

Energy Conservation, Renewable Resources and Electric Vehicle Adoption

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Abstract:

Pakistan is facing a severe energy crisis driven by urbanization, population growth, and industrialization. As of 2024, the country's power generation heavily relies on fossil fuels, resulting in high production costs and economic instability. This study examines three critical areas to address this crisis: energy conservation, renewable energy sources, and electric vehicle (EV) adoption. Energy conservation initiatives led by the National Energy Efficiency & Conservation Authority (NEECA) are essential for reducing consumption, but challenges like limited enforcement and public awareness hinder progress. Renewable energy policies aim to boost the share of renewables, yet slow project implementation and bureaucratic hurdles remain significant obstacles. EV adoption, supported by the National Electric Vehicle Policy (NEVP), is vital for reducing greenhouse gas emissions, although high initial costs and insufficient charging infrastructure pose challenges. By analyzing global best practices and conducting SWOT analyses, this study identifies gaps and provides recommendations to enhance energy conservation, streamline renewable projects, and promote EV adoption for a sustainable energy future in Pakistan.

Key words:

Energy Crisis, Renewable Energy, Electric Vehicles (EVs), Energy Conservation, Sustainable Development

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Introduction

Pakistan is grappling with a severe, longstanding energy crisis. The demand for energy has surged over the years due to urbanization, population growth, and industrialization. However, Pakistan's traditional sources of energy generation have remained inadequate to cope with the rising demand. As of 2024, Pakistan's installed power generation capacity is 42,131 MW, with 59% derived from thermal sources, 25% from hydropower, 9% from nuclear, and 7% from renewable sources (Bhutto, 2024). For electricity generation, Pakistan relies heavily on fossil fuels and imported energy sources. Thermal power plants, which constitute over 59% of the country's electricity generation capacity, have entangled Pakistan in high production costs and price volatility driven by fluctuations in global oil and gas markets (Bhutto, 2024). This reliance on imported energy sources has adverse effects, as increases in the prices of oil, liquefied natural gas, and coal in international markets result in rising electricity generation costs. In recent years, the prices of these commodities have dramatically increased, causing a sharp depletion in Pakistan's foreign exchange reserves. Consequently, the average generation cost has risen substantially. Moreover, this heavy reliance on imported fossil fuels is a major cause of the trade deficit and has put significant strain on the economy. Additionally, Pakistan has increased its use of coal to meet energy demands. Though this is a cost-effective solution in the short term, it poses severe environmental and health risks, raising concerns about long-term sustainability and climate impact. Furthermore, the energy infrastructure in Pakistan is outdated and insufficient to meet growing demand. The power sector's inefficiencies are exacerbated by chronic underinvestment in transmission and distribution infrastructure, leading to significant technical and commercial losses; nearly 16% of electricity is lost due to transmission inefficiencies and theft. This has contributed to a circular debt exceeding Rs. 2.8 trillion, worsening the financial burden on the government and escalating electricity costs for consumers. Frequent power outages and transmission losses are common, affecting both residential and industrial consumers.

Electricity prices have surged by 155% since 2021, driven by the government's strategies to secure loans from the International Monetary Fund (IMF). The average tariff now stands at \$0.23 per unit, significantly higher than in other developing economies, prompting industries and households to seek alternative energy sources. For instance, farmers are increasingly adopting off-grid solar systems, while businesses are installing rooftop solar panels to mitigate the impact of soaring grid electricity prices (Bhutto, 2024).

Pakistan is also under pressure to address its energy demands amid climate change. The country is particularly vulnerable to climate impacts, especially in sectors reliant on predictable water flows, such as hydropower. In response to this challenge, the government aims to reduce emissions by 50% by 2030, primarily through promoting renewable energy sources and energy conservation measures⁵.

Problem Statement

Pakistan's energy crisis has been aggravated by the inefficient use of energy, limited use of renewable energy resources, and public disinterest in electric vehicles, which has a broader impact on climate change. However, Pakistan has great potential to address these issues. Therefore, the situation warrants an extensive analysis to identify the loopholes in the existing policy and regulatory framework in order to provide a viable solution.

Scope of the Study

This study focuses on the energy sector and its impact on climate change, exploring various aspects such as energy conservation, renewable resources, and the adoption of electric vehicles. It aims to analyze the prevailing policies, regulatory framework, and implementation. The study also explores the potential for energy conservation, renewable energy sources like solar, wind, and hydropower, highlighting the challenges in policy implementation, financial constraints, and infrastructure. The aim is to provide a comprehensive understanding of the efforts, issues, and challenges in achieving a sustainable energy future for Pakistan, leading to a positive impact on the overall climate.

Research methodology

This research employs a mixed methods approach to gather comprehensive data. The methodologies utilized include:

- **Mixed Methods:** A combination of qualitative and quantitative research techniques.
- **Secondary Data Analysis:** Utilization of existing qualitative and quantitative data, including acts, regulations, policies, and projects relevant to the energy sector.
- **Interviews:** Conducted via Zoom with key stakeholders, including the CEO of PEDO, the Additional Director General of NEPRA, and the Section Officer for Climate Change.
- **Literature Review:** Examination of surveys, scholarly articles, journals, and relevant websites to support the analysis.

This multi-faceted approach ensures a robust understanding of the energy landscape and its implications for climate change in Pakistan.

⁵ <https://neeca.gov.pk/Detail/MmE3ZWE0ZWQtMDY4Yy00ZGUzLWFjYTMtZWRhOTg3YTQzYTY4>

Literature Review

Energy Conservation

Energy conservation refers to the set of measures and steps required to reduce energy consumption by using available energy more efficiently and minimizing energy waste⁶. This goal can be achieved through various methods, a few of which are listed below:

- **Efficient Energy Use:** Efficiency in energy use can be achieved by employing technology that requires less energy to perform the same task. For instance, using LED bulbs instead of incandescent bulbs results in lower energy consumption, as incandescent bulbs lose 80-90% of their energy as heat, making them only 10-20% efficient. Similarly, other energy-efficient home appliances can be used to reduce energy consumption (National Energy Efficiency and Conservation Policy, 2023).
- **Behavioral Changes:** Individuals can play a vital role by modifying their habits to reduce energy use, such as turning off lights when not in use and using public transportation instead of driving personal vehicles.
- **Energy Audits:** Surveys can be conducted to identify areas where energy is prone to waste, and this waste can be mitigated by implementing measures to improve efficiency.
- **Off-Peak Scheduling:** The public may be sensitized to use appliances during off-peak hours when energy demand is lower and costs are reduced, as communicated through messages printed on electricity bills.

By adopting these measures and practices, individuals can not only reduce their utility bills but also contribute to lowering greenhouse gas emissions and conserving natural resources (National Energy Efficiency and Conservation Act, 2016).

Policies on Energy Conservation

The National Energy Efficiency and Conservation Policy, 2023: The surge in energy prices and the increasing demand for energy, along with depleting energy resources, necessitate that Pakistan look for measures to enhance energy efficiency and conservation. Improving energy efficiency and conservation is one of the easiest and least costly pathways to enhance a country's energy sector sustainability. Saving one unit of energy is always cheaper than producing one unit. These measures also produce co-benefits such as industrial competitiveness, reduction in the energy import bill, transition to clean energy, and wider access to energy.

The National Energy Efficiency and Conservation Act of 2016 aims to strengthen the energy efficiency and conservation agenda in the country.

⁶ <https://neeca.gov.pk/Detail/MmE3ZWE0ZWQtMDY4Yy00ZGUzLWFjYTMtZWRhOTg3YTQzYTY4>

Moreover, there is an increasing demand to develop effective regulatory measures complemented by appropriate by-laws, regulations, policies, programs, and technical, economic, and fiscal interventions for an effective governance framework for energy efficiency and conservation in Pakistan. The National Energy Efficiency and Conservation Policy 2023 (NEECA Policy 2023) outlines several measures for the industry, transport, and building sectors to enhance energy efficiency and conservation in Pakistan. Here are some key measures for each sector:

1. Industry Sector:

- Energy Audits and Assessments: Conducting regular energy audits to identify areas for improvement.
- Minimum Energy Performance Standards (MEPS): Implementing MEPS for industrial equipment and processes.
- Energy Management Systems: Encouraging the adoption of energy management systems and practices.
- Incentives for Energy Efficiency: Providing financial incentives and support for industries to adopt energy-efficient technologies.

2. Transport Sector:

- Fuel Efficiency Standards: Establishing fuel efficiency standards for vehicles.
- Public Transport Enhancement: Promoting the use of public transport to reduce energy consumption.
- Electric Vehicles (EVs): Encouraging the adoption of electric vehicles through incentives and infrastructure development.
- Traffic Management: Implementing better traffic management systems to reduce fuel waste.

3. Building Sector:

- Building Codes and Standards: Enforcing energy-efficient building codes and standards.
- Energy Labeling: Introducing energy labeling for buildings to inform buyers and tenants about energy performance.
- Retrofitting Existing Buildings: Promoting the retrofitting of existing buildings to improve energy efficiency.
- Awareness and Training: Conducting awareness campaigns and training programs for builders, architects, and homeowners.

These measures aim to create a sustainable and energy-efficient environment across these critical sectors.

SWOT Analysis of the National Energy Efficiency and Conservation Authority (NEECA)

Strengths

- **Comprehensive Vision and Goals:** Clear vision and goals for energy efficiency and conservation.
- **Guiding Principles:** Strong emphasis on sustainability, conservation, and evidence-based approaches.
- **Strategic Sectors:** Focus on key sectors like industry, buildings, transport, energy, and agriculture.

Weaknesses

- **Institutional and Regulatory Gaps:** Identified gaps in institutional and regulatory frameworks.
- **Economic and Financial Gaps:** Challenges in financing and economic incentives for energy efficiency.
- **Technical and Operational Gaps:** Need for improved technical and operational capabilities.

Opportunities

- **Policy Measures and Deliverables:** Potential for impactful policy measures and deliverables.
- **Innovation and R&D:** Opportunities for innovation, research, and development in energy efficiency.
- **International Partnerships:** Strengthening coordination with international partners.

Threats

- **Informational Gaps:** Lack of adequate information and data for effective implementation.
- **Surveillance and Enforcement:** Challenges in monitoring, reporting, and verification.
- **Coordination Challenges:** Need for better coordination mechanisms with provincial governments and stakeholders.

Best Practices

South Asian countries have implemented various best practices in energy conservation that can serve as valuable examples for Pakistan. Here are some notable practices from different countries in the region:

India

- **Energy Conservation Building Code (ECBC):** This code sets minimum energy performance standards for new commercial buildings.
- **National Solar Mission:** Promotes the use of solar energy through subsidies and incentives, aiming to increase solar power capacity.

Sri Lanka

- **Green Building Certification:** Encourages the construction of energy-efficient buildings through a certification program.

Nepal

- **Renewable Energy Subsidy Policy:** Provides subsidies for the installation of renewable energy systems, such as solar and biogas.

Comparison with Pakistan (GAP Analysis)

Pakistan has also made strides in energy conservation, but there are areas where it can learn from its neighbors:

- **Energy Efficiency Standards:** Pakistan can benefit from adopting more stringent energy efficiency standards and codes, similar to India's ECBC.
- **Renewable Energy Subsidy Policy:** Pakistan can also provide subsidies for the installation of renewable energy systems.
- **Green Building Certification:** Pakistan can encourage the construction of energy-efficient buildings through a certification program by the concerned authority.
- **Public Awareness and Training:** Increasing public awareness and training programs, as seen in Sri Lanka and Bangladesh, can help promote energy conservation practices.

Renewable Energy Sources

Renewable energy is the type of energy derived from natural sources that are replenished at a higher rate than they are consumed. Examples of renewable energy sources include solar, hydropower, and wind. These sources are constantly being replenished and are plentiful all around us.

In contrast to fossil fuels, renewable sources do not cause harmful greenhouse gas emissions. Generating renewable energy creates far lower emissions than burning fossil fuels. The transition from non-renewable energy sources to renewable energy is essential for addressing the climate crisis.

Renewable energy in Pakistan is an emerging sector with significant potential. Currently, around 7% of Pakistan's total installed power generation capacity comes from renewable sources such as wind, solar, and hydropower. The country has set ambitious targets to increase this share to 20% by 2025 and to 30% by 2030. Hydroelectricity remains the dominant source of renewable energy; however, there is growing interest in solar and wind power. For instance, the Quaid-e-Azam Solar Park in Bahawalpur is one of the largest solar power projects in the country. Wind power projects are also being developed in regions like Jhimpir and Gharo. Expanding renewable energy is crucial for Pakistan to achieve energy security, reduce carbon emissions, and provide affordable electricity to its population. The government, along with international partners, is investing in various projects to harness the country's renewable energy potential.

Policy on Renewable Energy

Pakistan has delineated a policy to promote the development and integration of renewable energy sources. The Alternative and Renewable Energy Policy 2019 represents a significant shift toward sustainable energy development. This policy aims to increase the share of renewable energy in Pakistan's energy mix to 20% by 2025 and 30% by 2030. It focuses on promoting solar, wind, and small hydropower projects through competitive bidding and other incentives.

The Alternative and Renewable Energy Policy 2019 (ARE Policy 2019) aims to increase the share of renewable energy in the national energy mix to 20% by 2025 and 30% by 2030. It emphasizes competitive pricing, transparency, and the fast-track development of renewable energy projects. One of its key features is the promotion of decentralized energy solutions, such as net metering and off-grid systems, to enhance energy access in remote areas. Additionally, the policy provides various financial incentives to attract private sector investment and encourages the use of indigenous resources.

Despite its ambitious goals, the policy faces challenges, such as the need for infrastructure upgrades and effective implementation. Overall, the ARE Policy 2019 is a comprehensive framework designed to foster a sustainable and resilient energy future for Pakistan.

The policy reflects Pakistan's commitment to transitioning toward a more sustainable and resilient energy future. By leveraging its abundant renewable resources, the country aims to enhance energy security, reduce carbon emissions, and provide affordable electricity to its population.

SWOT Analysis of the National Electric Power Regulatory Authority (NEPRA)

Strengths

- **Comprehensive Legal Framework:** NEPRA operates under a well-defined legal framework, including the Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997, and its subsequent amendments.
- **Regulatory Authority:** NEPRA has the authority to regulate tariffs, licensing, and performance standards, ensuring a structured and fair energy market.
- **Focus on Renewable Energy:** Policies like the NEPRA (Alternative & Renewable Energy) Distributed Generation and Net Metering Regulations, 2015, promote renewable energy adoption.
- Net Metering Reference Guide for DISCOs

Weaknesses

- **Complex Regulatory Processes:** The extensive regulatory requirements can sometimes be cumbersome, potentially slowing down project approvals and implementation.
- **Enforcement Challenges:** Ensuring compliance with regulations across all stakeholders can be difficult, leading to inconsistencies in enforcement.

Opportunities

- **Market Liberalization:** Recent amendments aim to introduce competition and market forces in the power sector, which could lead to more efficient and cost-effective energy solutions.
- **International Collaboration:** Opportunities to strengthen coordination with international partners can bring in expertise and funding for energy projects.
- **Technological Advancements:** Embracing new technologies in energy generation and distribution can enhance efficiency and sustainability.

Threats

- **Political and Economic Instability:** Fluctuations in political and economic conditions can impact policy implementation and project funding.
- **Regulatory Overlap:** Potential overlaps with other regulatory bodies can create confusion and hinder effective governance.
- **Resistance to Change:** Stakeholders accustomed to the existing system may resist reforms aimed at introducing competition and market-based approaches.

Best Practices

In South Asia, several countries have made significant strides in adopting renewable energy practices, each with unique approaches and successes.

India

India has been a leader in the region, with substantial investments in solar and wind energy. The country has implemented large-scale solar parks, such as the Bhadla Solar Park, and has ambitious targets to increase its renewable energy capacity to 450 GW by 2030. India also promotes decentralized renewable energy solutions, like rooftop solar installations, to enhance energy access in rural areas.

Bangladesh

Bangladesh has focused on solar home systems (SHS) to provide electricity to off-grid rural areas and has successfully installed millions of SHS, significantly improving energy access. Additionally, Bangladesh is exploring wind energy potential along its coastal regions.

Sri Lanka

Sri Lanka has capitalized on its wind and hydro resources. The country aims to achieve 70% renewable energy in its electricity mix by 2030. Sri Lanka's wind farms, such as the Mannar Wind Farm, are key contributors to this goal.

Comparison with Pakistan (GAP Analysis)

Pakistan has a diverse mix of renewable energy resources, including hydro, wind, nuclear, and solar. The country aims to increase its renewable energy share to 30% by 2030. Key projects include the Quaid-e-Azam Solar Park and various wind farms in the Jhimpir and Gharo regions. However, Pakistan faces challenges such as policy implementation, financial constraints, and infrastructure development.

While Pakistan's renewable energy targets are ambitious, the country can learn from its neighbors by:

- **Enhancing Policy Frameworks:** Adopting clear and consistent policies like India's National Solar Mission.
- **Promoting Decentralized Solutions:** Implementing programs similar to Bangladesh's SHS to improve rural energy access.
- **Investing in Wind and Hydro:** Leveraging its wind corridors and hydro potential, akin to Sri Lanka and Nepal.

By adopting these best practices, Pakistan can accelerate its transition to a more sustainable and resilient energy future.

Hydro Power Projects

Name of Project	Production Capacity (MW)	Cost of Project (USD)	Donors	Dealing Organization
Dasu Hydropower Project	4,320	4.6 billion	World Bank, Local Banks	WAPDA
Diamer-Bhasha Dam	4,500	14 billion	Government of Pakistan, China	WAPDA
Tarbela Dam Extension-V	1,530	823 million	World Bank, AIIB	WAPDA
Mohmand Dam	800	2.6 billion	Government of Pakistan, Saudi Fund for Development	WAPDA
Neelum-Jhelum	969	5.1 billion	Government of Pakistan, China Exim Bank	WAPDA
Keyal Khwar	128	94 Million	KFW Germany & European Investment Bank	WAPDA
KurramTangi	83.4	108 Million	Turkey/Pakistan	WAPDA
Karot	720	1.7 Billion	China/Pakistan	Private Sector
Suki Kinari	870	1.9 Billion	China/Pakistan	Private Sector
Dasu (Stage-I)	2,160	4.2 Billion	World Bank	WAPDA
Mangla refurbishment and up-gradation	310	1.5 Billion	World bank	WAPDA

Mini Hydro Power Projects

Currently, 356 mini hydro power projects are underway, which will produce 32.5 MW of electricity at a cost of Rs. 5,250.19 million. Forty-four of these projects have been dropped due to various reasons, including site feasibility, land acquisition issues, and political interference. [Hydropower Resources Book 2022](#)

Adoption of Electric Vehicles

The shift towards electric vehicles (EVs) in Pakistan is framed as a critical step for reducing energy consumption and protecting the environment. The government aims for EVs to constitute 30% of the total vehicle population by 2030, aligning with broader renewable energy goals. This transition is vital as Pakistan seeks to decrease its dependence on fossil fuels and improve air quality, particularly in urban areas beset by severe pollution.

The adoption of EVs is expected to play a dual role: reducing reliance on imported oil and lowering greenhouse gas emissions. Despite contributing only 0.8% to global emissions, Pakistan is highly affected by climate change and environmental degradation. Thus, promoting EVs supports national energy policies and aligns with international environmental commitments.

To facilitate this transition, substantial investment in EV infrastructure, including charging stations, is essential. Competitive electricity rates for charging, compared to traditional fuels, will incentivize consumers. Furthermore, training programs for skilled professionals in the EV sector are critical for supporting local manufacturing and technological advancement. Embracing electric mobility underscores the synergy between energy consumption, environmental protection, and economic growth in Pakistan's future energy landscape. [WRI Insights on EV Adoption](#)

Policy on EV Adoption

The National Electric Vehicle Policy (NEVP) 2019 of Pakistan aims to promote the adoption of electric vehicles (EVs) to reduce greenhouse gas emissions and reliance on fossil fuels. Pakistan is demonstrating its commitment to becoming a key player in the EV revolution and is determined to achieve a remarkable 90% transformation by 2040. The driving force behind Pakistan's initiative to adopt this policy is the vision of a greener nation, aimed at reducing the environmental impact of transportation.

As the world embraces electric mobility, Pakistan is not just aiming for a 30% electric vehicle (EV) penetration by 2030; it is setting the stage for a competitive presence in the global EV market.

The "EV Charging Infrastructure Regulations 2024" by the National Energy Efficiency and Conservation Authority (NEECA) in Pakistan outlines the rules for establishing Electric Vehicle (EV) Charging Infrastructure across the country. The document aims to promote electric vehicles and standardize charging station installation. Key highlights include:

- **Purpose and Scope:** The regulations facilitate the development of EV charging stations, focusing on ensuring convenience, cost-effectiveness, and standardized charging solutions for both short- and long-term needs.
- **Charging Levels:** The regulations define five levels of EV charging, ranging from slow (Level 1, 220-240V) to ultra-fast (Level 5, over 350KW). The higher levels are intended for motorways and commercial spaces due to their power demands and costs.
- **Infrastructure Requirements:** New or reconstructed parking areas must allocate a percentage of spaces for EV charging. Additionally, safety protocols, equipment standards, and signage are mandated for all charging stations. Accessibility requirements also ensure a certain number of charging points are available for persons with disabilities.
- **Site Selection and Installation:** Sites for EV charging stations need to meet specific standards, including protection against physical damage, appropriate equipment clearance, and adherence to national and international safety codes. Maintenance and periodic inspection are mandatory to ensure proper functioning.
- **Battery Swapping Stations:** These facilities, where EV batteries can be swapped for fully charged ones, must comply with relevant technical standards. Tariffs for these stations will be determined by NEPRA in consultation with NEECA. NEPRA will establish a pricing structure for public EV charging stations based on power capacity and location. The stations can follow different tariff models, including flat rates or time-based charges.
- **Safety Provisions:** Extensive safety regulations are provided to prevent hazards such as electrical shocks and overloading. Proper grounding, protection against reverse power flow, and shock prevention mechanisms must be incorporated.
- **Registration and Fees:** EV charging stations must register with NEECA. The registration and annual fees vary based on the charging level, and penalties for non-compliance can include fines and revocation of the registration. [NEECA EV Regulations](#)

In 2024, Pakistan is making significant strides in developing its EV charging infrastructure. Here are some key points from the latest regulations and initiatives:

- **National Energy Efficiency and Conservation Authority (NEECA):** NEECA is responsible for setting standards and regulations for EV charging infrastructure. This includes ensuring that charging stations are efficient, safe, and accessible.
- **Government Investment:** The government has launched a Rs. 4 billion package to support the development of EV charging infrastructure. This initiative aims to establish charging stations in key urban centers and along major highways.
- **Collaboration with Oil Marketing Companies (OMCs):** The government is working with OMCs and the National Highway Authority (NHA) to deploy sufficient charging stations, including fast-charging facilities.
- **Tariff Structure:** The National Electric Power Regulatory Authority (NEPRA) is involved in setting preferential tariffs for EV charging stations to make them more economically viable.
- **Battery Swap Systems:** There are also plans to introduce battery swap systems, which can significantly reduce the time required for EVs to recharge.

These measures are part of Pakistan's broader strategy to promote EV adoption and reduce its carbon footprint. The focus is on creating a robust and reliable charging network to support the growing number of EVs on the road. This regulatory framework aims to ensure the safe, efficient, and wide-scale deployment of EV charging infrastructure in Pakistan.

SWOT Analysis of the Ministry of Climate Change

SWOT analysis of the Ministry of Climate Change's National Electric Vehicle Policy (NEVP) 2019 for Pakistan:

Strengths

- **Environmental Benefits:** Significant reduction in greenhouse gas emissions and air pollution, addressing 43% of airborne emissions from the transport sector.
- **Economic Savings:** Reduction in the oil import bill, which is a major economic burden for Pakistan.
- **Job Creation:** Potential to create new green businesses and job opportunities in the EV sector.
- **Government Support:** Strong backing from the government with incentives, subsidies, and tax breaks for EV manufacturers and buyers.

Weaknesses

- **High Initial Costs:** High costs of EVs and charging infrastructure, which may deter initial adoption.
- **Infrastructure Development:** Need for extensive development of charging infrastructure across the country.
- **Technological Dependence:** Reliance on imported technology and components for EVs.

Opportunities

- **Market Growth:** Growing global and local market for EVs, with potential for exports.
- **Technological Advancements:** Rapid advancements in battery technology and decreasing costs.
- **International Collaboration:** Opportunities for collaboration with international organizations and countries leading in EV technology.

Threats

- **Economic Instability:** Economic challenges and fluctuations that could impact funding and investment in EV infrastructure.
- **Policy Continuity:** Risk of policy changes with government transitions that could affect long-term goals.
- **Competition:** Competition from conventional fuel vehicles and hybrid technologies.

[https://en.wikipedia.org/wiki/Ministry_of_Climate_Change_\(Pakistan\)](https://en.wikipedia.org/wiki/Ministry_of_Climate_Change_(Pakistan))

Best Practices

- **India:** The FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) scheme provides subsidies for EV purchases and infrastructure development. The GST on EVs has been reduced to 5%, and there are additional incentives for local manufacturing.
- **Thailand:** The 3030 EV Production Policy aims for 30% of domestic vehicle production to be electric by 2030. Incentives include tax reductions and subsidies for both consumers and manufacturers.
- **Indonesia:** Plans to ban the sale of fossil fuel motorcycles by 2040 and cars by 2050. The government offers tax incentives and supports local EV manufacturing.

Charging Infrastructure

- **India:** Significant investments in charging infrastructure are underway, with plans to install charging stations every 25 km on highways. Public-private partnerships are encouraged to expand the network.
- **Thailand:** The focus is on developing a comprehensive charging network, including fast chargers in urban areas and along major routes.
- **Indonesia:** Collaboration with the private sector is key to building charging stations and integrating them with renewable energy sources.

Comparison with Pakistan (GAP Analysis)

- The National Electric Vehicle Policy (NEVP) offers incentives for local EV manufacturing, including reduced customs duties and tax benefits. The policy aims for 30% of all passenger vehicle and heavy-duty truck sales to be electric by 2030.
- While Pakistan's incentives are similar to those in India and Thailand, the scale and implementation are still developing. India and Thailand have more established frameworks and higher adoption rates.

Charging Infrastructure

- **Pakistan:** Investment in charging infrastructure is ongoing, with plans to set up stations in urban centers and along highways. Collaboration with oil marketing companies and the National Highway Authority is crucial.
- India's charging infrastructure is more advanced, with extensive networks already in place. Thailand and Indonesia are also ahead in terms of infrastructure development.

While Pakistan is making strides in EV adoption, it can learn from the best practices in South Asia, particularly from India, Thailand, and Indonesia. Key areas for improvement include expanding charging infrastructure, enhancing local manufacturing capabilities, and implementing robust government policies and incentives.

Energy Policies

There are eight key energy-related policies in Pakistan listed below:

1. The National Energy Efficiency and Conservation Act (2016)
2. National Alternative and Renewable Energy Policy (2019)
3. National Electric Vehicle Policy (2020-25)
4. National Energy Conservation Policy (2006)
5. Net Metering Regulations (2015)
6. KP Hydropower Policy (2016)
7. KP Solar Energy Program (2019)
8. KP Energy Development Strategy (2017)

SWOT Analysis of Existing Energy Policies

This situational analysis examines the Strengths, Weaknesses, Opportunities, and Threats (SWOT) of the above-mentioned energy-related policies in Pakistan.

Strengths

- **Legal Framework for Energy Efficiency:** The National Energy Efficiency and Conservation Act (2016) is one of the most comprehensive legal frameworks that establish energy conservation as a national priority. The creation of the National Energy Efficiency and Conservation Authority (NEECA) enables a centralized approach to reducing energy consumption across sectors. This policy has significantly promoted the adoption of energy-efficient technologies, especially in the industrial and residential sectors.
- **Focus on Renewable Energy Expansion:** The National Alternative and Renewable Energy Policy (2019) represents a crucial step in diversifying Pakistan's energy mix. The government's target of achieving 30% renewable energy by 2030 signals a commitment to reducing reliance on fossil fuels and mitigating climate change impacts. The policy is particularly strong in promoting public-private partnerships (PPP) and encouraging foreign direct investment in renewable energy projects.
- **Advancement in Electric Vehicle Transition:** The National Electric Vehicle (EV) Policy (2020-25) demonstrates a forward-thinking approach to addressing environmental and fuel import concerns. The policy offers significant incentives for manufacturers and consumers alike, from tax reductions to subsidies, making EV adoption more feasible for the general population. The policy also integrates plans for developing charging infrastructure, a key element in the success of EVs.

- **Empowerment of Provinces:** Khyber Pakhtunkhwa (KP) has demonstrated leadership with its Hydropower Policy (2016) and Solar Energy Program (2019). The hydropower policy capitalizes on KP's abundant water resources to develop sustainable energy, while the solar energy program aims to increase access to energy, particularly in off-grid areas. These policies reflect a province-specific approach that allows for local resource management and more tailored solutions for energy challenges. [KP Energy Development](#)
- **Consumer-Driven Renewable Energy:** The Net Metering Regulations (2015) are a strong example of a policy empowering consumers to contribute to the energy supply. By allowing households and businesses with solar or wind systems to sell surplus electricity to the grid, this policy encourages small-scale renewable energy generation. It effectively engages citizens and promotes self-sufficiency while reducing the burden on the national grid. [Net Metering Reference Guide](#)

Weaknesses

- **Fragmented Implementation of Energy Efficiency:** While the National Energy Efficiency and Conservation Act (2016) provides a solid framework, its implementation has been fragmented. Many industries and sectors remain non-compliant due to weak enforcement mechanisms. Furthermore, the energy auditing process lacks the necessary infrastructure and human capital for effective execution, delaying the full realization of the policy's potential.
- **Financial and Regulatory Barriers in Renewable Energy:** The National Alternative and Renewable Energy Policy (2019), although ambitious, faces significant financial constraints. Investment in large-scale renewable energy projects, particularly for wind and solar, requires considerable capital, which remains a challenge in Pakistan's current economic situation. Regulatory hurdles, including lengthy approval processes and complex bureaucracy, further slow down renewable energy development.
- **Slow EV Adoption:** Despite the promising incentives in the National Electric Vehicle Policy (2020-25), Pakistan's infrastructure for EVs remains underdeveloped. The policy's success heavily depends on the timely rollout of charging stations, which has been slower than anticipated. Additionally, the initial cost of EVs remains a significant barrier for average consumers, limiting widespread adoption.
- **Outdated Focus in Conservation Policy:** The National Energy Conservation Policy (2006) was progressive when introduced but has since become outdated. Its focus on conventional energy-saving techniques, such as retrofitting buildings and promoting efficient lighting, does not fully align with more modern approaches like

smart grids, energy storage, and the digitization of energy systems. The policy also lacks strong enforcement mechanisms and has seen little success in mobilizing public-private partnerships for energy conservation projects.

- **Limited Reach of Net Metering:** While the Net Metering Regulations (2015) encourage renewable energy generation, uptake has been limited to more affluent consumers who can afford the initial investment in solar panels or wind systems. The high upfront costs and lack of adequate financing schemes deter broader adoption, particularly in rural areas where energy poverty remains high.

Opportunities

- **Leveraging International Funding:** There are significant opportunities for Pakistan to leverage international climate finance and green energy funds to support its renewable energy transition. The National Alternative and Renewable Energy Policy (2019) and KP's Solar Energy Program (2019) can both benefit from partnerships with international donors and multilateral organizations committed to sustainable development.
- **Job Creation through Energy Programs:** The expansion of the solar and hydropower sectors in KP presents immense potential for job creation. The development of new infrastructure, including solar installations, hydropower plants, and related services, could create thousands of jobs in both urban and rural areas, thus contributing to Pakistan's broader socio-economic goals.
- **Technological Advancements in EV and Renewable Energy:** Emerging technologies, such as battery storage and smart grid systems, offer opportunities to integrate more renewable energy into Pakistan's national grid. The National Electric Vehicle Policy could be further strengthened by research and development partnerships that drive down the costs of EVs and improve battery performance, making EVs more affordable and efficient.
- **Decentralized Energy Solutions:** Policies like the KP Solar Energy Program and Net Metering Regulations present significant opportunities for decentralizing energy production. By promoting off-grid solar systems, these programs could help alleviate energy shortages in remote areas, reduce transmission losses, and increase the overall reliability of electricity supply in Pakistan.

Threats

- **Economic Instability:** The biggest threat to the successful implementation of these energy policies is Pakistan's ongoing economic instability. Rising debt, inflation, and a shrinking fiscal space limit the government's ability to fund new energy projects, offer subsidies, and create an enabling environment for renewable energy investments.
- **Political Uncertainty and Governance Issues:** Political instability and governance challenges continue to hamper long-term planning and the continuity of energy policies. Frequent changes in leadership can disrupt ongoing projects, delay policy implementation, and lead to inconsistent regulatory enforcement, particularly in energy conservation and renewable energy development.
- **Climate Change Impacts:** While many of these policies aim to mitigate climate change, the increased frequency of natural disasters, such as floods and droughts, poses a direct threat to energy infrastructure. Hydropower projects, for instance, could face operational disruptions due to irregular water flows, while solar installations are vulnerable to extreme weather conditions.
- **Energy Demand Outpacing Supply:** Despite the introduction of several energy policies, demand for energy continues to outpace supply. With a growing population and industrial demand, Pakistan risks falling further behind unless it significantly accelerates the implementation of these policies and expands energy production capacities.

Identification of Issues and Challenges

Energy conservation, renewable energy sources, and electric vehicle (EV) adoption are crucial for a sustainable future, but they come with several issues and challenges, some of which are listed below.

Energy Conservation

- **Behavioral Barriers:** People often resist changing their habits, even when it could save energy. This includes simple actions like turning off lights or using energy-efficient appliances.
- **Economic Constraints:** Upfront costs for energy-efficient technologies can be high, making them less accessible for some households and businesses.
- **Policy and Regulation:** Inconsistent policies and a lack of incentives can hinder energy conservation efforts. Effective regulations and incentives are needed to encourage energy-saving practices.

Renewable Energy Resources

- **Interruption:** Renewable sources like solar and wind are not always available, leading to reliability issues. Energy storage solutions, like batteries, are essential but still expensive and not widely implemented.
- **Infrastructure:** Transitioning to renewable energy requires significant changes to existing infrastructure, which can be costly and time-consuming.
- **Environmental Impact:** While renewable energy is cleaner, the production and disposal of technologies like solar panels and wind turbines can have environmental impacts.

Electric Vehicle Adoption

- **High Costs:** EVs are generally more expensive than traditional vehicles, primarily due to the cost of batteries.
- **Charging Infrastructure:** There is a lack of widespread charging stations, leading to “range anxiety,” where drivers fear running out of power before finding a charging point.
- **Battery Technology:** Current batteries have limitations in terms of range, charging time, and lifespan. Advances in battery technology are needed to make EVs more practical.
- **Grid Capacity:** Increased EV adoption will put additional strain on the electrical grid, requiring upgrades to handle the higher demand.

Addressing these challenges requires coordinated efforts from governments, industries, and consumers. Policies that provide incentives for energy conservation, investments in renewable energy infrastructure, and advancements in battery technology are crucial steps toward a sustainable future.

Conclusion

Pakistan's journey towards a sustainable energy future remains challenging. A holistic approach, integrating energy conservation, renewable energy expansion, and electric vehicle (EV) adoption, is vital for establishing a stable and efficient power sector. Achieving this requires substantial investments, comprehensive policy reforms, efficient governance, and long-term planning to ensure energy security and economic growth in the face of global energy and climate challenges.

To cope with the challenges of energy generation and to address concerns about climate vulnerability, Pakistan has significant potential for utilizing renewable sources for energy generation. These renewable sources include solar, wind, and hydropower, among others. However, the transition to renewable energy is slow due to financial constraints, a lack of technical expertise, and policy implementation issues. Addressing Pakistan's energy sector challenges requires comprehensive reforms, including improving governance, diversifying energy sources, and investing in renewable energy infrastructure. While the path to a sustainable energy future is filled with obstacles, strategic planning and effective policy implementation can pave the way for long-term energy security and economic stability.

Efforts include promoting energy-efficient appliances, industry practices, and public awareness. Despite the potential for solar, wind, hydropower, and biomass, renewable energy adoption is slow due to policy, financial, and infrastructure challenges. Electric vehicle adoption is also in the early stages, hindered by high costs, a lack of charging infrastructure, and limited awareness. Continued policy reform, public awareness, and infrastructure development are essential for a sustainable energy future.

Recommendations

Strengthening of Regulatory Framework for All Policies: To achieve the desired goals, it is essential to ensure coherence among the various policies prevailing at both the federal and provincial levels. There must be a single authority responsible for the formulation and implementation of a comprehensive policy covering the overall subject of power.

- **Action Plan:** Involve representatives from all energy-consuming sectors, policymakers, and community leaders to develop a consensus (Long-Term).

Regularization of Sectors: Rules are required to be established and meticulously observed for streamlining the standards and codes for sectors that consume the most energy, such as industry, transport, and buildings.

Action Plan: Specialized committees comprising industry experts, policymakers, and community representatives should be formed and involved in the formulation of sector-specific standards and codes for industry, transport, and buildings (Long-Term).

Behavioral Change: It is necessary to initiate widespread public awareness campaigns to educate citizens on the importance of energy conservation, the environmental and economic benefits of renewable energy, and the advantages of adopting electric vehicles.

Action Plan: Utilize social media, electronic media, and print media; conduct seminars and workshops in educational institutions and other public venues. Branding the public awareness message at public places will be key to fostering behavioral changes that support energy efficiency (Immediate, Medium, and Long Term).

Improvement in Procedural Mechanism: Establish clear deadlines for each stage of the approval process to ensure efficiency. Clearly define responsibilities for each step in the approval process to prevent confusion and ensure accountability.

- **Action Plan:**
 - Introduce software tools to remove repetitive tasks such as notifications, reminders, and approvals.
 - Use KPIs to measure the efficiency and effectiveness of the approval process.

- Conduct regular reviews of the approval process to gather feedback and identify areas for improvement.
- Analyze performance data to identify bottlenecks and areas for improvement (Immediate, Medium, and Long-Term).
- **Prioritize EV Adoption:** As transport is one of the highest energy-consuming sectors, the adoption of electric vehicles should be given top priority.
- **Action Plan:** The Ministry of Climate Change must engage existing auto manufacturers to switch to electric technology in their vehicles by forming a committee that includes policymakers and stakeholders. Incentivize the import of electric vehicles by providing duty relief (Immediate, Long-Term).
- **Explore New Financing Options:** Due to the trust deficit in the current situation, the government should appeal to the general wealthy public for investment in energy-saving technologies, solar installations, and renewable energy projects.
- **Action Plan:** Introduce an investment amnesty scheme to incentivize the public by providing tax exemptions for a certain period and no scrutiny of their investment (Immediate and Long-Term).

References

1. Bhutto, A. W. (2024). Pakistan's power crisis: A perfect storm of policy failures. *The Diplomat*. <https://thediplomat.com/2024/08/pakistans-power-crisis-a-perfect-storm-of-policy-failures/>
2. National Energy Efficiency and Conservation Act, 2016. (n.d.). National Energy Efficiency and Conservation Authority. <https://neeca.gov.pk/Detail/MmE3ZWE0ZWQtMDY4Yy00ZGUzLWFjYT MtZWRhOTg3YTQzYTY4>
3. National Energy Efficiency and Conservation Policy 2023. (n.d.). National Energy Efficiency and Conservation Authority.
4. Muhammad, S., Sibtain, A., Li, X., Bashir, H., & Azam, M. I. (n.d.). Title of the article. [Please insert the title if available].
5. United Nations. (n.d.). What is renewable energy? <https://www.un.org/en/climatechange/what-is-renewable-energy>
6. Bloomberg. (2024). It can cost more to power a house than rent it in Pakistan. <https://www.bloomberg.com/news/articles/2024-08-13/it-can-cost-more-to-power-a-house-than-rent-it-in-pakistan>
7. Khyber Pakhtunkhwa Energy Development Organization. (n.d.). Title of the report or page. <https://pedokp.gov.pk/Main/psp/36>
8. China-Pakistan Economic Corridor Authority. (n.d.). Project details. <https://cpec.gov.pk/project-details/16>
9. National Electric Power Regulatory Authority. (n.d.). <https://www.nepra.org.pk/>