

Imbalance of Energy Mix in Pakistan and its Consequences

Outline

1) Introduction

Owing to the lack of long term planning and constraints of financial and technical nature, the country's energy mix has been monopolized by the fossil fuels. The contribution from renewable resources is limited. This imbalance has led to severe economic, environmental and social repercussions. All such consequences, combined, pose a serious threat to the country's survival.

2) An overview of imbalance in the energy mix of Pakistan over the period of time.

3) Factors hindering Pakistan from mitigation of the imbalance in its energy mix.

i) Lack of political will to materialize hydel projects like Kala Bagh Dam.

ii) The technical and financial short-comings have hindered diversification of energy mix.

iii) Inefficient and short term planning has increased the imbalance in energy mix.

4) Consequences of the imbalance in energy mix.

- i) Imposing fossil fuels have trapped country in the vicious cycle of circular debt.
- ii) Causing power outages due to over-dependence on hydrocarbon based electricity.
- iii) Expensive electricity has contributed towards commodity supercycle.
- iv) Imbalance in energy mix has hindered Pakistani industry from competing in international market.
- v) Natural gas reserve under huge stress due to excessive use in electricity generation.
- vi) Degradation of environment:
 - a) Emission of sulphur and nitrogen oxides is causing smog, due to higher volume of thermal energy being generated.
 - b) Increased emission of carbon-dioxide is contributing towards global warming.

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s) Mitigation of the adverse impacts of imbalance in country's energy mix

i) Focusing on timely completion of renewable energy projects that come under CPEC.

ii) Installation of micro-hydel energy projects which require less investment and lesser technical expertise.

iii) Providing incentives and subsidy to consumers, installing renewable energy generation mechanisms at domestic scale.

6) Conclusion.

These days Pakistan is facing many problems. The number of problems, the country is facing is such that one cannot list those problems. As listing of infinite number of problems is not possible. However, it is ~~easier~~ ^{easier} to identify problems which are acting as mother of other problems. One such problem refers to the imbalance in the energy mix of Pakistan. Energy mix refers to a mixture of sources being used to meet energy requirements; mostly in the form of electricity. Too much dependence on a single resource leads to the imbalance in energy mix. Unfortunately, Pakistan has been suffering from this ailment of dependence on limited or one type of source ~~from~~ ^{for} quite a long period of time. The imbalance has emerged due to country's over-dependence on fossil fuel to meet its energy requirements. The "lion's share" of Pakistan's electricity generation comes from fossil fuels; which include coal, gas and liquid fossil fuels. The hydel energy is the second biggest contributor to the electricity supply to national grid. But, the contribution of fossil fuels alone is far more higher than all other sources combined. Owing to ^{the} lack of long term

of planning, financial, and technical constraints, country's energy mix has been monopolized by fossil fuels. The contribution of renewable resources is limited. This imbalance has led to severe economic, environmental and social repercussions. All such consequences, combined, pose a serious threat to the country's survival.

As the imbalance in Pakistan's energy mix has caused serious problems, in order to address those problems one will have to address the imbalance in energy mix first. In order to have an understanding of energy imbalance one must know; how it has evolved over a period of time. Since, its inception Pakistan has been facing energy crisis. The fossil fuels, appeared to be the most suitable way of energy generation initially, as it was the norm of those days. However, 1960s and 1970s Pakistan took several steps to diversify its energy mix. Construction of Tarbela and Mangla dams ^{and} installation of country's first nuclear power plant were so major developments, in an effort to diversify energy mix. However, the country was not able to build on early successes as it failed to construct more dams, or to invest in other mechanisms of electri-

icity generation. This led to a point in time where the fossil fuel energy generation peaked and then went beyond 65%. As of now 58.8% of electricity comes from fossil fuels; hydel power is 25.8% of total electricity production; nuclear energy contributes 8.8-6% while renewable energy production is only 5.6% of total electricity. The situation has improved due to hydel, solar and wind energy projects that are part of China Pakistan Economic Corridor (CPEC), but there is a long way to go in this regard as only a fraction of ^{source} goals has been achieved covered fraction of distance is covered yet, and long road lies ahead.

It is an established fact that over-dependence on fossil fuels to meet its energy requirements, has troubled Pakistan very much. In order to mitigate these troubles one must know the causes which have led to energy imbalance, or in other words the factors which are hindering the country from achieving its balance in its energy mix. One such factor is lack of political will. Political leadership has always opted for quick fixes, instead of long term solutions. For instance

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the construction of Kala Bagh dam has been a bone of contention among all the provinces. Punjab is in favour of Kala Bagh dam while other three provinces oppose the idea of Kala Bagh dam. Political leadership did not try to have a comprehensive debate and find a solution acceptable to all, ^{and} instead the project was aborted. Similarly, failure to address the grievances of area people from areas, those have the capacity to fulfill country's energy needs through non renewable resources. Thus, lack of political will has hindered country from diversifying its energy mix.

Furthermore, country's financial and technical constraints have also acted as obstacles in the diversification of energy mix. The country does not boast such state of the art institutes which can provide assistance in substantiation of commercial projects based on renewable energy technology. Although "National Science and Technology Park," housed in National University of Science and Technology can contribute to such projects in near future, as of now it is working on research based projects. Similarly, to install such projects requires

huge sums of money due to imported machinery and equipments. For instance a vertical axis wind turbine, having capacity to generate 200 watts costs around 3 million rupees. So, country's financial and technical constraints are one of the also contributing to the imbalance in country's energy mix.

Moreover, inefficient planning and lack of long term planning have also contributed towards the imbalance in energy mix. One such example is resorting to Independent power producers to overcome energy shortages. As most of these Independent Power Producers (IPPs) use hydrocarbons, the contribution from private sector in energy sector is solely hydrocarbon based. Similarly, the recurring floods are indication of government's negligence and lack of long term planning. Water which could have been used in energy generation, causes massive damage to infrastructure, and loss of life every year. Therefore, country relies more on the resources which it imports than those which it has in excess, when it comes to energy mix. Thus, causing an imbalance in the electricity's resources.

One cannot refute the fact that the imbalance in the country's energy mix is a thing of great concern. The consequences of this imbalance are severe. The adverse impacts can be seen in almost all walks of life. One such impact is the vicious circle of debt. The term that can describe this malady is circular debt. Circular debt refers to a situation in which a country ~~big~~ buys fuel or any other thing on credit, delivers the end product to the consumer, but is unable to recover the cost of ~~sever~~ oil or any such commodity. Pakistan imports most of its hydrocarbons for electricity generation. The per unit energy produced ^{from hydrocarbons} costs around which is far more higher than the other that of hydel and other renewable resources. As the common man of this country cannot afford such expensive thermal electricity, the full recovery becomes impossible. Fluctuating oil prices, devaluation of local currency and poor electricity transmission network have also played their part in circular debt. Circular debt has further weakened the already weak economy. Thus, it can be said that country is entangled in the web of circular debt.

Additionally, the hydrocarbon dependent energy sector ~~also~~ is unable to ensure uninterrupted supply of electricity. Interestingly the country and the people dwelling in the country face power outages, despite the country having the capacity to generate excess electricity. Pakistan has installed capacity of huge 4000MWH, but it still has to bear with power outages as 58% of total energy comes from fossil fuels according to Economic Survey of Pakistan 2022-2023. Pakistan imports most of its fossil fuel to generate electricity. ^{Owing to} ~~Due to~~ weak economy and expensive fuel the power plants are not supplied with sufficient fuel to generate electricity at the full capacity. So, too much dependence on fossil fuel has resulted in power outages in the country and that too, in twenty first century.

Another impact is that country is facing commodity supercycle driven by expensive electricity. Electricity cost in Pakistan is highest among the regional countries. This expensive electricity not only hurts industry, business and agriculture, but also it hurts the domestic

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consumers. In agriculture and industry the cost of produce increases due to expensive electricity. Similarly, business of a company providing services which involve use of electricity also recovers the losses by increasing prices. So, the imbalance in energy mix leads to increased electricity costs; higher electricity cost results in increased cost of industrial goods, agricultural produce and services. The higher prices of all the aforementioned generate a cycle in which an increase in prices of commodities is resulted. Thus, energy mix imbalance can lead to commodity supercycle owing to expensive electricity.

Moreover, Pakistani industrial goods are unable to compete in international market due to expensive electricity, power outages and limited supply of natural gas. The interruptions in electricity supply keep factories from working at optimal capacity; this results in increase in production cost and fewer products being produced. Similarly, the expensive electricity also contributes towards increased prices of industrial goods. Furthermore, natural gas serves as the primary fuel for many industrial units.

But, such units are not being supplied with enough gas as big volumes of natural gas are being used in electricity generation. As a result factories are unable to meet the demands. So, increased prices, delays in manufacturing and smaller production volumes have not allowed country's industry to compete in international market. All of these problems have emanated from the imbalance in country's energy mix.

Furthermore, the overdependence on fossil fuels ^{has} brought country's natural gas reserves under stress. Among major hydrocarbons, natural gas is one resource along with coal, which Pakistan possesses in abundance. Instead of using natural gas in a thrifty manner, the gas was used in an extravagant manner. According to ~~some~~ Economic Survey of Pakistan more than 50% of the country's electricity was ~~coming~~ coming from natural gas. Such squandering of natural gas has resulted in its depletion at an un-prioritized rate. Gas loadshedding and interruption in natural gas supply have become a new normal. Now is the time to take action, otherwise the country will run out of its gas reserves for good. So imbal.

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ance in country's ~~ix~~ energy have put the gas reserves under stress.

Additionally, the imbalance in country's energy mix has also exacerbated the degradation of environment. As the most of electricity generated comes from burning of fossil fuels. This excessive burning of fossil fuel releases several harmful substances in environment. Among all harmful substances released, the oxides of sulphur and nitrogen are creating the problem of smog. These gases are released on the combustion of fossil fuels. These gases react with the moisture present in atmosphere and form hazy substance which is known as smog. Smog creates problems in breathing and hinders the visibility of drivers on roads and highways. Thus, oxides of sulphur and nitrogen, which are the products of the energy mix imbalance, are contributing towards smog; which is a manifestation of the degradation of environment.

Another product of fossil-fuel burning for electricity generation, ~~is~~ that is adversely affecting environment is carbon dioxide. Among all the

methods being employed for power generation in the country, fossil fuel burning is the only one that emits carbon dioxide in atmosphere. Unfortunately, fossil fuel provides the lion's share in country's energy mix. Excess of carbon dioxide exacerbates global warming by catalyzing green house effects. Global warming further gives birth to various environmental maladies, such as increased ocean levels, rapid melting of glaciers and increased flooding. Thus, imbalance in energy mix gives rise to excess of carbon dioxide which leads to problems like global warming.

As it is apparent, that the consequences of energy-mix imbalance are harsh, now is the time to take adequate steps to overcome this imbalance. Otherwise, the situation is not going to improve in near future. One such step is to ensure timely completion of the renewable energy projects that come under the ambit of CPEC (China Pakistan Economic Corridor). The good thing for Pakistan is that, CPEC envisions many such projects which are based on renewable resources. Kohala dam is an example of hydel

energy. Similarly, a wind farm in Jhimpir, will serve as a source for wind energy. Many other such projects are part of CPEC. According to an estimate CPEC related power projects will add 12 projects of renewable energy by year 2026. The job of Pakistani authorities is to facilitate those who are working in such projects. Maintenance of law and order in areas where these projects are being installed is an important responsibility at state's end. Thus, timely completion of the projects which come under the domain of CPEC, will help in achieving balance in country's energy mix.

Another step which can help in achieving balance in energy mix is building micro-hydel energy projects. Financial constraint is a big issue when it comes to building huge dams, in order to increase hydel energy production. The solution to this problem is that, ~~Focus must~~ Emphasis must be laid on building small dams. Small dams can be constructed in northern part of country as it receives ample rainfall along with having suitable

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locations for building such dams. This will reduce dependence of localities on hydrocarbon-based electricity. As a result share of hydel power in energy mix will increase and the energy mix of the country will become more diversified.

Another way of addressing the problem of imbalance in country's energy mix is to incentivize energy generation at domestic scale. Some of the consumers, who can afford elect solar energy harvesting mechanism are using solar energy to generate electricity. In order to spread the base of users of renewable energy, who generate electricity at domestic scale, government will have to subsidize solar panels, vertical axis wind turbine etc. After, the number of users increases, then government will require to motivate these people, and add the surplus energy generated in national grid. Vertical axis wind turbines can be alternative to the traditional electricity in wind corridors, similarly, small turbines can be installed in rivers, canal and water-ways. The incentives by the government will encourage users to become self-sufficient in their electricity generation.

1 and also it may provide them an opportunity to get financial benefits by selling spare electricity to government. Thus, providing incentives and subsidy to consumers on domestic scale electricity generation can improve the contribution of renewable energy resources.

As balance in energy mix is very important in order to generate cheap electricity, and save natural resources from depletion. It is imperative to take such an approach that results in a decrease in the gap among the contributions from different resources. As of now the imbalance in Pakistan's energy mix is enormous. Pakistan is heavily dependent on hydrocarbons to meet its energy requirements, then comes the hydel energy as the second biggest contributor in country's energy mix; the contribution from nuclear, solar and wind energy is negligible. This imbalance has emerged as a result of lack of proper planning^{and} financial and technical constraints. But the most important thing is that, this imbalance in country's energy mix has created many problems. The harmful effects of this imbalance have equally affected the public,

businessment, industry and the government itself. The consequences include degradation of natural climate, economic turmoil and degradation of living standard due to this imbalance in energy mix and over-dependence on hydrocarbons for energy generation.

Although the negative consequences have already caused a huge amount of damage, the harms caused can be ameliorated by adopting such an approach which leads towards equitable contribution from renewable and non-renewable resources. So, a balanced energy mix may create such significant opportunities which are vital for the prosperity of Pakistan.