FUEL FOR THOUGHT

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1. CURRENT SCENARIO

1.1. Energy security and particularly the availability and cost of liquid fuels for the transportation sector should be of prime concern to Pakistan.

1.2. The World oil price were reported to be stabilized on July 27, 2005. On July 30, 2005, three days later oil prices surged to US $ 61 per barrel in N. Y. The price of oil hit an all-time high of US $ 70.85 per barrel in New York on August 30, 2005. It was enough to indicate a dangerously overheated global supply system. The price have more than doubled since 2000. The prices of Brent Crude approached US $ 150 per barrel at times in 2008. Demand pressure will continue to build. The current low level oil prices in the world should not lead to any misleading conclusions.

1.3. The US $ 4 billion pipeline that would bring Iranian natural gas to Pakistan and India is supposed to undermine the US energy polices according to US officials. The project therefore is likely to be stalled.

1.4. Oil constitutes 34.4% of the total primary energy supplies of Pakistan amounting to about 66.85 m TOE in the year 2013-14. Practically the entire energy for the public and private transport system in Pakistan is imported. The Oil import bill was US $ 15.47 billion last year (62% of the Export Earnings). Total import of oil and petroleum products in the year 2013-14 was 22.2 m TOE. The transport sector alone consumed 32.5% of the total energy consumed in the country.

1.5. Production of domestic oil wells on an average is 86,533 barrels per day, which can at best meet 1/3rd of the transport sector demand.
1.6. Pakistan is a net importer of oil. Good 1/3rd of its export earnings are consumed by the import of oil and petroleum products. A major break-through in domestic oil production in future appears to be highly unlikely.

1.7. The present scenario, therefore, does not indicate a sustainable energy supply system. The entire transport system in the country can be immobilized within a very short time, as there are no significant strategic reserves of oil.

2. COAL LIQUEFACTION

2.1. Coal is the most abundant fossil energy resource in the world and is the basic building block or energy source for hundred of products. Economically viable global coal reserves are expected to total one trillion tonnes, about half of which is composed of low grade coal such as sub-bituminous and brown coal. Pakistan has coal reserves of about 186 billion tonnes (including hypothetical resources of about 114 billion tonnes) most of it is low grade.

2.2. Conversion of coal into liquid fuels like gasoline, or diesel by several processes is technically feasible. During 1930’s the Germans developed two major coal liquefaction processes to commercial scale, and both were used to generate much of the transportation fuel used by the Germans in World War II. A so called Indirect Process was developed and used in Nazi Germany during WW II and for many years by South Africa. In both the cases those regimes were politically isolated and restricted to buy crude oil in the open market.

2.3. By 1944 Germany’s annual synthetic fuel production reached more than 124,000 barrels per day (6.5 million tons per year) from 25 plants of petroleum products from coal. At the end of WW II Fischer-Tropsch technology was under study in most of the industrial nations. However, the low cost and high availability of crude oil led to a decline in the interest in liquid fuels made from coal. The most wide spread use of CTL Technology took place in South Africa, where an estimated 300,000 barrels per day of gasoline and diesel is produced.
2.4. South African SASOL was founded in 1950 in Sasolburg, which utilized the German process (Fischer – Tropsch) to produce synthetic fuel, diesel and other liquid fuels from coal in 1955. Now they have three plants, the only commercial plants in the world using this technology today in their complex, which convert 55 million tons of coal per year. The fear of being boycotted due to apartheid led to major efforts to develop independence from crude imports. SASOL produces almost 40% of South African liquid transport fuels.

2.5. According to Market Watch Coal liquefaction is one of the backstop technologies that could potentially limit escalation of oil prices and initiate the effects of transportation energy shortages. It will be very educative to examine steps that are being taken steadily and rapidly in several advanced and developing countries in order to develop alternative sources of liquid fuels:

**United States:** US Bureau of Mines constructed and operated coal liquefaction plants in 1950. The discovery of large petroleum reserves in the Middle East had enormous impact on the politics of transportation-fuel production and usage during the 1950-60s in the US. The crude could be imported into US for about US $ 2 per barrel. In order to develop technologies that could significantly reduce the production cost of liquid fuels by the direct liquefaction process, the Department of Energy (DEO) initiated the Advanced Concepts for Direct Coal Liquefaction program in 1991. Over a period of 10 years that R&D activities contributed significantly towards cost reduction to about US $ 38 per barrel gasoline product. Investigations on alternative approaches are being made to develop technologies that might ultimately lead to a 25% in reduced cost of production. A plant using 6 million tons of coal annually could produce more than 3.6 million barrels of diesel and naphtha annually, making liquefaction of coal to diesel competitive at US $ 35 to 40 per barrel. Sulphur and aromatic–free F-T middle distillates are already being used as blend stock with conventional crude oil derived diesel in California to provide fuel that meets the states stringent specifications for diesel.
Private industry in the US has made strides in launching coal-to-liquids projects. According to the National Defense Magazine of the National Defense Industrial Association a barrel of synthetic fuel can be made for about US $ 40.

**China:** China is now the second-largest oil consumer in the world after the United States. With its rapidly growing demand for transportation fuels, scant domestic oil and natural gas resources but abundant coal, is likely to turn to coal as basis for providing synthetic fluid fuels for transportation, cooking, and applications that are not easily served by electricity.

China is in need of clean liquid fuel. It earmarked US $ 15 billion for coal-to-diesel fuel conversion plants and targeted replacing 10 percent of its oil imports with coal-liquid oil by 2013. China set up its first coal liquefaction research center in Shanghai, a strategic move to safeguard the nation’s increasing oil supply shortage. It is getting know-how from Germany, USA, South Africa and Japan. An experimental facility of Deutsche Montan Technologie GmbH, Essen, Germany DMT) has been completely transferred to Shenhua Group at Shanghai in 2004.

In 2002, China announced a US $ 2 billion investment for a DCL plant in Inner Mongolia based on HTI technology.

Royal Dutch / Shell has signed an agreement with China’s largest coal producer to study coal liquefaction, as the Chinese Government scrambles for solutions to a growing energy crunch and sky-high crude oil prices.

Chinese and South African officials began a feasibility study for two coal liquefaction plants in the northern province costing US $ 6 million. These projects would use technology from South African synthetic fuels firm SASOL to produce 6 million tonnes of fuel a year.

Estimates are reported for sites in China, where break-even cost of coal liquefaction may be in the range between US $ 25-35 per barrel of oil.

The Shenhua Group Corp, which is one of the world’s largest coal companies, began to construct the world’s first commercial direct coal liquefaction plant, located in inner Mongolia in 2003 at a cost of $ 3.2 bn. In the first phase the facility opened in 2009 and converts 3.45 mt of coal into a will ton of oil products (22,000 bpd). Beijing plans to have CTL Capacity approaching 50 mt by 2020.
Figures have suggested that it costs $67 – 82 a barrel to produce CTL fuel. But with prices of Brent crude approaching $150 pb at times in 2008, these figures begin to make economic sense.


China’s unconventional oil supply from coal-to-liquids plants are estimated to reach 750,000 b/d by 2030.

**Japan:** In 1940 Japan was producing 30,000 tons of coal-oil and continued until the end of World War II.

Liquefaction of coal has now been positioned as the strongest oil-alternative energy contender after the oil crises of 1973 and 1978.

Japan is proceeding ahead under the Sunshine Project and established state-of-the-art coal liquefaction technology. R & D programmes related to the so called NEDOL process have been carried out since 1984. Japan is providing know-how to China since 1982.

**Indonesia:** In Indonesia a new round of brown coal liquefaction technology development with the assistance of Japan is taking place. The Agency for the Assessment and Application of Technology of Indonesia and New Energy and Industrial Technology Development Organization (NEDO) of Japan began collaborative research in 1944 after screening of candidate coals for liquefaction.

**Australia:** Japan and Australia have collaborated for the development of commercial coal liquefaction plants based on brown coal.

The Australian Parliament decided as follows: “The desire for increased domestic energy security, and protection from economic instabilities affecting global oil price and supply, we should consider developing a coal – derived transport fuel industry to meet domestic demands”.

**India & Philippines:** Following the success of the Shenhua project US firm HTI undertook two new pre-feasibility studies. One of these studies was for
Oil India Ltd. to evaluate the viability of establishing a commercial facility in India using Assam Coal. The other study was for the Department of Energy of the Philippines. The objective of the study was to access the techno-economics of establishing a coal liquefaction hub in Philippines for countries in the Southeast.

3. CONCLUSION

3.1. Coal liquefaction is the answer to our energy security concerns. It can provide substantial relief to the country and will have enormous positive impact on the economy. Therefore, the time to act is now.

The benefits will be as follows:

- Domestic coal will be utilized in a better manner.
- It offers an alternative to continued dependence on oil imports and energy dependency.
- It will rebuild the energy industry.
- It will recreate new high-quality jobs.
- It will provide economic benefits of reducing foreign debt incurred due to imports.

3.2. Coal liquefaction is one of the backstop technologies that would limit escalation of oil prices. According to the International Energy Agency (IEA), CTL conversion is viable at oil prices US $ 40/barrel.

3.3. In South Africa F-T technology is well established commercially. SASOL has extensive construction and operating experience with F-T technology and converts annually million tons of coal into billion liters of synthetic fuels and billion liters of chemicals. It would be extremely desirable to enlist the collaborative support and expertise of a group like SASOL and China in exploiting coal recourses of Pakistan for producing liquid fuels. It will add entirely a new dimension to the energy sustainability in Pakistan.