

1. Write a short note on the distribution of natural gas across the world. Do you think natural gas can address the challenge of global energy crisis in the long run? Critically examine.

Introduction

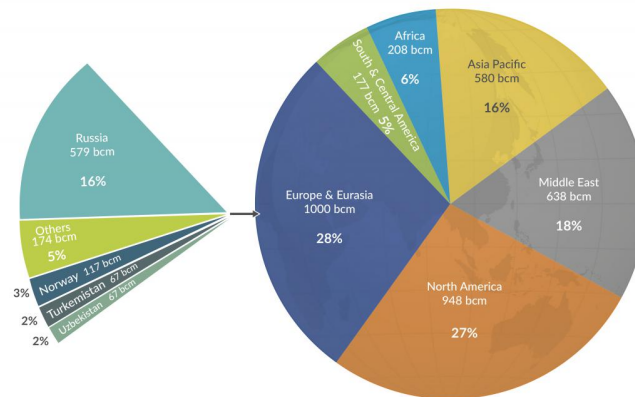
Natural gas is a fossil fuel which is a fossil energy source that formed deep beneath the earth's surface. Nearly 80% of the world's total proven natural gas reserves are located in ten countries. Russia tops the list, holding about a quarter of the world's total gas reserves, followed by Iran and Qatar in the Middle East.

Body

Natural Gas's distribution is widespread and this distribution can be seen from the following points -

1. Natural gas deposits are often found near oil deposits. Deposits of natural gas close to the Earth's surface are usually dwarfed by nearby oil deposits. Deeper deposits—formed at higher temperatures and under more pressure—have more natural gas than oil. The deepest deposits can be made up of pure natural gas.
2. In some places, natural gas moved into large cracks and spaces between layers of overlying rock. The natural gas found in these types of formations is sometimes called conventional natural gas. In other places, natural gas occurs in the tiny pores (spaces) within some formations of shale, sandstone, and other types of sedimentary rock. This natural gas is referred to as shale gas or tight gas, and it is sometimes called unconventional natural gas.
3. Natural gas also occurs with deposits of crude oil, and this natural gas is called associated natural gas. Natural gas deposits are found on land, and some are offshore and deep under the ocean floor. A type of natural gas found in coal deposits is called coalbed methane.
4. The world's top six natural gas producers are (2016) - United States (749 bcm), Russia (579 bcm), Iran (202 bcm), Qatar (181 bcm), Canada (152 bcm), China (138 bcm).

Global Production Breakdown



Today, natural gas is used in countless ways for industrial, commercial, residential, and transportation purposes. By energy source, natural gas accounts for the largest increase in world primary energy consumption.

- Abundant natural gas resources and robust production contribute to the strong competitive position of natural gas among other resources. Natural gas remains a key fuel in the electric power sector and in the industrial sector.
- In the power sector, natural gas is an attractive choice for new generating plants because of its fuel efficiency. Natural gas also burns cleaner than coal or petroleum products, and as more governments begin implementing national or regional plans to reduce carbon dioxide (CO₂) emissions, they may encourage the use of natural gas to displace more carbon-intensive coal and liquid fuels.
- In residential homes, the most popular use for natural gas is heating and cooking. It can further be used to power home appliances such as stoves, air conditioners, space heaters, outdoor lights, garage heaters, and clothes dryers.
- Natural gas can also be used on a larger scale in commercial settings, such as restaurants and shopping malls, where it is an extremely efficient and economical way to power water heaters, space heaters, dryers, and stoves.
- Natural gas can also be used as an alternative fuel for cars, buses, trucks, and other vehicles. Currently, there are more than 5 million natural gas vehicles (NGV) worldwide. Also, fuels derived from natural gas could help avoid a future oil crisis if they're poised to effectively compete in the oil-dominated transportation sector
- Methanol could be the most promising option for large-scale market penetration of a natural gas-based fuel for light-duty vehicles because of its low fuel cost and low additional cost relative to powering a vehicle with gasoline.

At the same time, there are multiple challenges with regards to future use of Natural gas on a large scale, some of which are listed below -

- To meet the rising natural gas demand which is projected, the world's natural gas producers need to increase supplies by nearly 69% from 2012 to 2040.
- Currently there is no globally integrated market for natural gas, and pricing mechanisms vary by regional market.
- As with any extractive activity, drilling for natural gas can lead to leaks. If the drill hits an unexpected high-pressure pocket of natural gas, or the well is damaged or ruptures, the leak can be immediately hazardous. Further, the leaks are an environmental hazard as they also leak mud and oil into the surrounding areas.
- If hydraulic fracturing was used to expand a well, the chemicals from that process can contaminate local aquatic habitats and drinking water with highly

radioactive materials. The uncontained methane released in the air can also force people to temporarily evacuate the area.

Conclusion

Natural gas is a win environmentally because it produces less local pollution and less carbon dioxide emissions than traditional petroleum and electricity generated from coal. But it's also necessary to consider the degree to which natural gas should replace other types of energy sources and the full life-cycle emissions associated with fuels derived from natural gas, which will help usher in a sustainable future for the world in terms of energy.

2. The supply of water has the potential to influence geopolitics, diplomacy and even conflict.

Introduction

Water politics, sometimes called *hydropolitics*, is politics affected by the availability of water and water resources, a necessity for all life forms and human development.

Body

We need water to survive. But it also fuels a country's commerce, trade, innovation and economic success. This has been the case for time immemorial, from the Nile in Ancient Egypt to the Amazon in the Brazilian rainforest.

While bodies of water typically help form natural borders of countries, several nations tend to share access to rivers or lakes – the Nile runs through nearly a dozen countries alone, for example. Given how conflict-prone humankind is, it's surprising there haven't been more dust-ups of a "hydro-political" nature.

The supply of water has the potential to influence geopolitics, diplomacy and even conflict

Experts agree: if there was no access to water, there would be no world peace. That's why one of the grand challenges of the next few decades could be maintaining this ultra-sensitive stasis of water management.

- In the 21st Century, freshwater supplies are drying up, climate change is raising sea levels and altering borders, explosive population growth is straining world resources, and global hyper-nationalism is testing diplomatic relations. Meanwhile, water demand is expected to go up 55% between 2000 and 2050. In the coming century, in terms of its value as a global resource, it's been described as "the next oil."

World peace hinges on hydro-politics: Experts agree: if there was no access to water, there would be no world peace.

- In many areas of the world, bodies of water run through several countries or brush up against many countries' borders. That's where something called "riparian water rights" come into play.
- In the case of a river, upstream countries – where the river originates – enjoy inherent power and leverage over the downstream countries. These kinds of riparian hotspots abound. And they're often in places that are already fraught.
- In the Middle East, the Jordan River basin is the primary water source for many regions, including Jordan, Palestine, and Israel, regions of long-standing political tensions. In Syria, meanwhile, the worst drought in close to a millennium has been partly blamed for the country's generation-defining civil war and radicalisation that led to the formation of so-called Islamic State.
- Egypt and Ethiopia have sparred over development of water from the River Nile for centuries: the iconic river originates in Ethiopia but ends in Egypt, which sets up an inherently combative relationship. In 2015, Egypt and Ethiopia put enough differences aside to construct the Grand Ethiopian Renaissance Dam on the river, which is Africa's largest dam. The countries also signed a deal that strives to ensure fair river access.
- Malaysia has a 99-year deal with Singapore, giving them paid access to fresh water from the Johor River.
- Singapore is arguably one of the most progressive nations on our planet, but without sufficient fresh water resources within its boundaries, all industry, trade, commerce and culture would all stand still."
- Afghanistan is an upstream country to many nations in the region, and is trying to use that advantage to develop its economy. For a country that's been subjected to decade upon decade of war and upheaval, the political power of water sources like the Kabul River could be a boon.
- If one includes virtual water in the picture, farmers are managing much of the water in the supply chain. And in countries that are water deficient, that imported embedded water is integral. In Europe alone, 40% of this "virtual water" comes from outside the continent.
- In reality, the water that goes into the country's food is being brought in from elsewhere. In other words, 160 countries depend on imported food – and the water needed to make it. That's why hydro-diplomacy is one of the great unsung heroes in maintaining global peace.

Conclusion

In the words of Kofi Annan, former UN Secretary General, in an address to the international community: "Fierce national competition over water resources has prompted fears that water issues contain the seeds of violent conflict. If the entire world's peoples work together, a secure and sustainable water future can be ours." However, water, as a resource, it is dependent on sustainability. This means that it entails sound socioeconomic development that safeguards the resource base for future generations. And that the concerns on resource use should transcend beyond

short term “on-site” gains, and should necessarily be on an environmentally sensitive use of resources including many possible “off-site” implications.

3. Energy has traditionally played an important role in global geopolitics, contributing to the rise of great powers, the formation of alliances and, in many cases, also to the emergence of wars and conflicts. Elucidate.

Introduction

Geopolitics of energy as it is called has been playing a major role in global diplomacy and has been a decider of rise of great powers, allies and enemies. This has been especially true post-industrial revolution where in the energy accounts for production of goods and services.

Body

Rise of great powers and Alliances:

- During the first industrial revolution time period, the control of coal production by Britain through its colonies helped it to build and expand its empire all over the world.
- United States of America was able to sustain post revolution owing to the rich energy resources available in the regions of Pennsylvania, Detroit, Rocky-mountains and so on.
- The newly emerged Germany, Italy were in control of rich sources of coal, iron in regions like Rhine valley leading to the rise of new empires.
- Most of the west Asian countries like Saudi Arabia, Iran, Iraq and so on were built on account of abundant oil and natural gas present in the region.
- The western alliance like that between USA and Turkey or Saudi Arabia and others hinges on the oil diplomacy.
- OIC was formed between nations to control the production of oil which is the key element of the alliance.
- Even Indian relation with several countries like UAE, Qatar, Venezuela etc., is friendly for the reason of energy resources. Also, India is maintaining friendly relation with both Iran and Saudi Arabia who are traditional rivals.
- The rich energy resources in Africa has attracted the hand of alliance from countries like China, India, Japan and others who have invested and launched programs like Asia-Africa Growth corridor and so on.
- Lately, formation of international solar alliance is an example of energy-based alliance. Similarly, several European countries have aligned together for renewable energy production.

Causing war and conflicts:

- France conflicted with Germany over the control of Rhineland (source of coal) post worldwar1 which is also a reason for rise of Hitler.

- The Gulf wars were fought for the control of oil in the West Asian region.
- The major events during the Cold War period like the Iranian revolution, USA's invasion of Afghanistan have energy control as the hidden agenda. Toppling of governments were sponsored by USA and USSR during the period in countries like Egypt so as to have a control on energy resources.
- Civil war in Nigeria and Sudan were fought for the reason of control of energy resources.
- The discovery of shale gas in the Arctic region has led to several global and regional conflicts like that between Russia and Northern European countries, USA and so on.
- The rivalry between the Western countries and regional countries like Iran is mainly on account of oil resources in the region. For the same reasons, intra-regional rivalry like that between Iran and Saudi Arabia exists.

Conclusion

Almost every conflict that has been fought or been fighting has an angle of control of energy resources. Be it be Russia-Ukraine conflict, South China Sea conflict or even the conflict between developed and developing countries over the renewable energy adoption to fight the climate change, energy has and will always play the major role in global geopolitics.

3. What are the components of sustainable resource management? Explain with the help of suitable examples.

Introduction

Sustainable Resource Management is the use of the available in a way that creates the ability of a system to thrive by maintaining economic viability and also nourishing the needs of the present and future generations by limiting resource depletion.

According to Global resources outlook 2019

- Resource extraction has more than tripled since 1970
- Resource extraction is responsible ~ 50% of greenhouse gas emissions and over 90 per cent of biodiversity loss and water stress.

Exploding human consumption is the driving force for Anthropocene extinction as per 'The living planet report' of WWF. These findings call for sustainable resource management.

Body

Components of sustainable resource management

- Human well-being
- Economic activity (GDP)

- Environmental impact

Human well-being

Resource extraction is needed for human development

- India's per capita GDP - \$1965 (world average ~ \$10,000)
- HDI – 0.64 (130/189)
- Per capita energy consumption ~ 1/5th of global average.
- ~300 million people do not have electricity
- 55% households live in mud or semi-concrete household (2011 census)

Economic activity (GDP)

- Employment need increasing the industrial base
- Doubling the farmer's income require high energy consumption.
- To increase India's manufacturing base and to decrease dependence on mineral import, resource extraction is important.

Environmental impact

- IPCC report has said that this is the last chance for fight against climate change.
- Resource extraction is responsible ~ 50% of greenhouse gas emissions and over 90 per cent of biodiversity loss and water stress as per global resources outlook 2019 (UNEP).
- Exploding human consumption is the driving force for Anthropocene extinction (The living planet report, WWF)
- Sustainable future is one three biggest challenges as per World Economic Forum.
- Mean temperature in Indian has risen by 0.66° C.
- Disaster – Kerala floods etc.

Conclusion

Emission mitigation pathway for development

- **Energy efficiency**
 - Alternative to aviation turbine fuel
 - Efficient power loom equipments
 - LED lights
- **Power sector decarbonisation** through renewable energy
- **Electrification of end uses** – eg: electric cook stoves; electric vehicle

Ingraining sustainable development concept in governance

- Impact assessment of any project

- EIA

Sustainable resource management is the answer to present crisis and the future need.

4. Examine the distribution of key nuclear elements in the world.

Introduction

Nuclear minerals are identified so due to presence of radioactivity in minerals caused by the inclusion of naturally-occurring radioactive elements in the mineral's composition. For the most part, minerals that contain potassium (K), uranium (U), and thorium (Th) are nuclear minerals.

Body

Global distribution of nuclear minerals

Uranium

- Mines in Canada, Australia and Kazakhstan cover over two-thirds of the uranium production across the world. As per 2016 data, Kazakhstan is the largest producer of uranium with 39% of world supply, followed by Canada (22%) and Australia (10%).
- A large reserve of uranium is estimated to be in sea water.
- Australia possesses around 30% of the world's known recoverable uranium reserves. Kazakhstan contains about 13% of the world's recoverable uranium.
- Canada was the world's largest uranium producer for many years, but in 2009 was overtaken by Kazakhstan. Other important countries with large known uranium reserves include Russia, South Africa, Niger and Namibia.
- India has minimal production of uranium and dependent on import for its needs.

Thorium

- Thorium is more abundant in nature than uranium.
- Monazite is the chief source of thorium in the world. Commercially viable deposits of Monazite can be found mainly in the beach sands in the coastal tracts of India, Brazil, Australia, Ceylon and Malaysia.
- India has possibly the highest thorium resources.

The current distribution pattern shapes the global geostrategic paradigm. Nuclear mineral play critical role in the energy security as increased strive for carbon free fuels compared to the traditional coal based energy production which is discouraged due to climate change obligations. Nuclear mineral supplier could control fuel and operations of nuclear power in any country and in a way energy security. Advanced reactors will be a source of geopolitical force in the near future.

Conclusion

India eventually succeeded to overcome its nuclear mineral supply short comings with the indigenously developed thorium based reactors. India has proved its credibility as responsible nuclear power. India bolstered its claim in the global nuclear order with number of civil nuclear agreements with various nuclear supplier nations despite of oppositions.

