Alternate energy as a sustainable energy resource in Pakistan

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Introduction

Renewable energy → 'replenished by nature'

Alternate Energy → Renewable + Sources of energy (nuclear and biomass) not renewable but abundantly present.

Europe heavily depended on fossil fuels (Grosskopf, 2011) → not blessed with abundance → depend heavily on oil imports.

So it invested in renewable energy→ solved the energy crisis and created thousands of jobs as well.

Asia

China has exceeded the U.S. in total electric power generation capacity which is 1234 Gw_e (IRENA, 2014) .

India could rely completely on renewable energy by 2050 (Pant, 2015)

Pakistan

The fuel imports of Pakistan account to $10.6 billion per annum (Khan, 2020) with around 0.76 wells per 1000 kilometer-square of area (Doggar, 2011).The natural gas reserves are rapidly diminishing.

Reliance on fossil fuels → Pakistan, far from achieving sustainable development goal to protect the environment.

Rationale of the study

- ✓ Researchers have emphasized that renewable energy is the solution for Pakistan's energy problem.

- ✓ However, there has been very little empirical analysis as to why the traditional form of energy is not as efficient as renewable or alternate.

- ✓ This paper in its first part of analysis presents the empirical evidence that traditional form energy using perishable resources such as fossil fuel is no longer efficient, environmentally hazardous and very costly.

- ✓ The second part is a discussion on alternate energy option for Pakistan

Literature Review

Developing countries contribute more to the environmental degradation because of their unsustainable practices (Khalil, 2015; Raupach, et al. 2007).

Khalil (2015) claims that continuation of current development strategies is not enough to achieve sustainable development goals.

Mehmood and Ayaz (2018) realize the real cause of energy supply-demand gap is the in the process.

The current energy security (energy supply-demand gap) issue in Pakistan can be resolved in two ways: by increasing energy efficiency or by using renewable energy sources (such as solar, wind and thermal)

the former is demand focused solution which is neither permanent nor sustainable given the unresolved circular debt issue due to changing political situation in the country and prevalent corruption.

A more sustainable approach towards it would be to switch to the renewable energy sources.

Literature Review

The energy deficit in Pakistan cannot be denied (Mehmood & Ayaz, 2018).

Here are some stats on how far we are from resolving the energy deficit:

➢ The supply and demand gap for power ranges from 5000 MWs to over 6000 MWs.

➢ Around Rs. 253bn of GDP was lost in 2015 owing to power shortage (Shahbaz, 2019)[1].

➢ A 29 percent of energy shortage by the year 2021 apprehended given the current situation demand and supply gap.

Can alternate energy be a solution for Pakistan? What is the potential of Wind and Solar Energy in Pakistan?

➢ The wind potential of Gharo-Keti Bandar Wind Corridor → around 50,000 MW power generation capacity (Khan, 2013).

➢ the future of renewable energy in Pakistan is such that it will attract foreign investors to invest in Pakistan. FBR data (Tax exemptions for wind and solar power generating companies u/s 126I for 5 yrs)

➢ Use of Solar powered tube-wells has improved agriculture in various villages in Sindh (Aazim, 2014)

1. Currently, Pakistan faces a cumulated loss of about Rs. 5 trillion (Malik, 2020). An update on circular debt due to non payment for FY20: Rs. 2150 bn as per senate standing committee on power.

Literature Review

Can nuclear energy be an option for Pakistan?

Often under the banner of finding a clean energy alternative to meet growth objectives, some international organizations such as International Atomic Energy Agency (IAEA) and United States Department of Energy deem it a sustainable option (IAEA, 2019; USDOE, 2020).

Pakistan has shown interest in this exposition.

Experts have advised against it (Houdbhouy, 2015; Stephan & Tynan, 2010).

'Let's go nuclear, safely' → 120000 of Fukushima could flee but 20 million of Karachi will not be able to.

Proposed Model

$$\Delta lco2kt_t = \alpha_{01} + b_{11} lco2kt_{t-i} + b_{21} gdp\_growth_{t-i} + b_{31} lfossil\_cons_{t-i}$$
$$+ b_{41} lrenewable\_energy_{t-1}$$
$$+ \sum_{i=1}^{p} \alpha_{1j} \Delta lco2kt_{t-i} + \sum_{i=1}^{q1} \alpha_{2j} \Delta gdp\_growth_{t-i}$$
$$+ \sum_{i=1}^{q2} \alpha_{3j} \Delta lfossil\_cons_{t-i} + \sum_{i=1}^{q3} \alpha_{4j} \Delta lrenewable\_energy_{t-1} + e_{1t}$$

✓ Co2kt represents carbon emissions in kilo tons.

✓ Gdp_growth shows GDP growth rate of Pakistan

✓ Fossil_cons is fossil fuel consumption (includes oil, natural gas, coal and petroleum), and

✓ Renewable_energy is the alternate Energy (Renewable resources such as solar, geothermal and wind along with nuclear energy)

Data

✓ Data – World Bank database from 1971 till 2019 and internal resources of FBR

Data Visualization

Table 1: Correlation

Variables	co2kt	gdp_growth	fossil_cons	renewable_energy
co2kt	1			
gdp_growth	-0.2717	1		
fossil_cons	0.9127	-0.2007	1	
renewable_energy	0.3374	0.384	0.263	1

Table 2. Lag

Variables	Lag(0)	Lag(1)
co2kt	1.0000	1.0000
lco2kt	0.8901	0.1098
d.lco2kt	0.0000	0.0000
gdp_growth	0.0000	0.0038
fossil_cons	0.5239	0.4018
lfossil_cons	0.3083	0.1719
dlfossil_cons	0.0000	0.0037
renewable_energy	0.2774	0.2722
lrenewable_energy	0.1706	0.1447
dlrenewable_energy	0.0000	0.0000

Table 4. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
co2kt	46	89256.06	56372.78	18929.05	201149.6
gdp_growth	49	4.702315	2.163922	0.468373	10.2157
fossil_cons	44	51.09622	9.108872	35.29485	62.47639
renewable_energy	44	3.067167	0.563844	1.963702	4.032139

Table 3. Model Estimation

Dependent variables	F-statistics	t-statistics	Cointegration	Model Estimation
lco2kt	1.074	-0.581	No	ARDL
gdp_growth	8.897	-2.708	Yes	ECM Model
lfossil_cons	4.045	-1.289	inconclusive	inconclusive
lrenewable_energy	5.237	-1.567	inconclusive	inconclusive

$$\Delta lco2kt_t = \alpha_{01} + b_{11}lco2kt_{t-i} + b_{21}gdp\_growth_{t-i} + b_{31}lfossil\_cons_{t-i} + b_{41}lrenewable\_energy_{t-1} +$$
$$\sum_{i=1}^{q1} \alpha_{1j}\Delta lco2kt_{t-i} + \sum_{i=1}^{q2} \alpha_{2j}\Delta gdp\_growth_{t-i} + \sum_{i=1}^{q2} \alpha_{3j}\Delta lfossil\_cons_{t-i} + \sum_{i=1}^{q3} \alpha_{4j}\Delta lrenewable\_energy_{t-1} + e_{1t}$$

Findings

- ARDL regression model results are shown in Appendix A. The results states that lco2kt at lags 1 and 2 are significant at 1% and 5% significance level along with 0.723 and 0.253 coefficients.

- Further, GDP growth at lag 2 has significant impact with increase of 0.004 in CO2 emissions in Pakistan.

- The fossil fuel has significant impact on CO2 emissions with (p-value <0.01) showing the consumption of nonrenewable resources are contributing 0.78 or 78% in CO2 which is damaging the environment and affecting climate. The renewable energy does not have significant impact in carbon dioxide emission in Pakistan.

- The ARDL model executed showed that in Pakistan, non-renewable energy consumption has significantly contributed in CO2 emission which is not a good indicator.

- Hence, the government of Pakistan must take serious actions for the use of renewable energy so that climate and the planet can be saved.

Conclusion and recommendations

- The data analysis and discussion paint a lucid picture of the current energy crisis in Pakistan and present viable solutions to the problem.

- The discussion has presented that the economy has faced huge loss because of the power shortage, damaging all sectors of the economy.

- Alternate source like Nuclear power is untested and dangerous but other forms of energy resources like wind and solar seem a viable option for Pakistan.

- The empirical analysis shows that fossil fuel affects the environment negatively.

- The amount of dollars Pakistan spends on oil import and extraction or electricity generation through traditional means could be utilized for investing in tapping the renewable energy sources for which cooperation on part of the government is vital.

- Subsidies to businesses and various tax advantages will further encourage private corporations to venture into clean energy to cater the current energy crisis in Pakistan.

Drawback of the study

Limited data on Renewable energy
Short run results
Limited resources

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. ardl lco2kt gdp_growth lfosil_cons lrenewable_energy, lags(2 2 2 0) aic

ARDL(2,2,2,0) regression

Number of obs   =   42

Sample: 1973 -   2014

F(9,   32) =   3205.65

Prob > F   =   0.0000

R-squared   =   0.9989

Adj R-squared   =   0.9986

Log likelihood = 99.192814

Root MSE   =   0.0261

lco2kt	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
lco2kt						
L1.	0.723108	0.116244	6.22	0.000	0.4863262	0.959889
L2.	0.253163	0.108356	2.34	0.026	0.0324492	0.473877
gdp_growth						
-	0.002698	0.002683	1.01	0.322	-0.002767	0.008163
L1.	0.000579	0.002986	0.19	0.847	-0.0055024	0.00666
L2.	0.004894	0.002403	2.04	0.05	-1.84E-08	0.009788
lfosil_cons						
-	0.781739	0.267539	2.92	0.006	0.2367805	1.326698
L1.	-0.2983	0.338794	-0.88	0.385	-0.9883983	0.391801
L2.	-0.39488	0.290512	-1.36	0.184	-0.9866304	0.196878
lrenewable_energy						
	-0.00125	0.034458	-0.04	0.971	-0.0714383	0.068938