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News: Coal Gasification

- The Ministry of Coal requested proposals from public and private sector participants for coal gasification projects as part of an Rs 8,500 crore viability gap funding (VGF) scheme.

Coal Gasification

- Coal Gasification is a process that transforms Coal into a Synthetic gas (Syngas), consisting of mixture of gasses such as Carbon monoxide (CO), Hydrogen (H_2), Carbon dioxide (CO_2), Methane (CH_4) and Water vapor (H_2O).
- Coal is reacted at high temperatures (typically 1,000–1,400°C) with a controlled amount of oxygen and steam.
- Syngas can be used to produce a wide range of Fertilizers, Fuels, solvents and synthetic materials.

The Process is as given:

- **Preparation:** Coal is crushed into a fine powder to increase its surface area and enhance the chemical reactions during the process.

- **Gasification Reactor:** The crushed coal is introduced into a high-temperature and high-pressure reactor along with limited oxygen or air and steam.
- **Chemical Reactions**: In the absence of sufficient oxygen for complete combustion, the coal undergoes a series of complex chemical reactions.
- These reactions break down the coal molecules into the components of syngas.
- **Gas Cleaning:** The raw syngas produced from the reactor contains impurities like tar, sulfur, and dust. These impurities need to be removed through a gas cleaning process before the syngas can be used further.

Benefits of Coal Gasification

- **Cleaner Alternative to Coal Combustion:** Coal gasification burns cleaner than coal for electricity. It captures pollutants before using the gas for power generation.
- **Versatile Syngas Usage:** The syngas produced can be used for various purposes, including electricity generation, production of cleaner fuels like hydrogen and production of chemicals like ammonia and methanol.

Uses of syngas

- Syngas is used as a source of green hydrogen as well as a fuel.
- It is also used to directly reduce iron ore to sponge iron.

- Chemical uses include the production of methanol which is a precursor to acetic acid and many acetates; liquid fuels and lubricants via the Fischer–Tropsch process and previously the Mobil methanol to gasoline process; ammonia via the Haber process, which converts atmospheric nitrogen (N_2) into ammonia which is used as a fertilizer; and oxo alcohols via an intermediate aldehyde.

Coal

- Coal is the most important and abundant fossil fuel in India. It accounts for 55% of the country's energy needs.
- The largest proved reserves are found in the United States, Russia, China, Australia, and India.
- The largest coal reserves in India are located in Jharkhand, Odisha and Chhattisgarh.
- In terms of production, China is the top coal producer since 1983. In 2011 China produced 3,520 million tonnes (mt) of coal – 49.5% of 7,695 million tonnes world coal production. In 2011 other large producers were United States (993 mt), India (589 mt), European Union (576 mt), and Australia (416 mt).
- Top coal exporting countries are Australia with 27% and Indonesia with 26% of total world coal export in 2010.

- Japan is the largest coal importer with 17% of total world coal import seconded by China having a share of 16% in 2010.
- Hard coal deposit spread over 27 major coalfields is mainly confined to eastern and south-central parts of the country. A cumulative total of 2,93,497 million tonnes of geological resources of coal up to a depth of 1200 meters have so far been estimated in the country.
- The coal resources of India are available in older Gondwana (570 million years to 245 million years ago) formations of peninsular India and younger tertiary (60 to 15 million years ago) formations of north-eastern region.
- Gondwana coal belongs to the carboniferous period. It is found in the Damodar, Mahanadi, Godavari, and Narmada valleys. Raniganj, Jharia, Bokaro, Ramgarh, Giridih, Chandrapur, Karanpura, Tatapani, Talcher, Himgiri, Korba, Penchgati, Sarguja, Kamthi, Wardha valley, Singreni (A.P.) and Singrauli are some of the important coal mines of the Gondwana formations.
- The Jharguda coal mine (Chhattisgarh) is the thickest coal seam 132 meters of the Gondwana period, followed by the Kargali seam near Bokaro belong to the Gondwana period.

Import of Coal

- As per the present import policy, coal can be freely imported (under Open General Licence) by the consumers themselves considering their needs based on their commercial prudence.
- Coking Coal is being imported by Steel Authority of India Limited (SAIL) and other Steel manufacturing units mainly to bridge the gap between the requirement and indigenous availability and to improve the quality of production.
- Coal based power plants, cement plants, captive power plants, sponge iron plants, industrial consumers and coal traders are importing non-coking coal.
- Coke is imported mainly by pig-Iron manufacturers and Iron & Steel sector consumers using mini-blast furnace.

Types of Coal in India

- As a result of exploration carried out up to the maximum depth of 1200 m, a cumulative total of 319.02 Billion tonnes of Geological Resources of Coal have so far been estimated in the country till April, 2018.
- Hard coal deposit spread over 27 major coalfields, are mainly confined to eastern and south central parts of the country.

- Top 5 States in terms of total coal reserves in India are: Jharkhand > Odisha > Chhattisgarh > West Bengal > Madhya Pradesh.
- Anthracite, Bituminous, and Lignite are the three types of coal found in India. Out of 319.02 Billion Tonnes of coal, Lignite accounts to 36 billion tonne, 96% of which is seen in Tamil Nadu.
- They are classified on the basis of carbon content. Anthracite coal consists of 80-98% of carbon. Bituminous coal consists of 60-80% of carbon content. Lignite consists only of 20-60% of carbon content.

Anthracite

- Anthracite is a hard, compact variety of mineral coal that has a high luster.
- It has the highest carbon content, the fewest impurities, and the highest calorific content of all types of coal.
- The carbon content is between 92.1% and 98%.
- It is used mainly in power generation, in the metallurgy sector.
- Anthracite accounts for about 1% of global coal reserves and is mined in only a few countries around the world.
- China accounts for the majority of global production; other producers are Russia, Ukraine, North Korea, Vietnam, the UK, Australia, and the US. Anthracite (more than 80% carbon content) is the best quality of coal.

- In India, it is found only in Jammu and Kashmir.

Bituminous / Black Coal

- Bituminous coal or black coal is relatively soft coal containing a tarlike substance called bitumen.
- It is of higher quality than lignite coal but of poorer quality than anthracite.
- The carbon content of bituminous coal is around 60-80%; the rest is composed of water, air, hydrogen, and sulfur.
- About 80 percent of the coal deposits in India are of a bituminous type and is of non-coking grade.

Lignite

- The lignite reserves stand at a level of 41.96 billion tones, of which 90% occur in the southern State of Tamil Nadu (Neyveli district).
- Other states where lignite deposits have been located are Rajasthan, Gujarat, Kerala, Jammu & Kashmir, and a union territory of Puducherry.
- Lignite coal generally has a low carbon and a high percentage of moisture and sulfur, along with organic material.
- It is almost 57-58 percent of the total production of tertiary coal and thus, it contributes to 1- 1.5% of total production.

- It is considered the lowest rank of coal due to its relatively low heat content.
- It has carbon content around 20-40% percent.
- It is mined all around the world, is used almost exclusively as a fuel for steam-electric power generation, and is the coal that is most harmful to health.

Viability Gap Funding (VGF)

- Viability Gap Funding (VGF) means a grant one-time or deferred, provided to support infrastructure projects that are economically justified but fall short of financial viability.
- If the sponsoring Ministry/State Government/ statutory entity aim to provide assistance over and above the stipulated amount under VGF, it will be restricted to a further 20% of the total project cost.