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30TH ANNUAL SCIENTIFIC MEETING

Energy Security and Sustainability:
Assessing the Present and
Foreseeing the Future

9-10 July 2008

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30TH ANNUAL SCIENTIFIC MEETING

ENERGY SECURITY AND SUSTAINABILITY: ASSESSING THE PRESENT AND FORESEEING THE FUTURE

9-10 July 2008
The Manila Hotel
Roxas Boulevard, Manila

30th ASM STEERING COMMITTEE

Academician Ceferino L. Follosco, Chairman

Members
Academician Eliezer A. Albacea
Academician Angel L. Lazaro III
Academician Leonardo Q. Liongson
Academician William T. Torres
Academician Filemon A. Uriarte Jr.
Academician Reynaldo B. Vea
Academician-elect Alvin B. Culaba

TABLE OF CONTENTS

Trans. Natl. Acad. Sci. Tech. Philippines 30:v-viii (2008)
ISSN 0115-8848

FOREWORD

AN ACCOMPLISHMENT REPORT ON THE 30TH ANNUAL SCIENTIFIC MEETING

The 30th Annual Scientific Meeting (ASM) of the National Academy of Science and Technology (NAST) had for its theme ***"Energy Security and Sustainability: Assessing the Present and Foreseeing the Future."*** The meeting was organized by the Engineering Sciences and Technology Division led by Acd. Ceferino L. Follosco as Chair. This was parallel and sequel to the 27th ASM in 2005 which dealt with food security because, after all, energy and food security are two sides of the same coin – the national imperative to secure for our people the blessings of a modern self-reliant and prosperous nation.

The ASM sought to bring the scientific community with various stakeholders together to inquire into the problems and opportunities in energy generation, utilization and conservation. In preparation for ASM, the Academy conducted roundtable discussions on relevant and high profile energy concerns. At the end of the meeting, the objective was to draft resolutions or action plans for achieving energy security including dedicated R&D programs, addressed to the Executive Branch, to Congress, the private sector, the general public and to the scientific community itself.

There were four plenary sessions, each topic dealing with issues and concerns affecting energy security and sustainability in the country. The topics identified were: *"Challenges in the Energy Sector;" "Energy and Health", "Energy and Food,"* and *"Energy Conservation and Competitiveness."* Aside from the plenary sessions, there were parallel technical sessions on energy sources in the afternoon of the first day where biofuels and other energy sources and technology were the foci of discussion.

Department of Energy Secretary Angelo T. Reyes, keynoted the affair while energy experts Francisco L. Viray, Vincent Perez, Virgilio T. Villancio, Algerico Mariscal and Meneleo J. Carlos, shared their expertise as plenary speakers. The participants were stakeholders belonging to the private sector, energy users, the oil products producers and distributors, the government agencies concerned with energy primarily the Department of Energy, the academe and other interested citizens. The two-day affair included scientific posters session that also featured the electronic poster version, investiture of new members of the Academy, and awarding ceremonies.

The 30th ASM was organized with the assistance from the Department of Science and Technology (DOST) and Monsanto Philippines. Inc. as patrons; Centro Escolar University, De La Salle University and UNESCO as sponsors; Ateneo De Manila University, Department of Agriculture through its Biotech Program, ISAAA, PCASTRD, PCHRD, Resins, Inc., SEARCA, UPLB Foundation, Inc., Institute of Plant Breeding, UPLB, Aspen Multisystem Corporation, Biotechnology Coalition of the Philippines, Crop Life Philippines, Emilio Aguinaldo College, Mapua Institute of Technology, Omnibus Bio-Medical Systems, PCAMRD, PhilRice, Program for Biosafety Systems, RFG Photography and Souvenir, Syngenta Philippines, Inc., as donors, exhibitors and advertisers. A total of PhP 2,215,214 was solicited from the abovementioned patrons, donors, sponsors, exhibitors and advertisers.

The 30th ASM Steering Committee was composed of Acd. Ceferino L. Follosco, Acd. Eliezer A. Albacea, Acd. Angel L. Lazaro III, Acd. Leonardo Q. Liongson, Acd. William T. Torres, Acd. Filemon A. Uriarte Jr., Acd. Reynaldo B. Vea and Acd.-Elect Alvin B. Culaba.

There were 218 evaluated entries for the scientific posters session: ASD - 60; BSD – 59; CMPSD – 58; ESTD- 8; HSD - 25; and SSD – 8. The winners of the 2008 NAST Best Poster Competition were as follows:

Agricultural Sciences

Introduced Bananas: New Cultivars, More Options for Banana Growers. Felipe S. de la Cruz jr., Lavernee S. Gueco, Olivia P. Damasco, Visitacion C. Huelgas, Fe M. de la Cueva, Teodora O. Dizon, Vida Grace O. Sinihin and Agustin B. Molina Jr.

Biological Sciences

A Rapid in Vitro Calorimetric Method of Determining Bactericidal Potency of Antimicrobials.
Ronald R. Matias, Leilani Baltazar, Wilfredo Verar Jr. Mark Ritumalta, Frederick de la Cruz, Madeline Fabros, Leila Florendo, Mario Panaligan and Alexander Tuazon

Chemical, Mathematical and Physical Sciences

Detection of Wilson's Disease by Atomic Absorption Spectrophotometric Analysis of Serum ad Urinary Copper and Ceruloplasmin Analysis.

Ma. Cristina B. Portilla, Jason Paul C. Manlinong, Cherrie B. Pascual and Abdias Aquino

Engineering Sciences and Technology

Enzyme Assisted Extraction and Carica papaya Latex-catalyzed Transesterification of Jatropha curcas L. Oil for Biodiesel Production. Andy B. Aquino Veronica P. Migo, Maxima E. Flavier and Evelyn B. Rodriguez

Health Sciences

Molecular Design of Sunflower (Helianthus annuus) Trypsin Inhibitor-1 (SFTI-1) Peptide Analogues of Dengue Virus NSB-NS3 Serine Protease Inhibitor.
Jerome Panibe

Social Sciences

Tindupi, P'ras, Samaluma, Ganus: Seasonal Calendar, Climate Change and Adaptive Strategies Among the Subanun in Mt. Malindang.
Luchi C. Servidal Castro, Liwayway S. Viloria, Johanna E. Hanasan, and Reymuind T. Bago.

A special prize was also awarded to the poster related to the theme.

Supercapacitor Electrodes from Natural Materials.
Benedict C. Laguesma, Carole M. Loable, Verna Aiza S. Posada, Tristan Calasanz and Erwin P. Enriquez

Six resolutions were presented and adopted in the plenary session and later endorsed to DOST Undersecretary Graciano P. Yumul and DOE Undersecretary Ramon G. Santos. These were:

1. *Support for the Use of Sugarcane and Cellulosic Feedstocks for Bioethanol Production;*
2. *Optimization of Crop Yields and Process Conversion of Jatropha for Biodiesel Production;*
3. *Review of Pertinent Provisions of the Philippine Clean Air Act;*
4. *Review of Government Policy on the Use of Nuclear Energy;*

5. *Strengthen Demand Side Management Programs; and*
6. *Resolution for Energy and Health.*

A total of 718 and 700 guests and participants attended the Annual Scientific Meeting on the first and second day, respectively. The number of participants was deliberately reduced to 600 as compared with the previous years. All invitees were prescreened and identified as stakeholders from the private sector different agencies and organizations in the energy sector.

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Keynote Speech

PHILIPPINE ENERGY SECURITY PLAN

Angelo T. Reyes
Secretary, Department of Energy
Republic of the Philippines

Thank you Madam Chairman, Secretary Alabastro, for that kind introduction and for making me appear more knowledgeable than I actually am. I only wish my wife Tessie could have heard your introduction so she would realize her low opinion of me is not universally shared. I suspect, though that there are a few husbands here today who share the experience of being frequently assured by their wives that, "You don't know anything!" Meron ba?

Anyway, more importantly, I must thank you, Secretary Alabastro. And your colleagues for the very important work you do at the Department of Science and Technology. As everyone should be aware, the DOST is a crucial and essential resource for those of us who labor in the energy sector. They are actually the ones who "know" things.

Allow me also to thank our host for the warm reception and the special arrangements made to ensure the success of this year's annual scientific meeting. I want also to extend my warmest greetings to all the participants here for giving utmost importance to this annual event. Thank you for being here. I believe your presence is an indication of your recognition that, whether we are in the private sector, academia, the non-profit organizations, or the government, we all share a responsibility to help develop real and long-term solutions to the country's most significant challenges, particularly with respect to energy which, as you know, underlies many other challenges.

This year's event, with the theme *"Energy Security and Sustainability: Assessing the Present and Foreseeing the Future,"* comes at a most relevant time since issues related to increasing energy demand, trailing supply, skyrocketing prices and apparently inadequate investments in the energy sector remain a matter of global concern.

Upon my assumption of the energy post in July 2007, I was directed by the President to prepare a 20-year Philippine Energy Plan. Incidentally, I was also entrusted with the stewardship of the Presidential Task Force on Climate Change, which is an indication of the realization that energy policy is intimately related to environmental policy. I know everyone here understands this. The energy choices we make affect not only our economic growth and development but also the kind of environment we will bequeath to our children. We need to

be constantly conscious of this. The updates 2007 Philippine Energy Plan (PEP) affirms the government commitment to pursue an energy independence agenda through a five-point reform package. The energy sector's agenda focuses on reaching a sustainable 60.0 percent energy self-sufficiency status by 2010 and creating a globally competitive energy sector.

I will be presenting you now a picture of the current state of the Philippine Energy Sector and a roadmap of where we ant to go in terms of the over-all energy program and power sector development.

The plans and programs I am presenting to you today are based on the outcomes of the Philippine Energy Summit last February and the Department of Energy's Strategic Planning Workshop, both of which were anchored on ensuring energy supply security, managing energy demand responsibly, and achieving sustainable development goals.

My presentation for today will run as follows:

First will be a brief review of the role of energy in economic development.

Next will be a picture of where we are now in terms of vital energy indicators, such as the mix of our energy supply resources, and where we stand in relation to significant milestones in sectoral energy development.

Next, I will present what we currently feel is the desirable energy state for the country. This will be shown in terms of strategic directions, plans and programs.

Finally, I will focus on the power sector development plan of the country. This will highlight the current power supply and demand situation and update you on the ongoing power market reforms.

We already know that energy is a crucial commodity without which there can be no progress and prosperity.

Energy is indispensable to our economic growth and to our nation's drive toward global competitiveness.

Universal access to energy is critical in helping reduce poverty and improve social equity.

And, finally, our energy choices reflect our environmental priorities.

Let me give you an overview of our current energy situation.

Primary Energy Mix

The primary energy mix shows the shares of various energy sources in the country's day to day energy requirements for both power and non-power use (like transport). In 2006, the combined total amount of energy in our energy mix reached 38.74 million tons of oil equivalent (MTOE).

Imported oil remained as our major source of energy, accounting for 34.1 percent share in the supply mix. We have, however, decreased our use of imported oil slightly, supply dropping from13.94 MTOE in 2005 to 13.20

MTOE in 2006.

The share of natural gas in the supply mix stood at 6.5 percent, which translates to 2.53 MTOE. Almost all of this comes from Malampaya Gas Field Production.

The share of coal reached 13.7 percent or 5.32 MTOE, the bulk of which is sourced through importation.

Geothermal production increased by 5.7 percent from its 2005 level of 8.52 MTOE and accounted for 23.2 percent share in the supply mix.

Hydro's share in the mix improved form 2.09 MTOE in 2005 to 2.47 MTOE in 2006, equivalent to a 6.4 percent share in the mix.

Supply from other renewable energy sources – fuelwood, charcoal, biomass – reached 5.77 MTOE, of which fuelwood accounted for a 63.6 percent share.

Viewed in terms of the country's self-sufficiency level, the share of indigenous energy stood at 55.4 percent in 2006. The country's self sufficiency level in 2007 is expected to increase very slightly to 55.7 percent, with the share of imported oil and coal still accounting for a quite significant 44.3 percent in the supply mix.

Potentials for Energy Sources

To address our current dependence on expensive energy imports, we are pursuing a strong commitment to the development of renewable energy resources. As a country located in the tropics, renewable energy resources, as you well know, abound in the Philippines.

In fact, we are the world's second largest producer of geothermal steam, and we can boast of 4,406 megawatts of geothermal reserves.

For wind resources, a study conducted in 2003 showed that the country has a total of 76,600 megawatts of potential installed capacity from wind energy resources. We have the biggest potential for wind energy resources in Southeast Asia.

For hydro, the country's 888 mini-hydro sites have a potential capacity of 1,784 megawatts.

For energy from the sun, solar radiation nationwide averages between 5.0 to 5.1 kilowatts per square meter per day. Based on our studies, more than 70 percent of the country's land area can harness solar energy resources.

Biomass energy from agricultural wastes is also available. Ricehull has the potential for producing 277 megawatts of power and bagasse has the potential for 236 megawatts.

Lastly, based on some technical studies, we have ocean energy potential equivalent to 170,000 megawatts power. This figure included both ocean thermal energy and marine current energy resources.

Based on these resource potentials, let me now show you how much we

have achieved in terms of growth in our use of renewable energy. Topping the list is hydropower which now generates 3,367 MW of power. This is followed by geothermal which produces 25.3 MW of power, biomass produces 20.9 MW, and solar energy produces 5.2 MW.

Alternative Fuels

Alternative fuels for mobile applications consist of biofuels, compressed natural gas and auto-LPG. These help cushion the impact of the high prices of petroleum products and also help reduce pollution emissions. Our program on biofuels was given impetus with the signing of Republic Act 9367, or the Biofuels Act of 2006, in January 2007. The law mandates the use of biofuels in the transport sector and establishes the Philippine Biofuel Program to improve the investment climate for the production, distribution and utilization of biodiesel and bioethanol.

To date, current biodiesel production capacity is pegged at 287 million liters as a result of a steady increase in infrastructure support. Presently, we have nine DOE-accredited manufacturers all over the country and the accreditation of three more is on-going. In 2007, the mandatory 1.0 percent biodiesel blend displaced a total of 62 million liters of diesel consumption, which is equivalent to PhP 2 billion in foreign exchange savings.

For bioethanol, we now have a voluntary 10.0 percent blending and supplies of 10 percent bioethanol are available in 105 Seaoil stations nationwide and 39 Shell Stations in Manila. More local investments in the production of bioethanol are currently being made. As of April 2008, five bioethanol projects were endorsed by DOE and registered with the Board of Investments (BOI) under the existing Investments Priorities Plan (IPP), four bioethanol projects were undergoing BOI review while one project was endorsed to the Philippine Economic Zone Authority (PEZA). The total estimated annual capacity of the aforementioned projects is about 467.8 million liters.

As to the use of auto LPG, there are currently 12,000 converted vehicles running and some 19 government-accredited conversion shops operating nationwide. The compliance by these service providers to existing auto-LPG standards is monitored closely by the Department of Energy.

Meanwhile, the commercial operation of the CNG mother station in Tabangao, Batangas and the daughter refilling station in Biñan, Laguna inaugurated in October 2007 by the President jumpstarted the use of CNG in the transport sector. Currently, there are 22 buses plying the Batangas and Laguna to Manila routes. As a promotional campaign, the DOE launched its *Libreng Sakay sa NGV Program* from March 24 to April 6 with 11 of these buses serving the riding public from Batangas/Laguna to either Cubao of the Mall of Asia. About 6,900 commuters availed of the said program.

Activities in the Downstream Oil Sector

The downstream oil industry covers activities that include the transport of crude oil from local production sites, the importation of crude oil, the processing of crude in local refineries and the storing of its intermediate and refined products, the distribution of products to the different bulk plants/depots or to end-users through tankers/barges and pipeline (from Shell/Caltex in Batangas to Manila), and the transport of products from depots to retail outlets.

There are two refineries in the country – that of Petron in Bataan and Shell in Batangas. In addition, there are other bulk suppliers who rely on direct importation of finished products, namely: Chevron, PTT Philippines (Petroleum Authority of Thailand PTT), Total Phils (France), Petronas (Malaysia), Pryce Gases, Liquigaz (Netherlands), Unioil/Oilink, and Seaoil Philippines.

To date, the industry has a total of 861 players in the various downstream activities as shown in this slide.

Production/Demand Mix

Oil remains a major energy source for the country, especially for the transport sector which accounts for over 60.0 percent of the oil demand.

Among the petroleum products, diesel has the biggest share of the market (38.0 percent) as this is used by buses, trucks, jeepneys, private vehicles, and marine vehicles.

Premium gasoline constitutes almost 2/3 of total gasoline demand.

Regular gasoline is mainly used for motorcycles/tricycles, farm implements, and fishing vessels.

AVTurbo or jet fuel is in demand for transport between the islands and across countries.

Kerosene is mainly used for lighting and cooking in remote areas.

LPG constituted 11.0 percent of the total demand for petroleum in 2007.

On a regional basis, the National Capital Region expectedly accounted for the biggest oil demand, using up to 42.2 percent share of our total oil consumption. This was followed by North Luzon at 18 percent, South Luzon at 15 percent, Visayas at 13 percent and Mindanao at 12 percent. The total Luzon share is about 75.0 percent.

More than 84.0 percent of the total market is credited to the combined sales of Petron, Chevron and Shell. The other industry players got the remaining 16.0 percent of the market.

As for LPG, the country remains a net importer of this fuel. Imports account for 76.0 percent of domestic requirements. The total Luzon share in LPG use is about 80.0 percent, followed by Visayas at 11.0 percent and Mindanao at 8.0 percent. In terms of market share, the new players combined

outscored the big oil companies in this sector, supplying more than one-third of LPG demand.

We have set our sights on what we want to achieve in the energy sector within a reasonable period. I will now show you the strategic actions that we have thus far come up with to achieve our desired energy state.

Strategic Directions

To achieve the desired energy state, the plans and programs of the DOE will be guided along the following major strategic directions.

ENSURE CONSISTENT, COMPREHENSIVE, RESPONSIVE AND INTEGRATED ENERGY POLICY

As a vital ingredient to economic development, energy policies should take into consideration the needs and requirements of other sectors in the economy, such as transportation and communication, public works like sea and air ports and highways and food production.

IDENTIFY AND ACHIEVE THE OPTIMAL (OR BEST) ENERGY MIX

Putting in place appropriate policy and program interventions and assuming their successful implementation, we hope to attain an energy mix that will ensure stable, secure, sustainable, environment-friendly and reasonably-priced energy.

PROMOTE GREEN AND CLEAN ENERGY

Another strategic direction is to take into account the long-term effects of energy development on global warming. The problem of climate change gives compelling reason for the energy sector to develop cleaner energy alternatives and employ clean technologies.

INSTITUTIONALIZE SOCIAL MOBILIZATION AND MONITORING MECHANISMS

The fourth strategic direction is to harness the cooperation of all key stakeholders in carrying out energy programs aimed at promoting energy efficiency and conservation and energy security. This is important since energy development impacts on all other sectors of the economy and the society. Given the energy constraints that we face as a nation, behavior and lifestyles changes will undoubtedly be required of individuals, organizations, and communities. This underscores the vital role of social mobilization efforts in eliciting personal commitments and in building the necessary public support behind the country's energy agenda.

Policy Thrusts

In terms of policy support, the energy family will work towards the following policy objectives:

ENSURE STABLE AND QUALITY SUPPLY OF ENERGY THROUGH:

- Intensifying the development and use of renewable energy and environment-friendly alternative resources and technologies;
- Accelerating exploration and development of indigenous oil, gas, and coal resources;
- Promoting energy efficiency and conservation programs; and
- Maintaining a competitive energy investment climate.

"Make energy prices reasonable and affordable; and implement social mobilization and monitoring mechanisms."

Strategic Actions: Alternative and Renewable Energy

In line with the strategic directions on clean and green energy, the DOE will promote the use of renewable energy and alternative fuels to increase their contribution to the overall energy mix.

Seen as a major action which the DOE has to work on intensively with concerned stakeholders is the immediate passage of the renewable energy bill.

On the other hand, the implementation of the National Biofuels Act and the Natural Gas Vehicle Program for Public Transport (NGVPPT) is expected to reduce our dependence on imported oil and impact on the country's economic performance through savings in fuel oil importations.

Under the National Biofuels Program, the DOE will issue guidelines for the registration and accreditation of biofuels producers, as well as initiate the conduct of studies on potential feedstocks for biofuels. Our PNOC-Alternative Fuels Corporation will aim to take the lead in the Jatropha research and development efforts in the ASEAN.

On the other hand, our NGVPPT Program envisions about 5,000 buses running on CNG by 2025. And by 2030, all of Batangas-Laguna-Manila buses will use CNG.

To promote investment opportunities in the renewable and alternative energy sources, a one-stop-shop for sustainable energy projects will be created. This effort will involve the codification of renewable energy standards, the creation of a renewable energy and alternative energy knowledge center, and the development of a monitoring and auditing system in cooperation with civil society groups.

Oil, Gas, Coal

The DOE will continue to promote investments in the upstream sector through the Philippine Energy contracting rounds. Plan are underway for the review of the PECR Guidelines to ensure its effectiveness in investment promotion.

We are also pushing for more investments to maximize the use of our local energy resources like oil, gas and coal. This can provide additional development income for certain local communities

Some of the strategies that we believe will facilitate the flow of foreign investments into the Philippine Petroleum sector include (1) promoting collaborative public-private sector partnerships; (2) streamlining the licensing process to facilitate the issuance of approvals, permits, certificates and clearances for the work programs of service contractors; (3) embarking on an intensive information, education and communication (IEC) campaign to improve the social acceptability of energy exploration and development activities; and (4) the putting up of a one-stop-shop to assist petroleum investors in addressing concerns such as government regulatory agency approvals, coordination with the local government units in the host communities, and dealing with environmentalists, NGOs and other interest groups.

Natural Gas

To expand the development of the Philippine natural gas industry, the DOE is pushing for the immediate passage of the downstream natural gas bill which will provide the impetus for the development of strategic infrastructure and boost the use of natural gas in both power and non-power applications. Furthermore, the DOE is promoting the establishment of a Philippine Natural Gas Institute which is intended to produce more local experts on natural gas exploitation and use.

Strategic Actions: Energy Efficiency and Conservation

Another major policy thrust of the government is its enhanced energy efficiency and conservation program. With pressing global issues such as high energy prices (with crude oil prices now hitting the 145 dollar mark) and understandable concerns for potentially catastrophic climate change, a massive program aimed at energy efficiency and conservation has to be immediately put into action and intensively promoted.

Thus the government, in close collaboration with the private sector, will continue to implement the national energy efficiency and conservation program, with sub-components as follows:

- Information, education and communication campaign;

- Government energy management program;
- Energy management program;
- Recognition awards system;
- Fuel economy promotion;
- Energy standards and equipment labeling program;
- Partnership/voluntary agreements; and
- Energy consumption monitoring of industrial, commercial and transport establishments.

An example of a priority program in this connection is the "Palit-ilaw" Program which encourages the use of compact fluorescent lamps or CFLs. The DOE is working for the calibrated phase-out of incandescent bulbs within one-year and their total replacement with more energy efficient CFLs.

Similarly, the DOE will develop, promulgate, and implement, together with the DTI-BPS, a minimum energy performance standard that will lead to the eventual phase out of the least efficient lamps in the market by 2010.

The DOE, together with its partners in the private sector, non-government organizations, and the academe, is also working for the immediate passage of the Energy Conservation Bill. This is intended to institutionalize energy efficiency as a way of life for every Filipino.

Investment Options

Ensuring a stable and quality supply of energy is a paramount concern and we believe we can only achieve this by:

- Maintaining a competitive energy supply that meets the quality and safety standards of government;
- Providing a level playing field in the conduct of business; and
- Encouraging the entry of investments in energy marketing and distribution and energy infrastructure by putting in place market-based incentives.

Electricity Costs

To make our electricity prices reasonable and affordable, we have outlined the following thrusts:

- Pursue full privatization of the remaining generation assets of the National Power Corporation including the contracted energy outputs;
- Accelerate implementation of open access and retail competition, starting in the economic zones;
- Ensure better targeting of subsidies for the poor;
- Facilitate the attainment of industry competitiveness;
- Implement demand side management; and
- Intensify public sector involvement in the reform process.

Oil Prices

Of course, our current most urgent concern, which was also aired by almost all of the participants in the course of the recently-concluded Energy Summit, is the high oil prices. To mitigate the effects of high oil prices, we are undertaking both immediate and long term measures.

These measures include: (1) the use of oil tax revenues for pro-poor projects; (2) reviewing the taxation schemes for petroleum crude and its products; (3) providing discounts and subsidies to vulnerable sectors, such as the rural and urban poor, small fisher folk and farmers, for their basic needs like food, shelter, and education; and (4) eradicating "*kotong and kolorum*" in the transport sector.

Social Mobilization

As earlier mentioned, the need to mobilize the entire society toward the achievement of energy sector goals was highlighted during the recent energy summit. The issue raised is, how to generate and sustain public awareness and action on specific energy issues such as energy efficiency. The lack of adequate, readily-available information and a clear policy framework remain real obstacles to mobilizing the public.

The strategies that we believe will institutionalize social mobilization and monitoring mechanism in the energy sector include the strengthening of various stakeholders' participation in the planning, implementation, and monitoring of energy plans and programs through a convergent cross-sectoral platform. Primarily, the aim is to eventually develop a mind and behavior switch that will enable the various publics to conscientiously adopt the efficient use of energy as a way of life.

Power Development Plan

I will now go into the Department's perspective in terms of its power development plan.

The 2007 Power Development Plan (PDP) provides a comprehensive summary of current developments in the power sector. This plan takes into account current fiscal and macroeconomic challenges. It also takes into account some key factors such as the commercial operation of the WESM, the priority infrastructure projects in the "super regions", and the government's commitment to intensify global competitiveness through reasonable electricity rates.

With the sector's dynamic characteristics, industry players need to be guided along the policy and program direction toward the full implementation of the reform program that aims to establish a more effective, competitive, and

responsive electricity market.

The country's total installed capacity as of end-2007 is 15,937 MW. This level was 1.2 percent higher than the previous year's level of 15,619 MW. In tern\ms of capacity mix, fossil fuel-based plants remain the dominant source with coal topping the list and accounting for a 26.4 percent share or 4.177 MW. This is followed by oil with 22.7 percent share. In terms of indigenous energy resources, hydroelectric power provided the highest share with 20.6 percent, while natural gas and geothermal plants contributed 17.8 percent and 12.3 percent, respectively. Wind and solar power on the other hand contributed a mere 0.2 percent to the mix.

For 2006, the country's total dependable capacity was 13,186 MW or 86.0 percent of the 15,937 MW total installed power output. **Dependable capacity** is defined as the maximum output that a power plant can provide under adverse conditions for a specified period of time, taking into consideration the plant's wear and tear conditions. Wind-based plants can only provide approximately 36.0 percent of their maximum output. In the case of hydroelectric power plants, their operational capability is highly dependent on the availability of water. Thus, dependable capacity is expectedly high during the rainy season and low during the dry months.

In terms of transmission resources, TRANSCA now covers a total length of 20,236 kilometers (ckt-km) for the whole Philippines. TRANSCO also administers an aggregate substation capacity of 24,489 megavolt-ampere (MVA).

In terms of generation mix, natural gas has the highest share of 32 percent, followed by cal with 28 percent.

Objectives of Power Sector Reforms

Power sector reforms are intended to provide for more **competition in the generation sector.** One goal of developing a competitive electric power market is to create a permanent framework for private sector participation in the generation business. There are two major market-related reforms currently being implemented for the electric power industry. These are: (1) the establishment of the wholesale electricity spot market which provides a mechanism for power producers to make available their excess daily capacity to bulk power users and traders; and (2) the introduction of open access and retail competition in the electricity market, which will allow power producers to sell their power directly to consumers and develop a price-responsive retail market in the country. These reforms are expected to exert downward pressure on electricity prices.

The commercial operation of WESM started in Luzon on 26 June 2006. To date, 34 generators and 16 distribution utilities have participated in the market with 3,217,295 megawatt-hours of total volume traded. These included spot transactions and volumes covered by bilateral power supply contracts. At

this time, the Philippine Electricity Market Corporation (PEMC) is currently assessing and preparing for the launching of the Visayas WESM.

Total electrification of the country has always been one of the government's priority thrusts. The DOE is bent on meeting the 100 percent barangay electrification target by 2009. This will help alleviate poverty in the countryside and make way for improved labor productivity, living standards, health services, education and family life. In this connection, the government has institutionalized private sector participation (PSP) in rural and missionary areas through its qualified third party (QTP) program. These QTPs – as stipulated in the Electric Power Industry Reform Act (EPIRA) of 2001 – are accredited private sector parties who undertake to provide electricity services to unviable and remote areas that are not covered or reached by franchised distribution utilities.

Our barangay electrification level as of 31 March 2008 reached 96.69 percent with the energization o 40,590 barangays. That leaves only 1,390 barangays yet to be connected. The remaining barangays are targeted to be electrified by the end of 2009.

Power Sector Reforms Update

The era of open access and retail competition in the Philippine Electricity Industry has moved closer to realization with the formal approval by the Board of Power Sector Assets and Liabilities Management Corporation (PSALM) of the 2008 sale schedule for the remaining generation assets of the National Power Corporation. Given this schedule, it is expected that the privatization of at least 70 percent of NPC's generation assets will have been achieved by the end of 2008. This will remove one of the two remaining preconditions specified in the EPIRA law for the implementation of open access and retail competition.

PSALM is likewise stepping up the transfer of the management and control of at least 70 percent of the total energy output of power plants under contract with NPC to private IPP administrators. The appointment of such independent administrators is expected to accelerate by September 2008. Upon completion, this will remove the final obstacle to open access and retail competition.

The privatization of the transmission facilities of TRANSCO was also successfully bidded out last December 12, 2007.

Proposed Measures to Power Sector Challenges

One of the challenges to energy supply sufficiency is that the EPIRA no longer allows NPC to put up new power plants or incur new obligations with independent power producers (IPPs). This means that all new generating

plants must be built by the private sector. Among the measures that have been identified to expedite the process of setting up new power plants by the private sector are for distribution utilities to quickly firm up their power supply requirements and for the environmental review of prospective power plants to be done according to Philippine laws within a short period of time.

It is recognized of course that promoting the greater use of renewable energy in the power grid requires renewable energy projects to overcome the challenges of economic competitiveness and the intermittent and seasonal nature of such resources. To meet the challenge of removing barriers to entry in the renewable energy sector, the following measures have been identified:

- Accelerate passage of a renewable energy bill;
- Require distribution utilities to establish at least cost portfolio of power supply contracts that include renewable energy options; and
- Integrate environmental costs in the power rate regulation methods.

That was a long presentation. I would have wanted it to be shorter but I thought it important for the scientist and technology experts gathered here to be brought fully up to date on what is happening in the rapidly changing energy sector. I thought is important because I believe that your help is absolutely required for this country to meet the formidable challenge of producing enough energy at reasonable cost to allow us to achieve our developmental goals. Compounding this challenge is the need to meet our rapidly increasing energy demand in an environmentally responsible way.

I am confident, however, that with the support of a group such as this, we can build on the little successes we have thus far achieved and improve our chances to realize our desired future. I believe that it must be our scientists and engineers – not our politicians - who must come together and show the rest of us the way forward, what it is we must do for the good of this country. I believe it is you who the rest of the country must look to, to innovate and lead. For my part, I am fully prepared to follow.

Thank you all for allowing me to speak to you this morning.

Maraming salamat and Mabuhay!

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Challenges in the Energy Sector

CHALLENGES IN THE PHILIPPINES' ENERGY SECTOR – A DISCUSSION

Benjamin S. Austria
Chair, Energy Committee
Philippine Chamber for Commerce and Industry

I congratulate Dr. Francisco Viray for the focused, yet comprehensive, presentation on the "Challenges in the Philippines' Energy Sector". It provides an excellent paper to start this Annual Scientific Meeting of the Academy centered on a very current and relevant topic, namely, *Energy Security and Sustainability.*

Indeed, energy is essential not only to economic and business activities but to all aspects of modern living. Hence the growing concern over the surging price of oil and its impact on economic growth and public welfare. Even before this current situation, the Philippine Chamber of Commerce and Industry (PCCI) has consistently recognized the role of sustainable energy, as elucidated in the paper of Dr Viray, in promoting competitiveness of domestic enterprises[1]. Hence, the PCCI has been organizing fora and discussion groups on "How to Make the EPIRA Work for the Economy" (EPIRA refers to the Electric Power Restructuring Act of 2001), PCCI continues to provide inputs in the crafting of energy legislation, in the formulation of implementing rules and regulations and as well comments on the implementation of energy policy.

[1] Alejandro, Jose S. and Benjamin S. Austria, 2006, The Implications of High Energy Costs on the Viability of Domestic Industries. 19th Statistical Research and Training Center Annual Conference,(Program and Abstracts) 6 October 2006, Mandaluyong City, p. 7.

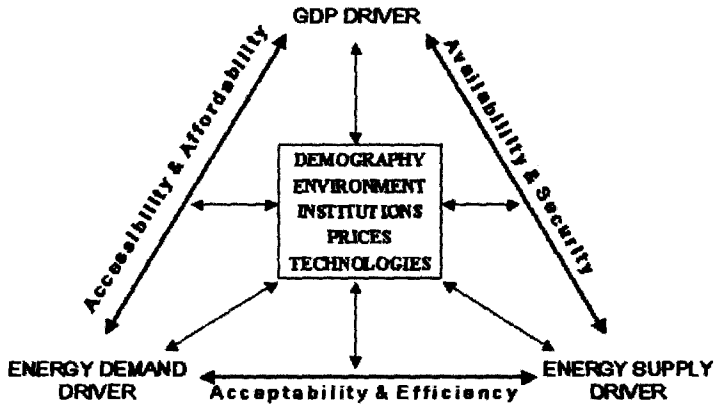

Fig. 1 Complex framework of the energy sector showing interconnections between goals, drivers and issues (from WEC 2004 Statement[2]).

As pointed out in the paper of Dr Viray, sustainable energy involves multidimensional factors. The complexity of the energy sector is graphically illustrated in Fig. 1 where the energy goals discussed by Dr Viray in his paper, namely availability, accessibility and acceptability are intertwined with the GDP driver, the supply and demand drivers and with factors and issues that include technologies, prices, institutions, environment and demography.

In view of the highly complex nature of the energy sector, it is crucial that policy and decision makers be aware of the implications (which may be far-reaching) of strategies, actions and developments within the sector. Thus the PCCI has been asking who is responsible for formulating strategies in the drive towards sustainable energy. This is particularly important considering the long term nature of energy projects and activities. Just recently, the PCCI has inquired on the status of the Council of Advisers on Energy Affairs, a body created by RA 7638 (The Department of Energy Act of 1992).

Besides defining energy security and sustainability and identifying the challenges in the energy sector from a Philippine perspective, Dr Viray provides a list of interventions that can be applied to meet the challenges. The proposals form an initial blueprint towards a sustainable energy future. Science and technology plays an important role in several of these interventions such as the development of domestic technologies, the search for, development

[2] World Energy Council, 2004, WEC Statement 2004: Reflections on the Dynamics of Oil and Natural Gas Markets. (World Energy Council: London), p. 3.

and utilization of indigenous resources and the maintenance of environmental quality.

As a geologist, I am aware of the role of this field in the search for and development of geothermal energy (an area where the Philippines is a world leader), petroleum, coal and uranium resources. Other fields of science and engineering are essential in the development not only of these energy resources but also that of renewable energy – wind, hydro, biofuels, biomass, ocean and solar. Likewise, implementation of energy efficiency programs benefit from the expertise of energy practitioners.

Turning the challenges to opportunities is realizable specially if there is cooperation between government, academe and the private sector. Let us build on and tap existing institutions with the PCCI, the Energy Council of the Philippines, the Energy Development and Utilization Foundation, Inc. (established in 1990 by the Department of Science and Technology and the Department of Energy), the Energy Professional Association of the Philippines among them. We also benefit from the wealth of knowledge, experience and expertise available in energy organizations such as the World Energy Council, the Asia Pacific Energy Research Center and the ASEAN Centre for Energy.

As a leading S&T institution, NAST can play an important role in influencing the paths to take that will lead our country to a sustainable energy future. This forum today is one step in this direction.

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Challenges in the Energy Sector

REACTION TO F.L.VIRAY'S CHALLENGES IN THE ENERGY SECTOR FOCUSING ON GOVERNMENT POLICIES & PRACTICES ON ENERGY

Meneleo J. Carlos Jr.
Chairman of the Board
Federation of Philippine Industries

Dr. Viray presented a very comprehensive picture of the energy sector with all the complexities arising from the apparent conflicting goals of the 3A's of sustainable energy – namely

AVAILABILITY of modern energy in adequate quantity and acceptable quality on a long-term basis

ACCESSIBILITY to modern energy in terms of price or affordability and sustainability

ACCEPTABILITY of energy sector activities in terms of their environmental and social impacts

But these apparent conflicts should diminish with time, as we sort out and implement the energy directions that we must take to satisfy the 3A's. In fact there are so many candidate interventions suggested in his talk that would occupy an entire weeks' forum. Many of these interventions will bear on the shifts in energy sourcing and use that we must make. These interventions include policies of government, R&D and technology inputs, programs to enlist management and capital, plus our ability as a people to adapt to the every growing changes in the sourcing and use of energy.

Dr. Viray presented his view of how the future of energy will shift from the Traditional Paradigm to an Emerging Paradigm that would bring about satisfaction of these 3A's, Availability, Accessibility, and Acceptabilility. One can see that the shift from where we are to a more accommodating future, will require coordinated planning, a lot of capital and sound management to go with it, and of course time. This period of transitioning to the new energy paradigm will require the best of our understanding and abilities in order to reach it in the shortest period and with the least pain. It will entail attracting the needed private sector management and capital to get there.

Obviously, renewable energy will be a principal direction to go and we are not strangers to this form having harnessed our dams and geothermal fields to provide electricity. In fact also our government had begun to look into the

future of energy when it enacted laws on biofuels and other forms of renewable energy. It is possible to harmonize our governing policies if these are based and interpreted according to some proven practices that are realities in the developed world where the private sector operates most effectively and efficiently for the public good. These practices are :

1. That prices are dictated by supply and demand in the more deregulated markets.
2. That markets are very good disciplinarians. Look at how more people now ride various forms of public transport, and how the traffic situation has eased considerably – adding to fuel efficiencies for all, and of course, less pollution.
3. That there are many alternative sources of useful energy that can be developed and made to compete
4. That competition is more effective than regulating for the public good and is necessary to encourage private enterprise to undertake needed investment risks in a more uncertain future
5. That long term private capital investments demand a level playing field
6. That the wise conversion of energy resources into useful forms require
    - Consideration of the environment
    - Massive capital
    - Long term planning

Dr. Viray then surmised and I quote: "There is a need for a light handed regulation that can move us faster towards the energy goals we want than what competition and free market forces would have done if left alone on its own. For example, if under the current global development and costs, using market forces alone to determine our energy mix will tend towards a predominantly coal-based energy mix. There could be a need to introduce certain policies and regulations to encourage other sources of energy, both indigenous and imported. Others will claim that regulation introduces price distortions that can favor one resource over another but I guess that's the challenge to policy makers." The reason for this is because there are strategic considerations for something as vital as energy and I will discuss the need for this light handed regulation some more

The goals of availability, accessibility and acceptability for sustainable energy have certainly entered the minds of our legislators and government policy makers, and yet they remain unbalanced because of other interventions. This is the reason why some of our energy policies may appear disjointed and must be further harmonized by the DOE; This then requires that when it comes to practice, we require the wise analysis of the DOE and the judgment of a truly independent regulator who will balance these opposing realities in the interest of all stakeholders. I will not discuss specific cases but I must

emphasize that we need the regulatory agency to act in a timely manner and to :

1. Explain clearly and transparently the basis for their decisions thereby educating everyone in the complex world of balancing the 3A's.
2. Explain the need for some legislative and policy reforms. There is nothing wrong in amending policies and laws provided that resulting effect is fair. What is wrong is to apply policies based on very different sets of circumstances that bear no resemblance to the present. Instead, it is important to recognize the need for change when change is needed in the public interest. All countries do these in their public's interest.
3. Provide confidence to those who wish to invest in the energy sector

In closing, let me say that we are fortunate that our past energy leaders in the executive (DOE) and legislative branches had the foresight to take actions towards Sustainable Energy.by:

- Creating the DOE thus recognizing the vital role and size of the Energy Sector as the line agency promoting policies and rules related to energy.
- Shifting our power sector away from petroleum into much lower cost energy sources to a level of only 10%.
- Investing in the light rail metro transits that displace many public vehicles running on petroleum.
- Enacting the Oil Deregulation Law which has denied the need of government to subsidize fuel, and
- Enacting the EPIRA to get the government out of the power sector and making it easier for private capital to take over in a timely manner.

Thank you.

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Energy and Food

THE FOOD AND THE FUEL ISSUE

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Abstract

The author believes that the current trends in diverting carbohydrate- and oil-rich crops into biofuels in countries that are well endowed with land resources and whose agriculture is well advanced are irreversible as new corridors of investment opportunity are created. Its long-term positive effect is in creating a wedge against the speculative increases in the world price of crude oil. The negative impact is in driving global food prices up to less affordable levels especially to the poor of the underdeveloped world.

As a positive dimension, the increased farmgate prices of commodities will serve as a powerful incentive to farmers around the world to raise farm productivity and, thus, income. Traditionally in the Philippines, domestic production of food- and feed-grains could not compete economically with cheap imported stuffs. Now, the tide is reversed. Likewise, if sugarcane and coconut products are used in a diversified way to include biofuel production, it will have a resonant effect on improved farm prices. It will be the driving force in transforming the industries from a moribund to a vibrant state.

Jatropha and sweet sorghum can play an important complementing role in biofuel production and may become an economic imperative for Philippine agriculture.

As agriculture expands its role to feed machines as well, the commercial opportunities are great. Agriculture can become an investment magnet for the business sector. Private business and the whole farming sector can form the alliance and synergy to transform the countrysides as engines for economic development.

The world is besieged with apocalyptic problems – global warming; the energy crunch; and the food crisis. The food riots that have come about across the globe are a grim reminder of what people with empty stomachs can unleash. This is the backdrop of the world situation as we focus on the particular issue on food vs biofuel.

I will use as frame of reference Dr. Emil Q. Javier's excellent paper which he presented at the 2008 Philippine Energy Summit, entitled: "Weighing the Trade–off: Food vs Fuel".

Dr. E. Q. Javier's paper has articulated the issues on gas emissions, use

of biofuels and its impact on food supply, as they relate to our particular situation in the Philippines. He has pointed out that such interwoven issues create conflicts as well as opportunities, which we should be on the lookout for. Allow me to give my views on the trade-offs between food production and biofuel use.

The worldwide spiralling cost of food grains, which has tripled in the case of rice and wheat is an offshoot of current trends in diverting carbohydrate– and oil–rich crops into biofuels and the dwindling stocks of food grains to meet rising demands associated with growing populations and affluence in Asia. Furthermore, grain production has suffered setbacks this year – millions of hectares of maize were flooded and destroyed in Iowa and the Midwest; the 7-year drought has adversely affected rice production in Australia; the Irrawaddi Plains in Burma were devastated by ocean surges. The Philippines has to adjust to these inevitable global developments.

Countries that are well endowed with land resources like North America, Brazil, Argentina, and Australia and parts of Europe will continue and widen their efforts towards biofuel production. This is because such efforts have opened up new corridors of opportunity for farmers, corporate farms, and the biofuel industries to generate more wealth. The ultimate effect of such energy substitution will be the reduction in world prices of crude oil to more reasonable levels. It may take sometime but certainly it will have a countervailing effect.

As world prices for rice, maize, wheat and soybeans dramatically increase, we soon find that our domestic production of rice and maize has become highly competitive with the more expensive imported stuffs. This will be the driving force to spur domestic production. This is a window of opportunity that the country should exploit to the hilt.

Let me provide some facts about the growing competitiveness of our domestic production. In the case of rice, the international price of Thai rice 100% B-grade has more than doubled to $950 per ton or an equivalent of P43/ kg. The farmgate price of palay in the Philippines has doubled to P17 to P21/ kg compared to 2003 rates or in milled rice equivalent it is around P28/kg. The rice that you buy at P35/kg to P40/kg is much cheaper than imported rice. For corn which is the main feedstock for ethanol production in the U.S., landed cost in the Philippines, without tariff, is P15/kg. Cost of locally produced corn is P13 - P14/kg. For soybeans, the Philippines makes an annual import of as much as 19-20 billion pesos worth of meal and whole soybean. Local production is only on 1,000 hectares. It was cheaper to import. But now the average landed price of soybean has steadily increased from the usual P14 - P21/ kg to P24-P29/kg. Local production of soybeans at 1.5 to 2.0 tons per ha. is now highly competitive.

Traditionally, farmgate prices of food grains in the Philippines have been so depressed thereby consigning the majority of the small farmers to the life of the underprivileged and marginalized.

Let me show you some facts. The costs and returns per hectare for rice production in the Philippines in 2002 for irrigated and rainfed areas are as follows:

Expenses -	P23,356.00
Cash (42%)	P9,721
	(58% hired labors, 15% for fertilizers)
Non-cash (26%)	P6,056
	(harvester's, landlord's & thresher's share)
Imputed (32%)	P7,579 (including P3,540 for family
	and operator's labor)
Gross Income	P29,044.00 (at P8.82/kg of palay)
Net Income	P 5,688.00 (or return to investment of 24%)

As one can see, it was hardly profitable to go into rice farming. But with the increased food commodity prices, it will provide the impetus in breaking the cycle of low productivity and poverty and uplift the small farmers economically.

In a similar vein, the coconut and sugar industries have long been in the economic doldrums. If we embark in the production of ethanol from sugarcane and biodiesel from coconut oil, these will create favorable commodity prices and incentives that may transform the stagnant industries to a vibrant state.

With adequate hectarage for expansion for sugarcane for ethanol production, it will spare cassava from being used for the same purpose. Instead, the thrust should be to convert cassava to flour and mixed with wheat flour at the highest acceptable proportion for baking purposes. In this way, we can rescue the shrinking "pandesal" from its tattered image.

As expounded by Dr. Javier, sweet sorghum can complement sugarcane for ethanol production. This is because the sugar mill operates at only seven months of the year. Sorghum can be grown separately in contiguous areas or planted after the ratooning of the sugarcane crops and while awaiting the regrowth to a new crop. I hope that Jatropha could find its niche in biodiesel production. It can provide a lot of employment opportunities for the upland dwellers and migrant workers because, just like in coffee plants, the Jatropha berries do not mature at the same time and harvesting will rely on hand-picking. For information, Jatropha production has been commercialized by British multinationals in Africa and Madagascar. Production is envisaged to be viable because the cultivars in use are genetically superior and they will be grown and processed under a mechanized system and use of plentiful labor. In Madagascar alone, the targeted plantation size is 450,000 hectares. In the Philippines, Jatropha production is a new venture and the Department of Energy intends to go at it in a big way. Its success will hinge on how soon we can resolve the imponderables relating to its agronomy, ecological fitness in the uplands or under coconuts and economic competitiveness as an energy source.

Lastly, let us take issue with the basic food question: "With the critical shortfall of grain supply worldwide, can the Philippines fend for itself and achieve sufficiency in production?" For current self-sufficiency, the average yield of rice must increase from 3.25 t/ha to 3.8 t/ha. For corn, the average yield of 1.92 t/ha must increase to 3.8 t/ha. In 2020, there will be about 106 million Filipinos. We should produce an average yield of 5 t/ha for rice and 4.7 t/ha of corn. The capability or technology to produce 8 to 10 t/ha for grain crops is at hand domestically. The greatest challenge is how we can bring the millions of farmers especially the underprivileged to the mainstream of raising productivity. Technology use requires substantial investments on the part of the farmer and country-wide application needs guidance in terms of a well organized extension machinery. With the devolution of extension functions to local governments , the efforts are fragmentary. To overcome these constraints, the strategy should be to entice big corporations to engage in farming where returns to investments can be as favorable as those in other ventures. The concept is for big business organizations like the Countryside Enterprise Development Foundation to get into the picture and establish a base of operations amidst farming communities through contract-growing schemes and other arrangements with various farmer groups. An alliance and synergy of this sort between corporate entities and farmer groups have proved highly successful in the banana, livestock, rubber and palm oil industries in Asia. We can follow the same scheme for the rice and corn industries. In fact, it is already beginning to happen in the case of the corn industry. Once agriculture becomes an investment magnet for the business sector, it will transform the countrysides as engines for economic development.

Finally, the solution to our food problem will remain delusional if we cannot effect a radical change in the way we manage our population problem. In 2020, the official projection for population growth is at 106 million Filipinos. It looks like we will overshoot this number. But there is still enough time to make the adjustments.

REFERENCES

Argamosa, Felipe M. 2007. *Jatropha curcas:* A strategic feedstock in the development of the Philippine bio-diesel industry. Proceeding of the Symposium on Biofuels:19-23.

Grunwold, Michael. 2008. The clean energy myth. Time April 7 Issue: 28-33.

Hallam, Luke. 2007. Natural fuel signs up for Jatropha oil. Natural Fuel via WA Business News.

Javier, Emil Q. 2008. Weighing the trade-off: food vs fuel. Paper presented at the 2008 Philippine Energy Summit, Mall of Asia, 31 January.

Philippine Agriculture 2020. A strategic plan for poverty reduction, food security, competitiveness, sustainability, justice and peace. National Academy of Science and Technology. Draft copy.

Ritter, Peter 2008. No grain, big pain. Time April 21 Issue: 32-35.

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Energy and Food

SIMULTANEOUS FOOD & BIOFUELS PRODUCTION AND ITS IMPLICATIONS ON FOOD SECURITY

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Abstract

Achieving food security while producing biofuel to power cars is one of the main challenges humanity faces in the new millennium. At present, is there enough food for all? Food reserves in storage are claimed to have declined by 22% compared to the 2005-2006 level and that food reserves shall decline further by 53 million tons (Mt) this year. In the Philippines, rice is the barometer of food security. The government claims there is no rice shortage but 2.7 Mt of rice should be imported for the lean months (July, August and September) as buffer stock. By 2015, or even earlier, rice supply will become even more precarious since a 22% supply deficit should be anticipated if the rice output of this year is simply maintained. It is hard selling that there is no rice crisis and that there is simply a price crisis. The price of rice relative to the 2007 level has indeed increased by 2.22x (P17.50 to P40.0/kg) this June 2008. Many believe that the current price of rice is already high. Using 3 different procedures in determining the true price of rice showed that 1 kg of rice is worth P66/kg (@ $1136/ton import price), P68.4/kg relative to its price in 1975(CPI) and it is P80/kg (considering price parity with the price of oil, oil-based inputs and just labor).

The world, in general, and the Philippines, in particular, is already experiencing difficulties in producing sufficient food for the growing population. Producing renewable energy through biofuel to address the declining oil supply and its almost daily escalating price and also producing adequate food require the same resources or inputs (land, water, initial energy or oil, fertilizer and machineries). In terms of land, as early as the 1980s, all the prime lands in the world are already used for agri- and – aquaculture. This occurred in the 1970s for the Philippines. Of the 1.4B ha of cultivated lands, 30% are already degraded. Erosion is occurring at 9M ha per year and soils are being destroyed at a rate 13x faster than they are being formed. If biofuels are to be produced at the intended amount, they will be grown in some 564 M ha more. This is the additional land area needed to produce the food requirements of 2 billion people by 2030. In the Philippines, we need to put into cultivation some 5M ha (or yield increase equivalent to the yield of 5Mha)for food crops production in the next 15-20 years to satisfy our food requirements which is also the area requirement if we are to produce 100% ethanol to replace gasoline.

Producing biofuels also requires more water (up to 10,000 li of water/li) than producing 1 kg of corn or rice (5000 li of water/kg) for food. The world is already suffering from varying levels of water scarcity. At present, 74% of water is used to

irrigate food crops. Biofuel crops, at the current area planted, use only 1% water but this water consumption will increase to 80% if the biofuel production plan materializes. Current data show that one out of three individuals in the world is now suffering from water scarcity. Global warming/ global climate change, droughts, more forest fires and high evaporation triggered by high temperature will further magnify the diminishing supply of fresh water both for agriculture and domestic use (household and industries).

So much land and water shall be used to produce biofuel in response to the oil crisis. The US government study conducted showed that all forms of renewable energy, including biofuels, however, will only supply 9% of energy needs or 2.25% if only the 4 (biofuel, solar, wind and wave) renewable energy sources are considered. If all the corn and soybean in the US will be processed, they will supply only 12 and 6% of their gasoline and diesel requirements, respectively. In the Philippines, fermenting all the sugarcane harvested in 390,000 ha sugar lands will only satisfy 7.5% of our gasoline requirement by 2011. Sugarcane will have to be planted in 5.3M ha to produce enough ethanol. This is the same area needed for food crops to supply the additional food requirements of 15-20 million Filipinos by 2020. Aside from sugarcane, there are other crops being considered in producing bioethanol in the Philippines. Sweet sorghum is one. It should be pointed out that sweet sorghum will be planted in lands using water which otherwise will be used for food crops. *Jatropha*, on the other hand, is being promoted as a biodiesel crop option since the food and many other uses of coconut oil have already made its price prohibitive. The main drawback of *Jatropha* is its low seed/ oil yield, thus, making its production uneconomical and low in energy balance. More detailed studies should be done.

The effect of biofuels on the environment and on biodiversity is another concern. Biofuel production produces voluminous wastes. Where will all the liquid wastes be thrown? Bio-cleaning the wastes is so cash- and energy-intensive, nullifying the energy balance or net energy yield of biofuel. Biofuel crops planted in new lands necessitates land clearing using fire as the easiest, cheapest and fastest tool. Part of the low energy return from biofuel production is that it also burns oil to prepare lands, plant, fertilize, harvest, and haul the feedstocks, thus, burning a tremendous amount of oil. Ethanol return from corn is only 6%. Furthermore, Nitrogen Oxide (NOx) emission from biofuel production increases due to the use of fertilizer and due to the burning of biomass and oil. Biofuel feedstock establishment is facilitated by burning and production thrives on monoculture. Endemic species' habitats are destroyed and biodiversity is sacrificed. This also happened when humankind burned and cultivated lands for food crops. The simple linear thought, therefore, is.....*more crops for food or biofuel = more lands and water use = more fertilizer or oil use = more erosion = more greenhouse gas emission.*

Humankind is in a difficult bind. Indeed, how could we face the millennium challenge of simultaneous food and biofuel production without sacrificing food security? Biofuel production is currently propelling further food price spikes. Last year, 100M tons of grain were processed into biofuel. It is hard to defend biofuel that they are not directly causing the current world food prices spikes. This year, the estimated deficit was 53M tons *Is is clear that without biofuel in the food equation, there is still enough food supply.* Food price increases have caused food riots in 36 countries. About 3 billion people are now affected especially those who spend 60-70% of their income on food, as they are simply priced out. The stomach of the poor are emptied by the biofuel-powered cars of the rich. Many Filipinos are hungrier and feel poorer than ever. The Millenium

Development Goal of poverty reduction is set back once again.

There many options other than biofuel—solar, wind, wave. The technology is now in place for solar- powered and battery/electric or hybrid cars for transport. In the Philippines (a tropical country), geothermal, hydro-electric, wind and solar power, are so abundant. They remain to be tapped.

Keywords: Food security, biofuel, ethanol, biodiesel, distillery slop, biodiversity, erosion, greenhous gas, global warming/climate change, food miles, globalization, cheap food, cheap oil

Abbreviations: GWP-global warming potential, Mt- million tons, Mha- million hectares, GHG-green house gas, NOx-nitrogen oxides, CPI-consumer price index, FAO-Food &Agriculture Organization, CIA- Central Intelligence Agency

Brief Background

The food crisis is real! Considering food production and consumption, the current food crisis is no surprise. On the production side, food production is carried out under an increasingly difficult production environment –global warming /global climate change - floods, typhoon, droughts, narrowing cycles of El Niño /La Niña, reduced R & D for agriculture, the continuing increase of oil price which propelled a price leap of oil-based inputs(fertilizer & pesticides), decreasing production capacity of the agro-ecosystem to meet requirements or the deteriorating resource base for production (Fig.1). The arable surface of the Earth (1.4 billion ha) is now fully utilized by agriculture and aquaculture (Buringh, 1989). In the Philippines, as early as the 1970s, all the prime agricultural lands (10 Mha) have already been cultivated. Expansion will encroach on fragile and less favorable agro-environments which are too steep, too dry, or with barren soils. Of the 1.4 billion ha cultivated lands, about 327 million ha or 34% have been degraded. An average of 9 million ha are eroded every year and soils are being destroyed 13 times faster than the natural soil formation. Some 400 million ha irrigated lands or 30% are desertified by salinization. With these diminishing lands for food production, "How Many People Could the Earth Support?" Ross McCluney (http://www.ecofuture.org / pop/rpts/mccluney_maxpop.html) revealed a wide range of values from only 2 billion (Pimentel estimates) to as high as 40 billion by eating a vegetarian diet as estimated by Revelle. In the Philippines, we made an estimate of our

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**Discussion paper as Panelist for the Plenary Session III : Energy and Food during the 30th Annual Scientific Meeting of the NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY, PHILIPPINES; held on 10 July,2008 at the Manila Hotel, Metro Manila, Philippines.*

ideal carrying capacity. At 0.43 ha/ person, about 28 million Filipinos could be ideally living in the country, our population in 1960s. It means, we have exceeded our ideal population 3X! The babies who will be born in the next 15 years will need another Philippines (Mendoza,2008).

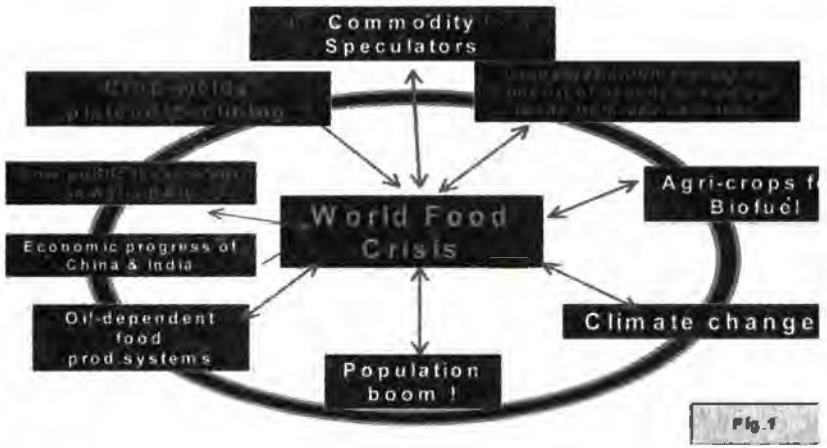
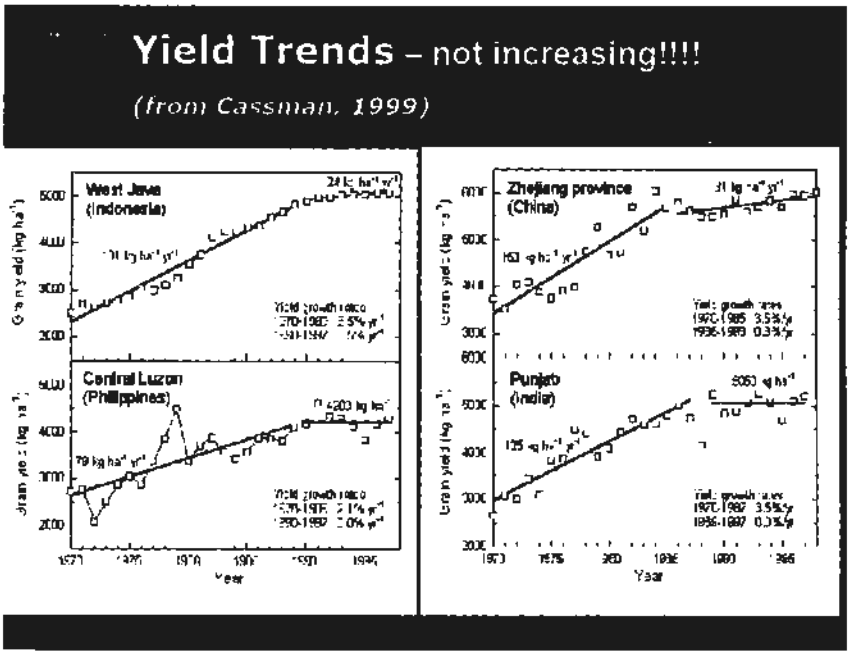


Fig.1

On the consumption side, the huge population especially among poor and food-deficient countries, the increasing affluence of fast-growing economies particularly China and India who comprised about 40% of world population, led to greater consumption of oil and meat or animal products. All together, the demand for food increased. The current trade regime or globalization has brought about the interconnected adverse effects not only on the environment but also on energy use (by increased food miles) and food insecurity especially in the poorer countries. Heavily subsidized agricultural products of developed countries and exported cheap to developing countries, like the Philippines, led to the belief that it is more practical to import foods. Why produce when it is cheaper to import? But this was short-lived as food prices in the world market had increased. The Philippines is now the largest rice importer in the world.

The Food Supply Status

Reserves of cereals (FAO records) revealed that world wheat declined 11 percent (2007), the lowest level of food reserves since 1980 as it is only good for 12 weeks of the world's total consumption - 22% less than the average 18 weeks food stored in 2000-2005. In Australia, wheat production decreased by 50% since the 2005-06 crop year because of drought while Canadian wheat fell 20.6 % in 2007 and their exports fell by 6 million tons. *US, Australia and Canada are the TOP 3 EXPORTERS OF CEREALS in the world.* Rice yields



came to a plateau or yield increases are so minimal. Rice production increased at 2.5-3.0% per year in the 1970s and 1980s. In the 1990s onward, the growth rate was only1.5 % (Fig.2).

Global stockpiles of cereals is estimated to decline by 53Mtons this year (Elisabeth Rosenthal: http://www.iht.com/articles/2007/12/17/europe/food.php).

Is there a rice shortage in the Philippines? There is no rice shortage .We have enough rice. The rice import @ 2.7 million metric tons is merely for buffer stock, the Government claims…This year 2008 , the 1st Harvest of the year was 7.1Mt (41%) and we still need to produce 10.22 Mt (59%) the rest of the year. Our expected harvest for the year is 17. 32 Mt (Source : Dept. of Agric., PDI , June 25,2008).Our rice supply may not be that critical this year but increasing population and the other yield depressing factors cited above may put our food security in great peril starting 2015 (or even much earlier) when our rice demand will increase by 20% relative to our 2008 consumption (Table 1).

Table 1. Estimated rice requirements/paddyrice equivalent,cropped area, demand gap & % increase in yield to meet the demand up to year 2020.

YEAR	Philippine Population (M)	Projected Rice Requirement(1) (M Tons)	Projected Rice Requirement(2) (M Tons)	Paddy rice Equiv.(1) (M Tons)	Paddy Rice Equiv.(2) (M Tons)	d Area Demand Gap(1) (M Tons)	Demand Gap(2) (M Tons)
2007	88.10	10.45	11.28	16.34	17.62	1.65	2.47
2008	90.04	10.68	11.52	16.70	18.01	1.88	2.72
2009	92.02	10.92	11.78	17.06	18.40	2.11	2.97
2010	94.04	11.16	12.04	17.44	18.81	2.35	3.23
2011	96.11	11.41	12.30	17.82	19.22	2.60	3.50
2012	98.23	11.66	12.57	18.21	19.65	2.85	3.77
2013	100.39	11.91	12.85	18.61	20.08	3.11	4.04
2014	102.60	12.18	13.13	19.02	20.52	3.37	4.33
2015	104.75	12.43	13.41	19.42	20.95	3.62	4.60
2016	106.95	12.69	13.69	19.83	21.39	3.89	4.88
2017	109.20	12.96	13.98	20.25	21.84	4.15	5.17
2018	111.49	13.23	14.27	20.67	22.30	4.42	5.46
2019	113.83	13.51	14.57	21.11	22.77	4.70	5.76
2020	116.11	13.78	14.86	21.53	23.22	4.97	6.06

**2.2% Projected Average Population growth rate/year up to year 2014,.*
2.1% year 2015 to 2019 and 2.0% by year 2020.
(1) Per capita consumption 118.67 kg/person (94 + 24 buffer, NFA)
(2) Per capita consumption 128.0 kg/person (based on RDA ,65% of 2000kcal from rice , 1.0 kg rice =3,700kcal , estimated by Mendoza,2001)
64 % milling recovery , 60:40 WS : DS crop ; 3.7 mt/ha DS & 2.8 mt/ha WS = 3.2 mt/ha
Assumed Cropped Area per Year= 4.3 Mha (1.5Mha irigated x 2 + 1.3Mha rainfed), Rqd.) 100
% Rice Sufficiency= (Actual Cropped Area/Cropped Area
Sufficient Yield level = Total Paddy rice rqd./Cropped Area :

Food Price Crisis or Simple Human Denials?

The era of cheap food is over, the Asian Development Bank Chief said. The UN's food price index rose 45 percent in the past 10 months but some prices have climbed even faster. Wheat went up 108 per cent in the past 12 months; Corn, 66 per cent and rice (220% ,2007 to date), the food that feeds half of the world, went "*from being a staple to a delicacy*," (Abah Ofon,2008) http://www.theglobeandmail.com/servlet/story/RTGAM.20080410.wfood0411/BNStory/International/home

Poor people are simply priced out ! In 2007, commercial rice can be bought as low as Php17.50/ kilogram. As of this date, rice is sold at P40/kg. Is it really expensive? Is this the true market price of rice in the Philippines? How much is the true price of rice? Prices were determined in three different ways (Mendoza, 2008) and the estimated prices are shown below :

Table 2. Estimated farm gate price of paddy rice and equivalent retail price per kg at various imported price (in USD/ton).

Imported Price of Rice (1) USD/ton	Farm Gate Price of Palay/ kg (2) PhP/kg	Retail Price per kg (3) PhP/kg
700	19.50	40.60
800	22.74	46.40
900	25.06	52.20
1136	31.63	65.89
1200	33.41	69.60
1300	36.20	75.40
1400	38.98	81.20
1500	41.76	87.00
1600	44.54	92.80
1700	47.33	98.60
1800	50.18	104.40
1900	52.90	110.20
2000	55.68	116.00

Notes:

1) Imported price at USD / metric ton, $1 = P43 exchange rate , no tariff. Shipping costs are included

2) The farm gate price of palay is estimated directly from the imported price plus costs of handling (Nueva Ecija is the reference pt.)

3) The retail price per kg is estimated at zero tarrif, $1 = P43 exchange rate, plus handling costs (Nueva Ecija is the reference pt.), 64% milling recovery

Imported rice (@$1136/t)
= P 66/kg (Table 2)
CPI corrected (1975 to 2008)
= P68/kg (Table 3)
Adjusted to current price inputs & just wage
= P86/kg (Table 4)

If the price of rice is Php 2.50/kg in 1975 and it is indexed to 2008, it should fetch Php 68.48/kg (Table 3). The 2008 rice price spike (P50/kg in Davao) was not a spike after all but reflective only of the true market price of rice in the domestic market (Mendoza , 2008). In the Philippines, the price of basic food is not allowed to freely move up or down based on the market forces. It is the policy of the state to make food available and affordable (food security) through direct and indirect interventions. In the case of rice, the National Food Authority (NFA) always ensures that enough supply is available (achieved mainly through importation) so that rice prices in the domestic market is stabilized. Viewed from the perspective of the low wage earners, this strategy of the government is highly laudable. If the government cannot force employers to increase wages, it can at least maintain food prices at affordable levels. But this is disincentive to the farmers because they could hardly make a living out

Table 3. Consumer price index of food, beverages, and tobacco.

Year (A)	FBT (*B)	1978=100 ©	1973=100 (D)	E
1973	55.40	55.40	100.00	1.00
1978	100.00	100.00	180.51	1.81
1988	380.40	380.40	686.64	6.87
1990	429.50			
1988	100.00	380.40	686.64	6.87
1992	157.30			
1994	180.70	687.38	1,240.76	12.41
1996	217.40			
1994	100.00	687.38	1,240.76	12.41
2000	145.50	1,000.14	1,805.31	18.05
1992	66.10			
1996	84.30			
2000	100.00	1,000.14	1,805.31	18.05
2007	134.90	1,349.19	2,435.36	24.35
2008* May	151.60	1,516.22	2,736.85	27.37

* (http://www.census.gov.ph/data/sectordata/2008/cp080501r.htm)

A = Representative years, B = CPIs for Food, Beverages, & Tobacco *Phil Stat Yearbooks (1987 – 2007)*

C = Adjusted CPI consistent with 1978 base price (1978=100) , D = Adjusted CPI using data in C to make 1973 as the base year (1973 = 100)

E = CPI or price ratio at 1973 base price ,

ex. How much is a kilo of rice in 1973 priced at Php 2.50 for May of 2008? ,

of farming. Subsidizing rice, a form of cash transfer to the poor, will mean huge costs. It was estimated that the National Food Authority will incur up to P37 Billion loss this year alone (PDI, June 13,2007).

Rice farming is associated to poverty. It is no surprise that poverty is a rural phenomenon in the Philippines since 9 out of 10 farmers are rice farmers.

Table 4 .Rice price adjustments as the price of oil increases

Oil Price per barrel (USD)	Price of Urea per bag (50kg)	Palay price per cavan (50kg) ; 1	Price of palay per Kg 2	Price of rice per Kg 3
100	1050	1050	21.0	**57.00**
110	1230	1230	24.6	**70.62**
120	1410	1410	28.2	**78.54**
130	1590	1590	31.8	**86.46**
140	1770	1770	35.4	**94.38**
150	1950	1950	39.0	**102.30**

1- Price of Urea = Price of Palay

2- Farm gate price of palay =palay price per cavan/50 kg

3- Price of rice (retail) = 2 x price of palay/kg + post-production costs

Post-prodn. = Drying/hauling, milling, warehousing, sack, profit(approx.P15/kg)

Oil Dependent Food Systems

Humanity is overconsuming oil. Over 1.5 trillion barrels of oil equivalent had been consumed since Edwin Drake drilled the first oil well in 1859 (www.energyandcapital.com) and in 40 years, the remaining1.5 trillon will be consumed at the current rate of utilization of 85 million barrels a day, or about 31 billion barrels/year (BP Global Statistical Review of World Energy, 2007). What Earth stored in 9 million years (Rodolfo,2007), humanity consumes in one years . In less than 2 years, the oil price might increase to $200/barrel. *The era of cheap oil is gone!* Hopefully, the conflict in Iran will be solved diplomatically. Otherwise, oil price might increase further to an unaffordable level although this event will accelerate further the shift to alternative energy sources and it will decrease considerably oil consumption which in turn will reduce significantly greenhouse gas emission, thus, saving humanity by not reaching the predicted tipping point - 2 degrees centigrade increase in temperature (Hansen, 2008).

Why is oil so important in our food systems ? Simple ! Our food systems use so much oil to cultivate, fertilize, harvest, process, store, and distribute food. From production – to- post production, rice utilizes an oil

equivalent of 830 li or 42 li oil @ 128kg/rice per person. Sugarcane uses 1120 li oil equivalent or 2.4 li oil @ 20kg sugar/capita. Prices of food are inevitably affected with oil price increases. *As the era of cheap oil is gone, so is the era of cheap food in view of the excessive dependence of our food systems on oil.* In the United States, 1514 li of oil equivalents are expended annually to feed each American. Agricultural energy consumption is broken down as follows: 31% for the manufacture of inorganic fertilizer, 19% for the operation of field machinery, 16% for transportation, 13% for irrigation, 8% for raising livestock (not including livestock feed), 5% for crop drying, 5% for pesticide production, 8% miscellaneous (Pimentel, David and Giampietro, Mario. 1994, McLaughlin, N.B., et al.2000; as cited by Pfeiffer, DA. 2003). The first International Agriculture Assessment on Science and Technology Development (IAASTD) approved by 54 governments scored industrial agriculture as a causal factor in increasing food prices, hunger, social inequities, and environmental disasters (http://www.agassessment-watch.organdhttp://www.panna.org/).

The Biofuel Mania

The over utilization of oil has brought about complex situations. The fast dwindling supply and the ensuing oil price spikes led to a breathtaking speed of biofuel production. Food crops (corn, soybean etc.) being processed into biofuel increased the demand of crops used as feedstocks which intensely compete with the same resources – land ,water, financial & human capital- being used for food production. The current thinking is that biofuel production is good for our economy as summarized in Fig.3.

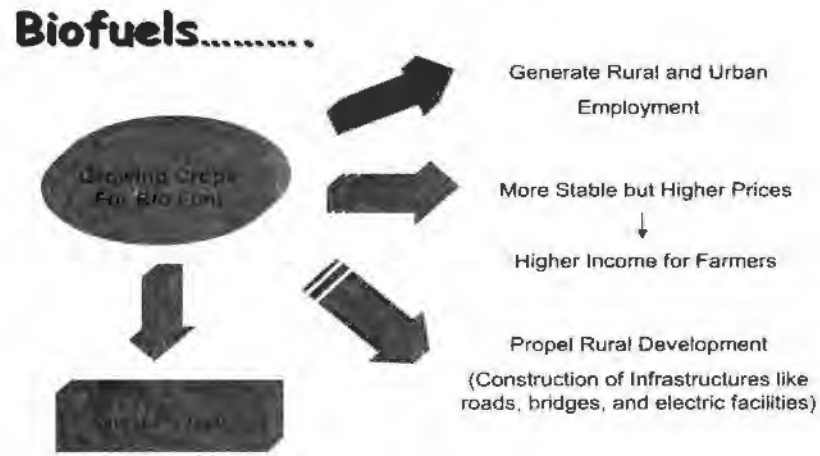


Fig.3

Let us assess biofuels if they are really advantageous .

Biofuels and Net Energy Yields

There are 2 considerations:

(1) Crops as Feedstocks- For bioethanol --- sugarcane, corn, sorghum, root crops; For biodiesel----- palm oil, soybean, rapeseed, canola, castor oil, *Jatropha,* and

(2) (2) Net Energy yields from a given crop source. *Net Energy Yield = Gross Energy yield less Cost of energy*. This can be simply derived by estimating the Energy efficiency(Ee)= Energy output / Energy input (Energy balance) and the Energy Intensity (Ei) = amount of energy used to produce 1.0 li of energy (ethanol) = 1/ Ee (Mendoza, 2008).

(A more detailed discussion of issues re: biofuel crops under Philippine conditions is included in Annex A). As shown on Table 5, only 1 crop-sugarcane - is showing a positive energy balance. In Table 6, the energy accounting for *Jatropha*, the most popular crop for biodiesel as it is not edible and it is known to grow in marginal soils , showed a dismal note. The energy balance ranges from 0.53 to 1.03 , for low and high yield, respectively at the field level production stage. It means that the energy consumed in processing is not yet included.

Table 5. Energy efficiency (Ee) of the various feedstock sources of ethanol production (Mendoza,2008).

FEEDSTOCK	YIELD LEVEL	ENERGY EFFICIENCY	ENERGY INTENSITY*	REFERENCE
Sugarcane[2]	Average	2.80	0.357	Mendoza et al 2007
	High	3.05	0.327	Mendoza et al 2007
Corn[3]	Low	1.06	0.94	Moriss 1994
	Average	1.25	0.800	Shappouri et al 1995
	High	1.38	0.724	Lorenz & Moriss, 1995
Cassava[4]	Average	1.00	1.000	Hill et al 2006
	High	1.32	0.757	Hill et al 2006
Sweet Sorghum	Average	0.91	1.090	Worley et al 1992
	High	1.09	0.910	Worley et al 1992

[1] Energy intensity = 1 , Energy Efficiency

[2] For Sugarcane, Ee as high as 8.0 was obtained in Brazil (Macedo et al 2004, Smeets et al 2006) which simply indicates the high potential of sugarcane for ethanol. But Ee=8.0 was not used and the Ee that was earlier estimated by Mendoza et al 2007 was used.

[3] For Corn, Ee as low as 0.75 was reported by Pimentel (2004)

[4] For Cassava, Hill et al (2006) reported only 1 Ee value

Table 6 . Energy (LDOE/ha) accounting of jatropha production on a ten year period(Ratilla,2008)								
	Year 1		Year 5		Year 10		otal (5 years	ptal (10year
	LDOE	%	LDOE	%	LDOE	%		
1.Fossil Fuel Based Energy Input (FFEI)								
Fuel (li)			45	9.67	45	9.67	90.000	315.000
Fertilizer								
Total	226.47	82.72	383.954	82.50	383.954	82.50		
2. Indirectly Fossil Fuel Oil Based Energy Input								
A. Labor								
B. Seeds (g)	0.89	0.33					0.890	0.890
C .Bolo	2.775	1.01					5.550	5.550
Total (IFFEI)	47.315	17.28	81.43	17.50	81.43	17.50		
Total Energy Input	273.785	100.00	465.384	100.00	465.384	100.00	1560.747	3887.667
Energy use/kg								
Seed Yield (kg/ha) (low)= 1700 kg/ha			0.91809		0.38114		0.91809	0.38114
Seed Yield (kg/ha)(high)= 2850kg/ha			0.54763		0.22735		0.54763	0.22735
Energy use/li oil yield								
Oil yield (low) (30%) = 251 li ton^{-1} seed			1.83805		1.30344		1.8381	1.3034
Oil yield (high)(35%)=202 li ton^{-1} seed			0.94243		0.66832		0.9422	0.6683
Energy balance (low yield)							0.435	0.527
Energy balance (high yield)							0.849	1.027

Biofuels and Energy Supply

The US government study showed that by 2030, all renewable energy including biofuels will only supply 9% of global energy needs. If divided equally among the 4 main sources, biofuel will only provide 2.25 % of the energy supply. The entire US corn harvest will only provide 12% of their gasoline needs and their entire soybean harvest, only 6% of their diesel fuels requirements. In Europe, 60 % of their arable lands could only replace 20 % of the fossil fuels used in transport. A 5.75% target would require ¼ of the EU's arable land (Goldman, 2006). In the Philippines, if all the sugarcane planted in the 390,000 ha are harvested & fermented into ethanol, it will only provide 7.3% of our gasoline requirements and sugarcane must be planted in 5.2 million ha to satisfy 100% of the country's gas requirements by 2011 . The 10% ethanol mix with gasoline needs 200,000 ha of new sugarlands (Mendoza et al.,2007). All over the world, biofuels production shall use lands over and

above the existing lands for food crops as follows: Brazil.....120 Mha, Africa... ..400Mha , Indonesia...20 to 30Mha and in USA...all their corn lands and 14 % more...Approximately, the new land requirements for biofuels would be 564 Mha. Where shall we get all these lands without affecting food supply ?

Biofuels and Water

About 2,000-10,000 li of water is needed to produce a li of biofuel. In Brazil, they use 2,200 li of water/ 1 li of ethanol from sugarcane, Phil = 3,000- 4,200, India = 3,500 li. 1 li corn ethanol consumes 4,000- 10,000 li of water in the US. Table 7 shows the water bill for ethanol production for various crops in the Philippines. The International Water Management Institute (IWMI) 5 year study on global water scenario showed that biofuel crops currently consume just 1 percent of the total water used globally .If biofuel usage rises as projected, it would be using 80 per cent more water by 2030. Currently, 74% of all water is used for irrigation. There shall be 3 billion extra people by 2050 and this will result in an 80 percent increase in water use for agriculture". "If people are growing biofuels and food at the same time, more water will be needed!"*Where shall we get all the water we need*?, David Molden asked (Sri Lanka-based IWMI). Production of biofuels could worsen water shortages (Alister Doyle,2006. http://today.reuters.com/News/CrisesArticle. aspx?storyId=L18850725 8/24/2006). At present,"One in three people in the world is enduring in one form or another, water scarcity".

Biofuels and the Environment

That biofuels are renewable and environment-friendly and they can help reduce global warming are the common perception . There are 2 main points for biofuels:(1) They are 'carbon-neutral.' When burned, the CO_2 released is re-absorbed by the crops for photosynthesis - so there is no net increase in CO_2; (2) Biofuels are renewable energy sources with a 1-year cycling time, while fossil fuel oils take several million years to be formed (Rodolfo, 2007). On the other hand, producing biofuel shows the following negative environmental features: In Brazil, more sugarcane and soybean for biofuel are grown by burning and clearing large forested areas of the Amazon jungle. Tropical forests cleared for sugarcane ethanol emit 50% more greenhouse gases than the production and use of the same amount of gasoline (David Tilman and Jason Hill, 2007). More oil palms are planted in Indonesia by clearing the forest and drying/burning their peat soils, making it the 3rd highest emitter of greenhouse gases (GHG). Every ton of palm oil produced results in 33 tons of carbon dioxide emissions—10 times more than petroleum (George Monbiot, 2007). As revealed by Friends of the Earth, production of palm oil is the biggest cause of rainforest devastation.

Massive production of biofuels in these areas will reduce the carbon content of soils and carbon stocks in forests and peat lands (UN-Energy 2007). Doug Parr, chief British scientist at Greenpeace, says 'producing 5% of biofuels may end up wiping out our existing ancient forests and all the carbon gains are lost' (Holt-Gimenez 2007).

Table 7.Water Consumed per li Ethanol Produced*

Feedstock	li Water Use/ li of Ethanol**
• Sugarcane	3,000 – 4,200
• Corn	3,670 – 6,060
• Cassava	3,000 – 9,700
• Sweet sorghum	3,100 – 5,200

** Li water/li ethanol = total water consumed ÷ total ethanol produced
*Data collected from various sources : Mendoza (2008)

Growing crops for biofuel now is following the industrial plantation agricultural technology. Industrial agriculture is so oil energy-intensive that it contributes an enormous amount of greenhouse gases. For instance, ethanol production from corn uses oil at every stage. The largest source of green house gases are the chemical fertilizers (nitrogen is often the limiting factor in crop production). *First*, a huge amount of oil is consumed in the manufacture of nitrogen fertilizer. Including transport and storage, the energy use ranges from 1.8-2.04 L of oil per kg nitrogen. 'Fertilizer energy' is 28% of the energy used in agriculture (Heller 2000). *Second*, once applied in the soil, 3-5% of it escapes as [nitrogen oxides] NOx. NOx has 296x global warming potential (GWP). For every 1 kg nitrogen, more than 10 kg CO_2 equivalent is emitted in the atmosphere. Above all, growing maize erodes soils, pollutes both surface and ground waters from fertilizer run-off and deep percolation. Also, industrial plantation thrives on large scale monocropping leading to significant biodiversity loss, soil erosion and nutrient leaching (UN-Energy, 2007). Because of these, more hydrocarbon-based fertilizers must be applied to offset soil fertility decline, along with more pesticides application; more irrigation water, requiring more energy to pump; and more fossil fuels to process polluted waters (Pfeiffer, 2003). Loss of topsoil has been a major factor in the fall of civilizations
(Carter & Dale, 1981, Ponting, 1993). Iraq, formerly Mesopotamia, is where 75% of the farm land has become a salty desert. It takes 500 years to replace 1 inch of topsoil. In soil made susceptible by agriculture, erosion is reducing productivity up to 65% each year. The soil is eroding 30 times faster than the natural formation rate (Pimentel & Pimentel, 1991). Biofuel production from corn (i.e., butanol, ethanol) is especially harmful because corn causes 50 times more soil erosion than hay crops (Sullivan, 2004). The US government has studied the effect of growing continuous corn and found it increases eutrophication by 189%, global warming by 71%, and acidification

by 6% (Powers, 2005). The greenhouse gas contribution of agriculture and land use change has been summed up to 32% (IPCC, 2006). Primary agriculture contributes 14%, land use change/deforestation,18%. As more biofuel crops will be grown, large land clearings/deforestation will be done. About 564M ha will be needed to grow biofuel crops. This huge land requirements will inevitably lead to more deforestation, further reducing biodiversity, decreasing water supply and water quality, and increasing further soil erosion (Tegtmeier, 2004). Orangutans, rhinos, tigers and thousands of other species may be driven extinct (Monbiot, 2005). In turn, this will lead to more GHG emission. The FAO World Food Summit (2006) Report revealed that conventional agriculture, together with deforestation and rangeland burning, are responsible for 30% CO2 and 90% of nitrous oxide emissions worldwide. The Amazon is being destroyed by farmers growing soybeans for food (National Geographic, Jan 2007) and fuel (Olmstead, 2006).

To reduce the cost of processing, coal is used in ethanol production, replacing petroleum (Farrell, 2006, Yacobucci, 2006 & Clayton, 2006). Using coal for burning/heating biomass factories increases global warming (Farrell, 2006).

Many people believe that sourcing biofuel from human inedible crop sources like cellulosic biomass will correct its ugly features. But biofuels from biomass are also not sustainable, are ecologically destructive (Tegtmeier, 2004), have a net energy loss, and there are insufficient biomass to make significant amounts of energy because essential inputs like water, land, fossil fuels, and phosphate ores are limited. Biomass yields will also decline when residues are removed from the soil (Johnson, 2006). Farmers will not sell their residues as prices of fertilizers rise due to oil and natural gas depletion. It will be cheaper to return residues to the soil than to buy fertilizer. Fertile soil will be destroyed if crops and other 'wastes'are removed to make cellulosic ethanol (Friedemann, 2007).

(Kumar & Goh, 2000; Nelson, 2002; Sheehan, 2003). Removing crop residues would rob organic matter that is vital to the maintenance of soil fertility and tilth, leading to disastrous soil erosion levels (Magdoff & Van Es, 2000). The most prudent course is to continue to recycle most crop residues back into the soil, where they are vital in keeping organic matter levels high enough to make the soil more open to air and water, more resistant to soil erosion, and more productive (Sampson, 1981). Intensive agriculture of the last 5 to 6 decades has already removed 20 to 50% of the original soil carbon, and some areas have lost 70%. To maintain soil C levels, no crop residues should be removed under any tillage systems or on highly erodible lands (Johnson, 2006).

Furthermore, producing biofuels like ethanol in sugarcane is accompanied by the generation of huge liquid wastes called distillery slops. Corn ethanol plants generate 13 L of wastewater for every L of ethanol produced (Pimentel, 2005). While ethanol contains considerable amount of potash and many other nutrients and has fertilizer value, it is highly acidic, is high in biological oxygen

demand (BOD), chemical oxygen demand (COD), and is foul-smelling. It is a highly pollutive waste if not properly treated and disposed. The production target of 120 billion L of ethanol and about 12 billion L of biodiesel by 2030 will produce about 3 trillion L of liquid wastes (Mendoza et al.,2007;Demafelis, 2007).Where will all these liquid wastes be thrown out? Avid proponents of biofuel will argue that the liquid wastes could be treated for re-use. The treatment costs will be enormous, will increase health costs, kill fish with insecticides that work their way up the food chain (Troeh, 2005).

Biofuels and Food Prices

Production of biofuels consumed almost 100 M tons of grains last year. It is hard to defend biofuels as not directly causing the current world food price spikes. This year, the estimated deficit was 53M tons *(16April,2008Monbiot. com). It is clear that without biofuel in the food equation, there is still enough food supply. If fermenting corn will be stopped, its price will decrease by 20 to 30 %.* In the US, ethanol production from corn (2008) is estimated at 11.4 billion gallons . This is equivalent to the food caloric requirements of 450 M people (@3000Kcal/person). By 2017, about 35 billion gallons will be produced which translates to the food caloric requirements of 1.4 B people (@3000Kcal/person). We cannot dictate to the US what to do with their corn. But the US produces 40 % of the world's total corn and supplies 70 % of all corn exports. Their ethanol production from corn not only propelled the increase in corn price but also in all food commodities including meat and dairy. Corn constitutes 50 % or more of livestock feed.

There are about 2.7 billion people in the world who are living on the equivalent of less than $2 a day (World Bank , 2001) and 85 % of Filipinos live on less than $2 a day! (CIA, 2006). Food crisis happens in many poor and food-deficient countries and
it is true even in rich countries :37 million poor in the U.S (observer.guardian. co.uk); 80 million in China (Paromita Shastri, livemint.com); 37 million poor in Indonesia (Indonesia-pretoria.org.za); 24 million in the Philippines (ifad. org) and 250 million in India (ews.bbc.co.uk). Caloric consumption typically declines as price rises by a ratio of 1:2.or for every 1% rise in the food price, 16 million people are made food-insecure. Some 1.2 billion people could be chronically hungry by 2025—600 million more than previously predicted (Runge & Sennauer, 2007)

What Renowned People & Institutions Say about Biofuels !

"Biofuels policy in the EU and the UK may have run ahead of the science". Professor Robert Watson *Jacques Diouf, head of the UN Food and Agriculture Organization said that* "a very serious risk that fewer people will be able to get food," particularly in the developing world,

http://www.iht.com/articles/2007/12/17/europe/food.php .

The International Monetary Fund noted that " The use of food as source of fuel may have serious implications on the supply of food if the expansion of biofuels continues." "The stomachs of the poor are losing out to the cars of the wealthy."

Jean Zeigler, a UN special rapporteur, calls the biofuel trade *"a crime against humanity."*

" Biofuels could end up damaging the natural world rather than saving it from global warming", Jeffrey A McNeely, chief scientist of IUCN .

We must avoid falling into the trap of having a *"cure worse than the disease!* ", the biofuel malady, according to Dr.Paul Crutzen.

Do we have Options other than Biofuels?

For the Philippines, there are many options in pursuing energy security other than biofuels and they are as follows : improve energy use efficiency - minimize the use of cars – walk, bike ride, shift to more renewable and environment-friendly sources of energy- solar, wave, and wind energy (Mendoza,2007, Rodolfo,2007 and 2008).

The food crisis is a wake-up call. There are several OPTIONS that can be done both on the production and consumption side.

On the food supply or food production , there are many possibilities (Mendoza, 2008) : 1) Growing food the whole year round is possible where sunlight is available. All the rest can be provided (soil, composts, water). If one so desires, land availability is not the issue. It is the willingness and interest of the individual. Sustainable food advocates claim that family farms and gardens not only can feed the world, they are the only food production approach that can sustain food in the long run (Bradley et al, 1992). A sunshine-rich country like the Philippines, whose climate is so accommodating for the whole year round growth of crops provided water is available, need not fear hunger. We have no freezing winter that requires expensive heated glasshouses to grow crops.

Oil-based agriculture is unsustainable agriculture (Ho, 2008). This old paradigm of industrial, energy-intensive, and toxic agriculture is a concept of the past (IAASTD,2008). Small-scale farming and agro-ecological methods provide the way forward to avert the current food crisis and meet the needs of local communities. For the first time an independent, global assessment acknowledges that farming has a diversity of environmental and social functions and that nations and peoples have the right to democratically determine their best food and agricultural policies (http://www.agassessment-watch.organdhttp://www.panna.org/). There is a need to pursue a biodiverse, integrated, and organic/sustainable (BIOS) agriculture as the core strategy to sustainable food security. Organic agriculture can feed the world (Winter 2007, Badgley et al., 2007). Organic farming requires lesser energy in growing crops and it is consistent with the declining fossil fuel oil supply; and diversified and

integrated farming gives higher production compared with the conventional monocrop farming. A case study comparing a monocrop and a diverse farm showed that the estimated food caloric value produced in the diverse farm is 61.7% higher than the conventional monocrop rice farm (Mendoza, 2001). Sufficient food calories (65% of 2000 kcal/day) for 48 persons in one year could be harvested in this farm. BIO-farm has 2 important requirements, namely :

(1) bio-farming is decision-intensive, hence, the farmers should own the land to enable them to make independent decisions and motivate them to rebuild and restore soil fertility @ impoverished soil >>> low yield>>> impoverished farmers >>> malnourished farm families ..... Smaller, more diverse farming systems require a level of husbandry that is simply uneconomical at any other scale. Organic crops and livestock demand specialist knowledge and regular monitoring (http://www.theecologist.org/archive_detail.asp?content_id=1184).
(2) The farmers need seed support as they have lost their indigenous/traditional seeds through long years of monoculture farming practices. The UN FAO estimates that 75 per cent of the genetic diversity of agricultural crops has been lost over the past 100 years (FAO, 1997).

On the consumption or demand side, the changing climatic pattern and the diminishing resource requirements to grow sufficient rice call for a *change* in the thinking that if we have not eaten rice, our meal is not complete or we have not eaten yet. Three options were earlier forwarded (Mendoza, 2008):

Option 1. Diversify our food caloric sources. We can supplement rice with corn, camote, or any other carbohydrate yielding crops. Simple estimates show that reducing the 65% caloric energy supplied by rice (translates to 124 kg /capita) to only 50% (translates to 95 kg/capita) makes us immediately self-sufficient in rice.

Option 2. Food wastage must be minimized or avoided. The current world food shortage is not simply the result of a production shortfall. It is how the food we produce are utilized or wasted. Why do we need to polish rice? Unpolished rice is more nutritious (rich in vitamins), and it gives higher milling recovery (from 64% to 72 % milling recovery of unpolished rice; bran is about 8%). This translates to about 1.2M tons of rice savings. About 10 to 15% more rice will be saved if we eat unpolished rice. Add together, this sums up to about 2.4 million tons of rice. We become more than self-sufficient in rice.

Option 3. In the Philippines, about 7.0 million tons of corn are fed to our poultry and livestock (We produce 6.0 tons, we import the rests). We just divert 2.5 million tons of corn, mill them and mix the milled corn grains with rice at 10 to 15 %, we automatically become food caloric self- sufficient. In the developed world, particularly the US, about 2/3 of their small grains (cereals of soybean) are fed to livestock. Everybody in the world wants to adopt the American diet. And we want to eat like the average Americans. We would need 5 more Earths, or only about 1 billion would live if all people eat like the Americans. Of the 2.13 B tons of grains produced this year, only 1.01 B ton, according to the United Nation's Food and

Agriculture Organization, will be directly consumed by the people. The production of biofuels will consume almost 100 M tonnes (16April, 2008Monbiot.com) to fuel cars, but 760 M tons will be fed to animals – an amount equivalent to 14 times the global food deficit of 56 Mtons(FAO, 2006)

The growing affluence of China and India leads to booming meat consumption, and is now the single dominant factor pushing up food and energy usage. As the Chinese become more affluent, they can now afford to buy more meat, beef and chevon. They now raise billions of sheep, and grow lots of corn and soybean just to feed their livestock{(1 kg pork = 5.6 kg corn equivalent, 1 kg broiler chicken = 4.8 kg corn equivalent, 1 kg corn equivalent = 0.7 kg corn + 0.3 kg soybean, 1 kg soybean = 3.2 kg corn) (Mendoza, 2001)}. This is called the thermodynamic loss of food via food type conversion. As feed Grain g animals g man, we lose 90% protein, 96% calories, 99% carbohydrates, 100% fiber. The 50 gram meat-dietary intake per day translates to 2 days of food if eaten as corn or soybean. It is a choice then of eating meat today and forgoing food for 2 days. It is not that we should abandon eating meat. The logic is to raise animals but not feeding them food that directly competes with human food. The ruminants feed on grasses or fibrous crop residues, in turn, producing manure for composts to fertilize our crops. For the Philippines, we are simply lucky as we are endowed with large coastal and marine waters (220 M ha) and fresh water (1.0 M ha) where fish can grow and multiply for the protein part of our nutrition. But again, good governance and people's cooperation in protecting the sea (preserve the remaining mangroves and plant more as they serve as fish breeding grounds) is the key to the revival of our seas teeming with fish. Bringing back the watersheds that supply free-flowing fresh water to the river during summer months favors the breeding and fingerling production of many fish species in the resulting brackish water of river banks.

References

Altieri,M and Elizabeth Bravo. 2007. "The ecological and social tragedy of biofuels," 5/1/07, www.foodfirst.org

BP Global Statistical Review of World Energy. June 2007. http://www.bp.com/statisticalreview

Badgely, C. Moghtader, J., Quintero, E., Zahem, E., Chappel, M.J., Aviles-Vasquez, K., Samulona,A. and Perfecto, I. 2006. Organic agriculture and the global food supply. Renewable Agric and Food Systems: 22(2):86-108.

BAS (Bureau of Agriculture Statistics); Average per capita of the Phils. 2007.

Bradley, Fern Marshall and Barbara W. Ellis, eds. Rodale's All-New Encyclopedia of Organic Gar Brar, D. S. and G. S. Khush. 1997. Wide hybridization for riceimprovements: Alien gene transfer and molecular characterization of introgression. pp 21-29 In M. P. Jones, M. Dingkhun, D. E. Johnson and S.O. Fagade eds. Interspecific hybridization: Progress and prospect WARDA, 01BP2551, Bouake, Cote d' voire.dening. Emmaus, Pennyslvania: Rodale, 1992.

Buringh, P. 1989. Availability of agricultural land for crop and livestock production. In *Food and Natural Resources*, eds. D. Pimentel and C.W. Hall. 69-83. San Diego: Academic PressBadgley et al .2007.Organic agriculture and the global food supply. Renewable Agriculture and Food Systems: 22(2); 86–108.

CIA. 2006. Philippines. *World Factbook*. 11 July 2006, Accessed 27 September 2006. http://sportsforum.ws/sd/factbook/geos/rp.html#Econ. Caroline Lucas Mep, et al "Fuelling a Food Crisis: The impact of peak oil on food security", The Greens/European Free Alliance, European Parliament, 12/06

Defra, 2005. The Validity of Food Miles as an Indicator of Sustainable Development: Final report, Department of Environment Food and Rural Affairs.

Doiron. 2008. http://www.alternet.org/story/81769/

Doyle, A. 2007.Food, biofuels could worsen water shortages. http://today.reuters.com/News/CrisesArticle.aspx?storyId=L18850725

Dufey Annie, "International trade in biofuels: Good for development? And good for environment?" International Institute for Environment and Development, 2006.

Delft Hydraulics in George Monbiot, "If we want to save the planet, we need a five-year freeze on biofuels" The Guardian, 3/27/2007

David Tilman and Jason Hill, Washington Post, 3/25/07

EIA. 2000. US-EIA Presentation : Long Term World Oil Supply,

(http://www.eia.doe.gov/pub/oil_gas/petroleum/presentations/2000/long_term_supplyindex.htm)

FAO (1997) .The State of the Worlds Plant Genetic Resources for Food and Agriculture, Food Agriculture Organisation of the United Nations, Rome.

FAO. 2006. Livestock's Long Shadow. ftp://ftp.fao.org/docrep/fao/010/a0701e/a0701e.pdf

Ford Runge and Benjamin Senauer, "How Biofuels Could Starve the Poor",Foreign Affairs, May/June 2007

Goodchild, Peter, 2007. petergoodchild@interhop.net

Hamer, Ed & Mark Anslow. 2008. 10 reasons why organic can feed the world. http://www.theecologist.org/archive_detail.asp?content_id=1184

Hansen, James .2003. Twenty Years Later: Tipping Points Near on Global Warming http://www.huffingtonpost.com/dr-james-hansen/twenty-years-later-tippin_b_108766.html .June 23, 2008 | 05:57 PM (EST)

Harrabin, Roger. 2008 Call for delay to biofuels policy .BBC Environment Analyst http://news.bbc.co.uk/2/hi/science/nature/7309099.stm

Holt-Giménez, E. 2007. Exploding the Biofuel Myths Food First/Institute for Food and Development Policy (http://www.foodfirst.org/, published in http://www.foodfirst.org/node/1715>

Leu, Andre. 2007. Organic Agriculture Can Feed the World in Organic Farming, Winter 2007, citing Jules Pretty, 2006. http://www.rimisp.org/getdoc.php?docid=6440 Pretty, 1999, The Living Land.

Mae-Wan Ho. 2008. Organic Cuba without Fossil Fuels. http://www.i-sis.org.uk/full/OrganicCubawithoutFossilFuelsFull.php. SIS Press Release 21/01/08

McLaughlin, N.B., et al.2000. Comparison of energy inputs for inorganic fertilizer and

manure based corn productionCanadian Agricultural Engineering, Vol. 42, No. 1, 2000.

Mendoza, TC. 2001. Pursuing Debates in Food Security in the New Millenium. SEARCA Professorial Chair lecture. Dept. of Agronomy, College of Agriculture, UP Los Banos, Phil. June 2001

MENDOZA, T. C. 2007. The Energetics of Ethanol Production and its Implications. *Asia Life Sciences* 16(2):115-138.

Mendoza T C.2007.ARE BIOFUELS REALLY BENEFICIAL FOR HUMANITY? Philippine Journal of Crop Science (PJCS) 32(3): 83-98.

Mendoza, T.C. 2008. Agronomic features, Ethanol Yields, Resource Use of Four Feedstocks for Ethanol Production Under Phil. Condition. *The Phil. J of Crop Science 3(1):*

Mendoza, T.C., E.T. Castillo and R. Demafilis. 2007. The Costs of Ethanol Production from Sugarcane under Eastern Batangas Conditions. *The Phil. J of Crop Science 32(3):25-48*

Mendoza, TC. 2008. Food security challenges. What must be done ? Power pt. presentation. "Peoples Forum on Hunger", held at PRRM Bldg., 56 Mother Ignacia, Quezon City, on March 28, 2008,

Mendoza TC.2008.Why food prices increase & what can be done. Philippine Journal of Crop Science 2008, 33(2): In Press

Ofon, Abah 2008. Globe and Mail, Canada.
http://www.theglobeandmail.com/servlet/story/RTGAM.20080410.wfood0411/BNStory/International/home

Pfeiffer, DA. 2003. Eating Fossil Fuels.
http://www.fromthewilderness.com/free/ww3/100303_eating_oil.html

Pimentel, David and Giampietro, Mario. 1994. Food, Land, Population and the U.S. Economy, Carrying Capacity Network, 11/21/1994.
http://www.dieoff.com/page55.htm

Raya Widenoja and Brian Halweil .2008.Analysis: Banning "Bad" Biofuels, Becoming Better Consumers http://www.worldwatch.org/node/5587– January 23, 2008 – 12:05am

Rosenthal, Elisabeth. http://www.iht.com/articles/2007/12/17/europe/food.php)

UNPF (United Nations Population Fund). World Population to 2300. New York: United Nations. http://www.unfpa.org/swp/ US EPA, 1998, Ruminant Livestock and the Global Environment

Vitousek, P.M. et al. 1986. Bioscience 36. http://www.science.duq.edu/esm/unit2-3

Ziegler, Jean. 2008. Philippine Daily Inquirer, April 15, 2008

Annex A. Technical Issues and Concerns for Some Crops Intended for Biofuel under Philippines Conditions*

There is a legal mandate to produce biofuel. Unless the law is repealed or amended, then, we are bound to comply with it. Out of necessity, the law was enacted to provide guidelines in biofuel production at the macro-level. The detailed production aspects (micro level) need to be addressed at the farm level. Summarized in this paper are basic information for the much talk-about biofuel feedstock sources under Philippine conditions. For ethanol they are sugarcane, sweet sorghum and corn and for bio-diesel, it is jatropha. Production of coconut oil for biodiesel (coconut methyl esther)or CME is a complex issue as the price of cooking oil had increased considerably.

1. Sugar Cane

(a) The energy balance for sugarcane is positive. As of to date, it is the only crop under Philippine condition that shows positive prospects for biofuel production. It has an energy balance (Ee) ranging from 2.8-3.0.If the fuel used in distillery slop waste application are included , then the Ee decreases.

(b) Distillery slop waste disposal must be put in place especially during the rainy season where re-use or application in sugarcane fields could not be done anymore. Submarine sea discharge of distillery slop waste, must not be done. Moreover, throwing away slop wastes in creeks or rivers and finally to the sea without adequate treatment and clean up should be avoided.

(c) While it needs improvement overtime, the technology from sugarcane is already in place in the country. Despite this, there is slow progress in the building ethanol plants for biofuel. During the last NAST meeting where sugarcane ethanol production was discussed, it was suggested that a Feasibility study (including Policy recommendations) must be conducted to compare the autonomous versus adjunct distilleries to existing sugar mills. One-and-half years to go, about 600 million li of ethanol is needed to satisfy the 10% the blend to gasoline as per Biofuels Act.

2. Corn

(a) Not only corn is used as animal feed, it is also the food staple for some 20M Filipinos.

(b) Yearly, we are importing about 1M tons of corn or more to satisfy our requirements.

(c) Earlier pre-feasibility study conducted under Cagayan condition showed negative IRR even at P8/kg corn. At present, the farm gate price of corn ranges from P12-15/kg.

(d) The net ethanol yield for corn is so low since the energy balance in

near 0 or slightly higher than 1. Much oil-based energy is used in planting to processing corn for ethanol.

It is good that using corn as feedstock for ethanol is already shelved .

3. Sweet Sorghum

(a) The agronomy of sweet sorghum production is not yet optimized under Philippine conditions.There are no locally bred variety for sweet sorghum (G x E principle, a variety which is good in India may not necessarily be good here). While breeding is in-progress, it requires time to hybridize, select progenies, tests the agronomic and yield performance of the selections across locations (adaptability) and years (stability). Likewise, crops cultural management practices – spacing, time of planting, fertilizer rates – are being optimized.Pest reactions, and agronomic performance of imported varieties are not fully known yet.

(b) Agro-processing interphases are yet to be done. The time of planting/ ratooning and harvesting to processing is yet to be optimized across locations. Ethanol yield that can be obtained from the stems are still low due to low brix and % Pol (low Apparent Purity= %Pol/Brix), low sucrose content. Our stoicheometric estimates indicates that ethanol yields per ton sweet sorghum stems could only yield 18-25li of ethanol or an average of 20 li (Mendoza, 2008).

Sweet sorghum is contemplated to be planted and harvested when there is no sugarcane harvesting ie. Moths of June,July, , August & September .Consider the 2 planting schedules:

Schedule 1 July, August to September harvest . This means sweet sorghum should be planted in March, April , May or early June to harvest in July, August to September . Planting in March and April needs irrigation while harvesting in July, August to September coincides with the rainy months . Too much rain will present difficulties in harvesting, besides the sucrose yields will be low.

- Sweet Sorghum grows tall (>2m), may easily lodge due to typhoons
- Cutting/loading/hauling presents too much difficulties
- Moisture has dilution effects on the juice à reduce sugar content in the juice
- Moisture simply adds weight, making harvesting & hauling expensive since these items are paid by the weight
- Ratoon establishment will be impaired if it is too wet.
- Bud germination will be low
- Weeding/cultivation will be difficult
- Poor growth of ratoons leading to poor ratoon yield

Schedule 2: December to January planting

- Very optimum planting time if irrigation facilities are in place. Without irrigation, crops will be subjected to drought near harvest time when water is so

critically needed due to grain filling and sugar storage in the stem
- Harvested sorghum will have good ratoons if irrigated immediately
- Late planted sorghum may be affected by the early onset of rains. Difficulties will be encountered at harvest.

Risks are higher in using sweet sorghum as feedstock for ethanol production.

(1) ITCZ location of the country (>22 typhoons yearly); harvesting months for August to September are the peak rainfall and typhoon months; global warming/ global climate change has made production environment so risky.

(2) Biological risk factors as pests and adaptability since we do not have locally bred cultivars.

(3) Cultural factors – it's a new crop in the many areas where it is planned to be grown.

Recommendation:

(1) More R & D is yet to be done as in breeding locally adapted variety, optimizing its cultural management practices, and in assessing how the crop adapts in varying soil, rainfall or climatic variations in the country. It is still premature to promote sweet sorghum as feedstock for ethanol production on a commercial scale.

(2) Village-level or small scale of production must be tested first to determine the following:
   a. Agronomic aspects of the crop
   b. Agro-processing interphase

(3) Sweet sorghum is a new crop in the many areas where it will be planted. Farmers will take sometime to familiarize themselves to its culture. To compete with other crops , it must provide higher income if farmers are to grow Sweet sorghum. Using current varieties, unfortunately, do not show positive economic return on the part of the farmers.

(4) The logistics side of sweet sorghum if used as feedstocks for ethanol must be studied. Deleafing the stems is so laborious. A self-deleafing cultivar must be developed as in sugarcane .

4. Jatropha

(a) There are no existing plantations yet from where the yield levels claimed @ 5-7 tons/ha could be validated. There are doubts that 5 tons yield level could be obtained (Mendoza et al , 2007) as shown in the following estimates :
@ (30% oil x 5 tons) x 3.03 gram glucose equivalence of oil in seed = 4.54 tons
@ 2.42 gram glucose equivalence of seedcoat and the presscake = 8.48 tons
Total = 13.02 tons/ha

(b) The D1-oil pricing formula: Seed price = 15% x diesel oil price , is too low for farmers to make profit from Jatropha (ie. Diesel oil price @

P60/li = .15 x P60= P 9/kg seed ; 1kg seed = 10kg fresh fruits, P=0.60/ kg-fresh fruits). The sharing practice between the coffee harvester and the owner in Batangas is 50: 50 (Sandoval, personal communication ,2007; pjsandoval@yahoo.com). If this will be adopted, nobody will harvest Jatropha fruits at P=0.45/kg-fresh fruits. At P.45/kg or P4.50/ seed , the gross income for the farmer will only be P7,650/ha @ 1,700 kg-see/ha or even at the high yield level of 2,800kg/ha , the gross income will only be P12,600/ha.(The yield data were extracted from the UPLB data)

(c) Extracting Jatropha oil mechanically is also inefficient. The coconut mechanical oil expeller if used in Jatropha seeds to extract oil is giving very low oil yield at 20-27% only. Mechanical extraction needs to be optimized. Although enzymatic extraction gives higher oil yield but the enzymes are expensive (Demafelis,2008). Extraction data were obtained under laboratory scale . They are yet to be done under pilot plant or commercial scale. The enzymes should be locally produced to reduce their costs if ever that is possible.

(d) Just like the extraction process, the experiences on Jatropha trans esterification processes are limited. Studies are still under way.

(e) Jatropha oil is suggested to be for the industry and not for transport fuel. The quality of JME (Jatropha Methyl Ester) for transport fuel is still untested (AIPSI Managing Director Rafael Diaz , PDI B9, Feb. 18, 2008)). This concern of AIPSI must be addressed.

(f) Jatropha massively planted in hillsides or watershed should be studied further to determine the following:

i. The effects on water supply downstream: Jatropha is drought tolerant, fine. But it also means that it absorbs limited moisture very well. This will lessen the moisture available to its companion plants and water supply downstream will also be depleted especially during El Nino years.

ii. Jatropha has 2 toxins: Cursin and Phorbol ester . What will happen to these toxins if there are huge leaf fall and branches in the soil? How will it affect water quality that flows downstream?

(1) Unlike studies on the reuse of distillery slops from potable ethanol plants, so far there is no similar study on biodiesel wastewater reuse in the Philippines *Jatropha* biodiesel industry.

(2). Energetics is the study on the energy input and generation for certain activity or process. Energy requirements for biofuel production cover all energy inputs from feedstock from production, harvesting, hauling to the factory, primary and secondary processing and waste treatment/ disposal. For policy direction on prioritization of feedstock and process, study of energetics should be given top priority .

Our initial study on the energetics of Jatropha showed very low energy balance at 0.5 to 1.05 for low and high yield ,respectively. It should be emphasized that our analysis is at the production level only . It does not include yet processing and waste disposal.

Recommendation: Slow down in plantation establishment for Jatropha until the above issues are settled. It goes without saying also that the publicized LBP funding window @ PhP 4.3 billion for large-scale production of Jatropha should be frozen. Loan takers (farmers) are not assured if they could payback their loans due to the very low seed yield & seed price. What will happen to their lands if they are used as collateral?

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References

Mendoza, T C , Oscar Zamora, Joven Lales. Jatropha : What the Public should know. (Published in PDI Sept.9,2007 Faculty of Crop Science, College of Agriculture, University of the Philippines at Los Banos tcm_uplb77@yahoo.com

Mendoza, T.C. 2008. Agronomic features, Ethanol Yields, Resource Use of Four Feedstocks for Ethanol Production Under Phil. Condition. *The Phil. J of Crop Science 3(1):*

Mendoza, T.C. 2007. Energetics of Ethanol Production from Sugarcane and its Implications. Asian Life Science Journal 16(2):115-136

Mendoza, T.C., E.T. Castillo and R. Demafilis. 2007. The Costs of Ethanol Production from Sugarcane under Eastern Batangas Conditions. *The Phil. J of Crop Science 32(3):25-48*

Mendoza T C, Eulogio Castillo & Annalissa L Aquino. 2007. Towards Making *Jatropha curcas* (*Tubang Bakod*) a Viable Source of Biodiesel Oil in the Philippines. Philippine Journal of Crop Science 32(1): 29-44

Mendoza T C.2007.ARE BIOFUELS REALLY BENEFICIAL FOR HUMANITY? Philippine Journal of Crop Science (PJCS) 32(3): 83-98.

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ENERGY CONSERVATION AND COMPETITIVENESS

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I will develop this topic along the following outline:

- Why manage energy?
- Resources for Energy Security and Sustainability
- Energy as a Resource for Competitiveness
- Energy Mangement and Conservation – Our Responsibility
- Global Competitiveness – an Industry Perspective
- Government Interventions in Energy Sector

Why Manage Energy?

Energy is derived from renewable and non-renewable sources. At present most of our energy for power and transportation are derived from petroleum, coal, and natural gas, all of which are finite non-renewable sources. When these are burned, they generate considerable amounts of gases which are primarily responsible for global warming and climate change. We all have experienced the fury and effects of climate changes in the floods and earthquakes that have visit our planet, becoming more frequent and intense in recent years.

These finite resources are also becoming increasingly expensive because global demand is rising with the rise in the economies of developing countries and of China, India, Russia and Brazil. As a result of these cost increases, there have been attempts to replace these with alternatives like biofuels which has caused a rapid escalation of food prices throughout the world. Hence, there is now a growing connection between the costs of fuel and food, to the point of making both commodities unaffordable to many poorer countries.

As we can see, energy today is becoming very expensive to the point of sourcing alternatives from our global food supply and making both food and fuels unaffordable. Therefore it is incumbent on us to manage it well, in the same way that we manage other valuable resources like our finances, human resources, and technology.

Resources for Energy Security and Sustainability

There are of course also renewable sources of electric energy, and we are fortunate that our past energy leaders had shifted our power generation

away from the use of petroleum sources. So that today, we are only dependent on 10% of our power generation from petroleum.

Many of these renewable resources have been exploited already and are familiar to us, such as the following :

- Hydroelectric and Run-of-River have a certain amount of seasonality because they depend on replenishment by rainfall. There are a few more dam-sites that are practical to develop, but most of these are relatively small in capacity.
- Geothermal steam is converted to electricity. We now rank second in the world in terms of electricity generated from geothermal sources, with the United States taking the lead. In fact there are many more sources of geothermal industry that there is thinking in the United States that they can supply all their power from geothermal energy. Similarly, there are many more such energy sources in our country that remain to be exploited, if only our people will understand that their exploitation is not going to degenerate our natural resources.
- Biomass are traditional sources of energy. For example, sugar cane bagasse has long been used in the sugar mills for heating and also to generate electric power. The thing to remember is that sugar, among all the cultivated plants, provide the most biomass per hectare per year. In fact sugar cane bagasse is now the focus of considerable research to derive ethanol via hydrolysis of the cellulose and subsequent fermentation to alcohol, as biofuel. Until such time, the more traditional route of fermenting sugars to alcohols is the current method of producing bio-ethanol. Meanwhile, coconut oil is also being converted to biofuel substitutes for and additives to diesel oil. In fact, there have been trials conducted in Japan that reveal the positive contributions of coco-methyl ester when used as an additive in diesel fuel. The results show that increases in efficiency up to 7% can be obtained from adding 1% of coco-methyl ester in diesel fuel. This is attributed to the detergent qualities of coco-methyl ester which tend to clean the valves and valve seats of carbon deposits thereby providing full compression and full power from the diesel engines. In addition there is evidence that the lubricity of coco-methyl ester also will contribute to the extended life of diesel injection pumps which normally require maintenance every 100,000 kilometers of travel.
- Wind power has also been exploited in the Pagudpud area of Ilocos Norte. And there are many areas in our archipelago where the wind normally passes through at great velocity as it crosses from and to the Pacific Ocean. In fact, wind power has become so extensively exploited by many developed countries that there is today a backlog of about three years in the order list of wind turbines. So much progress has also been attained that the normal commercial machines are now in the size range of 1.5 MW with 3 MW machines being introduced to the market – when only a decade ago these were in the range of 750 KW units.

There exists tremendous potential also throughout our country to exploit the combination of wind turbine for power generation and hydraulic pumping stations to be used to store energy when power is not needed. This is especially useful for areas that are not connected to the power grid, but where the topography of our country lends itself to such combinations. This concept was used in connection with our nuclear plant which contemplated storing excess power at night by pumping water up from Laguna Lake to the elevated Caliraya Lake.

- Solar power has been used commercially by the Cagayan Electric Power and Light Company or CEPALCO in a 1 MW installation jointly financed with a US AID grant. Apparently the installation is satisfactory because I understand that CEPALCO is planning to expand this capacity, which generates around 30 percent of the nominal capacity, comparable to wind power. There are considerable technology improvements in the production of solar cells in terms of energy gathering capacity per cell and also in terms of reducing costs per watt capacity – which makes the use of solar cells more and more interesting. In fact, the Lopez group of companies involved in Meralco and First Generation Holdings are reported to be investing in the manufacture of solar cells in the country.
- Nuclear power had been installed in Bataan for a capacity of 600 MW but was never operated due to various reasons, least of which were associated with technical considerations that could not be resolved. Certainly, nuclear power is clean and at today's terms can be very competitive because of the concentrated capacities that can be generated for large urban and industrial requirements. From the standpoint of safety, health, and climate considerations, there are many arguments that would justify giving nuclear power a hard second look. All the major industrial countries have substantial amounts of nuclear power, with France leading the group in terms of percentage of electricity generated from nuclear plants. It should be noted that our nuclear plant has two sister plants operating in Korea for the past twenty years without any incident. Of course at this time we have lost most of our trained personnel and must undertake very long term preparations if we are to revive our mothballed nuclear plant. It might be interesting to note that at present conditions, this nuclear plant would probably be worth up to US$ 3 Billion if it were in running condition. As a matter of foresight, former President Ramos had commissioned a group to locate ten possible sites for future nuclear plants to make us ready to utilize this form of energy again in the future.

There are however a few renewable resources that we remain to exploit, which are the following:

- Wave energy has been exploited in the developed countries but as far as I know these have not been commercialized extensively because of the very large investments needed to cope structurally with the strong wave

forces of nature. I understand some experiments are being conducted by our DOE in the areas where the water current flows are significant.

- Tidal energy has also been exploited in the developed countries but the capital costs are prohibitive at present. It is not as practical to exploit by countries near the equator because of the very small tidal variations.
- Ocean Thermal Energy Conversion or OTEC was tried in Hawaii several decades ago but I have not heard of any significant commercial attempts. Our country can exploit this type of energy in the future because of our proximity to very deep waters, which generate greater thermal differences between the deep water and surface water. Again these require relatively high capital investments which would tend to discourage commercialization.

All told, these renewable resources that have not yet been commercially exploited will probably remain curiosities with no serious attempts to commercialize them while there remain tremendous amounts of renewable energy still ready to be harnessed.

Meanwhile, the more popular sources of energy remain the non-renewable ones which include coal, gas, and petroleum including shale oil. The reason for this is because the capital costs to harness these resources are comparatively cheap, generally just a fraction of the capital investments to harness most of the renewable energy resources. In other words, most of the renewable resource power generators have very little operating costs but are very high in capital costs; and the reverse is true in the case of non-renewable power sources.

- Coal is the most extensive among the energy resources, and is available in most countries, even in our energy-shy country. Because of this, coal is the least volatile among these resources although recently it has been rising at a faster rate because of shortages in handling and delivering the coal supplies. The rate of price increases should therefore settle down when there are sufficient capacities for handling and delivering coal supplies throughout the world.
- Shale Oil is extensive in Venezuela (Orinoco River Basin) and in Canada (Alberta's Athabaska Oil Sands) amounting to billions of tons of supply. These are now being investigated to produce synthetic crude oils as feedstock for petroleum refineries. Even the USA has some limited amounts of tar sands which are also being investigated to produce synthetic crude oils.
- Petroleum Oils are still sourced to the extent of almost 50% from OPEC countries which operate as a world cartel responsible for regulating the supply and price of petroleum. As a result of recent oil price increases, there is again an active search for oil sources mainly from off-shore sources with recent large finds in Brazil and the Arctic region. These finds can be developed within a decade which seems to signal that oil prices are bound to settle somewhat from their recent highs. But to a large extent these will be due to curtailments in the wasteful use of oil and some changes in the life styles of

those countries with a high oil per-capita consumption. While oil as a source of power is no longer so critical in most countries, transport energy is still largely depended on fuels from petroleum sources.

- Natural gas is probably going to be more available as new sources are being exploited and developed, by converting to Liquefied Natural Gas or LNG. There are considerable amounts of gas still being discovered in the Asian off-shore areas which ensure that we will probably be sourcing a lot of electric power from this source in the decades ahead. One reason for the rising popularity of gas even in power generation is the fact that when used in combined-cycle gas turbines (CCGT) the thermal conversion efficiency can reach as high as 60+% while the traditional thermal power plants from coal and petroleum only yield 40% in thermal energy efficiency to electricity. In addition, the CCGT plants are lower in cost and faster to install. Another reason for the rising popularity of natural gas is the fact that it is cleaner burning than coal or petroleum in terms of particulate and CO2 emissions per unit of electricity generated.

There is also great interest to bring natural gas into the urban areas because it can be used not only to generate electricity but the residual thermal energy can be used to run air-conditioning or heating units thereby further increasing the total thermal energy conversion efficiency. In addition, even cars and buses are now being converted to run on compressed natural gas.

Because of these advantages, our country should prepare to import natural gas from the region by installing LNG receiving facilities in the same way that Japan and China have done. One advantage is that gas cannot be stored or inventoried economically and so the prices cannot be manipulated as much as petroleum can – unless we are prepared to spend on large underground storage areas e.g. abandoned mining pits, like is done in industrialized countries.

There are also natural gas that come out together with the more expensive petroleum resources which are called associated natural gas. In general, these are converted at site into chemicals like methanol or fertilizers like ammonia and urea. At present, prices of these chemicals have been rising rapidly reflecting the heating values of their natural gas raw materials. Fertilizers especially have been rising rapidly in prices due to the food prices and damage to agriculture caused by climate changes, which damage has to be replaced to provide better food security.

Energy as a Resource for Competitiveness

There is no doubt that energy today constitutes a greater percentage of the total cost of every product and service delivered than ever before. Because of this, the sensitivity to energy prices is becoming very critical to the country's competitiveness. This is the reason why there is a clamor from all

sectors to remove or reduce the taxes on energy. At one time PCCI advocated the removal of all taxes on energy because it has always been a primary input to our goods and services; the principle was that private sector should first be allowed to compete and make a profit and then it should be taxed on the profit that it makes – rather than preventing it from becoming competitive from the start. This view however has to be balanced against the sad state of our infrastructure and education which robs us of competitiveness and which can only be addressed by having sufficient funds and budgets for these purposes. Therefore, perhaps the middle view would be to simply reduce the rate of these taxes.

Energy use should always be viewed as essential to productivity, so it is the efficient and wise use of energy that should be considered in all its applications. For example, proper or sufficient lighting should always be available, but the use of the inefficient hot incandescent lamps should give way to the cooler safer compact fluorescent lamps in our households, factories, commercial., industrial, and public establishments.

For the transport sector, we should avail more of water transport whenever practical, because it moves cargo at the lowest cost per ton-kilometer than road or air transport. We are fortunate to be an archipelago with numerous waterways. Other continents build man-made canals to be able to transport their goods by water.

Another form of transport by water is the Roll-On Roll-Off or RORO which act as moving bridges along the shortest distances between islands, which interconnect our island nation so that road transport can provide the most direct routes to their end-destinations. In a sense this is more economical than the present hubs and spokes routes which is prevalent in the country today, where the hubs are major ports connected by shipping, and the spokes are both smaller shipping routes or roadways to the final destination.

Yet another form of transport that will pay for us to develop is a North-South railway system because our country is fairly long running from north to south. Rail transport in many countries are run by electricity and this is the way to go for the long term future in order to avoid dependence on petroleum fuels if possible.

We all need affordable energy to be able to use it for productive and competitive purposes. And the other side of affordability is the value that we create out of the energy that we use. This is the main thrust of countries like Japan and UK where the value of goods and services produced from their use of energy makes almost any cost of energy affordable to them, while unaffordable to many others. Thus, Japan has much more expensive cost of power than the Philippines but the average Japanese can afford this high energy cost because his output is valued more than our individual outputs. This is why Japan is able to absorb many oil-price shocks with more equanimity than other countries, including ours. We should therefore always monitor the value

of our produce versus the cost of electricity, and keep striving to increase the ratio as we keep progressing.

In this regard, the Philippines ranks higher in value added per unit electricity used than Indonesia, Thailand, and Malaysia but this is mainly due to the fact that many of our heavy industries folded up from non-competitiveness with the advent of globalization, and we shifted more of our economic activities to services. I would not consider this a favorable sign because it leads us vulnerable to predatory pricing when it comes to global shortages of some vital commodities like steel, etc. It would still be essential for us to maintain a strategic local supply of every vital commodity in order to prevent unduly sharp price fluctuations of vital inputs to industry and our daily life. On the other hand, countries which depend mainly on high energy using industries will be subject to severe shocks when the costs of energy climb sharply. China is one such example and this is the reason why she has had to sign up energy supply contracts to ensure that her industries are not shocked into non-competitiveness.

Energy Management and Conservation – Our Responsibility

Energy Management begins at the Planning and Design stages – and is a primary responsibility of everyone, government and private sector. If energy resources are going to be tight and expensive, then it is our responsibility to make sure that we can afford to run our investments, our homes, our offices, our factories competitively against others who are going to demand from that limited or finite supply. Therefore, we must attempt to match our energy supply with our uses in the most cost-effective or least cost operations.

As I stated earlier, natural gas can be used to generate electricity and the waste heat can be used to provide air-conditioning in a most cost-effective and efficient manner. Such an arrangement which generates maximum value will make natural gas affordable to our people even when others can no longer afford them.

One of the ways that we can use our investments in the power sector most effectively is to consider demand-side management practices. One of these is to increase the load factor by spreading the electricity load more evenly through the day, so that the capacity utilization is raised to the highest level possible. This reduces the capital costs per unit of electricity generated, and brings down our costs. Another way is to increase the power factor so that we can reduce the electricity line losses, and in some cases even reduce the size of transmission wires needed.

Energy conservation should always be foremost in our care for energy. In air-conditioning practice, the raising of the thermostat setting by just one degree centigrade can mean savings of about 10% of the energy requirements. Add to this insulation requirements, and you can deliver most

of the comfort to the human occupants of a building instead of to cooling the massive building structures.

There is also the need to use efficient technologies and apparatus. For example, air-conditioners and refrigerators now carry energy efficiency labels and energy efficiencies of these apparatus keep increasing with competition and rising energy efficiency standards imposed by regulatory agencies of the Departments of Energy and Trade & Industry. The most important of these is the advent of compact fluorescent lamps that are 80% more efficient than the incandescent lamps. There will soon issue efficiency standards to regulate the use of these lamps before the year 2010.

Global Competitiveness – An Industry Perspective

Industry is most sensitive to the high cost of energy and transportation for competitiveness. Therefore there is continually a search for ways to reduce energy costs while improving the reliability of energy delivery systems.

One approach in planning ahead is to match energy generation to the user requirements. For example, a new paper mill being designed was planned to have its own power supply. With the advent of cost-effective coal-burning fluidized-bed plants for steam and power generation as small as 25MW of capacity make it possible to self-generate power at the site. This avoids the transmission, distribution and systems loss charges that amount to about 20% of the total electricity charges. As a result also of the availability of smaller power plants, and advances in technology, there is also a trend towards decentralization of former large scale manufacturing operations into many distributed manufacturing plants. There are some strategic advantages also that accrue from this arrangement, to ensure the continued availability of products in the event of accidents in any of the manufacturing units.

Another reason for limiting over-centralization is the tremendous capital sunk in one location. It must be noted that for every dollar sunk into manufacturing capital investment, an equal amount of investment is usually needed for the corresponding power and energy supply units.

Government Interventions in Energy Sector

The government has a large stake in the energy sector since it is one of the major sources of government revenues. Among these are Import Duties, E-VAT, Income Taxes, Royalties, and Universal Charges, which together amount to more than 15% of the sale of energy. Therefore, next to the actual cost of energy source and capital, the government take is the largest of the remaining costs of energy generation and delivery. This is the reason why the government has been often requested to remove or reduce some of these taxes. On the other hand, as earlier stated, the government hesitates to forego

most of these except import duties which it has eliminated on petroleum products by reducing from 3% to zero, when the petroleum prices rose.

There is a valid argument however to reduce the royalties on natural gas to a level that will make our natural gas comparable with imported natural gas. The reason for this is because we expect soon to be importing natural gas because it is clean and more environmentally friendly than coal. It would be unfair if our domestic natural gas will come out more expensive than the imported gas, now that the costs of development have been met.

The government has considerable leeway to equalize the cost differences among the different sources of energy by its taxing authority. It would be good if the government can see its way clear towards using these powers to promote energy efficiency, environmental compliance, and competition among the different generating stakeholders through a more level playing field.

The government also has strong regulatory powers which it exercises through the Energy Regulatory Commission. In recent months, these regulatory powers have been much highlighted by varying claims and counterclaims from different stakeholders. What have become evident are the need for greater transparency in the actuations of the ERC vis-à-vis its multifaceted functions to :

>Balance the interests of all the stakeholders in its decision making process;
>Promote competition by leveling the playing field along the entire energy supply chain;
>Explain publicly, thoroughly and clearly its decisions for a better understanding of the energy industry;
>Favor environmentally friendly supply of energy
>Encourage energy conservation, demand-side management, and similar good practices, by enunciating general rules that shall accomplish these.
>Reward good practices in Performance Based Rate systems that trend towards decreasing rates instead of increasing rates.

To summarize, the government through its fiscal authority, the DOE through its policy advocacy and the ERC through its specific rulings and general rules, can lead in making energy sourcing, supply, and application an important factor in the competitive and sustainable development of our people and nation.

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Other Energy Sources and Technology

OIL, GAS AND COAL: TODAY AND BEYOND

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Introduction

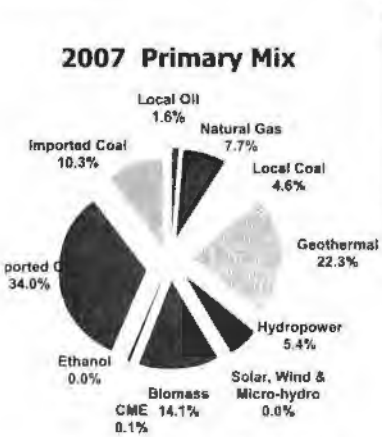
The paper serves to impart knowledge on oil, gas and coal energy resources – the supply potential, utilization and future developments in the light of energy sustainability. Energy is such a critical commodity whereby economic growth and development are anchored, it is a very opportune time to discuss the sustainability of energy supply. In this day and age where borders are opening up for global competitiveness, a country must have sufficient power for the requirements to meet standards and propel attendant activities. Social dimension of the demand for energy is the requirement for the economic and social activities of the people, for the alleviation of poverty and improvement of social equity. In addressing the energy demand, the country's energy choices reflect its environmental priorities. The content of this paper is largely culled from the presentations made in the Philippine Energy Plan Consultation road show of the Department.

Energy Situationer

Focus on Oil, Gas and Coal

The energy situationer provides the information on the shares of various energy sources in the supply for the economy's day to day energy requirements be it for power and non-power use and is shown in the energy mix. The mix factors both locally produced and imported fuels. In 2007, our energy mix reached a self-sufficiency level of 55.7 % with oil, coal and natural gas being the first, second and fourth main sources. Imported oil accounts for 34 percent share in the supply mix largely due to the demand by the transport sector. The share of natural gas stood at 7.7 percent while the share of coal reached 14.9 percent, majority of which is sourced through importation. In terms of importation, the share of imported oil and coal accounts for 44.3 percent in the supply mix. The 2007 mix shows 1.6% increase in consumption of the local coal and 1.2 % increase in the consumption of natural gas to compensate for the corresponding decrease in the consumption of geothermal and hydropower compared to the 2006 energy mix.

Specifically showing the share of energy sources in power generation is the power generation mix. The 2007 mix shows natural gas as the biggest fuel supplier in power generation at 32% followed by coal at 28%. Oil consumption for power generation has greatly diminished since the country stopped putting up new oil-fired power plants and old such power plants come into retirement. Oil is second smallest fuel supplier in power generation contributing around 9% of the power mix. The mix translates to 66% self-sufficiency level in power generation.



2007 Capacity Mix

Oil and Gas

On the supply side, oil is largely imported. Only 1.6% of the total oil demand in the energy mix is supplied by local oil production.

Local oil production dates as far back as 1979 with the first oil discovery of commercial quantity in Nido, Northwest Palawan by the Citiservice, Inc. The level of production was maintained more or less through the years, the number of oil producing fields increased to six in 1988 but in relatively small proportions. To date, oil production is sustained at greatly reduced volume of an average of 250 barrels per day in Matinloc and Nido still in the waters of Palawan.

Exploration efforts for both oil and natural gas continue in the different sedimentary basins identified in the country but most of these activities are within the waters around Palawan and near Borneo.

Generally, the oil production in the country is on downtrend due to the unsuccessful exploration campaign in the last ten years.

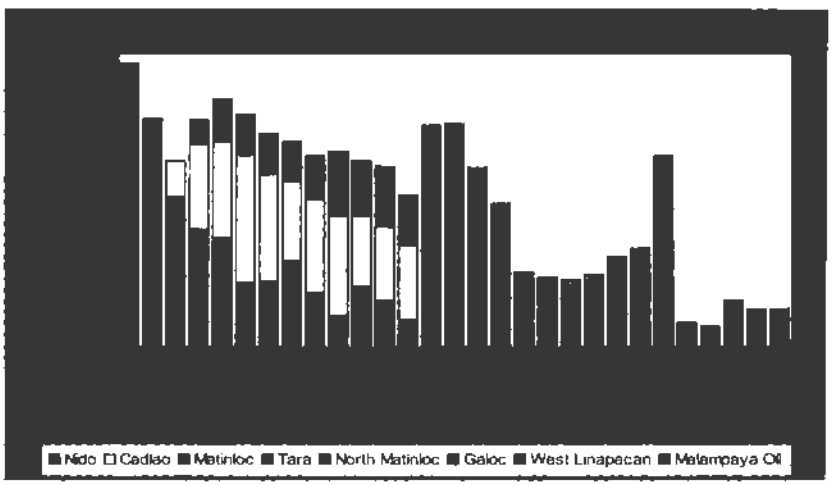
On the downstream side, as mentioned, oil dominates the energy mix largely because of the requirements from the transport sector which is at 60% of the total oil demand. Currently, the industry has a total of 861 players in

the various downstream activities ranging from crude oil transport from the production site to the different bulk plants/depots or endusers through tankers/ barges, pipeline (from Shell/Caltex in Batangas to Manila), to the retail outlets. It is important to note that we only have 2 oil refineries and 75%of the oil supply is imported.

The petroleum product consumption in 2007 can be broken down as follows: diesel at 38.0 %, premium gasoline at 18%, LPG at 11 %, regular gasoline at 5%, avturbo or jet fuel at 9%, and kerosene at 2%. Petroleum product consumption in Luzon consumes 75% of the total petroleum inventory. The National Capital Region has the biggest oil demand at 42 % followed by North Luzon at 18% and South Luzon at 15%. The Visayas region consumes 13% and Mindanao 12% of the petroleum products. Petron, Chevron and Shell dominate the oil market supplying 84% of the demand while other industry players supplies the remaining 16% of the market. The liquefied petroleum gas or LPG is imported used both for transport and residential/commercial purposes. We now have 12,000 Auto-LPG taxis converted and 19 government-accredited conversiun shops operating nationwide.

Natural Gas and Condensates

The first gas production in the country was in 1994 when PNOC-Exploration Corporation commenced the production of natural gas for power generation from San Antonio field in Echague, Isabela under SC 37. Initial annual production of natural gas from the field totaled to about 195 million cubic feet, in which the electricity generated was supplied to seven (7) municipalities of Isabela. At present, the gas field has been producing water along with the gas and its use for other purposes such as fuel for motorcycle is being evaluated.



The large-scale natural gas production in the country started in 2001 when Malampaya gas field produced natural gas as fuel for power generation specifically to supply the needs of the three (3) power plants: Ilijan, Sta. Rita and San Lorenzo, which have a total generation capacity of about 2,700 MW. The gas field is presently producing natural gas at an average annual rate of 357 million standard cubic feet and to date, has a total cumulative production of about 603 billion standard cubic feet as of end 2007.

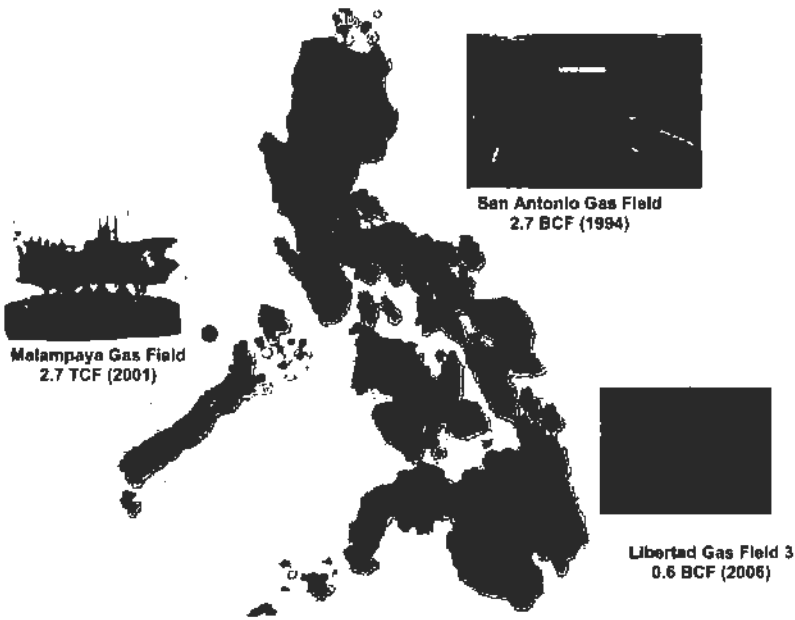
Condensate production from Malampaya that is associated with natural gas totaled to about 29 million barrels or an average rate of 15,000 barrels per day.

Expansion of the use for natural gas is being studied but initial utilization in the transport sector has been implemented. We now have 22 CNG buses plying along Batangas-Laguna-Manila route

Coal

The coal industry started in the country in 1977 and importation begun in 1988. The demand for coal continued to rise over the years such that

EXISTING NATURAL GAS FIELDS

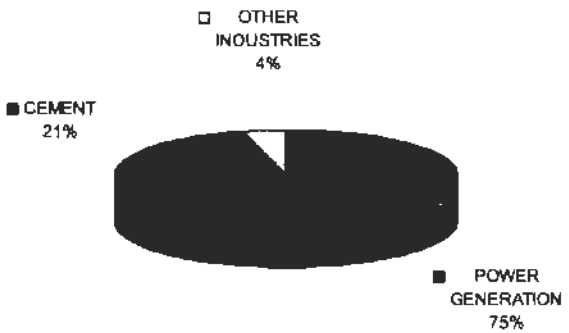


importation outgrew local coal production which had been relatively steady till 2001. The steep demand for energy and the veering away from oil posed the platform for active coal utilization. The continued rise in oil price also gives premium to the availability and cheaper price of coal for fuel considering that environmental mitigations in its use is already in place.

Upstream, for the year 2007, the indigenous coal production hit the 3 million mark at 3.75 million metric tons (MMT) run-of-mine coal, a 47% increase from 2006 production record. The output is largely attributed to the operations of Semirara Corporation located in Semirara Island in Antique and of PNOC-Exploration Corporation in Zamboanga Sibugay. The rest of the production comes from Cebu, Albay and Negros Provinces. Small-scale coal production accounts for around 3% of the indigenous coal supply. The said production, however, supplies only 37% of the coal demand which was at 10.4 MMT. The volume of coal imported in 2007 is at 7.7 MMT.

The consumption of coal is 75% for power generation, 21% for cement manufacture and the remaining 4% for other industries.

2007 COAL CONSUMPTION BY SECTOR, MM MT



TONNAGE

➢POWER GENERATION	7,823,827 MT
➢CEMENT	2,178,798 MT
➢OTHER INDUSTRIES	446,918 MT

World Reserves

To give a global view on the resources under discussion, below are the estimates of oil, gas and coal reserves worldwide by known institutions in the international energy sector.

- The World Coal Institute as posted on its website estimates that world reserves on oil is good for another 41 years, on gas for 63 years and on coal at 147 years.
- Australian research indicates that world fossil fuel reserves stands at 21% oil, 20% gas and 59% coal

Future Thrusts

In terms of policy support, one of the policy directions is to ensure stable and quality supply of energy which can be carried out by the following:

- Accelerating exploration and development of indigenous oil, gas and coal resources.

  The DOE will continue to promote and further draw investments in the upstream sector through the Philippine Energy Contracting Rounds. Plans are underway for the review of the PECR guidelines to ensure its effectiveness in investments promotion. The government is pushing for more investments to maximize the use of our local energy resources such as oil, gas and coal, which could also provide additional development income for the local community and to the whole country as well. Some of the strategies that are critical in facilitating the flow of foreign investments in the Philippine petroleum sector include: (1) promoting collaborative public-private sector partnerships; (2) streamlining the permitting and licensing process; (3) embarking into an intensive information, education and communication (IEC) campaign to improve the social acceptability of energy exploration and development activities; and (4) the putting up of a one-stop-shop to assist petroleum investors.

  Estimated local reserve of oil is at 43 million barrels, natural gas at 3,772 billion cubic feet and mineable coal reserves at 335 million metric tons.

- To boost the development of the Philippine natural gas industry, the DOE will push for the immediate passage of the downstream Natural Gas Bill which will provide the impetus for the development of strategic infrastructures and expand the use of natural gas in both power and non-power use.

- Pursuance of the Natural Gas Vehicle Program for Public Transport (NGVPPT) is expected to mitigate our dependence on imported oil and eventually impact on the country's economic growth through savings in fuel oil displacement.

Conclusions

- There is continued reliance in oil, gas and coal as energy sources.
- Oil is mainly consumed for the transport sector. Price forecast indicate continuous upward trend.
- Natural gas is consumed for power generation, and expansion of local utilization is yet to be developed e. g. transport
- Coal is still the logical choice to bridge the demand in power generation in view of availability and transportability of supply, and lower price
- Locally, renewed exploration interests on these energy sources are triggered by continued increase in the price of oil. Benefits include:
  ⇒ Exploration companies come to the country to explore
  ⇒ Every exploration activity redounds to additional information
  Achievement of energy self-sufficiency

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Other Energy Sources and Technology

PROSPECTS FOR WIND AND SOLAR ENERGY

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Abstract

The search for a renewable and sustainable energy source is now an active global research area. With more emerging companies dedicating their investments to renewable energy (RE) projects, there is no debate that it is about time the Philippines see renewable energy from its own eyes.

Globally, wind and solar energy are dominating other RE sources in terms of investments. With wind energy generating capacity increasing by 25% just in 2007, it leads other RE sources with a total of 47% share in total investments. The wind energy industry is backed up by 70 countries with China and India quickly following the trend. The wind power industry has already experienced supply chain difficulties due to booming demand, putting unprecedented pressure on turbine component manufacturers.

On the other hand, grid-connected solar photovoltaic (PV) capacity has grown by 52% globally in the past few years. Solar PV production worldwide increased from 1.8 GW in 2005 to 3.8 GW in 2007. The solar PV industry is rapidly catching up with the wind energy industry since it is now the fastest growing energy technology in the world.

Many countries (about 66 in 2007) have started to implement their own renewable energy (RE) policies. RE policies include tax incentives, value added tax exemptions and public competitive biddings for participating investors.

Going to the Philippine context, it is nothing but alarming to find out that the Philippines is highly dependent on imported oil and very minimally on renewable (solar, wind and hydro). Natural gas and coal are dominant fuel sources for power generation at 60% while renewables contribute 31% to the country's total Power Generation Mix in 2007. Just the past year, we have noticed a rapid fluctuation in oil and electricity prices. This is because of the strong global demand for coal and oil with the supply rapidly declining. Oil prices are expected to rise all throughout 2009 and this could have a severe impact on the economy.

Leaning onto renewables might just be the solution to the energy

cost fluctuation the Philippines is currently experiencing. Moreover, RE development will not just save pesos for the Philippines but also accelerate electrification in off-grid areas, promote sustainable growth and improve the country's energy security.

Moving on to the RE prospects in the Philippines; the country has a 700 MW wind energy potential. The country possesses high potential wind regions which include the Batanes and Babuyan Islands, northwest tip of Luzon (Ilocos Norte), higher interior terrains (in Luzon, Mindoro, Samar, Leyte, Panay, Negros, Cebu and Palawan), a well-exposed east facing coastal locations from Northern Luzon southward to Samar, the corridor between Luzon and Mindoro and between Mindoro and Panay. The first wind farm in Southeast Asia is in Bangui, Ilocos Norte and is currently producing 25 MW. The same wind farm was planning to expand its capacity to 33 MW by late 2008.

Solar energy is another leading prospect in the Philippines. Solar radiation nationwide has an annual potential average of 5.0 to 5.1 kWh per sq. meter per day. According to RE-VIEWS, Vol. 1 No. 1, the largest grid-connected PV plant in any developing country is the one in Cagayan de Oro. The said plant is the CEPALCO 950 kW Centralized PV Plant. Also, the Philippines is host to the first solar cell fabrication plant in Southeast Asia, Sunpower Philippines. Sunpower Philippines has two solar cell manufacturing plants – a 400 MW facility in Batangas and a 110 MW plant in Laguna. The solar cells produced are currently being exported. Another step in solar energy development by the Philippines is the building of the first Philippine solar-powered car, Sinag. Sinag was designed and built by students from DLSU with solar cells manufactured by Sunpower. The car is the country's very first entry to the 3000 km race, World Solar Challenge in Australia. The team finished 11th overall among 40 solar car entries from around the world.

Another growing RE prospect in the Philippines is the use of electrically-powered vehicles. The Philippines' E-Jeepney is the first locally manufactured electric jeepney. It is a project of GRIPP, Greenpeace and SOLARCO. The E-Jeepney is already plying commercial routes in Bacolod and Makati.

RE development in the Philippines is urgent because it has been projected that an additional 3,620 MW capacity is necessary by 2014. By 2014, Luzon would require an additional 1,950 MW, Visayas, an additional 820 MW and Mindanao, an additional 850 MW totaling to 3,620 MW all in all.

Potential wind and solar capacity additions include an 8.25 MW Wind Power Project, a 46 MW Wind Power Project in Burgos, a 7 MW Combined Solar-Hydro Facility and other Wind Power Projects. All in all, these additions will only produce a combined 146.25 MW of power which is too little compared to the projected 3,620 MW required by 2014.

Several market opportunities for wind and solar power are emerging in the country. Currently, there are 119 electric cooperatives nationwide.

Northwind has entered into an Electricity Sales Agreement with Ilocos Norte Electric Cooperative. WESM is already successfully operating since 2006 for electricity trading. NPC SPUG Areas are now opened for private sector participation. Additional markets for solar and wind energy include solar water heating for hotels and hospitals, solar dryer for fruit drying, solar for transport, wind power for domestic power, wind power for irrigation and hybrid wind and solar systems for telecommunications.

The Philippines has already brought RE development to the next stage by implementing its very own RE policies. These will serve as mechanisms to promote the growth of wind and solar energy. These are the E.O 232 / 462 or the Ocean, Solar and Wind (OSW) Law, the R.A. 9337 or the Reformed VAT Law which imposes zero VAT on sale of power and fuel generated from RE sources and the E.O 226 which gives income tax holiday and zero duty on capital equipment.

In addition, the RE Bill, which is supposed to further RE development by making the use of RE mandatory in the Philippines, has already been endorsed for approval in the Senate. Other proposed RE policies include feed-in tariffs, inclusion in the national building code of solar PV in new buildings and tax credits and capital subsidies for non-power applications of wind and solar energy.

There is no way the Philippines will not be able to follow the rapidly growing trend in RE development. The country is abundant in all types of resources, human and material, needed. Despite the huge power requirement projected by 2014, the Philippines should not be discouraged. What is important is that there are steps being undertaken and that the country is on the right track.

ABOUT NAST, Philippines

The National Academy of Science and Technology (NAST) Philippines is the country's highest advisory body to the government and the science community on matters related to science and technology. It also has the mandate to recognize outstanding achievements in science and technology made by Filipino scientist in all fields of science.

VISION, MISSION AND MANDATE

The National Academy of Science and Technology Philippines, founded in 1976, continues to stand today with a firm resolve to faithfully pursue:

Its **VISION**: A PROGRESSIVE PHILIPPINES ANCHORED ON SCIENCE

Its **MISSION:**

1. To recognize exemplary science and technology achievements among the young and among peers
2. To encourage individual Academy members to continue their scholarly pursuits thereby making the Academy the principal reservoir of scientific and technological expertise in the nation
3. To provide independent and science-based advice on problems facing the nation and the world
4. To link the like-minded institutions and individuals in promoting scientific achievement in the Philippines and abroad
5. To promote a strong science culture in Philippine society

Its **MANDATE**:

1. To recognize outstanding achievements in science and technology as well as provide meaningful incentives to those engaged in scientific and technological researches (PD 1003-A)
2. To advise the President and the Cabinet on matters related to science and technology (EO 818)
3. To engage in projects and programs designed to recognize outstanding achievements in science and promote scientific productivity (EO 818)
4. To embark on programs traditionally expected of an academy of science (EO 818).

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