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STATUS OF AGRICULTURAL WASTE AND UTILIZATION IN THE PHILIPPINES

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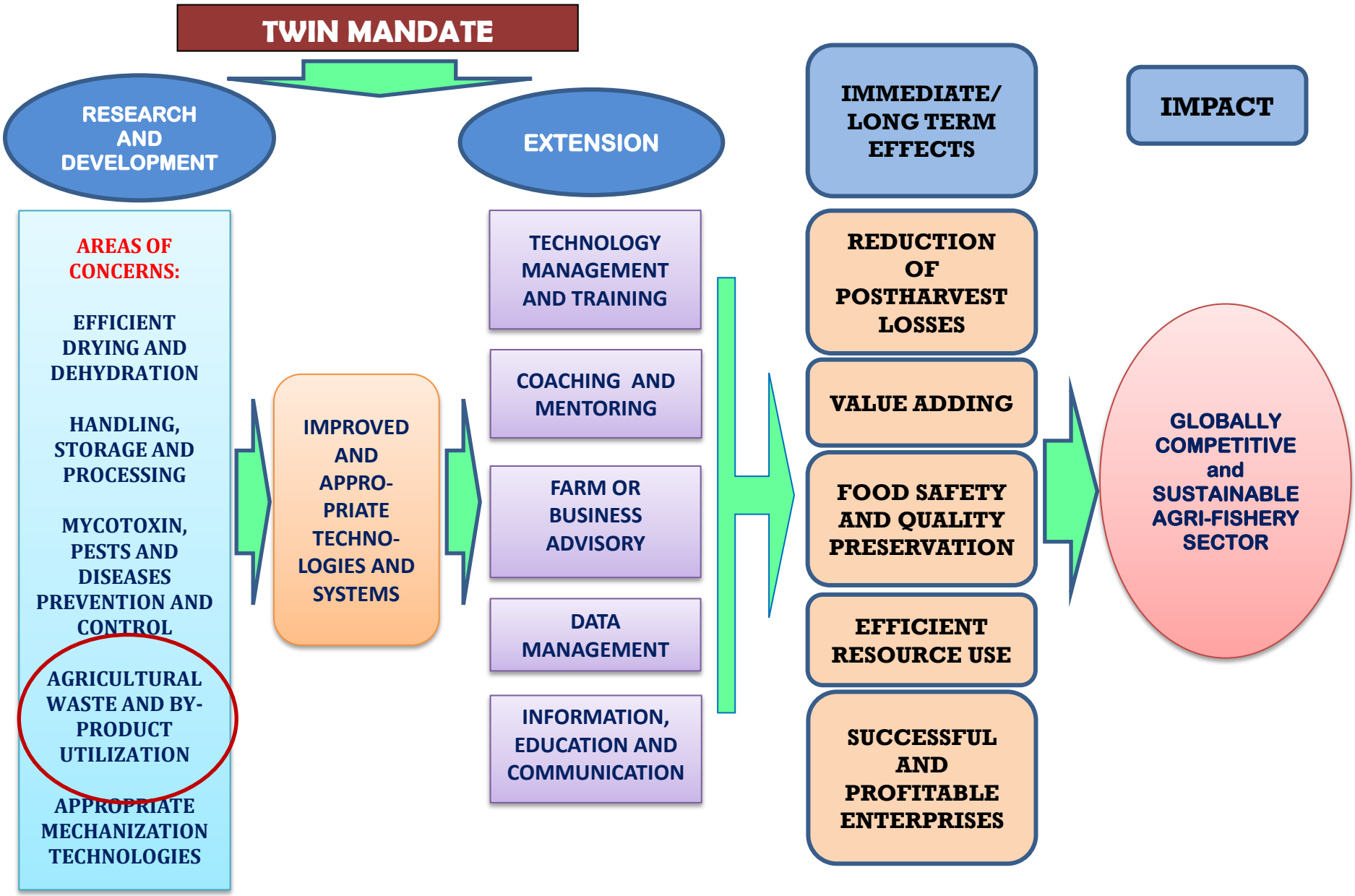
About PHilMech

Philippine Center for Postharvest Development and Mechanization

Mandate

Generate, extend and commercialize appropriate and problem-oriented agriculture and fishery postharvest and mechanization technologies.

The Development Framework of PHilMech



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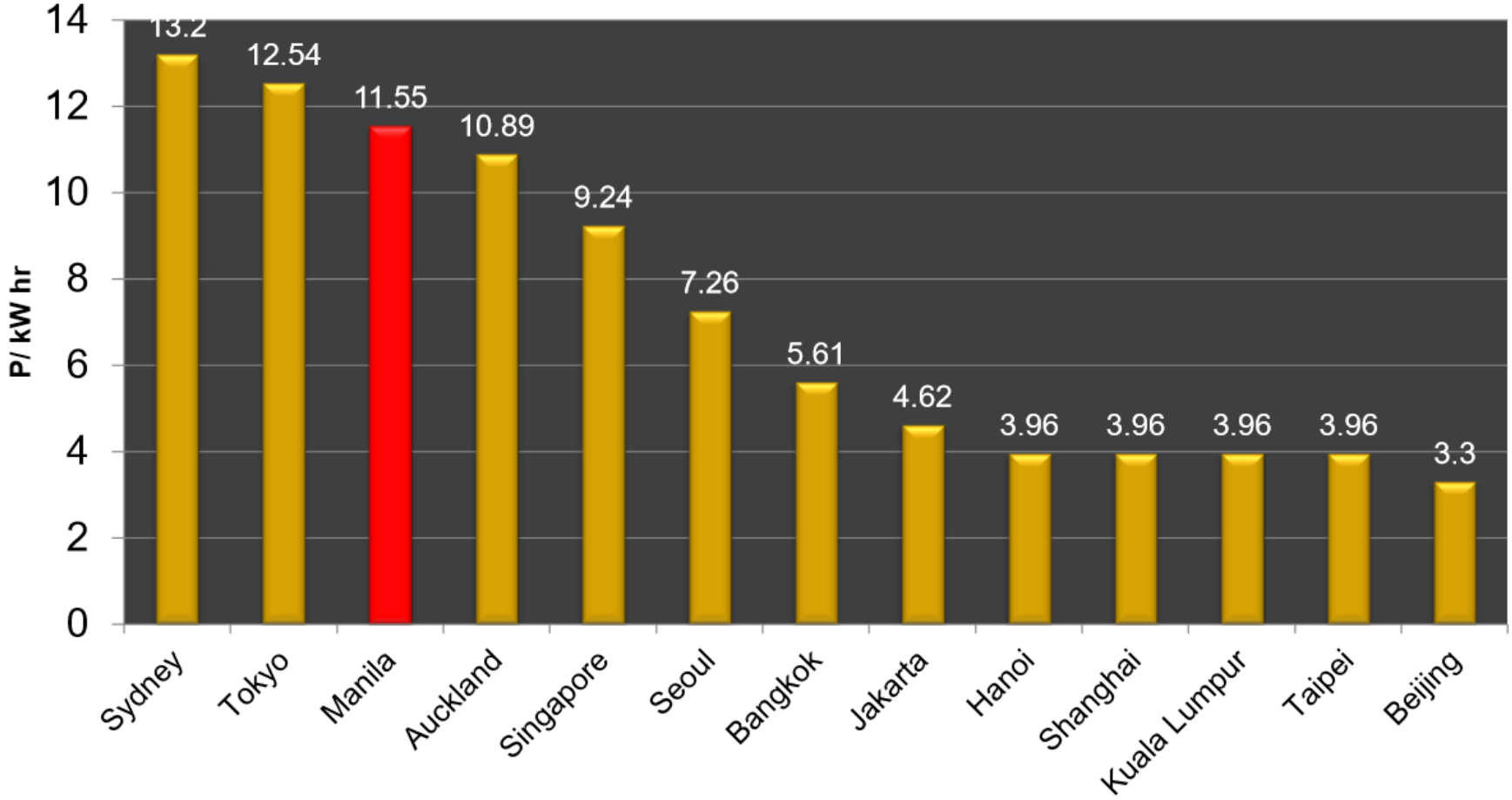
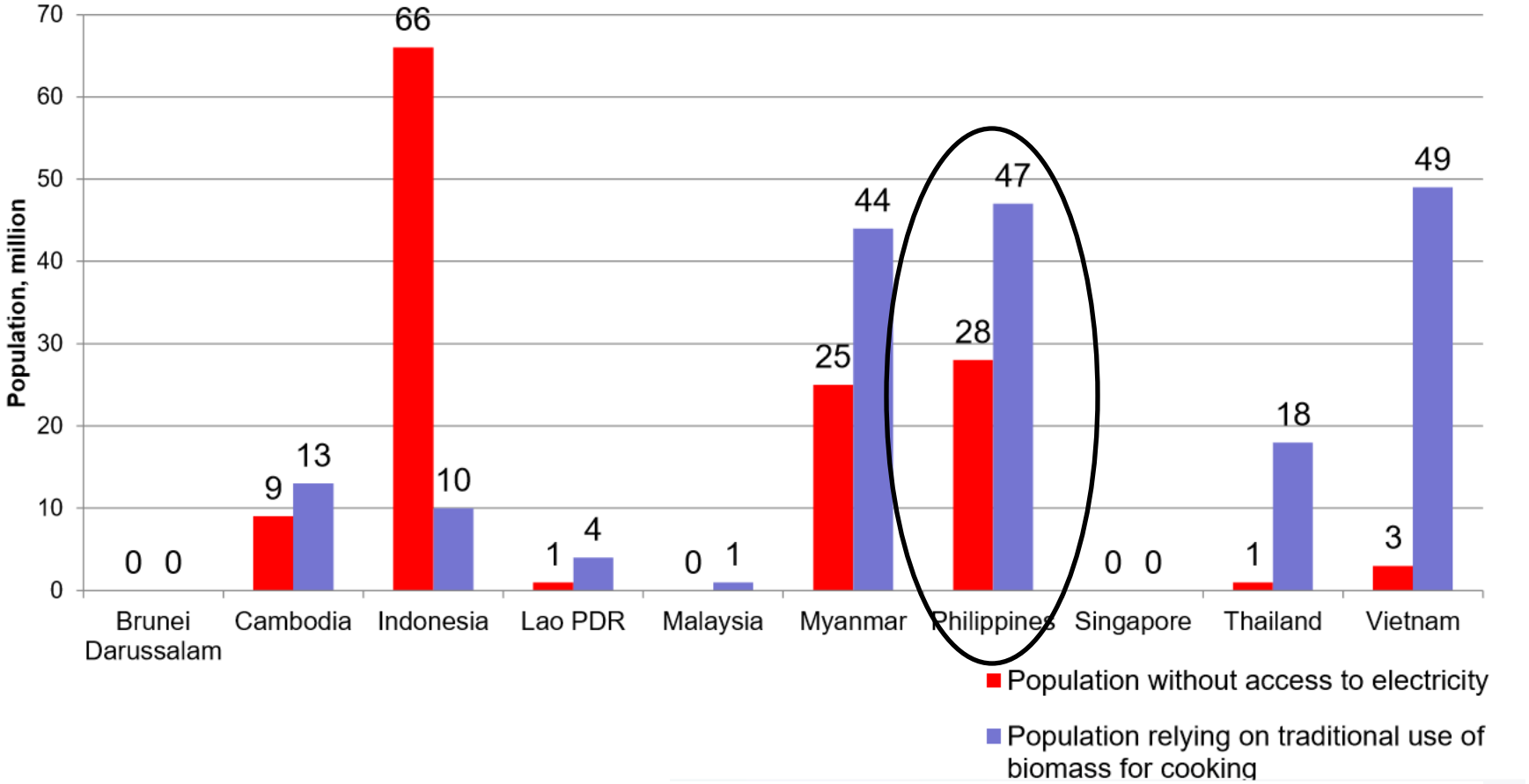
International comparison of cost of electricity



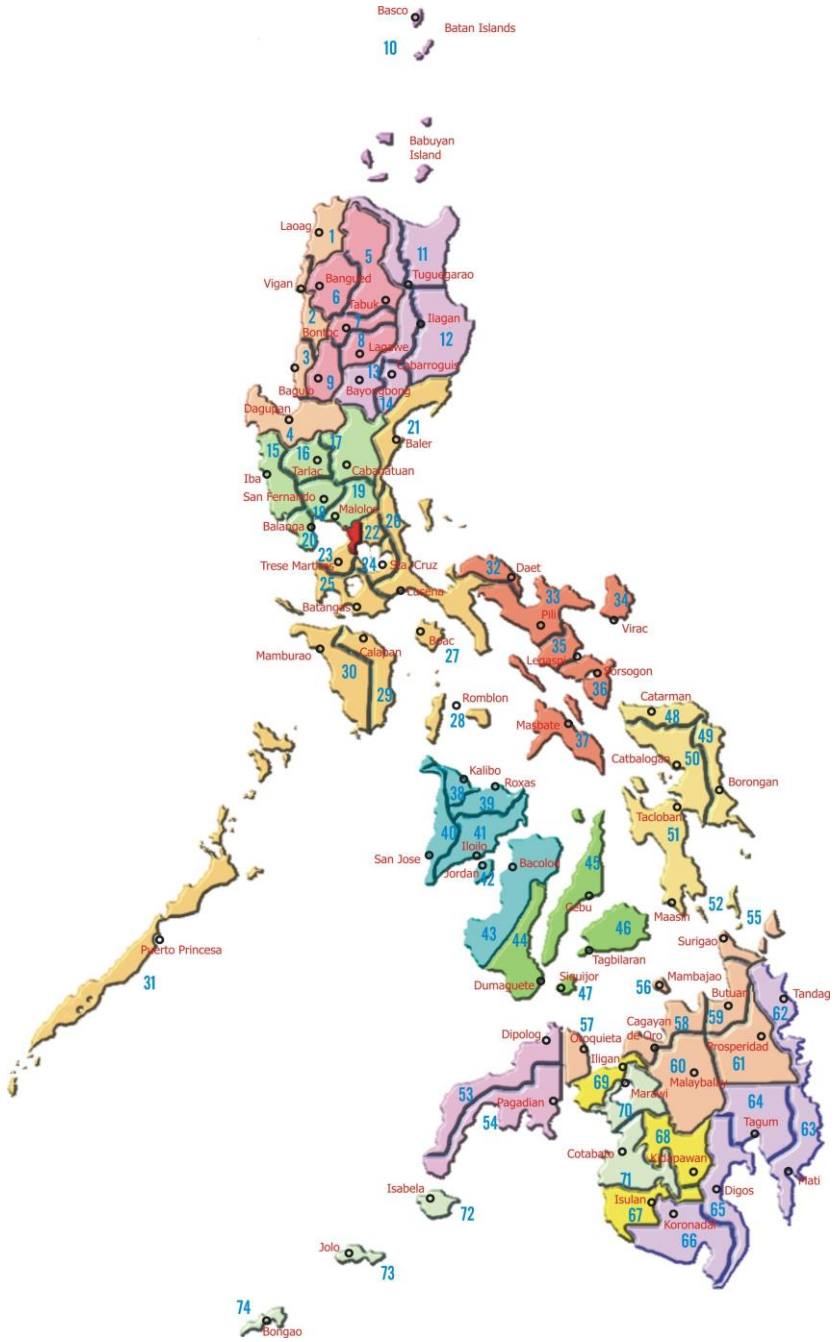
Source: Energy market authority, Singapore, 2013

Access to modern energy sources in ASEAN, 2011

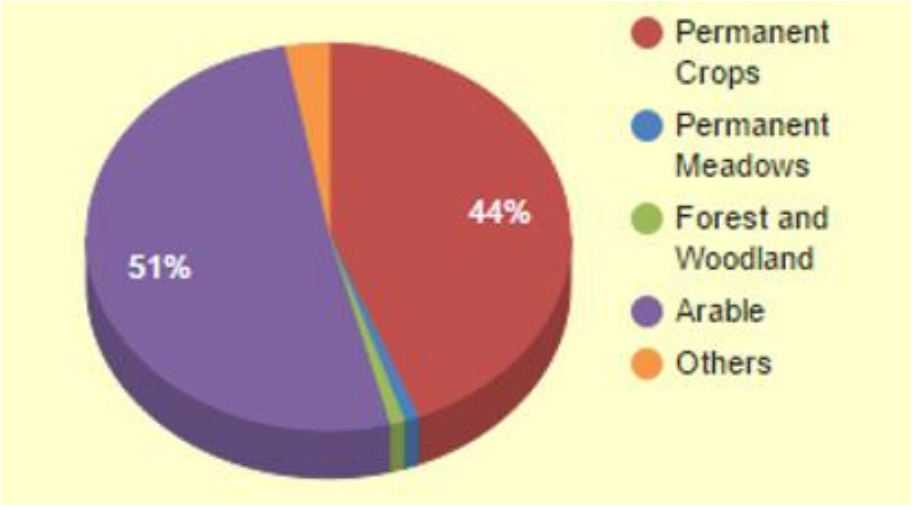


Source: World Energy Outlook, September 2013

One of the important concerns for a sustain able community is its capability to generate affordable, dependable and renewable energy sources



Distribution of agricultural area by type of utilization



Area: 30 Million Ha (13 M ha agricultural lands)
Population: 102,250,000 (2016)
Population density: 343 per square kilometer

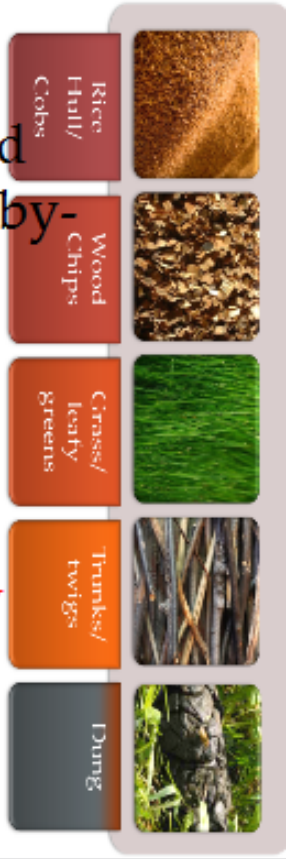
Approximately 32% of the country's total land area are agricultural land, of which 51% and 44 % are arable and permanent croplands, respec tively.

Major Sources of Biomass in the Philippines

FUEL SOURCE: BIOMASS

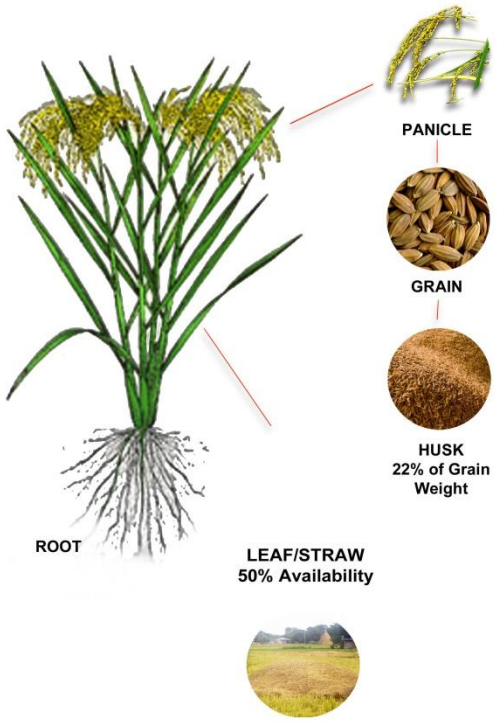
Legal Definition: RA 9513 (Sec. 4b)

- Non-fossilized biodegradable organic materials
- Originating from naturally occurring or cultured plants, animals & microorganisms include agri/by-products, residues
- rice hull/straw, corn cob/stalk,
- sugarcane bagasse, trash,
- coconut husk/shell, frond
- animal manure: poultry, piggery, etc.
- Biodegradable Industrial Wastes/MSW
- energy crops: napier grass, sweet sorghum, bamboo

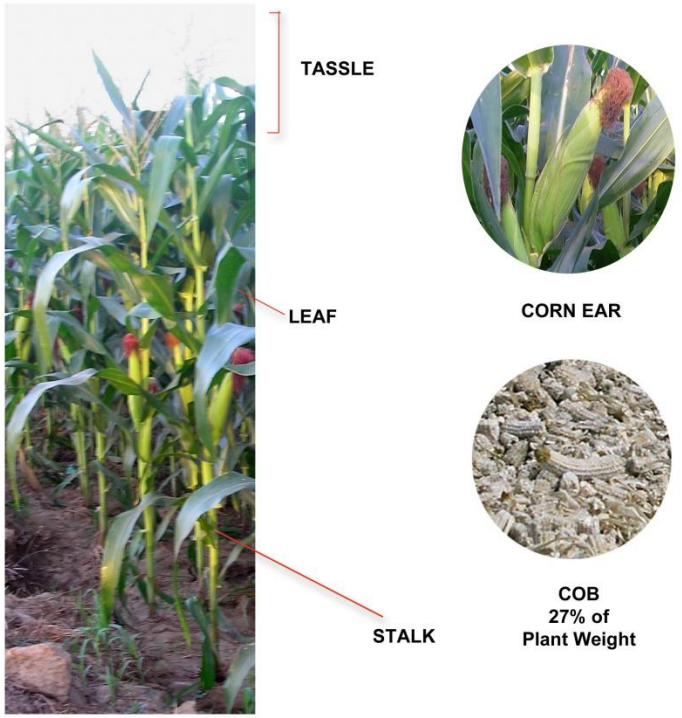


Major Sources of Biomass in the Philippines

Rice



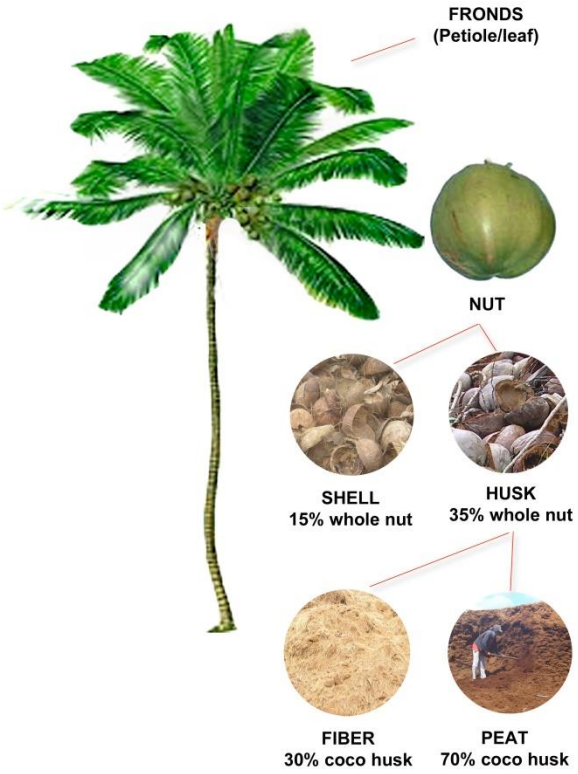
Corn



Biomass Parts of a Rice and corn Plant **(**Regalado, MJ.C & Tadeo, B.D, 2013; *Full Advantage Phils)*

Major Sources of Biomass in the Philippines

Coconut

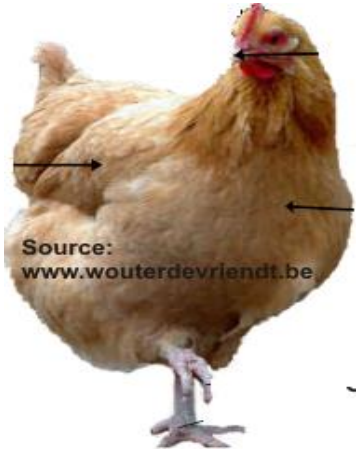


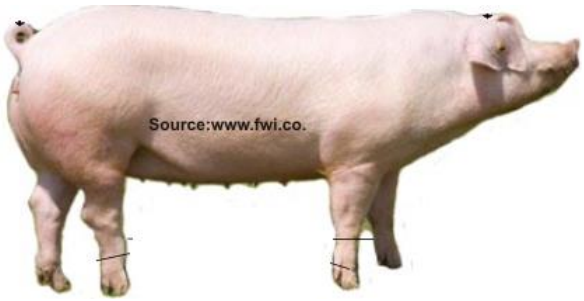
Sugarcane

Main Biomass Parts of a Coconut Tree **(**Regalado, MJ.C & Tadeo, B.D, 2013; *Full Advantage Phils)*

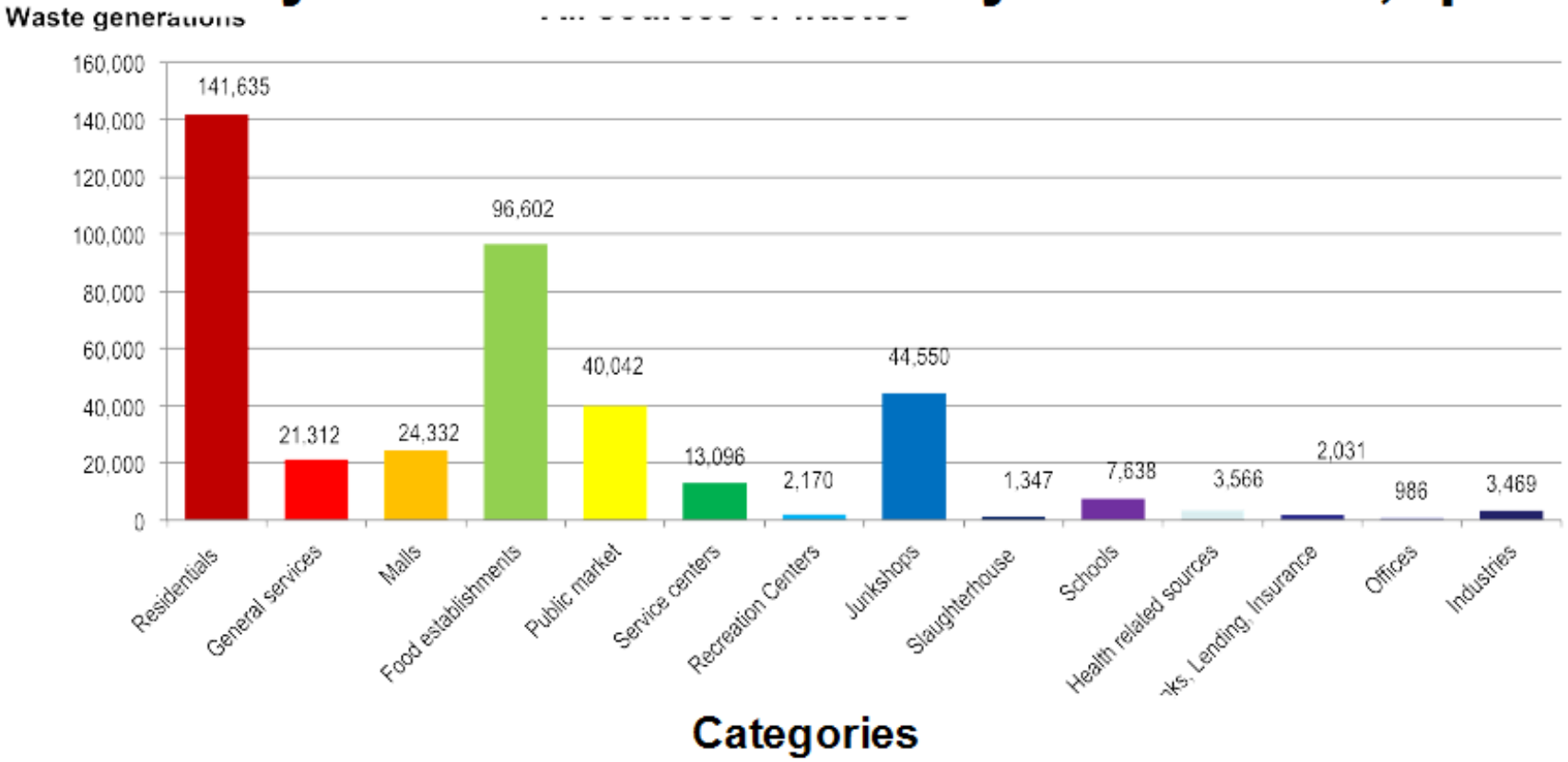
Major Sources of Biomass in the Philippines

Manures from Poultry and piggery farm





City Waste Generation by SOURCES, tpd



Source: Baguio City SWM Plan, 2015

Theoretical and technical residue volume of major crops in the Philippines, 2016 (Adapted from Tadeo, B.D. 2015)

Crop/Animal	Production [1]	Agricultural Residues	RPR[2], %	Theoretical tons	Recovery ability[5], %	Technical tons
1. Rice	17,627,245	Rice husk	22.5	3,966,130	95	**3,767,824**
		Rice straw	100.0	17,627,245	50	**8,813,623**
2. Corn	7,218,816	Corn cob	27.0	1,949,080	95	**1,851,626**
		Corn stalk	400.0	28,875,264	50	**14,437,632**
3. Coconut	13,825,080	Coco husk	33.3	4,603,752	90	**4,143,376**
		Coco shell	15.0	2,073,762	95	**1,970,074**
		Coco frond	197.7	27,332,183	50	**13,666,092**
4. Sugarcane	22,370,546	Bagasse	29.0	6,487,458	95	**6,163,085**
		Cane trash	10.0	2,237,055	50	**1,118,527**
5. Poultry (birds)	183,429,000	Chicken manure	4.5[3]	61,907,288	75	**46,430,466**
6. Hog (head)	22,316,600	Pig manure	2.0[4]	669,498,000	70	**468,648,600**

Sources: (1) FAOSTAT, 2016: rice, corn, coconut, sugarcane production are in tons while poultry in number of birds weighing 1.5 kg each, and hog in number of heads weighing 100 kg each; (2) Department of Agriculture (DA), PhilRice, Philippine Coconut Authority (PCA), Sugar Regulatory Administration (SRA), Philippine Sugar Millers Association (PSMA);(3) 4.5% daily chicken manure production effectively for 5 days per harvest; (4) 2.0% daily pig manure production effectively for 15 days per harvest; (5) Philippine Association of Renewable Energy Centers (PAREC), Full Advantage Phils International, Inc. (FA)

Technical Power Potential, 2016 (Adapted from Tadeo, B.D. 2015)

Agricultural Residues	Technical Volume, tons	Electrical Generation[(1)] kWh/kg	Power Potential[(2)] MWe
Rice husk	3,767,824	0.627	308
Rice straw	8,813,623	0.774	888
Corn cob	1,851,626	0.932	225
Corn stalk	14,437,632	0.872	1,639
Coco husk	4,143,376	1.398	754
Coco shell	1,970,074	1.758	451
Coco frond	13,666,092	1.139	2,027
Bagasse	6,163,085	0.316	254
Cane trash	1,118,527	0.545	79
Chicken manure	46,430,466	0.240	1,451
Pig manure	468,648,600	0.030	1,831
Total			**9,906**

Sources: (1) Averages from different sources (energy generation rate is dependent on the biomass heating value and moisture content, and electric efficiency of certain technologies) as mentioned in the following studies: Energy Efficiency and Power Generation in the Philippine Agro-Industries by Full Advantage Co. Ltd. for the International Finance Corporation; Biomass Resource Assessment in the Philippines by Philippine Association of Renewable Energy Centers (PAREC) for GEF=UNDP-DOE-CBRED Project. (2) Based on a 320-day annual operation. (3) Full Advantage Phils International, Inc.

Existing bio-energy conversion technologies being applied in the Philippines

1. Direct combustion
2. Biomass carbonization and densification
3. Gasification
4. Biogas

1. Direct combustion

Direct Combustion - This makes use of agricultural residues such as rice-hull from the mill, cogeneration using coconut shell, bagasse in sugar mills, kiln-drying of lumber, tobacco-curing, bakeries and other industries for the generation of electrical and heat energy.

Biomass Furnace

- Simple and compact design
- Fully automatic operation
- Clear air output
- With excellent temperature control system
- With ash scrubber unit
- 2 in 1 machine (heater and carbonizer)

Biomass-fed mechanical dryer

- ✓ Low operating cost and maintenance
- ✓ Dries paddy from dripping wet to 14% in 12 hrs at 40-45oC
- ✓ Dricen by a 12.5 hp diesel engine

Biomass-fed mechanical dryer

Two-stage drying system for cocopeat

- ✓ 1st stage: Belt press
- ✓ 2nd statge: rotary drum dryer

Biomass-fed mechanical dryer

Drying system for granulated cassava and animal feeds

- ✓ 6 layers of conveyor belts
- ✓ Fitted with PHilMech Biomass furnace

Rice Hull-Fire Power Plant (Privately owned-Operational)

Operational Biomass Power Plants under the project of Full Advantage Philippines

Rice Hull-Fired Power Plant (Privately owned-Operational)

Renewable Energy Project Development and Implementation

Full Advantage Phils. Internatinal Inc.

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Mandaluyong City, Metro Manila
Tel: (02) 388 5439

REurasia Management Corporation

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7th Floor Unit B 8 Rockwell, Hidalgo Drive, Rockwell Center
Makati City 1210, Philippines

Your Partner in Progress...

CTI Power Systems, Inc.

Unit 1511 AIC Burgundy Empire Tower ADB Avenue, cor. Garnet Road,
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Telefax no. 637-7705

Greenergy Solutions Inc. (GSI)

website: www.greenergysolutions.ph
401 Verde Oro Building, Commonwealth Avenue, Diliman, Quezon City 2126
Metro Manila, Philippines

2014	2015	2016	2016	2017
				
iPower (12 Mwe) Phase 1 San Jose City, NE	IBEC (20 MWe) Isabela)	BBEC (5 MWe) Pili Camarines Sur	GIFT (12 Mwe) Nueva Ecija	iPower (12 MWe) Phase 2 San Jose City, NE

2. Biomass Carbonization and Densification

3. Gasification

This is the process biomass fuel goes through to obtain fuel gas which can either be burned in a boiler or used for generating mechanical power using a diesel engine.

Philrice gasification stove

4. Biogas

Biogas –is a kind of gas that is produced during the anaerobic processing of organic matter such as manure, plant matter, or even municipal waste materials.

Existing Bio-energy Conversion Technologies Uses - Cooking - Brooding and mantle lamp - Commercial oven - Generator - Waster pump - Rice cooker

Scalable polyethylene drum digester (Bureau of Animal Industry)

Some barriers on Biomass Utilization/ Adoption

- Practice of open field burning of agricultural waste/ biomass is the cheapest and practical option prior to land preparation.
- Non-availability of efficient collection system of biomass after harvesting
- Limited initial capital expenditure for modern bio-energy technologies
- Lack of institutional set-up that could facilitate and promote biomass production for energy.

Philippine enabling laws on the utilization of agricultural waste for sustainable development

Important Philippine enabling laws enhancing the utilization of agricultural waste and sustainable development

Republic Act (RA)	Description	Purpose
RA 6969	Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990	- regulates, restricts or prohibits the importation, manufacture, processing, sale, distribution, use and disposal of chemical substances and mixtures that present unreasonable risk and/or injury to health or the environment
RA 8749	Clean Air Act of 1999	- Reduction of greenhouse gas (GHG) emissions in the country. - Prohibits incineration of municipal, biomedical and hazardous waste, except in cases of traditional small-scale method of community/neighborhood sanitation “siga”, traditional, agricultural, cultural, health, and food preparation and crematoria.

Important Philippine enabling laws enhancing the utilization of agricultural waste and sustainable development

Republic Act (RA)	Description	Purpose
RA 9003	Ecological Solid Waste Management Act of 2000	- mandates Local Government Units to divert at least 25 percent of their solid waste into recycling and composting, and away from disposal sites.
RA 9275	Philippine Clean Water Act of 2004	- Directs the DENR to safeguard our water resources and implement a wastewater charge system in all management areas through the collection of wastewater charges/fees.
RA 9367	Biofuels Act of 2006	- Mandates the blending of minimum 10% (E10) motor fuel grade (anhydrous), eventually locally-sourced bioethanol and 2% biodiesel and other biofuels made from biomass and primarily used for motive, thermal and power generation.

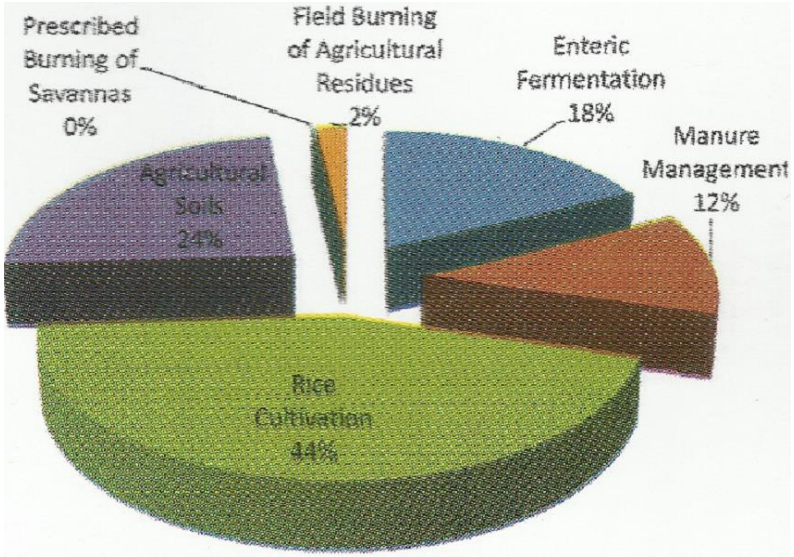
Important Philippine enabling laws enhancing the utilization of agricultural waste and sustainable development

Republic Act (RA)	Description	Purpose
RA 9513	Renewable Energy Act of 2008	- Establishes the framework for the accelerated development and advancement of renewable energy (RE) resources (biomass, solar, wind, run-off river hydro), and the development of a strategic program to increase its utilization.
RA 9729	Climate Change Act of 2009	- Systematically integrates the concept of climate change in various phases of policy formulation, development plans, poverty reduction strategies and other development tools and techniques by all agencies and instrumentalities of the government.

Important Philippine enabling laws enhancing the utilization of agricultural waste and sustainable development

Republic Act (RA)	Description	Purpose
RA 10068	Organic Agriculture Act of 2010	- Promotes, propagates, develops further, and implements the practice of organic agriculture that will cumulatively condition and enrich the fertility of the soil and increase farm productivity; - Reduce pollution and destruction of the environment; prevent the depletion of natural resources; - Protect the health of farmers, consumers and the general public.

Climate Change Mitigation and Adaptation



The 2000 greenhouse gas (GHG) inventory, the Philippine agricultural sector emitted more than 37,000 Gg CO2-equivalent, which is a 12% increase in the 1994 inventory.

GHG mitigation and adaptation measures:

- Use of agricultural wastes for renewable energy generation (RA 9513)
- Organic fertilizer production (RA 10068)
- Eliminate open field burning (RA 8749, RA 9003)
- Less water in irrigated rice

Final Remarks

- Energy from biomass constitutes an important part of the total energy supply in the country.
- Biomass energy is an ideal option to replace expensive energy supply during peak hours
- Agricultural waste/ Biomass is widely distributed and available in the country
- Agricultural waste/ biomass has the most positive community impact in the avoidance burning agricultural waste
- Power from the agricultural waste/ biomass has significant potential across the entire country.
- Biogas technology was included in the animal waste resource management program
- The government and the private sector must join hand and hand to utilize the untapped energy from biomass.

Mabuhay !

References

1. Full Advantage Co. Ltd. “Energy Efficiency and Power/Cogeneration in the Philippine Agro-Industries.” Final Report prepared for the International Finance Corporation, May 2010.
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3. Climate Change Commission. “National Climate Change Action Plan,” August 2011.
4. PHilMech Annual Report, 2015
5. Tuates, A.M. 2015. Bio-energy in the Philippines.
6. Regalado, MJ.C & Tadeo, B.D, 2013. Status of Agricultural Waste and Sustainable Development in the Philippines.