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Energy Efficiency and Conservation: Philippine Green Environment Programs

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ABSTRACT —Green technology is a system using innovative methods in creating environmental friendly products. It uses renewable natural resources and can effectively change waste pattern and production in a manner that will not harm the environment. Green technology can be in the area of energy, green building, environmentally preferred purchasing, green chemistry, and green nanotechnology. In pursuit of improving the country's energy security and mitigation measures for the effect of energy utilization to the environment, the Philippine government though the Department of Energy (DOE) is continuously implementing programs on the use of alternative fuels and energy technology, and in making energy efficiency and conservation a way of life. This paper intends to disseminate the green environment programs of the country in the area of energy which includes alternative fuels and energy technology and the national energy efficiency and conservation program. Key initiatives under alternative fuels and energy technology include the project "alternative fuels for transportation and other purposes" which aims to provide energy consumers with alternative and advance energy technologies that are more environment friendly. It includes auto liquefied petroleum gas (LPG) vehicles, natural gas vehicle program for public transport, electric vehicles, electric and hybrid vehicles. DOE's National Energy Efficiency and Conservation Program (NEECP) aims to make energy efficiency and a way of life thus improving the energy utilization of all users, and achieving an annual energy savings and equivalent emissions avoidance. The strategies to achieve these goals include the aggressive promotion of energy conservation and energy efficient technology through information, education and communication campaigns; intensify collaboration effort with the private sector in implementing the programs; continuous implementation and expansion of the appliance, equipment and building energy usage standards; integration of energy efficiency concepts in the procurement practices of the government; the use of alternative fuel; and periodic program monitoring and evaluation to assess the effectiveness of the energy efficiency and conservation programs.

Keywords: ***alternative*** *fuel, DOE, energy conservation, energy efficiency, green technology*

I. INTRODUCTION

The world needs energy in supporting its economic growth and development. Increasing quantities of energy is needed in building a better quality of life. Energy resources should be conserved and utilized efficiently to protect the environment. Energy resources can be non-renewable and renewable. The non-renewable sources come from fossil fuels. The most common are oil, coal and natural gas. Renewable energy sources includes wind, solar, geothermal, hydro and biomass.

Green technology encompasses a continuously evolving group of methods and materials, from techniques for generating energy to non-toxic products. Economic growth and development includes sustainability, source reduction, innovation, viability. Green technology can be in the areas of energy in forms of alternative fuels, new means of generating energy and energy efficiency; green building; green chemistry in the invention, design and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances; and green nanotechnology which involves application of green chemistry and green engineering principles [1]. Philippines in its pursuit of improving the energy security and protecting the environment continuously implements programs on the use of renewable sources of energy such as alternative fuels. The Department of Energy (DOE) develops and implements several programs such as the use of LPG for transportation and other purposes, use of natural gas for public transport, electric tricycles, electric hybrid vehicles and other energy technologies.

The National Energy Efficiency and Conservation Program (NEECP) is also developed by the DOE. The main goal of the program is make energy efficiency a way of life and to improve utilization of all users

through energy efficiency and conservation programs and to achieve an average annual energy savings and reduce CO2 equivalent emissions. The program covers policy, goal and strategy; fuel conservation program; and energy conservation measures in government.

II. ALTERNATIVE FUELS AND ENERGY TECHNOLOGY

Philippines is in pursuit of improving the country's energy security and mitigating the adverse environmental effect of energy utilization. To do so, the government though the Department of Energy (DOE) is continuously implementing programs promoting the use of alternative fuels and new and advanced energy technologies. DOE aims to effectively diversify and manage the utilization of energy resources of the country. Included in the program is the "Alternative Fuels for Transportation and Other Purposes". It is a locally funded project which aims to promote emerging and advanced energy technologies and to introduce alternative fuel for vehicles. It also aims to provide the consumers with alternative fuel which is more environment-friendly and to reduce dependency on oil imports.

1. Auto Liquefied Petroleum Gas (LPG) Vehicles

The increasing price of gasoline in 2007 pushed the commercial taxi owners and operators to utilize LPG as their transport fuel. DOE issued Department Circular No. 2007-02-0002 entitled " Providing the Rules and Regulations Governing the Business of Supplying, Hauling, Storage, Handling, Marketing and Distribution of Liquefied Petroleum Gas (LPG) for Automotive Use". This circular serves as a guideline for the increasing demand of LPG as transport fuel. In addition, to support this initiative, DOE, spearheaded the creation of an interim inter-agency AutoLPG Technical Working Group (TWG), with members from the Department of Transportation (DOTr), Land Transportation Office (LTO), Land Transportation Franchising and Regulatory Board (LTFRB), Department of Trade and Industry-Bureau of Product Standards (DTI-BPS), Department of Science and Technology (DOST), Department of Health (DOH), Department of Environment and Natural Resources (DENR), Department of Interior and Local Government-Bureau of Fire Protection (DILG-BFP), Technical Education and Skills Development Authority (TESDA), and private sector. The TWG serves as an inter-agency coordinating body to address overlapping issues in existing rules and guidelines governing the use of LPG in vehicles. In 2010, there were 17,500 taxi units that were successfully supported by DOE. The department facilitated the conversion of these units and in the establishment of 217 refilling stations that are privately financed. Likewise, additional standards, such as, PNS/UN ECE 67:2006, PNS/UN ECE 115:2006, PNS 04:2006 and PNS/DOE FS 03:2006, were developed and formulated to further improve public acceptance of using LPG in taxis. In June 2016, the interim inter-agency AutoLPG TWG was officially institutionalized through the adoption of the Joint Administrative Order (JAO) No.1 Series of 2016 entitled *"Creating the Inter-Agency Technical Working Group (TWG) on the Use of AutoLPG as Fuel for Public Transport and for Other Related Purposes."* The TWG is targeted to be established in key areas in of the country and aims to harmonize all autoLPG related policies, rules and guidelines. It also aims to establish a mechanism for collaboration, cooperation and coordination among member National Government Agrncies (NGAs) for the effective implementation of the program. DOE has partnered with State Universities and Colleges (SUCs) to integrate the Auto LPG technician course in their technical vocation course offerings. Graduates of the said course will compose the pool of experts and capable technicians for the repair and maintenance of LPG-fuelled vehicles. Information, education and communication (IEC) campaign, scientific studies and formulation and adoption of safety standards, rules and regulations are continuously conducted by the department in order to address the negative public perceptions on the auto LPG program. The University of the Philippines (UP) - Diliman, through its National Center for Transport Studies (NCTS) and Vehicle Research and Testing Laboratory (VRTL) togetehr with DOE, conducted performance testing of jeepneys running in LPG. The results was used as inputs in the development of standards for high-performance Philippine autoLPG jeepney [2].

2. Natural Gas Vehicle Program for Public Transport (NGVPPT)

In 2004, the government initiated the pilot testing of using the locally sourced natural gas as fuel for public transport through Executive Order (E.O.) No. 290 entitled *"Implementing the Natural Gas Vehicle Program for Public Transport (NGVPPT)"*. DOE was designated as the lead implementing agency of the program and other NGAs that have jurisdiction in other aspects of the program, as co-implementing agencies. An Executive Forum was also established to ensure a unified and coordinated inter-agency effort in the implementation of the program. In 2008, the DOE started the program by establishing the first compressed natural gas (CNG) refilling station at MamplasanBiñan, Laguna and thirty-two (32) units of CNG fueled public utility buses (PUBs) were commercially operated. The implementation of the initial phase was considered a success since there was a wide acceptance of cleaner public transport from the riding public. Furthermore, necessary standards were formulated to address public safety and technical issues. These will govern the specifications of equipment and the quality of the CNG buses and the refilling stations. Capacity building

activities are conducted to attain successful technical operations. There was a challenge in transporting CNG from the source to different refilling stations without using a pipeline. Through the use of Material Accumulator Transport System (MATS), the challenge was overcome. Overall, the pilot phase of using CNG for public utility buses was proven to be technically feasible. Economically, the establishment of supply infrastructure remains to be the challenge. Investment opportunities remain to be robust both in the supply infrastructure side and the off-taker side such as the procurement of CNG buses. As of 2014, through this program the country displaced a total of 4 million liters of diesel fuel and reduction in carbon dioxide (CO_2) emissions of around 4,400 metric tons [3].

3. Electric Tricycles

The Department of Energy, in partnership with the Asian Development Bank (ADB) and the Clean Technology Fund (CTF), implements the *Market Transformation through Introduction of Energy Efficient Electric Vehicles Project or the E-Trike Project* to promote energy efficiency and clean technologies in the transport sector. The project aims to reduce the sector's annual petroleum consumption by 2.8 percent (based on 20 million barrels annual consumption in 2010) and to avoid CO_2 emission of estimated 259,008 tons annually by shifting to 100,000 electric tricycles (e-trikes). The project started with twenty (20) locally assembled e-trikes. An improved lithium-ion batteries were used in those e-trikes. Results of the pilot test showed that the tricycle driver and passengers were more comfortable, more passengers are carried thus more income for the drivers. The introduction of e-trikes with lithium-ion battery technology is envisioned to pave the way for increased safety standards and improved environmental compliance which complements government's plan to support e-vehicle business. During the end of 2015, there were ten (10) new companies entered into the manufacturing of e-trikes which generated more than five hundred local jobs and has translated to about PhP500 million of investments. In 2015, the DOE conducted a total of twenty three (23) promotional activities such as IECs, focus group discussions and consultations from which participants came from LGUs, financial conduits and Transport Operators and Drivers Associations (TODA) in order to build up EV market as well as address the concerns on safety, range anxiety, battery and after sales support. The department is working with National Economic Development Authority to refine the implementation and deployment of e-trikes with the transport groups [4].

4. Electric and Hybrid Vehicles

In 2013, the Japan Non-Project Grant Aid was introduced by the Government of Japan (GOJ) to the Philippines. The Japanese Advance Products and its System (Next Generation Vehicle Package) was coordinated to DOE and the Department of Foreign Affairs (DFA). This non-project grant aid is generally designed to support the economic and social development of the country through the provision of Japanese next-generation vehicles. Similarly, the Japanese manufacturers will also be supported by means of the introducing their advance technology vehicles while contributing to our government's efforts of promoting efficient and environment-friendly Alternative Fuel Vehicles (AFVs). The Government of Japan will procure the next generation vehicles such as, hybrid vehicles (HVs), plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs), including charging stations and will be delivered to the Philippines through the DOE. It will then be deployed to the identified beneficiaries. Target beneficiaries include the Philippine National Police (PNP) Stations in the provinces of Leyte and Samar which are devastated by typhoon *"Yolanda",* NGAs' Regional Offices in Region 8 that are instrumental to emergency response operations and rehabilitation. NGAs that could assist in the conduct of research, performance testing and promotion of AFVs were also allotted with vehicles for promotional purposes [5].

5. Other Energy Technologies

The DOE continuously benchmark matured and emerging energy technologies in other countries which can be adopted in the country. Thorough evaluation, testing and validation need to be done to evaluate if the said technologies can be considered for domestic application, specifically in the transport sector. The DOE identified fuel derived from petroleum based waste materials such as plastics and rubbers; micro-energy harvesting and new power generation technologies; energy storage technologies; and energy technologies for household applications such as efficient non-wood based biomass stove for domestic cooking for evaluation and validation of its applicability. Once the technologies are assessed and approved to be locally applicable, performance testing and demonstration of the technologies will be developed for possible commercialization. On the short to medium term, the DOE plans to conduct studies to determine the appropriate business model and policy support toward the mainstreaming of these energy technologies [6].

III. NATIONAL ENERGY EFFICIENCY AND CONSERVATION PROGRAM (NEECP)

Energy efficiency and savings are not new to the Philippines. The Energy Conservation Law was enacted including the Electric Power Crisis Act of 1993 and adoption of independent power producers (IPPs) in 1994 following the shortage of power supply starting 1991; and the Electric Power Industry Reform Act in 2001 and the Government Energy Management Program in 2004 to address the high cost of electricity starting 2000 and the high oil prices in 2003. It also filed the energy efficiency and conservation bill in 2013 to address the anticipated power supply shortage. In 2004, Administrative Order No. 110 institutionalized a government energy management program that sought to reduce the government's monthly consumption of electricity (in kilowatt-hours) and petroleum products (in liters) by at least 10 percent. Savings from September 2005 to March 2013 amounted to P2 billion (P1.7 billion on electricity and P274 million on fuel). A follow-up Administrative Order No. 183 in 2007 directed the use of energy-efficient lighting system in government facilities. Earlier, the DOE issued a circular requiring all power-hungry establishments in the industrial, commercial and transport sectors to submit quarterly energy consumption reports and an annual energy conservation program report. The government also has an annual energy efficiency award, a recognition given to companies with significant energy savings achieved through the implementation of energy-efficient technologies and measures. In 2013, the program generated savings of 56 million LOE (liters of oil equivalent) and monetary savings of P2.4 billion and more than 90 million kilos of avoided carbon dioxide from 58 commercial and industrial establishments [7].

The Department of Energy (DOE) is mandated to provide adequate, reliable and affordable energy to industries to enable them to provide continuous employment and low cost of goods and services, and to the ordinary citizen - to enable them to achieve a decent lifestyle. Energy should not only be produced and used in a manner that will promote sustainable development and utilization of the country's natural resources but at the same time contribute to the country's overall economic competitiveness and minimize negative environmental impacts. Energy independence and savings program were introduced in 2010 which include increasing indigenous oil and gas reserves, developing renewable energy, increasing the use of alternative fuels, forging strategic alliances with other countries and implementing strong efficiency and conservation program. NEECP aims to make energy efficiency and conservation (EE&C) a way of life. The goal of the program is to improve utilization of all users through energy efficiency and conservation programs and to achieve an average annual energy savings of 23 MMBFOE and 5.086 Gg CO2 equivalent emissions avoidance [8].

An Energy Efficiency and Conservation Roadmap for the Philippines (2014-2030) was created. The main goal is to save energy equivalent to 10% of the annual final energy demand. The roadmap guides the country in building an energy-efficient nation and in making energy efficiency and conservation a way of life for all Filipinos. Energy efficiency will advance the country's economic development and help ensure energy security, optimal energy pricing and sustainable energy systems [9].

1. Energy Efficiency and Conservation Policy, Goal and Strategy

It is declared policy of the government to promote the judicious conservation and efficient utilization of energy resources through adoption of the cost-effective options toward the efficient use of energy to minimize environmental impact. The primary goal of the government towards energy efficiency and conservation is to make it a way of life, to save from the implementation of energy efficiency and alternative fuels programs increase awareness and reduce $C0_2$ equivalent greenhouse gas emissions. The strategies to achieve these goals include: the aggressive promotion of energy conservation and energy efficient technology to effect higher energy savings both for the consumer and producer through information, education and communication campaigns; intensify collaboration effort with the private sector in implementing energy efficiency programs through voluntary agreements; continuous implementation and expansion of the appliance and equipment energy standards and labeling implementation of building energy usage standards; integration of energy efficiency concepts in the procurement practices of the government; the provision of technical assistance in identifying, implementing and evaluating effective measures to improve energy use efficiency; the use of alternative fuel to reduce dependence on imported oil; and periodic program monitoring and evaluation to assess the effectiveness of the energy efficiency and conservation plan [8].

2. Fuel Conservation Program

Fuel conservation program includes carless day program, car pooling program, park and wait, park and pick, park and fly, park and walk and park and ride program. Carless day program is a fuel conservation measure that encourages commuters to burn calories instead of fossil fuel, reduce traffic congestion and air pollution, and leave the car at home one day a week. A carpool consists of three or more people that commute to work or other destinations in a private vehicle in which members work out their own arrangements on who drives and how often, schedules, and payments for gas and maintenance. Park and wait encourages motorists to turn off their engines when stopped for more than 10 seconds. This also calls for the reduction in warming engines to 30 seconds and to turn off engines when parked or when gassing up. Park and pick program encourages vehicles, particularly taxis, to park only at designated places or sites and not to roam around to pick up passengers.

Passenger, should proceed to designated places for their taxi ride. Park and fly are for domestic flight passengers with vehicles on a day or overnight trip. There are facilities at the airport where they can park and fly to and from their destination, and drive back home with their cars. Walking instead of riding is another option to save on fuel. Walking a distance is a more healthful option that will result to less vehicle emission; promotion of a healthy disposition for the body; and for a healthy Mother Earth. A short distance walk is a better alternative than a heavy consumption of fuel for a short trip. This is the concept of park and walk program. Park and ride encourages the use of public transport such as the MRT and LRT to help lessen traffic congestion at the same time provide seamless journey for the travelling public. Accessible or strategic sites will be provided near the stations of the MRT/ LRT for the vehicle owners to park their units and ride to and from their destinations using the identified transportation means [8].

3. Energy Conservation Measures in Government

The government's energy policies are grounded on two main thrusts: 1) to respond to the need of ensuring a continuous, adequate, and economic supply of energy with the end in view of ultimately achieving self-reliance in the country's energy requirements; and 2) to promote and adopt energy conservation, renewal, and efficient utilization of energy so that our energy supply and resource can keep pace with our country's growth and economic development. The Committee on Power Conservation and Demand Management was created with a mandate to pursue the said policies. To perform the said mandate, the Committee is riding on the campaign, "Power Patrol" with a clear goal of reducing the need for oil imports through energy efficiency that will lower the capital and operating costs of electricity, thus provide Filipinos with sufficient electricity at lowest possible costs. The household and village sector, commercial and industrial sector, and school and institutional sector are the three sectors that have been identified as target audiences of "Power Patrol."

"Road Transport Patrol" was launched recognizing the fact that transport is one of the highest energy-consuming sector next to industrial sector. Likewise, there is a considerable information gap among transport users, vehicle owners, drivers, technicians, etc. on the proper operating and maintenance practices to reduce fuel consumption. To bridge the gap, the "Road Transport Patrol" which aims to intensify information, education and training programs on road transport to address the needs of target participants. It aims to disseminate information and motivation campaign to achieve the necessary widespread change in knowledge, skills, and especially in attitudes on efficient utilization of fuel in vehicles. The program targets 5% fuel reduction by road transport users [9].

IV. CONCLUSIONS AND RECOMMENDATIONS

The existing programs of the Philippine government in the utilization of alternative fuels and energy technology and the national energy efficiency and conservation program will pave the way of achieving its goal of making energy efficiency and conservation a way of life. Proper implementation of the programs by the DOE and full cooperation of all stakeholders will reach the target of saving energy and reducing greenhouse gas emissions as targets in the energy efficiency and conservation roadmap of the country. Existing programs are to be continuously monitored and reviewed to ensure energy security, optimal energy pricing and sustainable energy systems in advancing the country's economic growth and development. Analysis and evaluation of the effectiveness of these government programs are highly recommended.

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