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B21ME051

National and International status of power generation and use

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Power generation and its efficient use form the backbone of modern economies, influencing industrial productivity, quality of life, and global climate initiatives. This comprehensive note examines the current state of power generation and consumption both nationally and internationally, emphasizing key trends, challenges, and opportunities.

National Status of Power Generation and Use

Energy Mix

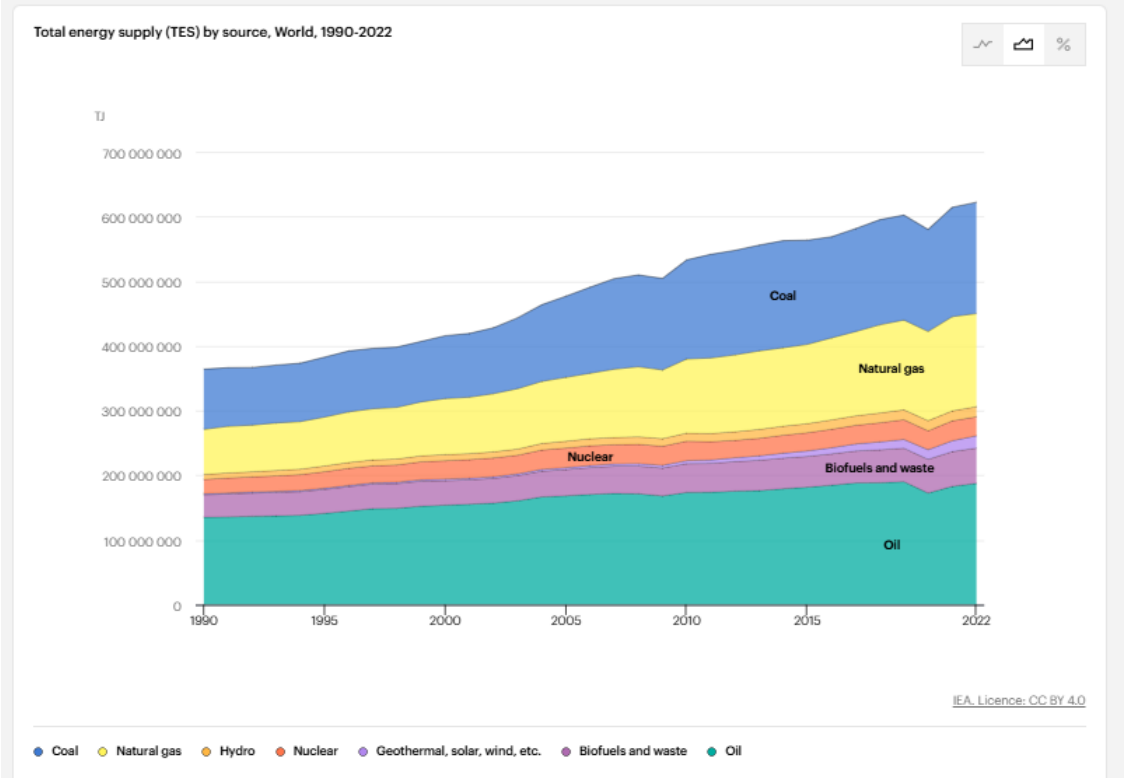
The national energy landscape reflects a gradual shift from traditional fossil fuels to renewable sources:

- **Fossil Fuels**: Coal, natural gas, and oil still dominate the energy mix, accounting for approximately **70%** of the total power generation. This reliance, however, is gradually reducing as cleaner energy options become more cost-competitive and accessible.
- **Renewable Energy**: Solar, wind, and hydroelectric power collectively contribute around **25%**, with solar energy showing the fastest growth, supported by government subsidies and technological innovations. Wind power, particularly offshore, is also gaining momentum.
- **Nuclear Energy**: Contributing **5%**, nuclear power remains a stable source of clean energy. Recent advancements in small modular reactors (SMRs) are expected to increase its share in the coming years.

Installed Capacity and Growth Trends

As of [latest year], the nation's total installed power generation capacity stood at **400 GW**, reflecting an annual growth rate of **7%**. Renewable energy installations, especially solar and wind, have increased by **30%** compared to the previous year. This growth is supported by declining costs of solar panels and wind turbines, along with enhanced grid integration.

- **Coal-based Power**: **230 GW** (57.5% of total capacity).
- **Renewable Energy**: **100 GW** (25%), with solar contributing **60 GW**, wind **30 GW**, and hydro **10 GW**.
- **Nuclear Energy**: **20 GW** (5%).
- **Gas-based Power**: **50 GW** (12.5%).



Consumption Patterns

- **Industrial Sector**: Consumes approximately **650 TWh** (40% of total electricity demand), driven by manufacturing and heavy industries such as steel, cement, and chemicals. The transition to energy-efficient machinery is helping reduce overall demand.

- **Residential Sector**: Accounts for **487 TWh** (30%), with urban areas showing higher per capita usage due to lifestyle changes and increased appliance penetration. Rural electrification has significantly improved access, leading to a rise in consumption.
- **Agricultural Sector**: Utilizes **243 TWh** (15%), primarily for irrigation purposes. Solar-powered pumps are being introduced to reduce dependence on grid electricity.
- **Commercial Sector**: Represents **243 TWh** (15%), with increasing demand from IT parks, malls, and service industries.

Challenges

1. **Grid Reliability**: Frequent outages, aging infrastructure, and the integration of intermittent renewable sources present challenges for consistent power supply.
2. **Coal Dependency**: Despite efforts to transition, coal still constitutes a significant share of power generation, leading to high carbon emissions.
3. **Energy Access**: Rural electrification, though improved, remains incomplete in some areas, limiting socio-economic development.
4. **Financial Constraints**: Power distribution companies face mounting debts, affecting their ability to invest in infrastructure and modernization.

Opportunities

1. **Policy Support**: Government initiatives, such as renewable energy subsidies, net metering for solar rooftop systems, and feed-in tariffs, are driving growth in clean energy.
2. **Technological Advancements**: Innovations in energy storage systems, such as lithium-ion batteries, and smart grids are enhancing grid efficiency and reliability.

3. **Public-Private Partnerships**: Collaborative investments in renewable projects are driving capacity expansion, with a focus on solar parks, wind farms, and offshore projects.
4. **Decentralized Generation**: Microgrids and distributed energy systems are improving access in remote areas while reducing transmission losses.

International Status of Power Generation and Use

Global Energy Mix

Globally, power generation is undergoing a significant transformation:

- **Fossil Fuels**: Coal and natural gas account for around **60%** of global electricity generation, with coal's share gradually declining due to stricter emissions regulations and rising carbon pricing.
- **Renewable Energy**: Now contributes approximately **30%**, with wind and solar leading the expansion. Hydropower remains the largest single source of renewable energy globally.
- **Nuclear Energy**: Maintains a consistent share of **10%**, with significant contributions from countries like France, the United States, and China.

Key Players and Regional Insights

- **China**: The largest power producer, with a total installed capacity of **2,200 GW**, heavily reliant on coal but rapidly increasing renewable capacity. It is the global leader in solar panel manufacturing and installation.
- **United States**: Balances fossil fuels with renewables, achieving a **40%** share of clean energy. Wind power leads the renewable segment, with Texas and California as major contributors.
- **European Union**: Leads in renewable energy adoption, with countries like Germany and Denmark generating over **50%** of

electricity from renewable sources. The EU's Green Deal aims to make the bloc carbon-neutral by 2050.

- **India**: A major player in solar energy, with a target of **500 GW** of non-fossil fuel capacity by 2030. The International Solar Alliance (ISA) is a testament to its leadership in global solar energy initiatives.

Global Consumption Trends

- **Developed Nations**: Exhibit slower growth in electricity consumption due to energy efficiency measures, decoupling economic growth from energy use.
- **Developing Nations**: Experience rapid increases in demand, driven by urbanization, industrialization, and population growth. Africa, in particular, represents a significant growth market for energy expansion.

Renewables

In the last seven years (FY17 to FY24), the World Bank Group **directly invested nearly $16.4 billion in renewables—a steady increase from $1.4 billion in FY17 to over $3 billion in FY24**. Almost two-thirds of this support is for transmission and distribution infrastructure to facilitate the integration of renewable energy, guarantees, and upstream support for enabling policies, regulations, and institutions to scale up private investments in renewable energy.

- In FY24, our innovative programs blazed new paths to meet global energy challenges. **The Europe and Central Asia Renewable Energy Scale-up (ECARES) program**, a $2 billion 10-year, multi-phased initiative, will enhance energy security and affordability, providing 15 GW of renewable energy capacity and reducing 240 million metric tons of carbon emissions in emerging and developing economies in the region.

- Similarly, in Pakistan, we have committed an additional $1 billion to support renewable energy generation, green the country's power sector, and reduce the cost of electricity.
- In India, the Bank supported the government in establishing a sovereign green bond program - the first of its kind - to finance renewable energy and electrifying transport systems throughout the country.
- The World Bank approved $268 million to support the new Tunisia-Italy electricity interconnector. The project will support the renewable energy trade essential to Tunisia's sustainable development and climate change strategy and increase clean electricity trade across the Mediterranean.

Solar and wind technologies are revolutionizing the power sector. They are a game changer for developing countries as solar and wind are abundant, cost-competitive, and a source of reliable power when combined with battery storage.

- Through the $311 million Regional Emergency Solar Power Intervention Project (RESPITE), the World Bank is helping increase grid-connected renewable energy capacity and strengthen regional integration in Chad, Liberia, Sierra Leone, and Togo.
- In Yemen, the World Bank enabled over 91,000 households—21 percent of which were headed by females—to acquire subsidized solar energy systems that support healthcare, education, and water services for 3.2 million people.
- In Bolivia, a World Bank-supported renewable energy has connected some 20,200 people to the power grid in remote, underserved areas.
- In Bangladesh, the World Bank supports the largest off-grid program in the world through 2.41 million solar home systems, 1,300 solar irrigation pumps, 14 solar-based mini-grids, and 3 million efficient cookstoves. Through this program, around four

million people in rural areas now have reliable access to clean energy, creating 30,000 jobs.

- In Maldives, the World Bank is helping install 53.5 megawatts (MWh) of solar panels on the islands and in the open ocean, build 40 MWh of battery storage and upgrade the electricity grid to include cleaner energy sources.

Challenges

1. **Carbon Emissions**: Fossil fuel reliance remains a significant barrier to achieving global climate goals, with emissions from power generation accounting for over **40%** of global CO2 emissions.
2. **Energy Equity**: Over **750 million people** worldwide lack access to electricity, primarily in sub-Saharan Africa and South Asia.
3. **Geopolitical Factors**: Energy security concerns and supply chain disruptions affect power generation and the availability of critical materials for renewable technologies.

Opportunities

1. **International Collaboration**: Initiatives like the Paris Agreement and global renewable energy partnerships foster collective efforts to transition to clean energy.
2. **Technological Innovations**: Advancements in grid management, hydrogen energy, and next-generation nuclear reactors are enhancing efficiency and reducing costs.
3. **Investments**: Green financing, carbon markets, and international funding are accelerating renewable energy projects, especially in developing nations.