

## UNIT 9: ENERGY RESOURCES IN PAKISTAN

Power is needed at every step of human life, for example, to lift and transport material and people, and to run machines. Whereas in early times, humans, animals, wind and water, and then wood and coal provided this resource, today petroleum, natural gas, hydroelectricity and atomic energy are the main sources of energy. In addition, bio-mass, solar and wind power, and tidal and geo-thermal power are also used. All over the world power and energy are vital for development and progress in all fields.

Power resources can be classified as renewable and non-renewable sources of energy. Natural resources such as water, waves, wind, and solar power are renewable i.e. they will not run out although they may fluctuate. Mineral resources such as oil, gas, coal, and nuclear energy are non-renewable sources even though nuclear energy may last longer than the other three. This is because the energy derived from these resources is dependent on their reserves which have developed over millions of years but are being depleted very fast. This also leads to a rise in the cost of production as well as the price of consumption.

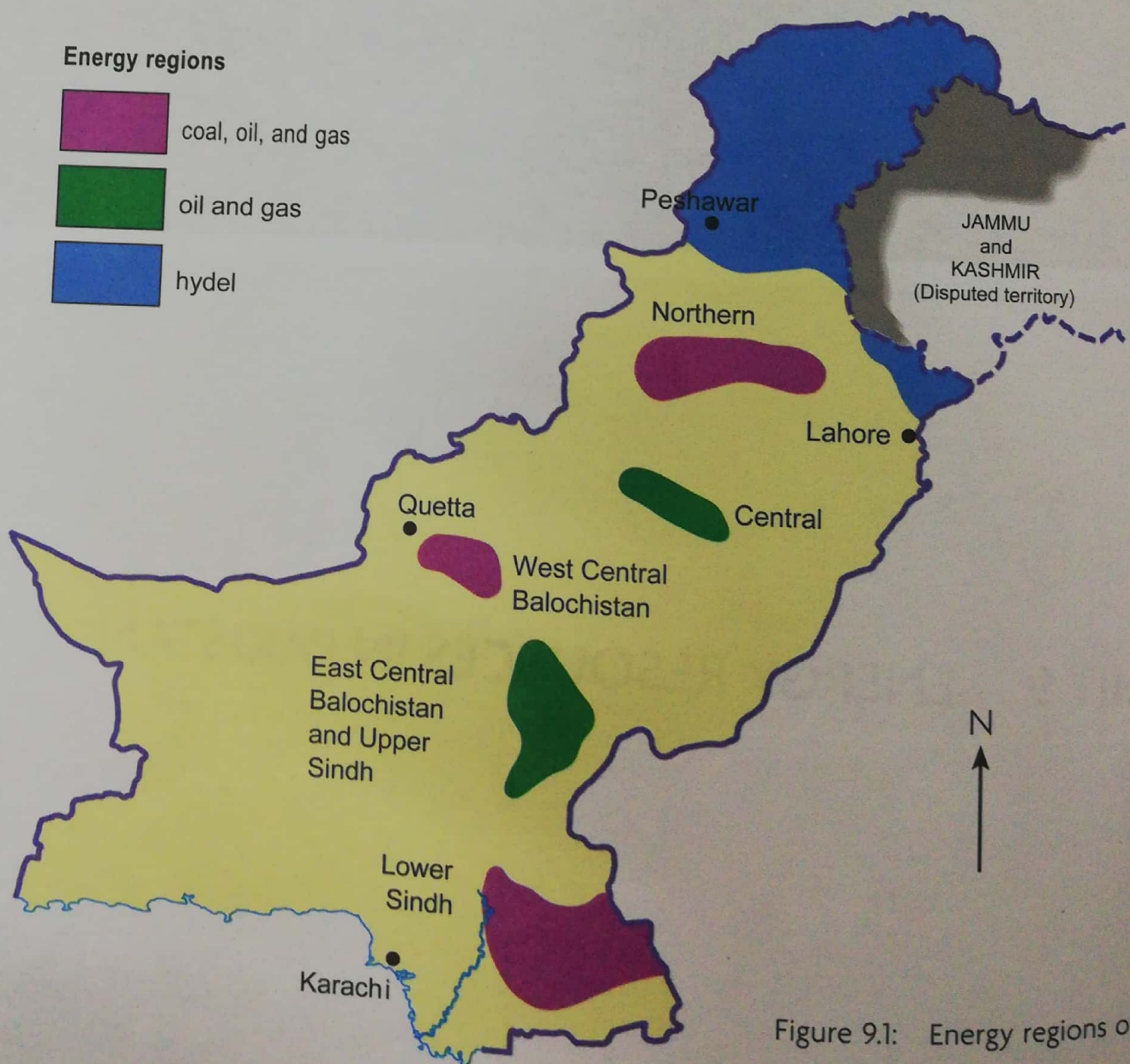


Figure 9.1: Energy regions of Pakistan



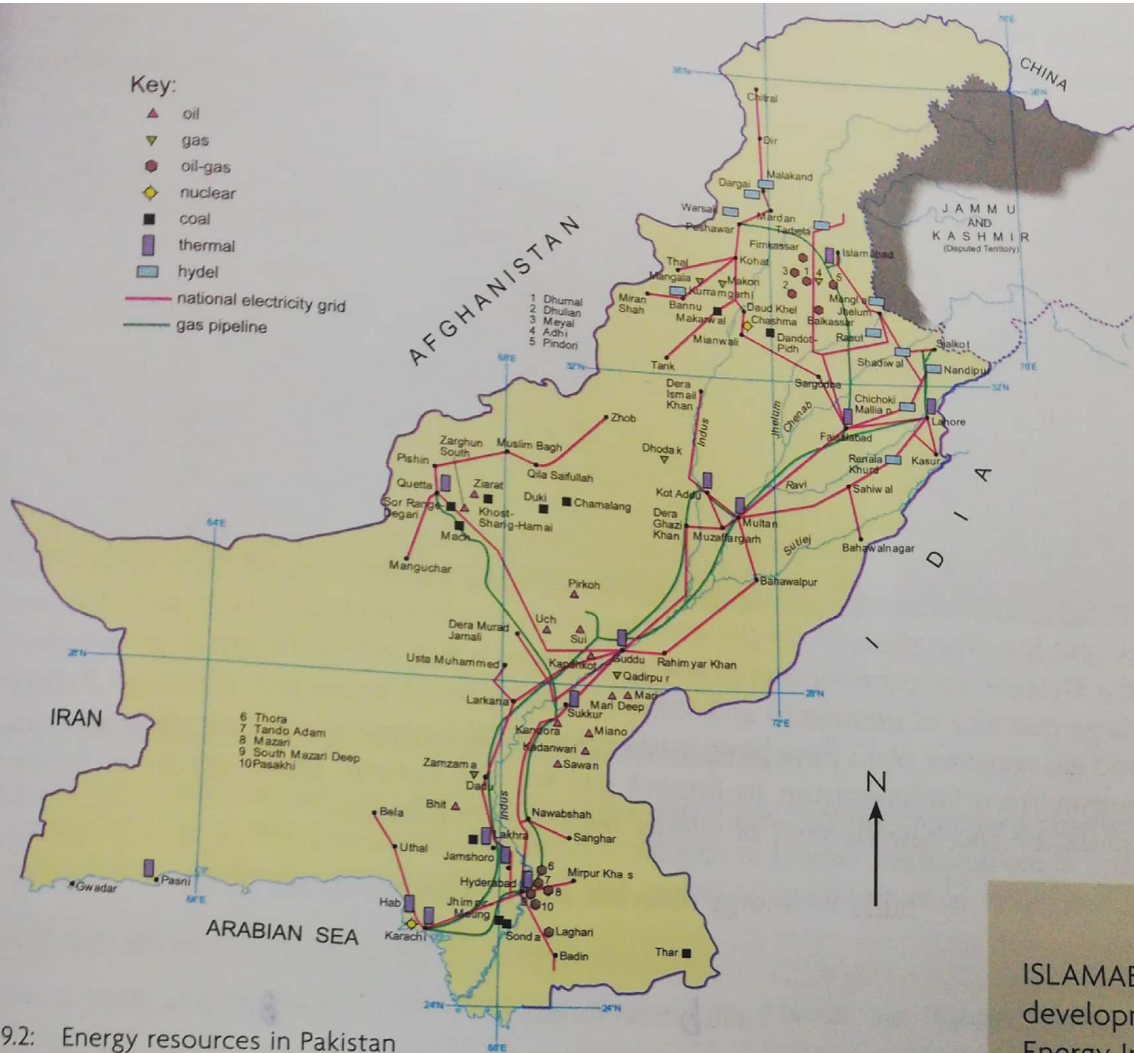


Figure 9.2: Energy resources in Pakistan

## Sources of energy in Pakistan

The primary sources of energy in Pakistan are gas, oil, hydro-electricity, and coal. Secondary energy sources are nuclear, LPG (Liquified Petroleum Gas), and CNG (Compressed Natural Gas). The use of solar power, wind power, and biogas are still in experimental stages.

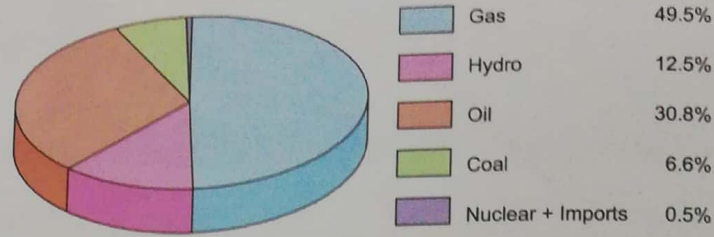
LPG is Liquified Petroleum Gas, and it is derived from fossil fuels, mainly natural gas. LPG is used most commonly in regions which do not have natural gas resources. In European countries, it is mostly used for heating and also for power generation and transport. LPG is stored in steel cylinders and can be transported by road, as is done in Pakistan, for domestic use in places like Gilgit which do not have access to piped gas supplies.

Compressed natural gas (CNG) is methane stored at high pressure, and is primarily used in place of petrol and diesel. It is found above oil deposits, and can also be collected from landfills or wastewater treatment plants, where it is known as biogas. CNG is stored and distributed in cylinders. It is mainly used in transport because of the lower price, and as a clean fuel, and is popular in South and South-east Asia, South America, and also in

ISLAMABAD: In a major development, the Energy Information Administration (EIA), the American federal authority on energy statistics and analysis, has estimated fresh recoverable shale gas reserves of 105 trillion cubic feet (TCF) and more than nine billion barrels of oil in Pakistan. Pakistan consumes 100% of the natural gas that it produces, so shale gas may be an area of future growth in Pakistan. (Published in *Dawn*, 28 August 2013)



Iran. The advantage of using CNG is that it is safer than other fuels in the event of a spill, because natural gas is lighter than air and disperses quickly when released, and it is a lesser threat to the environment than hydrocarbon fuels. Pakistan is the second among the top five countries in the world with the highest number of CNG-powered vehicles, namely Iran, Pakistan, Argentina, Brazil, and India.



Source: Pakistan Energy Yearbook, 2012

Figure 9.3: Percentage share of major sources of energy in Pakistan

Pakistan's consumption of energy is low compared to many countries of the world; it is 2.45 per cent less than the USA, 34 per cent less than Saudi Arabia, and 13.06 per cent less than India. Despite low consumption of energy, Pakistan is not self-sufficient in power resources. A large quantity of petroleum and some coal have to be imported. Although Pakistan has good gas reserves, plans have been made since 2008 for laying a gas pipeline from Iran and another from Turkmenistan to import gas for the future. More effort is needed for exploration and development of energy resources in Pakistan.

Table 19: Energy reserves and production (June 2012)

|             | Reserves                     | Production                    |
|-------------|------------------------------|-------------------------------|
| Coal        | 186 billion tonnes           | 3.61 million tonnes           |
| Natural gas | 56.01960 trillion cubic feet | 29.368777 trillion cubic feet |
| Crude oil   | 1052,383 million US barrels  | 710.451 million US barrels    |

Source: Pakistan Energy Yearbook, 2012

## Non-renewable resources

### Coal

Anthracite is classified as the best quality coal, bituminous as the next best, and lignite is regarded as a low quality coal. Pakistan's coal reserves are of poor quality lignite and sub-bituminous with low carbon content and a large quantity of ash, sulphur, and volatile matter, hence most of it is used in brick kilns. Coal mining in this region dates back to 1887; the coal seams are lean, with an average width of 0.3 to 0.9 metres. In 2009 the total coal reserve was estimated at 186 billion tonnes of which 175 billion is found in the Thar coalfield in Sindh.

There are three major coal-producing regions in Pakistan.

- i) The Salt Range and the Makarwal-Gullakhel coalfields
- ii) Coal deposits in Balochistan
- iii) Lower Sindh coalfields

### **i) The Salt Range and the Makarwal-Gullakhel coalfields**

The Salt Range coalfields extend over a large area; Dandot and Pidh are important coalfields. The quality of coal in the Makarwal-Gullakhel coalfields in Khyber Pakhtunkhwa is better than that of the Salt Range. The coalfields of this region are well served by railways.

### **ii) Coal deposits in Balochistan**

The three main coalfields in Balochistan are Khost-Sharig-Harnai, Sor Range-Degari, and Mach.

Khost-Sharig-Harnai is the largest and has the highest output in Pakistan. It has some coking properties, and after treatment it is turned into coke. Sor Range-Degari, an important coalfield, is 16 km east of Quetta. It has sub-bituminous coal containing ash and sulphur. The Mach coalfield, located 55 km north of Quetta on both sides of the Sibi-Quetta railway, also has coal of inferior quality. A large coalfield has been discovered at Chamalang with proven reserves of five million tonnes, while estimated reserves may go up to 25 million tonnes or more. The quality ranges from lignite to highly bituminous; presently only good quality coal is being mined.

### **iii) Lower Sindh coalfields**

The Lower Sindh coalfields account for 96 per cent of the total coal reserves of Pakistan. The Lakhra coalfield is located north of Hyderabad, and the Jhimpir-Meting, south of Hyderabad. The Sonda-Thattha coalfield occupies both banks of the Indus River, south of the Jhimpir-Meting coalfield. All these coalfields are small and have poor quality coal.

The Thar coalfield, discovered in 1992, carries 94 per cent of the total coal reserves of Pakistan but it contains poor quality coal located at a great depth; it is also far from the railway lines.





Figure 9.6: A brick kiln in Punjab

### Uses of coal

The coal in Pakistan is used largely in brick kilns as briquettes (a block of compressed coal dust used as fuel) and also in cement factories. A small quantity from Khost-Sharig-Harnai mines, after treatment, goes to the Pakistan Steel Mills in Karachi. Coal with coke properties is converted into coke for industrial purposes, and coal is also used to generate electricity. Most of the coalfields of Pakistan are well served with roads and railways, except for the Thar coalfield. The proposal is to generate and transmit electricity from Thar rather than transport the coal. Nonetheless, the coalfield should have a good transport link.

Since the coal quality in Pakistan is generally unsuitable for industrial use other than in brick kilns or for thermal power plants, bituminous coal is imported from India, Australia and Brazil.

### Petroleum

Some parts of Pakistan, being covered with marine sedimentary rocks, have geological conditions favourable for the formation and extraction of oil. In 1961, the Oil and Gas Development Corporation was set up to organize and undertake the exploration, development, production, refining, and sale of oil. In 1991, the first petroleum policy was framed by the government, with the objective of giving financial concessions to foreign firms to explore and develop oil reserves in Pakistan. As a result, several foreign petroleum companies are now working in the country. Recently, a foreign firm has been granted concession to explore for oil in the coastal waters off Pakistan along with state-owned Pakistan Petroleum Ltd.

### Production and consumption of petroleum

Oil exploration and production of petroleum in Pakistan have gradually increased over the years since the 1950s. Table 20 below shows petroleum production and consumption data from 2003 to 2012. However, despite the increase, oil imports are still required as Pakistan's oil production meets less than 25 per cent of its needs.

Table 20: Crude oil production, import, and consumption data, 2003–12 (tonnes)

| Year    | Production | Import    | Consumption | % of production |
|---------|------------|-----------|-------------|-----------------|
| 2003–04 | 3,035,275  | 8,101,783 | 13,817,797  | 22              |
| 2004–05 | 3,235,683  | 8,557,073 | 15,076,964  | 21.4            |
| 2005–06 | 3,211,112  | 8,891,269 | 14,988,128  | 21.4            |
| 2006–07 | 3,302,216  | 8,504,072 | 17,141,959  | 19.2            |
| 2007–08 | 3,434,811  | 8,708,331 | 18,438,785  | 18.6            |
| 2008–09 | 3,224,215  | 8,333,105 | 18,226,171  | 17.7            |
| 2009–10 | 3,180,326  | 7,121,119 | 19,431,286  | 16.3            |
| 2010–11 | 3,225,269  | 6,883,073 | 19,185,600  | 16.8            |
| 2011–12 | 3,296,661  | 6,319,342 | 19,027,701  | 17.3            |

Source: Pakistan Energy Yearbooks, 2009, 2012

Mining in Pakistan, especially coal mining, is a dangerous job as safety procedures are often neglected and accidents are quite common.

- On 21 March 2011 at least 45 miners died due to an explosion in a coal mine in the Surran Range, about 35 km east of the provincial capital, Quetta.
- On 14 February 2011, two Chinese engineers died in a chromite mine collapse in Qila Saifullah, Pakistan.
- On 27 January 2013, eight miners were killed by a methane leak in a coal mine in Duki, near Quetta.
- On 11 November 2013, three coal miners were killed by a trolley accident in Loralai District, Balochistan.



Crude oil, petroleum, and petroleum products remain one of Pakistan's top import items. From 2003 to 2012, Pakistan imported over 70 million tonnes of petroleum valued at a total of US\$ 45,320.44 million.

The bulk of oil is consumed by the transport and power sectors. The average shows that nearly 50 per cent is consumed by transport, about 40 per cent by power, followed by 7 to 9 per cent by agriculture, and the remaining amount by domestic and government users.

The pie graphs below show the comparative extent of consumption by sector since 2003 to 2012; whereas transport and power sectors remain high consumers, the other sectors' usage has considerably decreased.

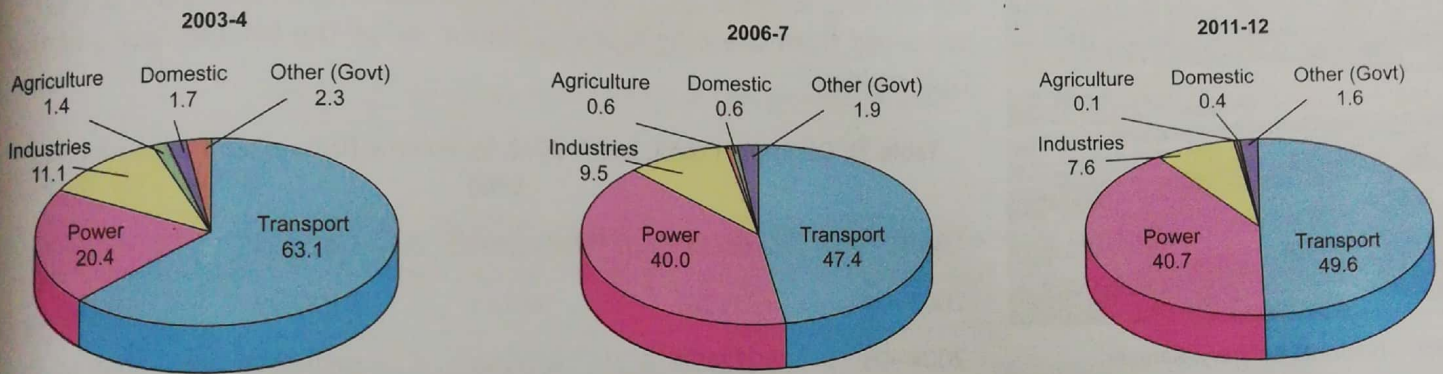


Figure 9.7: The comparative extent of petroleum consumption by sector (percentage wise)

## Oilfields

The two main oil-producing regions in Pakistan are Lower Sindh and the Northern Region both of which have several oilfields; however, these are all fairly small and several have already been depleted. Unless new fields are discovered and exploited in the near future, oil production in Pakistan will dwindle. The Lower Sindh Oilfields, which produce more than 60 per cent of the total petroleum output of the country, emerged as an important petroleum-producing region in 1981, with the discovery of the Khaskheli Oilfield in Badin District; thereafter, about 20 oilfields were discovered in quick succession. The Northern Region was identified as an oil-producing region in 1915, with the discovery of the Khaur Oilfield. Since then, a number of other oilfields have been discovered in the region. The Energy Yearbook 2009 listed 125 oilfields altogether in Pakistan; the number has risen to 150 (Energy Yearbook 2012). The drilling and extraction of oil is carried out by local as well as foreign organizations.

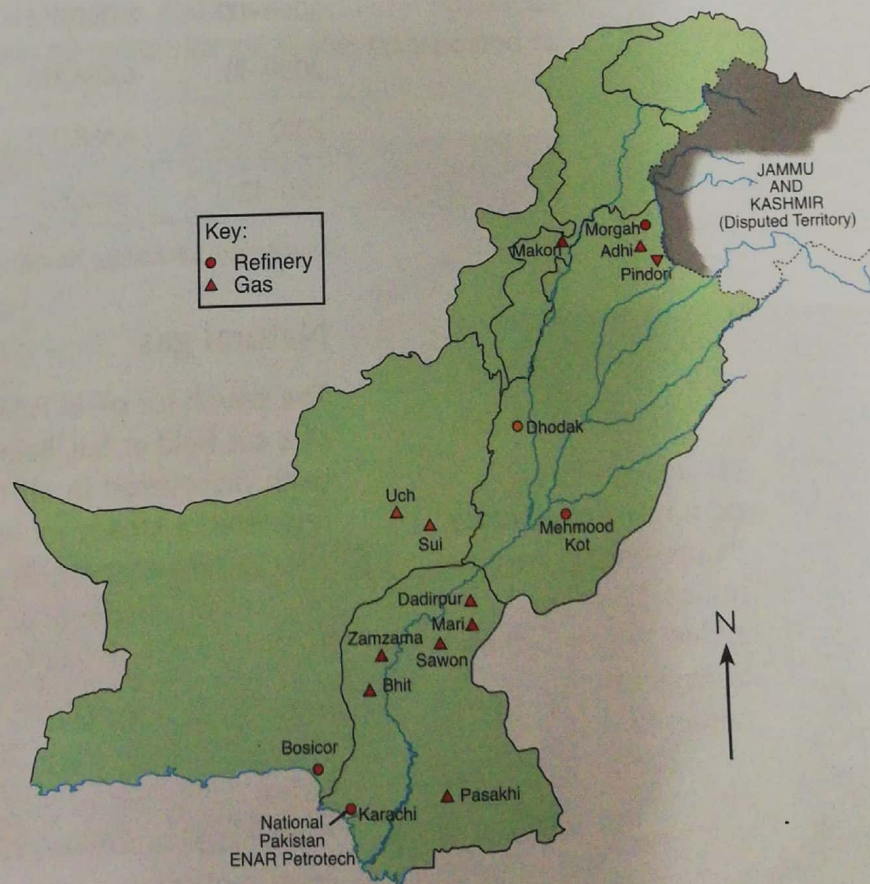


Figure 9.8: Gas and oil fields and refineries in Pakistan





Figure 9.9: National Refinery, Karachi

### Oil Refineries

There are seven main oil refineries in Pakistan (Source: Pakistan Energy Yearbooks, 2009, 2012). The small Attock Refinery at Morgah, Rawalpindi, is the oldest and refines the oil produced in the Potwar Plateau. The Dhodak Refinery is located in Punjab. The Pak-Arab Refinery, Pakistan Refinery, and National Refinery are located in Karachi. They refine oil produced in Lower Sindh as well as imported oil. The Bosicor Refinery is in Hub, Balochistan, adjoining Karachi, and a large refinery has been built at Mahmood Kot, Muzaffargarh District in Punjab.

However, since oil is a major component for thermal power and transport, the existing reserves and production in Pakistan are inadequate and oil is imported from the oil-producing countries of the Middle East and the Gulf regions.

Table 21: Oil import data, 2003–2012, by volume (tonnes) and value (million US\$)

| Year    | Crude oil | Petroleum | Products   | Value   |
|---------|-----------|-----------|------------|---------|
| 2003–04 | 7,835,261 | 1801.4    | 5,169,645  | 1317.53 |
| 2004–05 | 8,277,300 | 2605.58   | 5,675,985  | 1998.26 |
| 2005–06 | 8,600,570 | 3802.81   | 6,009,401  | 2848.62 |
| 2006–07 | 8,226,032 | 3776.74   | 8,239,859  | 3671.36 |
| 2007–08 | 8,423,613 | 5740.86   | 9,025,089  | 6205.97 |
| 2008–09 | 8,060,655 | 4243.71   | 9,974,184  | 5197.00 |
| 2009–10 | 6,888,295 | 3850.51   | 11,178,100 | 6144.59 |
| 2010–11 | 6,658,032 | 4685.59   | 12,370,887 | 8507.11 |
| 2011–12 | 6,112,732 | 5119.78   | 11,507,216 | 9430.00 |

Source: Pakistan Energy Yearbooks, 2009, 2012

### Natural gas

The search for oil in Pakistan resulted in the accidental discovery in 1952 of a gas field at Sui, Balochistan. Since then, a number of gas fields have been discovered in all the provinces of Pakistan. Gas production has registered a steady increase. In 1999–2000, the total natural gas output was 23,159 million cubic feet, 5.6 times what it was in 1971. The gas production figures have increased from 875,308 million cubic feet in 2001–02 to 1,400,025 in 2005–06 and close to 1,600,000 in 2011–12.

Natural gas is the second largest source of energy in Pakistan. If imported petroleum is set aside, natural gas becomes Pakistan's foremost domestic fuel. In 1999, Pakistan's estimated natural gas reserves were approximately 492 billion cubic metres. This will last for 25 years at the present rate of consumption.

FACTS AND FIGURES

Natural gas has no odour or smell, hence its presence is hard to notice. Odorizer is added to gas so that its leakage can be detected.



## Consumption of gas by sector

Although gas is consumed by various sectors, the energy sector is the largest consumer. In 2011–12, this sector consumed 27.8 per cent of the total natural gas output, followed by the fertilizer industry, 14.4 per cent; household, 20.3 per cent, other industries, 23.1 per cent, commercial sector, 3.1 per cent and transport 9.2 per cent (CNG).

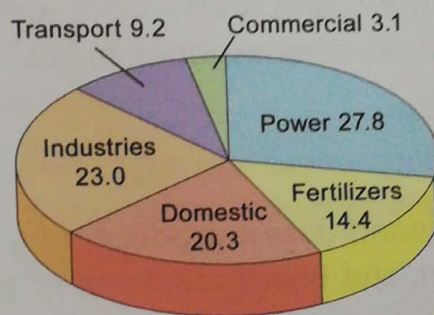


Figure 9.10: Consumption of gas by sectors (percentage wise)

## Major gas fields

The main natural gas regions in Pakistan are i) East Central Balochistan and Upper Sindh, and ii) Lower Sindh, and there are ten active gas fields in Punjab and five in Khyber Pakhtunkhwa.

### i) East Central Balochistan and Upper Sindh

This is the major gas-producing region of Pakistan where the Sui Gas Field, at the foothills of the Marri-Bugti Hills in Balochistan, is the oldest and most productive gas field in the country. The gas, which is of good quality with 90 per cent methane content, is found in the limestone in that area; it is transported by pipeline to Karachi via Sukkur and Hyderabad. Another pipeline goes to Lahore via Rahimyar Khan, Multan, and Faisalabad. From Faisalabad a pipeline goes to Rawalpindi, Islamabad, Wah and Peshawar. Sui gas is also transported to Quetta.



The Pirkoh Gas Field, discovered in 1977, went into production in 1983–84. It is a large field located about 100 km north of Sui. Gas from Pirkoh is fed into the Sui transmission line. Zin and Uch are two other gas fields in Balochistan close to Sui.

Marri, the second-largest gas field in Pakistan, is in Upper Sindh and was discovered in 1957. Marri gas has 73 per cent methane content and is used primarily in the production of fertilizer at Daharki, Mirpur Mathelo, and Machi Goth. Other important gas fields in the region include Kandhkot, which was commissioned in 1987 and supplies gas to the Guddu Thermal Plant and Khairpur.

## ii) Lower Sindh

The Lower Sindh region is the second-largest producer of gas in Pakistan. Khorewah, South Buzdar, Turk, Turk Deep, Bulchari, and Bhatti are some of the important gas fields in this area.

## iii) The Northern Region

Punjab and Khyber Pakhtunkhwa are the third gas-producing regions in Pakistan. Dhodak, Adhi, Pindori, Meyal, and Balkassar are some of the fields in Punjab. In Khyber Pakhtunkhwa, two more gas fields in Shakardarra, Kohat District, and Gurguri, Karak District have started production.