5	3.3	3	5.2	0.5	4.5	5.5	5.7	9.6

Source: Adapted by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2002, p. 38.

Where the Oil Goes: Worldwide Petroleum Imports by Destination: 2000 versus 2020

(in MMBD)

Source: Adapted by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2002, p. 38.

Gulf Petroleum Exports by Destination: 2000 versus 2020

(in MMBD)

Source: Adapted by Anthony H. Cordesman from EIA, International Energy Outlook, 2002, DOE/EIA-0484 (02), March 2002, p. 38.

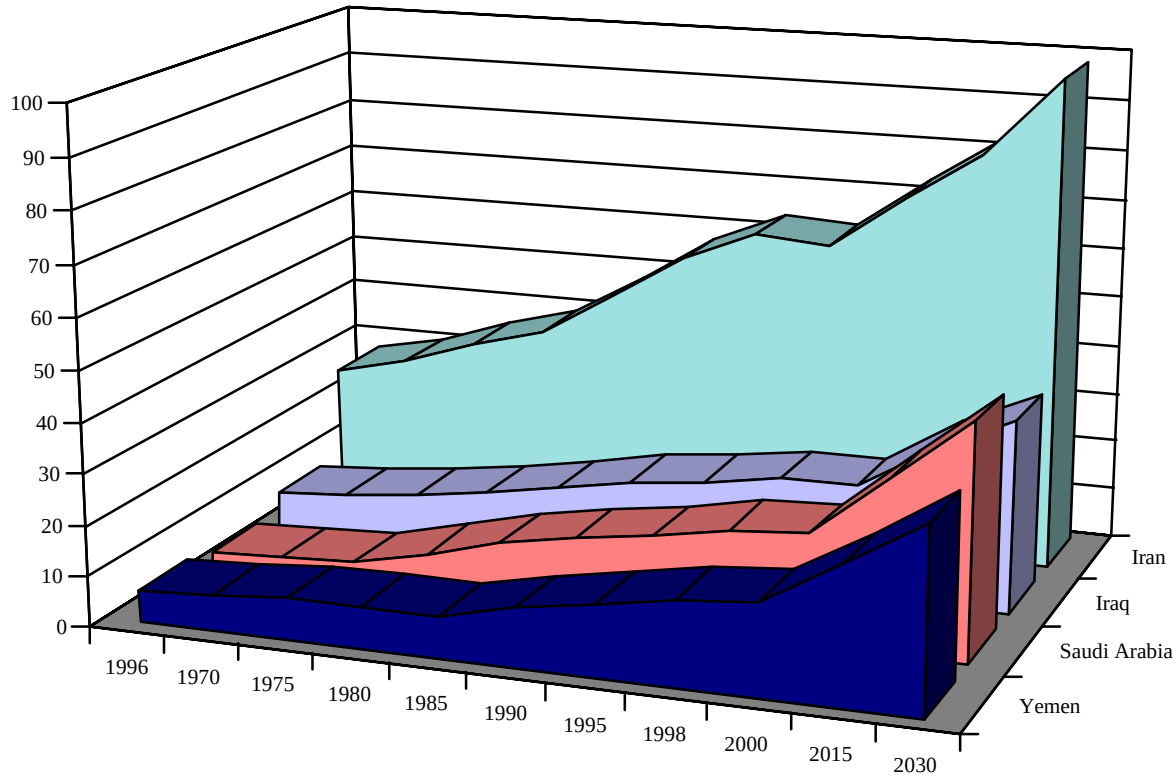
Persian Gulf Producers Will Account for More Than Half of World Oil Trade

- **The Persian Gulf has over 60% of the world's proven oil reserves: In excess of 660 billion barrels. It has an R/P ratio of over 80 years,**
- **The historical peak for Persian Gulf exports (as a percent of world oil exports) occurred in 1974, when they made up more than two-thirds of the crude oil traded in world markets**
- **The most recent historical low for Persian Gulf oil exports came in 1985 as a result of more than a decade of high oil prices, which led to significant reductions in worldwide petroleum consumption.**
- **Less than 40 percent of the crude oil traded in 1985 came from Persian Gulf suppliers.**
- **Following the 1985 oil price collapse, the Persian Gulf export percentage again began a gradual increase, but it leveled off in the 1990s at 40 to 50 percent when non-OPEC supply proved to be unexpectedly resilient.**
- **In the reference case, Persian Gulf producers are expected to account for more than 45 percent of worldwide trade by 2002—for the first time since the early 1980s.**
- **After 2002, the Persian Gulf share of worldwide petroleum exports is projected to increase**
- **gradually to almost 60 percent by 2020. In the low oil price case, the Persian Gulf share of total exports is projected to exceed 67 percent by 2020.**
- **All Persian Gulf producers are expected to increase oil production capacity significantly over the forecast period.**
- **Both Saudi Arabia and Iraq (assuming the lifting of United Nations export sanctions after 2002) are expected to nearly triple their current production capacity.**

Source: DOE/EUA, Annual Energy Outlook, 2002, pp. 58-59.

Living in a Crowded Desert: Population Growth in the Major Gulf Countries

(Population in Millions)

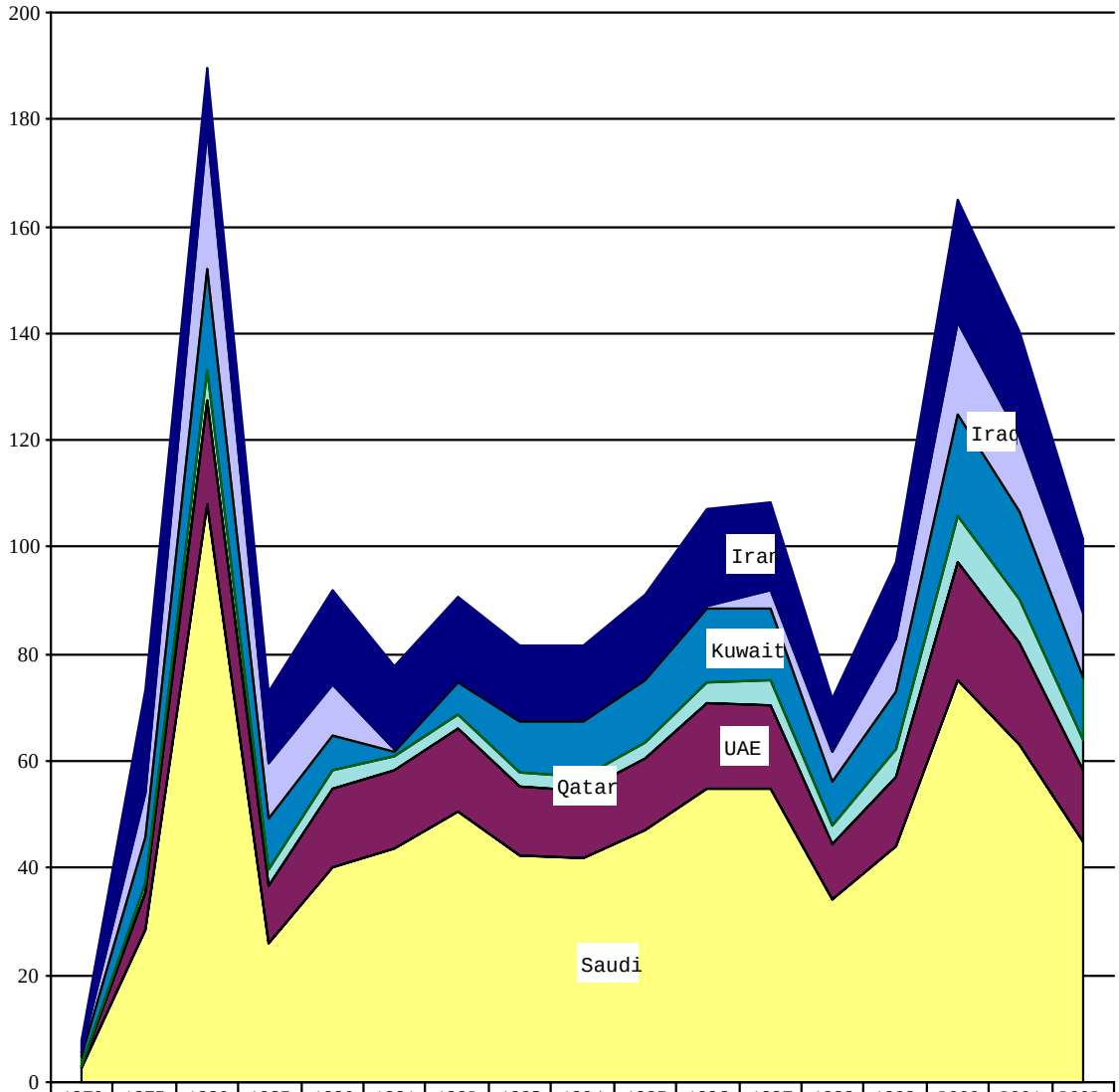


	1996	1970	1975	1980	1985	1990	1995	1998	2000	2015	2030
Yemen	6.1	7.2	8.3	8.5	8.4	11.6	14.1	16.6	17.8	26.6	36
Saudi Arabia	4.8	5.4	6.2	9.4	13.2	15.9	18	20.7	21.7	33.7	46
Iraq	8.2	9.4	11.1	13	15.7	18.4	19.9	22.3	22.3	31.3	38
Iran	26.8	30.1	34.9	39.1	47.6	56.9	63.1	61.9	72.7	82.1	98

Adapted by Anthony H. Cordesman from data provided by the US State Department and the World Bank database for World Development Indicators, 2000, pp. 40 and 44. The World Bank does not report on Bahrain and Qatar. World Bank figures are otherwise used for 1980, 1998, 2015, and 2000.

The Combined Impact of War, Politics, and Global Market Forces has been Massive Swings in Gulf Oil Revenues: 1970-2000

($Current Billions)

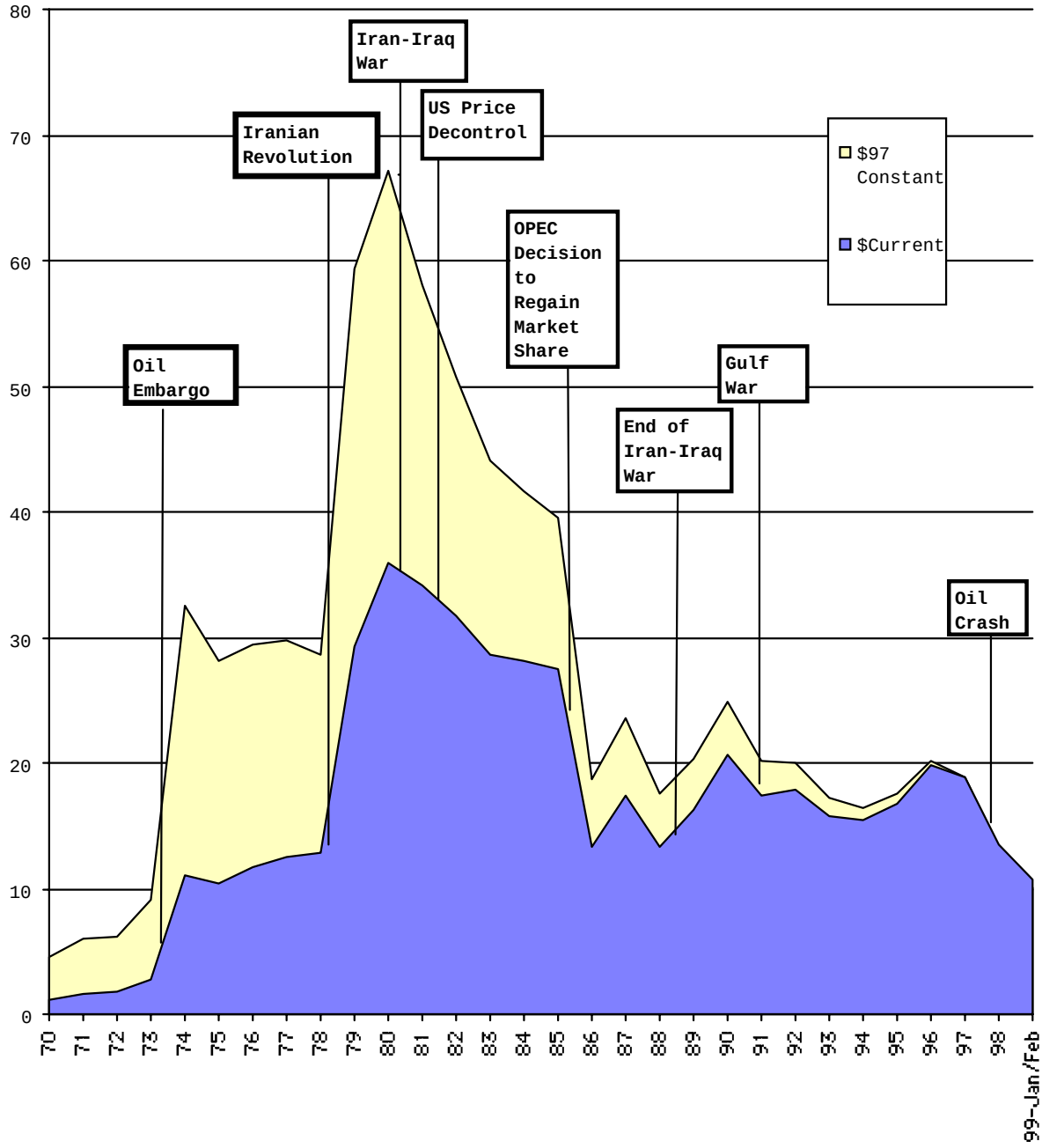


	1970	1975	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002e
Iran	2.4	19.6	11.7	13.7	17.9	15.8	15.5	14	13.8	15.4	18	16.3	10.1	13.9	23	19.9	13.6
Iraq	0.79	8.2	26.1	10.1	9.6	0.35	0.48	0.43	0.44	0.5	0.68	3.5	5.6	9.9	17.2	13.9	12.3
Kuwait	1.6	8.6	18.9	9.5	6.4	0.87	5.9	9.4	10.3	11.7	13.5	13.3	8.2	10.9	18.9	16.6	11.5
Qatar	0.23	1.8	5.4	3.1	3.3	2.8	2.9	2.7	2.7	3.2	3.9	4.8	3.4	5.1	8.7	8.1	5.8
UAE	0.52	6.8	19.4	10.9	14.8	14.4	15.2	12.7	12.6	13.5	16.1	15.8	10.2	13.3	21.9	18.9	13.4
Saudi	2.4	28.5	108.2	25.9	40.1	43.7	50.7	42.5	41.9	46.9	54.9	54.7	34.2	43.9	75.3	63.1	44.9

Adapted by Anthony H. Cordesman from Cambridge Energy Associates, World Oil Trends, 1998, Cambridge, Mass., 1998, pp. 26-27; Cambridge Energy Research Associates, OPEC Tilts to Market Share, World Oil Watch, Winter 2002, p. 28; and from projections by Energy Information Agency based on various editions of the "OPEC Revenues Fact Sheet," www.eia.doe.gov/emeu/cabs/opecrev2.ntml.

Politics, War, and the Trends in the Price of Saudi Arabia Light Crude: 1970-1999

($US Current and $US 1997 Constant)

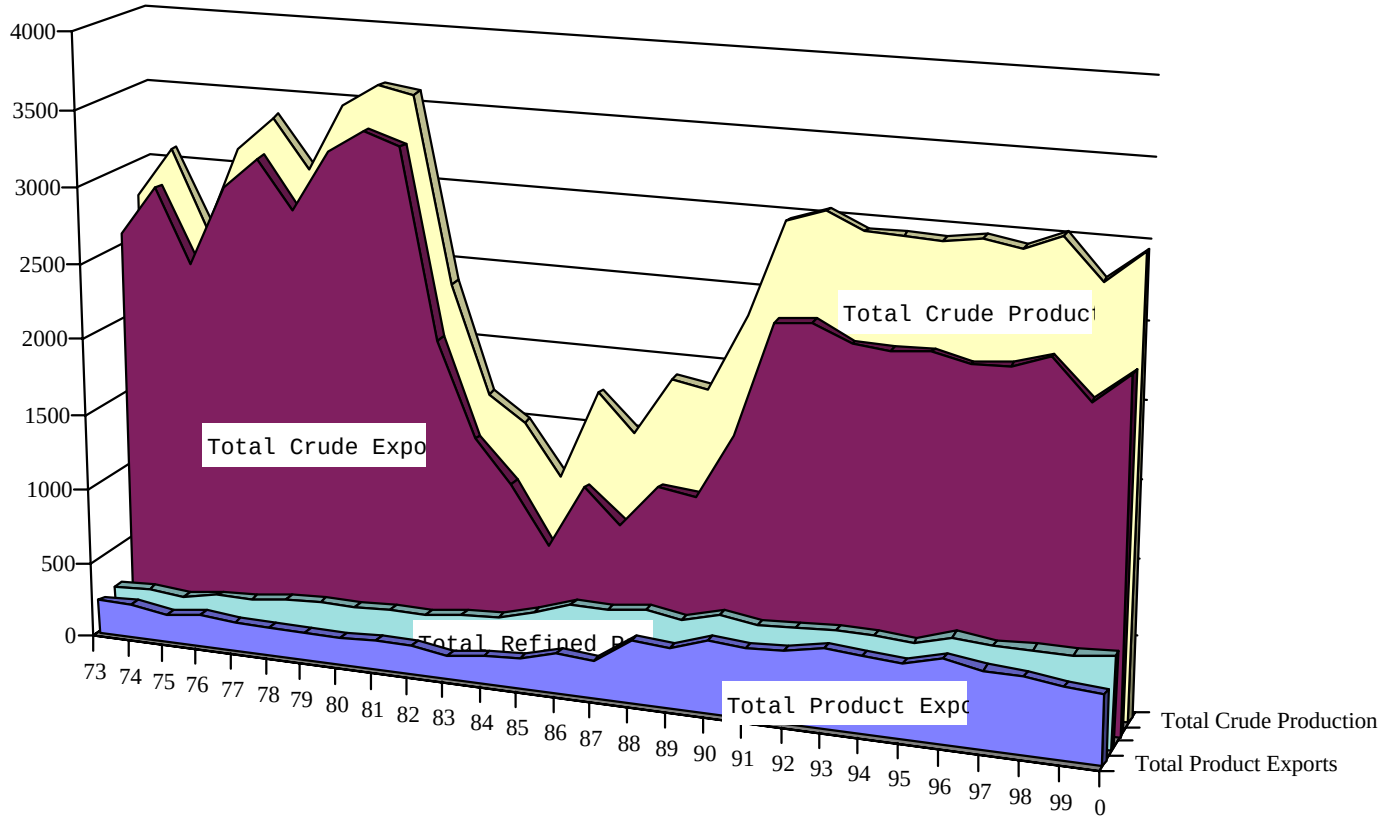


Total ME												
OPEC	13/31	18/87	17/91	9/53	15/19	14.77	15.99	16.75	16.84	16.99	17.18	18.3o
Total ME	13.95	19.57	18.40	10.25	16.49	16.19	17.43	18.34	18.59	18.84	19.08	20.16

Adapted by Anthony H. Cordesman from Cambridge Energy Associates, World Oil Trends, 1998, Cambridge, Mass., 1998, pp. 26-27.

Saudi Oil Production: 1973-2000

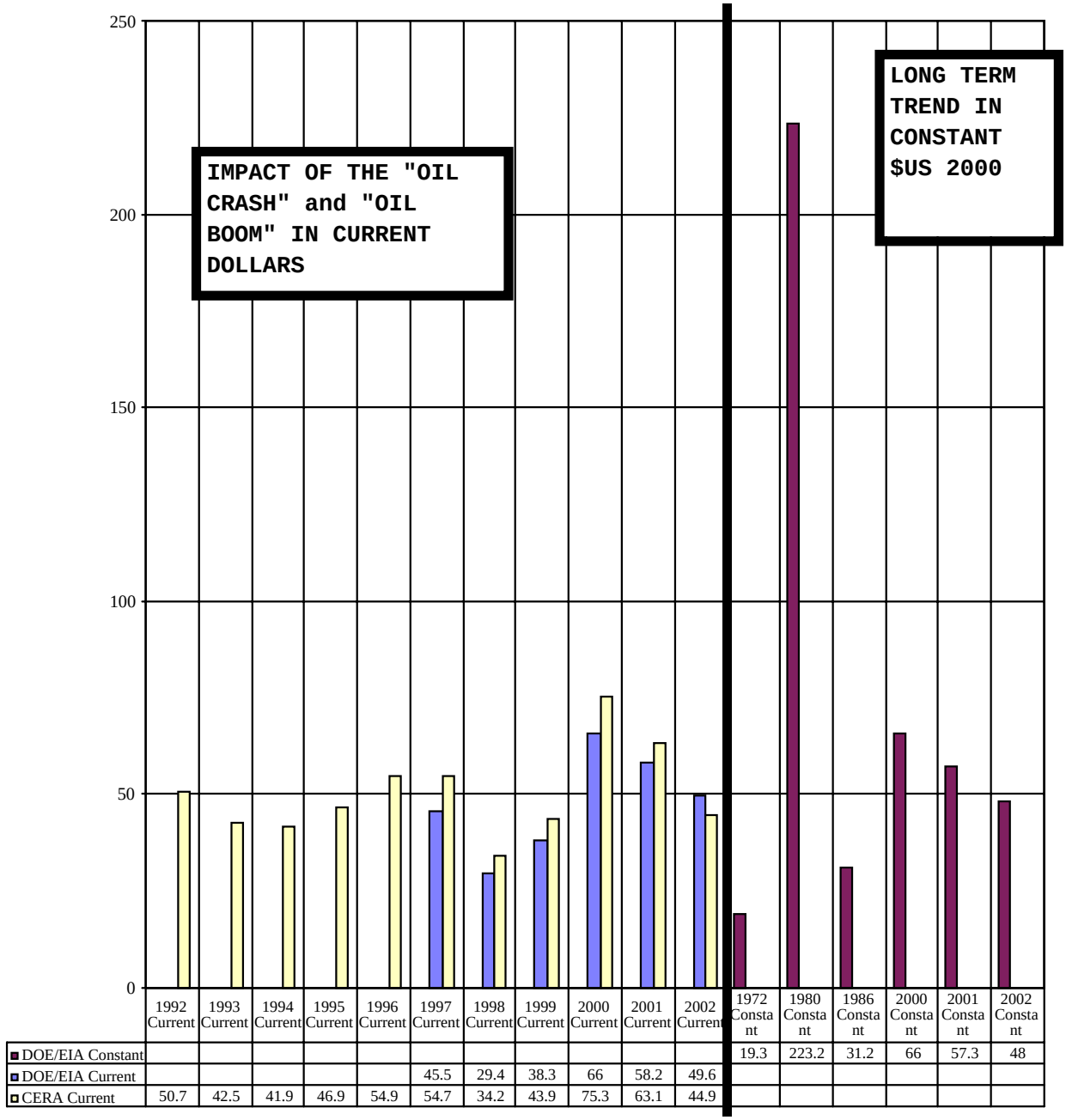
(in Billions of Barrels per Year)



Source: Adapted by Anthony H. Cordesman from Saudi Arabian Monetary Agency, 36th Annual Report- 1421H (2000G), Riyadh, SAMA, 2001, pp. 401-404; 37th Annual Report- 1422H (2001G), Riyadh, SAMA, 2002, pp. 411-416.

The Swings in Saudi Oil Export Revenues 1972-2001: Even the Boom in 2000 Was No Boom By Past Standards

(In $US Current and 2000 Constant Billions)



	1992 Current	1993 Current	1994 Current	1995 Current	1996 Current	1997 Current	1998 Current	1999 Current	2000 Current	2001 Current	2002 Current	1972 Constant	1980 Constant	1986 Constant	2000 Constant	2001 Constant	2002 Constant
DOE/EIA Constant												19.3	223.2	31.2	66	57.3	48
DOE/EIA Current						45.5	29.4	38.3	66	58.2	49.6						
CERA Current	50.7	42.5	41.9	46.9	54.9	54.7	34.2	43.9	75.3	63.1	44.9						

Source: Adapted by Anthony H. Cordesman from data provided by the EIA as of March 2001 and December 2001 (www.eia.gov/emeu/cabs/opecrev2.html.) and in Cambridge Energy Research Associates, OPEC Tilts to Market Share, World Oil Watch, Winter 2002, p. 28.