SENIOR FIVE TERM 3

TOPIC 3/3: Energy Production

Competency: The learner devises innovative ways of developing and using energy through analysing the production, consumption and sustainability of the various sources of energy to balance energy use and environmental stewardship.

Major Energy Resources

The world's major energy resources include **fossil fuels (coal, oil, natural gas), nuclear energy, and renewable sources (hydropower, solar, wind, geothermal, biomass)**. Fossil fuels still dominate globally, but renewables are rapidly growing in importance.

(i) Coal
- One of the earliest energy sources used by humans.
- Still widely used for electricity generation, especially in Asia.
- High carbon emissions make it less sustainable.

(ii) Oil
- Primary source for transportation fuels (petrol, diesel, jet fuel).
- Also used in petrochemical industries.
- Vulnerable to price fluctuations and geopolitical tensions.

(iii) Natural Gas
- Cleaner than coal and oil, used for heating, electricity, and industry.
- Increasingly important as a "transition fuel" toward renewables.

(iv) Nuclear Energy
- Provides large-scale electricity with low carbon emissions.
- Challenges include radioactive waste disposal and safety concerns.

(v) **Hydropower**
- Uses flowing water to generate electricity.
- Major renewable source in countries like Uganda, China, and Brazil.
- Can disrupt ecosystems if dams are poorly managed.

(vi) Solar Energy
- Harnesses sunlight through photovoltaic cells.

- Rapidly expanding due to falling costs and global climate goals.

(vii) Wind Energy

- Converts wind into electricity using turbines.
- Growing in Europe, North America, and parts of Africa.

(viii) Geothermal Energy

- Uses heat from beneath the Earth's crust.
- Reliable but limited to regions with volcanic activity (e.g., Kenya, Iceland).

(ix) **Biomass**

- Organic material (wood, crop waste, dung) used for cooking and heating.
- Still important in rural areas of Africa and Asia.

Comparison Table

Resource	Global Role	Key Advantages	Main Challenges
Coal	Major electricity source	Abundant, cheap	High emissions
Oil	Transport & industry	Energy-dense	Price volatility, pollution
Natural Gas	Heating & power	Cleaner than coal/oil	Methane leaks
Nuclear	Electricity	Low carbon	Waste, safety risks
Hydropower	Renewable electricity	Reliable, large-scale	Ecosystem disruption
Solar	Growing fast	Clean, scalable	Weather-dependent
Wind	Expanding globally	Clean, efficient	Location-specific
Geothermal	Regional	Reliable, low emissions	Limited geography
Biomass	Rural energy	Accessible, renewable	Indoor pollution

Note

- Fossil fuels still supply **~81% of global energy**.
- Renewables are crucial for **climate change mitigation** and **energy security**.
- Countries like Uganda rely heavily on **hydropower**, but are exploring **solar and biomass** to diversify.

Renewable Energy Sources

These are energy sources that **naturally replenish** and are sustainable over time.

- **Solar energy**: Harnessed from sunlight using solar panels.
- **Wind energy**: Generated by wind turbines.
- **Hydropower**: Produced from flowing water in rivers and dams.
- **Geothermal energy**: Heat from beneath the Earth's crust.

- **Biomass energy**: Organic materials like crop waste, wood, and dung.
- **Tidal/Wave energy**: Energy from ocean tides and waves.

 ***Key feature*:** They are clean, sustainable, and reduce greenhouse gas emissions.

Non-Renewable Energy Sources

These are energy sources that **cannot be replenished quickly**; once used, they are depleted.

- **Coal**: Fossil fuel formed from ancient plant matter.
- **Oil (Petroleum)**: Used for transport fuels and industry.
- **Natural gas**: Cleaner than coal and oil but still finite.
- **Nuclear energy**: Uses uranium; though low-carbon, uranium is limited and waste disposal is challenging.

Distribution of energy resources in Uganda

(i) **Hydropower (Renewable)**
- Concentrated along the **Victoria Nile** (Nalubaale/Owen Falls, Kiira, Bujagali, Karuma dams).
- Smaller hydropower stations on rivers like Mpanga, Nyagak, and Ishasha.
- Provides ~80% of Uganda's electricity.

(ii) **Biomass (Renewable)**
- Widely used in rural areas (firewood, charcoal, crop residues).
- Accounts for ~90% of household energy consumption.
- Distributed across the country, especially in agricultural regions.

(iii) **Solar Energy (Renewable)**
- High potential due to equatorial location.
- Solar mini-grids and rooftop systems expanding in rural areas (Karamoja, Northern Uganda).

(iv) **Oil & Gas (Non-renewable)**
- Discovered in the **Albertine Graben (Lake Albert region)**.
- Reserves estimated at 6.5 billion barrels, with Hoima as the hub for refinery and pipeline projects.

(v) **Geothermal (Renewable, potential)**
- Sites in **Katwe, Buranga, and Kibiro** (Western Rift Valley).
- Still under exploration, not yet commercialized.

Distribution of Energy Resources in East Africa

(i) **Kenya**
- **Geothermal**: Rift Valley (Olkaria, Menengai) – world leader in geothermal power.
- **Wind**: Lake Turkana Wind Project.
- **Hydropower**: Tana River dams.

- **Solar**: Northern Kenya (Garissa solar plant).

(ii) **Tanzania**
- **Natural Gas**: Offshore reserves near Songo Songo and Mnazi Bay.
- **Coal**: Deposits in Ngaka and Kiwira.
- **Hydropower**: Rufiji River (Stiegler's Gorge project).
- **Renewables**: Expanding solar and wind potential.

(iii) **Rwanda & Burundi**
- **Hydropower**: Shared projects on rivers like Rusumo Falls.
- **Methane gas**: Lake Kivu (Rwanda) – unique energy resource.
- **Solar**: Small-scale rural electrification projects.

Factors influencing the distribution of energy resources

The distribution of energy resources across the world (and within regions like Uganda and East Africa) is shaped by a mix of **natural, economic, technological, and political factors**. Here's a clear breakdown:

(i) Natural/Physical Factors

- **Geological formations**: Fossil fuels (coal, oil, natural gas) occur in sedimentary basins. Example: Uganda's oil reserves in the **Albertine Graben**.
- **Climate and sunlight**: Solar energy potential is highest in equatorial and desert regions. Example: East Africa has high solar potential due to year-round sunshine.
- **Topography and water flow**: Hydropower depends on rivers, waterfalls, and elevation differences. Example: Uganda's **Victoria Nile** supports major dams.
- **Volcanic activity**: Geothermal energy is concentrated in tectonic rift zones. Example: Kenya's Rift Valley geothermal fields.

(ii) Economic Factors

- **Capital investment**: Developing energy resources requires huge funding (dams, oil rigs, solar farms).
- **Market demand**: Regions with high industrial activity prioritize energy development.
- **Infrastructure**: Transport networks (pipelines, transmission lines) determine where resources can be exploited.

(iii) Technological Factors

- **Level of technology**: Advanced drilling, solar panel efficiency, and wind turbine design influence resource use.
- **Research and innovation**: Countries with strong R&D harness renewables more effectively.
- **Energy storage**: Battery technology affects solar and wind distribution.

(iv) Political & Social Factors

- **Government policies**: Subsidies, incentives, and regulations shape energy distribution.
- **Regional cooperation/conflict**: Shared resources (like the Nile) require agreements between countries.
- **Environmental concerns**: Climate change policies push nations toward renewables.
- **Population distribution**: Areas with dense populations need more energy infrastructure.

Summary Table

Factor Type	Influence on Distribution	Example
Geological	Determines fossil fuel & geothermal locations	Oil in Albertine Graben (Uganda)
Climate	Solar & wind potential	Solar farms in Northern Kenya
Topography	Hydropower sites	Victoria Nile dams
Economic	Investment & demand	Pipelines in Tanzania
Technological	Efficiency & exploitation	Kenya's geothermal plants
Political/Social	Policies & cooperation	Nile Basin water agreements

Energy production and consumption in Developed Countries

- **Production**
  - High reliance on advanced technologies (nuclear, renewables, fossil fuels).
  - Large-scale infrastructure for oil refining, hydropower, and wind/solar farms.
  - Example: USA produces energy from oil, natural gas, coal, nuclear, and renewables.
- **Consumption**
  - Very high per capita energy use due to industrialization, transport, and modern lifestyles.
  - Heavy dependence on electricity and petroleum for cars, industries, and households.
  - Example: USA consumes ~10 times more energy per person than many African countries.
- **Implication**
  - Developed countries face challenges of **overconsumption, pollution, and climate change**, making wise use critical for sustainability.

Energy production and consumption in Developing Countries

- **Production**
  - Limited infrastructure; often rely on **hydropower, biomass, and small-scale solar**.
  - Fossil fuel reserves (oil, gas, coal) may exist but are underdeveloped due to capital constraints.
  - Example: Uganda produces most of its electricity from hydropower (Victoria Nile dams).
- **Consumption**
  - Lower per capita energy use, but heavy reliance on **biomass (firewood, charcoal)** for cooking and heating.
  - Electricity access is limited, especially in rural areas.
  - Example: In Uganda, ~90% of households depend on biomass, while only ~30% have reliable electricity.
- **Implication**
  - Developing countries face challenges of **energy poverty, deforestation, and health risks** from biomass use. Wise resource use means expanding clean energy without degrading ecosystems.

Comparative Table

Aspect	Developed Countries	Developing Countries
Production	Diverse: fossil fuels, nuclear, renewables	Mainly hydropower, biomass, small-scale solar
Consumption	High per capita, industrial & transport heavy	Low per capita, household biomass dominant
Challenges	Overconsumption, pollution, climate change	Energy poverty, deforestation, limited access
Need for Wise Use	Reduce emissions, shift to renewables	Expand clean energy, conserve ecosystems

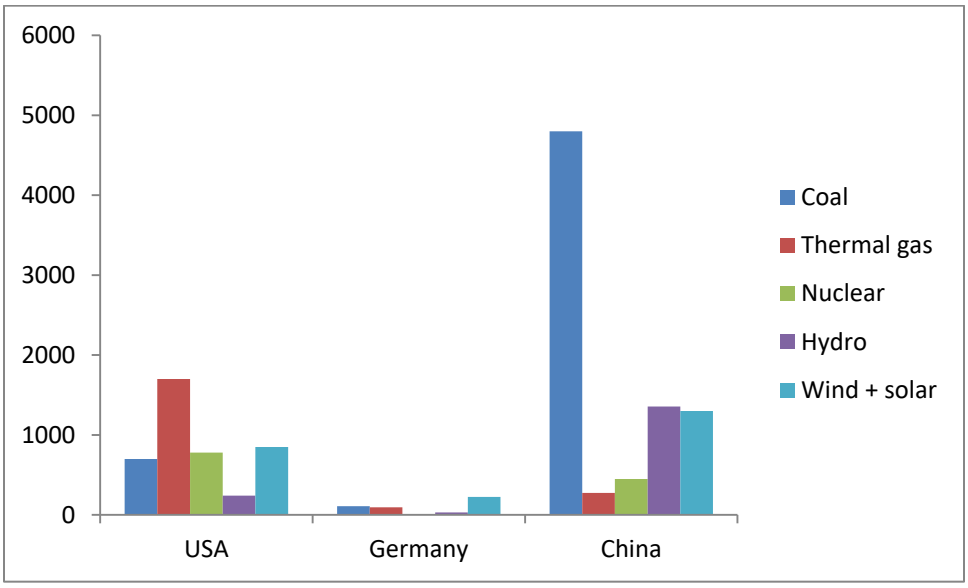
Why Wise Use of Energy Resources Matters

- **Global sustainability**: Developed countries must cut emissions, while developing countries must avoid unsustainable exploitation.
- **Equity**: Wise use ensures fair access to energy for all populations.
- **Future security**: Conserving non-renewables and investing in renewables prevents crises.
- **Health & environment**: Reduces pollution, deforestation, and climate risks.

A table showing different sources of energy generated (TWh) by four countries in 2024

Country/ energy type	USA	Germany	China	Uganda
Coal	700	108	4800	0
Thermal gas	1700	95	0	0.15
Nuclear	800	12	450	0
Hydro	242	30	1356	6
Wind + solar	850	225	1300	0.2

A bar showing different sources of energy generated (TWh) by three countries in 2024



Uganda is not included on the bar chart because it has negligible energy output

The factors affecting the development of energy resources in Uganda

The development of energy resources in Uganda is shaped by **natural factors (geology, rivers, climate), economic constraints (capital, infrastructure), technological capacity, political and policy frameworks, and social/environmental considerations**.

(i) Geological and Natural Endowment
- Oil reserves in the **Albertine Graben** provide potential for petroleum development.
- Abundant rivers (Victoria Nile, Mpanga, Nyagak) support hydropower.
- High solar radiation across the country enables solar energy expansion.
- Geothermal potential exists in Rift Valley sites (Katwe, Buranga, Kibiro).

(ii) Economic and Financial Constraints
- Large-scale projects (hydropower dams, oil refinery, pipelines) require heavy investment.
- Limited domestic capital means reliance on foreign investors and loans.
- Energy poverty persists, with many households still dependent on biomass.

(iii) Technological Capacity
- Limited local expertise in oil refining, geothermal drilling, and advanced renewables.
- Dependence on imported technology raises costs and slows adoption.
- Weak grid infrastructure limits electricity distribution, especially in rural areas.

(iv) Political and Policy Environment
- Government policies (Uganda Energy Transition Plan 2023) emphasize renewables and efficiency.
- Regional cooperation is needed for shared resources like the Nile.
- Policy uncertainty and corruption risks can discourage investors.

(v) Social and Environmental Considerations
- Biomass use (firewood, charcoal) causes deforestation and health risks.
- Hydropower dams can displace communities and affect ecosystems.
- Public acceptance of renewables depends on awareness and affordability.
- Climate change impacts (variable rainfall, droughts) affect hydropower reliability.

The factors affecting the development of energy resources in the world

The development of energy resources worldwide is influenced by a complex mix of **natural, economic, technological, political, and environmental factors**. Here's a clear breakdown:

(i) Natural / Physical Factors

- **Geological formations**: Fossil fuels (coal, oil, natural gas) occur in sedimentary basins; geothermal energy is concentrated in tectonic zones.
- **Climate and sunlight**: Solar energy potential is highest in equatorial and desert regions.
- **Topography and water flow**: Hydropower depends on rivers, waterfalls, and elevation differences.
- **Resource distribution**: Uneven global distribution means some regions are resource-rich (Middle East oil, China coal) while others rely on imports.

(ii) Economic Factors

- **Capital investment**: Energy projects (dams, nuclear plants, oil rigs, solar farms) require huge funding.

- **Market demand**: Industrialized nations consume more energy, driving development.
- **Infrastructure**: Pipelines, transmission lines, and refineries determine where resources can be exploited.
- **Global trade**: Energy resources are traded internationally, influencing development in resource-rich vs resource-poor countries.

(iii) Technological Factors

- **Level of technology**: Advanced drilling, renewable energy systems, and nuclear reactors enable resource exploitation.
- **Innovation**: Improvements in solar panels, wind turbines, and battery storage expand renewable use.
- **Efficiency**: Energy-efficient technologies reduce demand and shape resource development.

(iv) Political & Policy Factors

- **Government policies**: Subsidies, incentives, and regulations encourage or discourage certain energy sources.
- **International agreements**: Climate accords (e.g., Paris Agreement) push countries toward renewables.
- **Geopolitical tensions**: Oil and gas resources often cause conflicts or alliances (e.g., Middle East, Russia-Europe gas).
- **Energy security**: Nations prioritize domestic production to reduce reliance on imports.

(v) Environmental & Social Factors

- **Climate change concerns**: Pressure to reduce carbon emissions drives renewable energy development.
- **Public acceptance**: Nuclear energy faces opposition due to safety concerns; wind farms may face local resistance.
- **Population growth**: Rising demand for electricity and fuel influences energy development.
- **Sustainability**: Balancing exploitation with conservation is critical for long-term development.

Table of comparison of the factors affecting the development of energy resources in developed and developing countries

Factor Type	Developed Countries	Developing Countries
Geological / Natural Endowment	Often depleted fossil fuel reserves, but strong investment in renewables (solar, wind, nuclear).	Rich in untapped resources (oil, gas, hydro, solar), but underutilized due to limited capital.
Economic / Financial Capacity	High investment capacity, strong infrastructure, diversified energy mix.	Limited funding, reliance on foreign aid/investors, weak infrastructure, energy poverty common.
Technological Capacity	Advanced technology for exploration, refining, renewables, and energy storage.	Limited technology, dependence on imports, slower adoption of modern energy systems.
Political / Policy Environment	Strong regulatory frameworks, climate policies (Paris Agreement), subsidies for renewables.	Weak enforcement of policies, political instability, corruption risks, focus on short-term gains.
Social / Environmental Factors	Public pressure for clean energy, strong environmental movements, high awareness of climate change.	Heavy reliance on biomass (firewood, charcoal), deforestation, health risks, low awareness of sustainability.
Infrastructure & Access	Extensive transmission networks, reliable electricity access, smart grids.	Poor grid coverage, rural electrification challenges, reliance on mini-grids and off-grid solutions.
Global Trade & Geopolitics	Major players in global energy markets, influence prices and policies.	Vulnerable to global price fluctuations, often resource exporters with little local value addition.

Benefits of harnessing energy development

Harnessing energy development brings **wide-ranging benefits** for economies, societies, and the environment. Here's a clear breakdown:

(i) Economic Benefits

- **Industrial growth**: Reliable energy powers factories, businesses, and services.
- **Job creation**: Energy projects (hydropower dams, solar farms, oil refineries) create employment.
- **Revenue generation**: Export of oil, gas, or electricity earns foreign exchange.
- **Infrastructure expansion**: Energy development stimulates roads, transmission lines, and urban growth.

(ii) Social Benefits

- **Improved living standards**: Access to electricity enables lighting, cooking, refrigeration, and communication.
- **Education**: Schools benefit from electricity for computers, internet, and lighting.
- **Healthcare**: Hospitals use energy for equipment, refrigeration of medicines, and clean water supply.
- **Rural electrification**: Extends opportunities to marginalized communities, reducing inequality.

(iii) Environmental Benefits

- **Renewable energy reduces emissions**: Solar, wind, and hydropower cut greenhouse gases compared to fossil fuels.
- **Sustainable resource use**: Properly managed energy projects protect ecosystems and reduce deforestation.
- **Climate resilience**: Diversified energy sources reduce vulnerability to climate shocks.

(iv) Strategic & Political Benefits

- **Energy security**: Countries reduce dependence on imports by harnessing local resources.
- **Regional integration**: Shared energy projects (like Nile hydropower or East African pipelines) strengthen cooperation.
- **Global competitiveness**: Nations with strong energy systems attract investment and trade.

Problems associated with of harnessing energy development

(i) Environmental Problems

- **Pollution**: Burning fossil fuels releases greenhouse gases, contributing to climate change.
- **Deforestation**: Heavy reliance on biomass (firewood, charcoal) leads to forest loss, especially in developing countries.
- **Ecosystem disruption**: Hydropower dams alter river flow, affect fish migration, and flood habitats.
- **Waste disposal**: Nuclear energy produces radioactive waste that is difficult to manage safely.

(ii) Economic Problems

- **High costs**: Energy projects (dams, oil refineries, solar farms) require huge capital investments.

- **Price volatility**: Oil and gas prices fluctuate globally, affecting economies.
- **Unequal access**: Rural areas often remain underserved, widening the gap between urban and rural communities.

(iii) Technological Problems

- **Limited expertise**: Developing countries may lack skilled manpower for advanced energy technologies.
- **Infrastructure gaps**: Weak transmission networks cause power losses and unreliable supply.
- **Storage challenges**: Renewable sources like solar and wind need effective storage solutions to balance supply.

(iv) Political & Social Problems

- **Resource conflicts**: Shared resources (like the Nile waters) can cause disputes between countries.
- **Corruption & mismanagement**: Poor governance can delay projects or misuse funds.
- **Displacement of communities**: Large projects (dams, oil fields) often force people to relocate.
- **Public resistance**: Nuclear plants, wind farms, or pipelines may face opposition due to safety or land concerns.

Uganda's Key Policies and Strategies for Sustainable Energy

(i) **Energy Policy for Uganda 2023 (EP2023)**
- Vision: *Universal access to sustainable, affordable, and quality energy services for all Ugandans by 2040*.
- Focus on **renewable energy expansion** (hydropower, solar, wind, biomass, geothermal).
- Promote **energy efficiency** in households, industry, and transport.
- Encourage **private sector investment** and public-private partnerships.
- Strengthen governance through agencies like ERA (Electricity Regulatory Authority).

(ii) **National Development Plan (NDP III, 2020–2025)**
- Energy sector prioritized as a driver of industrialization.
- Targets expansion of electricity generation capacity and rural electrification.
- Promotes clean cooking solutions to reduce biomass dependence.

(iii) **Vision 2040**
- Long-term strategy to transform Uganda into a modern, prosperous country.
- Energy sector identified as central to economic transformation.
- Calls for diversification of energy sources and regional integration.

(iv) **Renewable Energy Strategy**
- Promote **solar mini-grids** and off-grid solutions for rural communities.
- Support biomass alternatives (biogas, improved cookstoves).

- Explore geothermal potential in Rift Valley sites (Katwe, Buranga, Kibiro).

(v) **Electricity Connections Policy (2018–2027)**

- Aim: Increase electricity access from ~30% to 60% of households.
- Subsidizes grid connections for low-income households.

Comparison table of energy policy of Uganda and that of Canada

Uganda's energy policy (2023) focuses on **universal access, renewable expansion, and rural electrification**, while Canada's energy policy (2023 outlook) emphasizes **net-zero by 2050, decarbonization, and energy transition pathways**. Uganda is tackling energy poverty and infrastructure gaps, whereas Canada is managing emissions reduction and diversification of a mature energy system.

Comparison Table: Uganda vs Canada Energy Policy

Aspect	Uganda Energy Policy 2023	Canada Energy Future 2023
Vision/Goal	Universal access to sustainable, affordable, quality energy services by 2040	Achieve net-zero greenhouse gas emissions by 2050
Main Focus	Expand renewables (hydro, solar, biomass, geothermal), improve efficiency, rural electrification	Transition from fossil fuels to renewables, electrification, carbon capture, hydrogen
Challenges Addressed	Energy poverty, reliance on biomass, weak grid infrastructure, financing gaps	High emissions, fossil fuel dependence, balancing economic growth with climate goals
Key Strategies	Subsidized electricity connections, private sector investment, clean cooking solutions, regional cooperation	Scenario modeling for energy futures, policy pathways for decarbonization, investment in clean tech
Primary Energy Mix	Hydropower (~80%), biomass (~90% of households), growing solar, oil reserves in Albertine Graben	Oil, natural gas, hydro, nuclear, growing wind/solar
Policy Instruments	Electricity Connections Policy, Renewable Energy Strategy, Vision 2040	Canada Energy Regulator scenarios, federal climate policies, carbon pricing
Long-Term Outlook	Diversify energy sources, reduce biomass reliance, industrialize sustainably	Net-zero economy, clean energy leadership, global competitiveness

Key Insights

- **Uganda**: Policy is about *access and affordability*, tackling energy poverty and expanding renewables to rural areas.
- **Canada**: Policy is about *transition and decarbonization*, reducing emissions while maintaining energy security.
- Both highlight sustainability, but Uganda's priority is **development and access**, while Canada's is **climate leadership and emissions reduction**.

Comparison table of energy policy of Uganda and that of Zimbabwe

Uganda's energy policy (2023) emphasizes **universal access, renewable expansion, and rural electrification**, while Zimbabwe's energy policy (2019 Renewable Energy Policy & Vision 2030 Compact) focuses on **clean energy transition, reducing biomass dependence, and achieving universal access by 2030**. Uganda is tackling energy poverty with hydropower and solar, while Zimbabwe is prioritizing diversification and climate resilience.

Comparison Table: Uganda vs Zimbabwe Energy Policy

Aspect	Uganda Energy Policy 2023	Zimbabwe Renewable Energy Policy 2019 & Energy Compact
Vision/Goal	Universal access to sustainable, affordable, quality energy services by 2040	Clean energy for all Zimbabweans by 2030, aligned with Vision 2030
Main Focus	Expand renewables (hydro, solar, biomass, geothermal), improve efficiency, rural electrification	Promote renewable energy (solar, hydro, wind, biomass), reduce reliance on traditional biomass
Challenges Addressed	Energy poverty, reliance on biomass, weak grid infrastructure, financing gaps	38% of population lacks electricity, 61% rely on biomass for cooking
Key Strategies	Subsidized electricity connections, private sector investment, clean cooking solutions, regional cooperation	Renewable energy targets, incentives for private sector, climate resilience, SDG 7 alignment
Primary Energy Mix	Hydropower (~80%), biomass (~90% of households), growing solar, oil reserves in Albertine Graben	Hydropower, solar, biomass, coal; growing focus on solar mini-grids and independent power producers
Policy Instruments	Electricity Connections Policy, Renewable Energy Strategy, Vision 2040	National Renewable Energy Policy (2019), National Energy Compact (Vision 2030)
Long-Term Outlook	Diversify energy sources, reduce biomass reliance, industrialize sustainably	Universal access by 2030, leapfrog to renewables, climate-resilient energy system

Debate whether developing countries should prioritise renewable or non-renewable energy sources to ensure long-term energy security.

Argument for Prioritising Renewable Energy

- **Sustainability**: Renewables (solar, wind, hydro, geothermal) are inexhaustible and reduce dependence on finite fossil fuels.
- **Climate resilience**: Developing countries are often most vulnerable to climate change; renewables reduce emissions and environmental damage.
- **Energy access**: Off-grid solar and mini-grids can quickly electrify rural areas without waiting for costly national grid expansion.

- **Economic independence**: Reduces reliance on imported oil and gas, shielding economies from global price shocks.
- **Job creation**: Renewable projects foster local employment in installation, maintenance, and innovation.

Argument for Prioritising Non-Renewable Energy

- **Reliability**: Fossil fuels (coal, oil, gas) provide consistent baseload power, unlike intermittent solar and wind.
- **Existing infrastructure**: Many developing countries already have systems built around fossil fuels, making them cheaper to expand in the short term.
- **Revenue generation**: Oil and gas exports can bring in foreign exchange to fund development.
- **Industrialization needs**: Heavy industries often require large, stable energy supplies that renewables may struggle to provide without advanced storage.
- **Transition fuel**: Natural gas, in particular, is seen as a bridge between coal/oil and renewables.

Comparative Table

Aspect	Renewables	Non-Renewables
Availability	Abundant, naturally replenished	Finite, geographically uneven
Cost Trend	Falling costs (solar, wind)	Rising costs, price volatility
Environmental Impact	Low emissions, eco-friendly	High emissions, pollution
Infrastructure Needs	Requires new grids, storage	Uses existing systems
Energy Security	Reduces import dependence	Vulnerable to global markets
Suitability for Growth	Good for rural electrification	Strong for industrial baseload

Conclusion

- **Short-term**: Non-renewables may still play a role in industrialization and revenue generation.
- **Long-term**: Renewables are the only sustainable path to energy security, especially for countries like Uganda that have abundant solar and hydropower potential.
- **Balanced approach**: Developing countries should adopt a **hybrid strategy**—using non-renewables as transition fuels while aggressively scaling up renewables to secure their future.

Thank You

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