Deposits reflect geological history

Energy resources are not spread uniformly across Earth. The key question is which past conditions formed, concentrated and preserved a usable deposit in a particular region.

1. COAL RECORDS ANCIENT PLANT-RICH ENVIRONMENTS

Coal formed from accumulated plant material that was buried and altered by heat and pressure over millions of years. Regions with suitable ancient swamp deposits and later burial histories can contain coal seams. A modern forest does not prove that coal lies beneath it, and a present-day dry landscape may overlie rocks formed in a very different ancient environment.

2. OIL AND GAS REQUIRE A SUITABLE PETROLEUM SYSTEM

Organic material buried with sediments can generate oil or natural gas as it experiences suitable temperatures over time. Sedimentary basins can provide thick sequences of source and reservoir rocks. In conventional accumulations, hydrocarbons migrate and collect where rock layers and structures trap them. Not every sedimentary basin contains a useful deposit: the right materials, burial history, timing and preservation must occur together.

3. URANIUM ORES REQUIRE CONCENTRATION

Uranium occurs in many rocks, but a trace amount is different from a concentrated ore deposit. Geological processes can move and concentrate uranium in particular places. For example, groundwater can transport dissolved uranium and deposit uranium minerals where chemical conditions change in sandstone. Other uranium deposits occur in different rock settings; there is no single rock type that contains all uranium ore.

THE COMMON PRINCIPLE

Geology controls where deposits occur. Population, demand and political borders do not create the underground resource, although they influence its development and use.

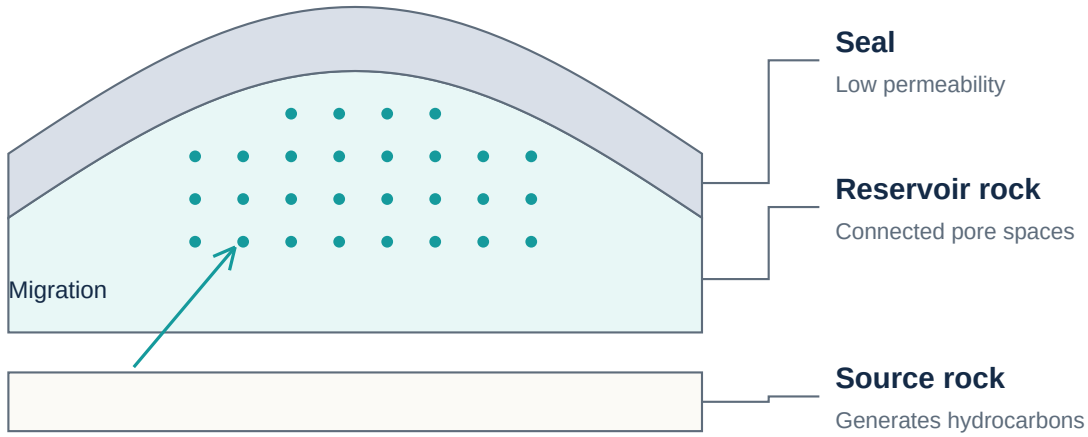
Coal formation: US EIA, Coal Explained.
Gas formation and accumulations: US EIA, Natural Gas Explained.
Uranium concentration: USGS, Geology and Genesis of Uranium Deposits.

Scope: College Board AP Environmental Science CED, Topic 6.4, p. 123.

Read the rocks, not just the surface

A simplified conventional oil-and-gas trap shows how source rock, reservoir rock and a seal work together. This model explains an accumulation, not every type of petroleum deposit.

1. A CONVENTIONAL TRAP IN CROSS-SECTION



Schematic, not to scale. Dots represent hydrocarbons in enlarged pores.

Oil and gas occupy spaces within rock, not a giant underground lake. A porous reservoir holds fluids; connected pores allow flow. A low-permeability seal and the trap geometry restrict escape, allowing an accumulation to persist.

2. THE ORDER AND TIMING MATTER

Source material must be preserved and buried under suitable conditions. Generated hydrocarbons need a migration route and a place to accumulate. A trap must be effective when hydrocarbons arrive and remain sealed afterward. Erosion, faulting or an ineffective seal can alter or destroy an accumulation. These differences help explain why nearby regions can have very different resources.

3. DO NOT APPLY THIS MODEL TO EVERY DEPOSIT

Some oil and gas remain in low-permeability source rocks, including shale. Such resources may require different recovery methods. Coal seams and uranium ores also have different formation histories.

Source, reservoir, seal and timing: USGS, Petroleum System Modeling Capabilities.
Conventional and unconventional accumulations: US EIA, Natural Gas Explained.
Core link: College Board, ENG-3.D.1, geological history and uneven distribution.

Scope: College Board AP Environmental Science CED, Topic 6.4, p. 123.

Separate location from usable supply

Extension: finding an energy resource, producing it and consuming energy are different things. These distinctions help you interpret maps and explain why a deposit may remain undeveloped.

1. RESOURCE, PRODUCTION AND USE ARE DIFFERENT

Resource location
Where it occurs

→

Production
Where it is extracted

→

Consumption
Where energy is used

A resource map does not automatically show mines, wells or energy demand. Transport and trade can connect a producing region to users elsewhere. Before comparing maps, read the legend: deposit locations, reserve estimates, annual production and annual consumption describe different quantities.

2. A DEPOSIT IS NOT ALL RECOVERABLE FUEL

A resource describes the material that exists or is estimated to exist. A reserve estimate applies additional criteria for known material and recoverability, including technical and economic conditions. Definitions differ by resource and reporting system, so check the source rather than treating every mapped tonne as extractable.

Cost, mining losses, infrastructure and land-use restrictions can limit recovery. A change in reserve estimates does not mean new fossil fuel formed on a human time scale.

3. COMPARE REGIONS USING PHYSICAL EVIDENCE

Imagine two regions with similar populations. Region A contains a sedimentary basin with suitable source rocks and preserved traps; Region B lacks those conditions but has accessible high-temperature geothermal reservoirs. Their energy options can differ because their geology differs, not because one population needs energy more. Geothermal heat exists within Earth broadly, but accessible high-temperature resources are often associated with tectonically active areas. A promising resource still requires site-specific investigation before development.

Geologic controls on deposits: College Board, ENG-3.D.1.
Resource and recovery measures: US EIA, How Much Coal Is Left?
Geothermal location: US EIA, Where Geothermal Energy Is Found.

Scope: College Board AP Environmental Science CED, Topic 6.4, p. 123.