Oil Shale: History of Policy and Incentives

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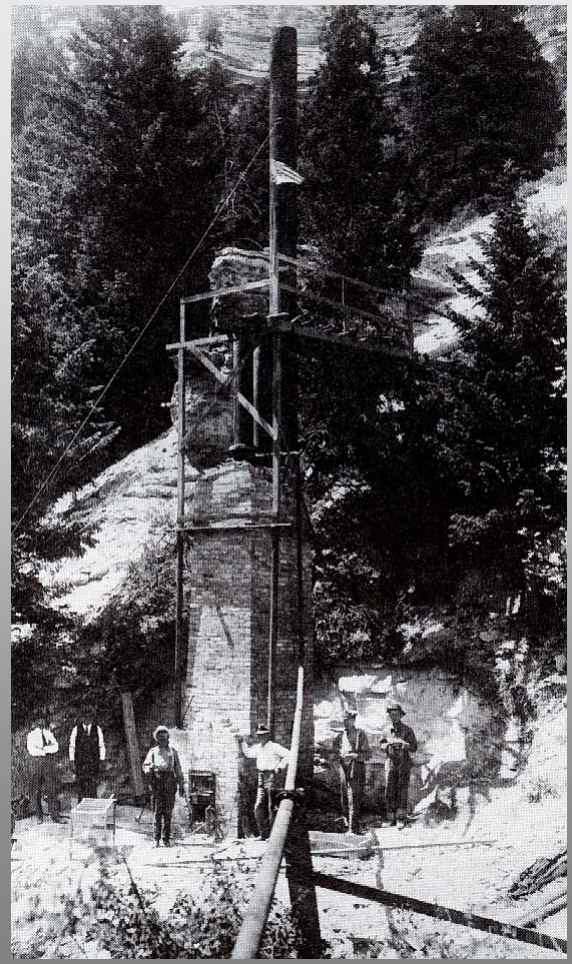
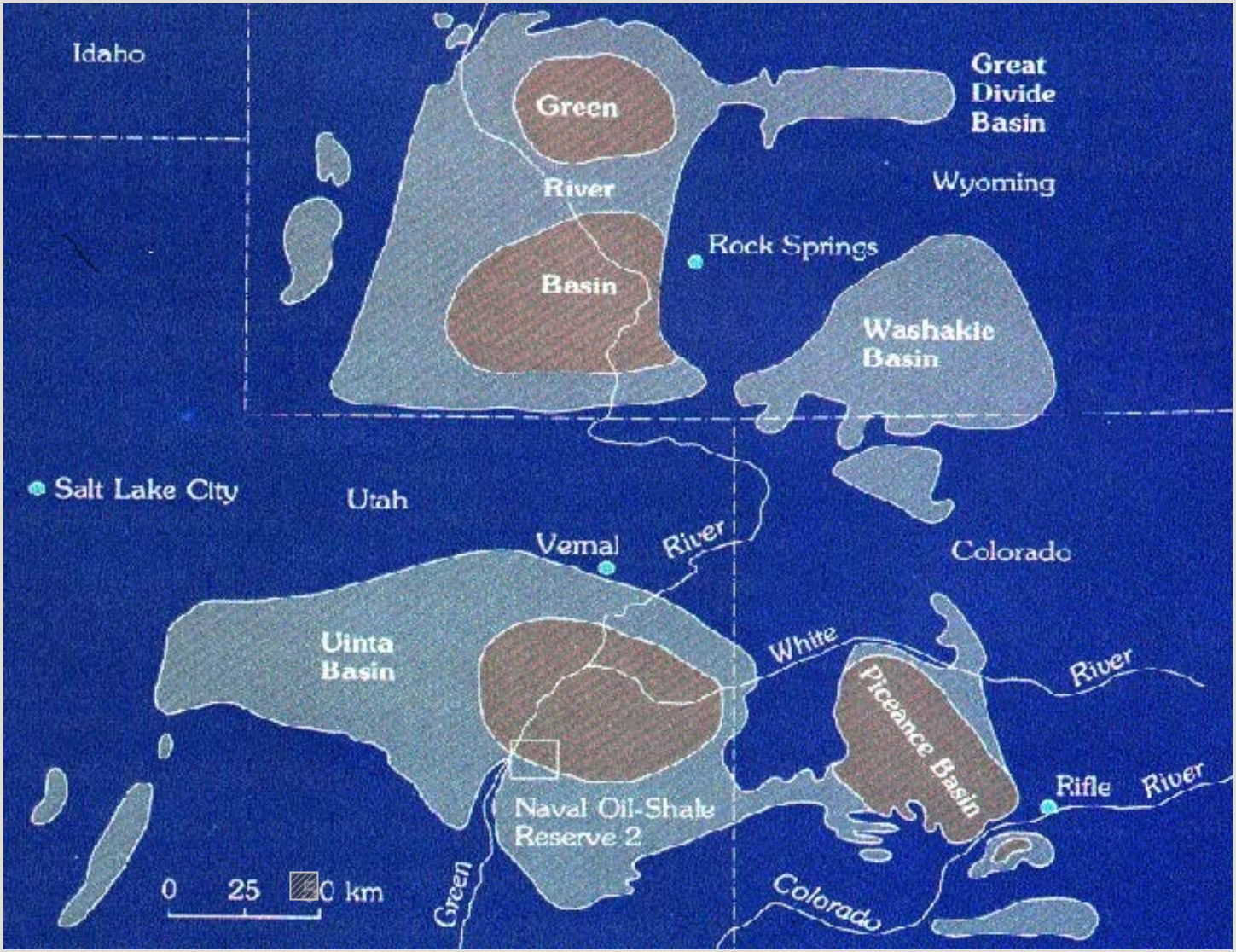
PART I
Legislative Policy History



Federal Interest

- Most promising oil shale resources occur in Green River formation that underlies 16,000 square miles of northwestern Colorado, northeastern Utah, and southwestern Wyoming
- ~ 72% of land overlying Green River Formation is federally held -- thus federal government's historic role and direct involvement in development of this resource

Oil shale > 10ft Thick Yielding 25 gal/ton



Source: U.S. Geologic Survey, Circular 523 (1965), as reproduced by U.S. Department of Energy in *Strategic Significance of America's Oil Shale Resources*, Mar. 14, 2005.

Early Federal Policy

- Pickett Act of 1910 set aside potential oil-bearing lands in California and Wyoming as sources of fuel for Navy
- Presidential executive orders later created NOSR Nos. 1 and 3 in Colorado and NOSR No. 2 in Utah

Synthetic Liquid Fuels Act of 1944

- During World War II, conserving and increasing nation's oil resources prompted passage of Synthetic Liquid Fuels Act of 1944 (30 U.S.C. Secs. 321 to 325)
- Congress authorized funds for Interior Department's Bureau of Mines to construct and operate demonstration plants to produce synthetic liquid fuel from oil shale, among other substances

Defense Production Act of 1950 (Ch. 932, 64 Stat. 798)

- Defense Production Act of 1950 intended to support collective United Nations action during Korean War
- Title III authorized governmental requisition of property for national defense and expansion of productive capacity

Defense Department Initiatives

- Defense Department interest in oil shale for producing quality jet fuel dates to 1951
  - U.S. Navy / Naval Petroleum and Oil Shale Reserves Office (NPSRO) started large-scale evaluations early 1970s
  - Air Force evaluated oil shale suitability for producing JP-4 jet fuel in late 1970s under Project Rivet Shale

Interior & Supplemental Appropriations Acts of 1980 (P.L. 96-126 & P.L. 96-304)

- $17.522 billion appropriated to Energy Security Reserve fund in Treasury Department:
  - Department of Energy committed $2.616 billion to three synthetic fuels projects
  - Defense Production Act approval of:
    - Union Oil Company's Parachute Creek (Garfield County, Co), &
    - Exxon-Tosco's Colony oil shale project (Garfield County)

Energy Security Act of 1980 (PL 96-294, Title I, Part B)

- United States Synthetic Fuels Corporation (SFC) established with authority to provide financial assistance to qualified projects that produced synthetic fuel from coal, oil shale, tar sands, and heavy oils

Tax Incentives/Disincentives

- Economic Recovery Tax Act (P.L. 97-48) of 1981 provided generous oil depreciation allowances
- Tax Equity and Fiscal Responsibility Act (P.L. 97-248) of 1982 rescinded depreciation allowances, reducing potential project sponsors' after-tax rates of return

Executive Orders

- 1981 EO 12287 (Decontrol of Crude Oil and Refined Petroleum Products) - removed price and allocation controls on crude oil and refined petroleum products
- 1982 EO 12346 (Synthetic Fuels) provided orderly transition of DOE's earlier synthetic fuel program to SFC

SFC Termination

- 1984 - General Accounting Office (GAO) reported excess worldwide oil capacity of 8 to 10 million bpd, and reversed trend in rising oil prices after early 1981
- 1985 - Congress terminated SFC under Consolidated Omnibus Budget Reconciliation Act (P.L. 99-272)

Energy Policy Act of 2005

- Section 369 (Oil Shale, Tar Sands, and Other Strategic Unconventional Fuels)
  - directs Interior Secretary to begin leasing oil shale tracts on public lands and
  - cooperate with Defense Secretary in developing a program to commercially develop oil shale, among other strategic unconventional fuels

Energy Policy Act of 2005

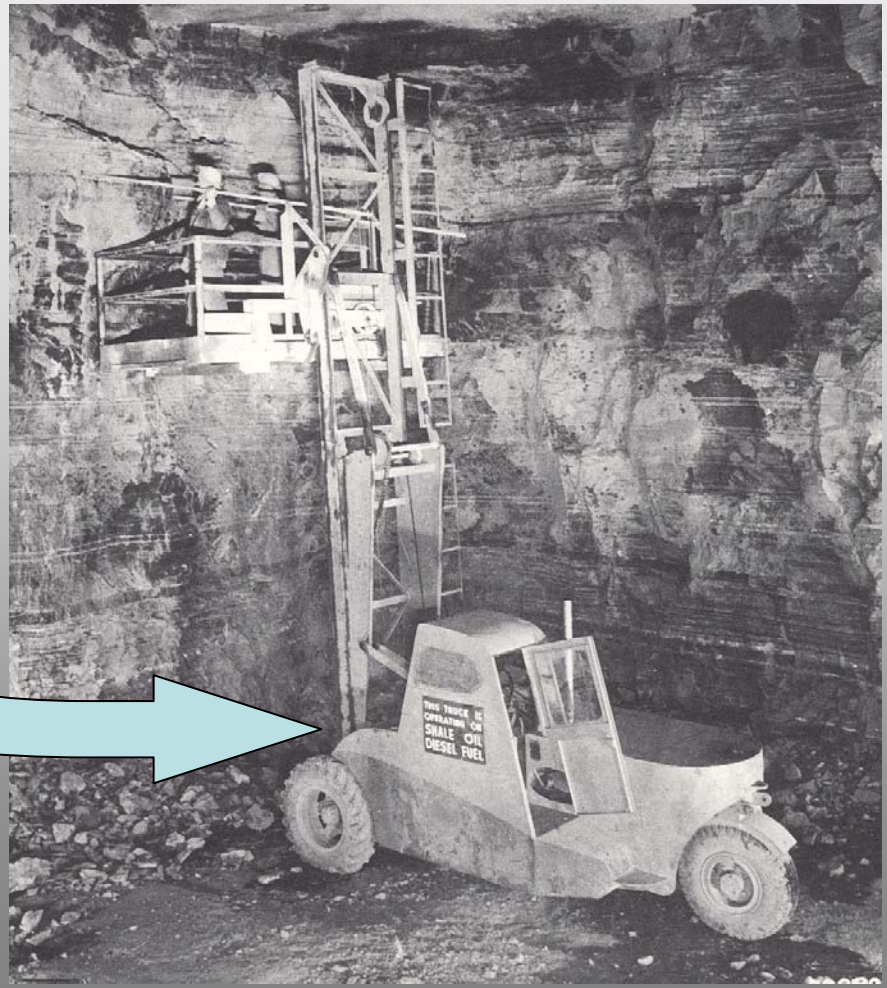
- Section 369(q) (Procurement of Unconventional Fuels by Department of Defense)
  - Directs Defense and Energy Secretaries to develop strategy for using oil shale produced fuel in meeting DOD fuel requirements
  - *Defense Secretary must determine its in the national interest*

PART II
Incentives and Disincentives to Development

Fungibility of Oil-Shale Distillates

- Perception: Oil shale serves as crude oil substitute or synthetic crude
- Reality: Oil shale produces range of middle distillates low in gasoline fraction

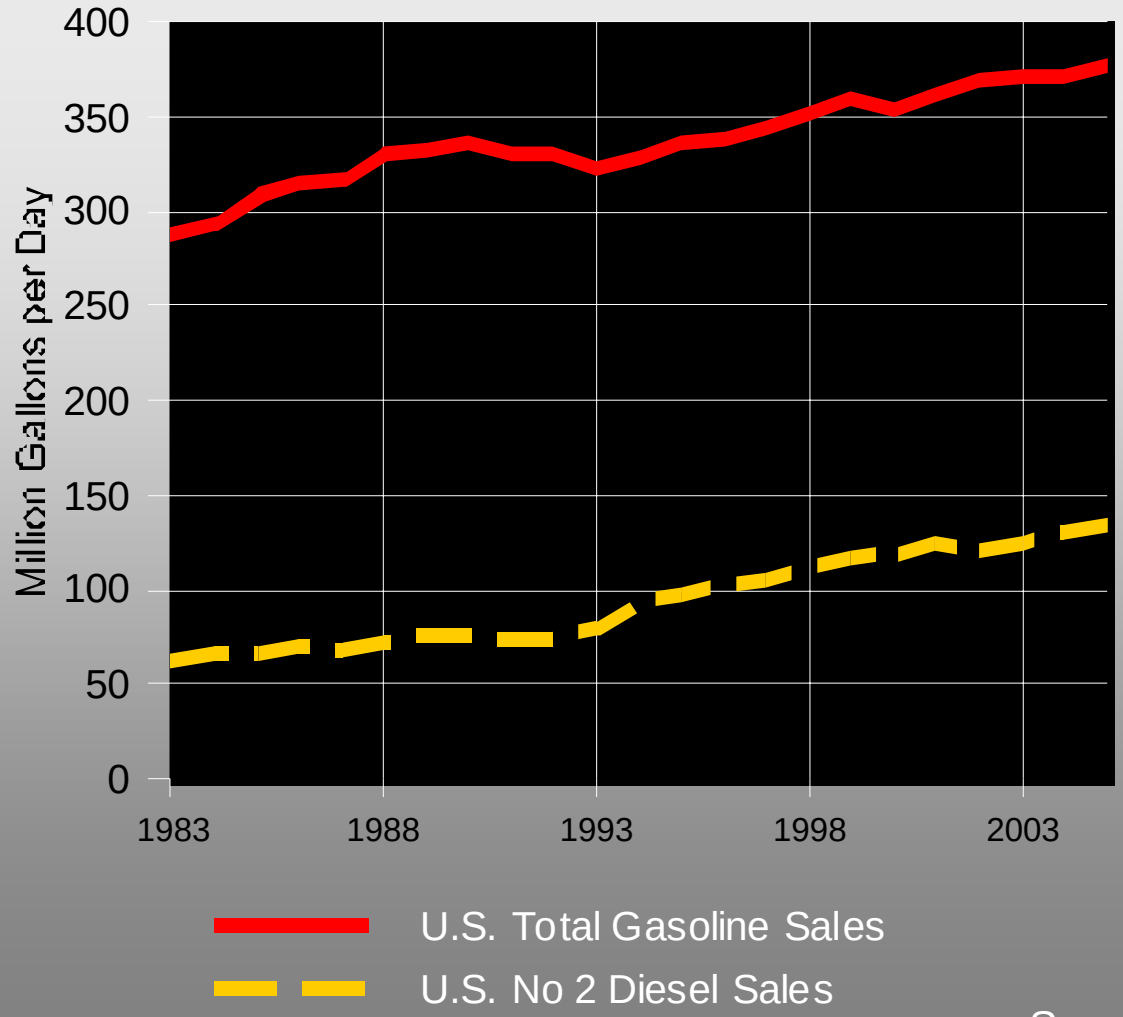
“This truck is operated on oil shale diesel fuel”



Oil-shale Distillate as Gasoline Feedstock

- Downside:
  - Additional energy and hydrogen needed to crack them
  - Further energy loss considering less efficiency of gasoline by spark-ignition engines
- Upside:
  - More efficient use by compression ignition engines (diesel)

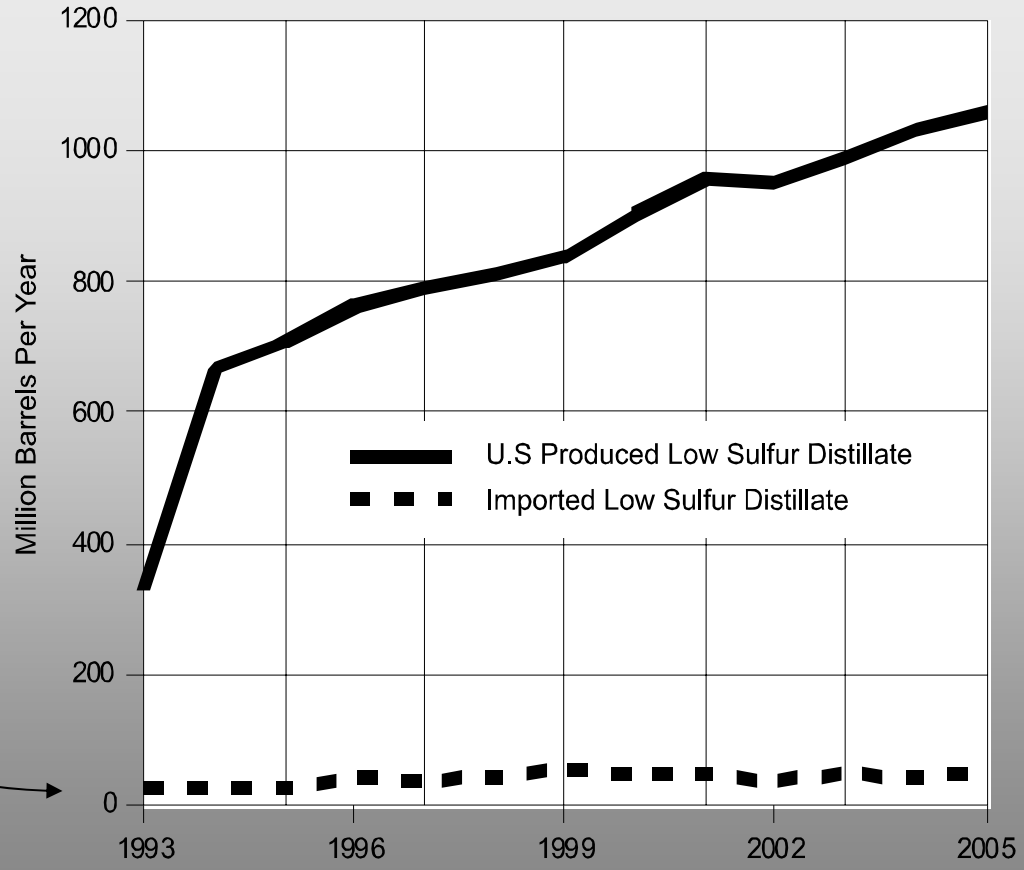
U.S. Trend in Diesel Sales



Source: U.S. DOE EIA

Imported Low Sulfur Distillates Target for Oil Shale?

Current 55 million barrels per year of imports is equivalent of 150,000 bpd in production, or three oil shale plants on scale of OTA's reference case 50,000 bpd facility



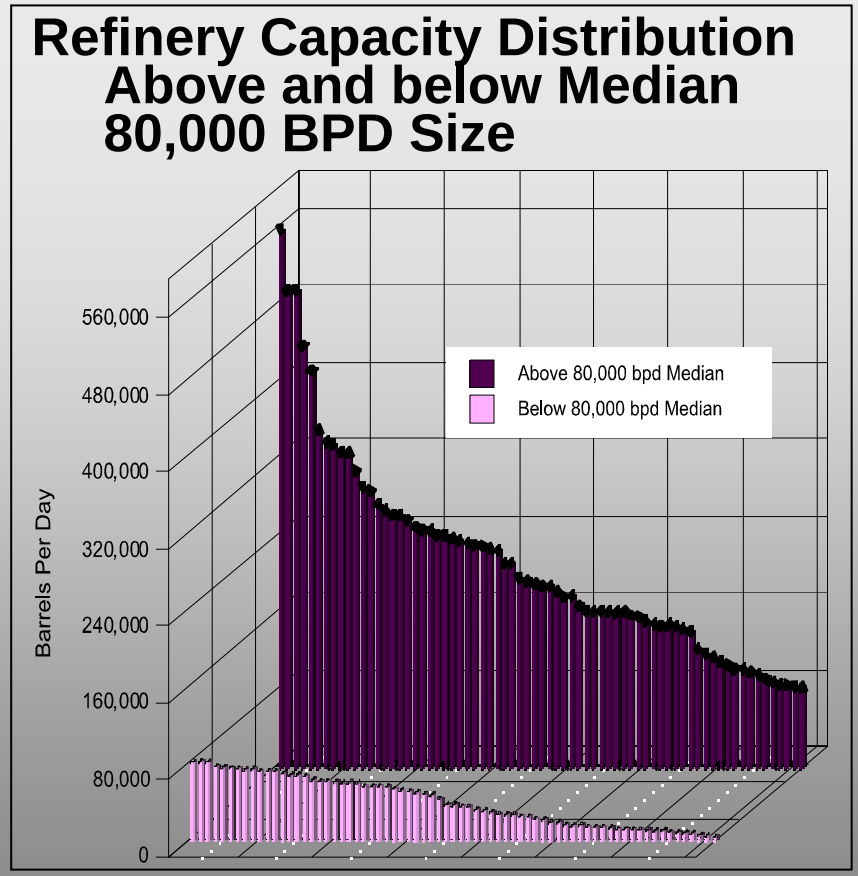
Source: EIA Petroleum Navigator, U.S. Refinery Production of Distillates 15-500 ppm Sulfur, and U.S. Distillates 15-500 ppm Sulfur Imports, at [http://tonto.eia.doe.gov/dnav/pet/hist].

Output Comparison

At most,
U.S. refineries yield
47% motor gasoline
vs.
33% middle-distillates

50,000 bpd oil shale facility ⟺ **150,000 bpd convention al refinery**

Matching middle distillate output



71 refineries above the median capacity are responsible for 85% of current overall U.S. production (14.8 million bpd)

Construction Cost
50,000 bpd above-ground retort excluding mining cost

1979 $ OTA estimate
- **$1.5 billion investment**
- **$8 - $13/bbl operating**

→

2004 $ Nelson-Farrar indexed:
- **$3.5 billion investment**
- **$13 - $21/bbl operating**

2005 $ Rand Corporation estimate
- **$5-$7 billion investment,**
- **$17 to $23/bbl operating**

2004 $ New refinery cost (Alexander's):
- **$2 - $4 billion investment**
- **$6/bbl operating cost (2003-2004 avg.)**

Diesel Fuel Demand Driver - Light-duty* Diesel Vehicles Sales

(*under 8,500 lbs gvw)

U.S. (2004) ~5% of light vehicle sales were diesel

~349,000 light-duty diesel trucks ~30,000 diesel passenger vehicles

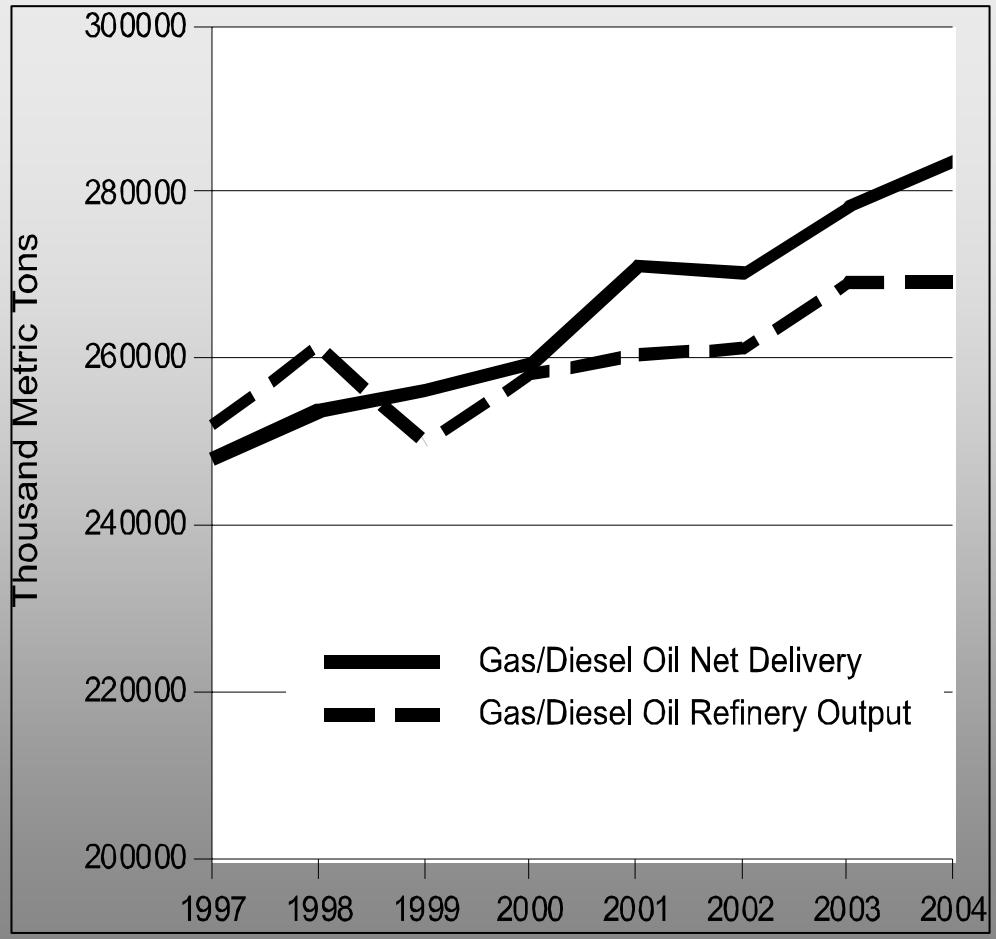
16.9 million total light-duty vehicles sales

Europe (2004) ~48% of new passenger vehicle registration were diesel

Vs 22% in 1998

EIA projects slower growth of U.S. light-duty diesel vehicles sales than Europe.

Diesel Registration Effect on OECD Refinery Output & Net Diesel Delivery



OECD: Organization of Economic Co-operation and Development

Emission Characteristics of Engines

Diesel Engines	Gasoline Engines
Lower CO, CO2	Higher CO, CO2
Higher NOx, PM	Lower NOx, PM

Compression-ignition (diesel) engines characteristically emit less carbon monoxide (CO) and carbon dioxide (CO2) than spark-ignition (gasoline) engines, but emit higher amounts of nitrogen oxides (NOx) and particulate matter (PM).

Clean Air Act Effect on Diesel Sales

- CO, NOx, and PM emissions for gasoline and diesel engines are regulated by Clean Air Act amendments
- Tier 2 Emission Standards are fuel neutral

Increasingly Restrictive Emission Standards for Diesel

		CO	NOx	PM10
1994 -1997	EPA Tier 1 Diesel Car	3.4* - 4.2**	1.0* -1.25**	0.08* - 0.10**
2004 - 2009	EPA Tier 2 Fleet Average		0.07	
	Bin 7	3.4* - 4.2***	0.11* - 0.15***	-* - 0.02***
	Bin 6	3.4* - 4.2***	0.08* - 0.10***	-* - 0.01***
	Bin 5	3.4* - 4.2***	0.05* - 0.07***	-* - 0.01***

* 50,000 mi ** 100,000 mi *** 120,000 mi

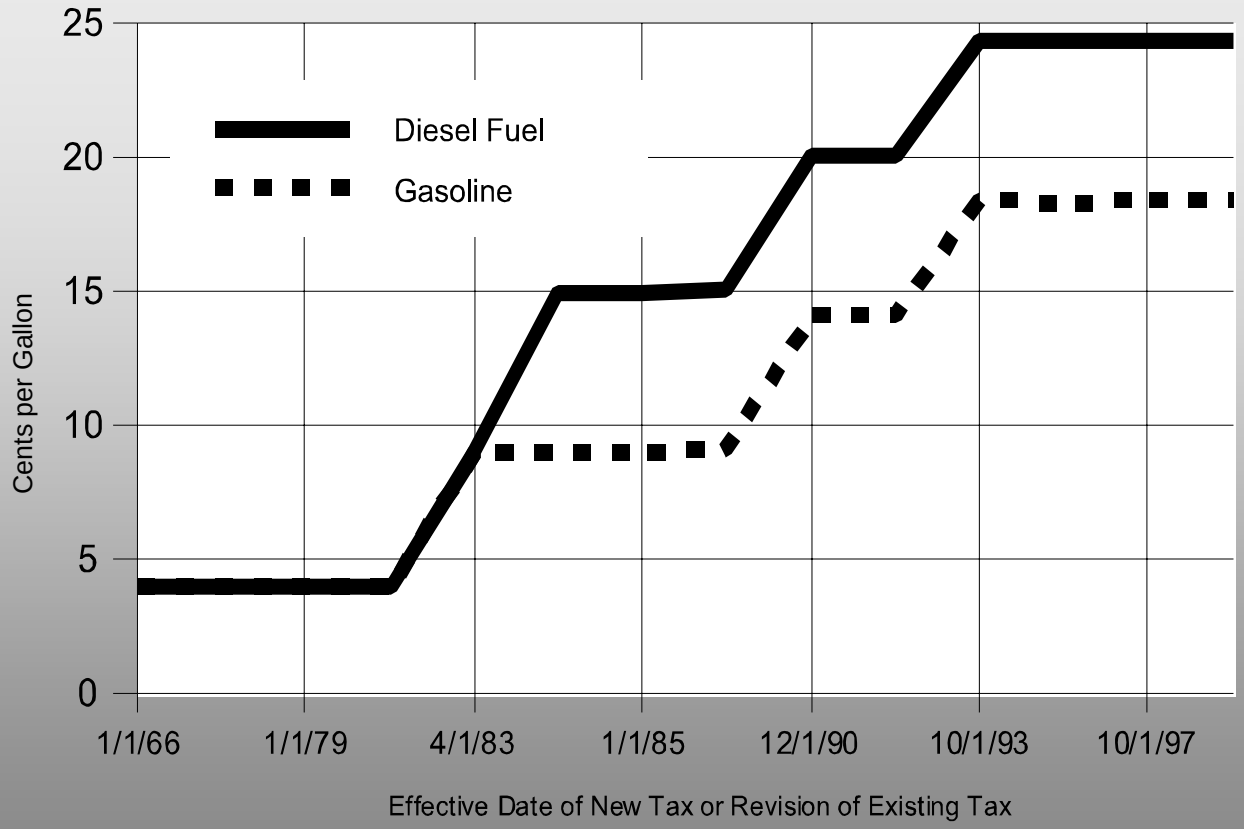
European Union Emission Regulations Diesel Cars

		CO	NOx	PM
1992	EURO 1	2.72	n. a.	0.14
1996	EURO 2	1.0	n. a.	0.10
2000	EURO 3	0.64	0.50	0.05
2005	EURO 4	0.50	0.25	0.025
2008	EURO 5	0.50	0.25	0.005

U.S. Fuel Tax

U.S. federal motor fuel tax favors gasoline over diesel fuel by 6¢ / gal.

18.4¢ vs 24.4¢



EU Motor Fuel Tax

- Diesel fuel taxed $0.62 per gallon less than gasoline (except in U.K.)
- End-use price difference in motor fuels correlates with increased diesel car registrations

	Diesel	Gasoline
France	$3.89	$5.26
Germany	$4.23	$6.08
U.S.	$2.45	$2.17

Dec 2005

Summary Points

- Misconception regarding oil shale's fungibility as gasoline feedstock
- Policies that attempt to foster oil shale development conflict with regulatory policies that favor gasoline as transportation fuel

Summary Points

- Without long-term concerted effort to produce oil shale, either through federal- or private sector-sponsored enterprise, economic viability will remain questionable
- Closest competitor now, may not be new crude discoveries, but Fisher-Tropsch coal-to-liquids or gas-to-liquids