



LEMBAGA ILMU PENGETAHUAN INDONESIA
(*INDONESIAN INSTITUTE OF SCIENCES*)

Center of Excellence : Integrated Biorefinery in Indonesia

“Innovative Bioproduction Indonesia (iBioI)”



YOPI

Research Center for Biotechnology, LIPI

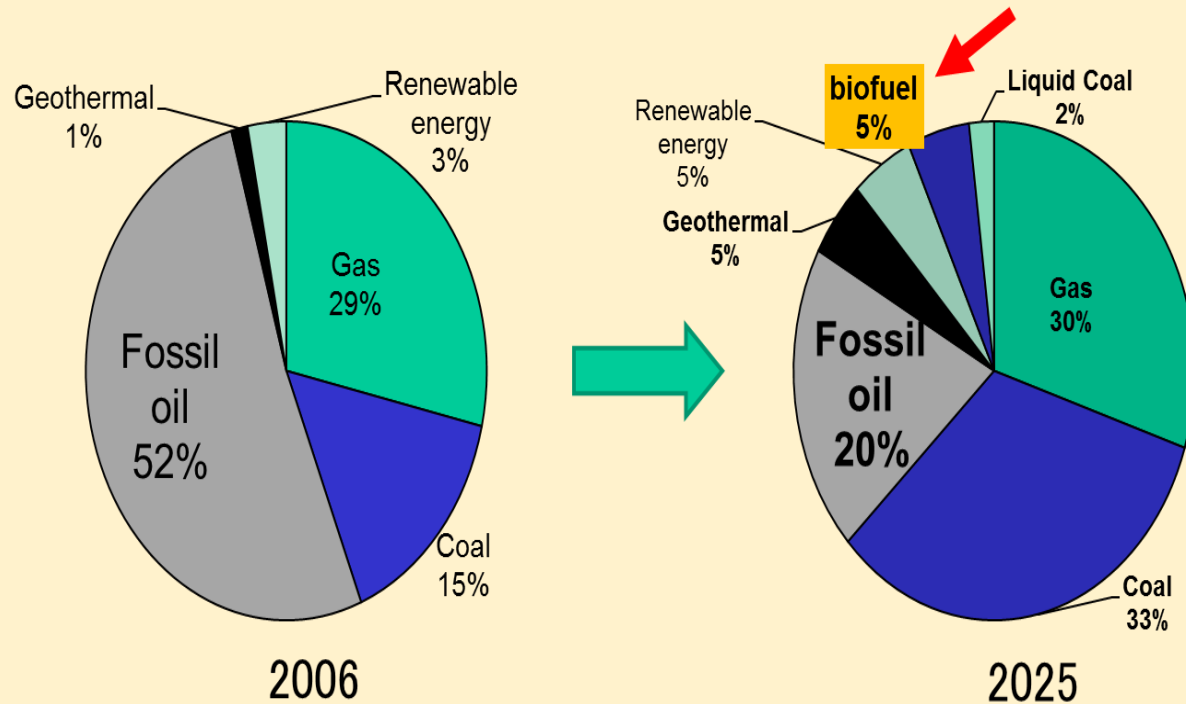
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How Important is the Integrated Biorefinery for Indonesia ?

Government Regulation on Energy Production

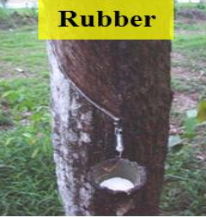
Strategy of Target of Energy Mix



⇒ Government Planning until 2025 : reduce utilization of fossil oil 20% & support to increase utilization of **biofuel (bioethanol, biodiesel) 5%**

- ✓ **Stock of fossil oil is decreasing**
- ✓ **Supply and distribution of energy demand : still a constraint**
- ✓ **Government Regulation related to utilization of fossil oil, biofuel etc.**
- ✓ **Potency of local resources : biomass materials**
- ✓ **Bio-refinery instead of Oil-refinery**
- ✓ **Need to apply of Integrated Biorefinery technology**

The Potential Cellulose (non-starch) Biomass in Indonesia

Biomass	Place	Production [million t/year]	Energy [million GJ/year]	
Rubber wood (ゴムの木)	Sumatera, Kalimantan, Java	41	120	 Rubber
Logging residues (伐木)	Sumatera, Kalimantan	4.5	19	
Sawn timber residues (製材残基)	Sumatera, Kalimantan	1.3	13	
Plywood and veneer production residues (合板残材)	Kalimantan, Sumatera, Java, Irian Jaya, Maluku	1.5	16	
Sugar residues (サトウキビ残渣)	Java, Sumatera, South Kalimantan	Bagasse : 10 Cane tops: 4 Cane leaves: 9.6	78	 Baggase
Rice residues (稲わら残渣)	Java, Sumatera, Sulawesi, Kalimantan, Bali, NTB	Husk: 12 Bran – stalk 2.5 Straw: 49	150	
Coconut residues (ココナッツ残差)	Sumatera, Java, Sulawesi	Shell: 0.4 Husk: 0.7	7	 Rice straw
Palm oil residues (パームオイル残差)	Sumatera new areas: Kalimantan, Sulawesi, Maluku, Nusa Tenggara, Irian Jaya	Empty fruit bunch (EFB): 3.4 Fibres: 3.6 Palm shells (PKC): 1.2	67	



⇒ Need to search microbial source and appropriate biomass
 ⇒ Screening microbes for biocatalyst production that suitable or degrading the biomass.

✓ As a biomass feedstock, the ligno-cellulosic materials are better for utilization because there are non-edible and no competition problems between foods

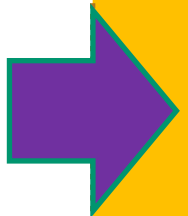
✓ There are abundant Cellulosic materials from agricultural waste fraction in Indonesia

✓ Cellulose-based biomass can be degraded by microbe and convert into valuable & functional product for human life

✓ Need Efficiency process : Biotechnology approaches will be focused on the development of microbes "cell factory" for production of chemicals and fuels from cellulosic materials

POTENCY OF MICROBIAL RESOURCES (INDONESIA)

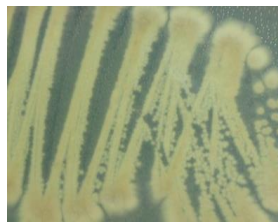
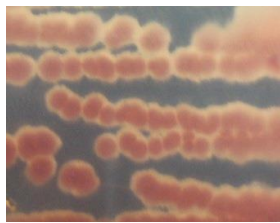
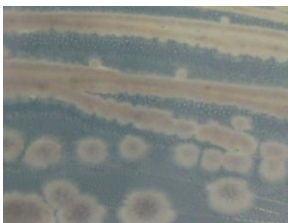
LIPI

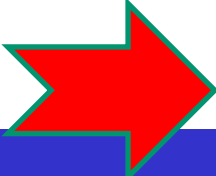


JST-JICA SATREPS PROJECT FY 2010-2015

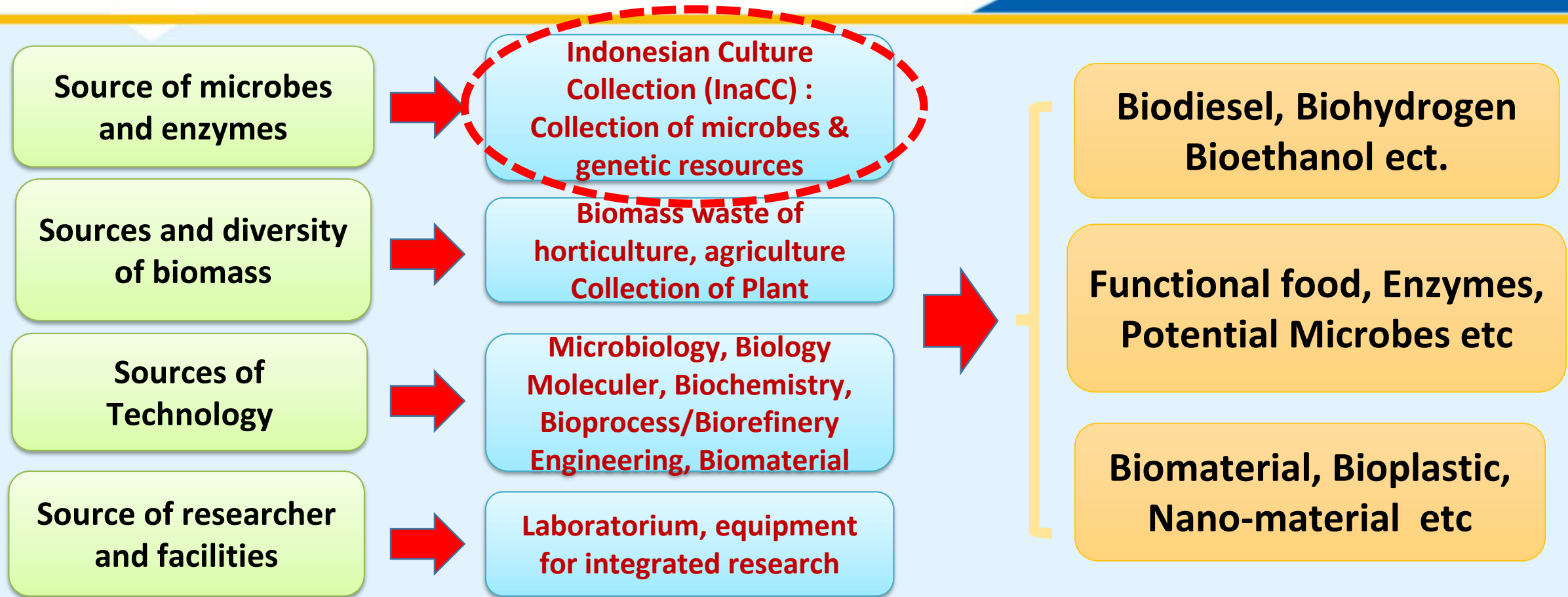
International Standardized Microbial Resource Center to
Promote Life Science Research and Biotechnology
Establishment of *Indonesia Culture Collection* (InaCC)

- ✓ Microbes Collection : More than 10.000 Strains (Bacteria, Actinomycetes, Fungi, Yeast, Bacteriophage)
- ✓ Need to be explore : bioprospective
- ✓ Need collaborative work : multi-disciplinary
- ✓ Access and Benefit Sharing of Local Microbes



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- ✓ Key-point : How to utilize this collection of microbes to support research on Integrated Biorefinery ?

Prospect of Research Related to Bio-Process, Biorefinery and Bioproduct based on biomasses (**cellulose** and **microbes**)

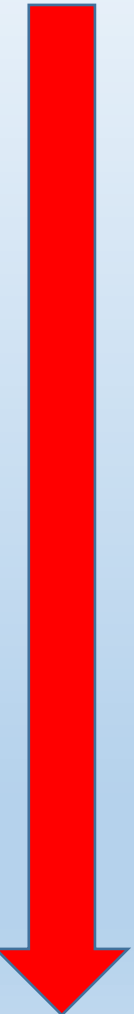


LIPI has been developing research topics on Bioprocess-Biorefinery technology

Supporting Research on Integrated Biorefinery Technology based on Biotechnology Approach

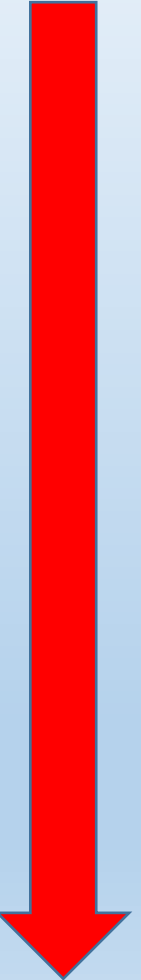
No	Topics	Fiscal Year	Project
1	Utilizaton of palm kernel cake for functional food production	2006-2008	<i>Indonesian Institute of Sciences (LIPI)</i>
2	Utilization of Indigenous potato (Porang ; <i>Amorphophallus onchophyllus</i>) for manno-oligosaccharides production using mannanase	2007-2013	<i>ITSF Toray grant, RistekDikti, LIPI</i>
3	Analysis of polyaromatic hydrocarbon-dioxygenase gene from Indonesia Marine Bacteria	2010	<i>Research Grant, ITSF Toray</i>
4	Utilization of carbohydrate from local potato : Umbi Kentang Hitam (<i>Coleus Tuberosus</i> Benth.), Ubi Kayu (<i>Manihot Esculenta</i>) & Tacca (<i>Tacca Leontopetaloides</i>)	2011-2013	<i>Indonesian Institute of Sciences (LIPI)</i>
5	Utilization of cellulose-based biomass for bioethanol production	2013-2103	<i>ITSF Toray grant, LIPI</i>
6	Production of xylo-oligosaccharides from xylan baggase, manno-oligosaccharides from sugar palm	2016-2018	<i>Indonesian Institute of Sciences (LIPI)</i>
7	Development of integrated biorefinery technology based on Biotechnology approach for potential microbes, biocatalyst and biofuels production	2013-now	<i>Research Center for Biotechnology LIPI</i>

**internal collabarotion Research at Indonesian Institute of Sciences
Managed by researcher from Research Center for Biotechnology LIPI*

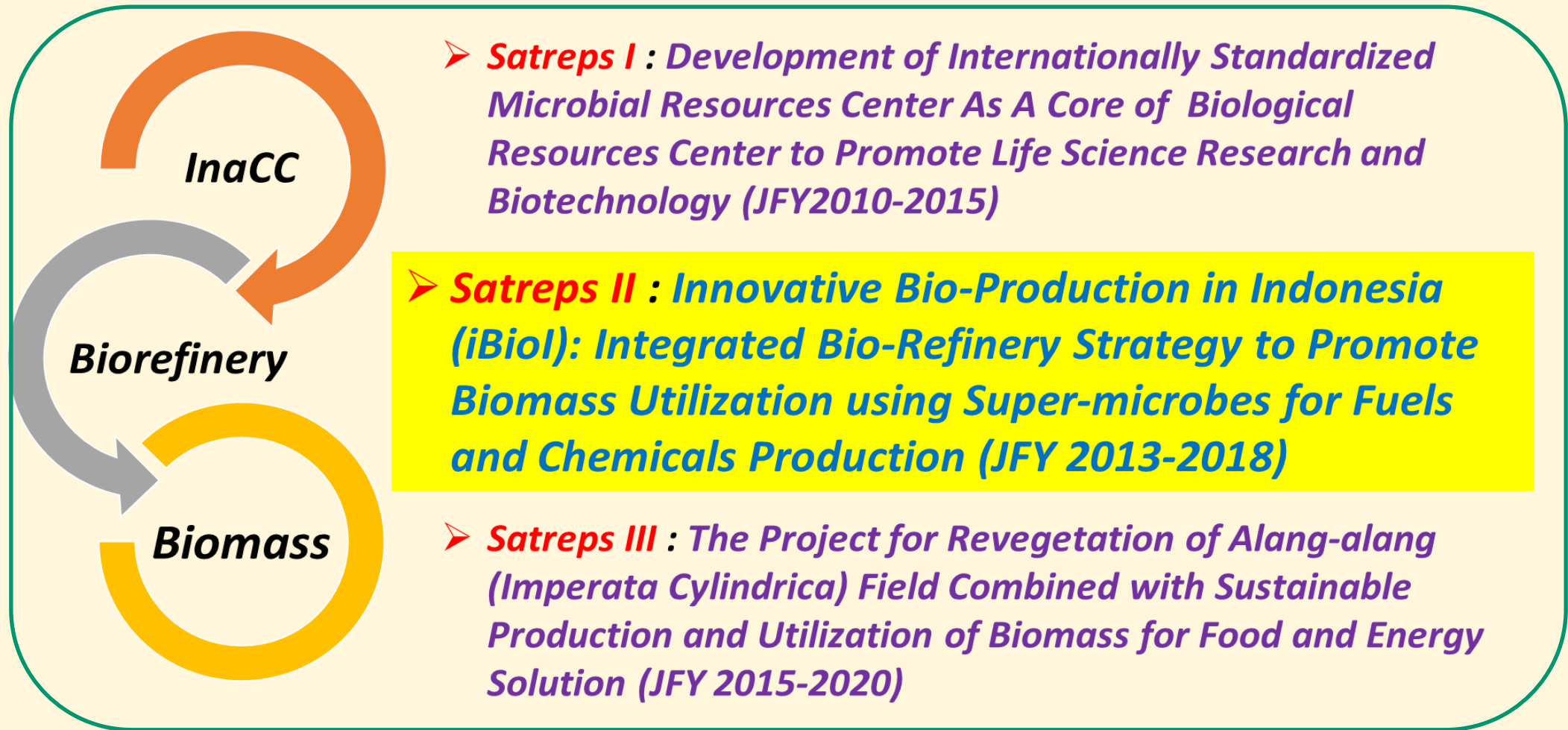


International Collaborative Work : Supporting Research on Integrated Biorefinery Technology

No	Topics	Fiscal Year	Project
1	<i>Isolation of indigenous microbes from Indonesia Environment</i>	2002-2010	<i>NBRC-NITE</i>
2	<i>Isolation and characterization of crude oil-degrading bacteria from Indonesian seawater</i>	2005-2009	<i>NEDO</i>
3	<i>Development of Consolidated Bio-Proccesing (CBP) for Bioethanol and Manno-Oligosaccharides Production by Yeast Cell Surface Engineering</i>	2011-2013	<i>JSPS-LIPI Bilateral Project</i>
4	<i>Development of Internationally Standarized Microbial Culture Collection in Indonesia</i>	2010-2015	<i>JST-JICA SATREPS Project</i>
5	<i>Innovative Bio-Production Indonesia (iBioI): Integrated Bio-Refinery Strategy to Promote Biomass Utilization using Super-microbes for Fuels and Chemicals Production</i>	2013-2018	<i>JST-JICA SATREPS Project</i>
6	<i>Producing Biomass Energy and Material Through Revegetation of Alang-Alang (<i>Imperata cylindrica</i>) Fields</i>	2015-2020	<i>JST-JICA SATREPS Project</i>



Research Supported by JST-JICA SATREPS Program



Innovative Bio-Production Indonesia (iBioI) : Integrated Bio-Refinery Strategy to Promote Biomass Utilization using Super-microbes for Fuels and Chemicals Production



Five Key Technologies



[3] Microbe breeding



**Biomass
in Indonesia**



[1] Pretreatment



[2] Enzymatic
degradation



[4] Fermentation



[5] Separation



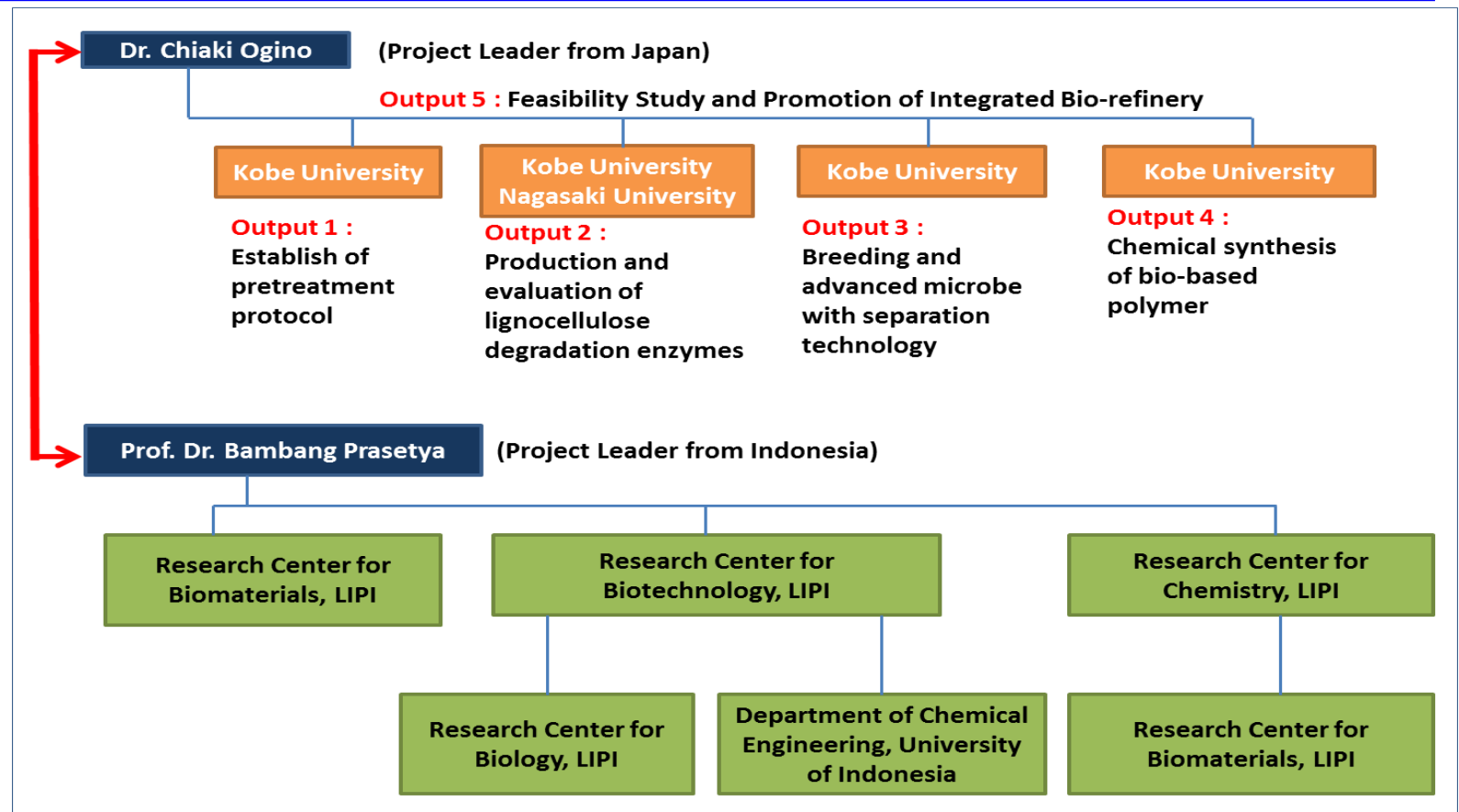
[7] Integration of process

✓ Efficiency process : focus on the development of microbes “cell factory” for production of chemicals and fuels from lignocellulosic materials

✓ There are five key technologies will be developed in this project to Development of Integration system : Consolidated Bio-Processing (CBP)

Main Activities & Structure of Integrated Bio-Refinery Research

- [1] Establishment of pretreatment protocol
- [2] Screening of degradation enzymes for ligno-cellulosic degradation
- [3] Microbe breeding for chemical and fuel fermentation
- [4] Establishment of efficient separation technology
- [5] Challenging of chemical synthesis of bio-based polymer from separated chemicals
- [6] Feasibility study of integrated process
- [7] Promotion of bio-refinery platform into industry etc.



Purpose of the Project

Establishment of *Bio-refinery research center in Indonesia*, especially for utilization of lignocellulose biomass to produce bio-fuels and bio-chemicals product using super-microbes

Current Progress on Establishment of Integrated Biorefinery Project

- ✓ *Developing of Cell factory for Biocatalyst production and Fermentation of biomass are in progress*
- ✓ *Once we got the Cell factory based on indigenous microbes, we can produce several type of biocatalyst that can be utilized in many industries*
- ✓ *Construction of Cell Factory (microbe-breeding) will be continuously conducted since the number of biomass type and biodiversity of microbes increase*
- ✓ *Making alliances among multidisciplinary scientists are important to proceed the implementation of this integrated technology*
- ✓ *For disseminate the integrated technology into industry, we should make special effort and expand the linkage among researchers, stakeholders and industries*

Supporting Activities for Integrated Biorefinery Project

- ✓ *Workshop, business meeting Indonesia and Japan Company : implementation of Biorefinery technology*
- ✓ **Full Supported by Japan Science & Technology, JICA, LIPI**

March 2016



January 2017



Supporting Activities for Integrated Biorefinery Project

Sakura Exchange Program in Science

- ✓ The Japan-Asia Youth Exchange Program in Science (SAKURA Exchange Program in Science: SSP) is a program to invite Asian young people to Japan for a short-term visit to encourage their dreams and enhance their levels in science and technology through exposure to Japanese science and technology.
- ✓ 10 young researcher/student from LIPI, RistekDikti, IPB, ITB and UI
- ✓ The purpose of this Sakura Program is "Promoting and Introduction of Biomass Utilization Advanced technology for Producing Valuable Bio-product to Young (Candidates) Researchers"



Supporting Activities for Integrated Biorefinery Project

Research Center for Biotechnology LIPI accepted an certificate as
Center for Excellence on Integrated Biorefinery in Indonesia from
Ministry of Research, Technology and Higher Education



Indonesian *Center of Excellence (CoE)*

Ministry of Research, Technology and Higher Education

- *An effort to improve nations's competitiveness through the quality of the research institutions*
- *Developing research institutions to produce innovative research for the benefit and welfare of the people*
- *Supporting for making a core research center in specific fields*



CoE for Palm Oil (2011)
CoE for Coffee and Cocoa (2013)
CoE for Tropical Horticulture (2013)
CoE for Rubber (2014)
CoE for Legumes and Tuber Crops (2014)
CoE for Biotechnology and Bioindustry (2014)
CoE for Rice Crops (2015)
CoE for Coconut Palm (2016)
CoE for Lignocellulose (2016)
CoE for Integrated Biorefinery (2016)



MINISTRY OF AGRICULTURE



Acknowledgement



日本学術振興会
Japan Society for the Promotion of Science



PUI Biorefineri
Terpadu

