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Lignocellulosic Agricultural Waste As a Versatile Source For Sustainable Energy In Indonesia

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Background

- The depleting reserves and high price for oil had significant effect on the role of oil in the energy mix.

- The current century—an era of environmental awareness (Kyoto Protocol in 1997)—requires energy resources to satisfy the world's future energy demands.

- Changes in the electricity sector, international concern over climate change, and domestic concerns about energy security provide opportunities for renewable energy sources to increase their market share.

- By 2030, the world is projected to consume two-thirds more energy than today, with developing countries replacing the industrialized world as the largest group of energy consumers.

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Background

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- Biofuel is a sustainable energy produced from biomass which may substitute fossil fuel and impact in greater energy security and reduction of greenhouse gas emissions.

- The Indonesian government has issued strategic policies to increase the share of renewable energy up to 17% of the total energy consumption by 2025, where 5% arises from biofuel including biodiesel, bio-oil, and bioethanol (Presidential Regulation of Republic of Indonesia No. 5 Year 2006).

Indonesian Academy of Sciences (AIPI)

Established by Law No.8/1990 of Republic of Indonesia

- An independent body that gives opinions, suggestions, and advice to government and society on acquisition, development and application of science and technology.
- Promotes science through scientific conferences and policy discussion forums, publications, national and international relations, and other activities.

Energy Scenario And Sustainable Energy In Indonesia

- Utilization of fossil fuel continuously contributes to huge amount of greenhouse gases emission that leads to climate change, the government of Indonesia prioritizes on energy supply securities by diversification of energy resources.

- The energy mixes in Indonesia are based on five main resources: crude oil, natural gas, coal, hydropower, and renewable energy. Although the country encourages utilizing renewable energy, the contribution is only around 3%.

- Considering natural condition and geography, Indonesia is blessed with great potential of renewable energy such as solar energy, wind energy, hydro and biomass energy. Noting the potential of renewable and sustainable energy resources in the country, the government must pay more attention on how to utilize it.

- Many efforts have been done to promote renewable energy such as to create energy policy and regulations, yet it still did not give any satisfactory result.

What Are The Obstacles Of Renewable Energy Sector In Indonesia?

- High initial costs due to imported technology and operations/ maintenance costs.

- Financing institutions consider renewable energy investment to be high risk. Loan interest rates are high.

- There is a lengthy investment permit process, land availability issues due to the conflicting status of land use, and lack of a reliable data system on renewable energy potential resources and feasible projects so very common it leads to cost overrun.

- Government, non-government agencies and the public should take a more proactive step to promote and use renewable energy in order to achieve the secure and environmentally sustainable energy resources.

Policies To Spur The Development Of Renewable Energy Sector In Indonesia

- Ensuring clean and clear land for renewable energy development.
- Issue attractive tariff regulations for purchasing of renewable energy-based power generation by the State-owned Electricity Company (PLN) and for non-commercial micro and mini scale of RE to attract private investment.
- Establish innovative renewable energy financing mechanisms that involve concessional, mixed grant-loan mechanisms to reduce financing risks.
- Streamline the permit process for renewable energy investment.
- Speed up the procurement process for renewable energy developers by applying direct contracting.
- Provide incentives for local renewable energy technology manufacturers and R&D institutions to lower technology costs in the future.
- Build capacity and certification of renewable energy development, operations and maintenance service providers to ensure the quality of project feasibility and sustainability.
- Build reliable data and information systems on the potential of renewable energy resources and feasible projects.

Indonesian Institute of Sciences (LIPI)

Established by Law No. MPRS 18/B/1967 of Republic of Indonesia

Vision:

To be a world class research institution in research, development and the use of science to improve nation's competitiveness

Mission:

- Create inventions of science to encourage innovation in order to improve the competitiveness of national economies
- Develop useful knowledge for the conservation and sustainable utilization of resources
- Increase international recognition in the field of science
- Improve the quality of Indonesian human resources through scientific activity.

Research And Development On Sustainable Energy In Indonesia

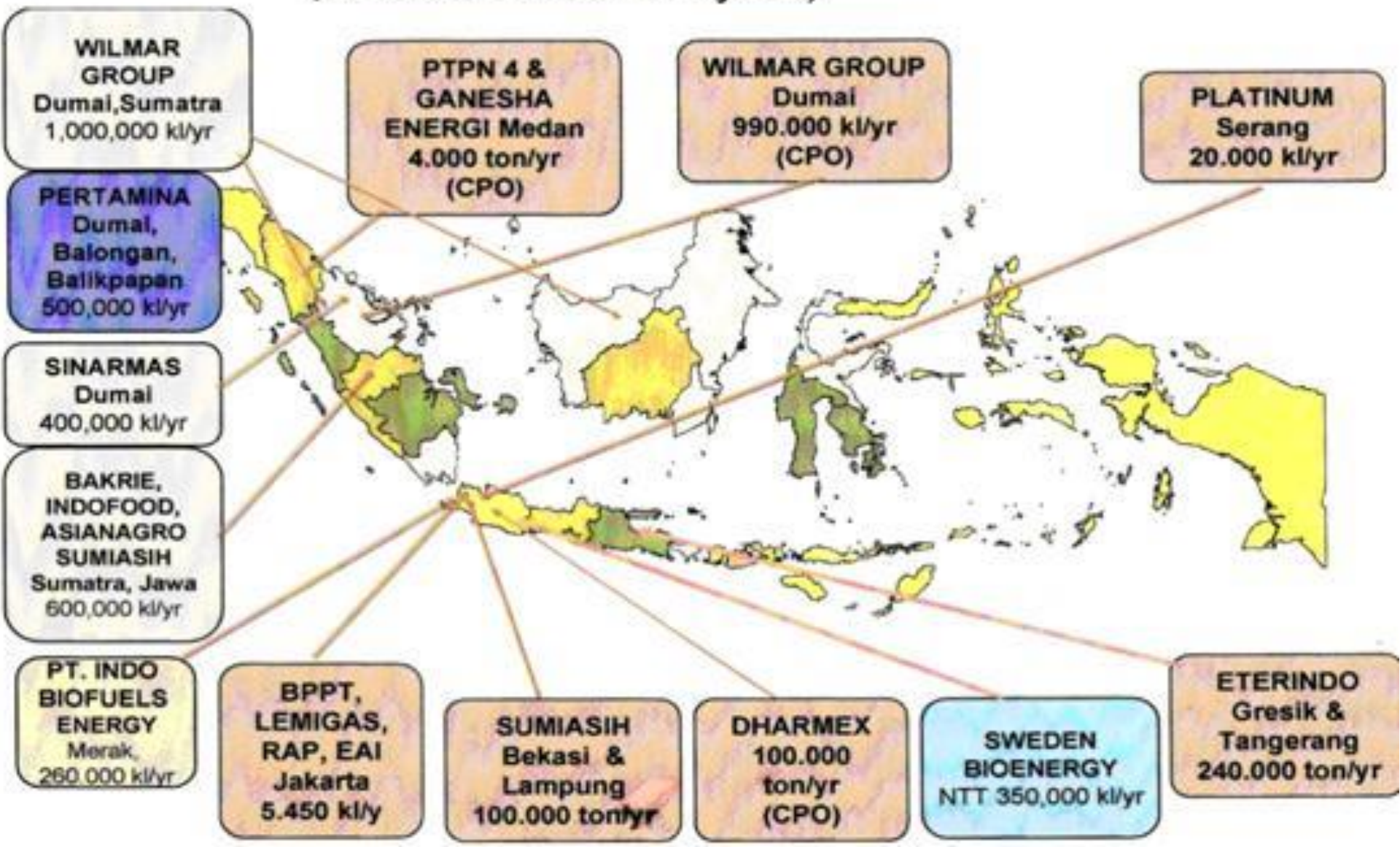
- Ocean wave energy
- Wind energy
- Hybrids
- **Biomass**
- Hydrogen
- Solar energy
- Geothermal

Renewable Energy Potential in Indonesia

	Resource Potential	Unused potential %
Hydropower	75,670 MW	94
Geothermal	27,510 MW	96
Mini hydropower	500 MW	83
Biomass	49,810 MW	99
Solar	4.8 kWh/m3/day	-
Wind	9,190 MW	99
Sea Current	35MW	100

http://www.gbgindonesia.com/en/energy/article/2011

Bio-diesel: Production plan up to 2010
(+/- 5.57 million KL/year)



Renewable Energy From Biomass – Innovation On Effective Utilization Of Agricultural Waste In Indonesia

- Protecting the environment has been the priority of many sectors in our endeavor to ensure sustainable development.

- Implementation of green energy development based on the use of biomass is in the right path in adopting a holistic approach in the promotion of renewable energy.

- The biomass energy potential is expected to increase remarkably, and as the first of the renewable energy sources to be developed for large-scale applications, especially in the palm oil industry and the methodology for energy harness by innovative utilization of waste from palm oil cultivation and processing.

Lignocellulosic Biomass In Indonesia

- The Indonesian Academy of Sciences concerns about the energy resilience in the country, therefore AIPI provides advocacy to the government and research agencies to come up with excellent alternatives. One of them is clean and sustainable energy that should be developed collaboratively by the stakeholders in research.

- Today bioethanol produced in Indonesia is from sugarcane molasses and cassava as first generation bioethanol (G1). However, related with its development, the use of G1 is unfavorable to be a major feedstock due to the conflict for food consumption.

- Biofuel produced from lignocellulosic biomass (agricultural waste), so-called second generation (G2) bioethanol, shows environmental advantages in comparison to the G1.

First generation biomass

Edible biomass

Raw material of glucose

Corn

Sugar cane

Second generation biomass

Inedible biomass

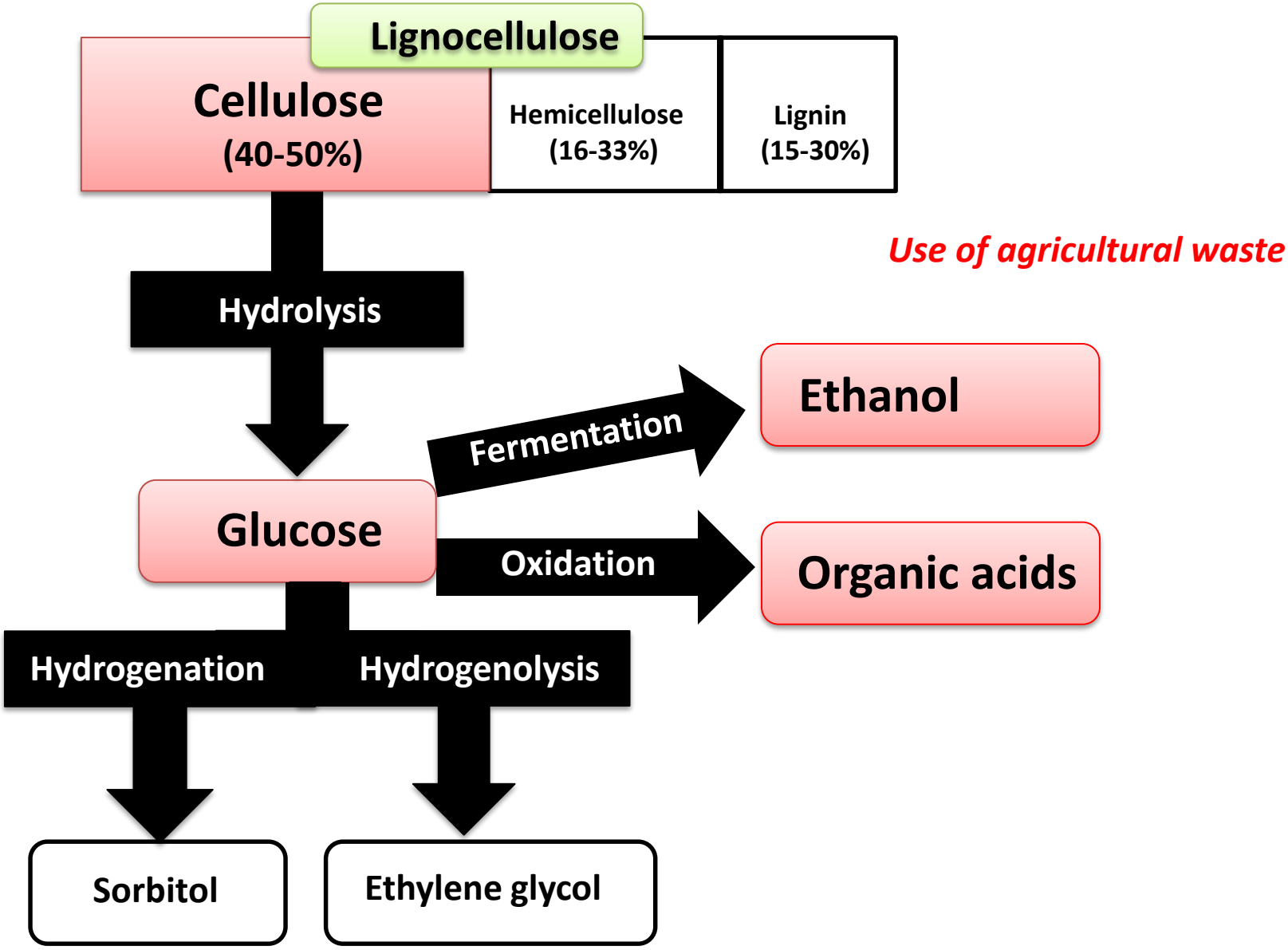
Lignocellulose
Woody material

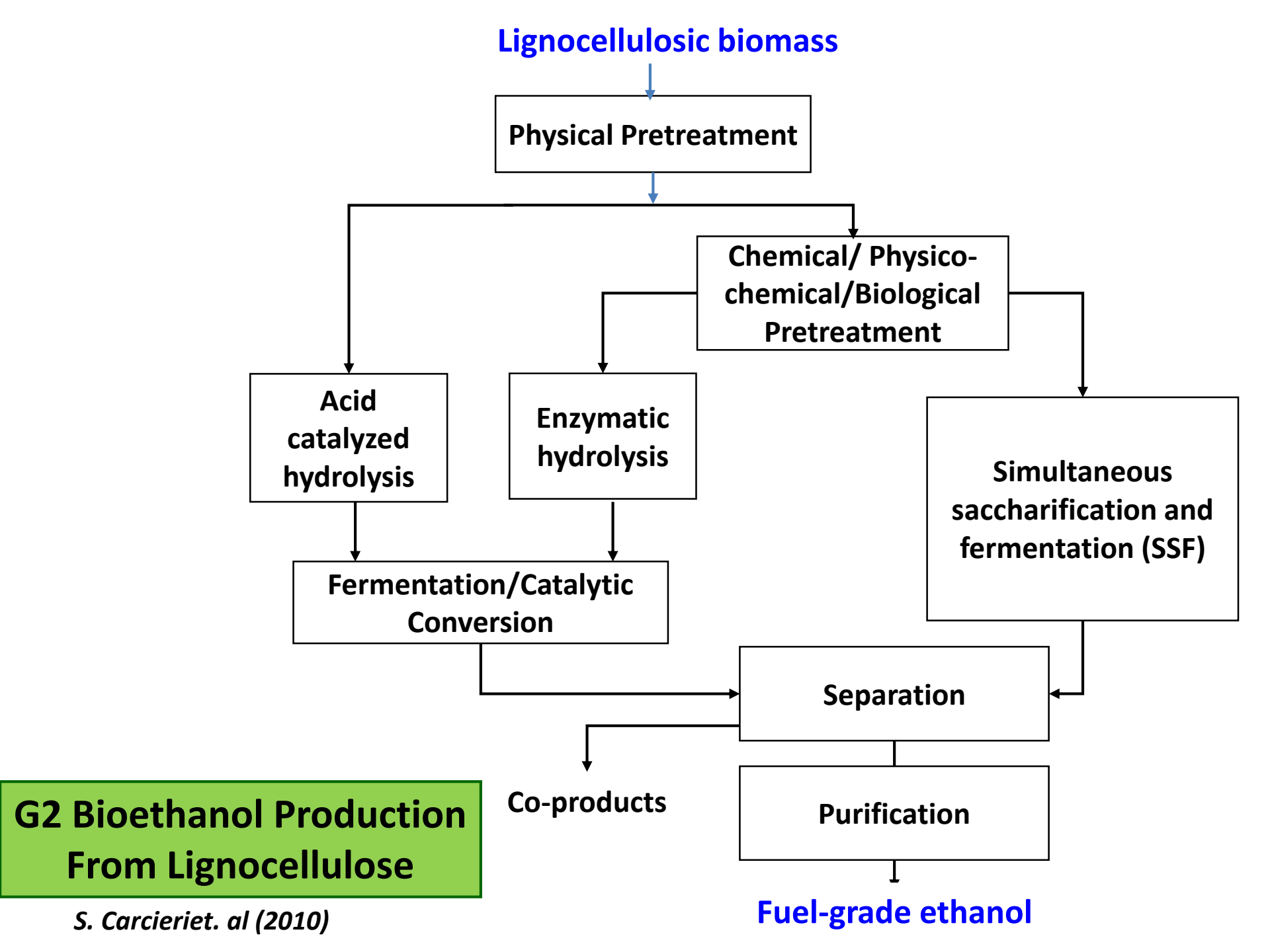
Most abundant organic compound on earth

Sierra et al., Biofuel News (2008)

Material	Value (US$/Kg)
Corn	0.24
Sugar cane	0.46
Woody material	-0.05

Lignocellulosic biomass to biofuel and biobased chemicals

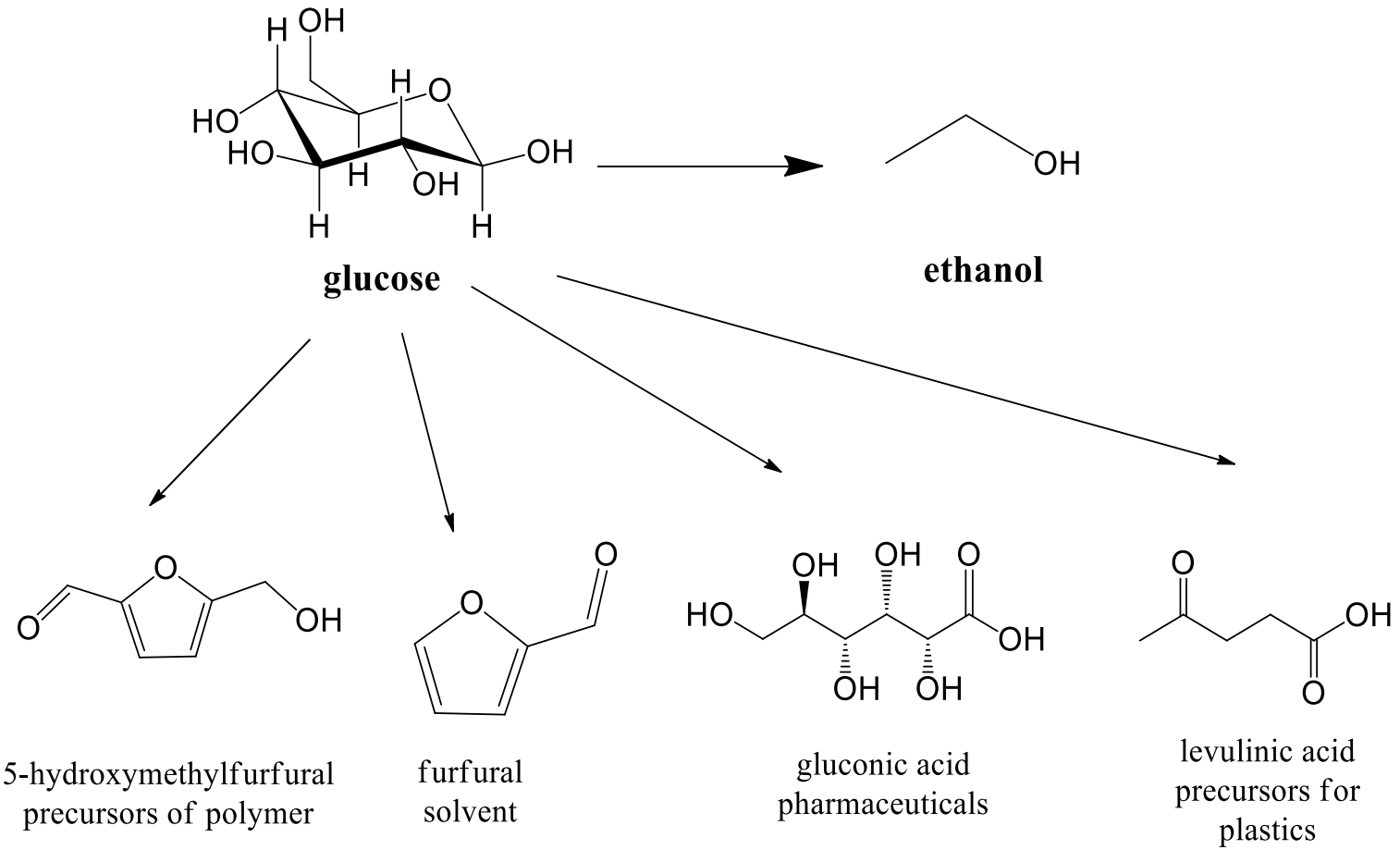




G2 Bioethanol Production From Lignocellulose

S. Carcieriet. al (2010)

Conversion Of Glucose To Ethanol And Co-products



The biorefinery concept will offer new economic prospects for agriculture and chemical industries through the production of various platform chemicals, biofuels, and energy.

Palm Oil

Plantation area and production of crude palm oil in Indonesia, operated by different types of business classes

Year	Plantation Land area (000 ha)				Production of CPO (000 tons)			
	SP	GP	PP	Total	SP	GP	PP	Total
2000	1.17	0.59	2.40	4.16	1.91	1.46	3.64	7.01
2004	2.23	0.61	2.46	5.28	3.85	1.62	5.37	10.83
2005	2.36	0.53	2.57	5.45	4.50	1.45	5.91	11.86
2006	2.55	0.69	3.36	6.59	5.78	2.31	9.25	17.35
2007	2.75	0.61	3.41	6.77	6.36	2.12	9.19	17.67
2008	2.90	0.61	3.50	7.01	7.10	2.29	9.80	19.20
2009	3.20	0.62	3.50	7.32	7.98	2.50	11.04	21.51
2011	3.62	0.64	4.65	8.91	8.63	1. 94	11.94	22.51
2012				9.01*				23.52*

Source : Directorate General of Estate Crops, Ministry of Agriculture of Republic of Indonesia (2013), Info SAWIT data centre (2013)

SH = smallholders; GE = government estate, PE = private estate.

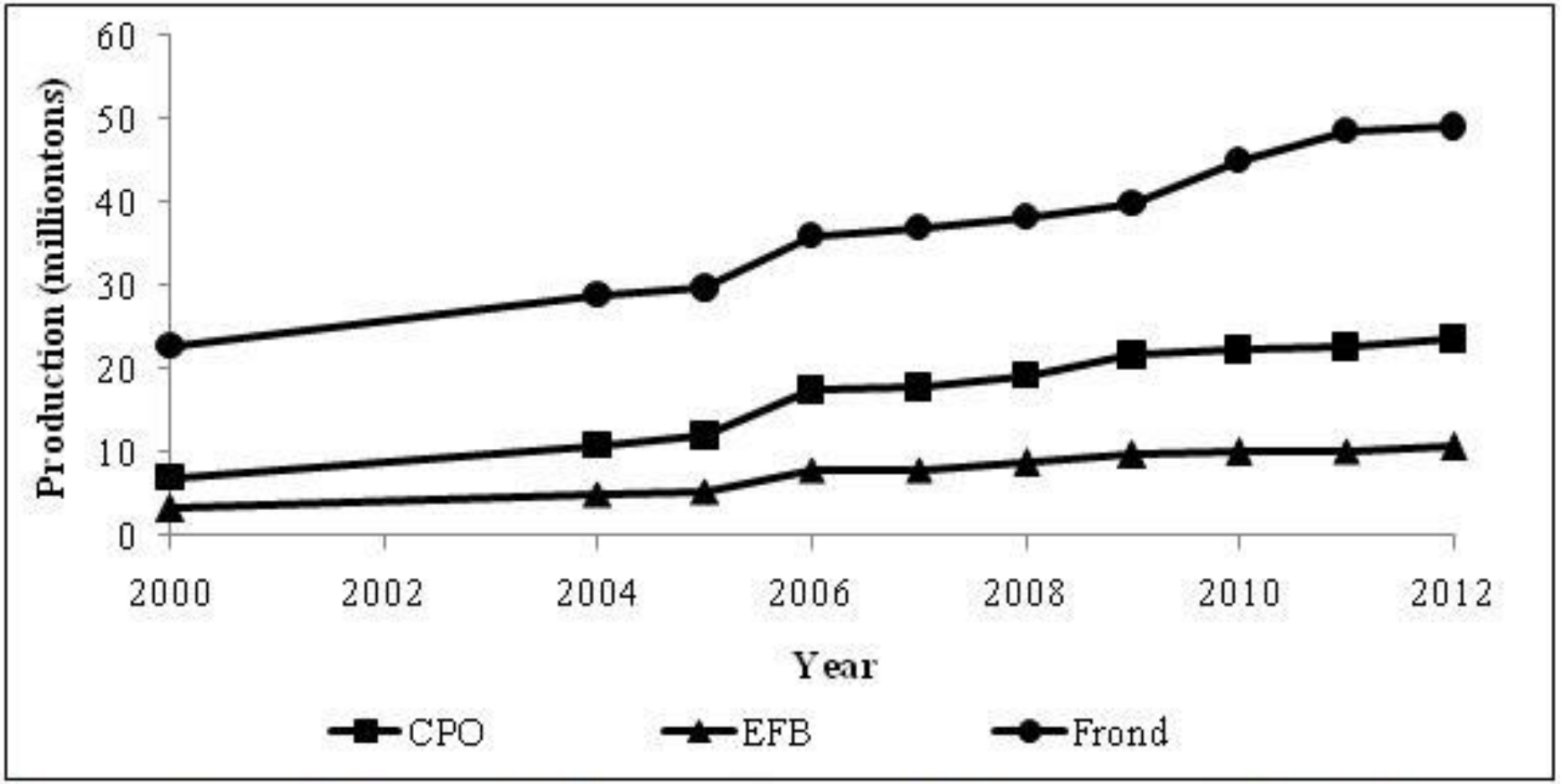
* **estimated data**

Palm oil production by province in Indonesia

Province	Production (million ton)		Province	Production (million ton)	
	2011	2012*		2011	2012*
Aceh	0.58	0.61	West Kalimantan	1.43	1.46
North Sumatera	4.07	4.14	Central Kalimantan	2.14	2.18
West Sumatera	0.94	0.95	South Kalimantan	1.04	1.06
Riau	5.73	5.84	East Kalimantan	0.80	0.82
Jambi	1.68	1.71	Central Sulawesi	0.19	0.20
South Sumatera	2.20	2.24	South Sulawesi	0.03	0.03
Bangka Belitung	0.50	0.51	Southeast Sulawesi	0.02	0.02
Bengkulu	0.86	0.88	West Sulawesi	0.24	0.24
Lampung	0.39	0.40	Papua	0.07	0.07
West Java	0.02	0.02	Papua Barat	0.06	0.06
Banten	0.02	0.02	**Total**	**23.09**	**23.52**

Source :Directorate General of Estate Crops, Ministry of Agriculture of Republic of Indonesia (2013), * estimated data

Potential availability of palm oil production waste in Indonesia



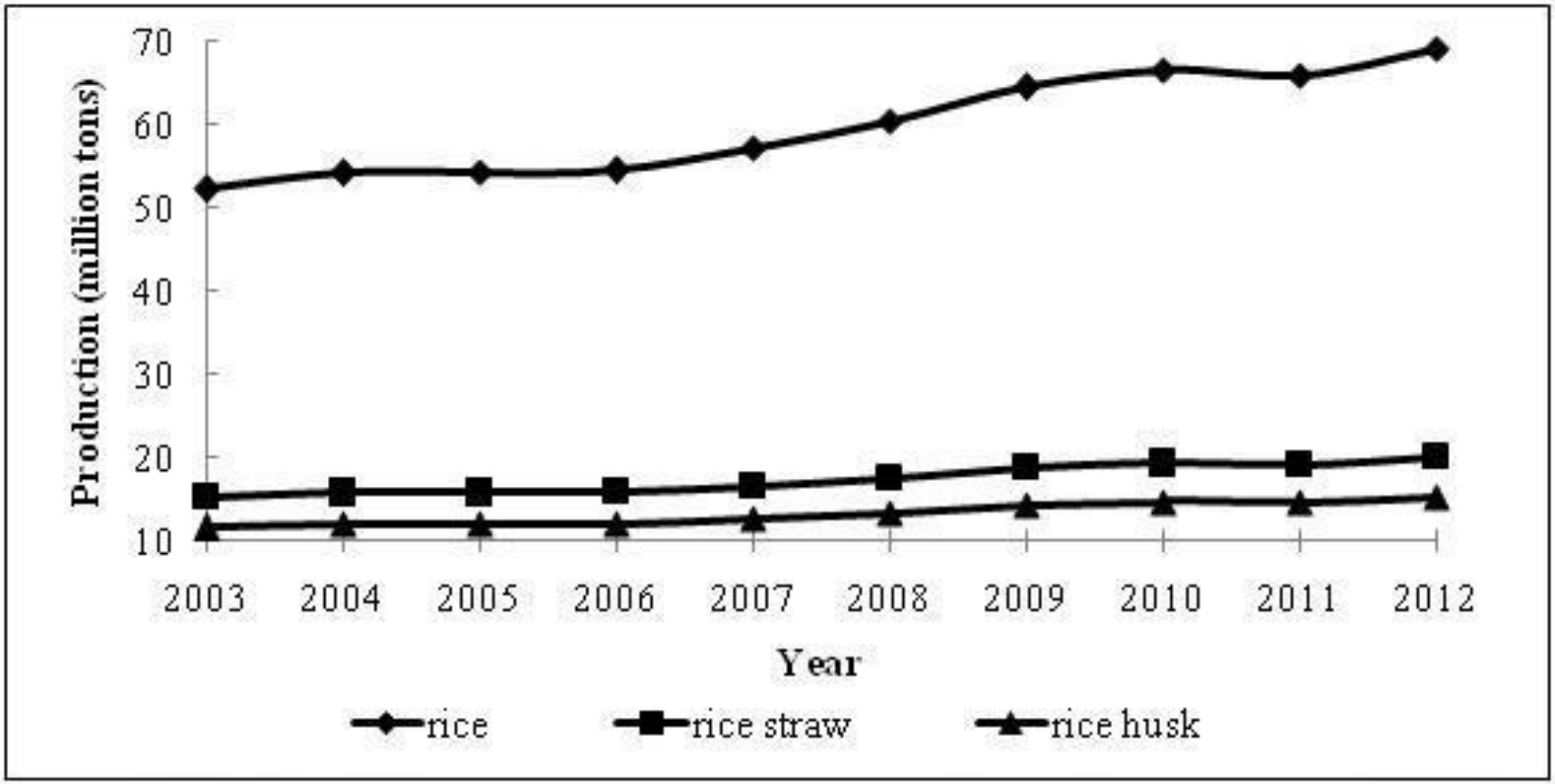
Source :Directorate General of Estate Crops, Ministry of Agriculture of Republic of Indonesia (2013)

Rice

Rice Production in Several Provinces of Indonesia in 2012

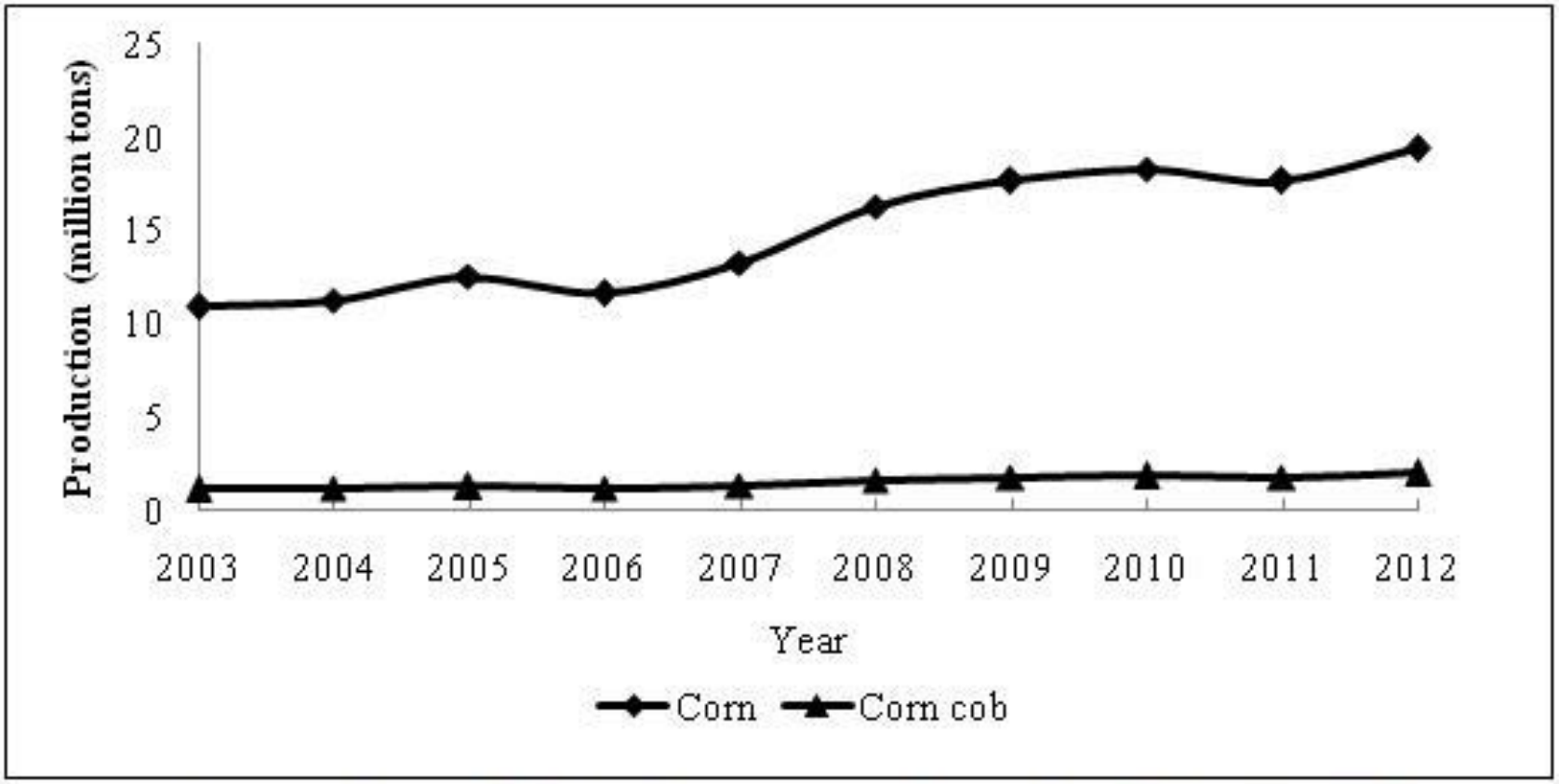
Province	Harvested area (thousand ha)	Production (million tons)	Province	Harvested area (thousand ha)	Production (million tons)
Aceh	387.80	1.79	Bali	149.00	0.87
North Sumatera	765.10	3.72	West Nusa Tenggara	425.45	2.11
West Sumatera	476.42	2.37	East Nusa Tenggara	200.09	0.70
Riau	144.02	0.51	West Kalimantan	427.80	1.30
Jambi	149.37	0.63	Central Kalimantan	251.79	0.76
North Sumatera	769.73	3.30	South Kalimantan	496.08	2.09
Bengkulu	144.45	0.58	East Kalimantan	142.57	0.56
Lampung	641.88	3.10	North Sulawesi	126.93	0.62
West Java	1918.80	11.27	Central Sulawesi	229.08	1.02
Central Java	1773.56	10.23	South Sulawesi	981.39	5.00
DI Yogyakarta	152.91	0.95	Southeast Sulawesi	124.51	0.52
East Java	1975.72	12.20	West Sulawesi	83.80	0.41
Banten	362.64	1.87	Papua	37.15	0.14
Gorontalo	51.19	0.25			

Potential Availability Of Rice Production Waste In Indonesia



Corn

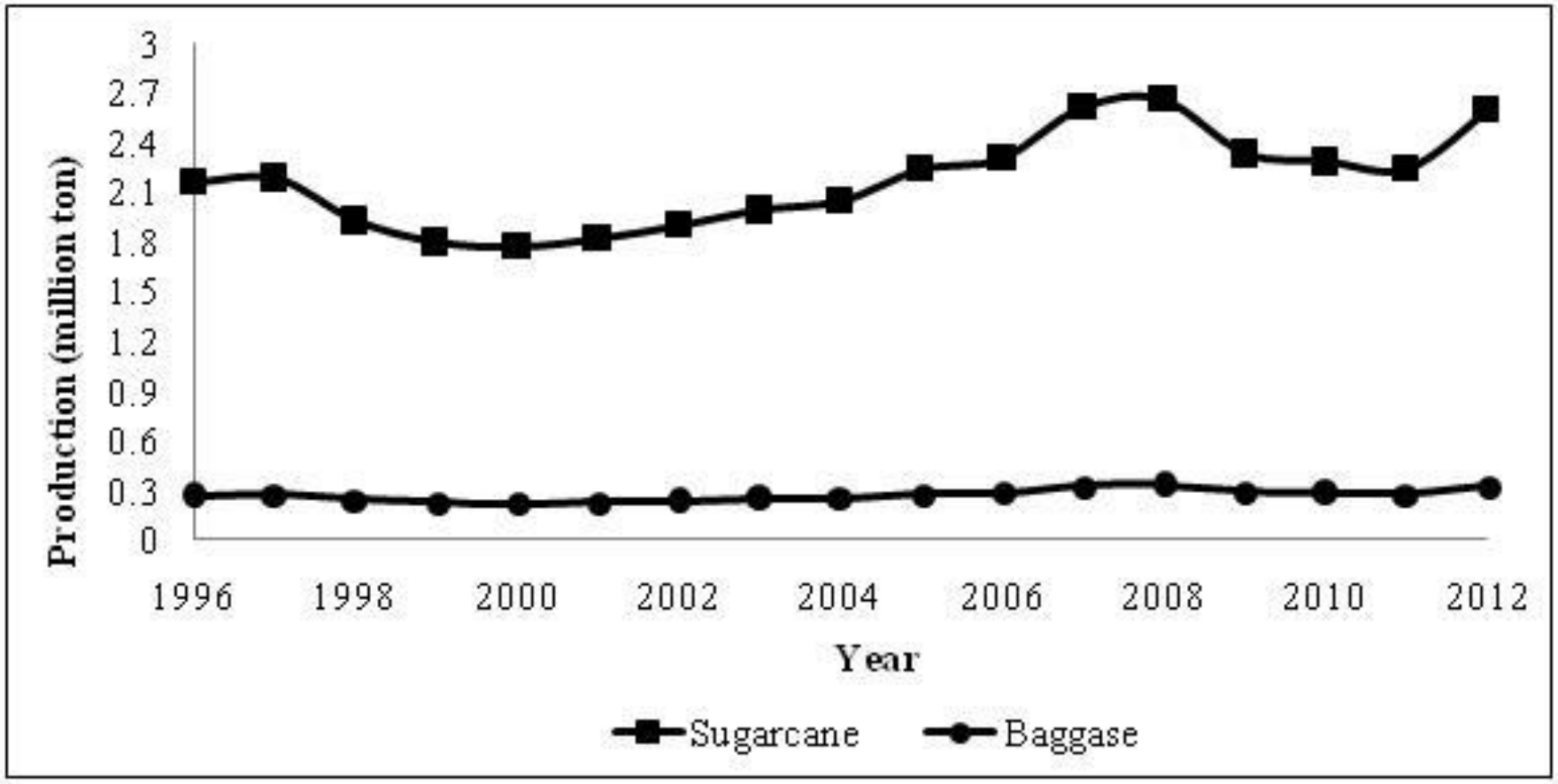
Potential Availability Of Corn Production Waste In Indonesia



Source : Directorate General of Estate Crops, Ministry of Agriculture of Republic of Indonesia (2013)

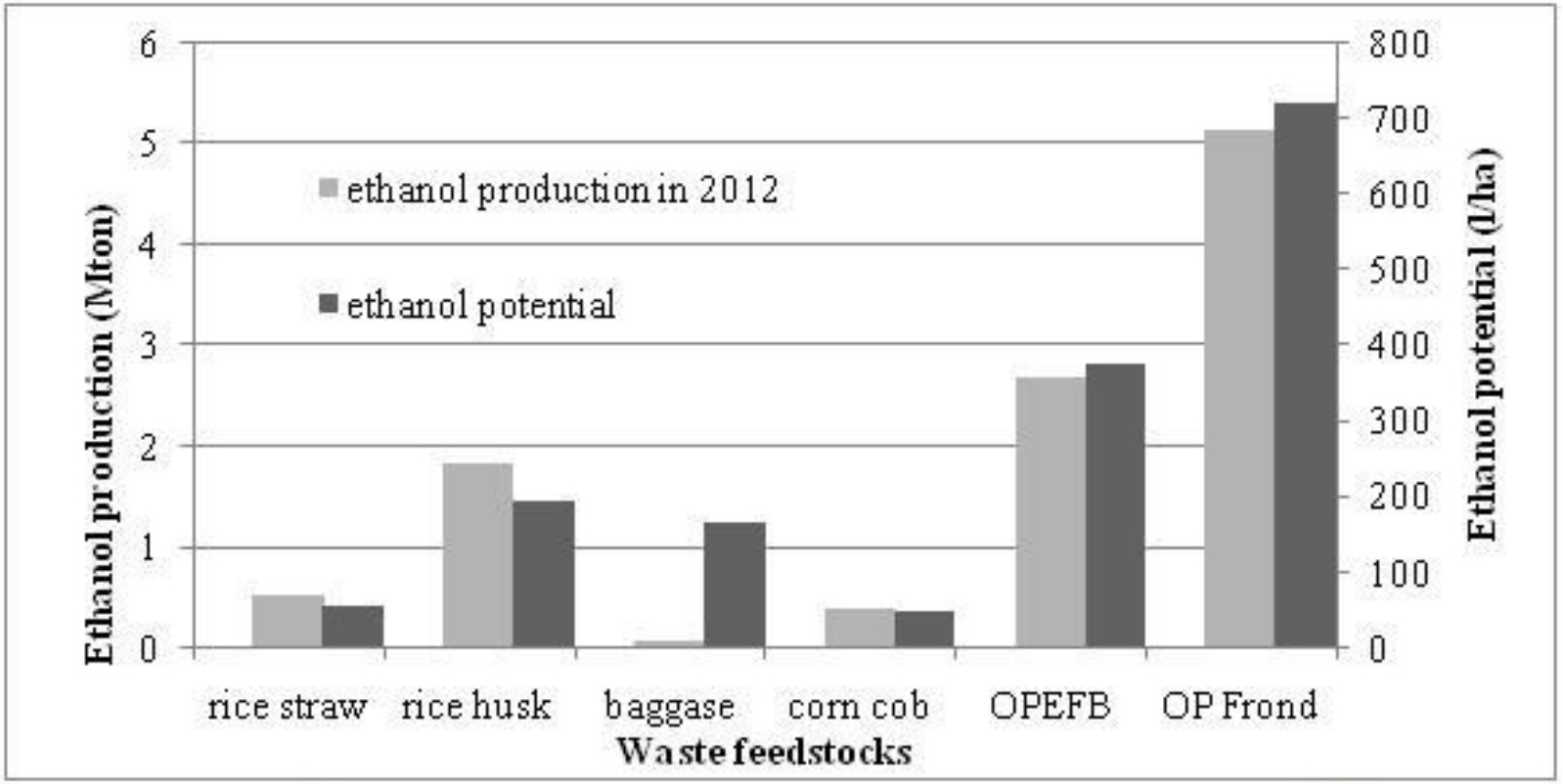
Sugarcane

Potential Availability Of Sugarcane Production Waste In Indonesia



Source : Directorate General of Estate Crops, Ministry of Agriculture of Republic of Indonesia (2013)

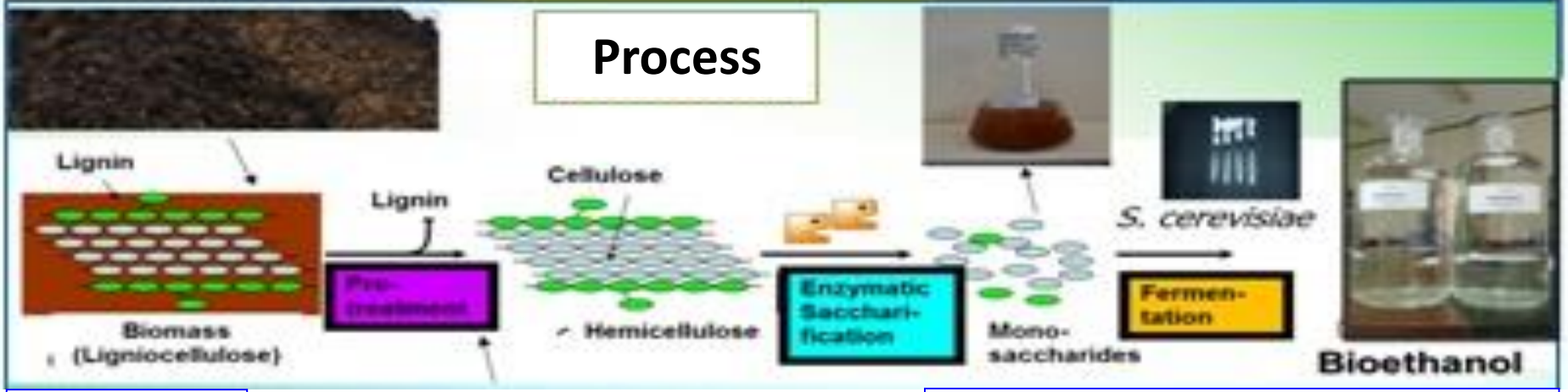
Ethanol Potential From Lignocellusic Agricultural Waste In Indonesia



- In 2012, Indonesia was able to record an anual ethanol potential of **palm oil tree waste, rice residue, corn cob, and bagasse approximately 7.81; 2.68; 0.38; 0.06 million tons**, respectively or **10.59 million tons** in total.
- This amount of G2 bioethanol would have a great contribution to fulfill the 4.99 million tons of ethanol demand in Indonesia by 2025.

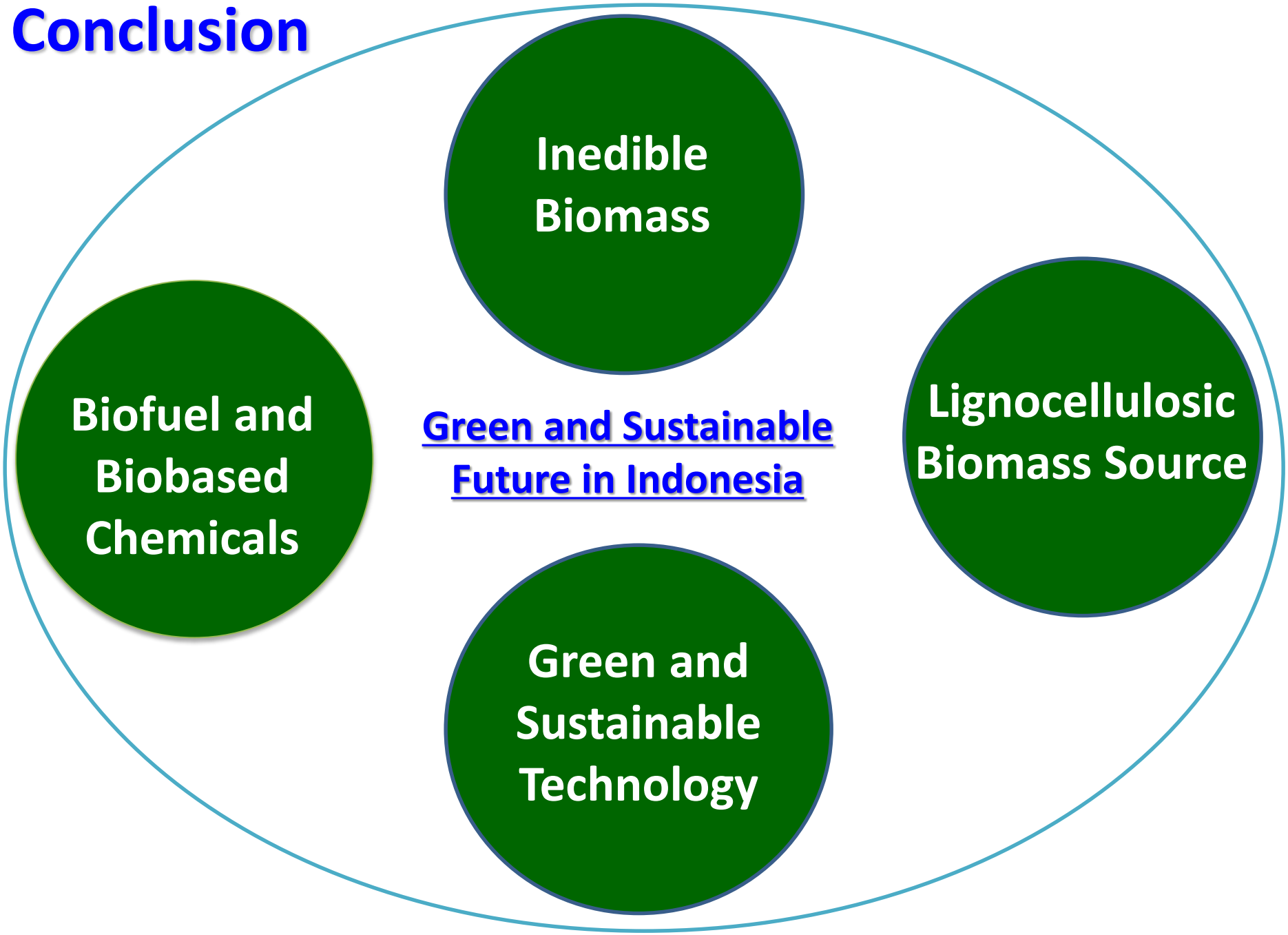
Y. Sudiyani, K. C. Sembiring, V. Berlianti, I. B. Adilina, Muryanto (2013)

G2 Bioethanol Pilot Plant at Research Center for Chemistry LIPI



Palm oil EFB → **G2 Bioethanol: 10 L/day, 99.5 % vol**

Conclusion


Inedible Biomass
Biofuel and Biobased Chemicals
Green and Sustainable Future in Indonesia
Lignocellulosic Biomass Source
Green and Sustainable Technology


Salamat
Thank you