PROJECT INVENTORIES and SHORT-TERM EXCHANGE PROGRAM (INDIA)

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Short-Term Exchange Program (STE)

- **CSIR-IICT was involved in organizing STE program for junior experts in the field of biomass and biowaste conversion and bioenergy production.**

- **The objective of STE is to strengthen the inter-regional exchange and to enhance the networking and exchange of young talents in Europe and India in the field of biomass and biowaste.**

EUROPE	INDIA
International Bureau of the Federal Ministry of Education and Research at the Project Management Agency c/o German Aerospace Center (DLR)	CSIR - Indian Institute of Chemical Technology

CSIR-IICT

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- **A call addressing the junior experts on objective of STE was proposed and published in March 2013 on the website.**

- **The Young European researchers were invited to visit renowned research facilities in INDIA.**

- **The hosting institutes for EU researchers included**

Hosting Institute	Place
TERI	New Delhi
CSIR-IICT	Hyderabad
GBPUAT	Pantnagar
JNU	New Delhi

Researchers from different parts of EU were selected for STE in India

Name of the researcher	University/Institute
Neeta Sharma	EU-Coordinator, SAHYOG, ENEA, Italy
Hans Westphal	DFG, Germany
Zsolt Barta	Budapest University of Technology, Hungary
Joe Bennett	University of York, UK
Sebastian Riedel	IPK Fraunhofer Institute, Germany
Carla Ferreira	LNEG, Portugal
Axel Funke	KIT, Germany
Gianpaolo Sabia	ENEA, Italy

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Invitation letters

Strengthening networking on biomass research and biowaste conversion-biotechnology for Europe India Integration (SAHYOG)

Short-term Exchange Programme proposal

SAHYOG Contact for Short-term Exchanges

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Department of Biotechnology
Ministry of Science & Technology,
Government of India

SEVENTH FRAMEWORK PROGRAMME

ORGANISATION
NAME
ADDRESS
COUNTRY

Place, Date

Invitation to participate in India-EU SAHYOG Short-term Exchange of researchers

Dear,

We would like to cordially invite NAME/ORGANISATION to participate in SAHYOG's Short-Term Exchange Programme.

SAHYOG (Strengthening Networking on Biomass Research and Bio-waste Conversion - Biotechnology for Europe India Integration) is supported by the European Commission within the 7th Framework Programme and by the Department of Biotechnology (DBT) of the Indian Ministry of Science and Technology. The main aim of the project is to bring together leading organisations that are actively carrying out research in the field of biomass production and bio-waste conversion within EU research programmes and Indian national institutions.

To enhance the networking and exchange of young talents in Europe and India in the field of biomass and biowaste a call for proposal addressing junior experts is published in March 2013. The winners are awarded for their outstanding academic records and their innovative and creative ideas in a relevant field of research. German as well as Indian experts select appropriate to visit renowned research facilities of their respective field of research in the partner country. The duration of the visit is around one week and is fully financed by SAHYOG. Therewith they will have the unique opportunity to gain first hand insights of the respective country's research landscape, make contacts and build new networks.

We would like to invite NAME/ORGANISATION to participate in the short-term exchange programme and host one of the selected European young researchers at your organisation for about one week in fall 2013. The programme for the visit might include a guided tour through your laboratories and facilities, presentation of respective research projects at your institution, a possibility for the awardee to present his research as well as a chance to exchange ideas.

If your organisation is willing to participate in the programme we would like to ask to fill in the attached letter of interest. After confirmation your organisation will be recognized with a short article on the SAHYOG website and you will be informed about the European young research visiting your institution.

We hope that NAME/ORGANISATION will accept this invitation to join the SAHYOG short-term programme and we look forward to this cooperation opportunity.

Best regards,

Dr. Neeta Sharma
ENEA, Italy
SAHYOG Coordinator

Dr. Priyangshu Manab Sarma
TERI - The Energy and Resources Institute
SAHYOG Coordinator India

SAHYOG Project

The increasing global demand for energy has led to scarcity of resources, climate change, environmental problems and a reduction in biodiversity. The Europe 2020 strategy tackles these problems by turning them into the challenge of implementing smart, inclusive and sustainable growth. As biomass and bio-waste are the most efficient and abundant renewable resources forming the basis for such an economy, biotechnology in the broad sense is one of the key technologies in this context. India is also recognising this key point with its National Action Plan for Greenhouse gas mitigation focusing on solar energy and renewable biomass. This lays the foundation for an EU-India partnership in a key area of interest of both the regions.

The main aim of the project is to actively link leading organisations in the field of biomass production and bio-waste conversion research carried out within EU research programmes and related programmes by Indian national institutions. All activities conducted within SAHYOG have the objective to contribute to a joint Strategic Research Agenda (SRA) finally leading to a roadmap for Indian and European policy makers and researchers, paving the way for a sustainable European Indian cooperation in the field of biomass production and bio-waste conversion.

SAHYOG-Short-Term-Exchange

Connecting young researchers is an important pillar for a sustainable and long-term cooperation. To enhance the networking and exchange of young talents in Europe and India in the field of biomass and biowaste, a call for proposal addressing junior experts is published in March [illegible]. The winners are awarded for their outstanding academic records and their innovative and creative ideas in a relevant field of research. With this component SAHYOG seeks to increase international cooperation in order to jointly contribute to the development of innovative ideas and solutions in the field of biomass production and biowaste conversion.

Young European and Indian researchers will be invited to visit renowned research facilities of their respective field of research. The objective is to strengthen the inter-regional exchange: Indian researchers will be invited to visit European institutions, European researchers will visit India. The exchange is envisaged for one week and is fully financed by SAHYOG. Therewith young talents will have the unique opportunity to gain first hand insights of the respective research landscape, make contacts and build new networks.

Eligibility Criteria

Proven excellent command of the English language

A graduate degree with above-average grades

Age: up to 35 years

Working in one of the following fields of research:

- Bioethanol production from lignocellulosic biomass
- Thermochemical conversion technologies (pyrolysis, gasification)
- Anaerobic digestion technologies (biogas, biomethane, hydrogen)
- Algae production and conversion systems
- Biomass to chemicals – the biorefinery approach
- Feedstock production and genetic improvement of plants
- Sustainability and life cycle assessment

Strengthening Networking on Biomass Research and Bio-waste Conversion - Biotechnology for Europe India Integration

Contact for SAHYOG Short-Term Exchange:

Dörte Merk
International Bureau of the Federal Ministry of Education and Research at the Project Management Agency c/o German Aerospace Center (DLR)
Doerte.Merk@dlr.de

Dr. S. Venkata Mohan
CSIR - Indian Institute of Chemical Technology (IICT)
vmohan_s@yahoo.com

Project Coordination:

ENEA, Italy
Dr. Neeta Sharma
[illegible]

TERI, India
Dr. Priyangshu Manab Sarma
[illegible]

Please find all relevant information for your application on
[illegible]

Department of Biotechnology
Ministry of Science & Technology,
Government of India

SEVENTH FRAMEWORK PROGRAMME

India-EU SAHYOG Short-term exchange programme

Letter of Interest

With this letter organization states its interest to participate in India-EU SAHYOG Short-Term Exchange programme organized in the framework of the project SAHYOG (Strengthening Networking on Biomass Research and Bio-waste Conversion - Biotechnology for Europe India Integration).

SAHYOG is supported by the European Commission within the 7th Framework Programme and by the Department of Biotechnology (DBT) of the Indian Ministry of Science and Technology.

Organization is interested in hosting one of the selected European scientists/young researchers for a one week visit in month 2013. The visit includes a guided tour through laboratories and other relevant facilities, the presentation of respective research projects at your institution, a possibility for the awardee to present his research as well as the chance to exchange ideas.

The organization is actively involved in the following research theme(s) (please mark the relevant field):

- Bioethanol production from lignocellulosic biomass
- Thermochemical conversion technologies (pyrolysis, gasification)
- Anaerobic digestion technologies (biogas, biomethane, hydrogen)
- Algae production and conversion systems
- Biomass to chemicals – the biorefinery approach
- Feedstock production and genetic improvement of plants
- Sustainability and life cycle assessment

The selected European scientists/young researchers with expertise/experience in the above mentioned fields can be selected.

Accommodation and travel costs are fully covered by SAHYOG.

Best regards,

NAME
POSITION
ORGANISATION

Place, Date

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- **The exchange was envisaged for ten days and the program for STE to be held in India was designed by CSIR-IICT and sent to the participating hosting institutes.**

	Day 1 (18 Nov-Mon)	Day 2 (19 Nov-Tue)	Day 3 (20 Nov-Wed)	Day 4 (21 Nov-Thu)	Day 5 (22 Nov-Fri)	Day 6 (23Nov-Sat)	Day 7 (24 Nov-Sun)	Day 8 (25 Nov-Mon)	Day 9 (26Nov-Tue)	Day 10 (27 Nov-Wed)
Program	Arrival at Delhi and Transfer to Accommodation	Presentation by TERI followed by presentations by EU Interaction session	Lab visit followed by discussion Transfer to Hyderabad	Presentation by CSIR-IICT and EU Lab visit followed by interaction session	R & D Institutes Visit Transfer to Delhi	Local tour In New Delhi	Transfer to GBPUAT Local tour	Presentation by GB PUAT and EU followed by Interaction session Lab and field visit and discussion Transfer to Delhi	Presentation by JNU and EU followed by Interaction session Lab visit followed by discussion	Departure
Station	New Delhi	New Delhi	New Delhi/Hyderabad	Hyderabad	Hyderabad/ New Delhi	New Delhi	Pantnagar	Pantnagar/New Delhi	New Delhi	New Delhi

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Visit to TERI

Day One

Interactive Session

Presentation by

European Researchers

Guest Lectures

Interactive Session during STE program at TERI, New Delhi

DAY TWO AT TERI

Visit to TERI Gram/Gwal Pahari

The researchers were taken on a visit

- Biomass Gasifiers system
- Micro propagation technology Park (MTP)
- Tissue culture lab/ poly house visit

- Fermentation Technology Research Center (FTRC) having several ranges of fermenter units (1,000 Lt to 15,000 Lts) and Smart Grid

Visit to CSIR-IICT

Day One

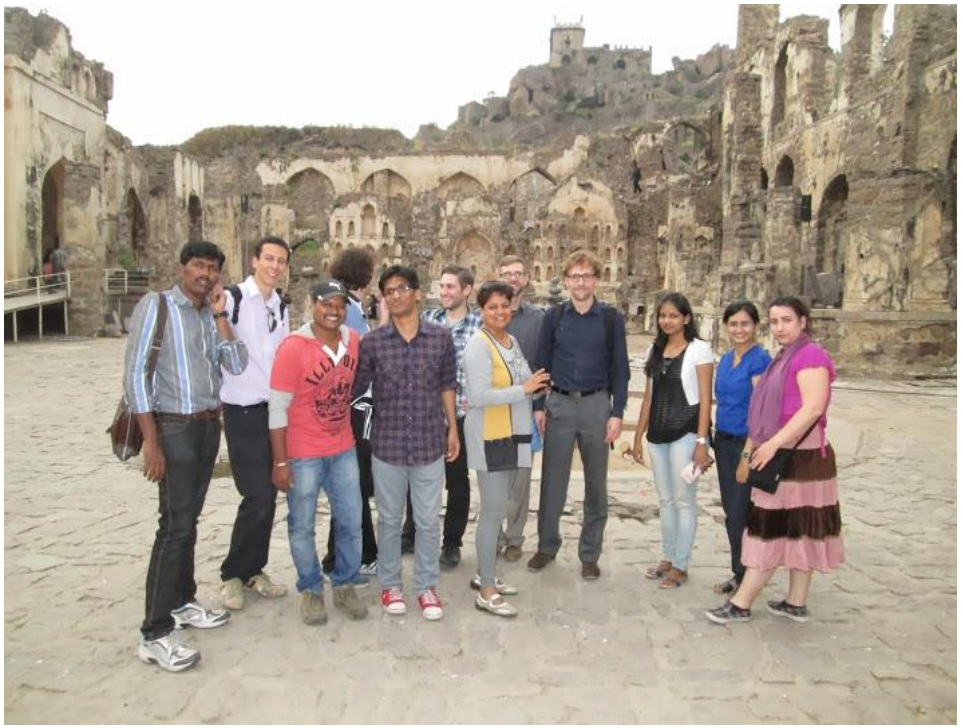
Presentation by European Researchers

Presentation by research scholars from CSIR-IICT

CSIR-IICT

Day Two

Field visit to ICRISAT, Hyderabad



City tour

Visit to GB Pant

Day One

Interactive Session

Guest Lectures

University campus visit

Day two At GB Pant

Visit to various facilities

- Vermi compost technology
- Feedstock preparation and conversion technology
- Cattle and poultry farm
- Mushroom research centre
- Crop Research Centre
- Vegetable Research Centre
- Floriculture Research Centre
- Agro-forestry research station of the university

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Visit to JNU

Presentations by JNU research scholars

Interactive Session

Guest Lectures

Visit to Various Facilities in JNU

- Visit to glasshouse
- Central Instrumentation Facility (CIF) at School of Life Sciences
- Advanced Instrumentation Research Facility (AIRF) at JNU
- Trip to the School of Biotechnology, JNU
- Visit to the fermentation units

University campus visit

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Initiation of Project Inventories

- One of the major challenges for documenting an inventory for projects funded under the theme of SAHYOG from Indian side was the lack of existing databases and thus the exercise of documenting the project inventory was initiated.
- The work of documenting the project inventory was divided to all the Indian partners.

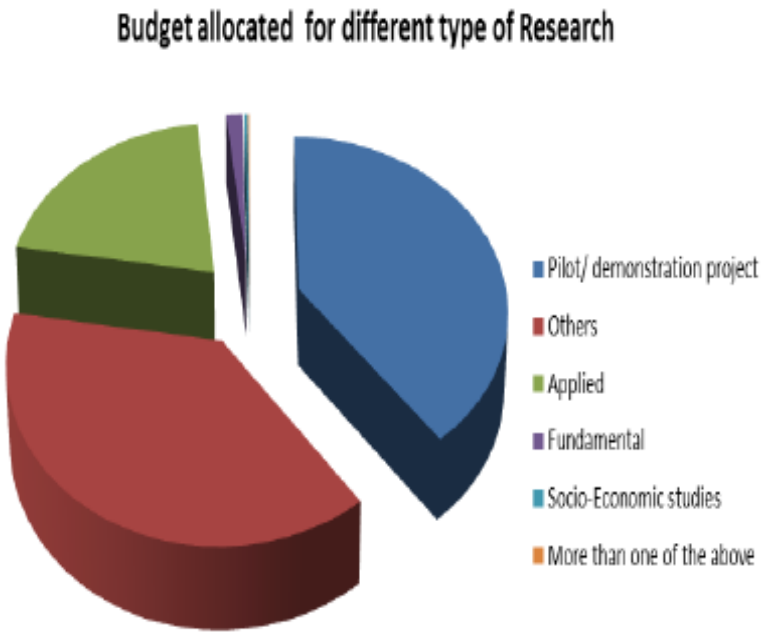
Indian partner Institutes	Project Inventories
CSIR-IICT	South India
JNU	North-West India
Tezpur University	North-East India
GB Pant	North India
ARTI	Central India

The criteria for considering the projects are as follows:

- Minimum funding: 1 million INR (~ Euro16600 as per current conversion rate)
- Time period: The projects for year 2007 onwards (completed and on-going)

• **Indian project inventory was based in the information available in the National Science & Technology Management Information System (NSTMIS) website.**

• **Apart from this source, the information was collected though correspondence and visits to nodal persons of different central and state ministries, state science and technology websites, state and central forest and agricultural department research institutes and other semi government and industrial funding sources.**



Type of Research	Budget allocated (in INR)	Euros (in million)
Pilot/ demonstration project	8805039650	135.46215
Others	8347727547	128.42658
Applied	4581116616	70.478717
Fundamental	309464326	4.7609896
Socio-Economic studies	53840212	0.828311
More than one of the above	33147920	0.509968
		0
Total Budget	**22130336271**	**340.46671**

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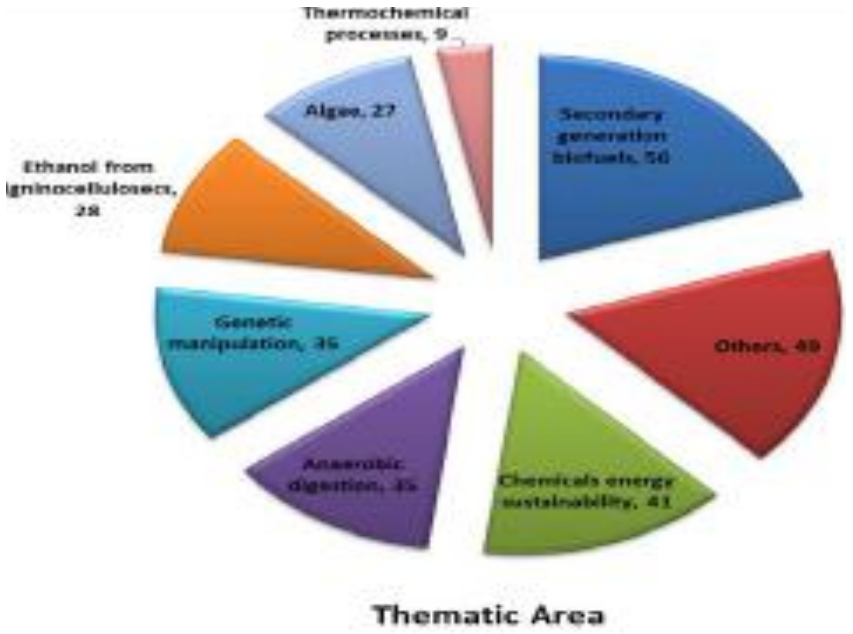
Categorization based on thematic areas

The inventory sheet indicates that the projects can have broadly classified seven broad thematic areas as follows:

- **Second generation biofuels**
- **Chemicals energy sustainability**
- **Anaerobic digestion**
- **Genetic manipulation**
- **Algae**
- **Ethanol from lignocellulosic and**
- **Thermochemical processes.**



Thematic Area	No. of Projects
Secondary generation biofuels	56
Others	49
Chemicals energy sustainability	41
Anaerobic digestion	35
Genetic manipulation	35
Ethanol from ligninocellulosecs	28
Algae	27
Thermochemical processes	9
Total	280

- **The majority of the project (56) were found to be running under Second generation Biofuel followed by projects working under others category (49) and Chemicals energy sustainability (41).**

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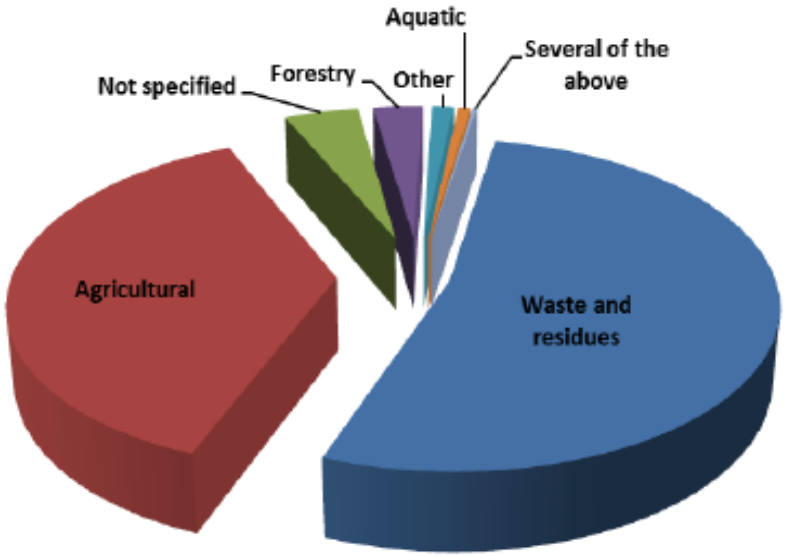
•**It could be also inferred that the total amount of funding for the 280 projects in the inventory turns out to be 22130,336,271 INR and that is equivalent to 350 million Euros.**

•**When classified into the selected thematic areas, it was observed that a major amount of funds have been accounted for anaerobic digestion.**

•**The second generation biofuels and funding on lignocellulosic ethanol is also significant.**

Thematic Area	Total Budget in INR
Anaerobic digestion	11654172366
Others	8616273359
Secondary generation biofuels	1109458427
Ethanol from ligninocellulosecs	230028260
Genetic manipulation	193429804
Algae	166063078.5
Chemicals energy sustainability	131492056
Thermochemical processes	29418920
Total Budget	**22130336271**



Budget allocated for different biomass sources

Categorization based on generic processes

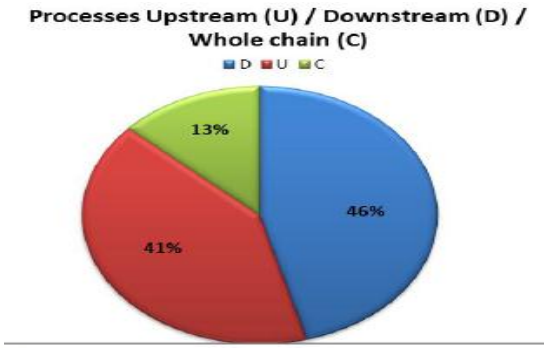
The projects sanctioned in India related to the current themes can be put into categories based on three processes of

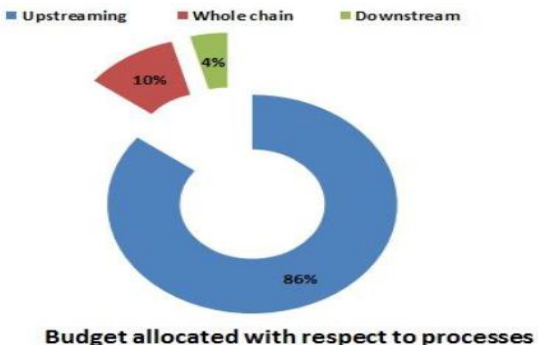
- **Upstream (128)**
- **Downstream (115) and**
- **Whole chain (37).**

Processes	No of projects
Downstream (D)	128
Upstream (U)	115
Whole chain (C)	37
Grand Total	**280**

Though the number of projects is higher for downstream processes, the budget of the projects sanctioned under the category of upstream is on the higher site.

• This indicates that major focus in terms of funding is for developing processes and thus can be implied that most of the research on the selected themes are on bench stage or in development.





Processes	Budget Allocated in INR
Upstream	18908324800
Whole chain	2304560014
Downstream	917451457
Total Budget	**22130336271**

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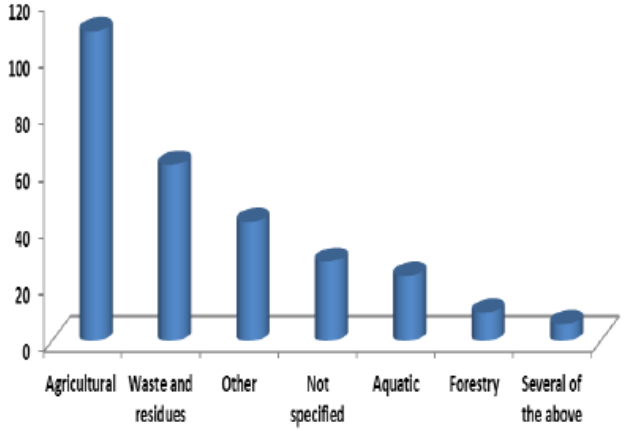
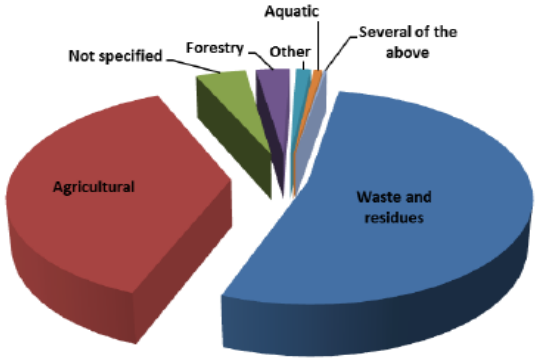
Categorization by type of biomass

•The majority of the projects identified from Indian side fall in the category of using agricultural biomass (109), which was then followed by the waste and residue (62) biomass source.

•The inventory also indicates that almost half of the total amount sanctioned for the total projects by various funding agencies are utilized in projects that utilize waste.



Types of Biomass	No. of Projects
Agricultural	109
Waste and residues	62
Other	42
Not specified	28
Aquatic	23
Forestry	10
Several of the above	6
Grand Total	**280**



Budget allocated for different biomass sources

Biomass Sources	Total Budget in INR
Waste and residues	1170700412 7
Agricultural	8328151254
Not specified	957977016
Forestry	636057865
Other	285107274
Aquatic	163431245
Several of the above	52607490
Total Budget	**22130336271**

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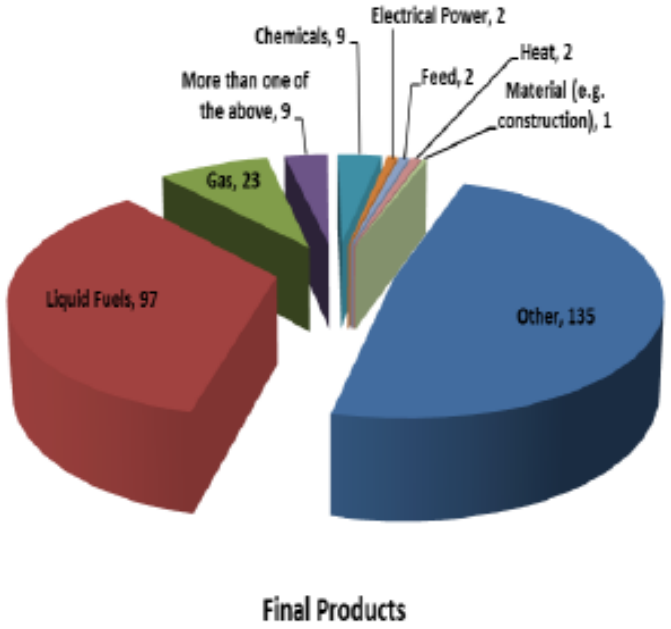
Categorization based on final outcome or product

•It was quite difficult to categorize the projects based on its final product or outcome of the project as this information was not clear either due to lack of full project overview or due to the fact that that achieved objectives/milestones were also not clearly mentioned on the project or source information.

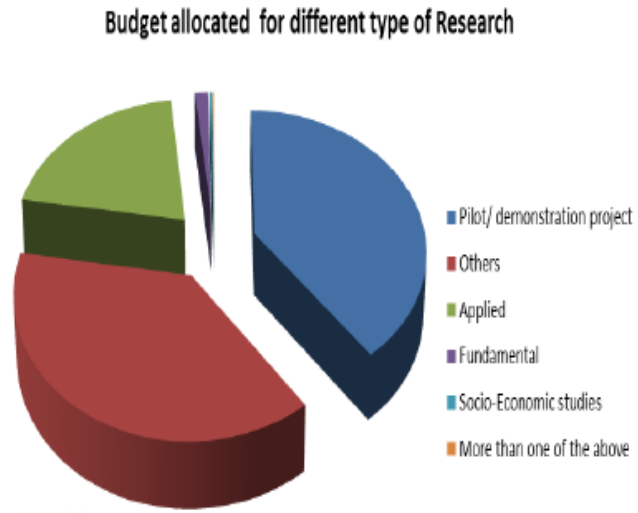
•Therefore the most identified final product after others (135) category were identified project have end product as the liquid fuel (97).

Final Products	No. of Projects
Other	135
Liquid Fuels	97
Gas	23
More than one of the above	9
Chemicals	9
Electrical Power	2
Feed	2
Heat	2
Material (e.g. construction)	1
Grand Total	**280**



Categorization based on the research focus

- It is observed that significantly low percentage of the total budget was sanctioned for basic and fundamental research.
- This section of the inventory deals with the type of research which was carried out by the Organization or researchers, i.e. fundamental, applied, pilot/ demonstrated or socio-economics studies etc.
- The majority of the project taken up indicates that most of them are working on applied research (167) as compared to research projects working on the fundamental concepts (45).



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More than one of the above	33147920	0.509968
		0
Total Budget	22130336271	340.46671

Type of Research	No. of Projects
Applied	167
Fundamental	45
Pilot/ demonstration project	44
Other	12
More than one of the above	8
Socio-Economic studies	4
Grand Total	280

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Projects for Collaboration

• Based on the selection criteria, a total of 90 projects were identified for collaboration from India which mainly depends on the project objective and their role on Biomass enhancement and Biowaste utilization and conversion using biotechnological interventions.

Reliability scale (1-5)

No. of projects	Reliability scale (1-5)
106	4
58	3

• Based on the selection criteria, a total of 108 projects were considered in "IN" criteria (selected).

Specific outcome from project Inventory

• A total of about 700 projects in the EU and 280 in India have been identified in an inventory of bio-based projects and a total funding of these projects is more than 1.5 billion Euro in the EU and 35 million Euro in India during the period 2007 – 2012.

SAHYOG-Biorefinery

Strategies and Research Recommendations

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Strategies

The key strategy to make biorefineries a successful endeavor is

- **Bringing together key stakeholders operating in multi-disciplinary partnerships and to accelerate the deployment of developed technologies.**
- **Identifying the most promising bio-based products can help to improve overall process economics and minimize the overall environmental impact.**
- **India has an abundance of biomass feedstock and the challenge is not the availability of resources but their efficient use.**
- **Key stakeholders should participate in regional and national debates on water-resource management**

For a succesful Biorefinery

- **Multi-disciplinary partnerships**
- **Value added products**
- **Efficient use of resources**
- **Sustainability**
- **Involvement of stakeholders**

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- **Plant-based raw materials have the potential to replace a large fraction of fossil resources as feedstocks for industrial productions**
- **Many key players, namely *government* and *farmers*, lack a holistic understanding of the impact of their actions on the overall value chain and this gap needs bridging.**
- **India's policy-makers need to strengthen environmental policies while allowing economic growth to still flourish.**
- **A business framework needs to be created that enables biorefineries to become competitive by setting frameworks for managing scale and Enforceable targets with real incentives.**

Strategies

- Understanding between government and farmers
- Creating incentives for investment
- Strengthening environmental policies
- Creating business framework

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Research Recommendations

- 80% of India's potential biomass is used in a decentralized and unorganized manner and is not commercially viable at the scale required in India.
- Only with sufficient investment, driving the development of technology and the scalability should be developed
- A mechanism to enforce sustainability need to be implemented.
- India will need to align with global environmental standards and among its states.
- Measurement practices and targets should be established in a focused and achievable way,

i.e. for biofuel content in aircraft fuel and diesel targets.

Key recommendations

- Driving the technology development
- Enforcement of process sustainability
- Global environmental standards
- Targets should be established in a focussed way

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Conclusions

- **Biorefinery show promises both for industrialized and developing countries and can make a significant contribution to sustainable development by adding value to the sustainable use of biomass.**

- **Biorefineries are expected to contribute to an increased competitiveness and prosperity in an economically, socially, and environmentally sustainable manner.**

- **New competencies, new job opportunities and new markets are expected to be realized.**

- **Enhancing outreach and education may help spur serious discussions on innovations in both land-based and water based biomass.**

THANK YOU