



Alternative Feedstock Options for Thailand

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Introduction

The overall objective of this article is to present the current status and future options for alternative feed-stocks for fuels and petrochemicals

Energy is essential for every region of the world. The uses of energy have expanded from early needs for lighting, heating and cooling to transportation and now to be part of every function including the production of chemicals and petrochemicals.

Historically, the demand for energy has continued to outpace the rate of supply of available sources. Oil, coal and natural gas, the traditional feed-stocks, are all fossil fuels and are highly regional making their transportation and distribution more complex. The availability of feed-stock at the right price and at the right location are more important than most other issues.

Exhibit 1 presents the regional disparity in the availability and use of current fossil fuel based feed-stocks.

In recent times, in addition to the debate of longevity of current supplies, the sustainability of fossil fuels without undue environmental disruption has been a significant point of contention.

In the past, the search for alternative feed-stocks has been primarily driven by economics. The recent search for alternative feed-stocks has been driven by the need for environmental sustainability in addition to economics.

Of all the major feed-stocks, oil, due to its energy concentration, ease of exploration and acceptable environmental impacts, has become the standard preferred feedstock. Other feed-stocks are considered alternatives to “oil”

Currently, the major alternatives to oil, for fuels and chemicals include: (1) coal, (2) natural gas and (3) bio-based – plant and/or animal based sources (including algae)

Other major alternative energy products include: 1) solar, 2) wind, 3) geothermal, and others. These will have an impact in energy uses like heating and power generation – but have little impact on others. They are still in their formative stages for common use, not because of their technology but because of infrastructure issues.

Hence, the current movement of alternate feed-stocks globally is commonly defined or discussed in terms of “alternatives to oil”.

In the last 45 years, most of the thought processes, programs and technology investments have been influenced by the “oil price”. The most recent push for environmental sustainability has added an additional incentive for development of alternative feed-stocks, in addition to economics.

Alternative Feedstock Platforms to Oil

Ultimately, economics will dictate the cost effectiveness of all of the alternative

platforms including the bio-fuels program. Current users of oil based feed-stocks will have to actively develop alternatives to succeed in the future. This can be accomplished through cost sharing, not by natural market forces.

Coal

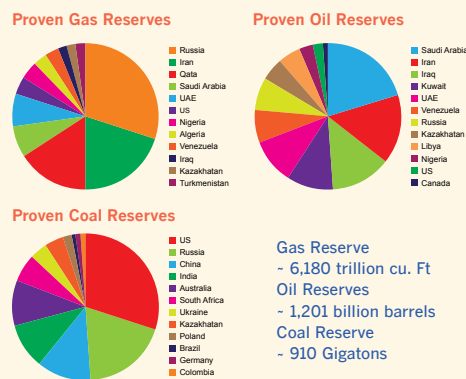
From early on, coal was considered a disruptive technology compared to oil and natural gas. Coal is not accessible by traditional drilling and transporting methods used for natural gas and oil. The major potential impact of coal mining, reclamation, cleaning and transportation has made coal a less attractive alternative to oil and natural gas in the past. Recent developments in “clean coal” technology are making it economical in certain regions of the world.

At the current time, coal technologies available for converting coal to chemicals include (1) gasification and subsequent syngas conversion to fuels and/or petrochemicals, (2) liquefaction and/or (3) solvent extraction.

The recent coal developments were driven by China, with the world’s second largest coal reserves, since it has limited supplies of oil and natural gas. Most of the technologies developed worldwide had an opportunity to prove their viability in China. This also provided incentives to several developing countries to explore their coal reserves.

Most major global organizations continue to improve the commercial viability of technologies that can use coal as a feedstock for chemicals.

Exhibit 1: Regional Disparity in Feedstock Availability



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Natural Gas

Natural gas is one of the cleanest and most cost effective sources of energy. The major complication in the use of natural gas is its location. Nearly 80% of the gas is inaccessible (not near pipelines and/or other means of transportation). In the past two decades, there has been a drive to monetize these stranded reserves through major additional functions including: (1) pipe lines, (2) transportation and/or conversion to methanol – a transportable radial – CH₂, which is the universal building block for all petrochemicals.

Bio-based

In general bio-based fuels carbon sources generated from animals and/or plants, and are generally defined as “renewable”.

These sources are rationalized based on: (1) renewability, (2) sustainability (3) environmental friendliness and (4) attractiveness for regions that are not oil rich.

If and when, algae technology – the holy grail of bio-based energy – is fully developed, fuel sources will no longer be region dependent. Algae can be produced in any region using the current available technology.

Currently, most emphasis on bio-feed-stocks is for the production of ethanol and/or bio-diesel. Bio-diesel and ethanol are very attractive for regions with rich biodiversity. They provide opportunities for biodiverse regions to produce energy for transportation and comfort.

However, the bio-fuels programs still have to compete with traditional oil based fuels for cost effectiveness. All over the world, governments provide mandates on blending, subsidies, etc., making the current programs more competitive.

The long-term survival of the bio based fuels programs will depend on government policies to make them economical until the technologies become cost competitive with oil.

Since oil producing regions also need to make their own commodities more profitable, they will continue to lower prices to make oil competitive.

Exhibit 2 presents the various routes of utilization for bio-based feed-stocks to produce plastics and chemicals.

Thailand - Alternative Feedstocks

Thailand represents a major region in South East Asia. As South East Asia’s largest industrialized nation with natural resources it occupies a significant position. Thailand is dependent on imported oil (approx. 250-300 MM barrels) to meet the domestic demand.

The Kingdom of Thailand, hosts a vibrant petrochemical industry (initially based on natural gas) which continues to become more and more dependent on oil (naphtha) for feedstock. Alternative feed-stock development in Thailand is driven by: (1) complexity of natural gas and oil access and (2) the ideal tropical location for bio-based products.

Thailand still has access to coal, natural gas and bio-based products as alternatives to oil.

Coal

Thailand has significant coal reserves. Almost all the reserves in Thailand contain sub-bituminous or lignite coals which have a lower energy content compared to other regions, reducing their competitiveness. The coal based developments in Thailand are still very viable – depending upon the technology emphasis.

The general coal technology consists of three phases: (1) coal mining, cleaning, (2) coal gasification and/or liquefaction, (3) conversion of gasification products to fuels and /or chemicals. Thailand, because of its technological developments and emphasis on petrochemicals, can leverage the Thai coal with other higher value coals available in South East Asia.

Natural Gas

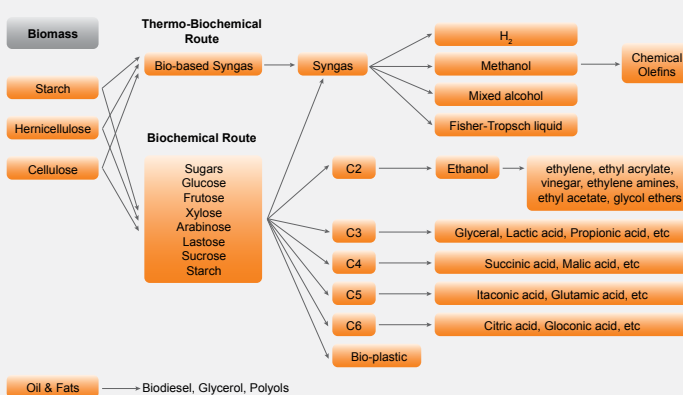
The majority of the natural gas (> 75%) in Thailand is consumed by the power sector followed by the petrochemicals industry and as a transportation fuel. Natural gas already plays a major role in Thailand’s domestic market and any new developments will focus on increased access, distribution and utilization.

Bio-based Feed-stocks

Thailand has more rivers and arable land per sq. km than most places in the world. The kingdom has a rich flora and fauna combined with a strong agricultural economy endowing it with the ability to develop a sustainable bio-based industry.

The major bio-based feed-stocks available in Thailand include sugarcane, molasses, cassava (tapioca), oil crops, and significant quantities of cellulosic biomass generated as agricultural & forestry waste. These feed-stocks can be effectively used to partially displace the oil demand originating from fuel/energy and petrochemical feedstock requirements.

Exhibit 2: Routes of Utilization for Biobased Feedstock





Opportunities for a Bio-based Industry in Thailand

Bio-based feedstock is the most suitable platform for Thailand due to: (1) enormous feedstock advantage and available arable land; (2) High potential to add value to agricultural products, (3) Strong support from government, for renewable energy, fuel (i.e. ethanol and bio-diesel) and bio-plastics

Exhibit 3 presents the current availability of various bio-based feed-stocks in Thailand. **Exhibit 4** presents an overview of the utilization of available feed-stocks in Thailand.

A major portion of Thailand’s current production of sugarcane, molasses and cassava is targeted for the export market. A significant proportion of the domestic consumption is in lower value products.

As the 4th largest producer of palm oil in the world, there are significant opportunities for production of bio-diesel and utilization of by-product glycerin as a feedstock for chemicals.

Independent of the region, development of bio-feed-stocks for fuel and chemicals must go hand in hand. Total focus on bio-fuels essentially fuels the debate of “food vs. fuels”. However, the development of value added chemicals and petrochemicals in addition to fuels – would be more economical and sustainable.

The utilization of bio-feed-stocks in Thailand is to produce bio-fuels with an estimated ethanol capacity of 2,575,000 litres/day and bio-diesel capacity of 500,000 litres/day – just a small portion of tremendous future capability.

The current bio-based chemicals production is limited to lactic acid which is currently being produced by Purac. This presents a significant opportunity for production of PLA which is by far the most popular bio-plastic material. Solvay plans to produce epichlorohydrin from glycerin in Map Ta Phut by 2011. PTT’s consideration of a development partnership with Mitsubishi for bio-based succinic acid is a significant development in bio-feed-stocks for chemical production.

In addition to the above, Thailand generates significant amounts of biomass in the form of agricultural waste. Future developments in the cellulosic technologies will facilitate utilization of this waste as well. The development of algae technology is being actively pursued in the country and globally. Algae as a feedstock for fuels and chemicals has great potential in Thailand. In future this will be the most significant contributor towards energy sustainability

Concluding Remarks

In summary, Thailand’s bio platform will make significant contributions to the future needs of both fuels and petrochemicals.

Of the three choice alternate feedstocks, coal, natural gas and bio-feed-stock, are the order of priority for Thailand right now. In future the order will change to be bio-feed-stocks followed by coal and natural gas.

Future development in the area of coal should focus on technology development and optimization of available coal processing facilities to increase energy content – which ultimately will help develop the coal based programs.

Natural gas developments should focus on transportation and logistics systems to increase the utilization efficiency.

Future developments in biofeedstocks should focus on 1) increased production of bio-fuels to meet the established blending mandates, 2) development of bio-based plastics & chemicals, and 3) keeping pace with next generation bio-fuel technologies like algae.

For long term sustainability, developments in fuels and chemicals must go hand in hand.

Chemical Market Resources Inc. is a twenty year old strategic planning firm for the global chemicals, petrochemicals and plastics industries – specifically in assisting monetization of innovative technologies. CMR Inc. has assisted several major organizations in Thailand in innovations and New product developments.
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Exhibit 3: Biobased Feedstock Availability in Thailand

Feedstock	Availability	Comments
Sugarcane	- 6th largest producer globally - Planted area - 1.02 MM Hectares - Production - 70 MM tons/yr	- Majority goes into sugar production - 70% of sugar is exported - Molasses is used for ethanol animal feed and potable alcohol
Cassava	- Planted area - 1.2 MM Hectares - Production - 27.4 MM tons/yr	- No. 1 exporter in the world - 63% exported - Animal feed (30%), ethanol (7%)
Palm Oil	- 4th largest producer globally - Planted area - 0.5 MM Hectares - Production - 1.6 MM tons/yr	- Mainly used for food, biodiesel and olechemical production - Yields are much lower compared to Malaysia - Increased efforts to improve yields
Agricultural Waste	Sugar cane - 25 MM tons/yr Cassava - 1.5 MM tons/yr Palm - 0.25 MM tons/yr Rice - 27 MM tons/yr	- Significant potential for utilization - Mainly gasified for energy - Current installed capacity 914.3 MW - Will benefit from Cellulosic technology developments

Exhibit 4: Overview of Utilization of Biobased Feedstocks in Thailand

