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Forex Savings through Biogas Energy in Pakistan

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Pakistan's economy is facing a significant energy crisis, primarily due to its reliance on imported fossil fuels to satisfy energy needs. Currently, approximately 30 percent of the country's import payments pertain to the Petroleum Group (State Bank of Pakistan, 2024). This dependence not only depletes foreign exchange reserves but also heightens economic vulnerabilities. The current energy mix is heavily skewed, with thermal sources contributing around 46 percent to electricity generation, while renewable sources such as solar, wind, and biogas, account for a mere 4 percent (GoP, 2024). This imbalance underscores the urgent need to diversify Pakistan's energy portfolio and reduce long-term reliance on expensive imports.

In this context, it is essential to acknowledge the significant but underutilised potential of the biogas sector in Pakistan. Biogas, produced from organic waste such as agricultural residues and livestock manure, represents a sustainable and locally sourced energy option. By investing in this sector, Pakistan can decrease its dependence on imported petroleum products and enhance its foreign exchange reserves, provided that decisive actions are implemented now. Given the country's elevated external debt and dwindling foreign exchange reserves, particularly following a recent foreign exchange crisis, it is critical to adopt strategies that conserve foreign exchange while addressing intertwined economic and energy challenges.

This report aims to investigate the role of the State Bank of Pakistan (SBP) in fostering, prioritising, and supporting the adoption of biogas technology in collaboration with government ministries and departments. This aligns with the SBP's Vision 2028, leveraging the country's strengths and existing opportunities on the global stage. The transformative potential of biogas energy can be unlocked through incentivising investments in biogas infrastructure, facilitating policy reforms, and enhancing sector development via accessible financing and awareness campaigns. Coordinated policy actions undertaken today to develop an inclusive and sustainable biogas sector could be instrumental in mitigating the energy crisis and preserving the country's foreign exchange in the long run.

1. ENERGY IMPORTS AND FX SPENDING

Pakistan's energy sector is significantly dependent on fossil fuel imports, primarily due to inadequate exploration and development efforts. This heavy reliance on imported energy is unsustainable for an economy that has consistently faced a current account deficit. According to the Central Asia Regional Economic Cooperation Program (CAREC) in its Energy Outlook 2030 report, Pakistan's energy demand is projected to escalate, reaching between 108 to 126 million tons of oil equivalent (TOE) by 2030 (Asian Development Bank, 2022).

Currently, approximately 30 percent of Pakistan's import payments are allocated to the Petroleum Group, encompassing petroleum products, crude oil, liquefied natural gas, liquefied petroleum gas, and others. The major energy-consuming sectors within this group include transportation, power generation, industry, domestic use, and agriculture. These imports are vital for various applications, including vehicle transportation, electricity generation, industrial raw materials, residential and commercial heating, agricultural needs, and aviation. Figure A illustrates the rising expenditure on energy imports over the past decade.

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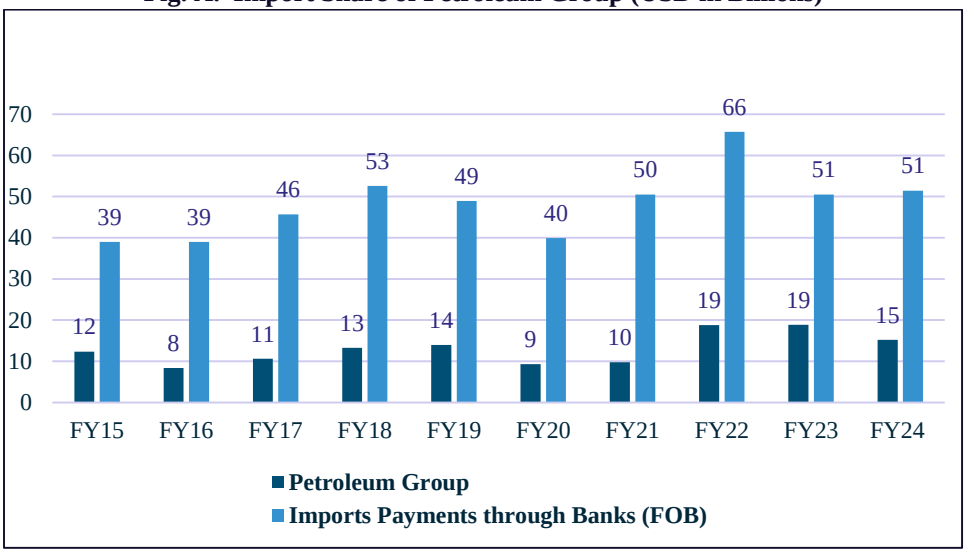
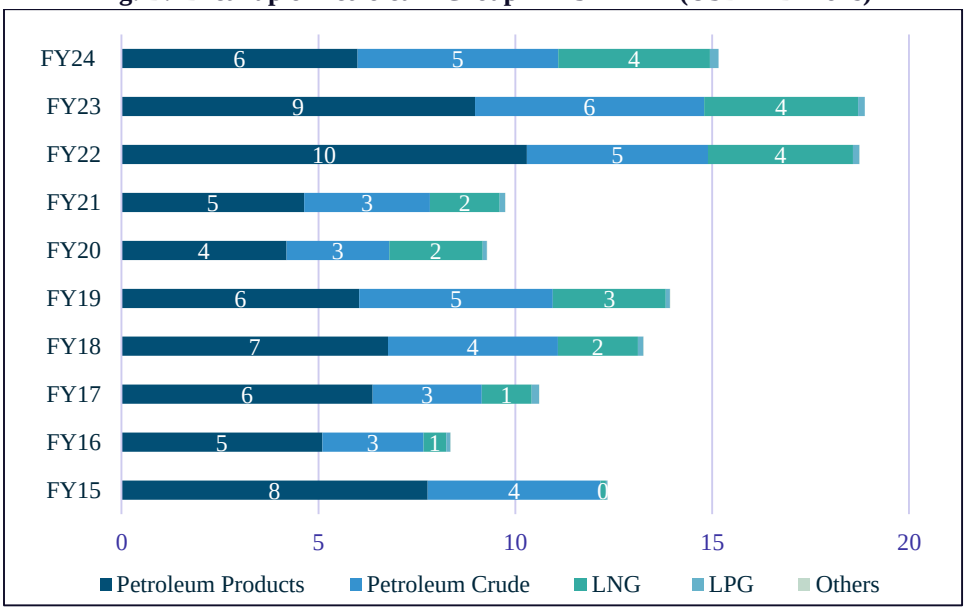
Fig. A. Import Share of Petroleum Group (USD in Billions)



Source: SBP.

The recent surge in payments for the petroleum group can be attributed primarily to escalating global energy prices, exacerbated by the COVID-19 pandemic and the Russia-Ukraine conflict. These price fluctuations have a cascading effect throughout the energy supply chain, leading to increased operational costs for businesses and a higher cost of living for citizens. Figure B illustrates the breakdown of energy import payments over the past decade.

Fig. B. Breakup of Petroleum Group FY15 - FY24 (USD in Billions)



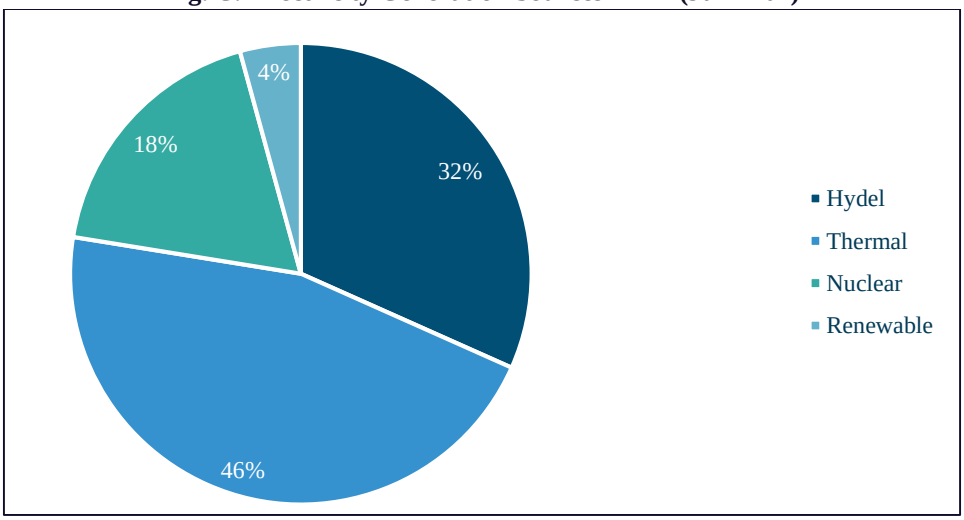
Source: SBP.

As Pakistan's external liabilities and debt continue to rise, a growing portion of its foreign exchange is being allocated to debt servicing. This trend could further strain foreign exchange reserves if energy imports persist without a strategic plan to reduce the energy import bill. It is pivotal to reevaluate the energy framework to achieve energy sufficiency and security, thereby conserving the foreign exchange of the country.

2. RENEWABLE ENERGY AND BIOGAS

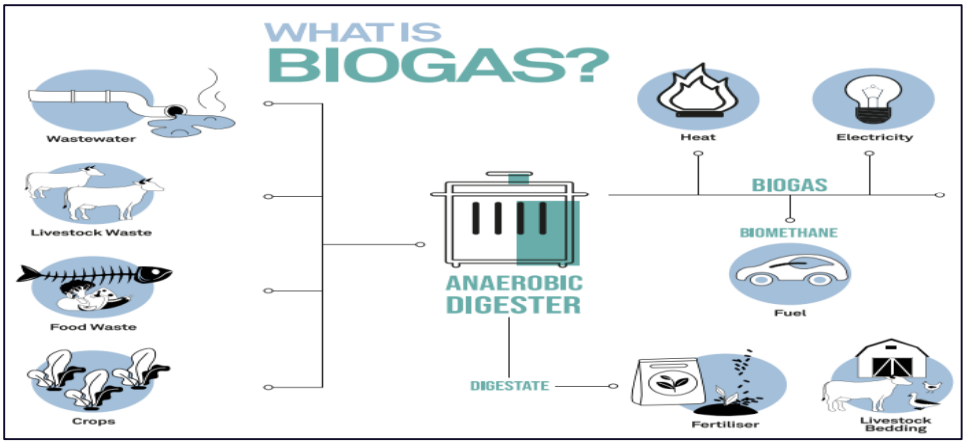
The Government of Pakistan (GoP) aims to achieve a 60 percent share of electricity generation capacity from indigenous clean energy technologies, including alternative renewable energy sources and hydroelectric power, by 2030 (Finance Division, GoP, 2023). Additionally, it has established a target to reduce greenhouse gas emissions by 50 percent within the same timeframe (GoP, 2024). Figure C presents the source-wise distribution of electricity generation, revealing that renewables currently account for only 4 percent of total electricity production. According to the GoP's Economic Survey of FY23, there are 36 wind power projects with an installed capacity of 1,835 MW, seven solar projects totaling 530 MW, and eight biogas co-generation plants at sugar mills with a combined capacity of 259 MW (GoP, 2023). This data suggests a significant lack of research, initiatives, and programs aimed at promoting biogas as an energy source.

Fig. C. Electricity Generation Sources FY24 (Jun-Mar)



Source: Finance Division, GoP.

Biogas is a renewable energy source composed of a mixture of gases, predominantly methane, carbon dioxide, and hydrogen sulfide. It is generated from various raw materials, including agricultural waste, manure, municipal waste, plant materials, sewage, green waste, and food scraps. The production of biogas occurs through an anaerobic process, wherein biodegradable materials are fermented in the absence of oxygen. The resulting gas is collected in an airtight chamber known as a biogas plant, designed specifically for gas storage (Liaquat, Qureshi, & Bari, 2022).



Source: PFAN.

Biogas burns cleanly, producing minimal smoke or odor, and generates heat. It can be upgraded to biomethane, which can be compressed for use in gas networks, as transportation fuel, or for electricity generation. In residential settings, biogas serves as a cooking fuel. Given Pakistan's abundance of organic materials, such as animal waste, wastewater, food scraps, crop residues, and plant waste, there is considerable potential for biogas production. Furthermore, the biogas production process yields organic fertilisers (both liquid and solid) and heat as byproducts, which can be utilised for industrial and commercial applications.

In contrast to other renewable energy sources such as solar and wind, both of which are intermittent and reliant on weather conditions, biogas provides a consistent and reliable energy source while also offering waste management solutions and fertilisers as byproducts. This dual functionality enables biogas to address multiple objectives through a single approach.

The benefits of biogas fuel for Pakistan include:

(i) **Foreign Exchange Savings**: If appropriate policies and incentives are implemented, biogas production can reduce reliance on imported fuels in the long term, ultimately saving the country's foreign exchange reserves spent on energy imports. Additionally, since fertilisers are currently imported, local biogas production can further decrease the import bill.

(ii) **Economic Development**: Biogas production can be decentralised, benefiting rural areas by providing local energy sources for households and creating employment opportunities. Small and medium-sized enterprises (SMEs) can play a vital role in this sector, contributing to economic development through their localised knowledge and adaptability.

(iii) **Utilisation of Organic Waste:** Biogas production facilitates the efficient use of organic waste such as animal dung, agricultural residues, and wastewater, helping to address considerable waste management challenges. This approach mitigates environmental risks and health hazards associated with waste disposal. Additionally, biogas is considered carbon neutral, as it absorbs carbon dioxide and prevents the release of methane, contributing to greenhouse gas mitigation.

(iv) **Renewable and Sustainable**: As a renewable energy source, biogas can support Pakistan's sustainable development goals and reduce greenhouse gas emissions, resulting in a positive environmental impact. Its production is independent of weather conditions, ensuring a reliable and steady energy supply.

(v) **Achievement of Goals and Targets**: Utilising biogas can decrease reliance on traditional fuels, thereby supporting the government in meeting various objectives related to sustainable development goals (SDGs), climate change mitigation, and financial inclusion.

3. SUITABILITY AND OPPORTUNITIES FOR PAKISTAN

Biogas is recognised as a zero-waste technology that transforms waste into energy, generating multiple revenue streams while reducing carbon dioxide emissions and addressing both waste management and sustainable energy challenges. The global biogas market was valued at approximately USD 25 billion in 2021 and is projected to grow to USD 37 billion by 2028, reflecting a compound annual growth rate (CAGR) of 5.4 percent (Liaquat, Qureshi, and Bari, 2022).

Key drivers of the biogas industry worldwide include the growing emphasis on diversifying energy portfolios, a swift transition to clean energy sources, effective waste management practices, and rising energy demand due to population growth. Europe leads in biogas production, with Germany holding the largest market share, followed by Spain, Italy, and Sweden.

The Government of Pakistan (GoP) has established a target to diversify its electricity generation mix, aiming to increase the share of renewables to 20 percent by 2025 and 30 percent by 2030 (Alternate & Renewable Energy Policy, GoP, 2019). The overall landscape and opportunities in Pakistan appear well-suited for the development of the biogas energy sector in several key areas:

3.1. Climate Financing

As a signatory to international climate agreements, Pakistan can utilize biogas projects to achieve its emissions reduction targets and contribute to global climate change mitigation efforts. Various financing options are available to Pakistan, one of the countries most affected by climate change:

(i) **Carbon Markets:** Engaging in carbon markets enables countries to generate revenue through the sale of carbon credits derived from biogas projects and other renewable energy projects. Pakistan has the opportunity to participate in carbon trading platforms and negotiate agreements with carbon buyers.

(ii) **International Climate Funds**: GoP can seek access to international climate financing mechanisms, such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF), specifically for biogas initiatives. These funds are designed to support projects that address climate change and foster sustainable development.

(iii) **Bilateral and Multilateral Partnerships**: Establishing partnerships with other countries or international organisations can facilitate financial support for biogas projects. GoP can negotiate agreements with nations or entities that emphasise renewable energy and climate action.

(iv) **Domestic Financing:** The GoP can allocate resources for biogas projects through budgetary provisions or create dedicated funds for renewable energy initiatives. Public-private partnerships can attract private investments in biogas infrastructure, enhancing access to expertise, efficiency, and funding. This approach can also improve public acceptance and facilitate the scalability of projects across various regions.

(v) **Development Banks and Financial Institutions**: Pakistan can pursue loans, grants, or technical assistance from development banks such as the Asian Development Bank (ADB) and the World Bank. These institutions provide financial products and expertise to support renewable energy projects, and Pakistan has collaborated with them on various development initiatives in the past.

3.2. Abundant Biogas Resources

One of Pakistan's competitive advantages in developing its biogas sector is the abundance of biogas resources available. The majority of the country's livestock is concentrated in Punjab, Sindh, and Khyber Pakhtunkhwa (KP), with approximately 10 million households involved in livestock farming. The scalable potential of resources in Pakistan includes:

(i) **Manure:** As the fourth-largest milk producer globally, Pakistan hosts around 196 million livestock, including buffaloes, cows, sheep, goats, and camels, generating approximately 417.3 million tons of manure annually (2018). Efficient utilisation of this manure for biogas could yield about 26,871.35 million cubic meters per year, which could produce 492 petajoules (PJ) of heat energy and 5,521 MW of electricity (Liaquat, Qureshi, and Bari, 2022).

(ii) **Municipal Solid Waste (MSW):** The organic fraction of MSW in Pakistan constitutes about 64 percent of total waste, with a potential biogas yield of 97 to 114 cubic meters per ton. Major cities, including Karachi, Lahore, Islamabad, Peshawar, Faisalabad, Multan, Quetta, Gujranwala, and Rawalpindi, collectively generate 24,131 tons of MSW daily, of which 5,631 tons per day are organic materials (Liaquat, Qureshi, and Bari, 2022), underscoring the high potential for biogas generation and utilisation.

(iii) **Rural Areas:** The rural regions of Pakistan possess significant biogas resources, including animal dung, MSW, agricultural waste, and agri-industrial waste. It is estimated that around 12 million cubic meters of biogas could be produced daily, which would be sufficient to meet the energy needs of 28 million people in rural areas (Liaquat, Qureshi, and Bari, 2022).

3.3. Weather Conditions & Locations

In much of Punjab and Sindh, weather conditions are favourable for biogas production, aided by readily available construction materials for biogas digesters. For example, the Landhi cattle colony in Karachi presents an excellent opportunity for a large-scale or multi-operational commercial biogas plant. Spanning approximately 3 km^2, this colony houses an estimated 400,000 animals (Liaquat, Qureshi, and Bari, 2022). Optimal

locations for biogas plants would be close to feedstock sources, industrial and residential consumers, with good road access and connectivity to the gas distribution network. Given its substantial consumer base, abundant feedstock, and established infrastructure, Karachi is a viable option for launching a biogas project.

3.4. Energy Security

Biogas represents a reliable and decentralised energy solution that diminishes dependence on imported fossil fuels while bolstering energy security. By leveraging local biogas resources, Pakistan can reduce the vulnerabilities associated with fluctuating international energy markets, facilitating a gradual transition from fossil fuels to renewable energy sources in a systematic and phased manner.

4. CHALLENGES FOR BIOGAS SECTOR

The biogas sector in Pakistan faces several challenges, including a lack of regulatory and institutional support, a weak supply chain, price volatility, inadequate logistical infrastructure, technological barriers, limited access to finance, and capacity gaps. Within the context of the SBP's role, the issues of financial access and awareness gaps are particularly pertinent.

4.1. Limited Access to Finance

One of the primary obstacles to scaling biogas production is the lack of bankable projects combined with insufficient financing options for small and medium-sized enterprises (SMEs). Many SMEs view the installation of biogas technology as an additional cost, underestimating its substantial environmental, economic, and social benefits. Furthermore, biogas projects are often perceived as requiring higher initial investments and longer payback periods compared to other renewable energy projects, such as solar PV and wind.

Although concessional financing is available from the SBP for renewable energy projects, the absence of effective due diligence mechanisms and the limited expertise of financial institutions in conducting financial appraisals for waste-to-energy projects hinders progress.

Without credit risk coverage, SMEs struggle to secure financing, resulting in a minimal presence of their projects on financial institutions' balance sheets. Consequently, lenders tend to impose high-risk premiums on SME financing, leading to a reluctance among these enterprises to pursue loans for biogas initiatives.

Moreover, smaller developers, particularly women, face challenges due to insufficient collateral and limited skills in financial planning and communication with banks. Women require support in developing project proposals, business plans, and implementation strategies to obtain financial backing for establishing biogas plants.

4.2. Awareness Gaps

The biogas sector is extensive, and various technological applications necessitate trained professionals and skilled personnel. There is a notable lack of foreign collaboration and funding to support high-level research projects and programs. At the industrial level,

senior management often lacks awareness regarding the techno-economic viability and critical success factors of biogas projects. Additionally, at the community level, women using raw biogas as a fuel source need education on the efficient use of biogas through technological interventions that can provide heat and electricity while minimising indoor air pollution.

5. POLICY RECOMMENDATIONS

SBP's Strategic Goal 3 (SG-3) under Vision 2028 emphasises the promotion of inclusive and sustainable access to financial services. This includes developing policies to encourage climate-resilient financing initiatives and implementing financial literacy programs as part of the National Financial Inclusion Strategy (NFIS).

In alignment with its strategic objectives, SBP can pursue the following actions in collaboration with other government ministries, departments, and stakeholders to incentivise and facilitate the biogas sector, thereby conserving foreign exchange in the long term:

5.1. Facilitating Access to International Carbon Credit Markets

Globally, carbon credits provide a mechanism for reducing greenhouse gas emissions by funding renewable projects. Each credit represents the reduction or removal of one metric ton of carbon dioxide or equivalent greenhouse gases. Countries with regulatory limits on emissions may buy carbon credits directly or through international exchanges to comply with environmental targets (compliance market), while others purchase credits voluntarily as part of their Corporate Social Responsibility (voluntary market). The global carbon credit market was estimated at USD 990 billion in 2023, with a compliance market of USD 949 billion (Reuters, 2024) and a voluntary market projected to grow significantly by 2030 (CarbonCredit.com, 2024).

SBP can play several critical roles in this space:

(i) **Market Facilitation**: Support the development of infrastructure and institutions for carbon credit trading. Biogas plants can sell carbon credits on international exchanges or directly to buyers for foreign currency. Developing the carbon market will also enable other renewable energy projects, such as solar and wind, to benefit from carbon credit sales, generating foreign exchange for the country.

(ii) **Collaboration**: Work with multilateral organisations, development banks, or central banks to establish a global carbon credit registry and trading platform. This would facilitate the sale of carbon credits from Pakistan to the international market. Engaging commercial banks in this initiative can create business opportunities and stimulate productive economic activity.

(iii) **Preferential Exchange Rates**: Offer attractive exchange rates to potential international buyers of carbon credits to encourage more sales agreements.

5.2. Exclusive Financing Scheme

With the expiration of SBP's Financing Scheme for Renewable Energy on June 30, 2024, an exclusive financing scheme for biogas should be established under priority sectors. This scheme can offer tailored financing based on plant sizes, categorising them

into small (1-20 cubic meters/day), medium (25-1000 cubic meters/day), and large (above 1000 cubic meters/day). Additionally, SBP could set annual financing targets for banks and introduce awards for those meeting lending thresholds, particularly aimed at SMEs and rural communities involved in the dairy, poultry, and agriculture sectors.

5.3. Encouraging Role of Women

SBP's existing refinance scheme for Women Entrepreneurs can be expanded to highlight women's involvement in the biogas sector. Outreach campaigns can emphasise the benefits and opportunities for women while establishing a network for women in the industry to share knowledge and support newcomers. Mentorship and educational programs in collaboration with NGOs and educational institutions can facilitate this. Furthermore, promoting the participation of women energy professionals in deploying biogas technologies will enhance their role in the sector and support gender equality initiatives.

5.4. Capacity Building and Awareness Campaigns

SBP can enhance capacity building and awareness for stakeholders in the biogas value chain through its National Financial Inclusion Scheme (NFIS). This can include organising workshops for farmers, entrepreneurs, and industry professionals, promoting biogas adoption, implementation, and access to financing opportunities. These initiatives can significantly improve understanding and engagement in biogas projects, ultimately fostering growth in the sector.

5.5. Policy Advocacy and Coordination

SBP can partner with government agencies, banks, and industry stakeholders to promote policies supporting the biogas sector. Key actions include:

- **Development of Carbon Credit Market:** The Ministry of Climate Change can be engaged for the development of project standards acceptable internationally and registration of projects such as biogas, wind, solar, etc. Since the carbon credits can also be sold internationally through brokers, the registration and other modalities for brokers can be regulated by the Ministry.
- **Climate Financing:** The Ministry of Finance can explore opportunities for accessing concessional climate financing for the establishment of biogas plants from global lenders like the World Bank, Global Environment Fund (GEF), Green Climate Fund (GCF), etc. Options might include loans, grants, or investments from stakeholders interested in the biogas sector.
- **Government Financial Assistance:** The Ministry of Finance can also be approached to introduce targeted subsidy / financial assistance as a fixed amount for setting up biogas plants based on their size/capacity. This could include targeted subsidies for equipment purchase, construction, and infrastructure development like financial assistance to biogas producers for procurement of plant/machinery to support the collection of biogas.
- **Public-Private Partnerships (PPPs):** The Ministry of Planning & Development can be approached for encouraging PPPs between government entities, private

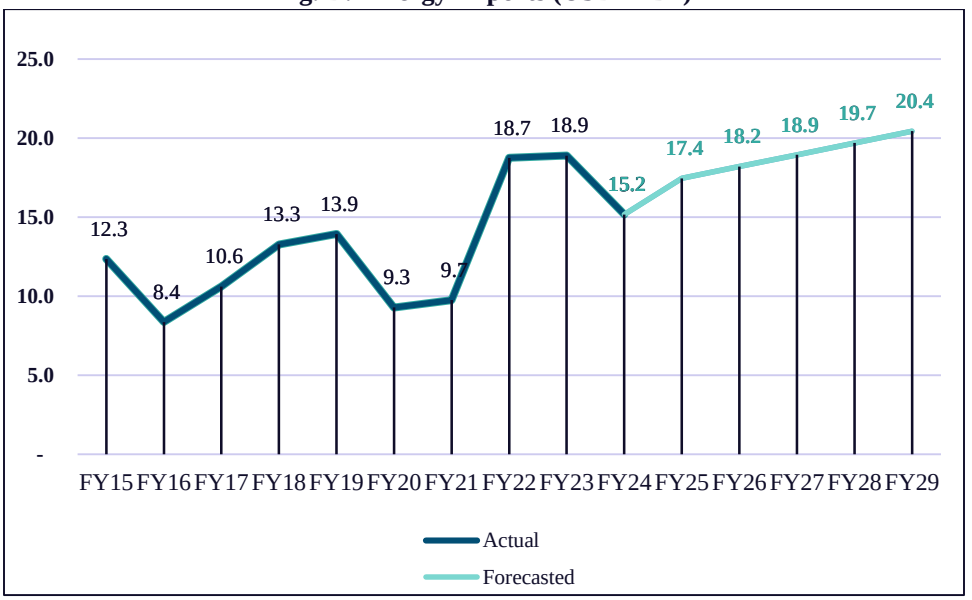
investors, and biogas project developers. This collaboration can leverage private sector expertise and capital while ensuring alignment with government sustainability goals. Offer incentives such as tax breaks, land lease agreements, or revenue-sharing arrangements to attract private investment in biogas projects.

- **Establishment of Biogas Development and Training Centers (BDTCs):** These centers can provide technical training, field inspections, and information & publicity assistance to the project implementers. SBP can coordinate with the Ministry of Education or Ministry of Planning & Development to consider the establishment of BDTCs.
- **Tax/Duty Incentives**: FBR may be engaged to consider tax/duty reliefs on transactions involving the establishment of a biogas plant, for instance, import of machinery and technical know-how.

6. POTENTIAL FX SAVINGS

A forecast utilising the exponential smoothing technique predicts that Pakistan's energy imports will increase from USD 17 billion in FY25 to USD 20.4 billion by FY29, as shown in Figure D. This projection is based on an analysis of actual energy import data from the past ten years, indicating a consistent growth trend. The forecast highlights the increasing reliance on energy imports as part of the country's overall energy strategy.

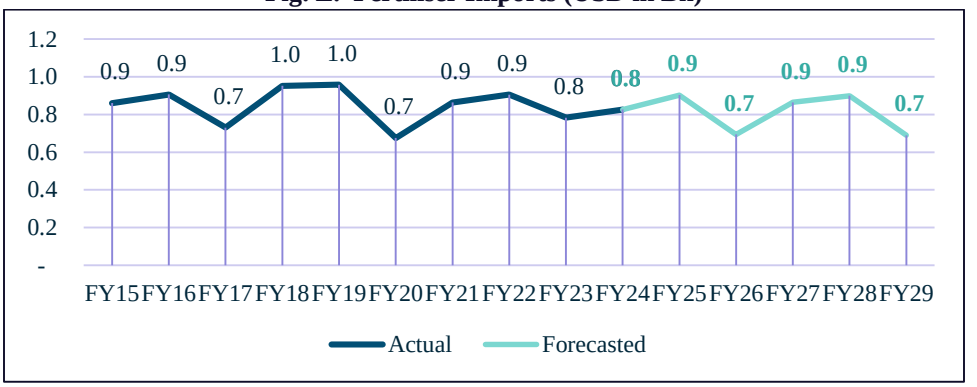
Fig. D. Energy Imports (USD in Bn)



Source: SBP.

Whereas the forecasting of fertiliser imports for the next five years based on the actual import data of the past ten years showed a relatively consistent trend, as shown in Figure E.

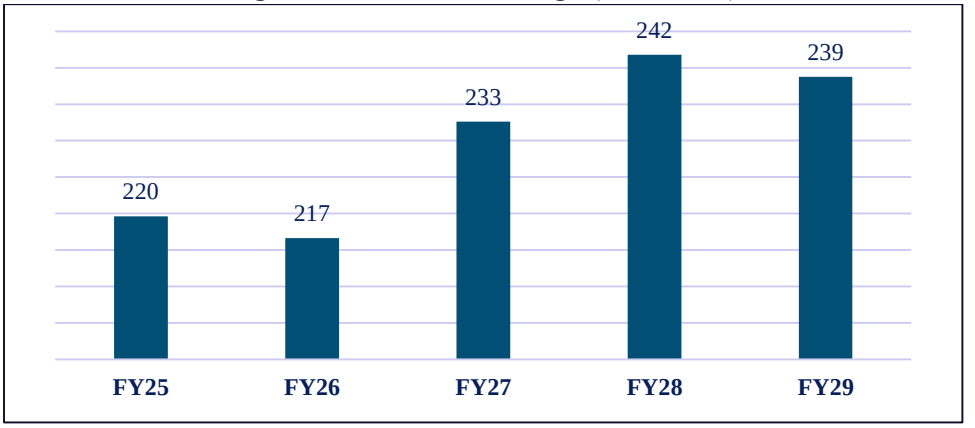
Fig. E. Fertiliser Imports (USD in Bn)



Source: SBP.

By targeting a 1 percent reduction in energy imports and a 5 percent reduction in fertiliser imports through the biogas sector's development each year, Pakistan could potentially save USD 1.1 billion in foreign exchange over the next five years. This projection aligns with the anticipated growth in energy and fertiliser imports, as shown in Figure F. These savings could significantly impact the country's economy by reducing reliance on imported resources and promoting sustainable energy practices.

Fig. F. Forecasted FX Savings (USD in Mn)



Source: SBP.

7. CONCLUSION

An import-driven energy policy is not sustainable for Pakistan, making it energy insecure in the long term. It drains foreign exchange reserves, exposes the economy to international energy price shocks, and heightens inflation risks, which in turn reduces the competitiveness of the country's exports. To address this, it is crucial to diversify the energy mix and transition to renewable resources like biogas, leveraging the country's strengths.

In light of SBP's objective of supporting the government in economic policies to foster development and fuller utilisation of the country's productive resources and its strategic plan for 2023-28 (SG-3), SBP can play an impactful role in the development of

biogas as a source of energy to save country's foreign exchange in the long run and contribute to sustainable economic growth.

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