SAHYOG Stakeholder Workshop
EU – India Cooperation on Biomass and Bio-waste Research and Development

6th June 2013, 13:30 – 18:00

Bella Center, Room 17, Copenhagen, Denmark

on the occasion of the 21st European Biomass Conference and Exhibition

Workshop Summary

The SAHYOG Project

The objective of the SAHYOG project is to actively and effectively link research activities implemented within EU research programmes and related programmes by Indian national institutions in the fields of biomass research and bio-waste conversion to prepare a Strategic Research Agenda and a roadmap for the advancement of RTD with mutual benefits.

Within SAHYOG broad networking of respective scientific and industry communities, twinning of large sets of research projects, as well as short term exchange visits of researchers are implemented.

Based on SAHYOG findings, RTD Roadmaps are elaborated through consultation with stakeholders at the governmental, research and industrial level that present a concerted planning of future research initiatives in the area of biomass production and bio-waste conversion.

This coordination activity is of large importance to systematically bridge the on-going respective activities from India and Europe that help providing the basis for novel applications in a sustainable bio-economy of the future – the so-called knowledge based bio-economy (KBBE).

SAHYOG is supported by the European Commission within the 7th Framework Programme (FP7-289615) and by the Department of Biotechnology (DBT) of the Indian Ministry of Science and Technology. It is coordinated by the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) and The Energy and Resources Institute (TERI) from India, and the consortium includes 7 partners from Europe and 6 partners from India.

The SAHYOG Consortium

- ENEA – Italian National Agency for New Technologies, Energy and Sustainable Economic Development, Italy (EU Coordinator)
- TERI – The Energy and Resources Institute, India (Indian Coordinator)
- ARTI – Appropriate Rural Technology Institute, India, Pune
- CSIR – Council for Scientific & Industrial Research, India
- CSIR – Council for Scientific & Industrial Research – Indian Institute of Chemical Technology (IICT)
- DLR – Deutsches Zentrum für Luft – und Raumfahrt e.V., Germany
- GB Pant University of Agriculture & Technology Pantnagar, India
- Jawaharlal Nehru University, India
- National Technical University of Athens, Greece
- NL Agency – Ministry of Economic Affairs, Agriculture and Innovation, The Netherlands
- Tezpur University, India
- VITO – Vlaamse Instelling voor Technologisch Onderzoek, Belgium
- Wageningen University and Research Centre – Food and Biobased Research / Wageningen International, The Netherlands
- WIP Renewable Energies, Germany

The SAHYOG Coordination

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Workshop Objectives

In this workshop activities and findings of the SAHYOG project were discussed with international stakeholders. Furthermore, project participants from India presented an overview of current research and development initiatives in the field of biomass and bio-waste in India.

Workshop Organisation – Workshop Summary

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Workshop Details

Conference Venue:	*Bella Center, Room 17, Copenhagen, Denmark* *on the occasion of the 21th European Biomass Conference and Exhibition (EU BC&E) in Copenhagen, Denmark on 3-7 June 2013*
Conference Language:	*English*
Project website:	*www.sahyog-europa-india.eu*

All workshop presentations are available at:

http://www.sahyog-europa-india.eu/stakeholder-workshops/2-uncategorised/57-sahyog-stakeholder-workshop

Workshop Summary

Opening Session

After a brief welcome to this SAHYOG Stakeholder Workshop ”EU – India Cooperation on Biomass and Bio-waste Research and Development” by **Rainer Janssen from WIP Renewable Energies**, the workshop was officially opened by **Jean-Francois Dallemand from the Joint Research Centre (JRC) of the European Commission**.

Mr. Dallemand underlined the importance of strong international networking in the field of biomass and bio-waste as well as the development of joint Strategic Reseach Agendas and action plans for future implementation of renewable energies worldwide. Such strategic documents should build upon existing work such as technology roadmaps published by the International Energy Agency (IEA). Thereby, it is important to acknowledge that policy drivers for biomass and bio-waste research and development may be different in India and Europe, with rural development and innovation most likely being key drivers in India. Finally, existing experience in India (such as research on Jatropha) should be identified and made available for other countries within South-South cooperation partnerships.

Neeta Sharma from ENEA, EU SAHYOG coordinator, presented an overview of the objectives and highlighted the main activities of the SAHYOG project.

She presented the first results of the work carried out to prepare the SAHYOG Inventories on the Biomass and Bio-waste Resource Potential in Europe and India.

Inventories of biomass and bio-waste potentials and research projects/programs elaborated and analysed within SAHYOG are the basis for the joint Strategic Research Agenda (SRA) finally leading to a Roadmap for policymakers and researchers. SAHYOG also ensures wide-range networking of relevant industries and scientific communities and establishes linkages between on-going research and innovation projects from EU, India and other countries. In order to do this and for the widespread communication of project activities and results, Dr. Sharma explained the program of the SAHYOG networking events (such as Twinning of projects from India and Europe, Short-term Exchanges of junior and senior researchers and Summer Schools in Europe) planned for the year 2013.

Biomass and Bio-Waste in India and Europe

In his presentation on “Sustainable Biomass Supply in India”, **Priyangshu Sarma from TERI**, Indian SAHYOG coordinator, underlined that currently 32% of the total primary energy use in India is still derived from biomass and more than 70% of the country’s population depends on biomass to cover its energy needs. Today, the availability of biomass in India is estimated at about 500 million metric tons per year. Modern biomass use thereby mainly includes the sugar industry which has been traditionally practicing cogeneration by using bagasse as a fuel as well as thermo-chemical conversion processes such as combustion, gasification or pyrolysis.

With respect to the development of a future bio-based economy in India the country will mainly have to rely on its considerable potential of agricultural residues whereas additional land resources for the cultivation of energy crops does not readily exist and priority of land use needs to be reserved for food production. In general, the Indian biomass resource base includes non-food energy crops (e.g. Jatropha, Karanja, Neem), forest resources and residues (e.g. pine needles, bamboo), agricultural residues (rice husks, stalks, wheat straw, groundnut shells), as well as wastes (e.g. Municipal Solid Waste, Kitchen waste, livestock waste). Furthermore, the use of sugar cane (residues) and sweet sorghum for energy production is also regarded as promising opportunity.

A recent study estimated that urban India generates 188,500 tons per day (68.8 million tons per year) of Municipal Solid Waste (MSW) at a per capita waste generation rate of 500 g per person per day. With regards to livestock waste the 283 million bovine animals generate about 1,250 million tons of manure per year whereas the 500 million poultry stock accounts for about 10 million tons of manure per year.

However, one of the main barriers to enhanced biomass and bio-waste use in India is the lack of central databases for biomass/bioresources in India. Furthermore, residues from the abundant SME based processing industries (e.g. sawmilling, woodworking, furniture industry, pulp and paper industry, food and fruit processing and fishery) are not well documented and due to current government policies it is forbidden to use forest resources, even for non-timber applications.

Kees Kwant from NL Agency started his presentation on “Biobased Economy in Europe and India” with the following definition: *A Biobased Economy is a sustainable economy, optimising economic value and natural value of biomass by replacing fossil resources*. Within the biobased economy the sustainable production and use of biomass will respect the following “triple P”:

- *People*: food security, land rights, prosperity
- *Planet*: soil, water, air, GHG, biodiversity
- *Profit:* business cases

The economic value creation pyramid of the biobased economy involves high-value, low-volume products for the pharma and fine chemicals industry, food and feed products, commodity and bulk chemicals as well as low-value, high volume products such as transport fuels, electricity and heat. For the future development of a biobased economy, biomass will need to replace fossil resources for a large variety of applications and agriculture will need to focus on the supply of food and chemicals. Furthermore, focus shall be placed on establishing a circular economy and making best use of existing waste streams.

In the SAHYOG project an inventory of biobased research projects in Europe and India has been elaborated which is available at the fully searchable on-line database under: http://www.sahyog-projects-database.eu/. The projects have been categorised with respect to the focus of research (i.e. biomass resources, agricultural activity, conversion technology, end products), the involved stakeholders (type of research, type of organisation), as well as the drivers for research. With this database, twinning of specific research activities between actors from Europe and India as well as the general EU-India cooperation for the realisation of a sustainable biobased economy shall be supported

In his presentation on ”Sweet Sorghum Valorisation in India” **Srinivas Rao from ICRISAT** presented activities and results achieved within the EU project SWEETFUEL (Sweet Sorghum: An alternative energy crop, www.sweetfuel-project.eu). SWEETFUEL aims to exploit the advantages of sweet sorghum as potential energy crop for bioethanol production with the main objective to optimize yields in temperate, sub-tropical and tropical regions by genetic enhancement and the improvement of cultural and harvest practices.

The energy crop sweet sorghum (*Sorghum bicolor* L. Moench) is raising considerable interest as a source of either fermentable free sugars or lignocellulosic feedstock with the potential to produce fuel, food, feed and a variety of other products. Sweet sorghum is a C4 plant with many potential advantages, including high water, nitrogen and radiation use efficiency, broad agro-ecological adaptation as well as a rich genetic diversity for useful traits. For developing countries sweet sorghum provides opportunities for the simultaneous production of food and bioenergy (e.g. bio-ethanol), thereby contributing to improved food security as well as increased access to affordable and renewable energy sources.

In India, two different sweet sorghum value chains are investigated, a centralised and a decentralised model for semi-arid tropical climates. For the decentralized ethanol production system, the whole production chain is realized at village level, namely the cultivation and harvesting of sweet sorghum, the milling of the stalks to produce juice, and the processing of the juice into ethanol. Thereby, this system provides maximum value creation and benefit at village level. Alternatively, for centralized ethanol production merely the cultivation and harvesting of sweet sorghum is performed at village level. After harvest, the sweet sorghum stalks are transported from the villages to centralized ethanol facilities.

Unfortunately, due to unfavourable policy framework conditions in India ethanol production from sweet sorghum is currently not economically viable. Recently, better progress was achieved in Brazil, the Philippines and China. Nevertheless, it is expected that sweet sorghum will increasingly contribute to the production of food and bioenergy within a future more sustainable global agricultural system.

As case study for the valorisation of bio-waste in Europe **Michael Köttner from IBBK Fachgruppe Biogas** gave a presentation on ”The Industry of Bio-waste Digestion in Europe, Feedstocks, Costs and Benefits”. In 2013 more than 7,800 (agricultural and communal) biogas plants are in operation in Germany with an installed electrical capacity of 3.4 GW and a power production of 22.63 billion kWh sufficient to provide electricity for about 6.5 million households. Currently, 850,000 ha of agricultural land are used for the production of energy crops for these biogas plants and the employment created is estimated at 40,000 jobs. Feedstock for biogas production in Germany is mainly energy crops (46.2%), followed by animal waste (23.9%), and agricultural residues (15.4%), with landfills, organic household waste, sewage sludge, organic industrial

waste, and landscaping contributing to a lower extent. However, recently the German Renewable Energy Act (Feed-in Law) has been modified to reduce the use of energy crops as feedstock for biogas plants while increasing the use of bio-waste, and to promote the use of heat in co-generation (CHP) installations.

Mr. Köttner presented several treatment technologies for bio-waste dry fermentation such as the continuous processes implemented by Linde KCA/Strabag, DRANCO, and Kompogas, and several discontinuous process technologies. The latter includes the widely used garage type digestors, simultaneous wet-dry digestion processes, and solid matter immersion processes, as well as the more innovative plastic tube reactors.

Finally, Mr. Köttner highlighted important economic success factors for bio-waste dry fermentation systems, such as continuous supply of suitable substrates, long-term waste supply contracts (including revenues from waste disposal fees), access to electricity grids at reasonable feed-in tariffs, as well as the posssibility to use excess heat from CHP units and to create revenues from compost or dried digestate sales.

SAHYOG Strategic Research Agenda (SRA) for India and Europe

One of the main objectives of the SAHYOG project is to prepare a joint Strategic Research Agenda (SRA) and a RTD roadmap on biomass and bio-waste for India and Europe.

The current status of the SAHYOG SRA on biomass and bio-waste from a European perspective was presented by **Ludo Diels from VITO**. In our fast growing and developing world the main drivers for the biobased economy are environmental problems, climate change, scarcity of resources, and the decrease in biodiversity. Mr. Diels presented the new production oriented value chain focussing on food products, biobased products, and existing non-food-products (see Figure 1).

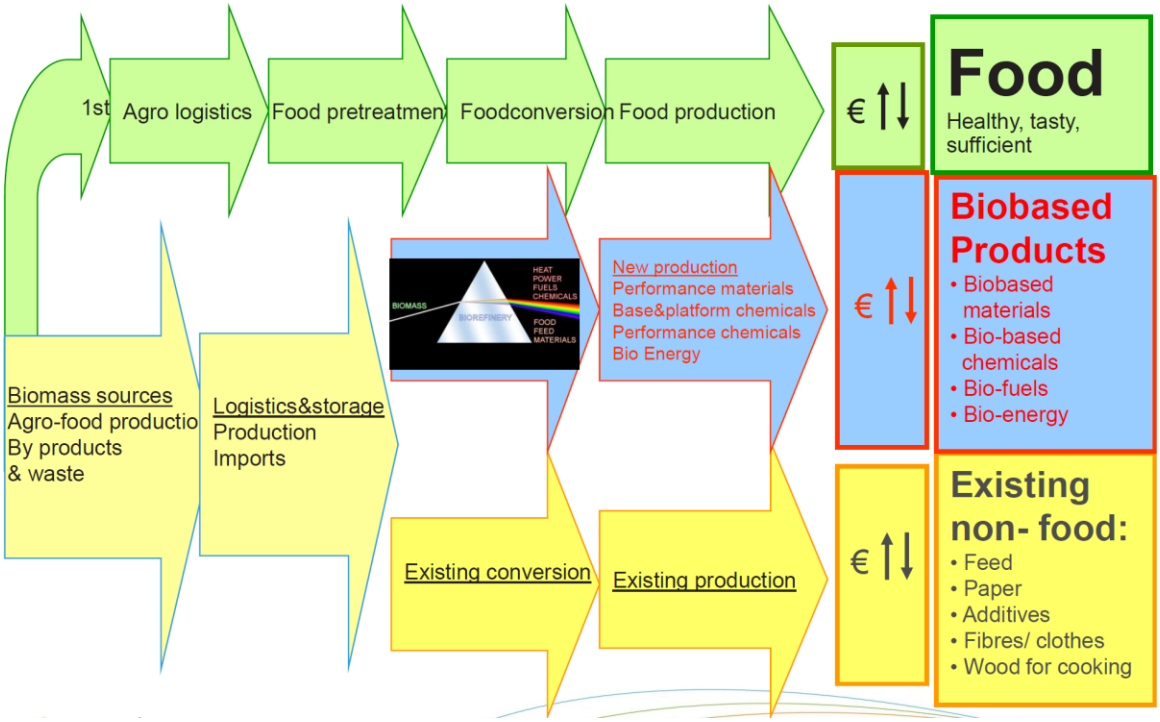

Figure 1: New product oriented value chain for the biobased economy

Today it is widely agreed upon that the economic value creation pyramid of the biobased economy involves high-value, low-volume products as well as low-value, high volume products as displayed in Figure 2.

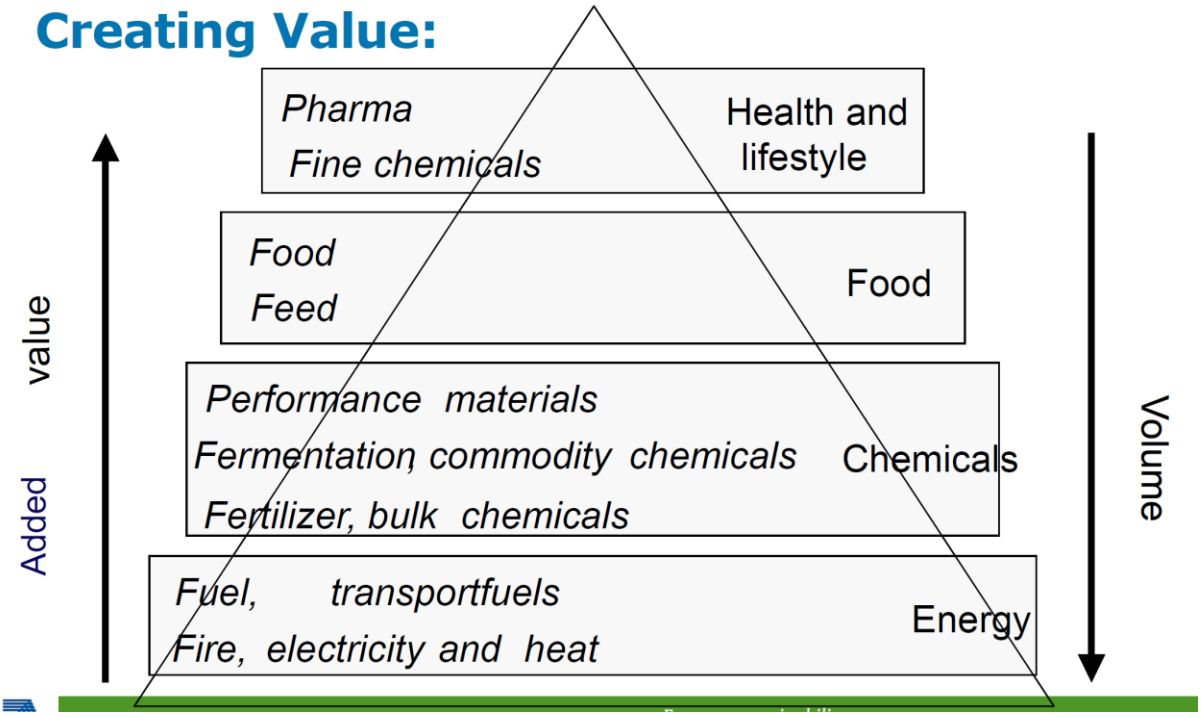

Figure 2: Value creation pyramid of the biobased economy (Source: K. Kwant)

The following needs and challenges in Europe serve as basis for the SAHYOG vision towards a future biobased economy. In the field of ***biomass production*** focus shall be placed on highly intensified agriculture, extension in Eastern Europe, multipurpose crops for biorefineres, wood & forest based biomass, as well as existing limited biodiversity. In the field of ***biorefineries*** main challenges remain on integrated concepts and value chains, process intensification, the identification of functionalised molecules, as well as waste and environmental management. Finally, with respect to ***markets and policies*** focus shall be placed on the promotion of recycling and cascading use of biomass as well as on certification of sustainable biomass and bio-waste resources.

Thereby, the SAHYOG SRA will build upon the vision document put forward by the ***Public Private Partnership on Biobased Industries – BRIDGE 2020*** (Biobased and Renewable Industriesfor Development and Growth in Europe). This vision document sees bio-based industries as core part of the bio-economy holding the potential to decouple economic growth from resource use while leading the transition towards a post-petroleum society. The BRIDGE industry vision is to use renewable resources, bio-waste and side streams as the major input source for materials, food and feed ingredients, fuels and chemicals, maximizing the added value along the value chains. At the centre of this vision, bio-refineries will gradually replace oil-refineries, by sustainably processing biomass into a spectrum of marketable products and energy.

The Indian perspective of the SAHYOG SRA on biomass and bio-waste was presented by **Neera Bhalla Sarin from JNU** and **Priyangshu Sarma from TERI**. It was reported that India's energy demand is on the rise, driven by high population growth, the modernization of lifestyles, higher electrification and fuel rates and a rapidly growing economy. Annual growth in energy demand reached 8% recently, doubling the historical average annual growth rates of the past 30 years. With GDP expected will grow at rate of 6.7 per cent in 2013-14 and energy demand expected to nearly double by 2030, India is set to surpass Japan and Russia to become the world's third largest energy consumer after the U.S. and China. This in turn will increase the GHG emissions by roughly three or four fold compared to 2005 levels with the power sector being the key driver of GHG increases. Despite India's rapid economic development 70% of the population still lives in rural areas and around 50% of the population is employed in agriculture, accounting for 16% of GDP.

Today, India is strongly dependent on imported fossil fuels to cover its energy demand and thus suffers from their high and increasing costs. Power generation from renewable sources currently accounts for about 20 GW (10% of total) with biomass contributing 2.6 GW. India's total biomass potential, however, is estimated at 18-23 GW, at least six times more than the current installed capacity. The majority of the biomass generated in India comes from the agriculture sector with significant untapped potential existing from bio-wastes.

Mr. Sarma reported that the current factors constraining the development of the biobased economy in India include an inadequate focus on biomass availability and supply chains, low feed-in tariffs and procurement prices, as well as inadequate appreciation of social and environmental benefits.

With respect to increased feedstock availability in India, the following goals have been identified for the short, medium and long term.

Short term

- Agriculture intensification
- Production site selection
- Supply chain management
- Better involvement of marginal farmers in supply chains

Medium term

- Adequate national policy for supply and procurement of biomass
- Improved logistics, handling and storage facilities
- Reduction of post-harvest losses
- Emphasis on diversified agriculture crops (millets, sorghum) i.e. semi-arid and dry land agriculture

Long term

- Consideration of the potential of unexplored crops/biomass
- Procurement plan for zero waste
- Improved investment strategies and marketing plans
- Value chain development for biobased molecules and compounds

The current Indian vision on biorefineries, as stated in India's Twelfth Five-Year (2012-2017) Plan, underlines the importance of biorefineries using agro-wastes as source for the production of energy and biomaterials. Thereby, biorefineries should be capable of sustainably producing a wealth of marketable products and energy. In the near future biorefinery systems in India will have a focus on the production of biofuels for transportation due to the present shortage of fuels and the lack of alternatives in this sector.

Existing policies in the biomass field comprise the National Policy on Biofuels notified by the Government in December 2009, which laid down detailed guidelines about introduction of bio-fuels. This policy includes an indicative target of 20% blending of biofuels both for biodiesel and bioethanol by 2017, promotion of biodiesel production from non-edible oilseeds on waste, degraded and marginal lands, and a Minimum Support Price (MSP) to be announced for farmers producing non-edible oilseeds as biodiesel feedstock.

Based on the current established first generation technologies for the production of biodiesel and bioethanol the Indian national programme on energy biosciences strongly promotes R&D on lignocellulosic ethanol and algal biofuels (for which pilot and demonstration units exist) as well as cutting edge technologies such as biobutanol and biohydrogen.

In conclusion, in order to make use of its large biomass and bio-waste potential, Indian Government entities need a coordinated and holistic approach as well as harmonised value chain based strategies to decrease the risks in investing in biobased industries. Furthermore, farmers need to be better informed about opportunities offered by the biobased economy and better motivated to increase their production and to make available existing bio-waste resources.

Panel Discussion on SAHYOG Strategic Research Agenda (SRA)

Guided by the moderators **Neera Sarin from Jawaharlal Nehru University** and **Robert Bakker from Wageningen UR** and the panellists **Srinivas Rao from ICRISAT, Kathy Elst from VITO** and **Dominik Rutz from WIP Renewable Energies**, the following main recommendations were discussed for the further development of the SAHYOG Strategic Research Agenda (SRA):

- Great care needs to be taken with respect to terminology and definitions used in the SAHYOG SRA. Existing terminology and definitions shall be used such as those from the EC bio-economy strategy.
- The drivers for the biobased economy need to be clearly stated in the introduction to the SRA.
- Thereby, it is important to emphasize that drivers are certainly different in India with respect to the EU, with food and energy security being the main drivers and no policies currently exist for the biobased economy in India.
- As biofuel production from non-food feedstock on marginal land will be one of the main priorities in India, a specific RTD focus shall be placed on sustainable resources from marginal lands (e.g. perennial crops, grasses).
- Further stakeholder consultations are needed for the completion of the SAHYOG SRA.

Annex 1 – Workshop Agenda

Thursday, 06 June 2013

13:30 *Registration*

14:00 **Welcome to the Workshop**

RAINER JANSSEN, WIP RENEWABLE ENERGIES, GERMANY

14:10 **OFFICIAL OPENING ADDRESS**

JEAN-FRANCOIS DALLEMAND, JOINT RESEARCH CENTRE (JRC), EUROPEAN COMMISSION

14:30 **SAHYOG Activities and Results**

NEETA SHARMA, EU COORDINATOR SAHYOG, ENEA, ITALY

14:40 **Sustainable Biomass Supply in India**

PRIYANGSHU M SARMA, IN COORDINATOR SAHYOG, TERI, INDIA

15:00 **The European Bio-based Economy**

KEES KWANT, NL AGENCY, THE NETHERLANDS

15:20 **Case Study: Sweet Sorghum Valorisation in India**

SRINIVAS RAO, ICRISAT, INDIA

15:35 **Case Study: Valorization of waste in Biorefineries in Europe**

MICHAEL KOETTNER, IBBK FACHGRUPPE BIOGAS, GERMANY

15:50 *Coffee/Tea Break*

16:30 **Presentation of the joint SAHYOG Strategic Research Agenda for India and Europe**

NEERA BHALLA SARIN, JAWAHARLAL NEHRU UNIVERSITY, INDIA
PRIYANGSHU M SARMA, TERI, INDIA
LUDO DIELS, VITO, BELGIUM

17:00 **Panel Discussion on the SAHYOG Strategic Research Agenda**

MODERATION:

NEERA BHALLA SARIN, JAWAHARLAL NEHRU UNIVERSITY, INDIA
ROBERT BAKKER, WAGENINGEN UR, THE NETHERLANDS

PANNELISTS:

SRINIVAS RAO, ICRISAT, INDIA

KATHY ELST, VITO, BELGIUM

DOMINIK RUTZ, WIP RENEWABLE ENERGIES, GERMANY

17:50 **Summary**

PRIYANGSHU M SARMA, TERI, INDIA

18:00 *End of the workshop*

Annex 2 – List of Participants

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