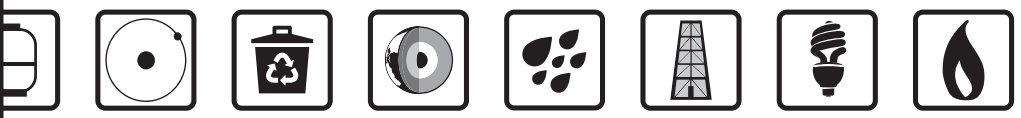


# Energy Analysis

Students use graphs of historical data and research historical and societal events to determine and analyze trends in energy.



**Grade Level:**  
■ Intermediate  
■ Secondary

**Subject Areas:**  
■ Science  
■ Social Studies  
■ Math  
■ Technology



# U.S. Energy Data

## Basic Energy Information

DATE	POPULATION	PRODUCTION (IN QUADS)	CONSUMPTION (IN QUADS)
1950	152,300,000	35.5	34.6
1960	180,700,000	42.8	45.1
1970	205,100,000	63.5	67.8
1980	227,200,000	67.2	78.1
1990	249,600,000	70.7	84.5
2000	282,200,000	71.3	98.8
2007*	301,400,000	71.4	101.4
2010	309,100,000	75.0	98.0

## Energy Production By Source (Quadrillion Btu)

DATE	COAL	NATURAL GAS	PETROLEUM	URANIUM (NUCLEAR)	RENEWABLES
1950	14.1	6.2	11.4	0	3.0
1960	10.8	12.7	14.9	0	2.9
1970	14.6	21.7	20.4	0.2	4.1
1980	18.6	19.9	18.2	2.7	5.4
1990	22.5	18.3	15.6	6.1	6.0
2000	22.7	19.7	12.4	7.9	6.1
2007*	23.5	19.8	10.7	8.5	6.5
2010	22.1	22.1	11.7	8.4	8.1

## Energy Consumption By Source (Quadrillion Btu)

DATE	COAL	NATURAL GAS	PETROLEUM	URANIUM (NUCLEAR)	RENEWABLES
1950	12.3	6.0	13.3	0	3.0
1960	9.8	12.4	19.9	0	2.9
1970	12.3	21.8	29.5	0.2	4.1
1980	15.4	20.2	34.2	2.7	5.4
1990	19.2	19.6	33.6	6.1	6.0
2000	22.6	23.8	38.3	7.9	6.1
2007*	22.7	23.7	39.8	8.5	6.6
2010	20.8	24.5	36.0	8.4	8.0

\*2007—largest consumption of energy in U.S. history.

Data: EIA



# U.S. Energy Timeline

## 1950's

- 1950 Americans owned 50 million cars; oil surpassed coal as the country's number one fuel source
- 1953 First atomic reactor to produce power began operation in Idaho
- 1954 Bell Labs invented the first solar cell
- 1954 The Atomic Energy Act of 1954 was passed
- 1955 More Americans traveled by air than by train
- 1956 First load of containers (truck trailers) transported aboard a cargo ship by sea for less than the cost of trucking them over land
- 1957 Shippingport reactor in Pennsylvania was the first nuclear power plant to provide electricity to customers in the U.S.
- 1958 The Jet Age began when airline companies began replacing propeller planes with jet planes; they used kerosene, which was less expensive than gasoline
- 1959 First fuel cell designed to produce electricity from hydrogen and oxygen

## 1960's

- 1960 OPEC - Organization of Petroleum Exporting Countries – established to control oil production
- 1960 First commercial-scale geothermal power plant began operation in California at The Geysers
- 1961 Coal had become the major fuel used by electric utilities in the United States to generate electricity
- 1965 Fuel cells used in the space program
- 1965 Recycling program started for aluminum cans
- 1969 Oil discovered on Alaska's northern slope

## 1970's

- 1970 Environmental Protection Agency (EPA) created
- 1970 First waste-to-energy plant began operation
- 1971 Surface mines replaced underground mines as the leading source of coal produced in the United States
- 1973-74 Arab oil embargo to protest Arab/Israeli War. The OPEC oil embargo focused attention on the energy crisis and resulted in:
  - An increase in demand for U.S. coal
  - Gasoline rationing
  - Emergency Highway Energy Conservation Act of 1974, part of a nationwide effort to reduce oil consumption
  - 55 mile per hour speed limits imposed
  - Plastic recycling began – plastic bottles replace glass containers
  - Nuclear Regulatory Commission (NRC) created to regulate the nuclear industry
  - Interest in space applications of photovoltaics grew
  - High oil prices increased interest in other energy sources, such as wind energy
- 1975 Strategic Petroleum Reserve began
- 1976 Electric Vehicle Act enacted
- 1977 Trans-Atlantic oil pipeline opened
- 1977 Department of Energy created
- 1977 The Surface Mining Control and Reclamation Act of 1977 enacted to reduce the environmental impact of surface mining, required mines no longer being used to be "reclaimed" or restored to their natural state
- 1977 Federal Energy Regulatory Commission (FERC) created to regulate energy production and transmission
- 1978 Public Utility Regulatory Policies Act (PURPA) of 1978 enacted to promote greater use of renewable energy, cogeneration, and small power projects
- 1978 Iranian Revolution shut down oil exports
- 1979 Nuclear accident at Three Mile Island nuclear power plant in Pennsylvania
- 1979 OPEC raised crude oil prices (prices tripled between January 1979 and September 1980)
- 1979 President Carter announced effort to reduce dependence on foreign oil

## 1980's

1980	For the first time, nuclear energy generated more electricity than oil in the United States
1980	First PV power plant opened in Utah
1981	Government price controls end on crude oil and petroleum products – now supply and demand set domestic crude prices
1982	First solar-thermal power plant opened in California
1984	Nuclear replaced hydropower as the second-largest source of electricity in the United States, after coal
1985	New cars and light trucks required to meet a Corporate Average Fuel Economy (CAFE) Standard for fuel economy of 27.5 miles per gallon
1986	Clean Coal Technology Act passed
1986	Chernobyl nuclear power plant accident in the former USSR (now Ukraine)
1986	OPEC lowered price of crude for first time by increasing production, oil consumption grew quickly while prices remained low
1989	Exxon Valdez oil tanker spilled 240,000 barrels of crude oil in Alaska's Prince William Sound
1989	High efficiency PV cells developed

## 1990's

1990	More than 2,200 megawatts of wind energy capacity installed in California — more than half of the world's capacity at the time
1990	Clean Air Act Amendments required many changes to gasoline and diesel fuels to make them pollute less
1990	Iraq invaded Kuwait causing crude oil price increase
1992	Recycling legislation adopted by 15 states
1992	President Bush issued Executive Order 12780, which stimulated waste reduction, recycling, and the buying of recycled goods in all federal agencies
1993	Two decades after the first oil embargo, 109 nuclear power plants operating in the U.S. provided about one-fifth of the nation's electricity
1997-98	Asian financial crisis has worldwide economic effects - demand for petroleum products declined and oil prices fell
1998	Electric utility deregulation began
1999	First hybrid electric vehicle, powered by both a rechargeable battery and gasoline, became available in the U.S.

## 2000's

2000	Americans owned 220 million cars
2000	EPA established a link between global climate change and solid waste management, noting that waste reduction and recycling can help reduce greenhouse gas emissions
2003	U.S. sponsored a \$1 billion, 10-year demonstration project to create the world's first coal-based, zero-emissions electricity and hydrogen power plant
2003	Invasion of Iraq disrupted crude oil supplies
2003	Nation's largest-ever power outage left much of the Northeast and parts of Canada without electricity for several days
2005	Hurricane Katrina (August) and Rita (September) caused massive damage to U.S. petroleum and natural gas infrastructure
2005	In September, U.S. residential natural gas prices were the highest ever recorded, reaching \$16.66 per thousand cubic feet
2005	Congress passed the Energy Policy Act of 2005: <ul style="list-style-type: none"><li>▪promoted the use of coal through clean coal technologies</li><li>▪required increased use of renewable fuels for transportation and new measures to reduce pollution from gasoline and diesel</li></ul>
2006	Coal production set a record high with 1.16 billion short tons
2006	The U.S. ranked among the top 4 countries in the world for hydroelectric generation, along with China, Canada, and Brazil, generating 44% of the world's electricity from hydropower
2007	Largest consumption of energy in U.S. history
2008	Oil prices reached new high – over \$100 per barrel, gasoline prices broke \$4.00 per gallon

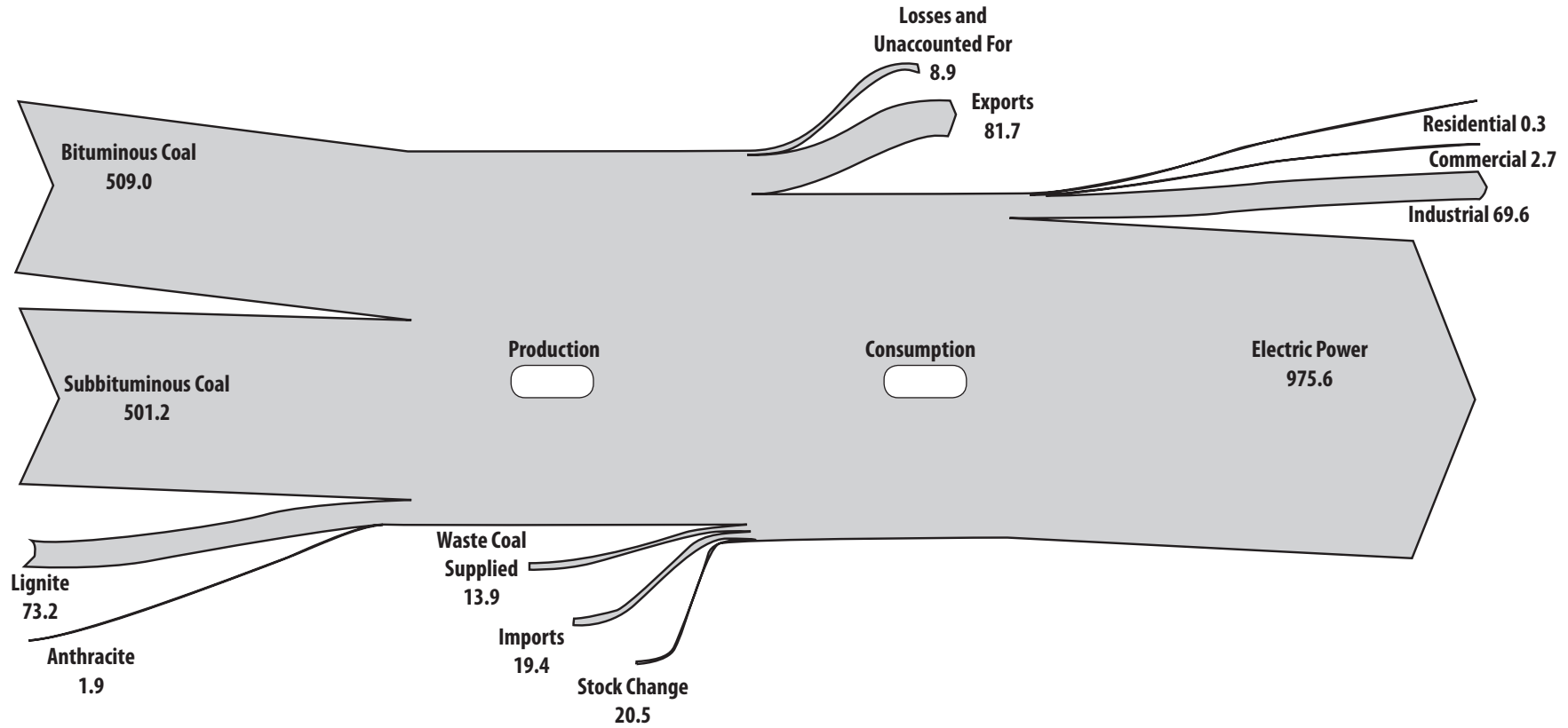
## 2010's

- 2010 29 miners killed in an underground explosion at the Upper Big Branch Mine in West Virginia, the worst mining accident in the U.S. since 1972
- 2010 Explosion and fire occurred on the offshore drilling rig Deepwater Horizon while drilling an exploratory well in the Gulf of Mexico. The accident killed 11 crew members and left oil leaking from the unfinished well into the ocean for months
- 2010 Secretary of the Interior Salazar announced a 6-month hold or "moratorium" on deep water drilling
- 2010 33 miners trapped half a mile underground in a mine collapse in northern Chile; after 69 days, everyone was rescued
- 2011 Tohoku earthquake and subsequent tsunami led to the accident and shutdown at Tokyo Electric Power Company's Fukushima Daiichi nuclear power plant and subsequent outages at other plants. As a result, LNG consumption at power companies in Japan was up 30% in May 2011 compared to May 2010.
- 2011 First offshore wind farm (Cape Wind Project off the coast of Massachusetts) approved in U.S.
- 2012 In February, the U.S. Nuclear Regulatory Commission (NRC) issued the first-ever combined licenses to build and operate two new nuclear reactors at the Vogtle Power Plant in Georgia. (The NRC had not issued a license to build a new reactor since 1978.) In March, combined licenses were issued to build and operate two new reactors at the Summer Power Plant in South Carolina.



# U.S. Coal Flow, 2010

Million Short Tons



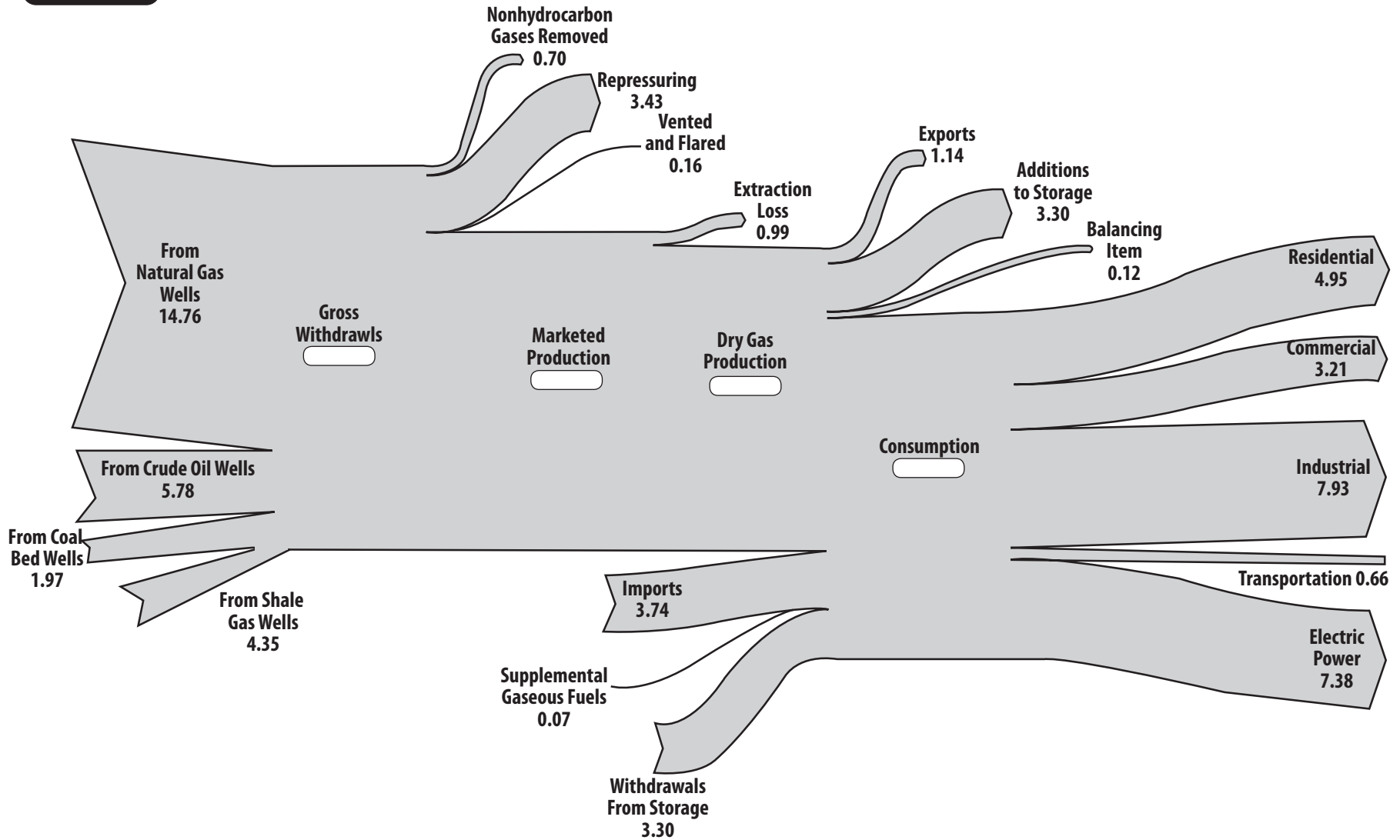
Data: U.S. Energy Information Administration/Annual Energy Review

**Production** → **Consumption**



# U.S. Natural Gas Flow, 2010

## Trillion Cubic Feet



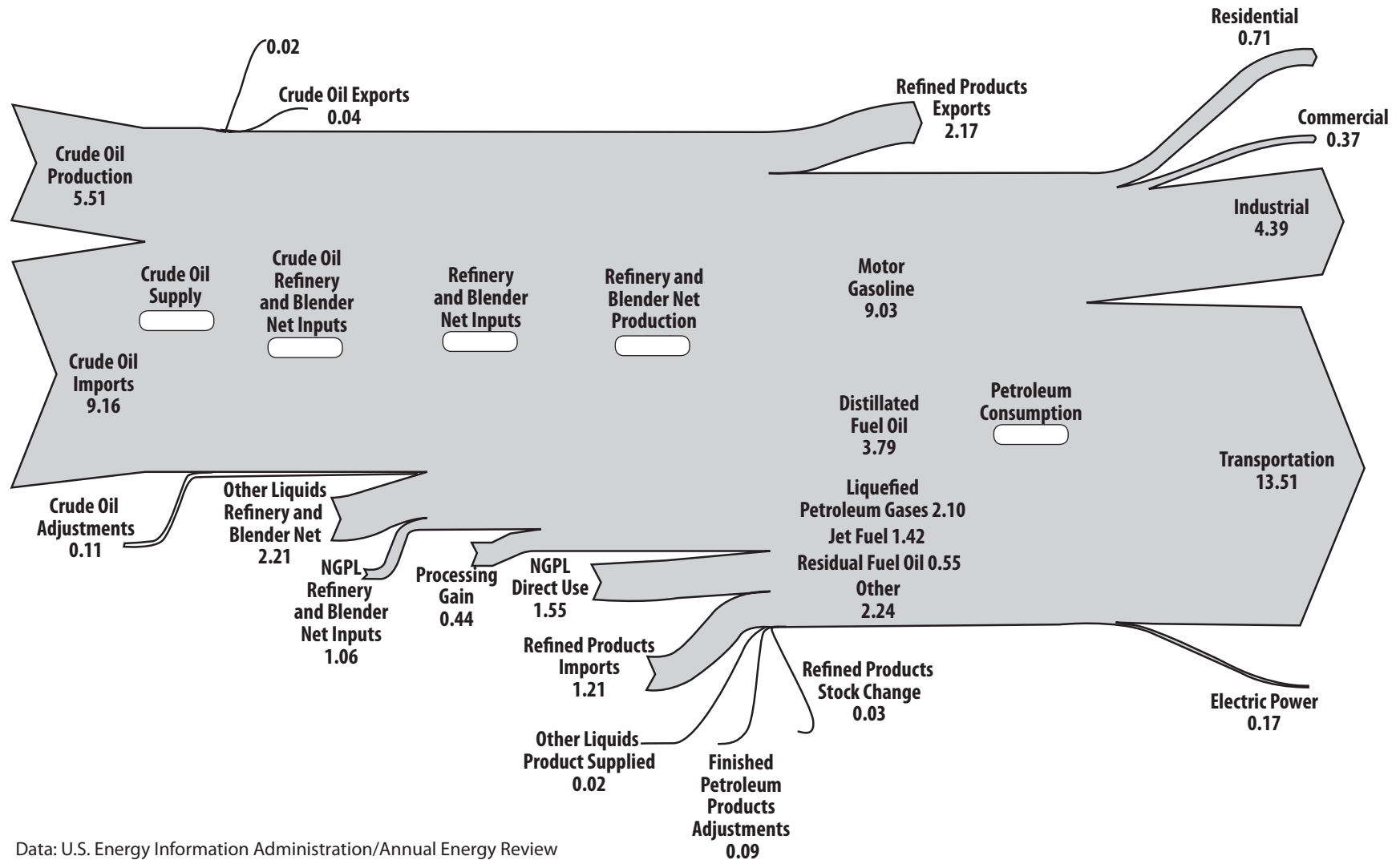
Data: U.S. Energy Information Administration/Annual Energy Review

**Production** → **Consumption**



# U.S. Petroleum Flow, 2010

## Million Barrels Per Day



Data: U.S. Energy Information Administration/Annual Energy Review

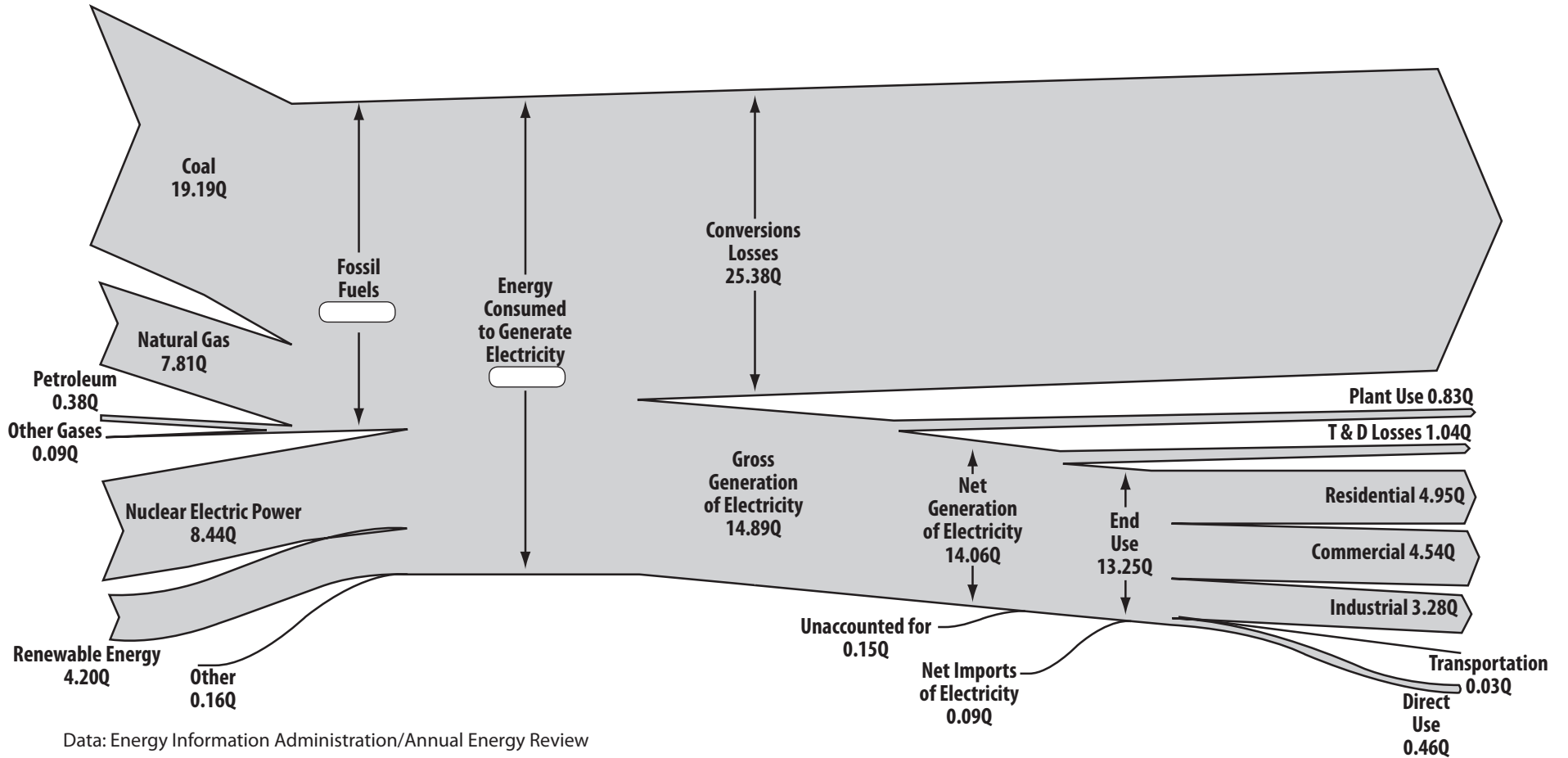
**Production** → **Consumption**





# U.S. Electricity Flow, 2010

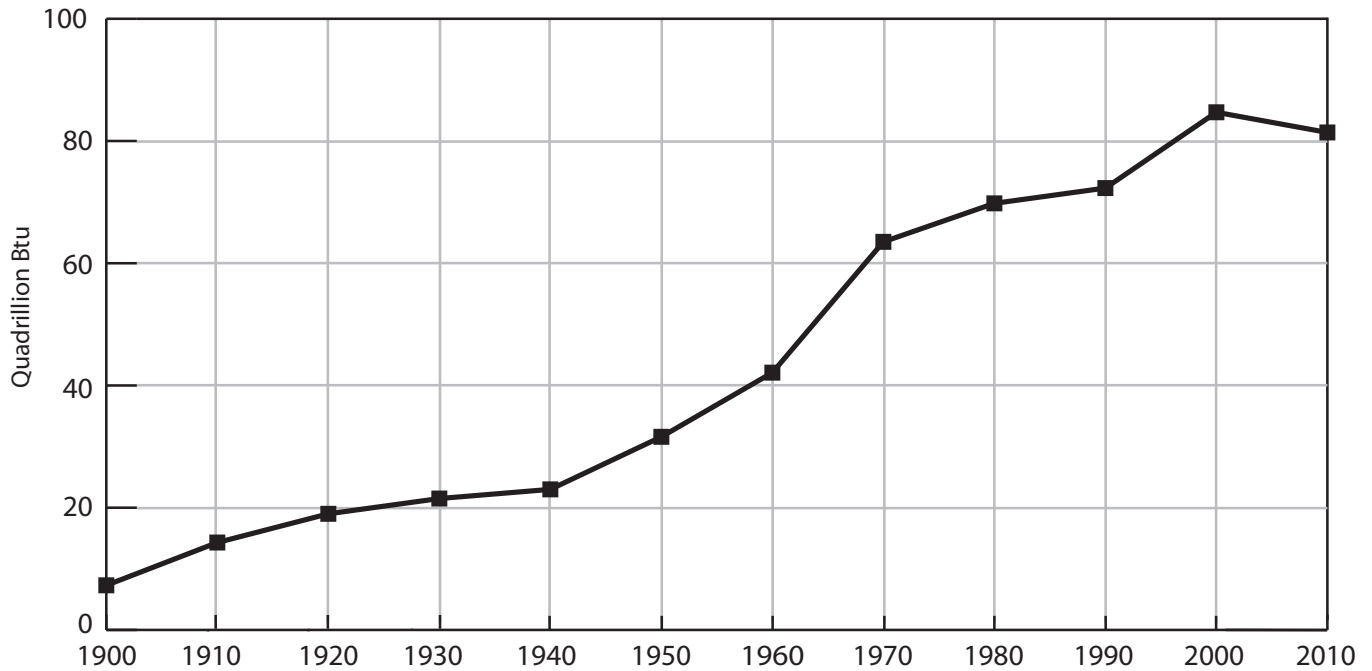
## Quadrillion Btu





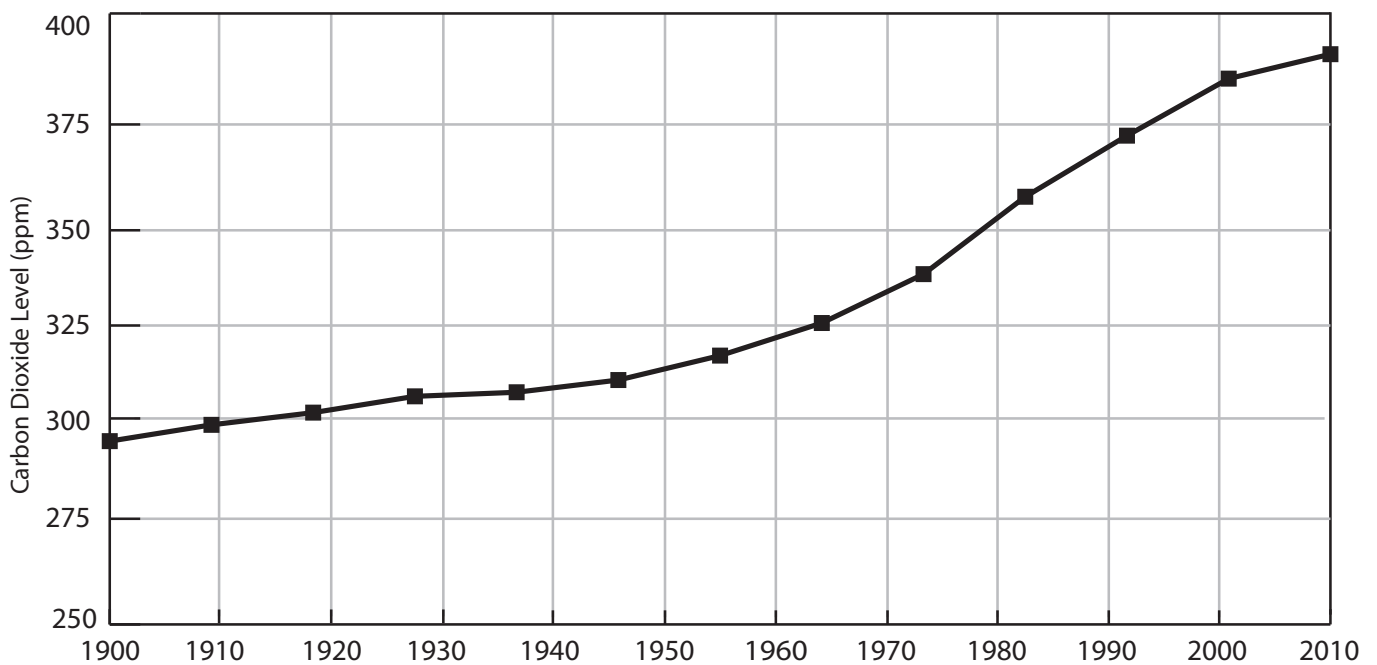
# Consumption and Impact

## Fossil Fuel Consumption



Data: AER Table 1.3 and Table E1

## Carbon Dioxide Level

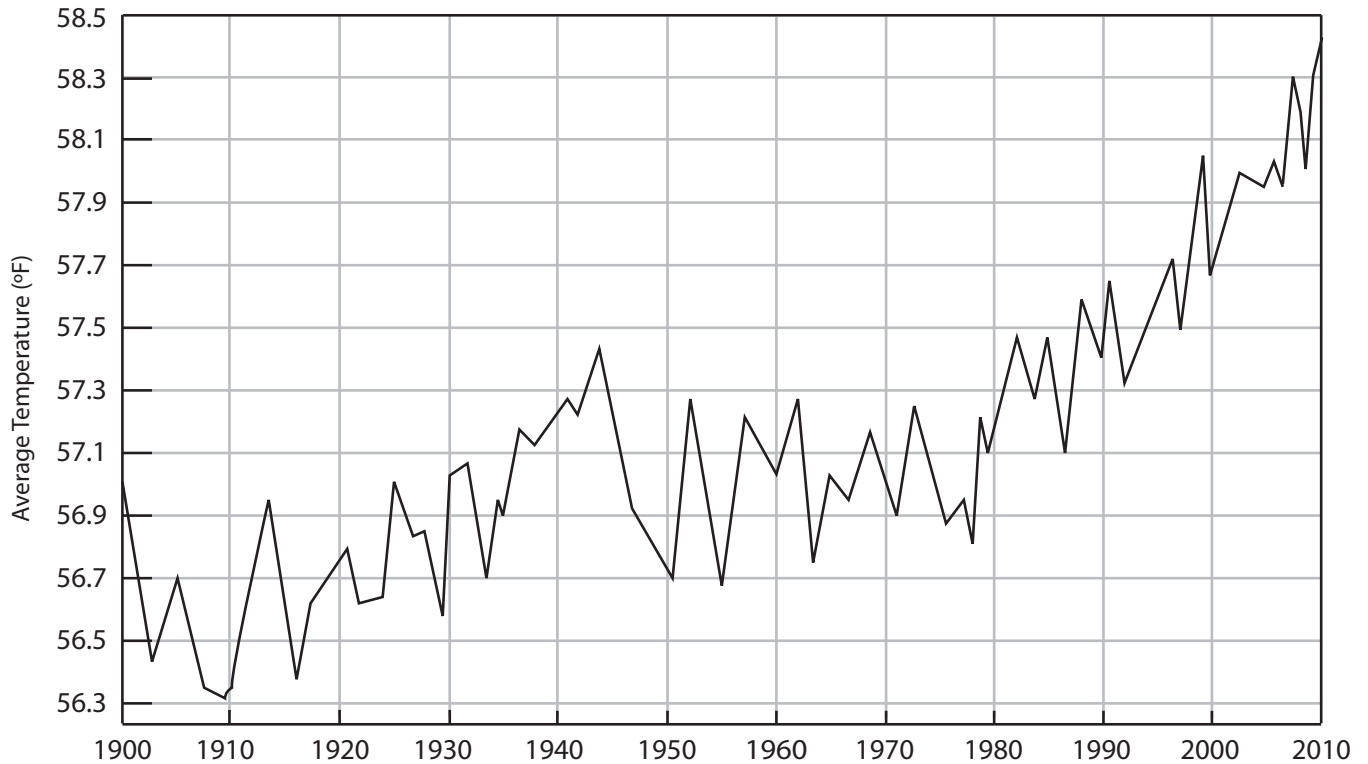


Data: Carbon Dioxide Information Analysis Center



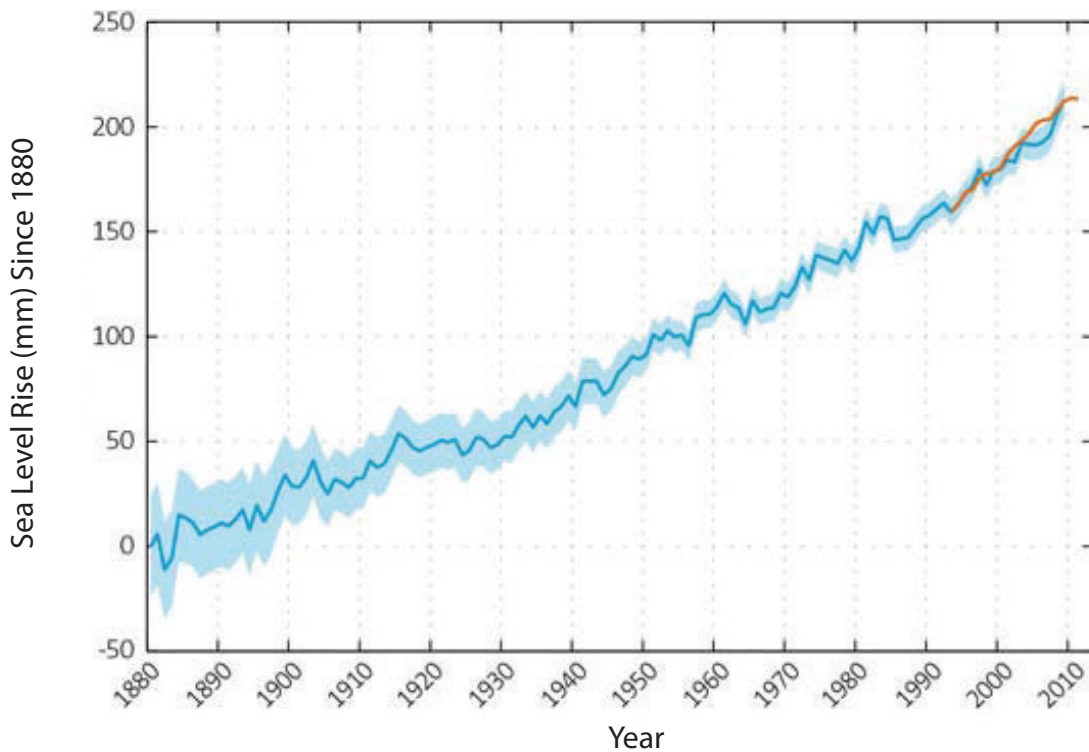
# Global Averages

## Global Average Temperature



Data: NASA Goddard Institute for Space Studies

## Global Average Mean Sea Level—1880 to 2011

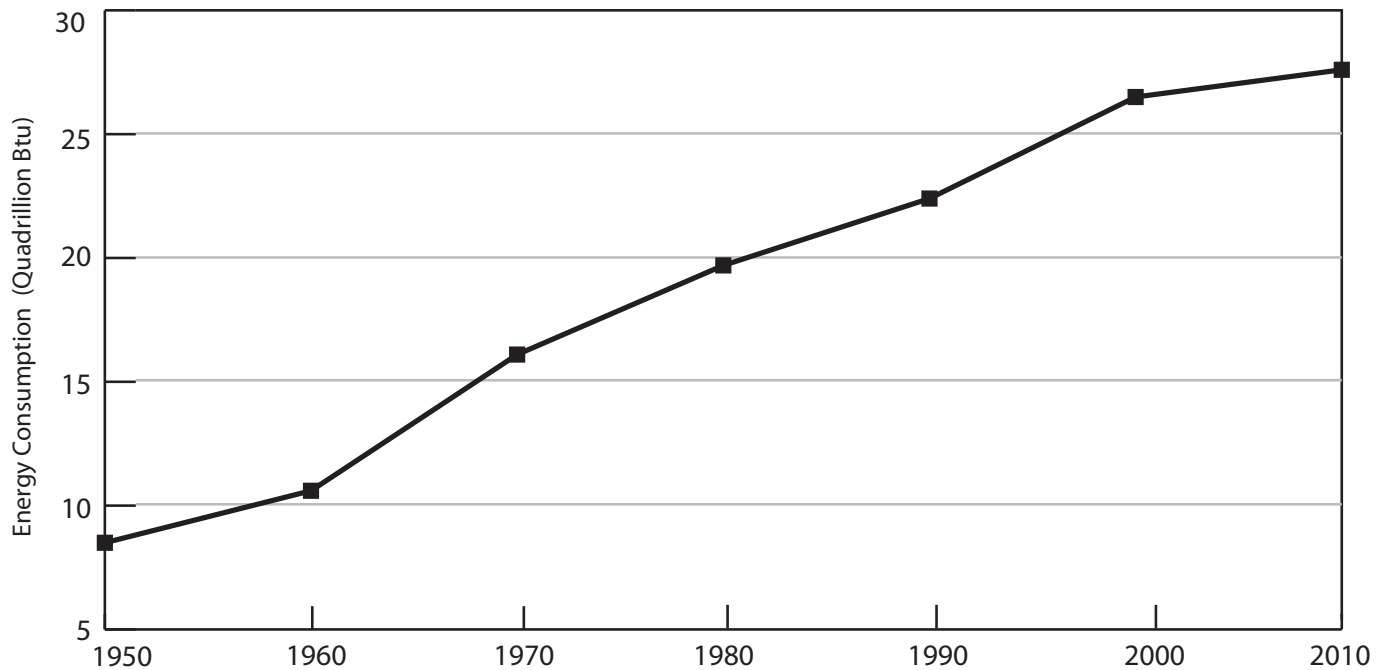


Data: Commonwealth Scientific and Industrial Research Organisation (CSIRO)



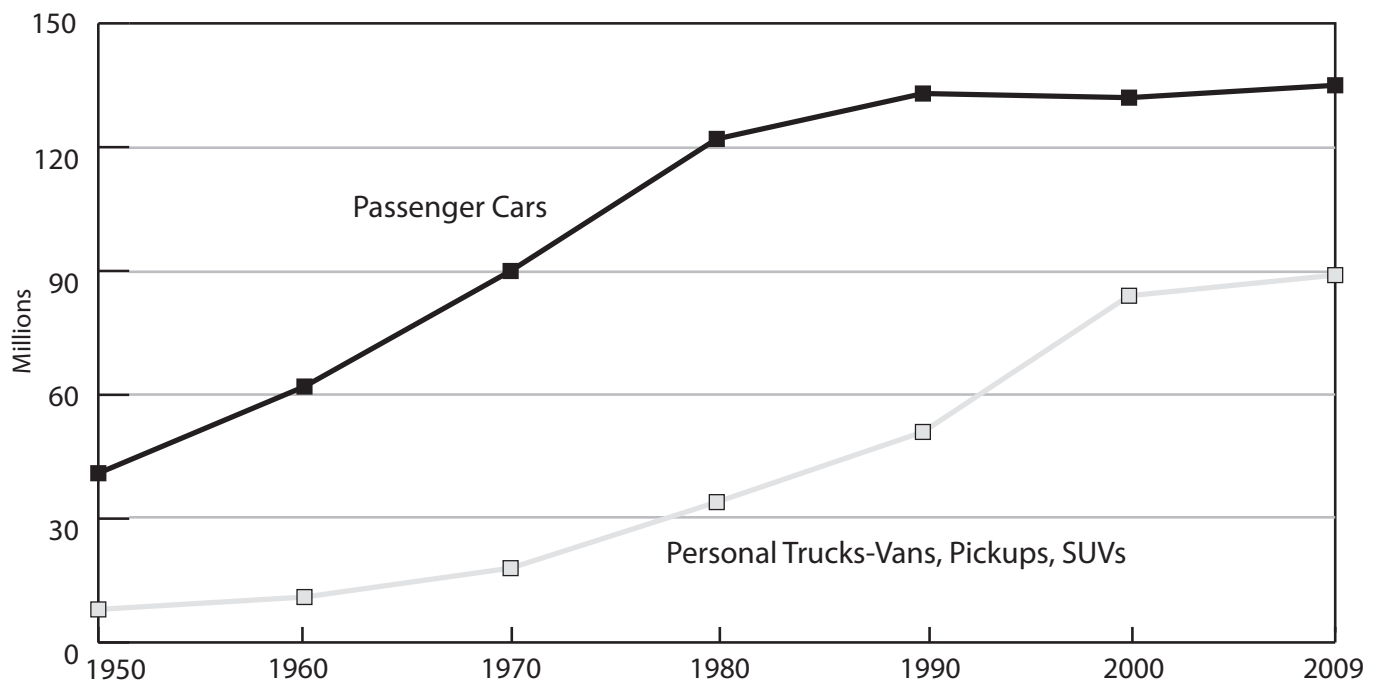
# Transportation

## Transportation Sector Consumption



Data: EIA Table 2.1e

## Number of Vehicles

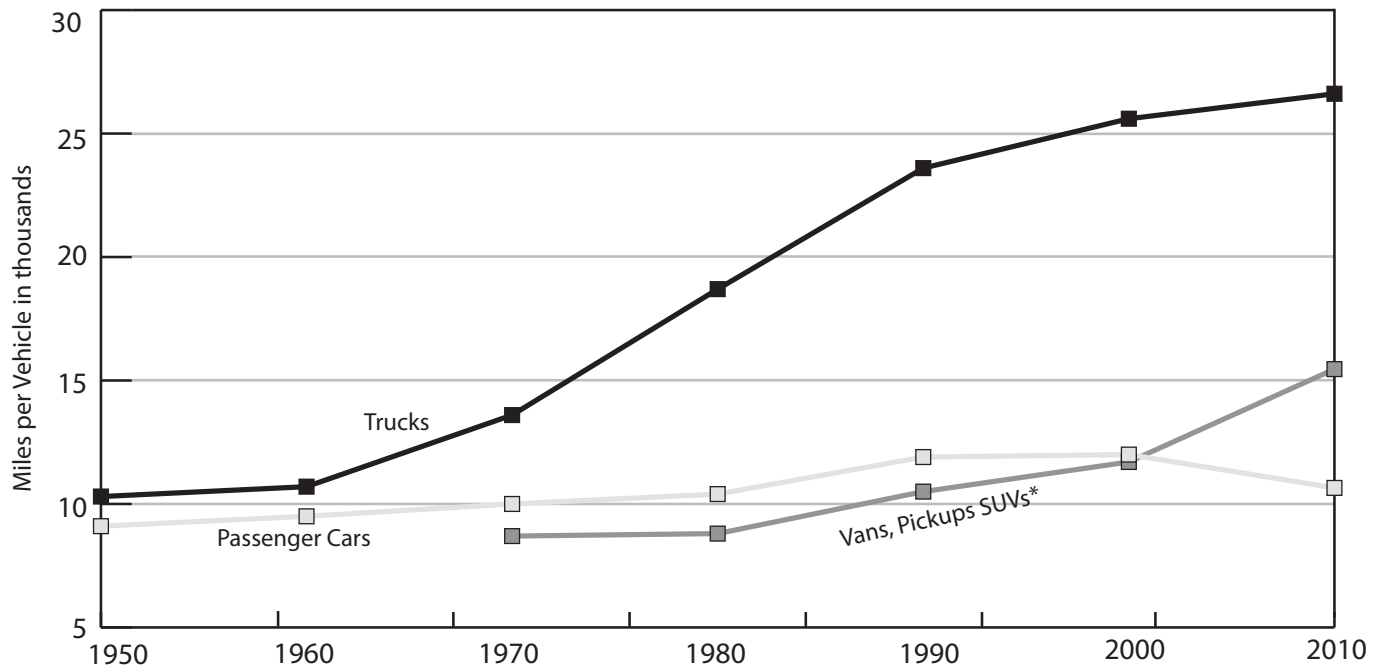


Data: DOE Transportation Energy Data Book Edition 30



# Motor Vehicles

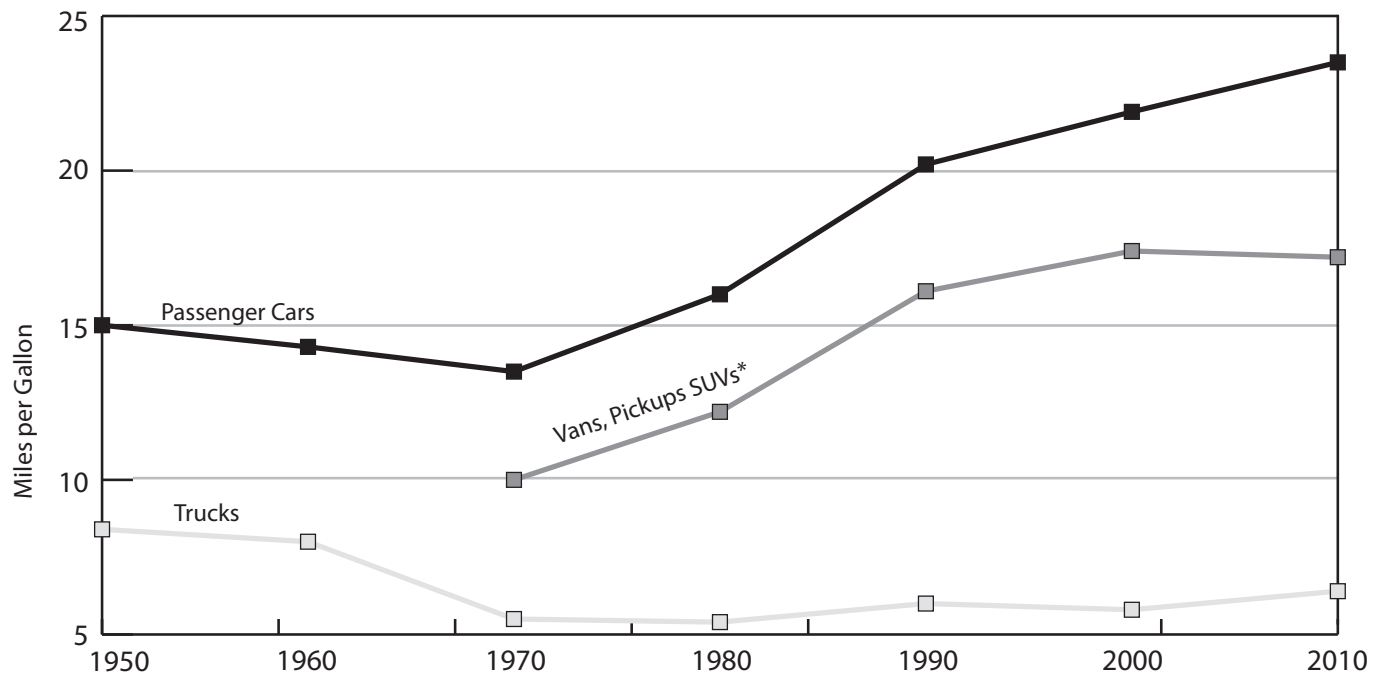
## Motor Vehicle Mileage



Data: Energy Information Administration

\*Included in Trucks until 1970

## Motor Vehicle Fuel Economy



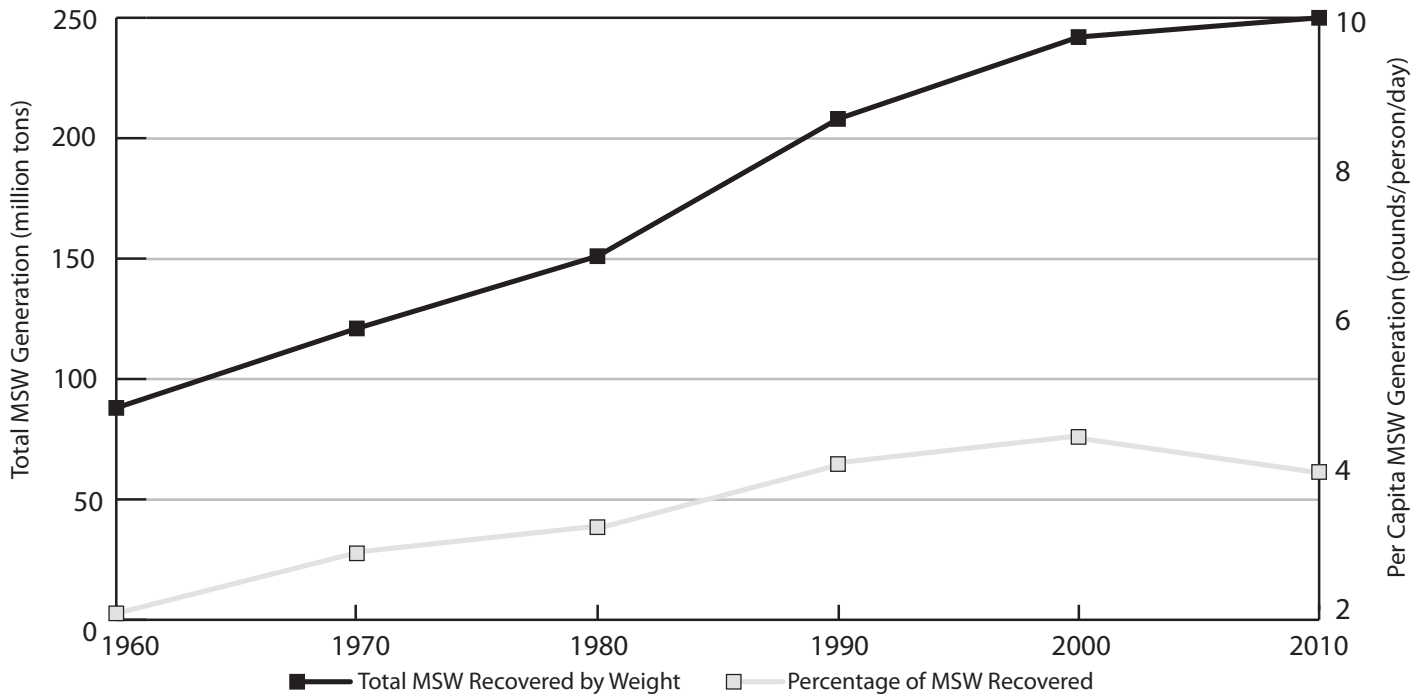
Data: Energy Information Administration

\*Included in Trucks until 1970



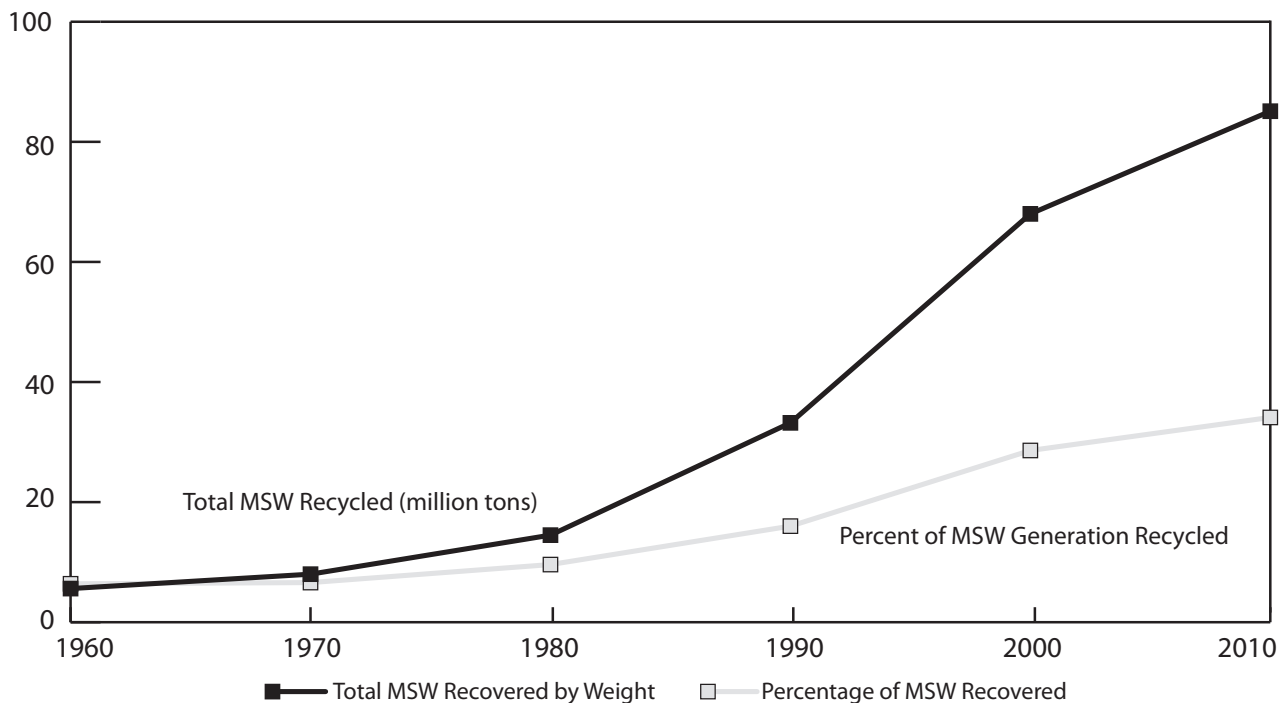
# Municipal Solid Waste Generation and Recycling

## Municipal Solid Waste Generation Rates from 1960 to 2010



Data: EPA MSW Characterization Report

## Municipal Solid Waste Recycling Rates from 1960 to 2010

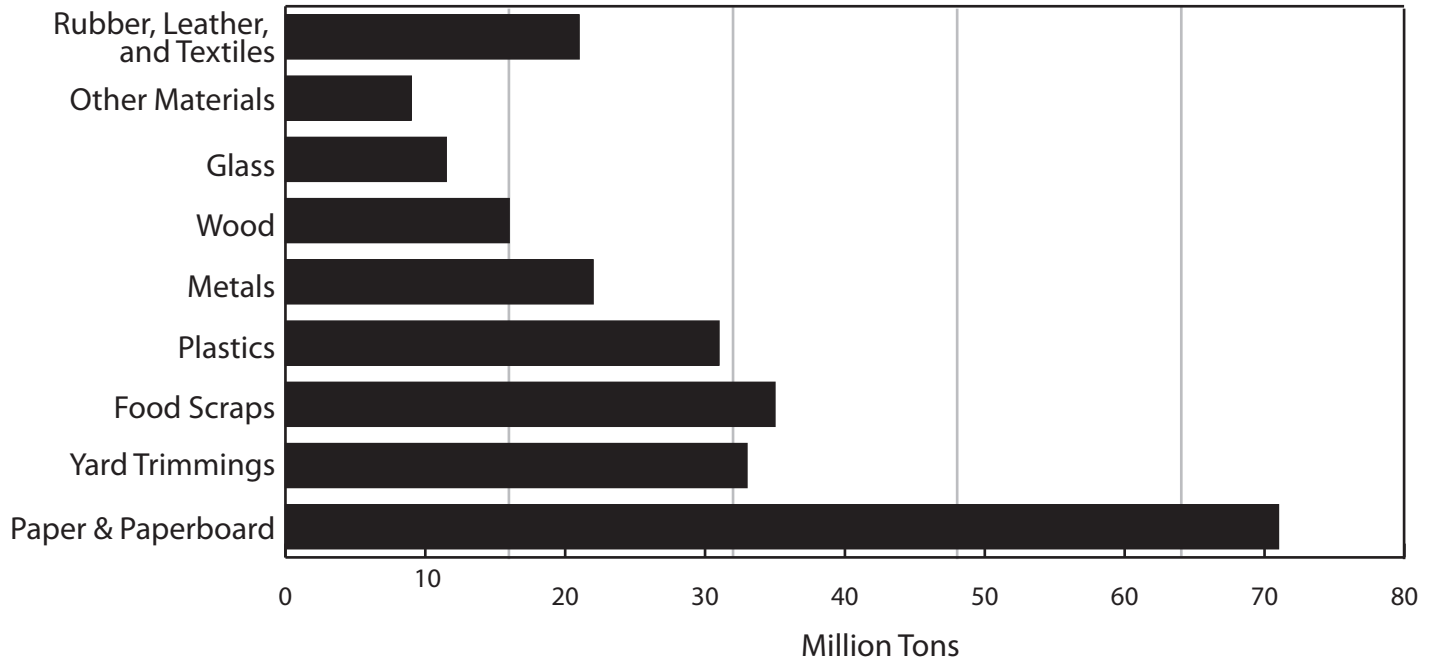


Data: EPA MSW Characterization Report



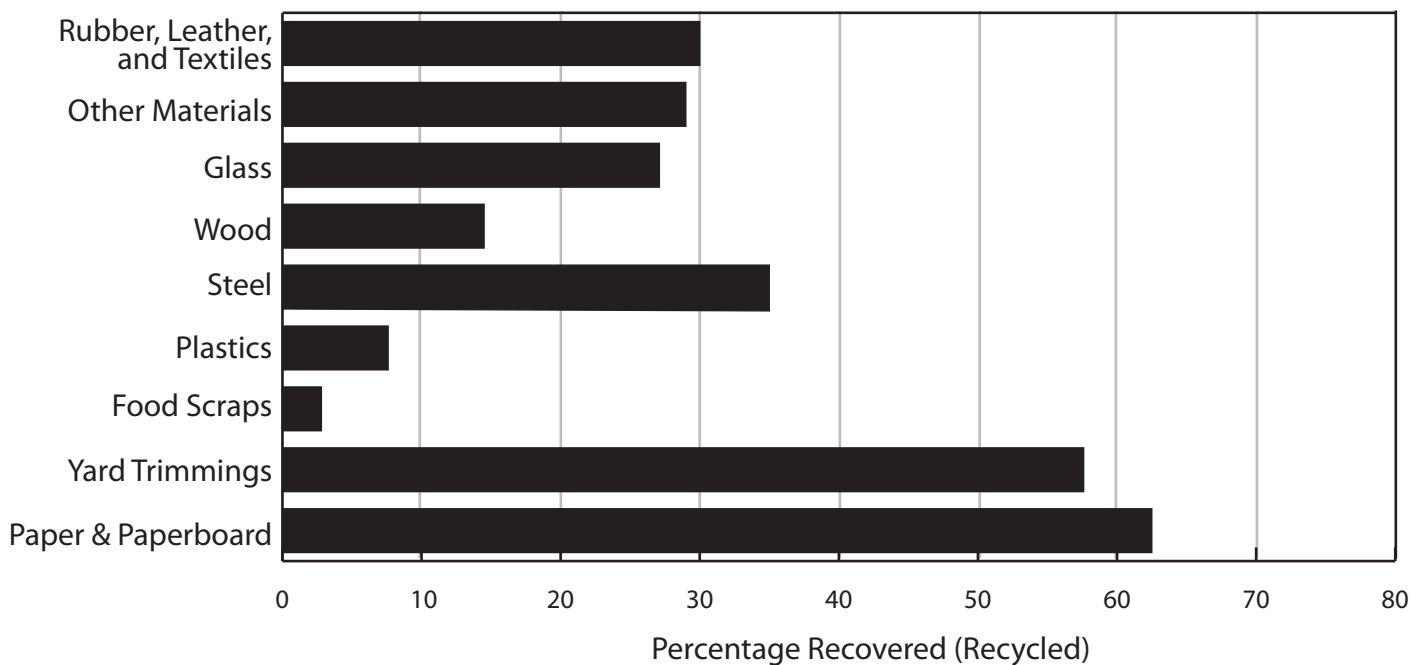
# Municipal Solid Waste Generation and Recycling

## Waste Generated by Weight, 2010



Data: EPA MSW Characterization Report

## Percentage of Waste Recovered (Recycled) By Weight, 2010



Data: EPA MSW Characterization Report