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Biofuel: An Australian Perspective in Abating the Fossil Fuel Vulnerability

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Abstract

The fossil fuels are now considered as one of the most environmentally unsustainable energy resources though they are the major energy source for transport sectors and other industries. Increased demand of fuel consumption can lead to the threat of energy supply instability and the consequences of energy uses and emission on both environment and economy are significant concerns of most of the countries. This article reviews the vulnerability of Australian fuel supply chain and a brief description on how biofuels can turn into significant alternative resources of fossil fuel. It has been observed that the prospective applications of biofuel can assist in abating both the greenhouse gas (GHG) emissions and fossil fuel vulnerabilities. Currently, Australia imports about 37% of the total crude oil demand managing a diverse supply chain system. The local refining capacities are not utilized properly. No more technically advanced projects are under consideration to achieve self-sufficiency to make the best use of domestic crudes in order to reduce the fuel imports. Though Australia possesses abundant facility of producing inedible biofuel feedstocks, high costs for feedstock processing has caused shut down of 68% of the existing biofuel refineries. But, biofuels can reduce over 60% of the GHG emissions caused by the same amount of fossil fuels. Though the Government has granted an excise of flat tax on biofuels until 2021 to promote the commercial growth in this sector, the lack of infrastructure investment from the Government has been slowed the progress of this industry since its inception. Establishment of regional biofuels refineries can reduce both the distribution transport cost and import load of the fossil fuels. Being alternative resources, biofuel production can effectively make the best use of deserted or unused lands, creating employment opportunities and reducing both fossil fuel market instability and environment pollutions.

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*Keywords:*Biofuel; Fuel Policy; Alternative Fuel; GHG Emission; Fossil Fuel; Low Carbon Emission; Clean Energy Regulation

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1. Introduction

Sustainable biofuels can contribute to the substantial reductions of emissions from transport sectors. They can also play a significant role to convert this sector as a low carbon emission economy. At present, about 5% of the total fuel consumption is contributed by various alternative fuels like biodiesel, bioethanol, gaseous fuels, etc. to the Australian transport sector [1]. Despite of its own production capacity, Australian domestic petroleum market has been inclining towards import of refined petroleum products increasing about threefold within the last decade [2], the vulnerability of supply chain management is aggregating [3-6]. Figure 1 shows the petroleum product supply chain management system of Australia from year 2000 to 2013 where the dependency on imported petroleum products is surely dragging the nation's fuel security into assailable state [7].The reasons are, shut down of existing refineries and the incapability of refining crude oil as per the domestic fuel standard [8].

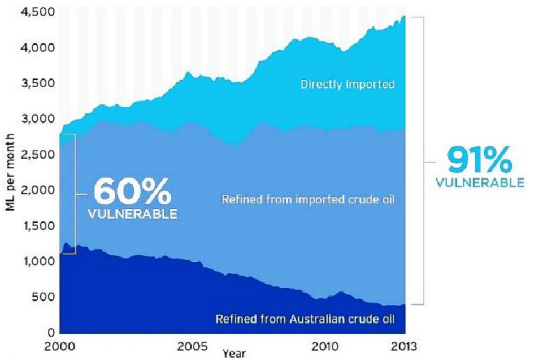

Fig. 1.Vulnerability of Australian Fuel Supply Chain [8]

There is always a threat of declining the overall fossil fuel reserve in worldwide due to increased consumption worldwide and political unrest in the oil producing regions. According to the National Energy Security Assessment (NESA) conducted in the year 2011, the overall domestic fossil fuel security rank will downgrade from high till 2016 in to moderate rank in the year 2035 [9]. That means, there will be some deterring issues which should be resolved prior to meet the local socio-economic requirement in order to sustain on the higher level of energy security. Other than the fossil fuels, there are several alternative resources like electricity, compressed natural gas, Gas-To-Liquid, Liquefied Petroleum Gases, bio-oil, bioethanol and biodiesel, etc. which can be potentially effective in Australia's renewable energy quest due to availability of those feedstocks. It requires developing the market demand of those alternative fuels as a suitable alternative for the vehicles and resolving some other barriers like taxation, regional feedstock production and fuel refining capacity development, etc. Certain effective and time frame based actions to be implemented to develop the biofuel policy in this country so that the feedstock of the respective biofuel can be produced, converted in to crude oil, refining from regional refineries and distributed to meet the demand and environment sustainability issues.

Due to increased population, the overall fuel consumption is increasing with the increased number of vehicle and industrial expansion like electricity generation. Therefore, cost of the fuel is increasing and Australia is facing trading imbalance which has been reported as more than AUD 20 billion [10]. This is evidently an unsustainable supply chain management system and economic burden to the consumers. Biofuel can be a potential source of coping with the local fuel supply deficiency and improve the environment as these are proven clean and renewable fuels. The feedstocks are mainly obtained from agricultural farming or forests. They can be either edible or nonedible, first generation or second generation, etc. based on the feedstocks and technical investigations to avoid any involvement in food vs fuel issues. Though the first generation biofuels, generated from various edible vegetable oils, sugar and starch around the world, differs from the second generation biofuels in terms of sustainability but can be used if demands of food based feedstocks are less than that of total production. Establishment of deep-rooted and nonedible feedstock farming in saline and degraded lands due to mining leftover, grazed and coastal lands can potentially improve the ecological condition and environment by reducing the GHG

emission [11]. To set up a reliable fuel supply market and protect the environment from GHG pollution, a substantial policy implementation and development of biofuel market is essential.

This paper has focused on the requirement of effective policy and framework development to meet the nation's fossil fuel demand for energy production in transport and industrial sectors. Biofuel has been found as potential in this regard which can abate the supply chain management instability created due to fossil fuel reserve attenuation threat in few decades around the world. There is a potential of creating biofuel based industry in this country considering as environment friendly and leading to national economic growth by reducing import load of fossil fuels, GHG emission, unemployment rate, unused and deserted lands, and sudden hike of fuel price due to fossil fuel supply interruption in the world as demanded by Australian market. Such investigation could be beneficial for other countries which are not producing enough fossil fuel for themselves.

2. Fossil Fuel and Refining Vulnerability in Australia

According to the table 1 [4], in 2012-2013, total consumption of Petroleum was 55,083.5ML. Diesel fuel consumption accounted around 40% in the transport sector. Net import was about 37% of total petroleum consumption, whereas, this country exported 75% of its own crude oil produced [12]. Conventional petroleum fuels provided 95% of liquid fuel demand and met about 34% of total energy consumed [4, 13]. Whereas, Natural gas and coal combinedly met about 60% and biomass met 3% of the total energy demand [14].

Table 1. Total gasoline and diesel fuel statistics of Australia between 2010 and 2013 fiscal year

Year	Crude oil & other refinery products (ML)		Automotive gasoline (ML)		Diesel (ML)		Total automotive diesel sales (ML)	Total automotive gasoline sales (ML)	Total petroleum product sales (ML)
	Import	Export	Import	Production	Import	Production			
2012-2013	29519.80	15761.4	3653.1	15602.8	12512.1	12875.6	22618.1	18658.7	55083.5
2011-2012	29494.5	17423.9	3671.1	15573	11224.9	12658.3	21642.6	18761.6	53961.8
2010-2011	31765.5	19619.6	2652.8	16642.8	8832.4	12858.7	20053.9	18725.2	52409.8

Most of the Australian crudes are light, sweet grade, typically low in sulfur and wax, and therefore higher in value than the heavier crudes [14]. Among those the Carnarvon Basin of Northwest Australia accounts for 72% of total Australian petroleum production. Most of this bounty is exported due to the lack of existing refining capacity, the proximity to Asian markets and the ability to demand premium prices for the light, sweet grade of oil produced. Subsequently, the country's North and Northwest regions completely rely on imports of refined liquid fuel products for domestic uses.The amount of total crude refining capacity has been declining for last decade in Australia due to failure in competing with the newer, more efficient, diversified and larger Asian refineries. It is only 17% of the domestically produced crude which is sent to the local refineries. But it was almost 37% a decade ago [7].Though the domestic refineries are still producing about half of the fuels consumed, the remainder crude being imported covers the refinery input. A large portion of fossil fuels are being imported as refined as well.It has been already presented through figure 1 that the vulnerability of fuel supplying capacity has been increasing day by day in Australia. Moreover, once few more refinery closures are complete by mid-2015, Australia will be left with only four refineries, equating to a reduction in domestic refining capacity of 42% since 2011. Any further rationalisation of domestic refinery capacity will further increase the proportion of refined products sourced from.

The declining trends of refining facilities in Australian refineries will have impact on increased load on liquid fuel import, complications on defence and aviation sectors due to risk of noncompliance from foreign refineries, increased price of refinery by-products which are mostly necessary for other petrochemical industries, etc. despite the capacity of developing more refineries as compliant to the local crude oils. In this way, the world's 9th largest energy producing country, Australia may find itself in a situation like no refineries, a liquid fuel stock of only 20

days and complete dependency on import by 2030 though there is a diversified market based supply chain management system has been strengthen the confidence of handling any market vulnerability [5, 6, 12, 15]. Therefore, any critical disruption in the foreign supply market will just lead to a run out of publicly consumed fuels within three days.

As long as the domestic refineries are capable, there may be a good relationship with outside refineries. This condition could be changed when there is peak demand of fuels for harvesting and defence uses as Australia is not meeting the obligatory reserve maintenance of at least 90 days equivalent net average fuel import of the prior year or equivalent produced crude oil [13]. As an instance of supply chain vulnerability, there was a scarcity of diesel supply for harvest season in the North-Western Victoria after 2 days of Geelong's refinery operation disruption due to an incident in 2012 [5]. When there is a capacity of producing own crude oil, the technology advancement should get priority to overcome local issues than to overlook it depending on outsourcing. This dependency increases vulnerability in the country's development issues. There is a potential of entrenching into higher crude oil production when the newly developed wells will reach into their peak production capacities. The unavailability of own refineries will be a disadvantage then. Also, lot of uncertainties will arise which may recede the potential exploration of new oil sources, profitable commercialization, and finding other technologies to use the unconventional sources like light tight oil, shale oil, Gas-to-liquid, Coal-to-liquid, bio-oil, etc. which are totally/partially dependent on petroleum refining processes.

Hence, the Australian Government should seek for enhancing the local fuel resourcing to meet any peak demand on transport sector, defence system and harvesting purposes. Table 2 shows the current status of transport fuel stocks in Australia. Australia is still not maintaining the overall stock of crude oil/petroleum for 90 days and the growing demand of consumption may make it harder to deal with it on the basis of refined fuel import process. Moreover, the International Energy Agency (IEA) has projected that the new policy (existing commitments to achieve any target) will require about 35% increase of world primary energy demand by 2035, whereas, Australian liquid fuel demand will rise up to 56.3 GL (about 2.2% more than that of 2012-2013) with reduced locally produced fuel supply[16, 17]. Among total demand of required energy, 59% would be met by fossil fuels and 17.8% by the renewable energy that urges new policy implementation in Australian energy market.

Table 2. Overall Petroleum stocks in Australia in end of months of recent years[16, 17]

Time period	Crude oil and refinery feedstocks (days)	Automotive Gasoline (days)	Aviation Gasoline (days)	Automotive Diesel (days)
May, 2014	26	20	126	13
April, 2014	25	20	132	13
March, 2014	26	20	129	15
February, 2014	22	18	104	14
January, 2014	23	19	141	19
2012-2013	25	19	88	17
2011-2012	25	19	88	18
2010-2011	29	18	104	17

3. Improving Liquid Fuel Security in Australia

With the existing technology in Australia, it is tough to attain 100% energy independence. Also it will not be technically acceptable to be 100% reliable on foreign supplies of refined fuels. Implementation of long term plans and optimizing the refining capacity as per both the produced crude oil quality and emission standards can help protecting the environment pollution and reduce the supply chain vulnerability. Therefore, the import load will not increase with the increased demand of consumptions over the years. Also, the emergency response mechanism of IEA can be beneficial for Australia to meet the temporary supply interruption of large amount of fuel [9]. As an additional issue, due to excessive utilization of fossil fuels for energy supply without significant consumption controlling, the energy based GHG emissions could be more than twice by 2050. Therefore, there is an urge from IEA to contrive attainable and effective technologies as per requirement to reach up to a global CO2 emission target

of reducing 50% by 2050 from the current emission levels [18]. Thus the world would be protected from global warming due to severe GHG emissions [18]. Australia is to cut its GHG emission by 60% by 2020 as per Kyoto Protocol [19]. Moreover, based on energy content, coal accounts 60% of energy exported from Australia [16]. Also two-third of the electricity production in Australia is dependent upon coal burning. Target of environment pollution reduction policy could affect the export based earning as well as inland consumption. Moreover, economic consumption of the customers and adaptation of alternative energy sources have provoked the price increase (59% since 2009) of per unit electricity uses in order to cover the profit and infrastructure costs [16].

There are many potential renewable and alternative energy resources (solar, wind, natural gas, hydro, geothermal, shale oil, bioenergy, etc.) which are available in this country to meet energy consumption in transport and power productions. Alternative fuels like biofuel can be abundantly produced in this country from local resources. This can reduce the CO2 emission level caused by the fossil fuel consumption [20]. There are still scopes of conducting effective research on the viability of producing and supplying standardized biofuels as per consumers' demand. Also the risk assessment and mitigation strategies related to both import based supply chain system and domestically produced alternative fuels need to be conducted to overcome any future trouble [5]. Australian Government has taken few initiatives to increase the use of biofuels. For instance, using B5 (i.e. 5% biodiesel blended with diesel) and E10 (10% Ethanol blended with petrol) have been approved for commercial use according to the Australian national fuel standards [21, 22]. Further research and effective supply chain management system can increase the total biofuel consumption. The Australian biofuels market is currently in the development stage with the government and private entities engaging in promotion of the technology across the country [23]. Significant investment and subsidies may establish the market of local fuel supply system which is renewable and cost competitive in comparison to the import cost of that amount of fossil fuel and the price of CO2 emission.

4. Biofuels in Australia

Evolution of biofuels (i.e. bioethanol and biodiesel) in Australia could be a potential source of supporting the green energy producing quest for improvement of environment, development of national economy, technical advancement and quality life in the society. Biofuel consumption in Australia has been increasing since 2003-04 and with significant support it may contribute in a good share of nation's total fuel consumption in near future.

4.1. Bioethanol

In Australia, E10, 10% ethanol blend with unleaded or premium unleaded petrol can be commercially available to use in petrol engines satisfactorily. Therefore, the energy content of the petrol is reduced by 3% but represents an excise facility of 4 cents per liter [24]. Also it can be detrimental to the older engines occurring the clogging of fuel filter due to solvent properties of ethanol. Ethanol produced from cellulosic materials is highly suitable to abate the GHG emission and food-vs-fuel issues. As per the report from Biofuels Association of Australia [25], total production capacity of ethanol is about 440 ML (0.44 GL) and all are in production. Mainly, the Red Sorghum (80 ML), Waste Starch (300 ML) and Molasses of sugar processing byproduct (60 ML) are the feedstocks contributing this ethanol production. It has been predicted that the demand of petrol (gasoline) will almost remain steady between 18 GL and 19 GL in 2030 [26]. Hence, there is a requirement of increasing the production of ethanol by 5 times of the recent status for an overall input of E10 fuel blend in the consumer market. Analysing the economic production process of feedstocks will be a prime focus to chase this target as the quality of feedstock governs the quality of the ethanol production as well as the blend quality. Due to abundant forest resourcing and land availability, Australian ethanol production quest can be accelerated with the lingo-cellulosic biomass or green wastes feedstock and corresponding efficient technical implementation for optimal output. The local production cost of ethanol is less than that of imported ethanol due to subsidy on fuel excise duty. Such facility should be given to endorse this potential industry. A detail status of biofuel production from ethanol in Australia has been discussed in Puri et al. [23].

Not only Australia is paying attention to develop the ethanol production infrastructure, there are many other countries which have already focused on increasing production of ethanol to cope with the fossil fuel demand,

supply vulnerability and environment sustainability. Both USA and Brazil are in global leadership of producing bioethanol from corn, lingo-cellulosic crops and sugarcane, etc. without making food-vs-fuel contradiction. Table 3 [27] demonstrates that production of ethanol in USA has been doubled within 2007-2013 [28]. These countries have also exported more than 6% of the total production. They have shown that the increase of ethanol production enhanced the value of the agro-products and investment for technological development [29].

Table 3. Ethanol Production in Various Countries [27]

World Fuel Ethanol Production by Country or Region from 2007-2013(Million Gallons)

Country	2007	2008	2009	2010	2011	2012	2013
USA	6521.00	9309.00	10938.00	13298.00	13948.00	13300.00	13300.00
Brazil	5019.20	6472.20	6578.00	6921.54	5573.24	5577.00	6267.00
Europe	570.30	733.60	1040.00	1208.58	1167.64	1179.00	1371.00
China	486.00	501.90	542.00	541.55	554.76	555.00	696.00
Canada	211.30	237.70	291.00	356.63	462.30	449.00	523.00
Australia	**26.40**	**26.40**	**56.80**	**66.04**	**87.20**	**71.00**	**116.23**
Rest of World	288.90	363.00	857.00	918.57	610.95	681.00	1272.00
World	13123.10	17643.80	20302.80	23310.91	22404.09	21812.00	23545.23

To gain such developed market stability, there was a substantial support from Government from 1997-2006 ($9 billion) to keep the corn prices lower than the production expenditure. By that period the bioethanol established its market and farmers/producers could earn the money of total expenditure from the consumer markets than no relying on the Government's financial assistance which reduced to $2 billion in 2013. Detail techno-economic steps and success statistics can be obtained from the 2014 ethanol industry outlook [30]. Since 2005, USA have been reducing their import load (-20% of earlier level) of fossil fuel and increasing the production of biofuel to meet the gap of total energy requirement at present (Fig. 2). The long term effective plan of reducing foreign dependency has shown growth in job field creation, contributing to the GDP and increasing the household incomes.

On the other hand, Australia, in spite of being one of the top 10 energy producing countries, it is going to increase its import load and trade gaps to avoid the infrastructure investment cost needed to establish self-sufficient biofuel market. The economic reports and the contrived policies have been showing more profits through short term plans than achieving the self-sufficiency. Comprehensive technical analysis and long term plan are required to regain a momentum of increasing self-sufficiency from both fossil fuels and alternative resources. Implementation of E10 bioethanol in overall gasoline consumption demand in Australia will be requiring about 1.9GL of bioethanol production. So, the business development policy taken by USA may turn in to a guide line for Australian renewable fuel market development by 2030 if any effective long term investment infrastructure can be deployed.

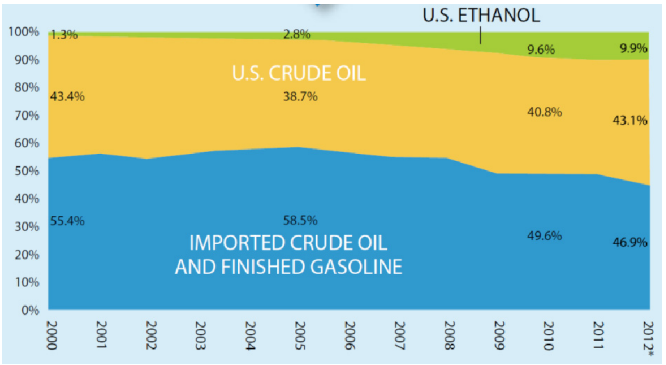

Fig. 2. Fuel supply chain management of USA [28]

4.2. Biodiesel

Biodiesel is mainly a mixture of methyl or ethyl ester of fatty acids which are obtained through the transesterification of vegetable oil/animal fat based triglycerides following some controlled chemical processes [31-38]. This is also known as cleanest renewable fuels that can be used mainly in the diesel engines. The fuel properties of biodiesels are almost similar to the diesel fuel following the ASTM D6751-09 standard and can be blended with it in any proportion [39-41]. Direct use of 100% biodiesel in an unmodified diesel engine is discouraged due to some variation in inherent properties of biodiesel fuels with diesel fuel [42]. But various diesel-biodiesel blends can be used which improves the emission performance of the fuel. Australian transport sector is almost solely dependent on liquid fuel consumption In Australia, 5% blend of biodiesel with diesel fuel (B5) has been approved to be sold in commercial outlets without any mandatory labelling [43, 44]. With this option, 5% of overall diesel fuel consumption could be replaced by 0.95 GL of biodiesel in 2012-2013. This requirement is also increasing with the increased demand of diesel consumption. But the current production capacity is just insufficient to supply this amount of biodiesel in the market [11, 16, 45]. Moreover, the *Commonwealth Scientific and Industrial Research Organisation* (CSIRO) investigation has revealed that the B26 also can conform to the petroleum quality [43], whereas, a taskforce of the Australian Government has described that the B20 would not have any detrimental effect on engine [22]. It necessitates more research and explorations on suitability of optimal biodiesel blend quantity to be used commercially in Australian states and territories.

One liter diesel fuel can produce about 2.67 kg of CO2 and that of 1 L biodiesel can reduce the net CO2 emission by 67.7% (~1.8kg) [45, 46]. Therefore, the supply assurance of higher blends of biodiesel in Australian diesel fuel market can substantially reduce a lot of CO2 emission.

Indeed, in terms of production capacity, there is no limitation of land availability in Australia to produce the required amount of biodiesel. Rather, there are some misconceptions that recede in developing a convenient biofuel policy in this country [1, 8, 12, 22, 47]. At present, Australia has a total installation capacity of 360 ML for biodiesel production but only 115 ML biodiesel is commercially produced from the tallow and waste cooking oil [25].

Batten and O'Connell [48] as well as RACQ [43] have referred that B5 blend of canola, waste cooking oil and the tallow based biodiesels can reduce GHG emission by 1.5%, 4.2% and 1.5% and for B20 blends, the GHG emission reduced by 7.6%, 19.3% and 8.7% respectively in comparison to the ultra-low sulfur diesel. The feasibility of commercially utilizing the higher biodiesel blends can significantly contribute to Australian resolution of reducing GHG emission by 60% as per Kyoto protocol within next 6 years [19]. The transport sector consumes most of the share of overall liquid fuels. Thus improving the quality of the fossil fuels by blending with biodiesels can reduce the import load and environment pollution. Therefore, technical investigations on commercializing higher amount of biodiesel blends could be one of the essential targets to increase the supply of biodiesel in the local market to lessen the fossil fuel vulnerability.

Moreover, the Government has granted a fixed tax excise subsidy to cope up with the initial investment cost and market creation phase until 2021 [Energy White paper 2012]. With abundant amount of deserted, grazed, coastal and mined land, it is essential to find out some oil rich and nonedible vegetable oil based plants which would grow in those lands. Ashwath [11] observed about 200 species of vegetable oil based plants for potential use as biodiesel feedstock and he found few feedstocks containing higher amount of oil and conversion rates. He proposed that the feedstocks like *Pongamia pinnata* (Karanja), *Calophyllum inophyllum* (beauty leaf tree), *Cocos nucifera* (coconut), *Syagrus romanzoffiana* (Queen palm), *Aleurites moluccana* (candle nut tree) and *Jagera pseudorhus* (jagera) can be readily grow in Australia to yield higher amount of oil for biodiesel production. There is a requirement of conducting detail analysis for provenance variations in various characteristics of these feedstocks to be considered as good source of biodiesel production. Due to excessive dependence on diversified international fuel market for energy security, both Government and private sectors failed to pay attention in developing biodiesel fuel market as per demand to be created. Moreover, few biodiesel refinery plants have been shut down due to discouragement in development of alternative fuel market. The feedstocks are also dependent on land quality and various environmental factors. Therefore, proper selection of feedstocks can make the business profitable by supplying fuel in the national fuel supply management system.

5. Discussions

As per December quarter of 2013 [4], as a member of the *Organisation for Economic Co-operation and Development* (OECD) countries, Australian Government earned 52.5 cents/liter and 51.5 cents/liter from selling of automotive diesel fuel and gasoline fuel respectively to the consumers. This is about 50% of the fuel price that covers all other expenses including production, refining, transportations and the profit of all the levels who bring it from well to the customers' engines. In the same time, Mexico and USA Governments earned 13.6 and 15.1 cents/liter respectively in Australian currency. The fuel price did not vary as much as the tax varied. Though the customers of this country are paying the price as it require, but the fuel policy and the technical establishment are not improving as it needs to develop the energy production, refining and distribution infrastructure from its own capacity [13]. Instead, the fuel price has to be set according to the international suppliers' policy. Moreover, the energy policy developers in Australia have made a superficial idea that the declining capacity of refineries will not affect the fuel demand in future due to diversified supply chain management with the international market. It infers that the Government will have to increase the price of the fuels if there is any market instability of the exporters and the people will be destined to pay more if there is no subsidy.

Higher operating cost, inadequate rail network and sea network to transport crude oil, shallowness of the berths for which the large crude carriers are unsuitable, increased technological intricacies to refine the locally produced crudes in to standardized petroleum products, etc. have been considered to cease the local refineries and import from outside markets [8, 13]. Such policy cannot build reliable progression of a nation's other interdependent business establishment. It seems the policy makers are totally complacent of showing some money saving in the transition period of essential technical evolution by following a silly term of "cost saving". As Australia is one of the developed countries in the world, it should focus on adopting long term and foreseeable policies to progress and establish its own product based market. It is high time to take plan of actions to build up modern and reliable land based and sea based communication systems for effective commercial purposes, making best use of long coastal areas with the help of convenient sized crude carriers, investing on technical advancement and skill development to cope up with the necessities to provide support local business activities. Otherwise, the increased trade gap is going to create a grievous inflation in the country's economic system.

A local refinery from local raw crude petroleum produces various by products other than gasoline and diesel fuels which are effectively used in various industries like aviation, energy production in the industries, chemical industries for various product development, road construction works, etc. These industries including the refinery expansion can facilitate more local jobs and utilization of skilled people which is now a threat to citizens/residents of this country. Nation's economy is mostly based on mining exploration for skill based job placement. The other industries are still in vulnerable condition due to short term economic analysis and over dependence on foreign suppliers. This dependence is just helping those producer countries to develop further. There is a large share of private investors in existing fuel management system in Australia. Hence, an adjustment cost incentive through primary investment from the government will surely encourage the private sector investors to explore more towards self-sufficient fuel market development.

A developed country should focus on import supply chain management system only after making the optimal use of local capacities and putting effort to deal with the demand gap from potential alternative resources. For instance, the biofuel policy in USA can be a model for other countries who would like to use the import supply chain management to achieve certain development in the alternative fuel development. That is the reason that USA will not face the trouble of fossil fuel scarcity from its exporters after 2035 as the alternative resources will be capable of support substantially (figure 2). If Australian Government targets on local biofuel (B5-B20 by biodiesel and E10 by the bioethanol) production and supply market, there will be a demand of producing about 1.2-4.5GL biodiesel and 1.9GL bioethanol to reduce the fossil fuel load by 15-30% by 2030. At present, only 0.115GL out of 0.360GL biodiesel production capacity is available for production from few feedstocks. Overcoming the techno-economic barriers can contribute significantly in this case. Selection of regional based most economic biofuel feedstocks, refining process and distribution system development, uncertainties in private sector based investment due to higher adjustment cost, consumer level information exchange, lack of infrastructure, etc. are few of the main barriers to adopt and promote biofuel in Australian transport fuel mix [1, 8]. Current excise duty on biodiesel until 30 June, 2021 may potentially contribute to achieve the target of GHG emissions and save AUD1.2 billion within this period.

Moreover, the deserted lands will be utilized economically creating regional work opportunities, reducing fuel transport and distribution loads based on regionally surrounding supply chain system from the commercial outlets. Non edible biofuel feedstocks cultivated in the unused lands will not be a competitor to food. Since the fossil fuel price has been increasing, the price of the commercially available biofuels may receive the appropriate price from customers by 2030 and with technical progress [18]. Information gap with the customers have been making a gap between fuel quality and their using compatibility in the engines.

Besides the evolution and establishment of biofuel based energy industries in Australia, the transport sector will be also depending on hybrid or electrical power based vehicle operation system. Various alternative fuels like GTL (Gas-to-Liquid), CTL (Coal-to-Liquid), LPG (liquefied Petroleum Gas), LNG (liquefied Natural Gas), waste to fuel, etc. can come into the play as a local provider to the fossil fuel demand when the peak oil period will be approaching by 2035. Therefore, diversified fuel development policy with foreseeing technical management and implementation can reduce the net importer vulnerability of fossil fuels in Australia.

Moreover, ceasing domestic refining capacity and depending upon foreign markets will make the industrial investors confused to expand the energy based business in this country. Import of the refinery by products may require more transport costs than the value of the raw materials and overall product cost could be increased.

6. Conclusion

The demand of fossil fuels and other refinery by products will be increasing with the increase of population and required industrial development. Therefore, Government must take steps to invest on long term techno-economic plans than the short term profits. Self-sufficiency with technical evolution to make the best use of domestic assets can reduce the trade gaps. Environment sustainability issues may influence the reduction of coal based export earnings and shut down of power plants. More use of fossil fuel will be responsible for increasing the GHG emissions. Therefore, the bioethanol and biodiesel can potentially contribute about 10-15% and more than 20% respectively of the total liquid fuel demand in the energy sectors. Both the power and transport sectors can utilize these renewable and biodegradable fuels for reducing GHG emission and achieving sustainability. The fuel supply chain management system should facilitate this sector based demands. Australia can depend upon import of fossil fuels and other petroleum by products with the target of achieving self-sufficiency in biofuel production and utilization following the fuel security infrastructure models of USA and Brazil. It has been proved that the non-edible feedstocks can be grown in unused lands giving potential of technology development for small or medium sized fuel processing plants in various regions of the county. Also the quest of technology development to optimize the refining capacity of crudes through government funds can let away the prejudice of surrendering over the establishment of new and efficient refineries in the country. These efforts will help making the best use of lands, people, and money to bring a sustainable national economic condition. Thus, proper and timely endorsement of biofuel industry and its policy can potentially abate the fossil fuel vulnerability in this country.

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