

# India's Energy Security: Challenges for a Growing Economy

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## **India's Energy Consumption**

Consumes 3% of world energy.

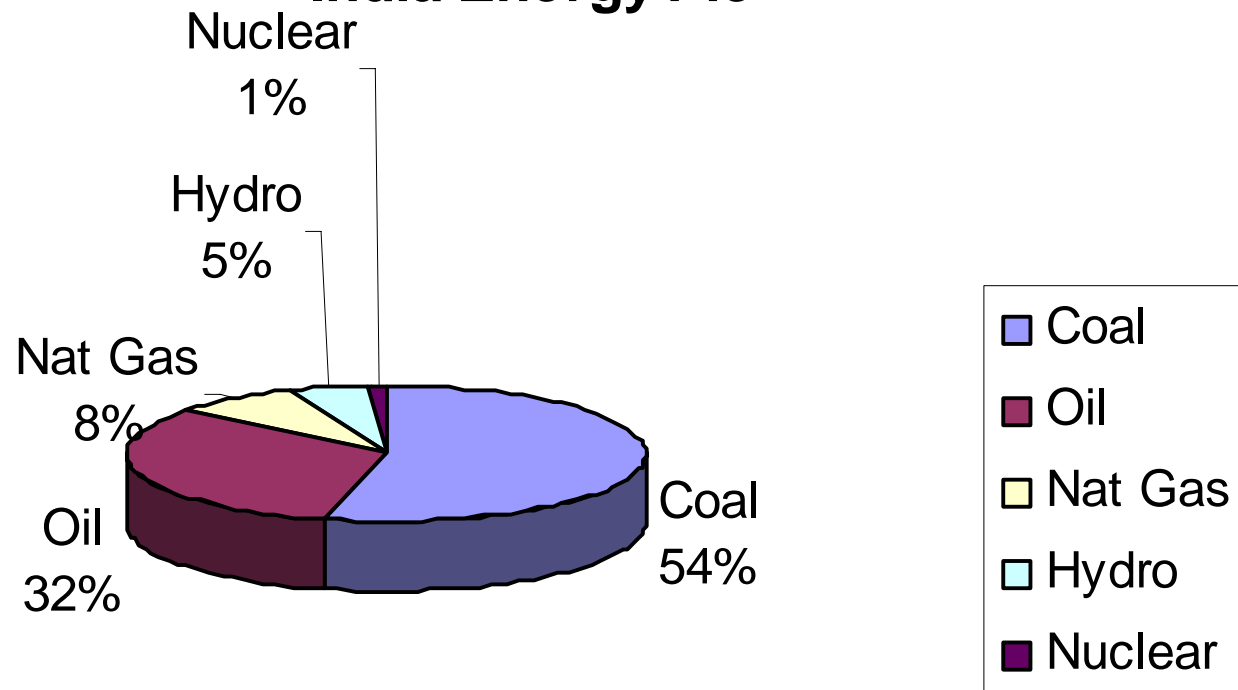
Soon will be the world's fourth largest consumer of oil, currently is the sixth.

Electricity generation, industry, transportation, household.

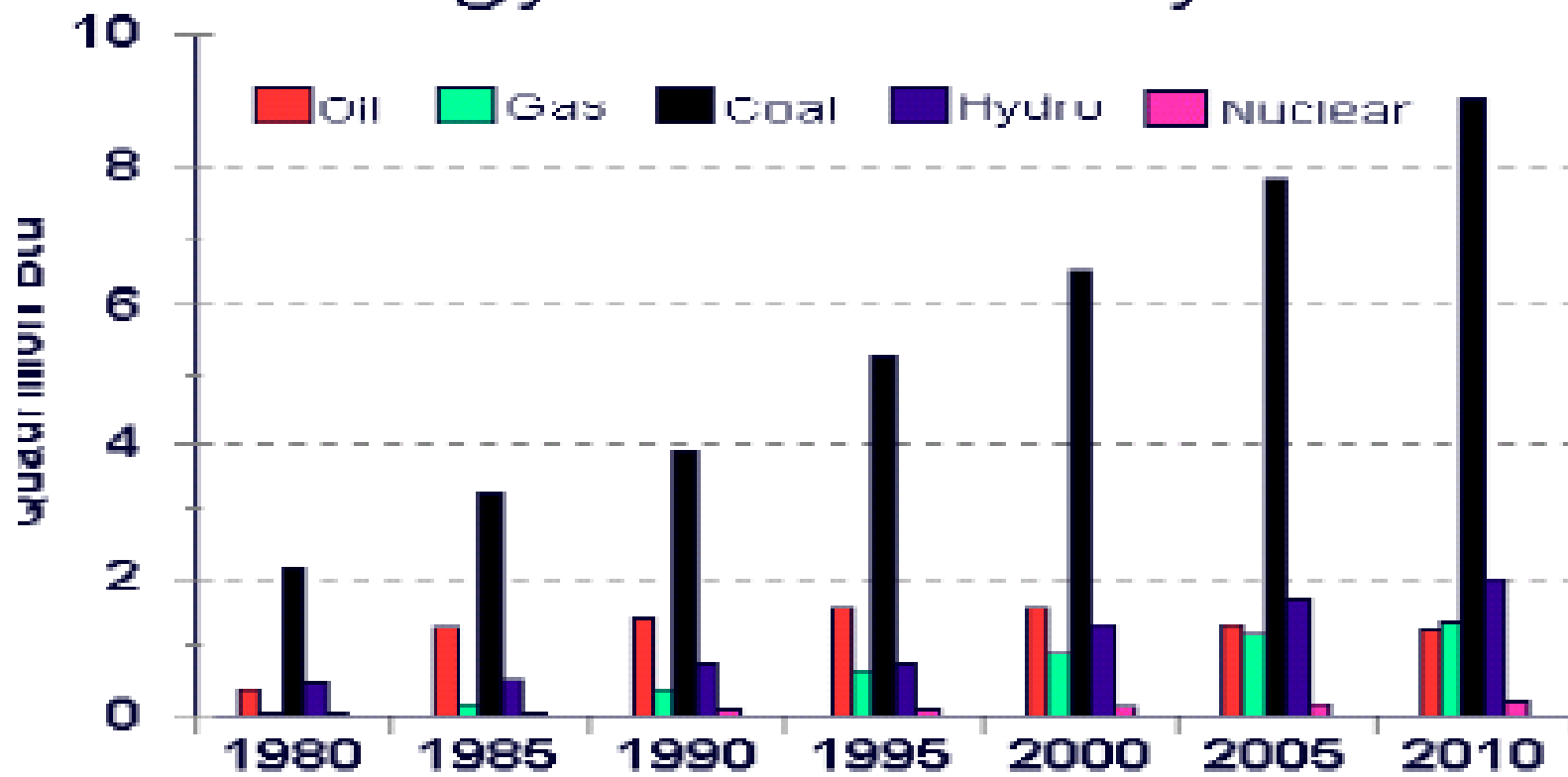
Population, economy and quality of life.

A growing economy needs a reliable energy supply. For the economy to grow at 9%, the power supply would have to grow by 12%.

## India Energy Pie



# Energy Production by Fuel



Source: U.S. Energy Information Administration

## **Energy Security:**

Supply disruptions, independence from imports and price volatility, and energy needs of individuals.

No large primary energy source.

Poor maintenance of electric transmission lines.

No comprehensive energy policy. Ad hoc cluster of policies.

Institutional fragmentation: Ministry of Petroleum and Natural Gas, the Ministry of Coal, the Ministry of Non-Conventional Energy Sources, the Ministry of Environment and Forests, the Department of Atomic Energy, and the Ministry of Power.

Risk: supply, market, technical.

## **Politics of Energy**

Realist turn in foreign policy. “Enlightened self-interest.”

Broader conception of security: energy interests part of military and foreign policy.

Economic considerations in foreign policy decisions.

Energy cooperation: bilateral.

Pipeline diplomacy.

Realities of the globalized world.

Changing geopolitics- multinational corporations rather than nation states.

Transit fees to countries.

Diversification.

Confidence-building measure: France-Germany, US-China, China-Taiwan, Japan-China: spillover effect economic to political.

Conventional sources:

Oil

Gas

Coal

Renewables:

Hydro

Solar

Nuclear

## **Petroleum**

Current 32%. Demand expected to increase by 2.4% annually.

Reliant on imported oil: 68%; 60 % comes from the Persian Gulf, a politically volatile region. Leaves the country at the mercy of foreign nations.

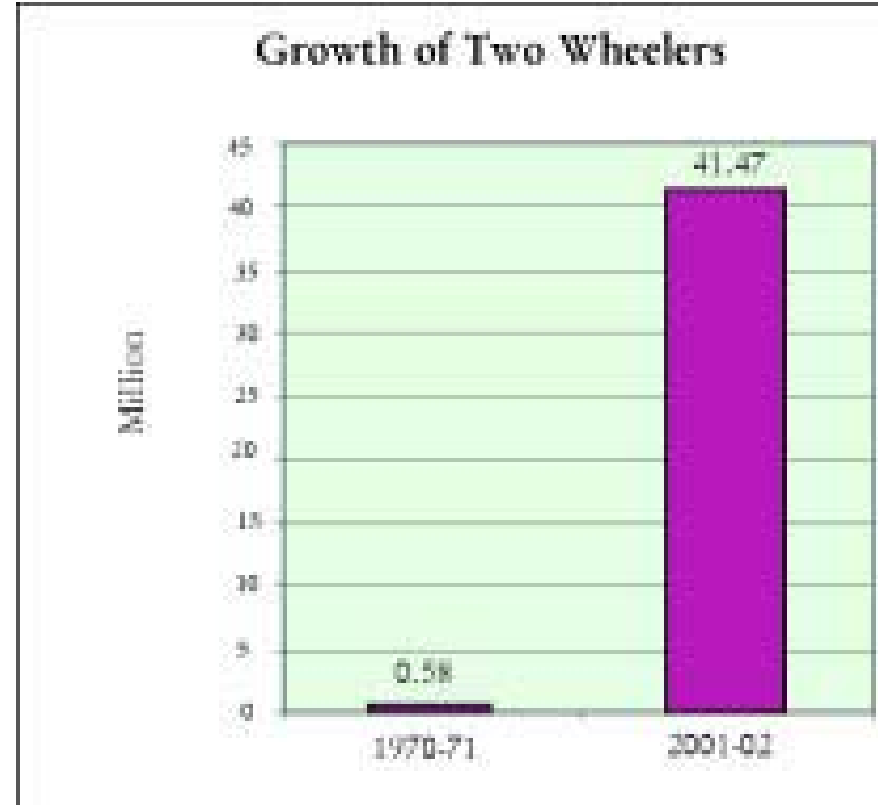
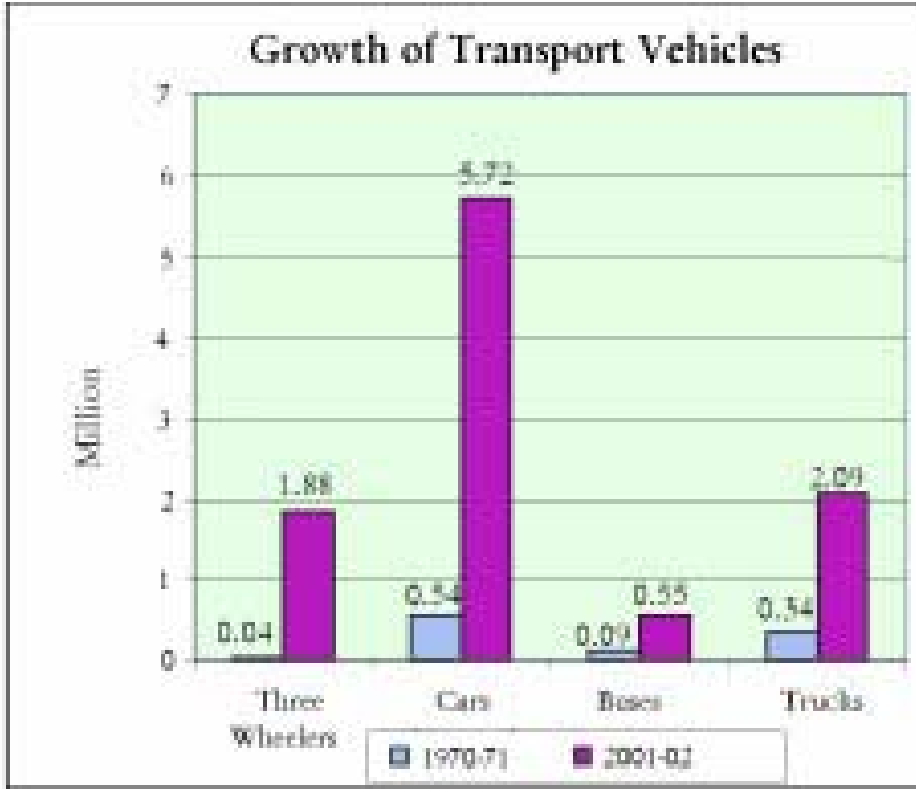
Fluctuating prices: A rising oil imports bill accounts for almost one-half of the country's trade deficit.

Automobiles: In 2003-04 5.7 million, expected to reach 200 million by 2030.

Increased exploration.

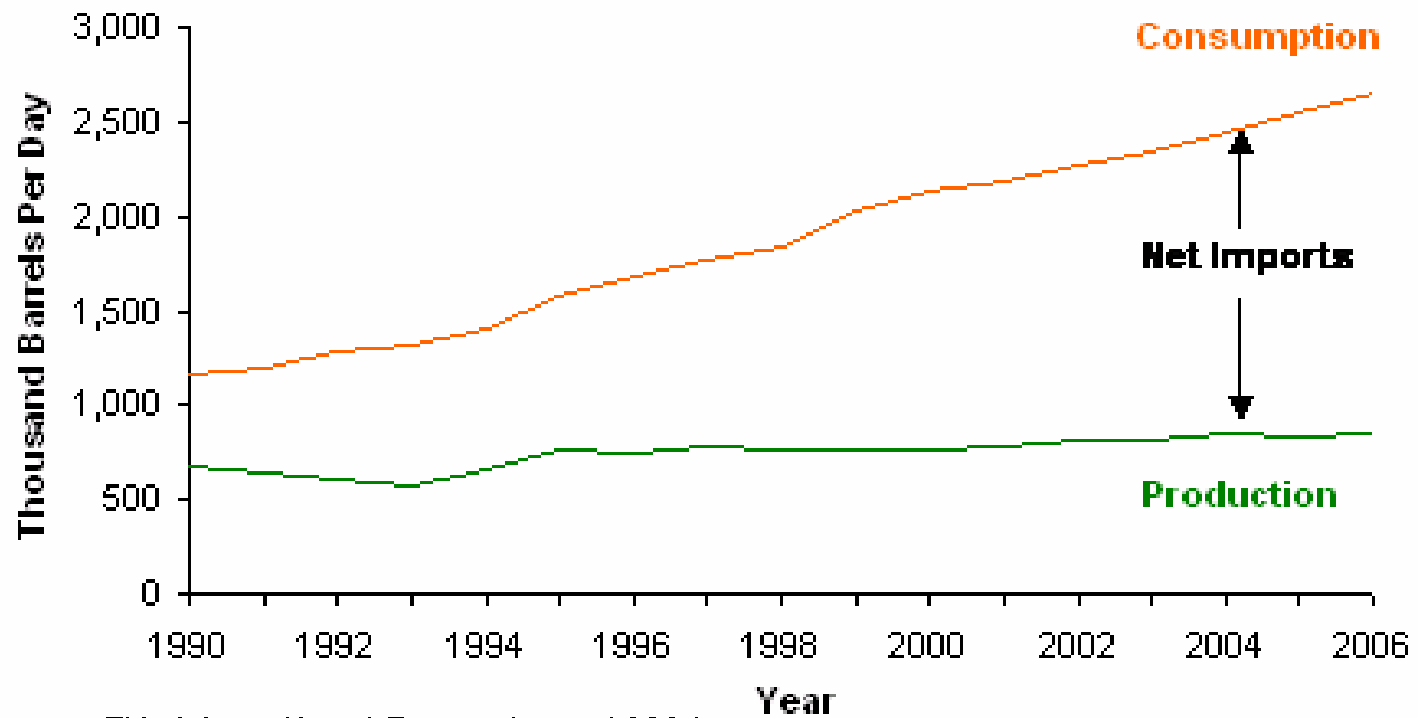
Currently 0.4% of the world's proven reserves. Will last 7 years.

# Growth in Vehicles



Source: Centre for Monitoring Indian Economy Pvt. Ltd. (CMIE)

## India's Oil Production and Consumption, 1990-2006\*



Source: EIA *International Energy Annual 2004*;  
*Short-Term Energy Outlook* (Jan. 2007)

\*2006 is estimate

Indian firms' investment in overseas oilfields: ONGC Videsh holds interests in 25 oil and natural gas projects in 15 countries, spanning Africa, Asia, Latin America, and the Middle East.

Projected to reach \$3 billion within a few years.

Sudan: \$750 million invested in oil.

Nigeria: purchase about 44 million barrels of crude oil per year on a long term basis.

Syria: contract for the exploration, development and production of petroleum with a Syrian company.

Sakhalin, Russia, and Vietnam and Myanmar in Southeast Asia are also potential suppliers to the Indian market.

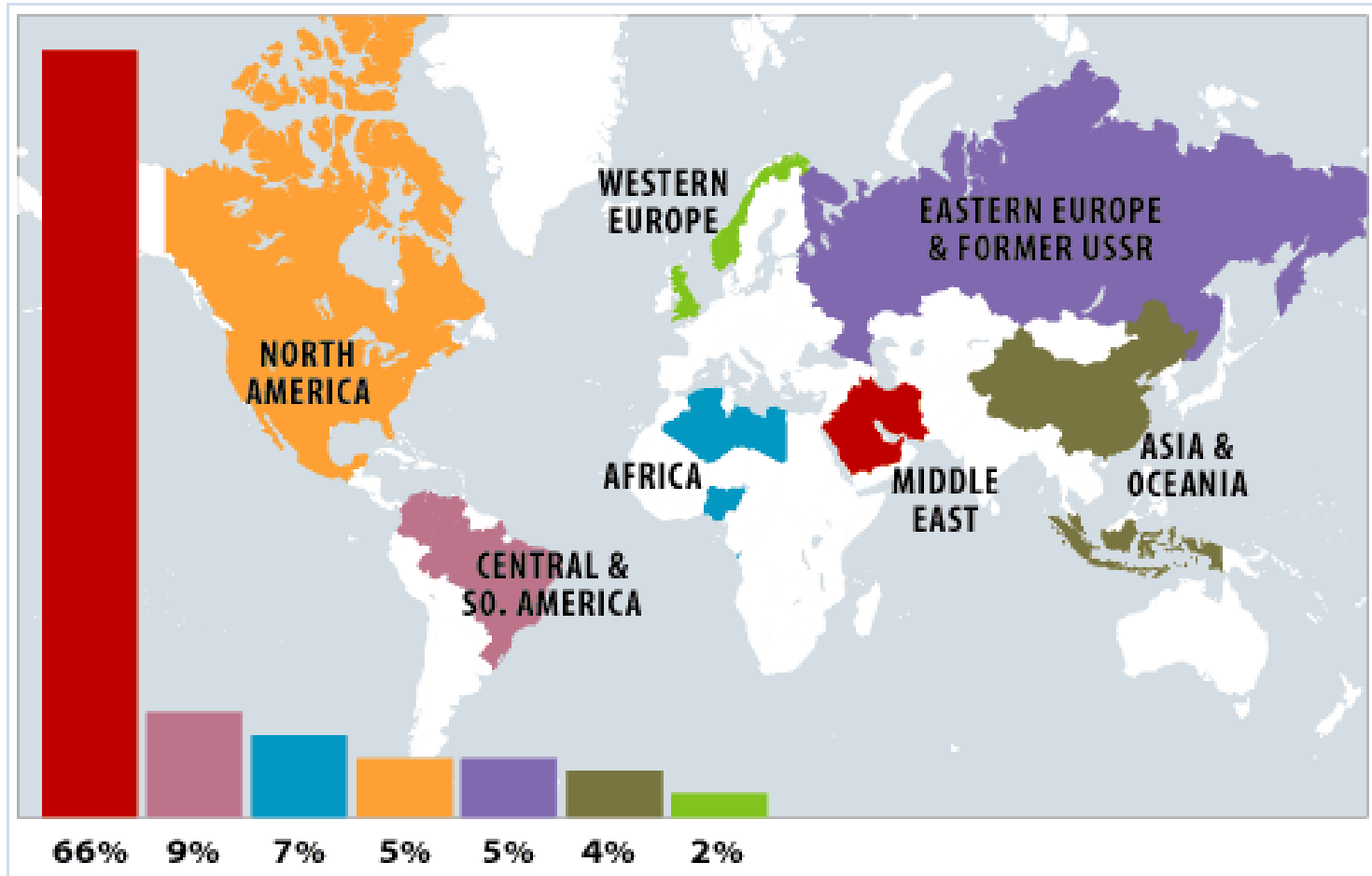
Caspian Basin: gain a foothold.

Tajikistan: stationed troops, provided \$40 million aid package and refurbished an air base near the capital Dushanbe.

Also pursuing relations with Kazakhstan, Azerbaijan and Iran.

Use of soft power.

## Where Are the World's Oil Reserves?



Many of these countries are known for severe violations of human rights, sponsorship of terrorist activities, and general misuse of oil revenues.

Direct competition with fellow Asian countries like China and Malaysia.

Contributes to accelerating global depletion of non-Middle East oil reserves, and will lead to increasing dependence on the Middle East.

Thus economy highly vulnerable to supply disruptions.

Building a strategic crude oil reserve facility on its southern and eastern coasts.

## **Coal**

Accounts for 54% of the country's energy need.

Domestically available; regionally concentrated.

Stable prices.

Electricity generation is predominantly coal-based.

Fourth largest producer of coal in the world next only to China, the US and Australia.

Will last only 40 years at the current rate of consumption.

Transportation and mining costs.

High ash content (SPM) and low calorific value but low sulphur.

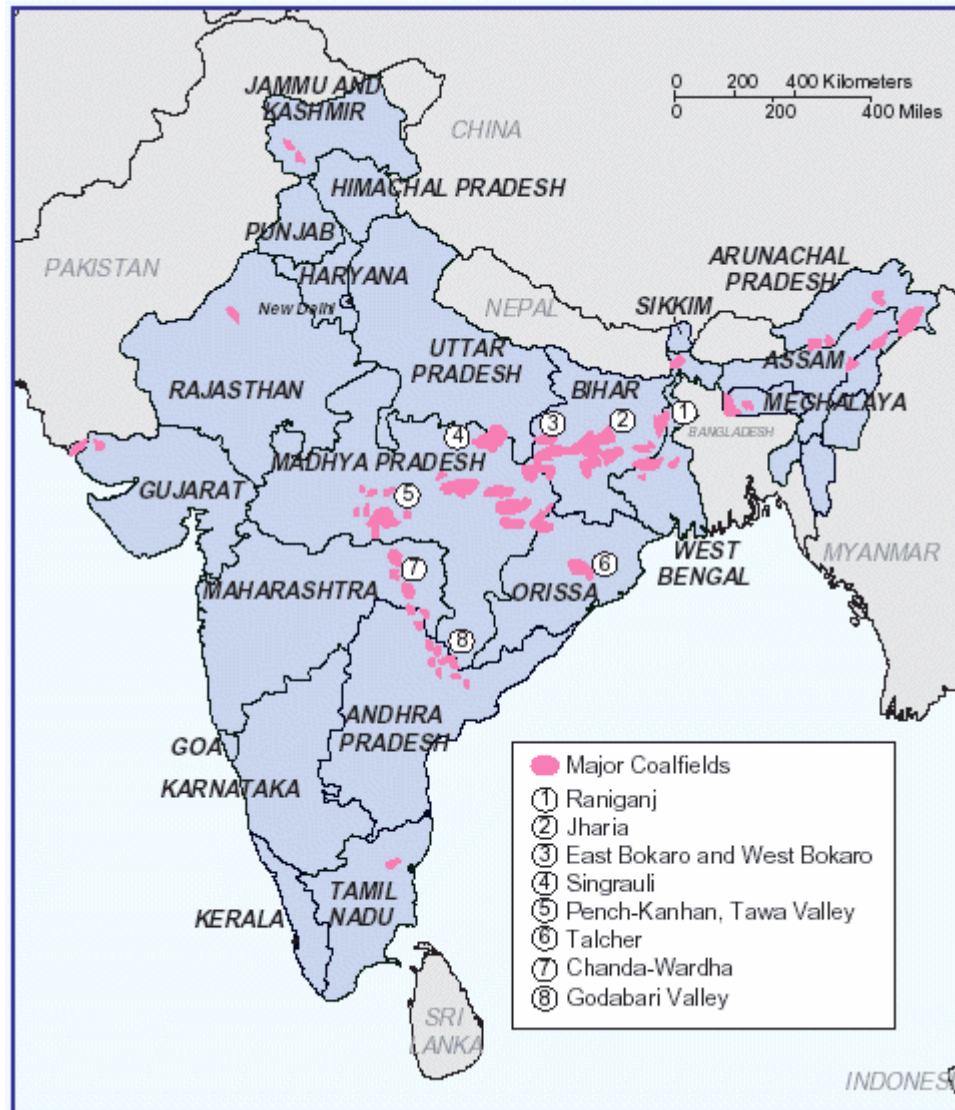
Increase in carbon emissions.

Environmental consequences.

Average age of coal burning plants is 25 years and many facilities are outdated.

The Naxalite rebellion is strongest in states that have coal reserves. The five states in which the movement is strongest account for 85% of India's coal deposits.

# India Coal Reserves



## **Natural Gas**

Supplies 8% of the country's energy needs.

More reserves being discovered each year.

Preferred fuel in the future, use expected to grow at 5% per year.

Unlike oil, trade in natural gas unregulated, room for fixing prices through long-term contracts.

Imported LNG from Qatar.

High capital requirement.

Natural gas pipeline from Burma: Main opposition from Bangladesh.

Pipelines to import gas into India from Iran, Oman, and Bangladesh.

The Oman-India: \$7 billion price tag, a possible shortage of reserves, and the difficulties of building a submarine pipeline in deep waters (3.5 kilometers).

Bangladesh-India submarine pipeline: \$1.2 billion that would run from Bangladesh to the Vishakapatnam-Kakinada coast in Andhra Pradesh, India, and connect to an above-ground pipeline that would extend to Delhi via Calcutta.

\$2 billion pipeline from Myanmar through Bangladesh to Haldia in India.

## **India-Pakistan-Iran pipeline**

Indo-Iran pipeline: overland route, deep sea.

Iranian gas cheaper. Iran has 16% of world reserves.

1835 kms long; 800 through Pakistan.

Initially carry 60 million cubic metres of gas, split equally between Pakistan and India .

Cost \$7 billion; Pak \$8 billion transit fees, \$1 billion taxes and savings in energy \$5 billion.

In case of supply disruptions- Iran guarantee as supplier same amount of LNG.

International consortium.

Baluchistan.

US: Turkmenistan-Afghanistan-Pakistan-India line.

In-principle agreement on transportation charges.

Gas priced at \$4.93 (mBtu), basis of pricing for the entire 25-year duration of the contract.

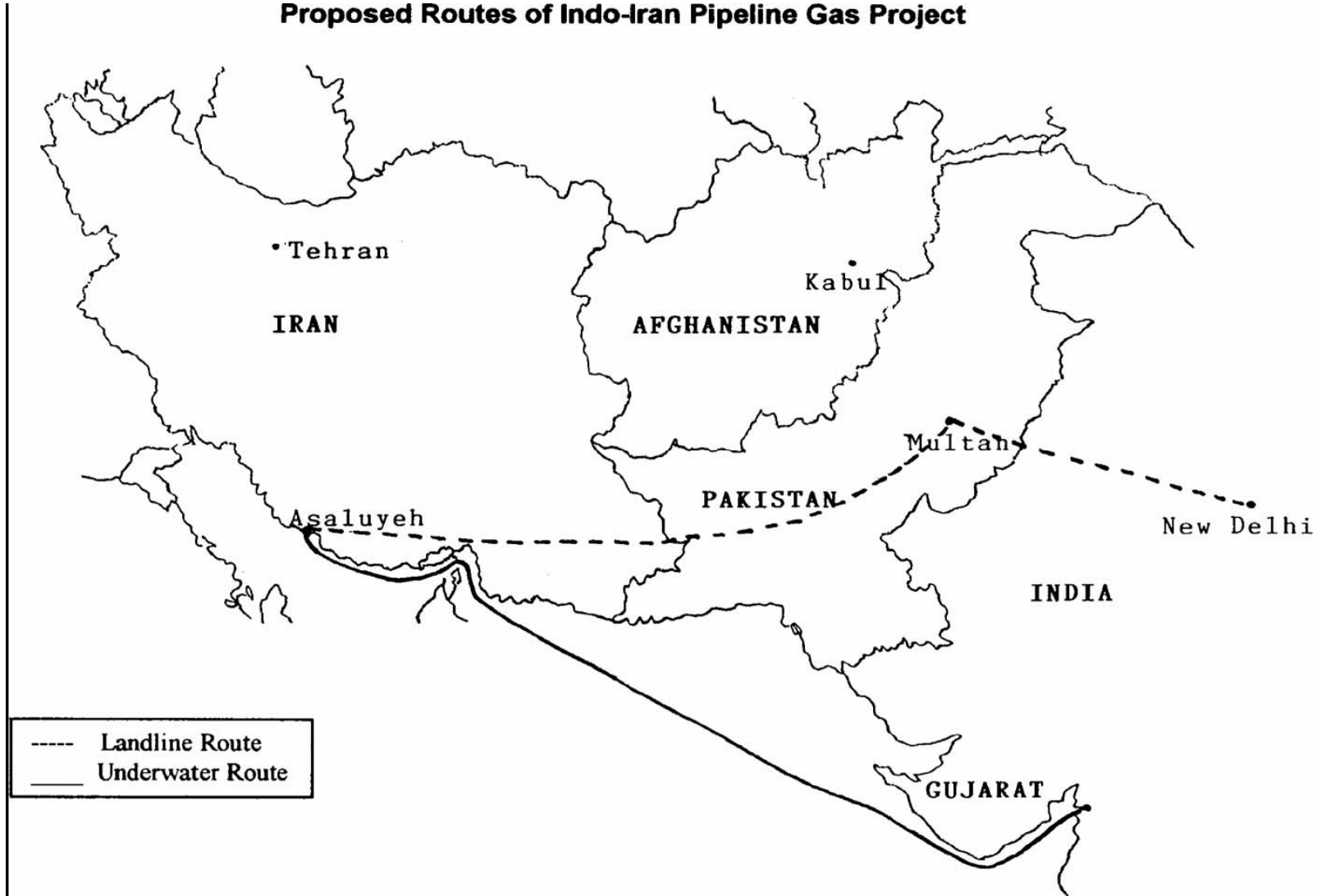
Iran: revision in the price every three years.

Transportation costs: Pakistan \$0.70-0.75 per mBtu.

Transit fees: Pakistan \$0.493 mBtu New Delhi \$0.20.

# Natural gas pipeline routes

**Proposed Routes of Indo-Iran Pipeline Gas Project**



## **Renewable Energy Sources**

Indian Renewable Energy Development Agency, which is a part of the Ministry of Non-Conventional Energy Sources.

Non-conventional sources require land: fuel vs. food dilemma.

## **Hydroelectric**

5% of energy production.

Eighth largest consumer of hydroelectricity.

Cheap.

North East, Uttaranchal and Himachal.

Construction costs for the dam and for generating system high, the ultimate cost of generating electricity is quite low.

Clean and non-polluting.

Ecological and social costs.

Import from Nepal and Bhutan.

## **Solar**

Most parts of India get 300 days of sunshine a year.

One of the largest national programs to promote the use of solar energy.

Used for heating as well as cooling, and for generation of electricity.

Operating solar-energy systems may be inexpensive in the long run, but costs are high for installing the necessary equipment.

Cannot at present times generate significant amounts of energy through solar power.

Market for PV technology and progress has been made in the deployment of small, stand-alone PV systems.

The present conversion efficiency of commercially available photovoltaic cells is less than 15 percent.

Cost-effective way to provide energy to small villages and remote areas off the national grid where there is a shortage of electricity.

## **Wind**

Wind energy potential rated third in the world after US and EU.

Strong seasonal winds blow across the Indian subcontinent April through September.

India ranks fifth in the world in the number of wind power installations.

Wind turbines through generous tax incentives.

Geographically limited.

Fickle.

Pollution free energy source.

Wind power could win acceptance in areas suffering from poor air quality.



## **Biomass**

The burning of wood and other plant matter to produce electricity or fuel such as ethanol or methanol.

Bagasse from sugar mills.

Economic feasibility.

## **Nuclear Energy**

Clean (non-polluting).

Large amounts.

High risk.

High costs.

Radioactive waste.

Limited uranium, thorium converted to fissile material.

**Operating Nuclear Power Plants in India**  
**(as of January 2001)**

<b>Power Plant</b>	<b>City or District</b>	<b>State</b>	<b>Total Capacity (MWe)</b>
Kaiga	Kaiga	Karnataka	440
Madras	Madras	Tamil Nadu	470
Narora	Bulandshar District	Uttar Pradesh	470
Kakrapar	Surat District	Gujarat	440
Rajasthan	Via Kota	Rajasthan	880

Source: Utility Data Institute

## **Indo-US Nuclear deal**

Grant India access to civilian nuclear technology.

Separating military and civilian nuclear facilities and opening its civilian facilities to IAEA inspectors.

US companies will be allowed to build nuclear power plants in India, and also supply fuel for nuclear reactors.

Fast-breeder reactors (FBRs): While New Delhi has maintained that FBR would jumpstart power generation, it is also seen as an essential part of India's weapons program, since it produces good weapons-grade plutonium.

Bordered by two other nuclear-armed states, Pakistan and China.

Not signed the Nuclear Non-Proliferation Treaty.

Agreed to permanently classify 14 of its 22 nuclear power reactors as civilian facilities.

IAEA "India-specific" Safeguards Agreement and an Additional Protocol.

Persuade the 44-nation Nuclear Suppliers Group.

Bush “change with the times”: Friendly, democratic and powerful regional ally.

Ratified by the US Congress: Amendment of the 1978 Atomic Energy Act, which forbids nuclear trade with a non-NPT nation, can only be done by legislative action in the US.

123 Agreement: Politicians; Nuclear scientists: Kakodkar, Grover, Raghuraman.

Dependent on fuel supply on other countries- influence on foreign policy.

U.S. restrictions on its ability to reprocess spent nuclear fuel. (Reprocessing is a key step in making weapons-grade nuclear material).

## **Current scenario**

Energy self-sufficiency.

Energy demand will increase faster than economy due to growth in the manufacturing sector.

Policy changes.

## **Liberalization**

ONGC- public sector more active in energy sector than private industries.

Foreign energy companies can now take one-hundred percent ownership interest in enterprises valued up to \$350 million.

Ventures in generation or distribution using hydroelectric, coal, lignite, oil, or gas generating plants no longer need consent of the government.

Regulations have been reduced in the coal sector to try to entice foreign investment.

## **Reform**

State Electricity Boards on a sound fiscal basis

Remove subsidies

Market prices

Competitive energy markets

Conservation and efficiency

Public transport

## **Recommendations**

Short-term

Oil to Coal

Medium-term to long-term

Natural Gas

Hydro

Nuclear

Renewables

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