

Day 1

International Conference on Sustainable Biofuels 2018 "A joint event of Mission Innovation and Biofuture Platform" February 26-27th, 2018, New Delhi

Session Summaries

Session I: Opening Ceremony and Plenary Talk

Dr. Renu Swarup in her welcome address explained that India was one of the first few countries which joined Mission Innovation programme and she briefed the activities undertaken by India in all seven innovation challenges. Our partnering with the Biofuture platform further promotes engagement of the private sector and collaborative R&D. She also mentioned about the detailed action plan that India has chalked out for itself after discussions between the Department of Biotechnology and the Department of Science and Technology within the Ministry of Science and Technology, Government of India and in collaboration with other ministries. As a part of this the intensive Research and technology development as also human resource and capacity building that was initiated has yielded fruits with some technologies being now ready for commercialization. She emphasised that bilateral and multilateral corporations was a way forward to speed up the development and deployment of clean energy technologies.

Dr. Sarah Webb, Mission Innovation Secretariat, UK, stressed the need to spread the message of Mission innovation, its goals and targets. MI can help deliver a substantial boost in public-sector investment for R&D; increased private sector engagement and investment in energy innovation and greater awareness in the area of clean energy. She highlighted the progress made by the MI since its launch in 2015 and said that the MI commitment was half-way through its mission and hoped that there would be tangible outcomes by the time it ends.

Ambassador **Mr. J. Antonio Marcondes, Brazil** in his address congratulated Govt. of India for holding the conference and all the work being carried out in India on clean energy development. He emphasized the fact that scaling up of bioenergy is an undeniable issue and cannot be postponed any further. Different agencies are functioning relentlessly with many nations (IRENA, Below50, UNIDO, etc.) and have been able to raise awareness, promote dialogue and collaboration to bring about new policies to usher the carbon bioeconomy. He deliberated that the three factors that will help counter the challenges faced by the industry would be good market policies, effective research and development and the private sector investments and involvements.

Prof. Ashutosh Sharma, Secretary, DBT & DST, Ministry of Science & Technology, India, highlighted India's interest and progress in all the seven Mission Innovation Challenges and the country workshops organized by the DBT and DST in these challenges. He praised the willingness of investors and industries to take forward the leads provided by R&D community. He said that India will honor its commitments of Paris agreement and has already more than doubled Government spending on R&D in clean energy portfolio. India has already announced call for joint R&D proposals in Off Grid and smart grid innovation challenges and the response is very good. Calls for other areas will follow soon.

Dr V.K. Saraswat, Member NITI Aayog, in his key note address noted that collective wisdom of all participating countries can foster clean energy revolution. He further highlighted that this event will enable different countries to exchange their experience and share best practices for development and commercialization of advanced biofuels. More importantly, he emphasised that while developing alternative fuels, the scale and sustainability should be kept in mind. Dr Saraswat detailed the various possibilities of generation of Biofuels through biochemical and thermo-chemical routes. He noted that though several options are available but still there is need for intense R&D to bring down the costs to affordable levels.

Prof. Jack Saddler delivered the plenary talk on “Advance Biofuels: Pathways to decarbonise transport fuels”. He discussed the Biorefining concept which can help us move from a Hydrocarbon economy to a more sustainable carbohydrate based cleaner fuels. In his overview, he informed that the IEA was formed during the oil crisis with energy sustainability as the major driver, however over the years; the focus has been changed to environment/sustainability concerns.

Most of the biofuels are focussed on road transportation with bioethanol and biodiesel being used as blend components. With increasing focus on decarbonisation in aviation and shipping and long distance trucking, Drop-in fuels are gaining more focus. Finally summarizing his talk, he reiterated that the way forward was not quantification on the % blending we achieve, but how efficiently we are able to decarbonise our energy requirements. For this, we need to continue and expand our existing conventional biofuel options and make these more sustainable. We need to build up on multiple strategies for making drop-in fuels more efficiently and use oleo-chemical based drop-in biofuels as a bridge to lignocellulosic drop-in biofuels.

Session II: National Perspective on Sustainable Biofuel Innovation Challenges & Collaboration Opportunities

Session Chair: Ms. Sarah Webb.

Mr. Renato Godinho -Biofuture Platform discussed:

- 20 countries launched the Biofuture platform at COP22.
- Globally Bioenergy Consumption to increase 3 times by 2030.
- Country led model, leveraging of work of partner organizations.
- Released vision statement of biofuture platform includes that creating the conditions for scaling up the low carbon bioeconomy is both an urgent and vital challenge.

Mr. Arthur Milanez -Brazil: Brazilian Development Bank (BNDES)

- Spoke about the recent history of 2G ethanol in US, Europe and Brazil and current status.
- Spoke about public policy on 2G ethanol in Brazil and opportunities for collaboration at Brazil and partnership for R&D projects

Dr. Preto Fernando -Canada

- Canada's perspectives on Biofuel and MI program and about Canadian production of 1st generation and 2nd generation ethanol by industry.
- Clean fuel standard regulatory framework in Canada and government investments in clean technology.
- Need for collaborating with partner countries under MI program.

Prof. XU Jingliang - China

- Fuel Bioethanol production and development in China.
- Grain based ethanol production and status of advanced bioethanol plants in China
- Subsidies available in China for advanced bioethanol production.
- Casava based 200,000 tons/year Bioethanol plant at China.
- Also spoke about micro-algae based large scale cultivation.

Dr Sangita Kasture -India

- Explained the national Biofuel policy vision and mandate
- DBT Bioenergy roadmap vision 2020- different centre of excellence in Bioenergy, Fellowship program, creation of pool of 100 scientists and various network partners.
- Promote cutting edge research in synthetic and system Biology.
- Listed outcome of national workshop on sustainable Biofuels and that of stakeholder workshop conducted under MI

Session III: Technology development and the need for innovation

Session Chair: Prof. Shanmugam

Prof. Shanmugam identified the challenges for commercialization of 2G-ethanol such as variety and consistency of feedstock, collection and transport of feedstock, water and energy usage and the higher CAPEX/OPEX.

Prof. AM Lali, DBT-ICT centre presented the salient points of its technology, which is feed stock agnostic, for fractionation of biomass and subsequent conversion to ethanol. Very low dosage of enzymes and recycling of yeast are the major innovations. He informed that technology has been proven at 10TPD scale and now an order for 400TPD plant has been received.

The process for 2G ethanol developed by Ms Praj Industries was explained by **Dr. V. Joshi**. A multi-feed pilot at 12 TPD based upon this technology has been demonstrated to Oil companies and order for 400 TPD plant has been received.

The POET-DSM process was presented by **Dr. Hans Van der Hombergh** in which he shared some highlights of the commercial plant and also in the enzyme development.

Dr. SSV Ramakumar from Indian Oil Corporation discussed the three 2G-ethanol demonstration plants being set up at different parts of India with different technologies. He

also informed that IOC has decided to set up global first commercial plant for ethanol based on refinery tail gases on a fermentation technology offered by Lanzatech.

Dr. Jarmo Heinonen presented the biofuel perspective of Finland, which has over 80% of its area under forest, and thus has a strong experience in handling forest residues. He informed that Finland will achieve production of renewable Biofuel which will exceed the set target.

Session IV: Global Status of Biofuel Technologies & National Perspective

Moderator: Dr. Adam Brown

Mr. Duncan Akporiaye, Director, SINITEF Energy, Norway presented the lead talk and suggested that any bioenergy technology must pass the criteria of sustainability. Norway has target of 50% reduction of transport sector emissions by 2030 and for this all transport fuels will have 20% blending with Biofuels. There are research institutes and industry which are working on integrated biorefinery concept and on production of drop-in Biofuels.

Dr. Maria Georgiadou of European Commission explained the policy framework and different activities of promotion of Biofuels in Europe. EU members, under MI are increasing their R&D spend on development and deployment of clean energy technologies.

Mr. Miguel Ivan lacerda de Oliveira of ReNovaBio Brazil laid emphasis of LCA based evaluation of Biofuels for true CO₂ sequestration. Use of Biofuel electric hybrid could provide a solution.

Mr. Edgar Santoyo Castelazo, Ministry of energy, Mexico informed about the clean energy initiatives of Mexico. Mexico has a bioenergy Innovation cluster and roadmap which targets 35% clean energy in total electricity generation.

Mr. Gustavo Collar Benavente, Paraguay explained the growth of Biofuel industry in Paraguay and the legal framework in place to support bioenergy.

Ms. Maria, Councillor, Embassy of Sweden highlighted the great advances made in promotion of bioenergy in Sweden and that the energy mix presently has more than 50% renewable content. Sweden is involved in joint collaborative work with India on smart grid innovation challenge and is willing to work on sustainable Biofuel area as well.

Dr. Kees Kwant, IEA, The Netherlands highlighted the efforts made to facilitate commercialization of conventional and advanced biofuel. He also discussed the IEA roadmap with sustainable biomass supplies and commercialization of new technologies. A concerted international action has to be developed through MI.

Mr. Jeffrey Skeer/ Sakari Oksanen, IRENA, highlighted the emerging biofuel markets and feasibility of technologies. Adopting modern farming techniques and reduced food chain waste and losses can present a new foodstock for Biofuel production. Food vs fuel may get replaced with food and fuel only if new areas are brought under agriculture and better yield are obtained.

Dr. Gerard Ostheimer, Below 50/SE4ALL, explained the concept of Below50 (technology option for production of fuels which have at least 50% less carbon footprint). He highlighted the involvement of many companies which have shown commitment for at least 50% emission reduction in their operations. Below 50 will also explore more opportunities with Indian companies.

Day 2

Session I: Sustainable Biofuels- Technology Scale up Opportunities

Moderator: Dr. Anjan Ray

Mr. Pasi Rouso, President, Chempolis introduced sustainable biorefining technologies developed by Chempolis which is actively engaged in overcoming obstacles in 2G ethanol scale up technology. He said that Formicobio™ technology developed by Chempolis offers almost complete dissolution of lignocellulosic biomass to separate lignin from cellulose and improves the overall economics of hydrolysis. While a standard approach may not work in all scenarios, the availability of technology, state of art engineering, equipment, partners and global co-operation are essential for a successful commercial plant.

Mr. GS Krishnan, President, Novozymes (India) highlighted that there is an important role for technology and enzymes to develop alternative sources for fuels. Highlighting the complexities in bio-ethanol production, the future lies in providing customized solutions and working closely with industry partners for faster solution to 2G ethanol challenges. Novozyme has worked extensively in bringing down the cost of enzyme for 2G ethanol industry and works closely with commercial facilities worldwide. Local enzymes production will enable further cost improvements over time.

Mr. Anil Pande from Hindustan Petroleum Corporation Limited highlighted the initiatives being taken by HPCL to set up four large 2G ethanol plants in India. He emphasized on the need to streamline supply chain management of biomass. Factors critical for the success of 2G ethanol plants in India include educating farmers and their active involvement, technology development, addressing issues involving consumables as chemicals, enzyme, water etc, and lastly, feedstock diagnostics and management.

Ms. Myrsini Christou, Centre for Renewable Energy Sources and Saving (CRESS), Greece talked about challenges in supply chain and feedstock issues. The biomass supply should be streamlined, regularized, be affordable and sustainable. For the India scenario, harvesting period window is very small, and thus logistics should be planned accordingly. Farmer's active participation is also very important to get good quality feedstock throughout the year.

Dr. DK Tuli, DBT Bioenergy Chair, emphasised that 2G ethanol industry would soon be reality in India. He added that enzyme cost has come down by several fold and technology has also advanced in recent years however he added that challenges are there to reduce the cost as feedstock available in India is diverse and dispersed, logistics of raw material is another challenge and water recycling is must. He listed five hotspots that need to be taken care of for success of 2G bioethanol industry.

Dr. Syed Shams Yazdani from ICGEB talked about the challenges faced by enzyme developers in cellulase production for 2G ethanol industry. He talked about the role of DBT-ICGEB centre for advanced bioenergy research in enzyme development. He stressed upon the role of increasing both quality and quantity of enzyme on cost reduction of 2G ethanol. He described a potential enzyme developed in his centre which exceeds the performance of best commercial enzymes.

Session II: Advanced Biofuel Options

Moderator: Mr. Preto Fernando

The first lead talk was delivered by **Dr. Jennifer Holmgreen (CEO, Lanzatech)**. The key points stressed were:

- Need to bring down emissions by carbon recycling technologies
- Gas Fermentation Technology which can convert CO and CO₂ to ethanol
- MSW gasification followed by Syn gas microbial fermentation to ethanol
- Commercial plant in a IOC refinery to produce ethanol from refinery gases
- Collaboration with IOCL from CO₂ to acetate to oil containing ω-fatty acids
- Production of Aviation fuel from ethanol

Prof. P Wangikar: PAN-IIT discussed on :

- Cyanobacterial Fuel
- Algal fuels
- Process engineering
- Photobioreactor design and fluid dynamics
- Enzyme engineering for glucosidase to make it more tolerant at high temp and pH

Mr. Ramesh Bhujade, Reliance Renewable India, explained though a significant progress has been made in algal technology, it still needs refinement before algal based fuels become sustainable. He explained, RW3 (Reliance wet waste to wealth) technology which involves Catalytic hydrothermal liquefaction (HTL) of wet Algal Biomass to oil or Drop-In Biofuels.

Mr. Ivo Fouto (Chief Executive Officer, Cenerbio, Brazil) noted that

- Energy Cane (Sugarcane genetically improved by regular, non-transgenic breeding programme) because of very high CO₂ capturing capability is of great interest.
- Presented Life Cycle analysis comparison of Energy cane based ethanol
- Energy cane has better energy content and India may find it as suitable option

Dr. Laxmi Narasimhan, Shell India discussed advantages of IH2 technology like:

- True multi-feed technology
- Drop-in fuels from waste biomass through integrated hydrolysis
- In municipal waste, no need to remove the plastics, it can be co-processed.
- Scalable technology, energy recovery of 72% and very good GHG reduction
- Energy recovery 72%

Mr. Dave Cepla, Honeywell UOP, USA said that:

- Honeywell UOP has created knowledge through Invention and Innovation and applied it to the energy industry for 100+ years.
- 60% of world gasoline, 70% of PET bottles, and 90% of biodegradable detergents are produced through UOP Technology.
- Two renewable technology portfolio: Inedible oil/Animal fats to green diesel and jet and Biomass to green fuels through rapid thermal pyrolysis (RTP) are commercial
- FCC co-processing with biocrude is a breakthrough technology to produce sustainable cellulosic derived transportation biofuels.

Session III: Policy support for commercialization

Chair: Dr. Renu Swarup

Co Chair: Jose Antonio marcondes de Carvalho, Ambassador, Ministry of Foreign Affairs, Brazil.

Mr. Rasmus Valanko, (WBCSD, Switzerland) spoke about the need for collaboration between different government supported programmes on R&D for advanced Biofuels. The most important factor to promote Biofuels on very large scale is to bring down their production cost through innovations and then provide a proper policy framework to create markets.

Mr. Plinio Nastari (Brazil) emphasised on policy support for commercialization and explained of Brazilian Renovio programme which classifies fuels according to their LCA footprints. Brazil has in place good pipeline system to transport E27 gasoline fuel and specifications of Biofuel containing fuels are in place.

Ms. Maria Georgiadou (European Commission) discussed about the legislations and directives at force at European commission which provide support to Biofuels. Commercialization of technologies through European investment banks and funds/ grants under Horizon 20:20 are available to industry.

Mr. YB Ramakrishna (India) discussed about the ethanol blending programme for transport gasoline in India. 1G ethanol is simply not able to meet the mandate of 10% blending of gasoline and hence Government has drawn up a big programme to develop 2G ethanol from agricultural waste and 12 such plants are likely to come soon. Potential sources of biodiesel such as used cooking oil are under evaluation. Indian Government will soon declare its new Biofuel policy including the support mechanism for 2G ethanol.

New Delhi Declaration

Based upon the intense pre-conference discussions between the MI co-leads countries (India, Brazil, China and Canada) and Biofuture Platform facilitator, a draft New Delhi Declaration on Sustainable Biofuel was prepared. Subsequently the modified draft was shared with MI countries, Biofuture countries and with IEA and IRENA, several useful suggestion were made to make the New Delhi Declaration more effective and focused.

On 26th Feb, a closed door meeting of MI IC#4 leads, members, and Biofuture members attending the conference, was held where the final draft of New Delhi Declaration was adopted. This declaration is available at <http://mission-innovation-india.net/new-delhi-declaration/>

The Delhi Declaration reaffirms the commitment for joint R&D, encourage collaborations, data sharing and dissemination of best practices. It also calls for achieving innovative breakthrough and cost reduction of biofuels with enhanced private sector investments. International exchange of researches and students is also mentioned in the New Delhi Declaration.

Major Recommendations of the Conference on Sustainable Biofuels

The two day deliberations in the conference led to clear consensus which is:

- Scaling up of bioenergy is an undeniable issue which cannot be postponed any further
- Continued dialogue and collaborations will result into appropriate policies for assuring low carbon bioeconomy
- Private sector engagement is essential for large scale commercialization of biofuels
- While developing alternate fuels the scale and sustainability factors must be considered
- Apart from biofuels, drop-in fuels are gaining more focus
- Rather than emphasis on quantity of biofuel produced, their ability to decarbonise is more important.
- Lignocellulosic ethanol has already seen fair degree of commercialization and continued innovations are resulting in cost reduction
- The 2G ethanol technologies should be feed agnostic
- Availability of sustainable feedstock in required quantities still need attention
- Individual country led models are the ideal solutions and no single model can be best option for all countries
- While food versus fuel remains the guiding principle, some countries with vast land can also consider food and fuel model
- Enzymes and yeast have seen huge development and several institutes have developed suitable molecules applying synthetic and system biology
- India has two platform technologies for production of 2G ethanol, both technologies are proven on large pilot scale and are available for large commercial plants
- Ethanol based on gas fermentation has already seen commercialization using waste industrial gases
- Nordic countries like Norway, Sweden and Finland have made very good progress for producing biofuels based on their abundant forest resource
- IEA and IRENA have studied several models for sustainable production of low carbon fuels
- Below50 has been able to involve some large companies which have shown commitment for at least 50% reduction in emissions

The major way forward actions:

- Need for collaborative research and development in sustainable biofuels for cost reduction
- Exchange of best practices for speedy commercialization
- Appropriate policies for market development and support to sustainable biofuel industry
- Involvement of private sector and investors
- Classification of biofuels based upon their life cycle footprint
- Exchange of researchers and innovators between member countries
- Public funding support for national, bilateral and multilateral collaborations on identified objectives

Major Deliverables/ outcomes of the conference

The conference led to:

- Clear understanding of current developments in bioeconomy made by participating countries and exchange of best practices
- Increased awareness among the policy makers about the aspirations of investors and industry for large scale commercialization
- Enhanced understanding about country specific collaborations
- Establishing direct contact between researchers/ industry/ investors of different countries

