

Evolve of Technology with Biofuels for Transportation

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Abstract— When “biofuels” became a catchphrase from a word, hopes are soaring for us that it is the end of high-priced oil and environmental problems will finally come to an end. Politicians, farmers, consumers and environmentalists are slowly realising that the situation is far more complicated. Biofuel has big capabilities and there is a valid reason to peruse it. However, the current biofuel production models are not working, there are more sustainable and more efficient biofuels options on the horizon. The major trouble is that the lack of technology and the expenses required to process these materials, makes existing mass-production impossible. The relevant question for this 21st century is how to utilize biofuels without hurting consumers or the environment. Legislation should be reflective of the current and future realities of the biofuels industry. The aim of this paper is to analyse Technology Roadmap: Biofuel for Transportation.

Key words: Technology Roadmaps, Transportation, Sustainability, Biofuel

I. INTRODUCTION

The world is on the edge of unexpected growth in the production and use of biofuels (liquid fuels derived from plants and other biomass). Increase in price of oil, concern of national security, the desire to increase farm incomes, and a host of new and better technologies are pushing many governments to enact powerful incentives for the production and use of these fuels. This, in turn, is giving rise to huge investment in biofuel for transport [6].

Present trends in energy supply and use are unsustainable, both socio-economically and environmentally. If proper control and actions are not taken, energy-related greenhouse gas emissions (GHG) will be double by 2050 and increasing oil demand will be serious concerns. We should all come together and focus on low-carbon energy technologies. This will play a vital role in the energy revolution required to make the changes happen. To successfully reduce GHG emissions, energy efficiency, numerous types of renewable energy, carbon capture and storage, nuclear power and new transport technologies will all require extensive organization [5].

At present only 2 % of total transport is provided by biofuels, but novel technologies will offer considerable potential for growth over the coming years. The International Energy Agency (IEA) prepared a report on the Technology Roadmap Biofuels for Transport and it predicts that by 2050, 32 exajoules of biofuels will be used internationally, providing 27% of world transport fuel. To accomplish this dream, strong and balanced policies are required that create a steady investment environment and permit commercialisation of advanced biofuel technologies, efficiency improvements and additional cost reductions along the various production chains of diverse biofuels. Thorough sustainability requirements are the most important thing to ensure that biofuels provide substantial GHG

emission reductions without causing any harm to food security, biodiversity or society [5].

To achieve our dreams, we have to focus on the key steps over the next 5 to 10 years, as well as long-term milestones, which include the following below:

- Recognize barriers and difficulties and how to overcome these issues.
- Recognise key conversion pathways.
- Main R&D gaps and how to work forward while ensuring sustainability.
- Classify and identify market necessities and policy requirements.
- Outline and plan international collaboration needs.

II. METHOD

My research paper is to focus on Evolve of Technology with Biofuels for Transportation; the methodology of the study is based on two namely:

- In depth literature review
- To critically analyse the papers relating to Technology Roadmap for transportation.

The methodology undertaken for this research can be summarized in the following points:

A. Data Capture

An initial search was performed in scientific databases: International Energy Agency, Institute of Economic Affairs, PubMed and Science Direct, Google scholar, British Library, and Navigant research. The search criteria were based on key words like transport biofuel, technology roadmap, biofuel, bioethanol and biodiesel and international collaboration.

B. Sampling

In approximate 25 articles were read and selected that had the most relevant information and appropriate to the subject, and a total of 8 articles were chosen which is relevant for my paper write up and that can be found in the references section.

C. Results

Based on the descriptive research and the variables used to analyse the information (research articles), provides the results of research that are the basis for the discussion and conclusions.

III. RESULT AND DISCUSSION

There is a valid reason to chase biofuel. Although the current biofuels production process is not working efficiently, there are more sustainable and more efficient biofuels options on the horizon. The major problem is the lack of efficient technology and the expenditure needed to process these materials makes current mass-production impossible. The relevant question for today is how to utilize

biofuels without hurting consumers or the environment. Legislation should be reflective of the current and future realities of the biofuels industry [2].

The International Energy Agency (IEA) organized the Technology Roadmap Biofuels for Transport in consultation with representatives of government, industry, academia and non-governmental organizations. This report shows a chart, a course for expanding the production and use of biofuels to 2050, in a sustainable way. Liquid fuels and blending components, which are produced from biomass feedstock, which are used mainly for transportation can provide up to 27% of world transportation fuel by 2050 [2].

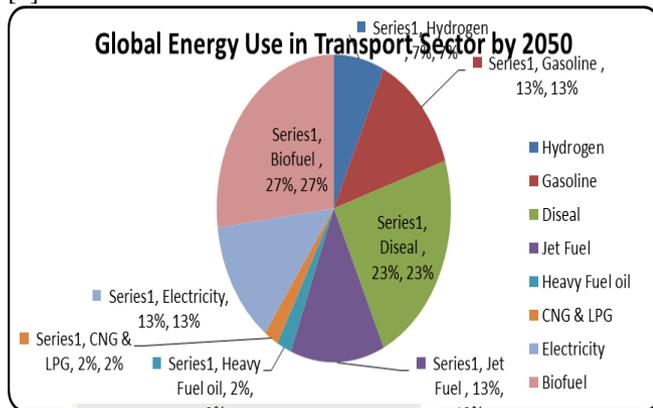


Fig. 1: Global Energy use in Transport sector by 2050.

Source: IEA, 2010.

Note: CNG – Compressed Natural Gas; LPG – Liquid Petroleum Gas

Biofuels is the key solution to provide transport fuel with substantially lower CO₂ emissions than original conventional gasoline or diesel when discussing the full "life cycle" of production - that is, from the field to the vehicle. But there are warning: it is important to decrease the use of fossil energy during cultivation, transport and conversion of biomass to biofuel. It is also very critical to avoid direct or indirect land-use changes, such as converting forests to grow biofuel feedstocks, which release large amounts CO₂ and could offset the CO₂ reduction potential of biofuels. Advanced biofuel technologies which are being developed, are currently at the demonstration stage (produced mainly from lignocelluloses biomass such as wood and straw), need to be commercially deployed within the next ten years and will provide the major share of biofuels by 2050 [6].

Mostly vehicle efficiency will be the most significant and most cost-efficient way to reduce transport-emissions. Biofuels will still be needed to provide low-carbon fuel alternatives for planes, marine vessels and other heavy transport modes, and will finally provide one-fifth of emission reductions [5].

A. Requirement of Efficient Biofuel technologies

The essential requirement to address the growing challenge of climate change has led to more closer inspection of biofuels to evaluate whether they can be produced, traded and be used sustainably. Biofuel has been criticised due to its negative impacts on the environment through deforestation, spread of monocultures, biodiversity loss and higher GHG emissions under uncontrolled land-use change. Apart from all these, the food crisis of 2007-08 and the rise of commodity prices intensified the debate over food versus

fuel and the significant consequences of biofuel production on food security. With all these debates, scientists started to enquire the environmental superiority of biofuels. Due to these constant worries, sustainability has been encouraged as essential condition for biofuel for its long-term viability and for continuous public support to renewable energy and to climate change mitigation.

Due to this hyped up criticism, a range of biofuel certification schemes appeared, all purporting to ensure sustainability. These schemes also seem to be pushed by the need to regulate the existing and potentially vast future trade flows in feed stocks and biofuels between industrialized economies and developing countries [4].

"Further support for advanced biofuel research, development and demonstration is still needed to improve conversion efficiencies and reduce costs. In addition, investments in commercial-scale production units will be a key to enable advanced biofuels to reach full market maturity," said Mr. Diczfalussy at the launch of his report IEA Technology Roadmap Biofuels for Transport in Washington in April 2011. In IEA Technology Roadmap Biofuels for Transport report, it was also mentioned, "Government action is needed to provide a stable, long-term policy framework for biofuels that allows for sustained investments in biofuel expansion. Specific support measures that address the high investment risk currently associated with pre-commercial advanced biofuel technologies will be vital to trigger industry investments in first commercial plants."

Realistically, if all these substantial investments are put in place, most biofuel technologies could get very close to cost-competitiveness with fossil fuels, or it can be produced at lower costs in the longer term (International Energy Agency, 2011). Generally, most biofuel production still relies on a few crops driven mainly by government support, including subsidies and mandates. Most lucrative feedstocks that compete directly with food crops (e.g. Jatropha, sweet sorghum) are still at primary development stages. This concern of land being taken away from food production may favour using agricultural residues as feedstock for second-generation biofuels. However, dedicated energy crops might bargain for higher biomass productivity per unit of land. The enormous demand for biomass for second-generation biofuel production plant requires complex logistics systems and good infrastructure to provide economically competitive costs for biofuel. This is a really great challenge in the rural areas where poor infrastructure, complex land property and small land holdings, increases the complex structure of feedstock logistics (e.g. in Cameroon, India, South Africa and Tanzania)[4].

B. Sustainable biofuels is key for future transport

'With world population growing by more than 30% to 9 billion people in 2050, and food demand increasing approximately 70% according to estimates by the Food and Agriculture Organization of the United Nations, competition of biofuel production for land with food, fodder, as well as fibre production needs to be carefully addressed to avoid negative impacts from biofuel expansion on food security,' said Mr. Diczfalussy in his report IEA Technology Roadmap Biofuels for Transport. Transport is a most important source

of greenhouse gases. It is assumed that reducing the greenhouse gases from transport will help to achieve reducing the greenhouse gas emissions by minimum 80 per cent compared to levels in 1990 and 2050. For this to happen a large amount of investments and policy changes are required for sustainable biofuel [3]. All the controversy regarding biofuels has hit the headlines. Biofuel is promoted as a sustainable alternative to fossil fuels, many scholars and scientists have argued that they are neither sustainable nor green. Critics have also scrutinised the economic cases and examined whether biofuel production is currently a cost effective option. All the criticism of the close relationship between biofuels and development has been further supported by rising works and papers regarding the link between biofuel production and the spike in food prices. In addition to scholars have huge doubt about land rights, as the industry will grow, how can we ensure these are preserved [3]?

But biofuel is not all damaging and evil. In the July 2013 report on biofuels and food security by the UN CFS high level panel of experts on food security and nutrition, suggests it might be time to reconsider its benefits: employment and income opportunities, increased agricultural productivity, reduction of CO₂ emissions and increased energy independence. In the report it was concluded by the author that "the potential impact of biofuel policies and projects can differ widely according to national and local conditions and to the choice of specific technologies and feedstock."

With all the conflicting evidences and debates, I think it's time to question ourselves, is biofuels good or bad and how can we improve the policy to make biofuel cultivation green, equitable and sustainable[1]? If second generation/advanced fuels are the answers for the future, what actions need to be taken now to ensure the development is in a sustainable way, make sure that once the technology is ready for market they can be quickly introduced, avoiding any lock-in to first generation fuels. [1]. what steps can be taken to improve the sustainability of biofuel solutions and the transport sector widely speaking.

C. Future Perspectives for Biofuels in Road Transport

Road transport biofuel, in the EU account for 4.7% (13,985 ktoe) of total energy consumption. It is divided into biodiesel (10,644 ktoe), bio gasoline (2,892 ktoe) and other liquid biofuels (422 ktoe). Biofuels are compatible with today's engines and vehicles and can be blended with present fossil fuels to a certain extent. For road transport purpose, the most promising biofuels are liquid biofuel and drop-in biofuels, such as B7, E10, E20 used in fleets. The promotion of biofuels is a huge priority in political agenda and energy-climate policy in Europe. There is a big push to use energy from renewable sources, with a binding target of 10 % share of renewable energy in transport by 2020. In addition, Directive 2009/30/EC allows for the blending of ethanol into petrol up to 10 % (v/v) and for a Fatty Acid Methyl Ester (FAME) content of 7 % (v/v) in diesel. In 2013, the European Parliament mentioned about placing a 6 % cap on first-generation biofuels and a 2.5 % incorporation threshold of advanced biofuels which are produced from waste or algae. To be very honest, the increase in biofuel use in road by 2020 and future expansion, depends on regulatory

policy and support, availability of more diverse feedstock's including energy crops and wastes. Global expansion of biofuels use in road transport also depends on the ongoing development of engines which will be able to use higher blends of ethanol and diesel [7].

The future of biofuel is very bright and there is a huge progress all over the world especially India. In India, Kolkata is Inaugurating the bio-diesel dispensing unit at Haldia Dock Complex. Union minister of road transport, highways and shipping, Nitin Gadkari said that the government is working on the standards for bio-diesel usage. "In a couple of months, new standards will be in place," Nitin Gadkari also said. Haldi Port becomes the first green bio- diesel port in India. The minister visited Emami Agrotech Plant of Haldia, which will supply all the necessary bio-diesel required. In response, Aditya Agarwal, director of Emami Group, said, "In fact B50, B80 or even B100 worked wonders for tractors. They not only made agriculture cost-efficient, but made engines more robust, with least pollution. Fossil-fuel fumes are leaving the nation diseased. Moreover, the job potential is huge. Nagpur Municipality earns Rs 18 crore from sewage water as methane can be extracted from it. Nearly 100 buses are already running on bio-CNG in Nagpur. A massive question needs to be raised, why cannot other municipalities follow it? It is simplest way of turning the 'waste into wealth.' On global scale, governments have long sought to reduce petroleum import dependence, primarily to improve energy security and the balance of trade.

IV. CONCLUSION

Assuming that if biofuels route is taken for reducing greenhouse gas emissions from the transport sector, there is the environmental community that can and must do to minimize the environmental impacts of biofuels and maximise the climate change mitigation benefits. There are plenty of arguments regarding biofuel is curse or blessing. There are some important issues which need to be discussed and agreed.

It is very important to discover effective solutions to make sure that biofuels are sustainable, carbon reductions are maximised by optimized solution and dealing with the challenging situation of land use issues, especially indirect impacts.

It should be well researched and debated that if second generation/advanced fuels are the solutions for the future, what methods should be taken for sustainable development and to ensure that once the advanced technology is in market, it can avoid the lock-in to first generation fuels?

Stable and long-term policy framework should be created to increase the confidence of investor and allow for the sustainable expansion of biofuel production and also support and encourage international collaboration [8].

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