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RESEARCH ARTICLE

ALTERNATE ENERGY: FUEL FOR "MODI'S INDIA" AND "SMART CITIES"

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ABSTRACT

India is the world's fastest growing economy, second most populous and largest democracy in the world. All these factors also make her one of the most energy requiring nations of the world. Since it does not have enough of the mineral oil and gaseous resources, it has to depend on other nations for fulfilling its energy needs, 80% of oil, 1/4 of its total coal consumptions and 1/6 of natural gas are imported from energy rich nations. With this perspective a lot of money is spent on importing the oil from Middle East countries like Iran, Saudi Arabia and other nations, rich of oils. This also makes its economy vulnerable to the continuous threat due to presence of very volatile geo-political peace and increasing instability. Since, Indian economy will keep on expanding especially the manufacturing sector with the "Make in India" initiative by the current government. The domestic production of other energy sector like solar power and electricity production is not catching up with the required growth rate; it would be inevitable to say that alternate energy especially the bio-fuels from biomass can help India to become self dependant in the energy front and a big booster to the "Make in India" campaign.

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INTRODUCTION

With representing one fifth of the world population and ranked sixth at the world's energy demand, growing at a pace of 7% - 8% for the next two decades, India is facing a challenge to meet its hunger for energy for households, transportations and industrial uses. According to the report prepared by the Institute for the Analysis of Global security dated January 21, 2004, (http://www.iags.org/n0121043.htm), India has sufficient coal reserves but merely 0.5 % of the global oil reserves. India has to import almost 70% of its oil. World energy outlook published by International Energy Agency warned India will be importing 80 % of its total oil, it will be in need, by 2030 (http://www.worldenergyoutlook.org/). This also raises a question mark on its energy security. Key to energy security is guarantees of supply and a large no of reliable suppliers. This has developed a sense of feel to make India stand on its feet to secure her energy needs, by exploring new options and one of them is to use inexhaustible biomass or bioenergy as a raw material for the fuel production. India produces sufficient amount of biomass which can act as a secure, reliable and affordable energy resources for India's sustained economic development. "The Earth Report" from the Television For The Environment Organization (TVE.org) have found that about 300+ million tones of crops wastes is produced in India every year and farmers burns 80% of it to get rid off it and make way for the crops of the next seasons. The almost same data is presented by the report given by Indian Agricultrual Rsearch Institute (IARI) in its report (IARI, 2012). There is a need to exploit these huge untapped bio resources. There is a shift to next generation of fuels from first generation ethanol produced from food crops to second generation bio fuels from bio wastes. India has realized this but somewhat late and for the same, India is now the only country with full fledged ministry dedicated to utilize and explore new horizon in production of bio fuels from these biomasses. By 2030 human population will touch the mark of 8 billion and 9.22 billion by 2075 which will further add pressure on the limited resources present on earth as per the report published by UN, Social and economic affairs, 2004 (http://www.un.org/en/development/desa/policy/wess/wess_archive/2004wess_part2_eng.pdf). Without a doubt this much big population will be consuming much more of the resources, what are been consumed now and lead to a situation difficult to control, which is a threat to sustainable develpoment. Fossil fuels are limited, nuclear energy is dangerous and can cause much more damages, in case of accidents then the benefits, as we saw what happened in Chernobyl (Klugbauer, 1995). It is also the high time to think of dying environment and on our dependence on fossil fuels, which needs to be replaced with alternative source (Manish and Banerjee, 2008). Renewable energy is not evenly distributed, but is the only alternate

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available to us. And one of the important renewable energy sources is Bio energy. Bioenergy is the world's most widely used form of renewable energy and contributes with 15% of total energy available to the world. Bio energy has always been a reliable source of energy to humans since ages. In the modern world also, there has been a sense of feel to shift back to our reliable, inexhaustible and renewable biomass based energy.

Make in India initiative and energy need

India is a young nation since its population as a whole has a median age of 28 years (http://www.cnbc.com/id/49472962) This huge English speaking talented and disciplined work force, provide an opportunity to the world's money surplus nations to come in India and invest in manufacturing here. India also provides a huge market for the world manufacturers. Prime Minister Narendra Modi, made an invitation to all the world to make from pins to ships, papers to submarines, fertilizers to satellites, plastic to cars to generate jobs in India and making India as a global manufacturing house. But with this economic opportunity the challenge for India is to meet the energy requirement for all these ambitious plans.

Energy Scenario

Energy is the soul of development of any nation and contributes maximum in development of any country. And its value is much higher when we talk about developing nations like India, China, Brazil, South Africa and other Latin American and Asian countries. If significant steps are not taken then the developing countries has to face the burn. Present energy consumption situation will increase the damage to health of population and environment like global warming, and will reduce the chances of full economic growth (McMichael, 2006). But the rise in demand always leads to rise in price and the cost has to be born by someone. From top to bottom all the users from big companies to common man, has to bear the burns. Energy can be classified in to three type's primary and secondary on the basic of extraction, commercial and non commercial and renewable and non-renewable (Hoogwijk, 2003). Primary energy sources are generally converted in to secondary energy sources for industrial use. Like coal, natural gas and biomass and others are converted in to steam and electricity. Energy available in market with a price tag are considered as commercial energy like natural gas, coal and oil while fuel such as cattle wastes and agricultural wastes or traditional energy source are non commercial one (Hoogwijk,, 2003). Renewable energy sources are infinite and inexhaustible like wind energy, biomass energy, tidal, solar etc. on the other hand fossil fuels are non renewable sources of energy (Ma, 1999). In 2008 European Commission came up with a proposal for renewable bio fuels to be used as transfer fuel mix. In European Union the major share of bio fuels is shared by biodiesel and represents 82% of total biofuel produced (Bozbas, 2008). Biomass can be used to produce ethanol. It can be used in blended form and for the production of further refined fuels (Rittmann, 2008).

Pollution Caused by Fossil Fuel

Global energy needs are fulfilled by fossil fuels like coal, gas and oil. And each year 6 billion tonnes of carbon in the carbon dioxide is added and make the situation worse for the already chocking earth's atmosphere. The rate of Carbon dioxide pollution increase is >3% per annum (Raupach, 2007). Global warming is increasing the temperature of the atmosphere and that has caused melting of the glacier and has posed a threat to coastal land line area of each continents and India has a large coastal line (Cox, 2000). United Nation convention in 1992 on climate change was focused to limit as well stabilizes the green house gases concentration at a level that would prevent further degradation and destabilization of environment. And according to a report published in PNAS, titled "Global sea level linked to global temperature" and with global warming the temperature is keep on rising responsible for the melting of the glaciers (Vermeer, 2009). There is rise in global surface temperature around the world almost at a rate of 0.2°C/decade (Hansen, 2006) It is a matter of concern as has been rise of 1.0 degree Celsius temperature can add 20 cm rise in sea level from 1990s sea level (Hansen, 2006; Grimm, 2008 and Giannakopoulos, 2005). Since its the use of fossil fuels which is main culprit for environmental change (Spurny, 1996), we have to search for an alternative fuels like biodiesel.

Energy Security for Smart cities

There can never be energy security for energy borrowers. Key to energy security depends on guarantees of supply and a large no of reliable suppliers. This has developed a sense of feel to make India stand on its own feet to secure its energy needs by exploring new options and one of them is to use inexhaustible biomass or bio energy as a raw material for the fuel production. India produces sufficient amount of biomass which can act as a secure, reliable and affordable energy resources for India's sustained economic development. And there is need to exploit these bio resources. First generation of biofuels cannot be suitable for the coming future so there has been a shift to next generation of biofuels i.e second generation of biofuels (Lee, 2013). And India is the only country with full fledged ministry dedicated to utilize and explore new horizon in production of bio fuels from these renewable sources of energy i.e. biomasses.

Alternative Energy

Alternative energy like renewable energies are present in huge infinite and inexhaustible amount but these can be tapped at only available places. We can tap solar energy, wind energy, tidal energy where they are evenly and available in large amount (Dresselhaus, 2001). But due to the uneven distribution of this energy in the world we cannot use them on that much level which has been touched by fossil fuels. Fossils fuels will last for only two decades more. And new techniques like electric cars and hydrogen based vehicles are costly. If we try to replace all the fossil fuels running vehicles on the road with other kinds of vehicles then we also have to find a solution for billions of tones of metal wastes of dumped cars. And it will choke our roads. But use of other fuels like biofuels which can be used in place of diesel and petrol or gasoline is the intelligent feasible option (Naik, 2010).

Biofuels

It would not be wrong to say biofuels are fuels of future. The concept of using vegetable oil as a fuel dates back to 1895 when Dr. Rudolf Diesel the developer of the diesel engine that runs on vegetable oil (Shay, 1993), demonstrated his engine at the World Exhibition in Paris in 1900 running on peanut oil as fuel. Biofuels include ethanol, biodiesel, ethyl tertiary butyl ether (ETBE), butanol and others. Now focused has shifted on to use biowaste to generate biofuels. Biomass wastes like lignocellulosic wastes which are obtained from food crops. Instead of using edible crops as it can add to the food price rise we can use lignocellulosic wastes. Worldwide efforts are been made to replace fossil fuels with biofuels. But we have not to blindly follow anything to produce biofuels. We should not support replacement of land area worth for food crops with biodiesel crops. To meet the demands of biofuels deforestation and land conversion should not be supported. United States of America is the largest consumer of the fossil fuel and U.S. is making aggressive policies to lower its dependence on the fossil fuels and shifting focus more on biofulels. Different states are making their policies to lose their dependence on fossil fuels and have developed interests in biofuels like California, Kentucky (Hoekman, 2009). The two most common biofuels in the U.S. are ethanol and biodiesel**.** These biofuels are used in blended form but not in isolation. Biofuels includes biomethane, biodiesel,bioethanol, syngas, vegetable oils, green diesel, bioethers, biogas and solid biofuels.

Lignocellulosic Based Bio-fuels

Most of the countries in world are agricultural based economies. Their main occupation is agriculture and large amount of lignocellulosic waste are generated through forestry, agricultural practices, timber industries and other agricultural methods. Table 1 show that most of the biomass gets wasted, and causes environmental pollution as well as a huge bio-energy loss (Levine, 2009).

Table 1. Percentage of agricultural waste biomass produced and properly used [3]

Sno.	Total Biomass produced 500Mt (%)	Biomass utilized properly
1	Cereal crops (70%)	58%
2	Oil seed crops (6%)	7%
3	Fiber crops (13%)	23%
4	Pulses (3%)	2%
5	Sugar cane crops (2%)	2%
6	Other crops (6%)	8%

Bio-fuels from kitchen wastes

Biomasses obtained from waste food products and edibles coming out from restaurants, dhabas, hotels, vegetable markets, fish markets, edible oil industries and households wastes. Residential and resturant wastes particularly the kitchen wastes contain several reusable substances of high value such as soluble sugars and fibres. There is no Direct disposal solutions of such wastes to soil or landfill causes serious environmental problems. Improper treatment and disposal of such waste have a negative impact on the environment and also on human health (Quan, 2004), therefore, a number of methods are used for waste management such as prevention or minimization in generation, material recovery, recycling, incineration and disposal in controlled landfills (He, 2011). An important part of kitchen waste is biologically easily degradable. During past decades, organic biodegradable waste has been treated with anaerobic digestion (AD) and also organic matter has found a good use as a suitable method for treatment of and production of energy from combustion of biogas. Among biological treatments, anaerobic digestion of biodegradable organic wastes is the most popular and cost–effective, due to the high energy recovery and low environmental impact (Lin, 2013). Of late research in the field of biological treatment of food waste to produce ethanol, biogas and bio diesel has gained momentum, particularly in developed countries (Lin, 2013). Separation processes are used for separating waste oil and rudimental solid component of food waste. Chemical synthesis is utilized for biodiesel production with oil and fermentation techniques are used for ethanol production from solid parts. With the increase in environmental concern the process is now carried out by the use of microbes and enzymes (Lin, 2013). This is a very ecofriendly way to produce quality added products from the biodegradation of these kitchen wastes and produce not just only biofuels and biogas but also the production of manure for the agricultural land and with no bad odour and flies, so we can also prevent spreading of diseases. The cost associated with bioenergy production is lower than the cost for normal municipal way to deal with these wastes and consequences in term of outbreak of diseases (Demirbas, 2008).

Food wastes Types

Solid food waste and liquid food wastes are the two major classes of food wastes. Solid food wastes includes food scraps, bread, biscuits, cakes, buns, fruits and vegetables, coffee grounds and coffee filters, tea leaves, tea bags, rice, flour, pasta, eggs and eggs shells, shells from fishes, smaller bones from meat, fishes and poultry wastes, popcorns, sweets and chocolates, flowers and leaves from temples around the city. Liquids waste includes dairy milk wastes, cheese industries waste, cooking oils and animal's fats.

Second generation bio-fuels and biodiesel from kitchen wastes

According to the UMEVA (Umea. Sweden) the leading municipal company responsible for water and sewage, waste and recycling and landfill sites in the municipality of Umeå, Sweden, working on production of bio-fuels from municipal waste, one tonne of food wastes can be recycled in to 50 litres of biodiesel (Yao, 1999). Kitchen waste obtained from 712 households in six months can produced 3500 litres of biodiesel and if one car has an efficiency of ten kilometres per 0.75 litres of petrol than it means with this much amount of biodiesel it can loop around the world. And not just this the dry materials left after extracting fuels is a good source of bio fertilizers (Yao, 1999).

Biodiesel from cooking oil

Use of vegetable oils as a fuel dates back to 1895 when Dr. Rudolf Diesel made diesel engine ran on vegetable oil. Some researchers believe that biodiesel have increased the prices of foods and have caused shortages of food. Waste cooking oils is one of the most important kitchen wastes and is a good raw material for the biodiesel productions (Ma, 1999). Usage of waste cooking oil is quite environment friendly step and prevents contamination of land and water, and produce less toxic gases on combustion (Ramadhas, 2004). Bio-fuels from domestic households and kitchen wastes are good for fuel diversification but also strengthens our fight against pollution. Energy production from fuel waste is attracting our attentions because of environment friendly sustainable development (Mohamed, 2006). Pre-treatment of food wastes for sugar production and then for fermentation of that sugar for ethanol production was carried out by Kim and his co-workers (2011) (Kim, 2011). They did it by using lab scale fermenter after performing pre-treatment by using mixture of enzymes like carbohydrase, glucoamylase, cellulase and protease. Fermentation was carried by using enzyme carbohydrase and microbes *Saccharomyces cerevisiae*. Kitchen food waste was chosen for the ethanol production by placket burman design by Ma *et al*., 2008 (Ma, 2008). Parameters were screened by the use of Placket burman design, which can be employed for the better production of ethanol by SSF by microbes. In this case they employed *Zymomonas mobilis*. Parameters were based on enzymes and nutrition only. But on experimentation they found that microbes can utilize kitchen waste without any need of any additions of any extra nutrition. Glucoamylase are the enzymes which have found extension use in biofuel production. Use of alternate source of energy for the production of enzymes and then produced enzymes activity on this source for the production of alcohol is a good idea. Kitchen waste was used for the production of ethanol and also for the rearing of the enzymes used in the bio-fuel production (Wang, 2010). But the problem of low porosity of kitchen waste was overcome by addition of paddy husk and corn stover (Wang, 2010). Corn stover was found to be more effective than paddy waste and was used with kitchen waste with a ratio of 1:3.75 (Wang, 2010). For the better ethanol production from the kitchen wastes and refuses a new efficient strain of yeast *Saccharomyces cerevisiae KRM-1* was isolated by repeated ethanol fermentation and it was observed Cell recycle performing flocculation, an easy simple and faster methods for industrial ethanol production (Ma, 2008). Patle et al., 2007 performed and investigated the production of ethanol by the use of mixed enzyme culture of *Zymomonas mobilis and Candida tropicalis* under alkaline, acidic and enzymatic hydrolysis methods (Patle and Lal, 2007). Out of the three the maximum output was observed in the case of the enzymatic and almost nill in the case of alkaline based hydrolysis (Patle and Lal, 2007).

Food waste consists of high amount of carbohydrates and can be used to produce ethanol is a good way to treat waste and also meet increasing energy demands (Lin, 2013). As a matter of fact the food wastes varies from day to day so Davis et al., (2008) took two different food wastes on the basis of different maltose, glucose, fructose and starch to test the amount of ethanol and glycerol produced. A mathematical model of SSF based on experimentally matched rate equations for hydrolysis by enzymes and fermentation by yeast, was developed in Matlab Simulink (Davis, 2008). The basis of this experimentation was based on the enzymatic hydrolysis of the food in to sugars and fermentation of sugar in to ethanol (Davis, 2008). Bio-energy production from municipal sewage waste was also studied in lab by Jeyapriya and Saseetharan, (2008) at room temperature under anaerobic fermentation (Jeyapriya and Saseetharan, 2008). With increase of fermentation period the biogas production was also increased and a total of 3.2 liters of biogas was obtained by performing anaerobic fermentation period of 120 days. With the change in pH, production was significantly affected. COD, BOD, total nitrogen content and total carbon content etc were tested with interval of time and the results showed stability of the wastes Hydrogen production was studied from food waste material by anaerobic fermentation. The reaction undergoes a change from mixed acid fermentation to ethanol fermentation. Fermentation was carried at CSTR and parameters likeoxidation reduction potential, organic loading rate, pH, temperature, hydraulic retention time, partitioning connection weights were tested (Shi, 2009). Cooking oil is also an important kitchen waste and biodiesel is produced from it by methanolysis of waste edible oil by lipase. But the lipase enzyme underwent inactivation even if it was immobilised in the availability of methanol. So to overcome this challenge, Yuji Shimada *et al*., (2001) developed a step wise process and carried out the reaction with much more efficiency (Shimada, 2002).

Biofuels from Animal Wastes

Petroleum companies like BP, shell and conoc Phillips which are multinational companies also want to take their share of pie by producing biodiesel from different ranges of biomass present in the form of industrial and urban waste like animal fats, slaughter house wastes and other agricultural wastes (Lebedevas, 2006; Rausser, 2008).

Cellulosic Ethanol

U.S. and Brazil are the leaders in bio-ethanol production. Unites states produces most of the ethanol from cornstarch while Brazilian produces most of the biofuels from sugarcane contrary to European countries which produces oils from rapeseed. But now efforts are focused on production of biofuels from agricultural and forest wastes. Perennial grasses, switch grasses, miscanthus which are rich of source of celluslose. Without a doubt the biofuels forms an integral part of sustainable development (Solomon, 2010).

Biofuels from Microalgae

Recently algae are given very importance and considered as new and important source of biomass. The reason can be as it do not require any agricultural land, fresh water and can manage its own nutrients from waste waters and carbon dioxide coming from burning of fossil fuels. They also have a high productivity with less energy input. But when it comes to case of growing them on open scale than only few species have ability but they grow overcoming competitions and predators (Rodolfi, 2009; Day, 2012; Chisti, 2007). But a more research and technical edge is needed to make this feasible and to compete with other renewable resources.

Biofuel cells

With just at starting phase biofuels cells do not claims to be the only solution to the problem of rising fuel prices but can play their role very efficiently (Davis and Higson, 2007). Fuel cells based on hydrogen and methanol were been used but new fuel cells using hydrocarbon also came into market (Bagotzky, 2003). Hydrogen storage and safety is always a concern. And to use biomass as a source of energy is good idea. These biofuel cells will consume organic waste like bioreactor and will produce energy like fuel cells. Either whole microbe or enzyme based biofuel cells can be a source of alternative energy, like lactose waste can be used by microbe [50] and enzymes in immobilized forms can also be used in microbe fuel cells (Ramanavicius, 2005).

Biomethane

It is the fuel which is produced by the anaerobic digestion. Anerobic digestion which was just a method developed only for waste water treatment. Animal, agricultural and kitchen wastes when treated an aerobically by the microbes it can produce methane gas. 27 EU countries making full use of methane production by anaerobic digestion for reduction of green house gases under the Kyoto protocol (Karagiannidis, 2009). Biogas is considered as a potential fuel for supporting almost half of the biofuel supply and also a ten percent of all European automobiles transport fuels (Oliveira, 2012).

Bio methanol

Methanol and ethanol are the main bioalcohol which can be generated from biomass. Carbohydrates, sugar, lignincellusloe rich subastance are used to produce sugar from them and that sugar is then converted to biofuels by fermentation. Methanol is mostly produced by synthesis gas but now enzyme based methanol production is gaining momentum. Methanol can be produced from almost all kind of biomasses by enzymatic methods and electrolysis (Obert, 1999).

Some Success Stories

Brazil

Brazil is the leader in biofuels production and utility (Assis et al., 2007). Brazil produces most the alcohol fuel typically by fermenting ethanol from sugarcane. According to a *Economic Research Service, Washington, DC,*report (Coyle, 2007). biofuel production in Brazil is now challenged but for good, to meet its need as well as the hungry world. Brazil is pushed to its limit to produce more and more ethanol not just for the domestic industries but for the growing world markets. Its trying to maintain its top position of world leading supplier of ethanol. This is a sign that world is shifting it dependence more and more on biofuels (Valdes, 2011). Brazil produces a total of 18 billion liters of biofuel in the form of bio-ethanol and more than 10% is exported to U.S. Brazil was also the first country to use alcohol cars. With the availability of flexi-fuel engine fitted cars in Brazil called "Flex" and leading car manufacturers like Volksvogen, General motors, Fiat and others make cars who can effectively run on biofuel, gasoline and blend of both (Bastian-Pinto, 2010). And it has been estimated by petrobras the state run oil company of Brazil that there will be 70% Flexi vehicles in Brazil by 2020. It was 2003 when flex fuel running engines based vehicles were introduced in Brazil and these vehicles can run on E0 to E100 (Goldemberg, 2008).

China

China is the world's second fastest growing economy, most populous country with second largest economy after America and one of the top consumers of fossil fuels. Its large population and growing economy needs energy for maintaining the growth rate. In 2003 China produced 25.9 x 10^8 metric tons of industrial, 14.7x 10^8 metric tons of manure, 7.1 x10^8 metric tons of crops residues, 2.1x 10^8 metric tons of fuel wood, 1.5 x10^8 metric tons of municipal wastes (Junfeng and Runqing, 2003 and Zhao, 2012). But most of it goes in to dump and cause environmental problems. If this huge amount of biomass will be used to produce bio-fuels it will be a big step and turning point in becoming self reliance on energy needs (Yang, 2009). Suzhou Clean Waste Vegetable Oil Recovery Co., Ltd, based in Suzhou, in East China's Jiangsu Province, is an environmental protection enterprise dedicated to disposing of kitchen leftovers (Mo, 2009). The company sends a dozen trucks to restaurants city-wide every day, loading food garbage to airtight containers and shipped them back to workshops for harmless treatment. The kitchen leftovers, after being simply sorted out, are poured into cylinder-like containers, and then their solid matters are separated from oil and water after high speed operation. The grease drawn by centrifugal machine, after seepage and evaporation, will be turned into bio-diesel. The remaining solid kitchen leftovers will become organic fertilizer like the post fermented high-protein waste, and the bio-gas produced during the process can be used for the power generation for production in factory area.

Japan

In Kitakyushu City in southern Japan**,** a pilot plant to produce ethanol from food waste was established as for the city's Eco-Town project. The city started the collection of food waste from some elementary schools, hospitals, and households in the city on June 11, 2007. New Energy and Industrial Technology Development Organization (NEDO) commissioned a plant, built by Nippon Steel Engineering Co., had been working fine from its inception since the February 2007. The plant processes 10 tons of food waste into 400 liters of ethanol per day. Citizens providing food waste in bags, having a barcode and without the use of any official collectors/traders on per single bag deposited earn ecopoints as an incentive and can use these points for getting the eco-products. At the collection center, the depositers are provided proper information regarding sorting of food waste, for effective processing of into ethanol. Rice and wheat-based bread ans starcy wastes food items are Ideal food materials for ethanol production.

Hawaii

Keffer et al., 2008 made an assessment on the biofuel production in Hawaii and the national demands (Keffer, 2009). Based on soil types, zoning and yearly rainfall the data suggested that sugarcane, bangrass, eucalyptus grandis and leucaena leucocephala are the potential biofuel producers. This study of Hawaii natural energy institute supported on cropping scenario and by making a effective choice based on energy diversification and good provision for storage and harbouring facilities for production and transportation of biofuels can support the aim to displace 20% of total highway fuels by 2020.

Taiwan

Taiwan is an island country and imports 98 percent of its total highway fuels (Tsai, 2007). To overcome the dependence on the biofuels the country is focusing on the diversification of the kinds of fuels and their sources. Keeping this in view biomass energy is now given priority. Biodiesel from the waste edible oil is an environment friendly step and can help to loosen the burden of dependence on fossil fuels. This issue becomes more important as this country is resources limited. From mid 1990s focus is on biomass based biofuels. If we compare the hydrocarbon in biodiesel and fossil fuels, biodiesel have C_{12}-C_{22} as same that of fossil fuels for which they can be used in place of biofuels (Srivastava, 2000).

Kentucky

The commonwealth of Kentucky is the 37^{th} largest state of the United States of America. It is the state where use of biodiesel has grown up to 1,100 percent since 2002 and 2004 according to the report "Clean Cities" published (2004) by the us dept of energy; U.S. This state uses biodiesel mix as B20 and B2 (Copulos, 2005).

Advantages of Biodiesel and future challenges

Some scientists and researchers and activists believe that with increase in bio fuels there has been an increase in food prices. Mueller and his co-workers (2011) found that it's completely rubbish to claim that bio fuels production added price to food crops like grains (Muller, 2008). Till now the process employed were not having economical advantage but with enhanced research and increased in fuel prices has changed the equations (Msangi, 2007). Biodiesel is about 10% oxygen by weight and contains no sulphur, are biodegradable, nontoxic, renewable source of energy, can be used alone or mixed with petroleum fuel, has a high flash point making it one of the safest of all alternative fuel, runs in any conventional, unmodified diesel engine. Biodiesel are environment friendly and their benefit outweighs its inconveniences (Qureshi and Ezeji, 2008). Biodiesel have high amount of oxygen as compared to the fossil fuels which add to its combustion power. Bio fuels also help in preventing cancer by reducing the release of cancer causing smoke (Ivanoiu, 2011). Any fuel, which claims to be viable alternative to fossil fuels should have high energy output, environmental gains, should have economic edge and can be produced in bulk without claiming food crops, land for food crops and without promoting deforestation (Hill et al., 2006). When ethanol and biodiesel energy output is compared to the energy input both are found to be 93% and 25% more efficient. They produce green house gases 41% and 21% less then the fossil fuel respectively (Hill, 2006). The same can also be produced by growing low input biomass crops on unused lands, marginal lands and also from biomass generated in the form of agricultural wastes. Which can silent the question raised on food based biofuels (Hill, 2006). The other challenge is to maintain a technical edge. 2nd generation is replacing the 1st generation fuels. Technical and economic challenges need to be met, continuous supply of biomass all year round is also a challenge, and continuous research and investment is also an important issue that has to be met. But in compare to saving environment this is a small price (Sims, 2010).

Conclusions

Vast amounts of biomass simply go to waste, if utilized properly could be used as biomass feedstock for biofuel production. Other concentrations of wastes abound like animal feedlot wastes, abattoir and fish offal, other food processing wastes, biomethane from landfill operations can support the growing demands of fuel for the nations around the world. House hold wastes coming from the human population living in cities and towns, municipal wastes is underutilized. A few municipalities use some: Dayton, Ohio, ferments to biogasse and burns this to generate electricity; some municipalities in The Netherlands produces sufficient amount of bio-methane to meet the requirements of CNG filling stations; San Diego, California, generates enough high quality biomethane to supply some to the natural gas pipeline. But there is much more which can and should be done to not only improve the quality of wastewater discharge but also efficiently capture the energy currently often just wasted. All this involves quite substantial infrastructure development and improvement. So we can use wastes and some oil crops which can provide us raw material for biofuels. For a country like India with huge population and high poverty ratio, shifting towards biofuels from agricultural biomass can help it achieve better economic growth and simultaneously can contribute in saving environment.

REFERENCES

Assis, V., Elstrodt, H., and Silva, C. F. 2007. Positioning Brazil for biofuels success. *McKinsey Quarterly*, *2*(I), 116.

Bagotzky, V. S., Osetrova, N. V., and Skundin, A. M. 2003. Fuel cells: state-of-the-art and major scientific and engineering problems. *Russian journal of electrochemistry*, *39*(9), 919-934.

Bastian-Pinto, C., Brandão, L., and de Lemos Alves, M. 2010. Valuing the switching flexibility of the ethanol-gas flex fuel car. *Annals of Operations Research*, *176*(1), 333-348.

Bennetto, H. P., Delaney, G. M., Mason, J. R., Roller, S. D., Stirling, J. L., and Thurston, C. F. 1985. The sucrose fuel cell: efficient biomass conversion using a microbial catalyst. *Biotechnology letters*, *7*(10), 699-704.

Bozbas, K. 2008. Biodiesel as an alternative motor fuel: Production and policies in the European Union. *Renewable and Sustainable Energy Reviews*, *12*(2), 542-552.

Chisti, Y. 2007. Biodiesel from microalgae. *Biotechnology advances*, *25*(3), 294-306.

Copulos, M. R. 2005. Economic, Security and Environmental Impacts of Alternative Fuel and Automotive Technologies A Cost/Benefit Analysis of the Clean Cities Program.

Cox, P. M., Betts, R. A., Jones, C. D., Spall, S. A., and Totterdell, I. J. 2000. Acceleration of global warming due to carbon-cycle feedbacks in a coupled climate model. *Nature*, *408*(6809), 184-187.

Coyle, W. 2007. The future of biofuels. *Economic Research Service, Washington, DC.*

Davis, F., and Higson, S. P. 2007. Biofuel cells—recent advances and applications. *Biosensors and Bioelectronics*, *22*(7), 1224-1235.

Davis, R. A. 2008. Parameter estimation for simultaneous saccharification and fermentation of food waste into ethanol using Matlab Simulink. In *Biotechnology for Fuels and Chemicals* (pp. 379-389). Humana Press.

Day, J. G., and Stanley, M. S. 2012. Biological constraints on the production of microalgal-based biofuels. In *The Science of Algal Fuels* (pp. 101-129). Springer Netherlands.

Demirbas, A. 2008. Biofuels sources, biofuel policy, biofuel economy and global biofuel projections. *Energy conversion and management*, *49*(8), 2106-2116.

Dresselhaus, M. S., and Thomas, I. L. 2001. Alternative energy technologies. *Nature*, *414*(6861), 332-337.

Giannakopoulos, C., Bindi, M., Moriondo, M., LeSager, P., and Tin, T. 2005. Climate change impacts in the Mediterranean resulting from a 2 C global temperature rise. *WWF report, Gland Switzerland. Accessed*, *1*, 2006.

Goldemberg, J. 2008. The Brazilian biofuels industry. *Biotechnology for biofuels*, *1*(6), 1-7.

Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., and Briggs, J. M. 2008. Global change and the ecology of cities. *science*, *319*(5864), 756-760.

Hansen, J., Sato, M., Ruedy, R., Lo, K., Lea, D. W., and Medina-Elizade, M. 2006. Global temperature change. *Proceedings of the National Academy of Sciences*, *103*(39), 14288-14293.

He, X., Iasmin, M., Dean, L. O., Lappi, S. E., Ducoste, J. J., and de los Reyes III, F. L. 2011. Evidence for fat, oil, and grease (FOG) deposit formation mechanisms in sewer lines. *Environmental science and technology*, *45*(10), 4385-4391.

Hill, J., Nelson, E., Tilman, D., Polasky, S., and Tiffany, D. 2006. Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels. *Proceedings of the National Academy of Sciences*, *103*(30), 11206-11210.

Hoekman, S. K. 2009. Biofuels in the US–challenges and opportunities. *Renewable Energy*, *34*(1), 14-22.

Hoogwijk, M., Faaij, A., van den Broek, R., Berndes, G., Gielen, D., and Turkenburg, W. 2003. Exploration of the ranges of the global potential of biomass for energy. *Biomass and bioenergy*, *25*(2), 119-133.

http://www.un.org/en/development/desa/policy/wess/wess_archive/2004wess_part2_eng.pdf

IARI, 2012. Crop residues management with conservation agriculture: P otential, constraints and policy needs. Indian Agricultural Research Institute, New Delhi, vii+32 p.

Ivanoiu, A., Schmidt, A., Peter, F., Rusnac, L. M., and Ungurean, M. 2011. Comparative Study on Biodiesel Synthesis from Different Vegetables Oils. *Chemical Bulletin of" POLITEHNICA" University of Timisoara*, *56*(70), 2.

Jeyapriya, S. P., and Saseetharan, M. K. 2008. Energy recovery from municipal solid waste in an anaerobic reactor. *J Environ Sci Eng*, *50*(3), 235-238.

Junfeng, L., and Runqing, H. 2003. Sustainable biomass production for energy in China. *Biomass and Bioenergy*, *25*(5), 483-499.

Karagiannidis, A., and Perkoulidis, G. 2009. A multi-criteria ranking of different technologies for the anaerobic digestion for energy recovery of the organic fraction of municipal solid wastes. *Bioresource technology*, *100*(8), 2355-2360.

Keffer, V. I., Turn, S. Q., Kinoshita, C. M., and Evans, D. E. 2009. Ethanol technical potential in Hawaii based on sugarcane, banagrass, Eucalyptus, and Leucaena. *Biomass and Bioenergy*, *33*(2), 247-254.

Kim, M., and Day, D. F. 2011. Composition of sugar cane, energy cane, and sweet sorghum suitable for ethanol production at Louisiana sugar mills. *Journal of industrial microbiology and biotechnology*, *38*(7), 803-807.

Klugbauer, S., E. Lengfelder, E. P. Demidchik, and H. M. Rabes. "High prevalence of RET rearrangement in thyroid tumors of children from Belarus after the Chernobyl reactor accident." *Oncogene* 11, no. 12 1995: 2459-2467.

Lebedevas, S., Vaicekauskas, A., Lebedeva, G., Makareviciene, V., Janulis, P., and Kazancev, K. 2006. Use of waste fats of animal and vegetable origin for the production of biodiesel fuel: quality, motor properties, and emissions of harmful components. *Energy and fuels*, *20*(5), 2274-2280.

Lee, R. A., and Lavoie, J. M. 2013. From first-to third-generation biofuels: challenges of producing a commodity from a biomass of increasing complexity. *Animal Frontiers*, *3*(2), 6-11.

Levine, R., Oberlin, A., and Adriaens, P. 2009. A Value Chain and Life-Cycle Assessment Approach to Identify Technological Innovation Opportunities in Algae Biodiesel. In *nanotech conference and expo, Houston, TX*.

Lin, C. S. K., Pfaltzgraff, L. A., Herrero-Davila, L., Mubofu, E. B., Abderrahim, S., Clark, J. H., and Luque, R. 2013. Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective. *Energy and Environmental Science*, *6*(2), 426-464.

Ma, F., and Hanna, M. A. 1999. Biodiesel production: a review. *Bioresource technology*, *70*(1), 1-15.

Ma, F., and Hanna, M. A. 1999. Biodiesel production: a review. *Bioresource technology*, *70*(1), 1-15.

Ma, H., Wang, Q., Zhang, W., Xu, W., and Zou, D. 2008. Optimization of the medium and process parameters for ethanol production from kitchen garbage by Zymomonas mobilis. *International Journal of Green Energy*, *5*(6), 480-490.

Manish, S., and Banerjee, R. 2008. Comparison of biohydrogen production processes. *International Journal of Hydrogen Energy*, *33*(1), 279-286.

McMichael, A. J., Woodruff, R. E., and Hales, S. 2006. Climate change and human health: present and future risks. *The Lancet*, *367*(9513), 859-869.

Mo, H., Wen, Z., and Chen, J. 2009. China's recyclable resources recycling system and policy: A case study in Suzhou. *Resources, Conservation and Recycling*, *53*(7), 409-419.

Mohamed, A. R., and Lee, K. T. 2006. Energy for sustainable development in Malaysia: Energy policy and alternative energy. *Energy Policy*, *34*(15), 2388-2397.

Msangi, S., Sulser, T., Rosegrant, M., and Valmonte-Santos, R. 2007, June. Global scenarios for biofuels: Impacts and implications for food security and water use. In *10th Annual Conference on Global Economic Analysis, Purdue University, Indiana*.

Muller, A., Schmidhuber, J., Hoogeveen, J., and Steduto, P. 2008. Some insights in the effect of growing bio-energy demand on global food security and natural resources. *Water Policy*, *10*, 83.

Naik, S. N., Goud, V. V., Rout, P. K., and Dalai, A. K. 2010. Production of first and second generation biofuels: a comprehensive review. *Renewable and Sustainable Energy Reviews*, *14*(2), 578-597.

Obert, R., and Dave, B. C. 1999. Enzymatic conversion of carbon dioxide to methanol: enhanced methanol production in silica sol-gel matrices. *Journal of the American Chemical Society*, *121*(51), 12192-12193.

Oliveira, I., Gominho, J., Diberardino, S., and Duarte, E. 2012. Characterization of Cynara cardunculus L. stalks and their suitability for biogas production. *Industrial Crops and Products*, *40*, 318-323.

Patle, S., and Lal, B. 2007. Ethanol production from hydrolysed agricultural wastes using mixed culture of Zymomonas mobilis and Candida tropicalis. *Biotechnology letters*, *29*(12), 1839-1843.

Quan, C. C., Yin, P. H., Zhao, L., Shan, X. Z., Zhang, X., and Yu, H. H. 2004. Assay on the Harmful Volatile Components of the Refined Waste Edible Oil Gained from the Restaurant Sewer by Static Headspace and Gas Chromatography. *Mass Spectrometry*, *4*.

Qureshi, N., and Ezeji, T. C. 2008. Butanol,'a superior biofuel'production from agricultural residues (renewable biomass): recent progress in technology. *Biofuels, Bioproducts and Biorefining*, *2*(4), 319-330.

Ramadhas, A. S., Jayaraj, S., and Muraleedharan, C. 2004. Use of vegetable oils as IC engine fuels—a review. *Renewable energy*, *29*(5), 727-742.

Ramanavicius, A., Kausaite, A., and Ramanaviciene, A. 2005. Biofuel cell based on direct bioelectrocatalysis. *Biosensors and Bioelectronics*, *20*(10), 1962-1967.

Raupach, M. R., Marland, G., Ciais, P., Le Quéré, C., Canadell, J. G., Klepper, G., and Field, C. B. 2007. Global and regional drivers of accelerating CO2 emissions. *Proceedings of the National Academy of Sciences*, *104*(24), 10288-10293.

Rausser, G. C., and Papineau, M. 2008. Managing RandD risk in renewable energy. *Department of Agricultural and Resource Economics, UCB*.

Report by Institute for the analysis of global security. Titled: "India's Energy security challenge". http://www.iags.org/n0121043.htm

Report by world energy outlook. Titled: "World Energy Outlook 2013 Factsheet. How will global energy markets evolve to 2035, http://www.worldenergyoutlook.org/

Report published in CNBC titled: India's Secret Weapon: Its Young Population. http://www.cnbc.com/id/49472962.

Rittmann, B. E. 2008. Opportunities for renewable bioenergy using microorganisms. *Biotechnology and bioengineering*, *100*(2), 203-212.

Rodolfi, L., Chini Zittelli, G., Bassi, N., Padovani, G., Biondi, N., Bonini, G., and Tredici, M. R. 2009. Microalgae for oil: Strain selection, induction of lipid synthesis and outdoor mass cultivation in a low□cost photobioreactor. *Biotechnology and bioengineering*, *102*(1), 100-112.

Shay, E. G. 1993. Diesel fuel from vegetable oils: status and opportunities. *Biomass and Bioenergy*, *4*(4), 227-242.

Shi, Y., Zhao, X. T., Cao, P., Hu, Y., Zhang, L., Jia, Y., and Lu, Z. 2009. Hydrogen bio-production through anaerobic microorganism fermentation using kitchen wastes as substrate. *Biotechnology letters*, *31*(9), 1327-1333.

Shimada, Y., Watanabe, Y., Sugihara, A., and Tominaga, Y. 2002. Enzymatic alcoholysis for biodiesel fuel production and application of the reaction to oil processing. *Journal of Molecular Catalysis B: Enzymatic*, *17*(3), 133-142.

Sims, R. E., Mabee, W., Saddler, J. N., and Taylor, M. 2010. An overview of second generation biofuel technologies. *Bioresource technology*, *101*(6), 1570-1580.

Solomon, B. D. 2010. Biofuels and sustainability. *Annals of the New York Academy of Sciences*, *1185*(1), 119-134.

Spurny, K. R. 1996. Atmospheric Particulate Pollutants and Environmetal Health. In *Aerosol Inhalation: Recent Research Frontiers* (pp. 175-185). Springer Netherlands.

Srivastava, A., and Prasad, R. 2000. Triglycerides-based diesel fuels. *Renewable and sustainable energy reviews*, *4*(2), 111-133.

Tsai, W. T., Lin, C. C., and Yeh, C. W. 2007. An analysis of biodiesel fuel from waste edible oil in Taiwan. *Renewable and Sustainable Energy Reviews*, *11*(5), 838-857.

Valdes, C. 2011. *Brazil's ethanol industry: looking forward*. United States Department of Agriculture.

Vermeer, M., and Rahmstorf, S. 2009. Global sea level linked to global temperature. *Proceedings of the National Academy of Sciences*, *106*(51), 21527-21532.

Wang, X. Q., Wang, Q. H., Liu, Y. Y., and Ma, H. Z. 2010. On-Site production of crude glucoamylase for kitchen waste hydrolysis. *Waste Management and Research*, *28*(6), 539-544.

Yang, H., Zhou, Y., and Liu, J. 2009. Land and water requirements of biofuel and implications for food supply and the environment in China. *Energy Policy*, *37*(5), 1876-1885.

Yao, J. Analyzing and Expending the Concept of Systems Selling in Theory and Practice.

Zhao, Z. Y., and Yan, H. 2012. Assessment of the biomass power generation industry in China. *Renewable Energy*, *37*(1), 53-60.

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