

IMPACT OF US DOLLAR INDEX ON INDIAN ENERGY IMPORT COMMODITIES MARKET USING TIME SERIES ANALYSIS MODEL

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Abstract- The world is witnessing the highest value of US dollar index which is creating a buzz among the financial experts, researchers, traders, small and medium-sized enterprises and larger sized enterprises. US dollar index (USDIX) is a measure of the value of the U.S. dollar relative to a basket of six foreign currencies of the world defined with different weights of the currencies. The Indian energy market is an exorbitant import oriented market with coal and solar modules (solar panels) being the dominant imported products for energy market. It has been recorded that about 80 percent of coal is imported from Indonesia, Australia, South Africa followed by US. For FY 2022-23, government aims to reduce the imported coal amount substantially but due to crunch in domestic coal, an import norm for coal (blending purpose) has been announcement for private and state run coal based power plants. Similarly with only 3 GW solar cells domestic manufacturing capacity, India depends heavily on import of solar cells to meet up the target of 100 GW of electricity through solar based plants. The major exporter of solar cells for India is China, Malaysia and Taiwan and among others. The daily coal requirement for thermal power stations nowadays is 2.1 million ton creating more demand for coal import in country. The data has been analyzed through time series trend analysis (graphical approach) and compounded annual growth rate (CAGR). The analysis of data shows the presence of more factors affecting the import quantity of coal and solar cells respectively.

Keywords: US dollar index, energy market, coal, solar modules, import & export, US dollar, inflation rate, GDP

1. Introduction:

Capital or money a most important element for survival and for fulfillment of the need of human kind. As per economist, the three prime use of money are medium of exchange, accounts unit and to define value of the commodity and thus it is important to validate every commodity as per foreign or world standards and exchange market feasibility (**Dollar, 1984**).

The US dollar is the world most dominant currency and reserve currency which are held by central banks in significant amount to cater the development needs of the country. There are various reasons backing up US dollar to be an international currency listed as means of currency reserves, means of exchange markets, means of international financial markets and as a unit of account for settling of partialities and parities. Talking in numbers, about 60 percent foreign exchange reserves of central banks are in US Dollar followed by euro (20%), yen (6%), pound sterling (5%) and others (6%) respectively (**Dominant Reserve Currency, (2020), (B. Kenen, 1983)**). Therefore, US Dollar Index has been designed which is a geometrically-averaged calculation of six currencies such as euro, Japanese yen, British pound, Canadian dollar, Swedish krona and Swiss franc. The weight of each currency is been weighted against US dollar and the trading based on US dollar index became operational for futures trading in 1985. The weight of each currency differs calculated with the formula as below with **Table 1** depicting the weight of each currency **ICE futures U.S. (2015)**.

$$USDIX_{0.042} = 50.14348112 \times EURUSD^{-0.576} \times USDJPY^{0.136} \times GBPUSD^{-0.119} \times USDCAD^{0.091} \times USDSEK^{0.042} \times USDCHF^{0.036}$$

Currencies		Weights of the currencies Component of the Index
1	The euro	57.6%
2	Japanese yen	13.60%
3	British pound,	11.90%

4	Canadian dollar	9.10%
5	Swedish krona	4.20%
6	Swiss franc	3.60%

Table 1: Weight of six currencies consisting US DOLLAR INDEX
Data Source: ICE futures U.S.

India is a country which imports many of products from its neighboring and far-flung countries among which top five commodities are Petroleum (Crude), Gold, Petroleum Product, Pearl and Coal respectively. The **table 2** below depicts the worth and share of import commodities for India and **table 3** depicts the percentage wise share of top 10 countries import to India for the FY 2021-22 (April- November).

Rank	Commodity	(US\$ Billions)		Share (in Per cent)	
		2019-20	2020-21	2019-20	2020-21
1	Petroleum: Crude	102.7	59.5	21.6	15.1
2	Gold	28.2	34.6	5.9	8.8
3	Petroleum Products	27.8	23.2	5.9	5.9
4	Pearl, Precious, Semiprecious Stones	22.5	18.9	4.7	4.8
5	Coal, Coke and Briquettes, etc.	22.5	16.3	4.7	4.1
6	Electronics Components	16.3	15.3	3.4	3.9
7	Vegetable Oils	9.7	11.1	2	2.8
8	Organic Chemicals	12.2	11.1	2.6	2.8
9	Computer Hardware, Peripherals	9	10.4	1.9	2.6
10	Plastic Raw Materials	10.4	9.7	2.2	2.5

Table 2: Rank wise top 10 import commodities values and share for India for the FY 2019-20 and 2020-21.
Data Source: Department of Commerce, India Budget

Country	Share of (%) percentage
China	15.50%
UAE	7.30%
USA	7.20%
Saudi Arab	5.00%
Iraq	4.90%
Switzerland	4.70%
Hong Kong	3.20%
Indonesia	2.90%
Singapore	2.90%
South Korea	2.90%

Table 3: Rank wise import to India share by different countries for the FY 2021-22 (April- November)
Data Source: Department of Commerce, India Budget

From **table 2**, it was found and seen that coal is one of the top five commodity which India is importing which is effecting the overall production cost and tariff rate of electricity in Indian market. Coal being the prime component for electricity generation in India followed by solar, makes Indian coal market highly volatile market with direct impact of US Dollar Index on Indian currency. Despite being the fourth largest coal reserve, India stills depends on imported coal to fulfill the needs of various coals and cement plants. Many thermal based plants in India which are located in off- mines area are dependent on imported coal for its operation. As per the ministry of coal reports, it was observed that highest consumption of coal in India is be electricity sector, followed by steel, cement and other industry **Tongia & Gross, (2019)**. The seasonal variations specifically monsoon seasons has impacted production of coal. s

Also, to achieve the national goal of 100 GW of electricity through solar by the end of 2030, it is important to leverage the market for solar cells and modules manufacturing making India a global leader in solar cell manufacturing. With only 3 GW of solar panel manufacturing capacity in India creates a huge gap for solar panel import market in India. China being the global manufacturing hub for solar cells, import of solar cells is highest for China, followed by Malaysia and Taiwan. As per the report of minister of state for new & renewable energy and

power the table 4 depicts the quantum of imported solar cells/ modules for the FY 2014-15 to 2017-18 in MW (**solar panel import, 2018**). Thus, with rise in import of solar cells and modules share, the government of India has invited bids to raise the domestic manufacturing capabilities. Lately a scheme with a 50 percent reverse bid capacity was launched for solar modules manufacturing with e viability gap funding (VGF) as a financial aid (**Solar PV Manufacturing, 2019**).

Year	Imports (MW)	Indian Production (MW)	Total of (Imports + Indian Production) (MW)	Imports as % Total	Value in Million US\$ (For China)
2014-15	1275	170	1445	88.24%	603.34
2015-16	4186	206	4392	95.31%	1960.26
2016-17	6375	206	6581	96.87%	2817.34
2017-18	9833	587	10420	94.37%	3418.96

Table 4: Depicts the import and production data for solar panels in India with solar panels imported from china worth for the FY 2014 to 2017.

Data Source: Department of Commerce, Ministry of Commerce & Industry

Thus, with high percentage of coal and solar cell/ modules import to India will have an impact from rise in US dollar index witnessed in recent times/ months. Thus, the objective of the paper is to find and analyzed how the Indian coal and solar cells/ modules/panels market varies as per the fluctuations in US Dollar Index considering past years data.

2. Literature Review:

Electricity is one of the prerequisite for economic development and so it is important to know about the value of commodities required for electricity generation at both national as well as international level. The working paper of **Avdjiev et al., (2019)**, has tried to investigate the triangular relationship between US dollar strength, cross-border bank flow and actual level of investment with fluctuation in US exchange rates and found that US dollar strength and cross border bank flow and investment value are inversely related to each other. **Shik LEE & LIU, (2010)** in their study worked on various factors that are affecting the US Dollar index correspondingly depreciating or appreciating the world economy. A correlation between each industry/ sector index and US dollar index was checked and analyzed which shows high impact of US dollar index on each sector index affecting capital flows and market dominance. **Harpaz et al., (1990)** has shown the efficacy of future market with changing US dollar index values. The study was carried out to know whether investors were drifting towards US dollar Index future contracts market or day settlement market. Productivity of coal has been the major factor for coal prices long-term fluctuations across the world leading to trading of coal. Another factor that is affecting the price of coal are natural gas and oil production and trading market as per the research of **Ellerman, (1995)**. The disturbance in coal prices in China due to unusual volatility has increase the cost of electricity and power shortage in the country. **Yang et al., (2012)** argued that price of coal has increased globally due to rise in demand of coal in global market leading to requirement of formulations of new policies for trading of coal in US, UK and China's market to make global energy economy more stable. In the work done by **Ali & Rahman, (2012)**, a

positive relationship between Australian coal export and exchange rate of Australian dollar with the US dollar (A\$/US\$) was found. With one million tones export of Australian coal, a rise of 0.002450 USD was recorded in Australian dollar against the US dollar. The trading amount of Indonesian coal depends dominantly on exchange rates and export price of coal that affects the economic growth of the country reducing GDP value. The study of **Ambya & Hamzah, (2022)**, shows that short term elasticity of exchange rates has shows that with rise in 1 percent in exchange rate has reduces the export of coal value by about 2.9 percent. It has been found that exchange rate and USD has huge impact on electricity market price. The Spanish electricity spot prices has witness a impact with US dollar values and US/Euro exchange rate values and so it is required to develop a balance between renewable deployment and market price of the electricity generated through renewable **Muñoz & Dickey, (2009)**. In recent years, countries across the world are gradually shifting towards renewable sources for power generation. Of all the renewable sources, solar being the prominent one leading to trade of solar modules/ cells /panels. (**Taghizadeh-Hesary et al., 2021**) Japan in order to increase their solar module installations has opted new strategies and green financing modules considering exchange rate and self-sufficiency ratio.

Thus, by reviewing papers the main conclusion drawn and observed that no/less particular work has been done focusing on Indian energy import commodities products. Very few works have been done to know about the market trend of coal and solar cells import with US dollar index value fluctuations. The main focus of the paper is on coal market trend analysis. Thus, the paper aims to analyses the impact of US dollar index on import values for coal and solar cells which are two of the major commodities of India energy market considering exchange rates, inflation rate and GDP values collected from relevant sources.

3. Methodology:

The secondary data has been collected from relevant sources such as official sites, government portals which have been analyzed using time series model. The pattern for collected data does not have cyclic or trend component, but have irregular component with indefinite fluctuations and variations creating noise in the series. Recent year data's has been considered as to know the impact on recent trade market. Also, to witness the growth rate CAGR analysis is been performed to witness the percentage rise or fall in recent data collected for coal import, solar cell import and GDP. The analysis has been done using graphical representation of data in order to make data more easily understandable. The trend analysis for import quantity of coal and solar cells has been performed using compounded annual growth rate (CAGR) analysis.

Data selection

The most critical step to determine high correlation between the selected parameters and to maintain the overall quality of work is data selection. The data has been selected from relevant sources such as international organizations such as IEA, CEA, coal statistics report, IEX, exchange rate UK, IMF and among others to avoid any vagueness and inconsistency in data collected. The selected data has been accessed to avoid any in-discrepancies and redundancy in data set to get more subtle results.

4. Analysis:

US Dollar Index and Import of Coal

India being one of the major producers of coal still depends on imported coal with Australia, Indonesia, South Africa and USA being the most dominant exporters. Similarly with high solar potential but limited solar cells/modules/panels manufacturing capacity, the import of solar cells/modules was recorded highest from China, Malaysia, Taiwan, and Hong Kong and among others. The change in US Dollar Index value are predominated with reasons such as Russia-Ukraine war, US consumer price inflation recorded from October 2021, rising interest rate and US bond yields, affecting the global economy with other currency losing worth against US dollar.

Analyzing the import of coal from 2011 to 2021, it was recorded that the value is highest for FY 2019-2020 with a rise of 5.60% from previous year. As known the highest consumption of coal is in thermal power plants, so it was recorded as per Central electricity Authority (CEA) report, about 21.35 percent of total 20.60 million tons of coal imported for the month of April 2022, has been consumed by thermal power stations (**Fig 1** and **Fig 2**).

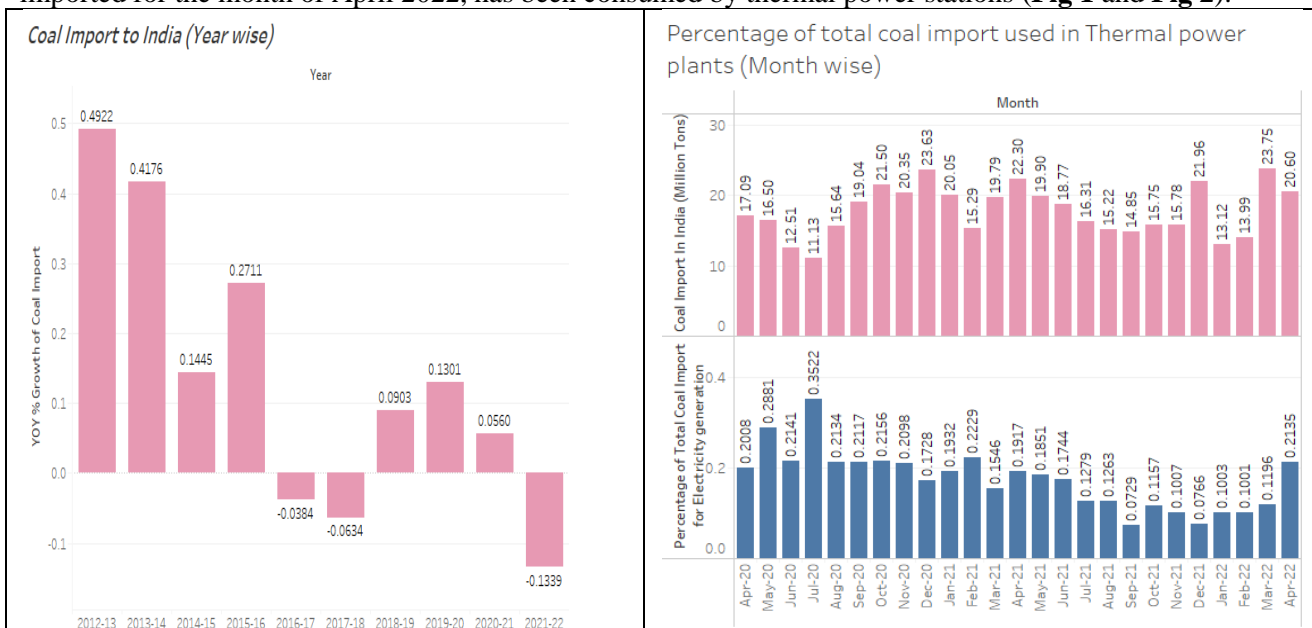


Fig 1: (Designed with Tableau) Percentage change in coal import for India for FY 2012-13 to 2021-22 respectively.

Data Source DGCI&S, Kolkata

Fig 2: (Designed with Tableau) Month wise data for percentage of total coal import used by thermal power plants India as per Data source CEA reports

US Dollar Index increasing value and coal import to India value (**Fig 3**) depicts that with approximately 2.23 % change in dollar index value has caused a decrease in coal import value by 23.75 million ton to 20.60 million ton i.e., by about 13.26 %. But as the country is witnessing high demand of electricity and with reduction in coal domestic production, the import of coal to fulfill the need of thermal stations are increasing for the month of January 2022 to May 2022 as per CEA report (**fig 4**).

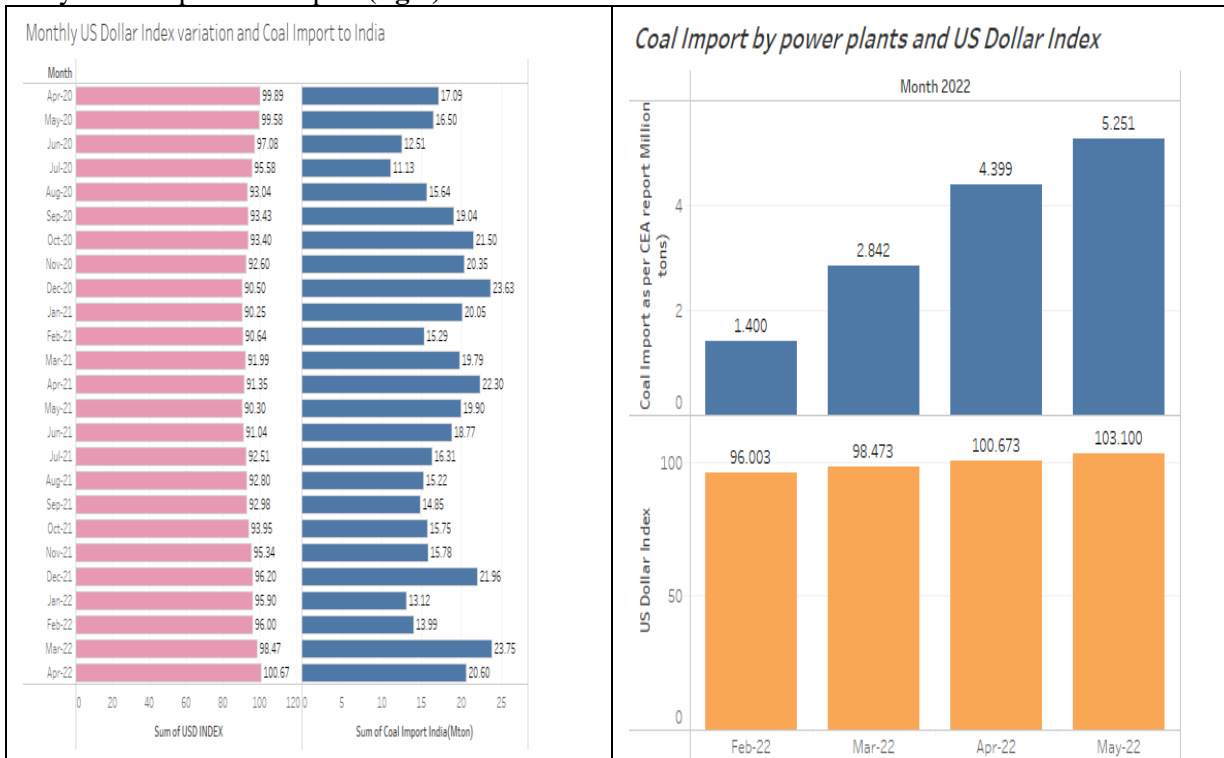


Fig 3: (Graph Designed with Tableau) Movement of USDY and coal import to India month wise. **Data source** DGCIS, Kolkata and WSJ markets

Fig 4: (Graph Designed with Tableau) Movement of USDY and coal import to thermal power station in India month wise. **Data source** CEA and WSJ markets.

For the same month (Jan 2022- May 2022) (**Fig 3**), the quantity of coal import (in thousands) has not been affected and a steady rise is observed with rise in US Dollar Index value depreciating the Indian rupee value to 79.4881. Also, with rise in US dollar value, rise in imported coal value is observed which depicts that there are certain more factors that are affecting the coal import values in Indian market (**Fig 4**).

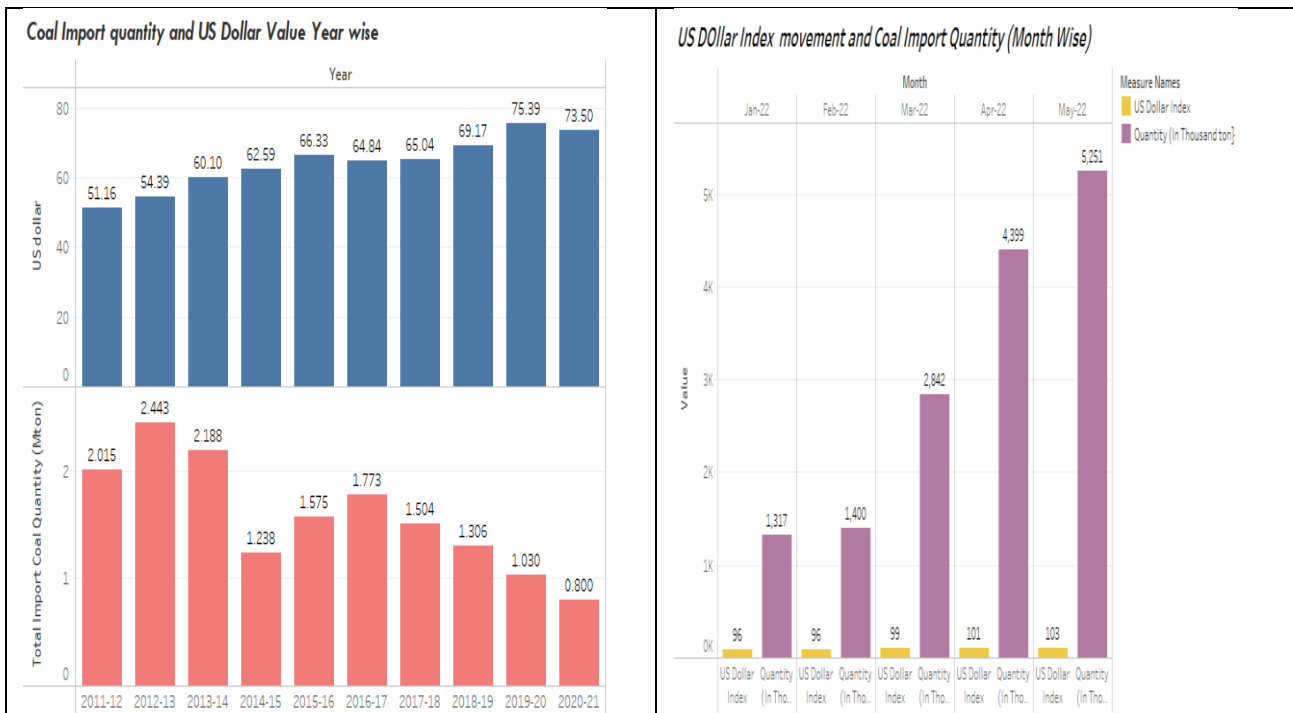


Fig 5: (Graph Designed with Tableau) Movement of USD value and coal import in India year -wise **data source** CEA and RBI

Fig 6 : (Graph Designed with Tableau) Movement of USDY and coal import to India month wise **data source** DGCIS&S, Kolkata and WSJ markets

Generally India import 5 different types of coal with different percentage of total imported coal amount classified as anthracite, metallurgical coal, bituminous, sub-bituminous and lignite Whilst is the largest producer of bituminous coal mined in the eastern and central states of India. From the time series coal data, it was observed that the import value of sub- bituminous type of coal is highest from the data screened for FY 2011-12 to 2020-21. The Fig 7 bar graph depicts each year coal import value by type.

Year wise Import of Coal (By type)

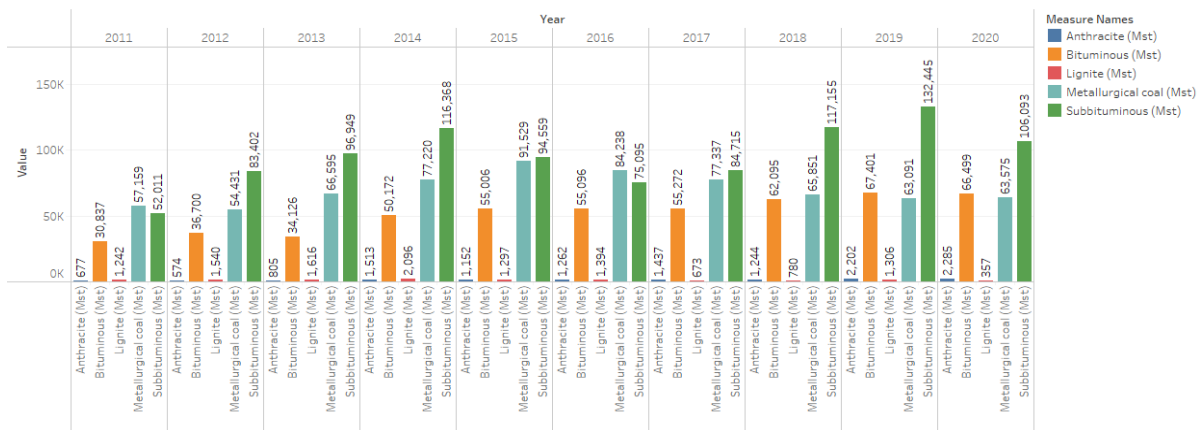


Fig 7: (Graph Designed with Tableau) Year wise import of coal by type to India **Data Source** U.S. Energy Information Administration

For the year 2019-20 and 2020-21, Indonesia and Australia is the highest exporter of coal that is import to India with South Africa, USA and Russia followed. The percentage share for import of coal from Indonesia is 46.94% and 43.04% respectively followed by Australia by 18.80 % and 25.56%. Also, it is observed that the share of USA has increased from 3.31% to 5.68% showing a worth between US dollar and Indian rupee denomination. For Indonesia in the FY 2020-21, a decrease of about 20.74% in coal import value was recorded and for the same period Australia recorded a hike in coal import to India by 17.77% (Fig 8). The import of coal from different countries has created different import total amount worth with the effect of varying US Dollar Index value.

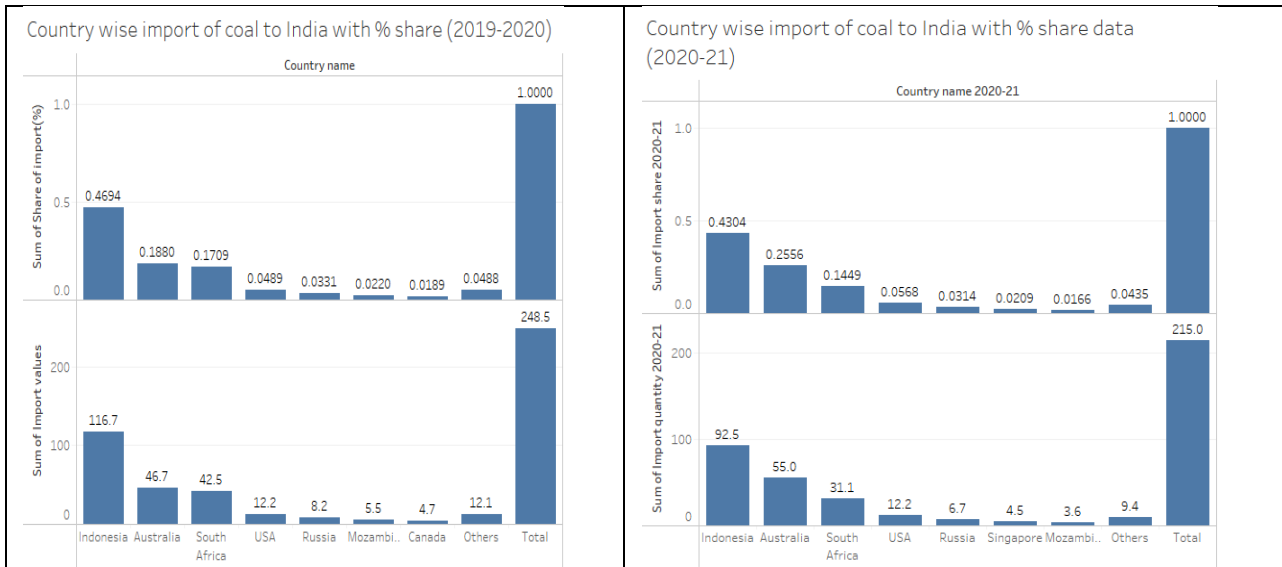


Fig 8: (Graph Designed with Tableau) Country wise import of coal to India for FY 2019-20 and 2020-21 respectively
Data Source: Ministry of Coal

The denomination of Indian currency with different currency varied US dollar Index (year wise) is depicted in **Fig 9** which shows that pound sterling has the highest value followed by Euro and Yen values. The value of US Dollar Index in the early months of 2022 has started increasing exponentially affecting either negatively or positively the worth of Indian rupee in different denomination(s) **Fig 10**.

Worth of Indian Ruppee in different denominations (Year wise)

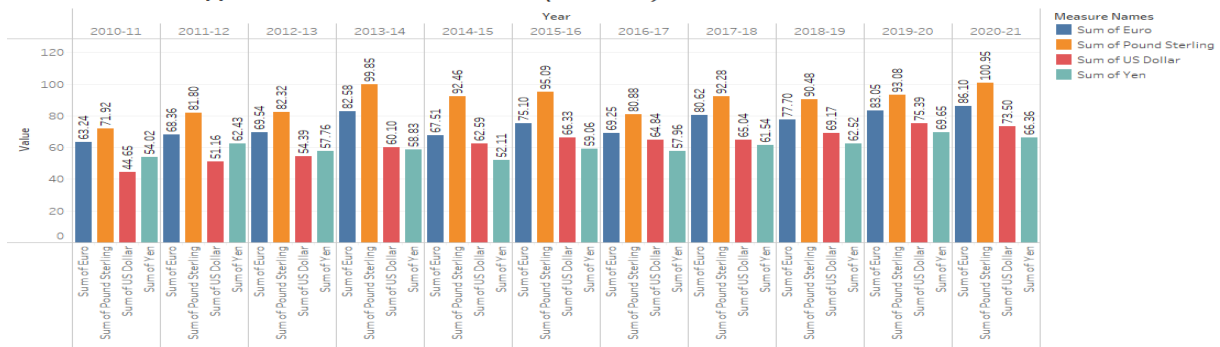


Fig 9: (Graph Designed with Tableau) Worth of Indian currency in different denominations year wise from FY 2010-11 to 2020-21 **data source Ministry of Coal.**

US Dollar Index and other currency movement

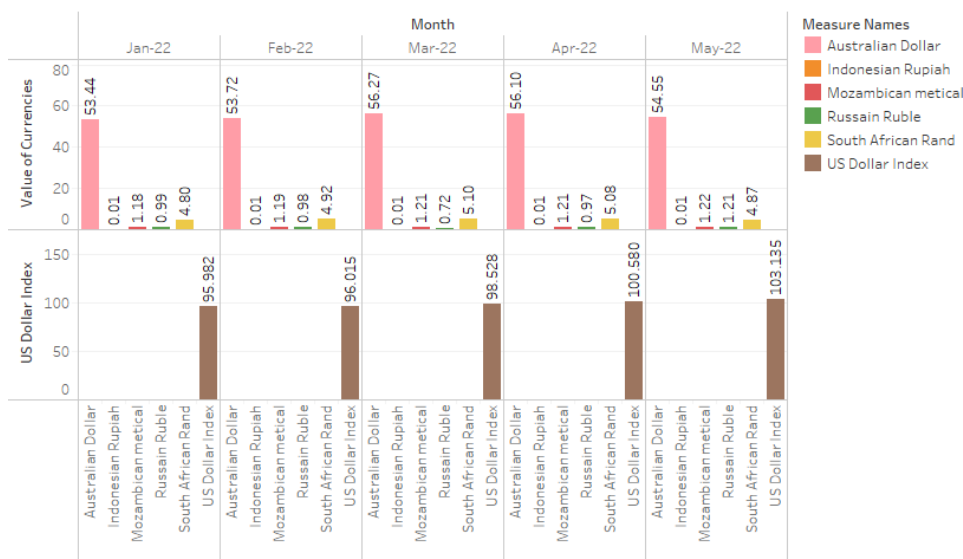


Fig 10: (Graph Designed with Tableau) US DOLLAR INDEX affect on different currencies worth in Indian rupee currency denominations (Month-wise Jan 2022 to May 2022 **Data Source:** Yahoo Finance and UK Exchange rates and RBI

Along with US dollar index values, WPI inflation and GDP values are also factor that affects the coal import value for the country. The GDP per year growth rate is negative for fiscal year 2020-21 which leads to reduction in coal import value for same fiscal year. Also it is observed that for fiscal year 2016-17 to 2017-18 the value of % GDP growth rate is reduced but the quantity of coal import is increased by about 9.60 percent (Fig 11). The WPI (wholesale price index which is a measure to reflect the average change in price of commodities), shows an exponential rise in values in recent times being in double digit value from few months as depicted in Fig 12. The wholesale price index for coal also witnessed a hike in value reaching up to 130.9 values for the month of April 2022 reducing the coal import value to 20.60 million tons from 23.75 million tons for March 2022 graphically represented in **fig 13**.

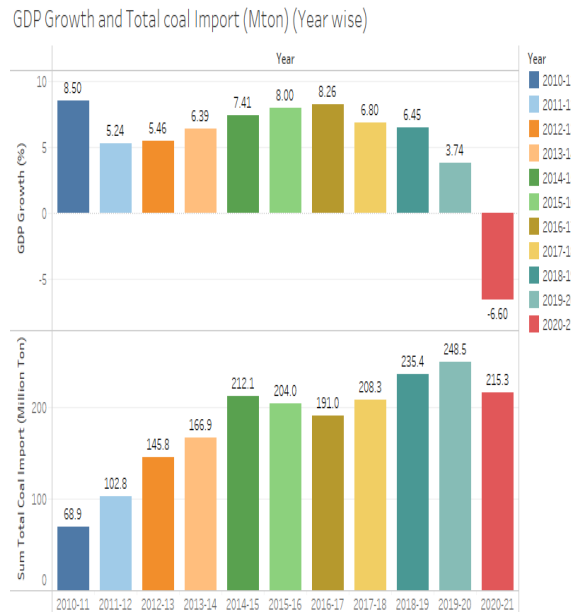


Fig 11: (Graph Designed with Tableau) GDP growth rate impact on total coal import value for fiscal year 2010-11to 2020-21 **data source** World Bank and Macrotrends

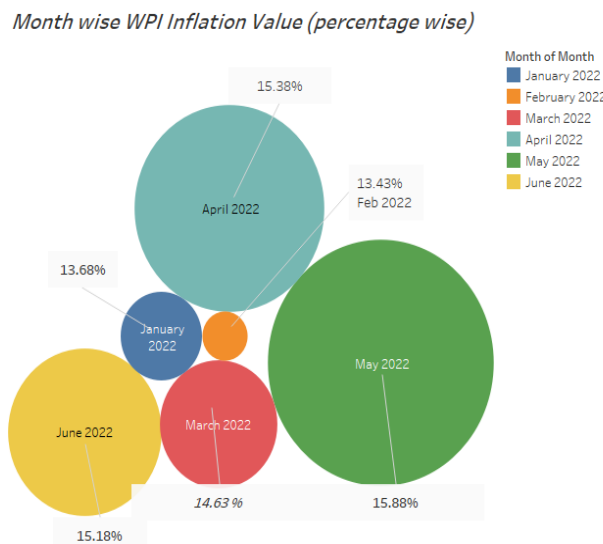


Fig 12: (Graph Designed with Tableau) Wholesale Price index inflation values India month wise data: **data-source** Office of Economic Adviser- DIPP, Labour Bureau and National Statistical Office.

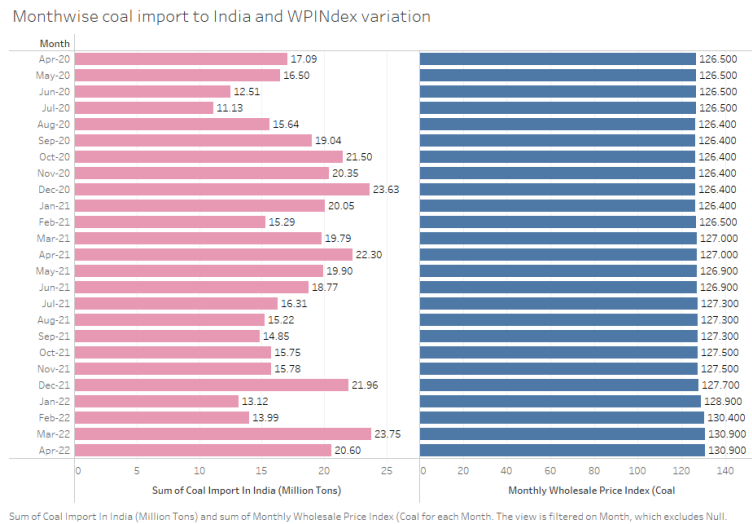


Fig 13: (Graph Designed with Tableau) Effect of Wholesale Price index on coal import data (Month wise) **Data Source** Office of Economic Adviser- DIPP and Ministry of Coal

US DOLLAR INDEX and Import of Solar Cells/Module

Solar cell/ module import in India is high with low manufacturing capacity. The abrupt rise in value of US Dollar Index shows less or no negatively impact on solar cell/ modules import from China, which shows less impact of US Dollar Index on Chinese Yuan equivalency on Indian currency. A record hike of about 128 % in solar cell import from China, shows the market demand of solar cells in Indian market creating more business opportunities to aim the target of clean energy by 2030 (Fig 14) . For the fiscal year 2021-22, Hong Kong and Malaysia are the next countries which import large quantity of solar modules/cells to India. But Hong Kong solar cells import value witnessed no import quantity for the month of February 2022 with US Dollar index value rising by about only 2.62 %. Similarly, for Malaysia the quantity of solar cells import raised exponentially with reduction in US Dollar worth by 6.29 % for the month of February and March 2022. (Refer Fig 15 and Fig 16). For the fiscal year 21-22, the import of solar cell from China, Hong Kong and Malaysia are 96988.85, 2009.75 and 557.17 respectively.

Import of Solar cells from China and worth of US Dollar Index

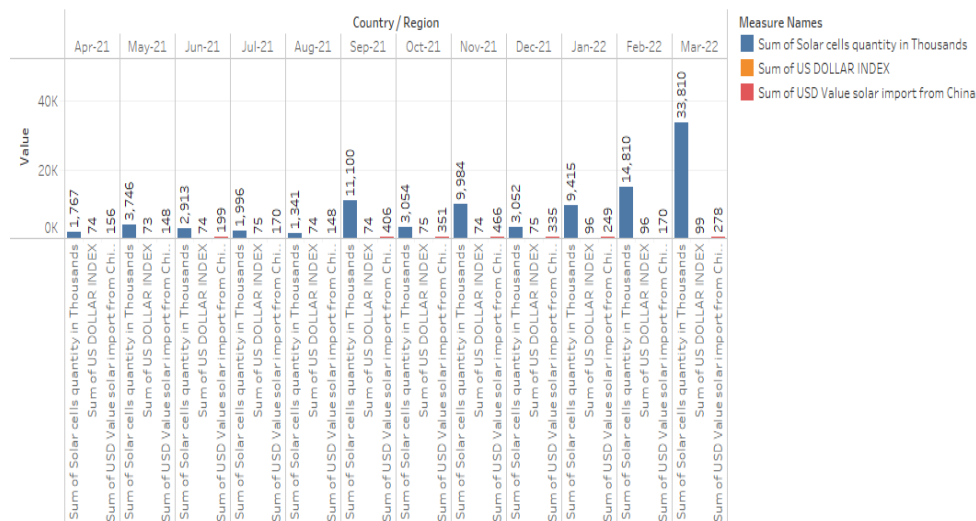


Fig 14: (Graph Designed with Tableau) Import of solar cells from China variation with US Dollar Index. **Data Source** Ministry of Commerce India

Import of solar cells Hongkong and worth in US Dollar

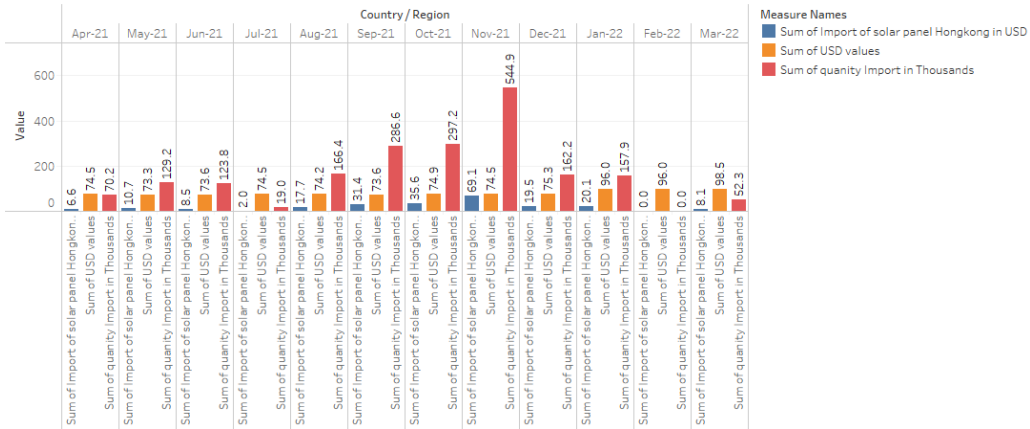


Fig 15: (Graph Designed with Tableau) Import of solar cells from Hong Kong variation with US Dollar Index. **Data Source** Ministry of Commerce India

Solar Cell Import from Malaysia and US Dollar worth

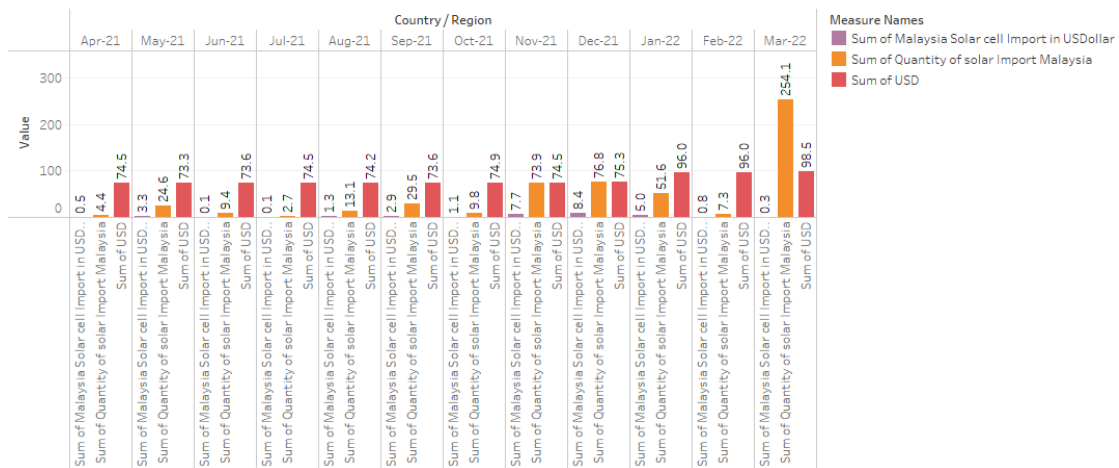


Fig 16: (Graph Designed with Tableau) Import of solar cells from Malaysia variation with US Dollar Index. **Data Source** Ministry of Commerce India

CAGR analysis for coal and solar cell import:

CAGR is calculated to know the rate at which the value has grown over the years or month for a defined amount of time. The general formula to calculate the compounded annual growth rate for import values, the formula used is as below:

$$CAGR = \left(\left(\frac{EV}{BV} \right)^{\frac{1}{n}} - 1 \right) \times 100$$

EV=Ending value
 BV=Beginning value
 n=Number of years

Compounded annual growth rate (CAGR) analysis depicts that irrespective of the rise in US dollar Index value, the growth rate per year and month for the import of coal is highly fluctuating showing no similar trend as like US Dollar Index value. The highest value of CAGR was observed for the month of March 2022 and lowest for June 2021 with a value of 2.872 % and -2.268% respectively for month on month coal imported to cater the requirement of thermal power plants. The Fig 17 shows the variation in demand and consumption of imported coal quantity depicting vulnerabilities in the total amount. From fig 18 it is clearly visible that 2014-15 observed lowest value of CAGR with -5.53% and highest for the year 2015-16 with a value of 2.435 %. It was also observed that government is emphasizing on reduction of coal import value with a CAGR of -2.351 % and -2.492% for the fiscal year 2019-20 and 2020-21 respectively.

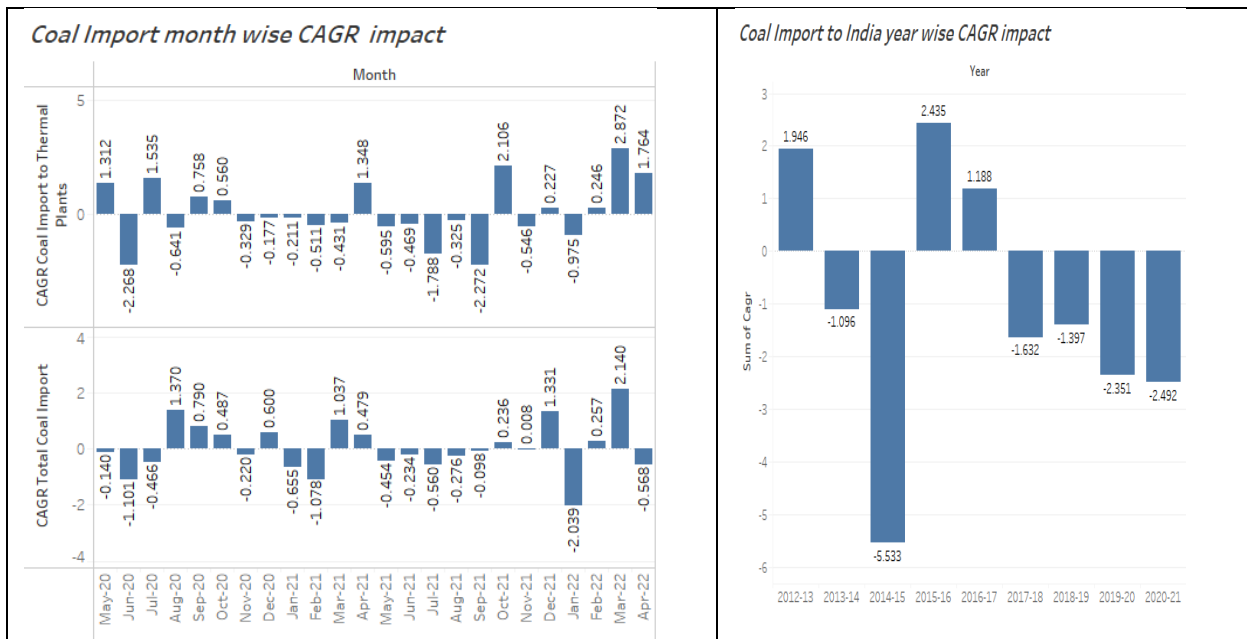


Fig 17: (Graph Designed with Tableau) Variation in CAGR for import quantity of coal to India and specifically to power plants (month wise). **Data Source** Ministry of Coal India, CEA and self analysis

Fig 18: (Graph Designed with Tableau) Variation in CAGR for import quantity of coal to India (year wise). **Data Source** Ministry of Coal India and CEA self analysis

The month wise CAGR variation of solar cell import is highest for the month of September 2021 followed by November 2021. The lowest variation with respect to last month import quantity was recorded for the month of October 2021 and December 2021 respectively.

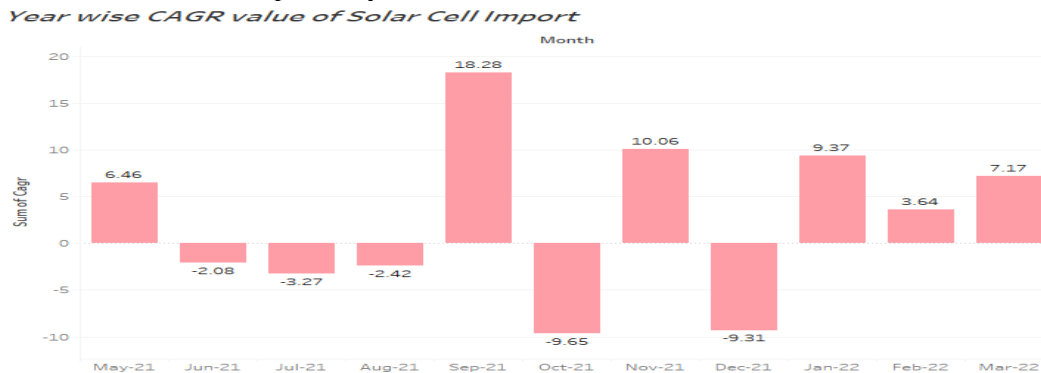


Fig 19: (Graph Designed with Tableau) Variation in CAGR for import quantity of solar cells to India (month wise). **Data Source** Ministry of Commerce India

5.
6. Discussion

The electricity market of India has attracted a FDI inflow of US\$ 15.89 billion between April 2000-March 2022 shaping Indian electricity market as great investment opportunity market. The government has also announced a fund of US\$ 2.57 billion to attract production link incentives for solar modules manufacturing (IBEF). The time series data obtained from relevant sources analysis has helped to know about the direct and indirect implication of US Dollar index on imported coal quantity in recent months.

The value of import to India is dependent on the value of worth of denomination of Indian currency for different currency across the world and thus the government of India has listed the worth of currency effective from July 2022 shown below **table 5**:

Foreign Currency	Rate of exchange of one unit of foreign currency equivalent to Indian rupees (For Imported Goods)
Australian Dollar	56.45
Bahraini Dinar	219.05
Canadian Dollar	63.25

Chinese Yuan	12
Danish Kroner	11.15
EURO	83.25
Hong Kong Dollar	10.4
Kuwaiti Dinar	268.6
New Zealand Dollar	51.2
Norwegian Kroner	8.2
Pound Sterling	97.6
Qatari Riyal	22.7
Saudi Arabian Riyal	22
Singapore Dollar	58.5
South African Rand	4.8
Swedish Kroner	7.95
Swiss Franc	84.1
Turkish Lira	4.7
UAE Dirham	22.5
US Dollar	80.95

Table 5: Indian rupee denomination in different foreign currency applicable to imported goods from July 2022. **Data Source:** Ministry of Finance, GOI

Coal and solar being the most dominating source for generation of electricity in India has created the import of coal and solar modules counted in important import commodities. The rising value of US Dollar Index has impacted neither strongly nor weakly the coal import market for India. The US Dollar Index rise has not lead to decrease in quantity of coal import but will have its effect on total import cost. For one tone of coal import the costs lies between Rs 17,000-18,000 whilst the same for domestic coal production cost only Rs 2,000 per tons. The plan of government to cut down the import quantity of coal has taken a new route as for blending of coal, government has made a mandate for state generating companies and independent power producers (IPPs) to import at least 10 percent of coal to avoid coal domestic production shortage. This will have an impact on thermal power generated electricity tariff rate surging the value by about 60 to 80 paise per unit. Also, the time series data for coal import shows that market players who are direct user of imported coal has not been affected much with rising US Dollar index value but the indirect user and end-user of electricity will be effected. The **Fig 20** below depict that the rising value of US Dollar Index with stagnant value of WPI, leads to increase in import coal quantity. Thus, the increased value of US Dollar Index and wholesale price index inflation has not affected the quantity of coal import values negatively, making coal special commodities for economic growth of the country.

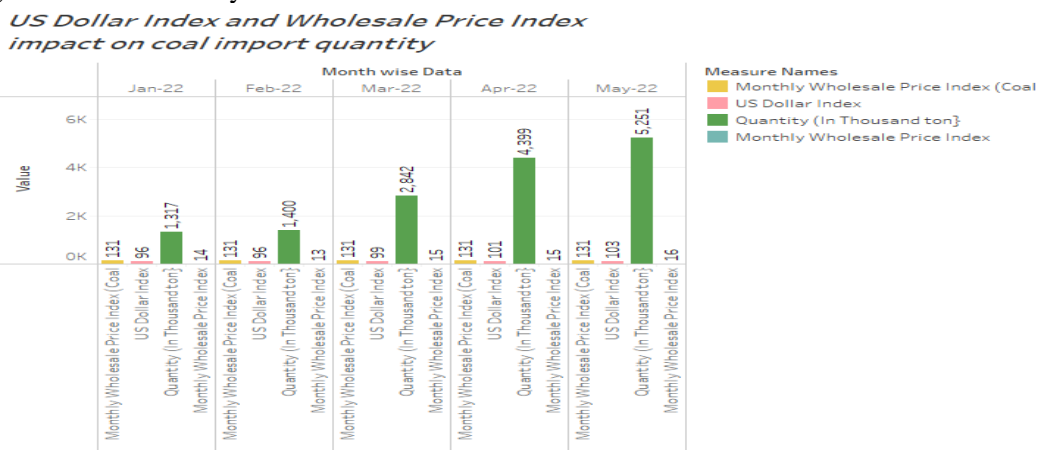


Fig 20: (Graph Designed with Tableau) Import of coal variation with US Dollar Index and WPI for coal commodity. **Data Source** Office of Economic Adviser- DIPP and Ministry of Coal and Yahoo Finance

Along with coal, the import market for mining equipment in India has also high worth million dollar market with a share of about 6 percent of US import trade. For the fiscal year 2020-21, Indian mining equipment market was of worth dollar 894 million decreased from dollar 1019 million from fiscal year 2019-20. This reduction in worth of mining equipment import was observed when the value of US dollar value was not increasing exponentially, pointing towards other factors responsible for import market (**Global Trade Atlas**). The value of Australian dollar worth in

Indian denomination increased for the month of January 2022 to March 2022, after which the value started reducing with exponential rise in US dollar Index value that shows that the import quantity of coal from Australia will be impacted with changing value of Australian dollar **fig 21** and **fig 22**. Similarly, the worth of Indonesian Rupiah has also not affected much with rising US Dollar Index value as observed for the month from Jan 2022 to August 22 (**fig 21**).

US Dollar index value is not the only predominant factor for import of solar cells/modules for country like China, Malaysia, Hong Kong and Singapore and among other. The rising value of WPI inflation has not affected the market of solar import for the month of January to March 2022 as with increasing percentage WPI inflation, the solar cell import quantity to India has also increased **Fig 23**. Therefore, factors such as government imposed taxes, quantity requirement and government regulations along with US Dollar Index and wholesale price index is affecting solar cell and coal import to India from different countries.

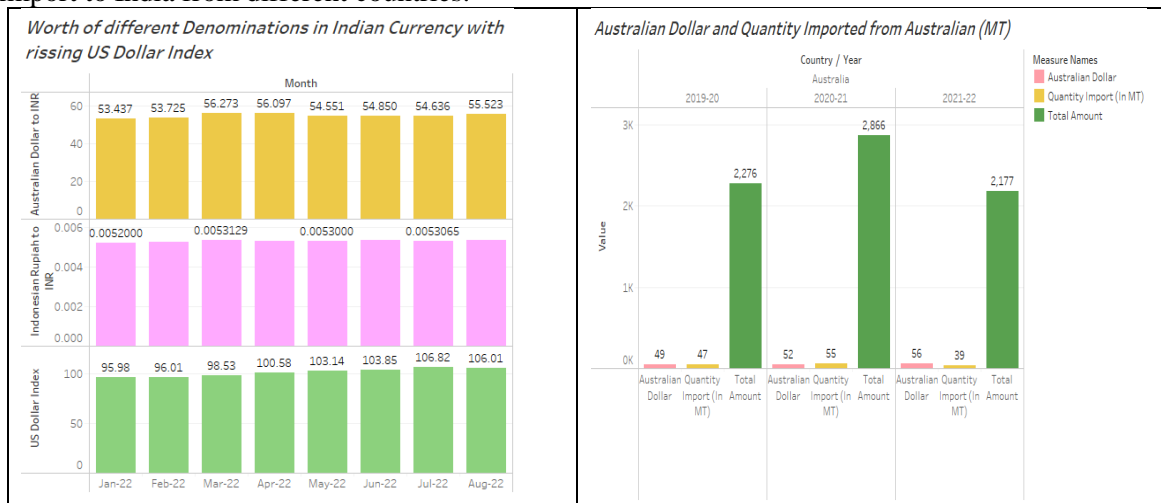


Fig 21: (Graph Designed with Tableau) Worth of Indian currency denomination in different currencies with rise in US Dollar Index value. **Data Source** Yahoo Finance and UK Exchange rates and RBI

Fig 22: (Graph Designed with Tableau) Australian dollar variation impact on quantity of coal import to India. **Data Source** UK Exchange rates and RBI, Ministry of Coal, India

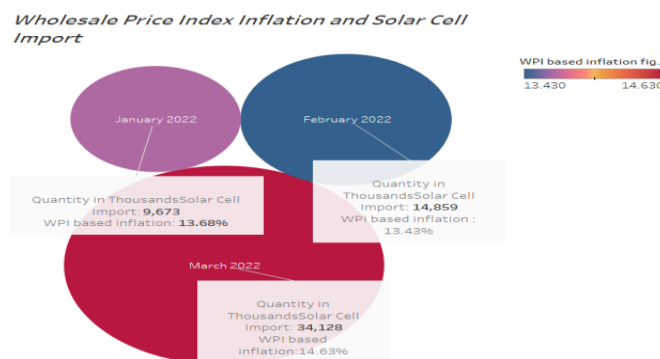


Fig 23: (Graph Designed with Tableau) WPI Index value and solar cell import to India. **Data Source** Ministry of Commerce, India

The calculation of CAGR for solar cells and coal import depicts that the fluctuations in the total quantity of import are backed by series of factors such as inflation in exporting value, trade behavior, supply chain constrains and bottlenecks, foreign relations between the countries and among others.

7. Conclusion

Contrary to the general belief that rising value of US Dollar Index will showcase same effect on every countries currency and will have negative impact on every tradable commodities, the impact of US Dollar Index inflation has not as much pessimistic to the import quantity of coal and solar modules/cells to India. The main reasons for less impact on these tradable commodities are high demand of electricity in the country and un-fulfillment thorough domestic manufacturing and production capacity. Although the public and private players for imported coal users are searching for an alternative to reduce the import coal dependency, to reduce the rising production cost value and tariff values. Similarly, with the government PLI schemes for solar panel manufacturing, the domestic solar based plant players are taking steps to have more of domestic manufacturing to further reduce the overall cost of solar based

electricity by cutting down the import duty and other charges effects. Thus, the government should follow manufacturing strategies of major solar cell exporters across the world and discuss on the policies for the same. Also, the government needs to work on strengthening of solar cell/ module manufacturing more and should focus on reducing the coal usage and dependency for generation of electricity. The mathematical calculation of CAGR has helped to know the actual fluctuation rate for imported coal and solar cells quantity. This CAGR percentage calculation has shows that the demand for neither imported coal nor imported solar cells has shown any linear or circular trend for a stated period creating import market for energy commodities more unstable and vulnerable in nature.

Limitations

The paper has considered only GDP and WPI values along with US dollar Index values to analyze the import value of energy commodity. The paper considered only two major energy commodity such as coal and solar cells, emphasizing more on coal import creating scope for future work. The uncertainty in secondary data could be found while undertaking analysis of data.

REFERENCES:

1. *EXPONENTIALSMOOTHING*.
http://du.ac.in/du/uploads/departments/Operational%20Research/24042020_Course%20MOR204_Econometric%20Modeling%20and%20Forecasting_Kaushal%20Kumar.pdf
2. The U.S. dollar as the world's dominant reserve currency. (2020). *IN FOCUS*.
<https://crsreports.congress.gov/product/pdf/IF/IF11707>
3. The international role of the dollar: Theory and prospect. (1984).
<https://www.nber.org/system/files/chapters/c6838/c6838.pdf>
4. Group of Thirty, New York, & B. Kenen, P. (1983). *The role of dollar as international currency*.
https://group30.org/images/uploads/publications/G30_RoleDollarIntlCurrency.pdf
5. ICE futures U.S. (2015). *U.S. dollar index contracts*.
https://www.theice.com/publicdocs/futures_us/ICE_Dollar_Index_FAQ.pdf
6. External sector, <https://www.indiabudget.gov.in/economicsurvey/doc/eschapter/echap03.pdf>
7. Tongia, R., & Gross, S. (2019). Coal in India : Adjusting to transition. *Brookings*.
https://www.brookings.edu/wp-content/uploads/2019/03/Tongia_and_Gross_2019_Coal_In_India_Adjusting_To_Transition.pdf
8. Ministry of New and Renewable Energy. (2018). *Import of solar panels*.
<http://164.100.24.220/loksabhaquestions/annex/15/AU397.pdf>
9. Solar PV manufacturing in India silicon ingot - wafer- PV cell- PV module. (2019). *TERI*.
<https://www.teriin.org/sites/default/files/2019-08/ppt-Solar-PV-anufacturing.pdf>
10. Shik LEE, D., & LIU, H. (2010). An analysis of several factors affecting the U.S. dollar index. *Journal of Cambridge Studies*.
<https://www.repository.cam.ac.uk/bitstream/handle/1810/255442/201001-article11.pdf?sequence=1>
11. Harpaz, G., Krull, S., & Yagil, J. (1990). The efficiency of the U.S. dollar index futures market. *Journal of Futures Markets*, 10(5), 469–479. <https://doi.org/10.1002/fut.3990100504>
12. Avdjiev, S., Bruno, V., Koch, C., & Shin, H. S. (2019). The dollar exchange rate as a global risk factor: Evidence from investment. *IMF Economic Review*, 67(1), 151–173. <https://doi.org/10.1057/s41308-019-00074-4>
13. Ellerman, A. D. (1995). The world price of coal. *Energy Policy*, 23(6), 499–506. [https://doi.org/10.1016/0301-4215\(95\)91231-z](https://doi.org/10.1016/0301-4215(95)91231-z)
14. Yang, C. J., Xuan, X., & Jackson, R. B. (2012). China's coal price disturbances: Observations, explanations, and implications for global energy economies. *Energy Policy*, 51, 720–727. <https://doi.org/10.1016/j.enpol.2012.09.010>
15. Ali, M. L., & Rahman, S. F. (2012). Influence of Australian coal export on a\$/US\$ exchange rate: A longitudinal study. *International Business & Economics Research Journal (IBER)*, 11(4), 397. <https://doi.org/10.19030/iber.v11i4.6876>
16. Ambya, A., & Hamzah, L. M. (2022). Indonesian coal exports: Dynamic panel analysis approach. *International Journal of Energy Economics and Policy*, 12(1), 390–395. <https://doi.org/10.32479/ijeep.11978>
17. Muñoz, M. P., & Dickey, D. A. (2009). Are electricity prices affected by the US dollar to Euro exchange rate? The Spanish case. *Energy Economics*, 31(6), 857–866. <https://doi.org/10.1016/j.eneco.2009.05.011>

18. Taghizadeh-Hesary, F., Yoshino, N., Inagaki, Y., & Morgan, P. J. (2021). Analyzing the factors influencing the demand and supply of solar modules in Japan – does financing matter. *International Review of Economics & Finance*, 74, 1–12. <https://doi.org/10.1016/j.iref.2021.01.012>
19. <https://www.ibef.org/industry/power-sector-india>
20. <https://www.trade.gov/country-commercial-guides/india-energy>