THE NON-CONVENTIONAL ENERGY SYSTEMS (NES) CENSUS OF PANAY AND GUIMARAS

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Abstract---*This paper presents in brief selected results of the census of non-conventional energy systems (NES) of Panay and Guimaras. The census was conducted by the Central Philippine University- Affiliated Non-conventional Energy Center (CPU-ANEC) as part of the National Census of NES mandated by the Department of Energy (DOE) through its Non-Conventional Energy Division (NCED). One important finding shown by the results of the census is that biomass is the greatest contributor of non-conventional energy in Panay and Guimaras. Another important finding which is somewhat already expected, is that wind pumps proliferate in Iloilo. However, many of these are inoperational due to technical failure and a good number had been damaged by strong typhoons. Findings like these can serve as useful inputs in the formulation of area-based energy plans to effectively promote the widespread use of non-conventional energy. Furthermore, other government and private institutions, individual researchers, project implementors and entrepreneurs can also make good use of these findings as well as other additional information that can be gleaned from the results of the census. The complete results are available at the CPU-ANEC office to interested parties upon request.*

INTRODUCTION

The Department of Energy (DOE), in its effort to increase the contribution of non-conventional energy in the total energy mix of the country in order to help lessen the country's dependence on imported fuel oil and promote environment-friendly energy systems, decided to strengthen its non-conventional energy program which is being implemented through its Non-Conventional Energy Division (NCED).

One of the initial steps undertaken towards this end was the conduct of the National Census of Non-conventional Energy Systems (NES). The main objective of the census was to establish a database of baseline figures on the extent of NES utilization in the country. This baseline database will provide information that can serve as useful inputs in the formulation of future non-conventional energy programs. Such a database can also be a source of helpful information even for other non-energy-related undertakings.

DEFINITION OF TERMS

Non-conventional or ***renewable energy*** is energy derived from resources whose utilization are not as widespread and as large-scale as conventional ones such as oil, large hydro, and geothermal. These non-conventional energy resources include wind, solar, biomass (vegetal and animal matters such as wood, rice hull, bagasse, animal wastes, etc.), ocean (current, wave, thermal) and microhydro (small streams or waterfalls).

Non-conventional energy systems (NES) refer to devices or systems that convert these non-conventional energy resources into useful energy forms. NES are usually characterized as site-specific, modular, small scale and decentralized. NES covered in the census are enumerated and defined in the following paragraphs.

Wind energy conversion systems (WECS) convert energy in the wind into a rotational motion which is used directly for mechanical application as in *wind pumps*, or converted further to electricity for more varied applications as in *wind turbine generators*.

Solar energy systems are of two types: those that directly use the heat energy from the sun for heating or drying purposes like *solar dryers (excluding concrete pavements)* and *solar water heaters*; and those that directly convert sunlight into direct current (DC) electricity using solar cells as in *Photovoltaic or PV systems*.

Biomass energy systems convert stored energy in biomass into heat or another fuel form either by direct combustion as in *stoves, ovens, kilns, boilers, dryers*, or by controlled decomposition as in *biogas*

digesters.

Microhydro systems convert energy from moving or falling water using a water wheel or a turbine for direct small-scale mechanical application and/or electricity generation.

METHODOLOGY

The Affiliated Non-conventional Energy Centers (ANECs), established by NCED in nineteen (19) state and private universities and colleges strategically located in all the regions throughout the country were mandated to conduct the census in their respective areas of coverage. NCED provided the ANECs with an initial list of NES installations found in their areas of coverage. This list, though not complete and up-to-date, provided a document to start with. The ANECs verified the existence of the listed installations, updated the list and used the same as a starting point. It was left to the individual ANECs to decide on how to identify additional installations not found in the initial list.

Census questionnaires (one per NES type), the enumerator's manual and the table formats to be used in reporting the results were provided by NCED to ensure uniformity of collected data and reported results, but the ANECs were given the freedom to formulate their own strategies in implementing the census.

Most of the ANECs started conducting the survey during the third quarter of 1994 and have completely covered all the provinces in their areas by the end of 1995, but in some areas, especially in areas where the ANECs are newly established, the census is still ongoing.

CPU-ANEC's coverage included the provinces of Aklan, Antique, Capiz, Iloilo and Guimaras. The census of these provinces was started in Iloilo in October 1994. Eight full time enumerators mostly fresh engineering graduates, were fielded out and were able to cover all the five provinces in three months. The help of municipal planning officers and barangay officials were solicited by the enumerators in identifying additional NES installations in their respective municipalities and barangays. After the data gathering, data from the questionnaires were then entered into a computerized database using the NESCON program, also provided by NCED. A copy of the database files created by the program and the printed results in the prescribed table formats were then submitted to NCED for aggregation at the national level.

RESULTS AND OBSERVATIONS

The complete results of the census are presented in seven (7) tables prescribed by NCED as follows: Table 1, Contribution by resource by province/ municipality (in BFOE); Table 2, Contribution by resource by province/municipality (in Percent); Table 3, Contribution by technology by province/ municipality (in BFOE); Table 4, Contribution by technology by province/municipality (in Percent); Table 5, NES installation by province/ municipality by capacity; Table 6, Number of NES installation by province/municipality; and Table 7, Non-operational NES installations.

These results are available at the CPU-ANEC office, College of Engineering, Central Philippine University, Jaro, Iloilo City. Census results for other areas in the country are also available at the concerned ANEC offices while national level results are available at the NCED office, PNPC Complex, Fort Bonifacio, Makati City.

Only selected results for Panay and Guimaras are gleaned out from these tables and presented here together with some important observations.

Noncon Energy Contribution by Resource

Table 1 shows that biomass resources (manure, bagasse, ricehull, cocohusk, cocoshell, wood/ woodwastes, and charcoal combined) is the greatest contributor of non-conventional energy in Panay and Guimaras. This contribution amounts to 1,970,862.82 BFOE (barrels of fuel oil equivalent) which is 99.99% of the total noncon energy utilization. Among the biomass resources, bagasse contributes the most (1,327,659 BFOE, 67%). This is due to the presence of large sugar mills in Iloilo, Capiz and Antique which utilize bagasse as fuel for their boilers. The next highest biomass contribution is by wood/woodwastes (636,736 BFOE, 32%). This is attributable to the use of fuelwood and woodwastes in bakery ovens, in commercial stoves and furnaces, and in pottery and lime kilns. Ricehull contributes only 5,966 BFOE (0.3%) but the amount can be considered important because of the fact that ricehull is always considered as rice milling waste and a problem for rice millers to dispose of.

The other sources of noncon energy, despite the considerable number of installations identified, contribute very insignificant amounts: solar, 126.87 BFOE and wind, 2.46 BFOE. This is because these systems are mostly used for household applications only thereby requiring very small per-unit

capacities. Besides, many of the identified installations are inoperational due to a couple of important reasons discussed in the section of Non-operational NES installations.

Noncon Energy Contribution by Technology

By technology (Table 3), boilers are the largest contributors (1,846,175 BFOE). These boilers are used in the sugar centrals to generate steam for power generation and sugar processing and these have very large capacities. Ovens, kilns and furnaces, combined, contribute 119,895.3 BFOE. Most of the ovens are used in bakeries. Kilns and furnaces are used for pottery making and lime production. Biomass fueled dryers also contribute a fair amount (2,694.6 BFOE) while the other remaining technologies have very small BFOE contributions: biogas, 123.3; solar water heater, 113.4; PV, 13.3 and wind pump, 2.5.

NES Installations by Capacity

Table 5 gives a summary of NES installations by capacity. Capacities are expressed in different units for different technologies and the units are by no means equal. This may be a little confusing because larger values do not necessarily mean that the capacities are greater than those with lesser numerical values. Wind pump capacity, for example, is expressed in cubic meters (cu.m.) of water output and the total would result to a larger number compared to those of the other technologies. The boiler capacity, on the other hand is expressed in kilowatt (kW) which will consequently result to a smaller number. In terms of the amount of equivalent energy, however, the boiler capacity would translate to a much bigger amount compared to that of the wind pump because a kilowatt of power could pump hundreds of cubic meters of water.

All the 18 biogas digesters identified have a combined total of 1,325.4 cubic meters of digester capacity. The 8 boilers have a combined capacity of 1,135 kilowatts while the 391 ovens, furnaces and kilns only amounted to 27 kilowatts. The two dryers have a total combined capacity of 2.6 tons per hour while the three gasifiers all found in Iloilo have a total capacity of 71.5 horsepower. The PV systems have a combined capacity of 6.973 watt-peak or only 6.973 kilowatt-peak. The five solar water heaters all found in Aklan registered a total capacity of 925 cubic meters of hot water output. The 288 wind pumps, majority of which are in Iloilo, have a combined capacity of 239,504 cubic meters

AREA	Manure	Bagasse	Rice-hull	Coco-husk	Coco-shell	Wood/ Woodwaste	Char-coal	Total Biomass	Solar	Wind	Total
REGION 6	123	1,327,659	5,967	55	30	636,736	163	1,970,733	127	2	1,970,863
AKLAN	0	0	40	0	17	10,950	0	11,006	115	0	11,121
ANTIQUE	0	26,394	14	55	0	5,193	53	31,708	0	0	31,708
CAPIZ	37	352,919	0	0	0	11,811	18	364,784	2	0	364,786
GUIMARAS	0	0	0	0	0	578,848	0	578,848	0	0	578,848
ILOILO	86	948,347	5,913	0	13	29,934	93	984,387	10	2	984,399

Table 1. NES Contribution by Resource by Province (in BFOE)

AREA	Bio-gas	Boiler	Dryer	Kiln/ Furnace	Other Biomass	Total Biomass	SWH	PV	Total Solar	Wind Pump	Other NES	Total
REGION 6	123	1,846,175	2,635	119,895	1,872	1,970,700	113.40	13.30	126.70	2.50	33.40	1,970,861
AKLAN	0	0	0	11,007	0	11,007	113.40	1.50	114.90	0.00	0.00	11,121
ANTIQUE	0	3,576	14	28,118	0	31,708	0.00	0.00	0.00	0.00	0.00	31,708
CAPIZ	37	352,919	0	11,829	0	364,784	0.00	2.20	2.20	0.00	0.00	364,787
GUIMARAS	0	548,864	0	29,984	0	578,848	0.00	0.00	0.00	0.40	0.00	578,848
ILOILO	86	940,817	2,621	38,958	1,872	984,354	0.00	9.60	9.60	2.10	33.40	984,400

Table 3. NES Contribution by Technology by Province (in BFOE)

AREA	Biogas (cu.m.)	Boiler (kW)	Dryer (T/hr)	Gasifier (Hp)	Oven/Kiln Furnace (kW)	SWH (cu.m.)	PV (Wp)	Wind Pump (cu.m.)	Wind Turbine (kW)	Other NES (kW)
REGION 6	1,325.4	1,135.0	2.6	71.5	27.0	925.0	6,973.0	239,504.2	1.0	2.0
AKLAN	0.0	0.0	0.0	0.0	0.0	925.0	804.0	0.0	1.0	0.0
ANTIQUE	1.6	60.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CAPIZ	81.0	1,000.0	0.0	0.0	0.0	0.0	1,150.0	0.0	0.0	0.0
GUIMARAS	0.0	0.0	0.0	0.0	10.0	0.0	22.0	27.0	0.0	0.0
ILOILO	1,242.8	75.0	2.1	71.5	17.0	0.0	4,997.0	239,477.2	0.0	2.0

Table 5. NES Installation by Province by Capacity

of pumped water output. The only wind turbine found in Aklan has a capacity of one kilowatt.

Number of NES Installations

A total of 836 NES installations were identified throughout Panay and Guimaras (Table 6). Of these, 552 are found in Iloilo, 97 in Capiz, 86 in Antique, 64 in Aklan and 37 in Guimaras. Ovens, kilns and furnaces, combined, were found to be the most numerous of all NES installations (391). This is followed by wind pumps (288) and PV systems (117). Most of the wind pumps are found in Iloilo and the most common application is domestic water pumping. This proliferation could be attributed to the four wind pump manufacturers all based in Iloilo with Condor having installed the most number of units. PV installations are also numerous in Iloilo and Guimaras because of the implementation of a Rural PV Electrification Project in two pilot barangays in Iloilo and Guimaras by the Special Energy Program of the National Electrification Administration.

Other NES installations identified were biogas systems (18), boilers (8), solar water heaters (5), gasifiers, (3), dryers (2), wind turbine (1), other biomass (2) and other NES (1). These numbers represent what have been identified during the census period and are in no way final. There may still be other existing NES installations which have not yet been identified, new ones are being installed while others are decomissioned or demolished. The database is being updated as new data become available through continuous monitoring and identification of new installations.

Non-operational NES Installations

Various non-operational NES have also been identified during the census and Table 7 gives the summary of these installations by technology and by reasons for being non-operational.

Twenty-two (22) inoperational biogas systems have been identified with ten (10) having technical reasons for being inoperational, one (1) listed economic and eleven (11) gave other reasons. There were four (4) inoperational boilers, two (2) have technical failures, one (1) has economic and one (1) has other reasons. For wind pumps, fifty-nine (59) were identified as inoperational. Forty (40) of these were found to have technical causes of failure, one (1) is economics while eighteen (18) are caused

AREA	Biogas	Boiler	Dryer	Gasifier	Kiln/ Furnace	Other Biomass	SWH	PV	Wind Pump	Wind Turbine	Other NES	Total
REGION 6	18	8	2	3	391	2	5	117	288	1	1	836
AKLAN	0	0	0	0	57	0	5	1	0	1	0	64
ANTIQUE	1	1	1	0	83	0	0	0	0	0	0	86
CAPIZ	9	2	0	0	63	0	0	23	0	0	0	97
GUIMARAS	0	2	0	0	31	0	0	1	3	0	0	37
ILOILO	8	3	1	3	157	2	0	92	285	0	1	552

Table 6. Number of NES Installations by Province

SYSTEMS	REASONS		
	Technical	Economics	Others
BIOMASS	25	12	36
Biogas	10	1	11
Boiler	2	1	1
Dryer	7	3	1
Oven/Kiln/Furnace	3	6	23
Gasifier	3	1	
SOLAR	-	-	-
Solar Water Heater			
Solar Dryer			
Photovoltaic			
WINDPUMP	40	1	18
MICRO-HYDRO	-	-	-
OTHER NES	-	-	-

Table 7. Non-operational NES Installations

by typhoon damage. Of the ovens/kilns/furnace systems, twenty-nine (29) inoperational units have been identified. Only three (3) installations stopped because of technical failure, six (6) because of economic reasons while twenty-three (23) installations listed other reasons for being inoperational. Of the four (4) inoperational gasifiers, three (3) have technical reasons and one (1) has been inoperational due to economic reason.

CONCLUSIONS AND RECOMMENDATIONS

The census revealed in finer details the status of non-conventional energy utilization in the country. NES being site-specific and location-sensitive in application, the details provided by the census could serve as useful inputs for the integration of the use of non-conventional energy systems into the rural development plans in the local, regional and national levels.

These results, however, are not final. There may still be existing systems that the enumerators failed to locate due to lack of information or accessibility constraints. New installations may have come up or existing ones may have been demolished or abandoned. Continuous monitoring and updating is necessary. Nevertheless, these being baseline figures can still serve some meaningful and useful purpose to different users.

The usefulness of these data is not limited to the DOE or the ANECs alone. Other government and non-government institutions as well as private individuals, especially entrepreneurs, could make good use of these data. Thus, there is a need to make these people know of the existence of these data and to make these data easily available to interested users.