

MUTHAYAMMAL ENGINEERING COLLEGE
(An Autonomous Institution)
(Approved by AICTE, New Delhi, Accredited by NAAC &
Affiliated to Anna University)
Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

19GES20 - RENEWABLE ENERGY SOURCES

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19GES20 - RENEWABLE ENERGY SOURCES

UNIT I - Introduction

UNIT II - Solar Energy

UNIT III - Wind Energy

UNIT IV - Bio Energy

UNIT V - Other Renewable Energy Resources

Course Objective

To learn the present energy scenerio and the need of Energy conservation.

To understand the concept of solar energy production and it's application.

To understand the concept of wind energy generation.

To analysis the biogas and it's application.

To develop the some other renewable energy sources.

Course Outcome

To understand the basic concept of energy sources.

To explain the field application of solar energy.

To identify the wind energy into some alternate form of energy

To explain the biogas generation and its impact on environmental

To outline the utilisation techniques like hydro ,wave,tide and hybrid energy sources.

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UNIT I : INTRODUCTION

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamilnadu, India and around the World - Potentials - Achievements / Applications – Economics of renewable energy systems.

UNIT II : SOLAR ENERGY

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Application

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Applications – Solar thermal Power Generation

Fundamentals of Solar Photo Voltaic Conversion – Solar Cells
– Solar PV Power Generation – Solar PV Applications.

UNIT III : WIND ENERGY

Wind Data and Energy Estimation – Types of Wind Energy
Systems – Performance - Site Selection – Details of Wind
Turbine Generator – Safety and Environmental Aspects.

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UNIT IV : BIO - ENERGY

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters
– Ethanol production – Bio diesel – Cogeneration - Biomass Applications.

UNIT V : OTHER RENEWABLE ENERGY SOURCES

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small
Hydro-Geothermal Energy Hydrogen and Storage - Fuel Cell Systems –
Hybrid Systems.

Text Book and Reference Book

TEXT BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	G.D. Rai	Non Conventional Energy Sources,	Khanna Publishers, New Delhi,	2011.
2.	Twidell, J.W. & Weir	A, Renewable Energy Sources	EFN Spon Ltd, UK,	2006

REFERENCE BOOKS:

Sl. No	Author(s)	Title of the Book	Publisher	Year of Publication
1.	David M. Mousdale	Introduction to Biofuels,	CRC Press Taylor & Francis Group, USA	2010
2.	Chetan Singh Solanki	Solar Photovoltaic, Fundamentals, Technologies and Applications,	PHI Learning Private Limited, New Delhi	2009
3.	S.P. Sukhatme	Solar Energy	Tata McGraw Hill Publishing Company Ltd, New Delhi,	1997.
4.	Sinduja S	Renewable Energy Sources	Anuradha Publications	2012
5.	Tasneem abbasi and T.A Abbasi	Renewable Energy Sources: Their Impact on Global Warming and Pollution	Prentice Hall India Learning Private Limited	2010

World Energy use

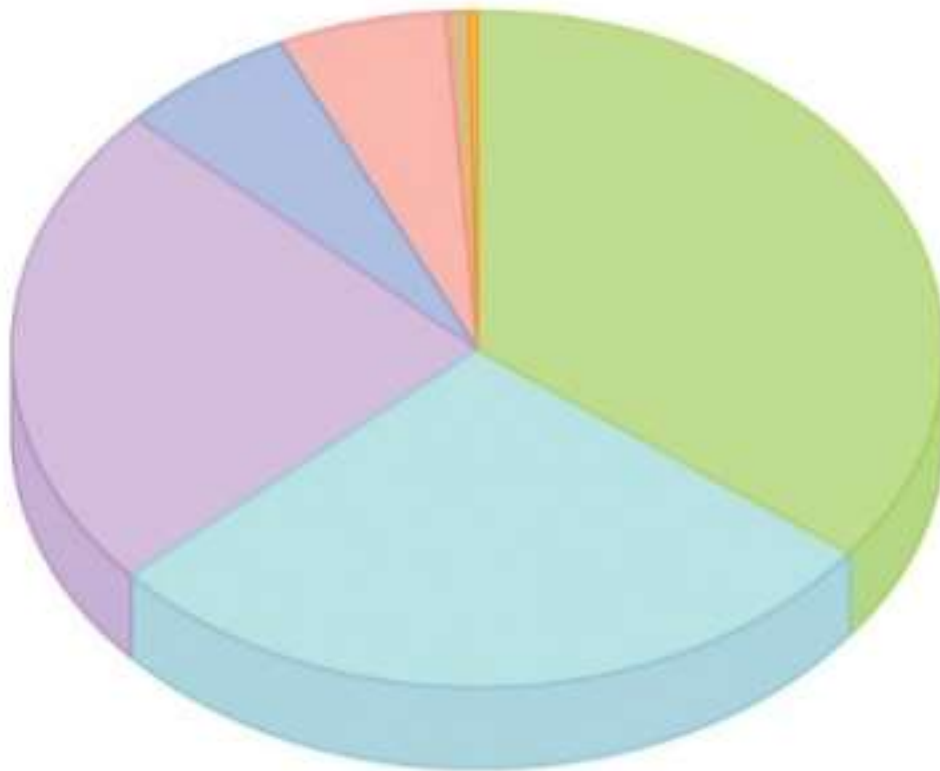
Energy is an important ingredient in all phases of society.

Reliable energy sources is crucible for economic growth and for maintaining the quality of our lives.

But the current level of Energy consumption and production are not sustainable.

40% of world energy comes from oil.

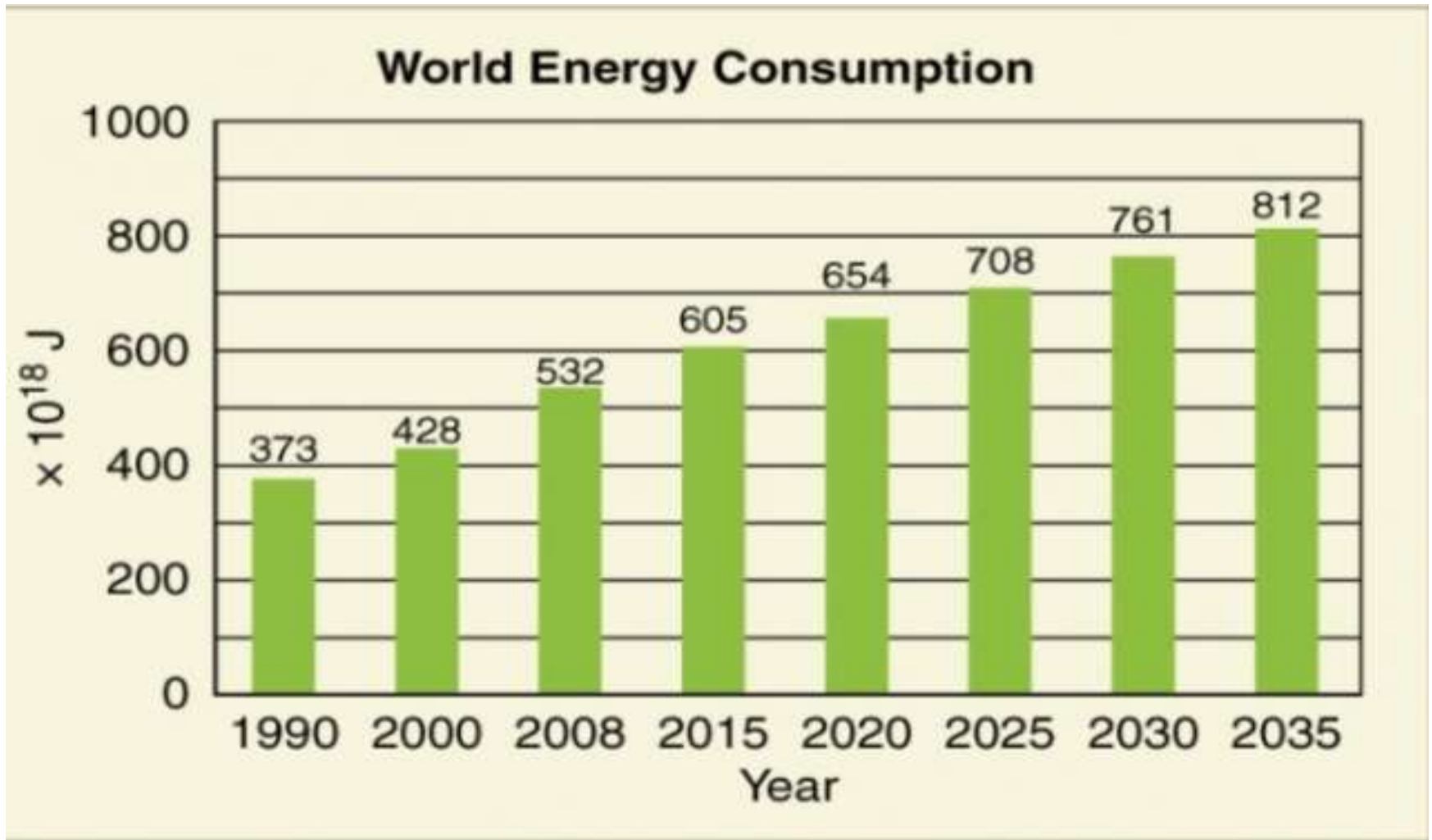
World energy use



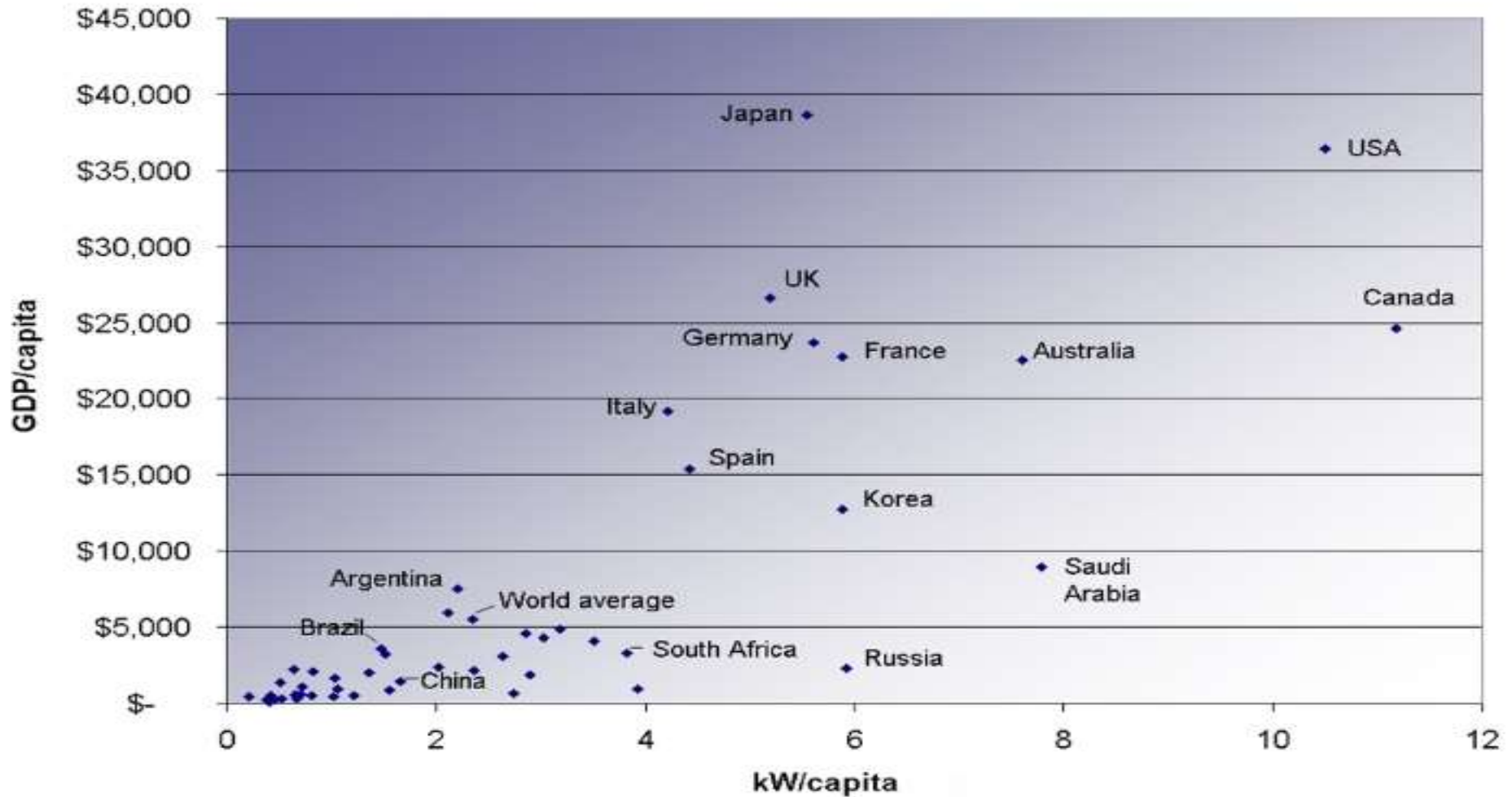
Petroleum:	3527 ~ 35.43%
Coal:	2802 ~ 28.15%
Dry natural gas:	2335 ~ 23.46%
Hydro-electricity:	624 ~ 6.27%
Nuclear-electricity:	576 ~ 5.79%
Geothermal, wind, solar, biomass:	86 ~ 0.86%
Geothermal, biomass, solar not used for electricity:	5 ~ 0.05%

Total: 9955

The World Growing Energy Needs



Energy and Economic Well being



Reserve of Energy Resource

Reserve

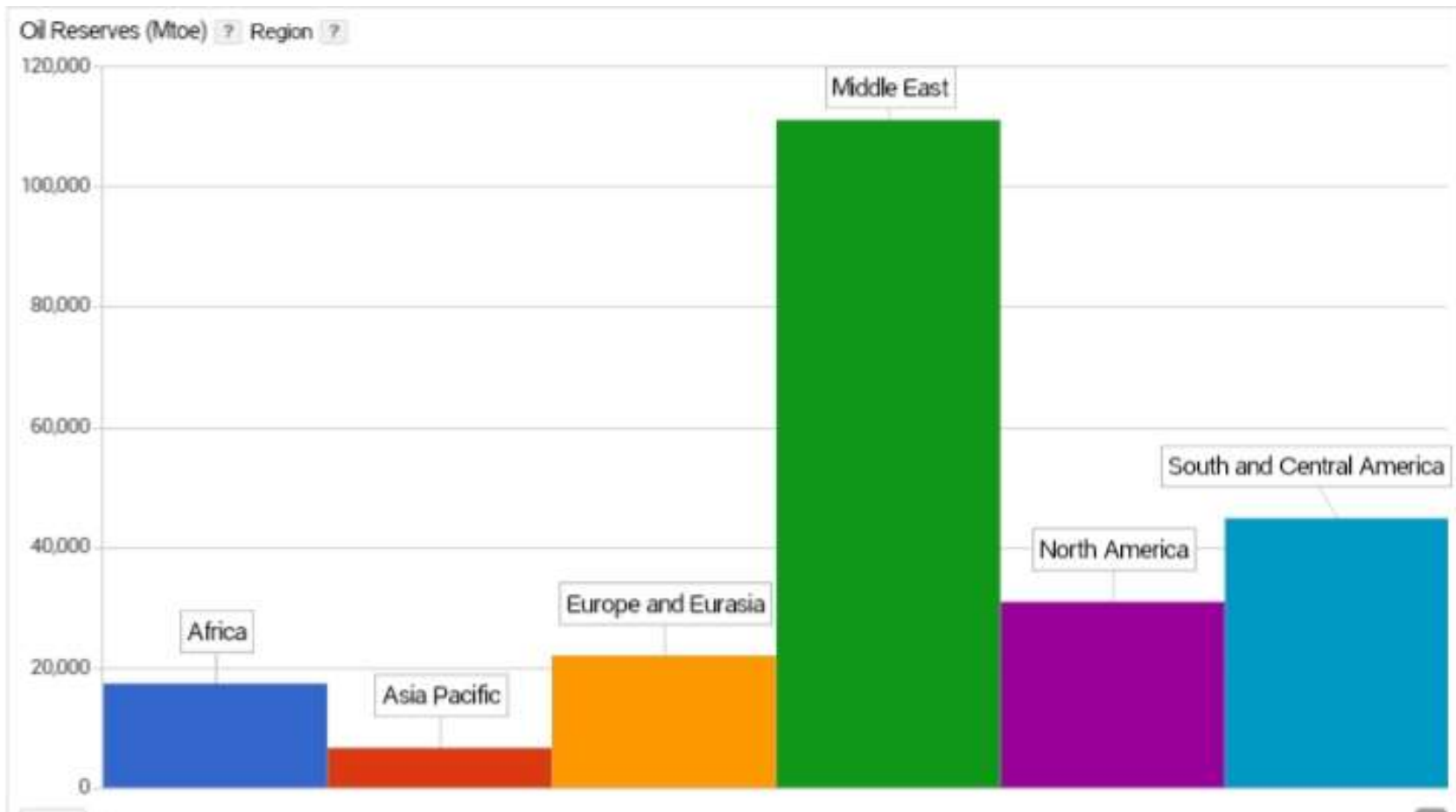
Reserves are deposits of natural resources like fuels, elements, and minerals that are known to exist with a reasonable level of certainty based on geological and engineering studies.

Reserve of Energy resources

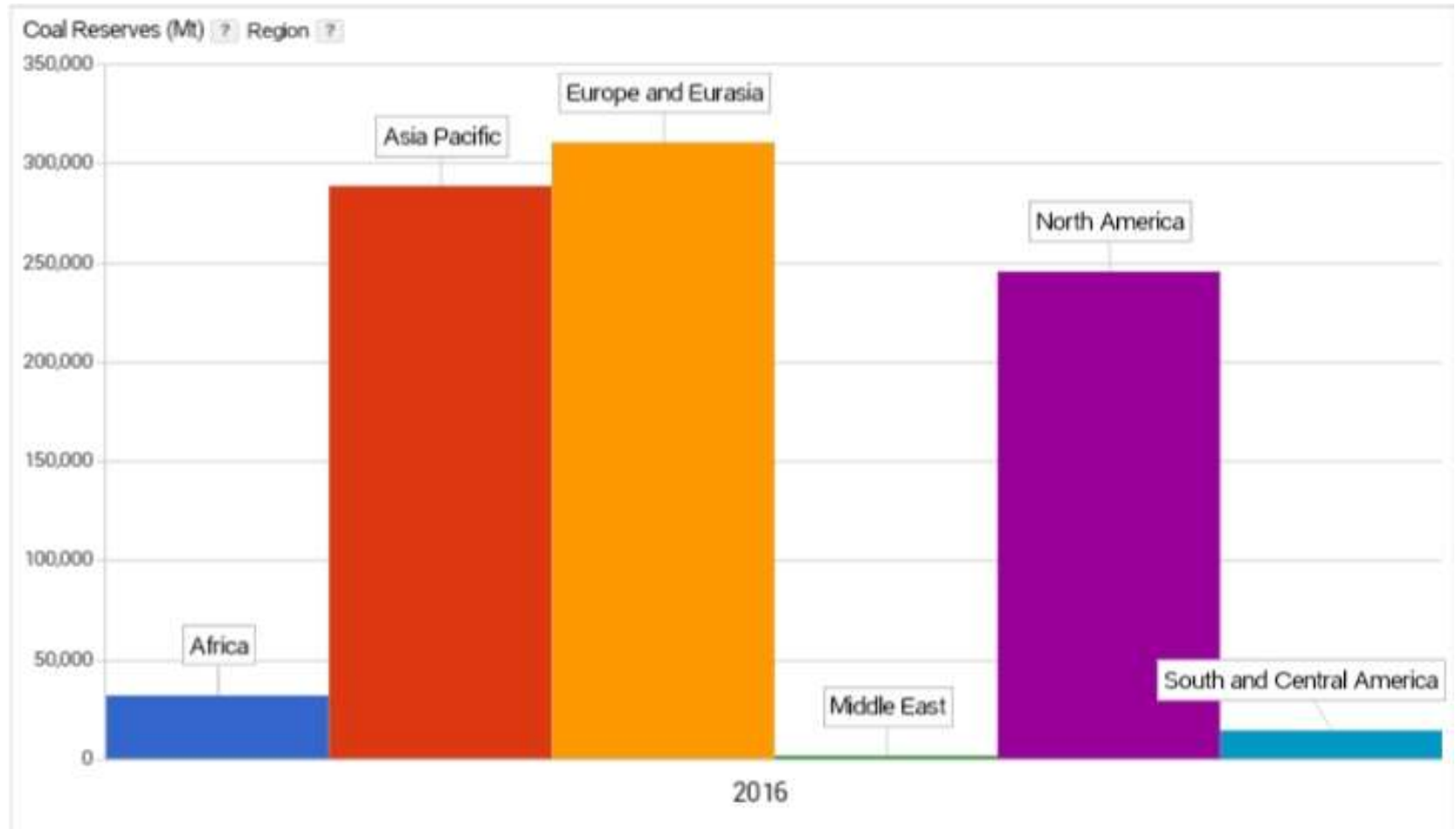
Types of Reserves

- 1.Oil reserves
- 2.Coal reserves
- 3.Natural gas reserves

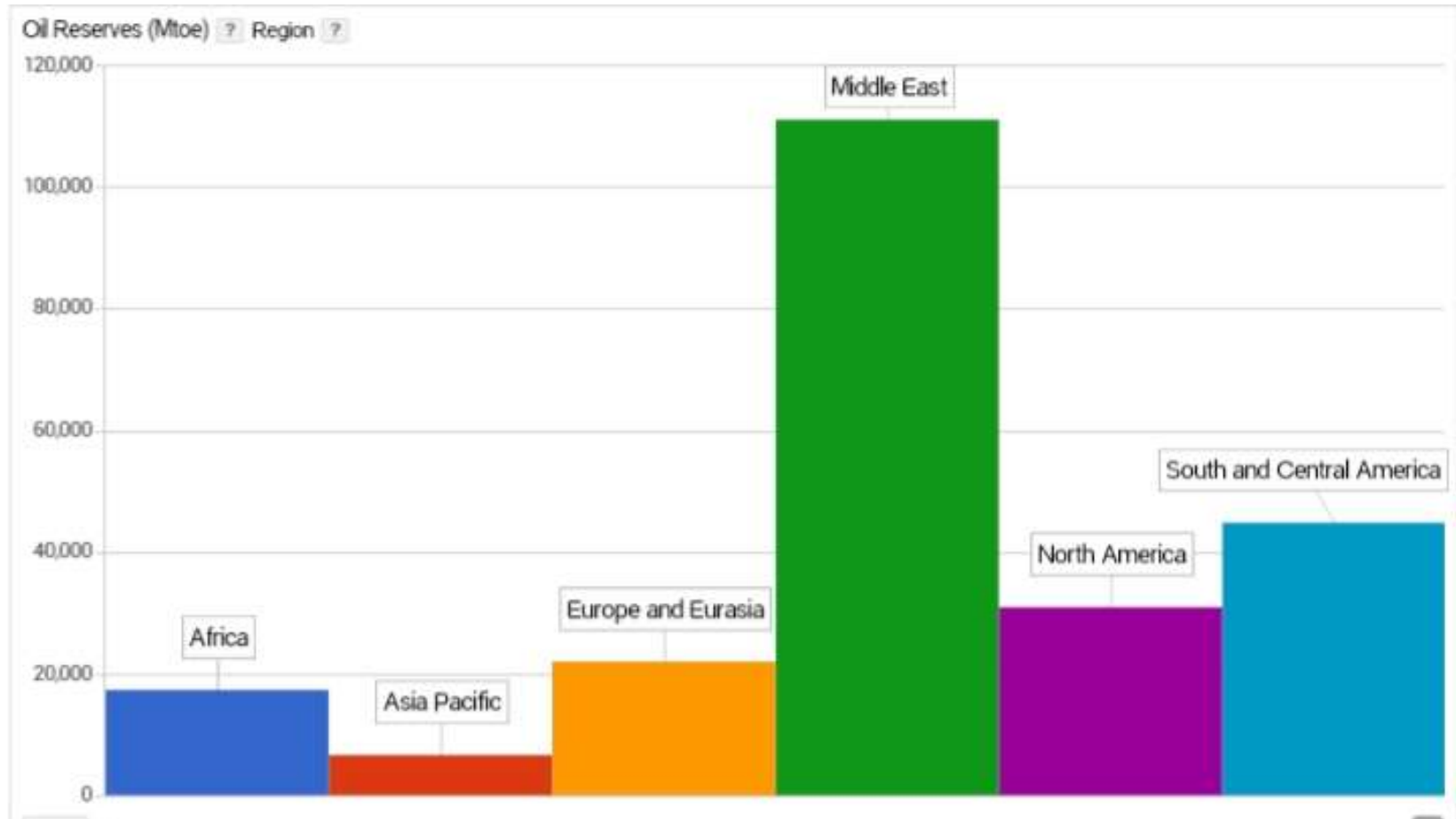
Oil Reserve



Coal Reserve



Natural Gas Reserve



India's Energy Reserves

Coal	Main fossil energy reserves in India at 286 billion tons and 41 billion tons of lignite. These are available in eastern and southern belts of the country.
Crude Oil	Limited to 757 million tons m ³ .
Natural Gas	Limited to 1241 billion tons m ³ .
Nuclear Energy	Uranium can fuel only 10,000 MW pressurized heavy water reactors (PHWR).

India's Energy Reserves

The capacity addition in renewable energy was about 27,300 MW in 2012.

Technology	Capacity Installed in MW by 2012.
Coal	11,202
Hydro	38,990
Renewable	27,300
Gas	18,381
Nuclear	4,780
Total	201,473

India's Energy Reserves

Thermal	54.4%
Hydro	21.60%
Renewable	10.90%
Gas	10.10%
nuclear	2.7%

Environmental aspects of Energy utilisation

- All energy sources have some impact on our environment.
- Fossil fuels—coal, oil, and natural gas—do substantially more harm than renewable energy sources by most measures, including air and water pollution and global warming emissions.
- However, renewable sources such as wind, solar, geothermal, biomass, and hydropower also have environmental impacts, some of which are significant.

Environmental Impact of Wind Power

- Harnessing power from the wind is one of the cleanest and most sustainable ways to generate electricity as it produces no toxic pollution or global warming emissions.
- Wind is also abundant, inexhaustible, and affordable, which makes it a viable and large-scale alternative to fossil fuels.

Environmental Impact of Solar Power

- The environmental impacts associated with solar power can include land use and habitat loss, water use, and the use of hazardous materials in manufacturing, though the types of impacts vary greatly depending on the scale of the system and the technology used—photovoltaic (PV) solar cells or concentrating solar thermal plants (CSP).

Environmental Impact of Geothermal Power

- The most widely developed type of geothermal power plant (known as hydrothermal plants) are located near geologic “hot spots” where hot molten rock is close to the earth’s crust and produces hot water.
- Geothermal plants also differ in terms of the technology they use to convert the resource to electricity (direct steam, flash, or binary) and the type of cooling technology they use (water-cooled and air-cooled).

Environmental Impact of Biomass

- Biomass power plants share some similarities with fossil fuel power plants: both involve the combustion of a feedstock to generate electricity.
- Thus, biomass plants raise similar, but not identical, concerns about air emissions and water use as fossil fuel plants.
However, the feedstock of biomass plants can be sustainably produced, while fossil fuels are non-renewable.

Environmental Impact of Hydroelectric power

Hydroelectric power includes both massive hydroelectric dams and small run-of-the-river plants. Large-scale hydroelectric dams continue to be built in many parts of the world (including China and Brazil), but it is unlikely that new facilities will be added to the existing US fleet in the future.

Energy Scenario in India

- Coal dominates the energy mix in India, contributing to 55% of the total primary energy production.
- Over the years, there has been a marked increase in the share of natural gas in primary energy production from 10% in 1994 to 13% in 1999.
- There has been a decline in the share of oil in primary energy production from 20% to 17% during the same period.

Energy Scenario in India

Reserves/Production (R/P) ratio

- If the reserves remaining at the end of the year are divided by the production in that year, the result is the length of time that the remaining reserves would last if production were to continue at that level.
- India is the fourth largest producer of coal and lignite in the world. Coal production is concentrated in these states (Andhra Pradesh, Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Orissa, Jharkhand, and West Bengal).

Energy Scenario in India

Oil Supply

- Oil accounts for about 36 % of India's total energy consumption. India today is one of the top ten oil consuming nations in the world and will soon overtake Korea as the third largest consumer of oil in Asia after China and Japan.
- The country's annual crude oil production is peaked at about 32 million tonne as against the current oil consumption by end of 2007 is expected to reach 136 million tonne(MT).

Energy Scenario in India

Natural Gas Supply

- Natural gas accounts for about 8.9 per cent of energy consumption in the country.
- The current demand for natural gas is about 96 million cubic metres per day (mcmd) as against availability of 67 mcmd.
- By 2007, the demand is expected to be around 200 mcmd.
Natural gas reserves are estimated at 660 billion cubic meters.

Energy Scenario in India

Electrical Energy Supply

The all India installed capacity of electric power generating stations under utilities was 1,12,581 MW as on 31st May 2004, consisting of 28,860 MW- hydro, 77,931 MW- thermal and 2,720 MW- nuclear and 1,869 MW-wind (Ministry of Power).

Energy Scenario in India

Nuclear Power Supply

- Nuclear Power contributes to about 2.4 percent of electricity generated in India.
- India has ten nuclear power reactors at five nuclear power stations producing electricity.
- More nuclear reactors have also been approved for construction.

Energy Scenario in India

Hydro Power Supply

- India is endowed with a vast and viable hydro potential for power generation of which only 15% has been harnessed so far.
- The share of hydropower in the country's total generated units has steadily decreased and it presently stands at 25% as on 31st May 2004.
- It is assessed that exploitable potential at 60% load factor is 84,000 MW.

Energy Scenario in Tamil Nadu

- A 2018 report lists Tamil Nadu as one of the top nine renewable energy markets in the world.
- Now a day, 14.3 per cent of all the energy demand in the state is met by renewable energy, primarily solar and wind.
- There is an ever increasing demand for energy in spite of the rising prices of oil & other fossil fuel / depletion of fossil fuels.

Energy Scenario in Tamil Nadu

The environment-friendly renewable energy sources are perennial in nature, available locally and quite suitable for decentralized applications. The important renewable energy sources are as follows:

- Wind Energy (including offshore wind)
- Solar Energy

Energy Scenario in Tamil Nadu

Biomass and other forms of bio energy

- Small Hydro
- Tidal Energy
- Ocean Thermal Energy

Among the above mentioned sources, the first three renewable energy sources, viz., wind, solar and bio energy are being harnessed in a big way in India and also in Tamil Nadu.

Energy Scenario in Tamil Nadu

Wind Energy

Tamil Nadu is pioneer in promoting wind energy in the country. The State has the highest wind power capacity in the India, contributing about 23% of the country's total wind installed capacity, with an installed capacity of 8,506.72 MW contributing about 27% to the State's total installed power capacity.

Total wind installed capacity is 8507 MW. With 23% of India's total wind installed capacity, Tamil Nadu holds first place in the country.

Energy Scenario in Tamil Nadu

The State has harnessed around 11,717 million units of wind energy during 2019-20 upto January 2020.

Maximum wind generation harnessed to the grid was 5095.6 MW on 27.07.2017 and 107.317 MU on 19.07.2018.

Solar energy

Total solar installed capacity is 3974 MW.

The State has harnessed around 3,842 million units of solar energy during 2019-20 upto

Energy Scenario in Tamil Nadu

January 2020 which is around 35% increase compared to last year.

Maximum solar generation harnessed to the grid was 3018 MW on 19.02.202 and 20.12 MU on 17.02.2020.

Application of Renewable Energy resources

Solar energy

- It is used to power radio and TV stations.
- It is also used to supply power to lighthouse and warning light for aircraft.
- It can be used for power generation in remotely situated places like schools, homes, clinics and buildings.
- Water pumps run on solar energy in remote areas

Application of Renewable Energy resources

Wind energy

- It is used to run pumps to draw water from the grounds through wind mills.
- Wind energy has also been used to run flourmills to grind the grains like wheat and corn into flour.
- Now-a-days wind energy is being used to generate electricity.

Application of Renewable Energy resources

Geo thermal energy

- Geothermal hot water can be used for many applications that require heat.
- Its current uses include **heating buildings** (either individually or whole towns), raising plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes, such as pasteurizing milk.

Application of Renewable Energy resources

Hydropower energy

- Hydropower is a method of sustainable energy production.
- Since ancient times, hydropower from watermills has been used as a renewable energy source for irrigation and the operation of mechanical devices, such as gristmills, sawmills, textile mills, trip hammers, dock cranes, domestic lifts, and ore mills.

Application of Renewable Energy resources

Tidal energy

- We can use tidal energy to supply electricity to our homes and businesses.
- We can use tidal energy in some places instead of burning coal and oil that contribute to global warming.
- Tidal generators (or turbines) work like wind turbines, except it is ocean currents, not wind, that turns them.

Application of Renewable Energy resources

Biomass energy

- Biomass systems range from small stoves used in homes for heating or cooking to large power plants used by centralized utilities to produce electricity.
- Industry and businesses use biomass for several purposes including space heating, hot water heating, and electricity generation.

Application of Renewable Energy resources

Hydrogen energy

- Hydrogen and fuel cells can provide energy for use in diverse applications, including distributed or combined-heat-and-power; **backup power**; systems for storing and enabling renewable energy; portable power; auxiliary power for trucks, aircraft, rail, and ships; specialty vehicles such as forklifts; and passenger

Economic of of Renewable Energy resources

- The world currently gets about 80% of its energy supplies from fossil fuels because these sources generally provide energy at the lowest cost.
- The cost advantage of fossil fuels over renewable energy sources has been decreasing in recent years.
- Renewable energy costs are expected to decline further in the future, while fossil fuel prices will likely rise.

Economic of of Renewable Energy resources

