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# Energy Research and Development Statistics: Relevance to the National Energy Program

by
Graciano P. Yumul, Jr[1]., Raul C. Sabularse[2] and Nonilo A. Peña[3]

**ABSTRACT**

Energy sector is one of the prime backbones in the industrial and economic development of a nation. In support of the Philippine Energy Plan and recently of the Ten-Point Agenda of the President of the Republic of the Philippines, the Science & Technology (S&T) sector has rationalized its activities and institutionalized research and development (R&D) undertakings on the field of energy sector. The Energy R&D activities are an important precursor to the technological advances required to ensure sufficient, stable, efficient and environmentally-acceptable energy supplies.

The statistical data that will be presented in this paper will highlight activities relating to the performance of the energy sector, in particular energy R&D indicators. In essence, this provides an overview of the extent of Energy R&D activities in the country. The paper will focus on the Energy R&D undertakings in different forms of energy resources. An attempt will be made to analyze the significance of these R&D activities in the Philippine Energy Plan and their potential contribution to the country's economic growth. Other historical energy statistics showing the developments and performance of various energy development and utilization will also be presented.

## I. Introduction

Since the first oil shock in the 70's, there has been robust effort in the Energy Research and Development (R&D) activity throughout the world. Compounded with international oil supply related incidences in the 80's, 90's & 2000's, Iran-Iraq, Persian Gulf Wars and OPEC oil production cuts, respectively, which caused oil price hikes on international energy markets, the investments in energy R&D activities were boosted. In particular, addressing development of alternative energy sources and innovative energy technologies using non-fossil-based energy resources were given emphasis.

In the country, although there were several energy R&D activities being undertaken during the late 70"s & 80's, it was during the establishment of the Philippine Council for Industry and Energy Research and Development (PCIERD) in the mid-80's that energy R&D activities were rationalized and given emphasis. The PCIERD is one of the sectoral councils of the Department of Science and Technology (DOST), which is mandated to serve as the central agency in the planning, monitoring and promotion of scientific and technological research applications in the industry, energy, utilities and infrastructure sectors. It has the authority to set and specify R&D goals and priorities, and rationalize the allocation of available resources for its delineated sectors. The R&D program and projects set were within the Philippine Energy Plan (PEP) strategies and priority areas defined by the Department of Energy (DOE).

In this paper, an overview of the country's energy profile and program thrusts will give an over-all perspective of the current energy situation and its influence towards the

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energy R&D activity direction. Energy R&D expenditure statistics supported under the DOST Grants-In-Aid Program and its level compared with other sectoral concerns will be presented. An overview of the international energy R&D trends will also be made as reference information. However, it is anticipated that the magnitude of R&D activities and investments are in the most extreme circumstances. Hence, analytical findings on the energy R&D trends and its future directions will also be highlighted.

## II. Energy Situationer

The Philippine Energy Plan for the recent decades has been geared towards national macroeconomic goals focusing on economic growth, poverty alleviation and market-based industry. To complement with these goals, the energy sector sets out strategies and goals in ensuring sufficient, stable, accessible and reasonably priced energy supply. Pursuance of socially-and environmentally-compatible energy projects is also a priority.

The country is highly dependent on imported energy. Thus, it has to contend with the vulnerability changes in international fossil-based prices and uncertainties in the behavior of the energy market. Extensive exploration and development of indigenous energy resources to enhance self-sufficiency has been a continuing thrust of the government since the oil crisis in the 70's. Efforts towards the development of untapped indigenous resources take priority in the energy program. In Year 2002, the level of energy self-sufficiency attained 50.90% usage of indigenous energy resources, which significantly increased from the last decade of 30.5%. The historical energy mix shows the trend of volume and percentage share of energy utilization from the different indigenous and imported energy sources [Annex 1] *(1)*. Imported energy sources in the energy mix include supply of fossil-based fuel for the transport, commercial, industrial and household sector. It is almost the same case with the power generation sector. The level of indigenous energy resources is a little higher than 50%, and is dominated by diesel/oil and coal-based power generation plants [Annex 2] *(1)*.

In support of accelerating the poverty alleviation efforts, an accelerated barangay electrification program was conceptualized in 1999. It included the expansion of electricity grid-line and offering alternative energy sources like renewable energy from hydro, solar and wind resources in the off-grid remote barangay areas. The level of barangay electrification in 2002 reached up to 87.10% of the total 41,995 barangays in the country energized [Annex 3] *(1)*. As a result of R&D undertakings and technology demonstration projects in the field of renewable energy resources, it is noteworthy to point out that a significant number of renewable energy technologies has been installed under the barangay electrification program.

| No. of Energized Barangays per Type of Power Supply | | | | |
|---|---|---|---|---|
| **Power Supply Scheme** | **1999** | **2000** | **2001** | **TOTAL** |
| Grid Extension | 713 | 1,058 | 1,013 | 2,784 |
| Off-grid | | | | |
| Solar | 42 | 78 | 207 | 327 |
| Micro-hydro | | 13 | 3 | 16 |
| Hybrid | | 2 | 2 | 4 |
| Generator Set | | 215 | 28 | 243 |
| T O T A L | 755 | 1,366 | 1,253 | 3,374 |

*Table 1. PEP-DOE 2003-2012 (1)*

Aside from the utilization of indigenous energy resources, energy conservation and efficient use of energy is also a major program thrust. It aims to improve energy

usage of energy consuming sectors. As a result, it defers the need for new investments for new power generating facilities and reducing environmental hazards resulting from energy production and utilization. The energy conservation and efficiency programs are focussed on the major users of energy, namely: industrial, transport, power, household and commercial sectors. The programs included energy management trainings, massive energy efficiency information campaign and promotion of linkages and cooperation among R&D institutions. Strategies on energy efficiency of household appliances, industrial equipment and facilities and demand-side management by power generation and distribution utilities are also pursued. The intensified implementation of the energy efficiency programs generated actual energy savings of 1.8 million barrels of fuel oil equivalent (MMBFOE), or about a 27.8 % increase from the previous year's accomplishment *(1)*.

## III. Energy R&D Local Highlights

In the 80's, a national effort to define the Energy Sector Science and Technology (S&T) thrusts was undertaken in support of the development of the S&T Master Plan. A technical panel composed of academe, industry, government and non-government organizations identified the S&T actions plans for the energy sector, including the R&D directions and priorities. To facilitate identification of specific action plans and program, the energy sector was sub-categorized into conventional resources – oil & gas, coal, hydro, geothermal & nuclear, and non-conventional – biomass, solar, wind, micro-hydro and energy conservation *(3)*. From then, the R&D activities were coordinated, updated as warranted and its direction evolved from various environmental scanning, information exchange and consultations with different stakeholders through technical advisory committees.

With the identified priority areas, the PCIERD-DOST annually allocates grants-in-aid funds from the national budget and externally-sourced funding assistance to support energy R&D activities. Table 2 shows the annual expenditure of R&D supported under the PCIERD and DOST Grants-In-Aid Program. These expenditures were too limited and do not reflect the national budget expenditures for the energy R&D activities. Other government agencies and state universities and colleges also implement R&D projects sourced from the national budget. There was an effort to monitor all R&D expenditures from different sectoral coverage through an understanding between the DOST and the Department of Budget and Management (DBM). It was agreed that all budget coming from the national government that are allocated for R&D activities will have to pass to DOST for endorsement. The aim was to rationalize the allocation of resources, avoid duplication of R&D activities and focus R&D efforts in-line with the identified national priority program. However, this effort needs to be strengthened and consistently implemented. Hence, other R&D funding sources coming from the private, non-government organizations and especially international funding agencies, with large chunk of R&D funds granted locally were not monitored well.

| PCIERD & DOST GIA Energy R&D Supported (In Million Pesos) | | | | |
|---|---|---|---|---|
| | Energy R&D Areas for PCIERD & DOST GIA | | | |
| Year | Renewable Energy | Energy Conservation | Conventional Sources | TOTAL |
| 2002 | 4.816 | | 2.723 | 7.539 |
| 2001 | 1.510 | | | 1.510 |
| 2000 | 0.276 | | | 0.276 |
| 1999 | 1.289 | | | 1.289 |
| 1998 | 0.276 | | | 0.276 |
| 1997 | 0.554 | | 0.283 | 0.837 |
| 1996 | 2.190 | 1.689 | | 3.879 |
| 1995 | 3.743 | | 11.689 | 15.432 |
| 1994 | 2.380 | | | 2.380 |
| 1993 | 0.665 | 0.124 | 0.698 | 1.487 |
| 1992 | 2.430 | | | 2.430 |
| 1991 | 1.130 | | | 1.130 |
| 1990 | 0.370 | 0.315 | 0.444 | 1.129 |
| TOTAL | 21.629 | 2.128 | 15.837 | 39.594 |

*Table 2. PCIERD-DOST Project Management Information System*

It is highly noticeable that majority of the energy R&D activities supported were mostly on the renewable energy area. This is in line with the strategies under the Philippine Energy Plan to encourage utilization of indigenous energy resources and environmentally-benign technologies. Hence, the national energy thrusts of the present administration are focused on the development of alterative fuel for the transport sector, which were founded through the R&D outputs support by the DOST and other government agencies. This includes the utilization of compressed natural gas for transport and coco-methyl ester (CME) as diesel fuel substitute and additives. On the power development program, the PCIERD-DOST initiatives on wind power development through the detailed wind regime assessment in specific potential sites, off-grid stand-alone wind power-related demonstration project and development of the Philippine wind energy atlas have triggered full-scale wind power generation investment in the country. At present, there are two (2) grid connected wind-farm power generation plants with a total capacity of 150 MW being established in Ilocos Norte. Other investors are now developing other potential sites using the information that resulted from the specific area wind regime monitoring and wind energy atlas data. For remote area energy supply, the locally-developed micro-hydro technology is being replicated in different remote mountainous communities for electrification and livelihood program.

While the energy sector is considered as prime mover of the national economy and significantly contributed to its growth, the R&D expenditure share of the energy sector is too minimal compared with other socio-economic sectors. In the survey made by the DOST in 2002, it only accounts about 1.24% share of R&D expenditures from the different private and government institutions in the country.

| R&D Expenditures by Sector and Socio-Economic Objective, 2002 (In Million Pesos) | | | | | | |
|---|---|---|---|---|---|---|
| Socio Economic Objective | | Sector of Performance | | | | |
| | Total R&D Expenditures | Gov't Agencies | Higher Education Institutions | | Private | % Share of R&D Expenditures |
| | | | States College & Univ. | Private Colleges & Univ. | Non-Profit Inst. | |
| 1. Exploration & exploitation of the earth | 70.05 | 54.79 | 15.14 | 0.12 | 0 | 3.79 |
| 2. Infrastructure & general planning of land-use | 27.73 | 17.39 | 8.89 | 0.14 | 1.31 | 1.50 |
| 3. Control & care of the environment | 177.07 | 55.49 | 82.79 | 10.25 | 28.54 | 9.58 |
| 4. Protection & improvement of human health | 239.41 | 78.37 | 106.26 | 51.42 | 3.36 | 12.96 |
| **5. Production, distribution & rational utilization of energy** | **22.93** | **20.89** | **1.97** | **0.07** | **0** | **1.24** |
| 6. Agricultural production & technology | 762.49 | 447.33 | 278.17 | 3.23 | 33.76 | 41.26 |
| 7. Industrial production & technology | 193.37 | 141.49 | 39.41 | 11.96 | 0.51 | 10.46 |
| 8. Social structures & relationships | 147.00 | 7.79 | 76.83 | 29.9 | 32.48 | 7.95 |
| 9. Exploration & exploitation of space | 0.50 | 0.50 | 0 | 0 | 0 | 0.03 |
| 10. Defense | 56.52 | 56.50 | 0 | 0.02 | 0 | 3.06 |
| 11. Other, ICT | 43.26 | 43.22 | 0.04 | 0 | 0 | 2.34 |
| 12. Others, not elsewhere classified | 103.82 | 42.13 | 27.11 | 11.86 | 22.72 | 5.62 |
| 13. Not classified | 3.82 | 3.82 | 0 | 0 | 0 | 0.21 |
| Total R&D Expenditures | 1847.97 | 969.71 | 636.61 | 118.97 | 122.68 | 100.00 |

*Table 3. Results of DOST 2002 R&D Survey (2) covering 3 sectors (government, heis and private non-profit institutions) only. Private industry not included.*

## IV. Energy R&D International Trends

Before 1970's, the world has benefited with cheap and abundant energy supplies. After the oil shocks in the early 70's, energy R&D investments portfolios were enormously financed by the national governments of different countries to overcome the dependency on fossil-based energy supply. Most of the advanced countries have invested on energy R&D activities in various new energy systems and technological developments. The investments went to the search for alternative energy resources, innovative energy efficiency technologies, intensive exploration of new petroleum targets and creation of future energy market. Even with the international energy-related incidences that caused international oil price hike in the 80's and 90', the situation briefly stabilized due to intensified technological development in the usage of alternative energy sources and energy efficient technologies. The optimism generated by these developments persisted even during the short-lived oil price hikes in the international market. The downside is that national governments commitment to undertake energy R&D activities have suddenly declined in most of the advanced countries. At the same time, the international trend in the shift from regulated to deregulated environment in the energy industry and related utilities have compounded additional pressure on energy R&D investments. Hence, to a larger extent, the government commitment to energy have become less urgent than other socio-economic priorities.

A survey among the 22 member countries of the International Energy Agency (IEA) documents the dramatic decline in the scale and diversity of energy R&D. In 1995, 98% of all IEA member country energy R&D was carried out by only 10 countries *(3)*. A comparison of the federal energy R&D budgets for these 10 countries, in 1980 and

1995, reveals that the decline was particularly sharp in Germany, the United Kingdom, and the United States. Only Japan and Switzerland showed increases as shown in Figure 1. The changes represent an overall decline of 39% in energy R&D funding. Investments in energy R&D have also fallen across the board *(7)*. A small group of advanced industrialized countries has been responsible for about 95% of the world's energy R&D investments. The energy R&D enterprises of these countries embody the capability for future technological changes in the world's energy systems. Recently each of these countries reduced its public and private sector investments in energy R&D – in some cases by more than 70% *(6)*.

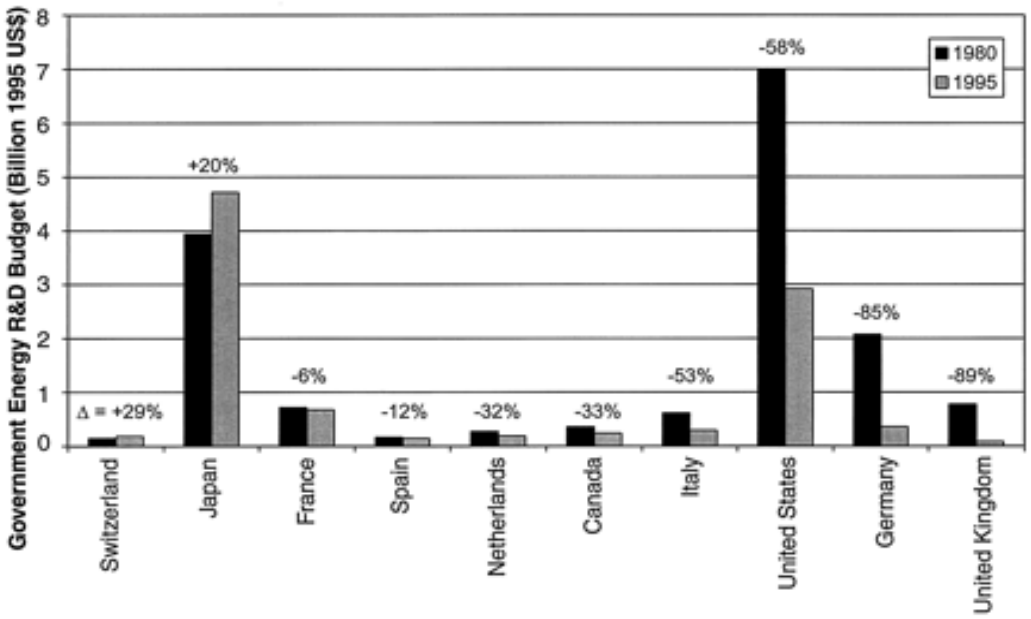


***Fig. 1.*** *Government energy R&D budgets for selected IEA countries showing the difference in spending (Δ) between 1980 and 1995 (4).*

In this environment of reduced energy R&D attention to the broad needs of energy security, diversity, and sustainability, national energy policies tend to be chaotic *(5)*. The variation among countries with respect to the areas of energy R&D priorities was distributed in a wide array of energy technological developments and resources. Overall, some countries have eliminated broad classes of energy technology R&D from their research portfolios, shifting their priorities toward a favored technology, whereas other countries have cut back on their energy technology R&D across the different energy sub-sectors of development.

It is noticeable in Figure 2 that national governments have different priorities with regard to energy R&D investment areas. Hence, all these nations have energy policies that address the development of renewable energy and energy efficient technologies as a way of overcoming their energy security needs and commitment in protecting the environment. However, it is the Dutch & German governments that invest the majority of their energy R&D resources in these technology areas. Others have their own major concerns in other energy forms like fusion, fission & other fields of technological developments.

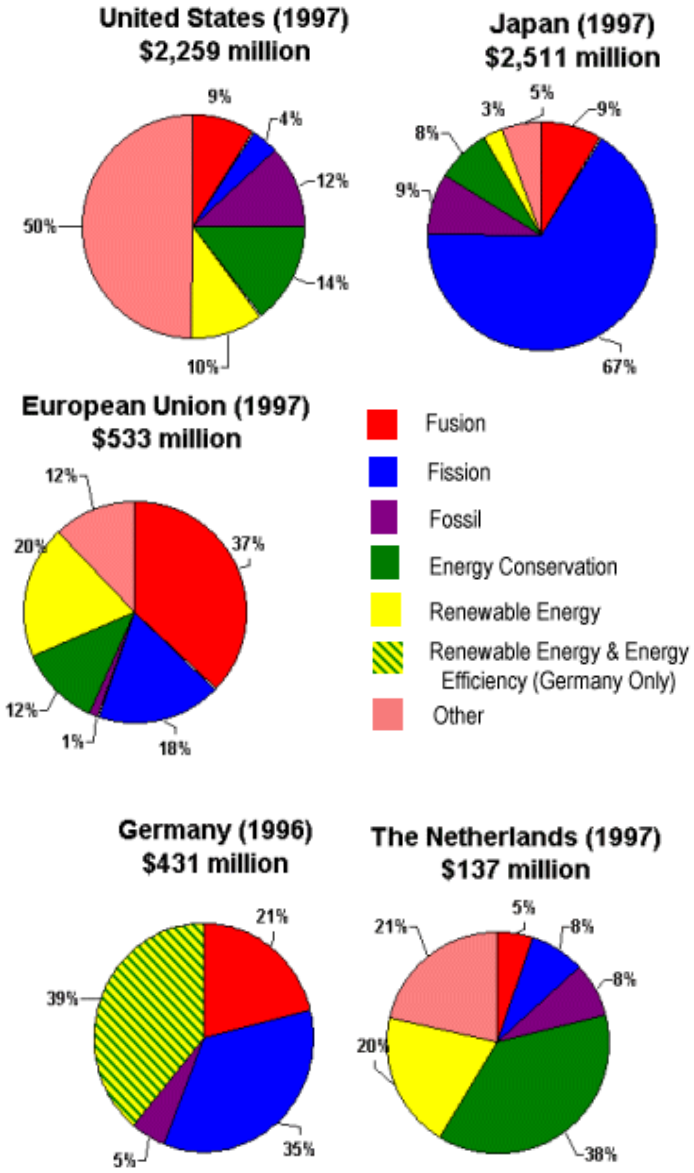


*Figure 2: Public Sector Energy R&D Porfolios (5)*

## V. Analytical Findings

Based on the energy statistics presented in this paper, below is a summary of analytical findings derived from the information gathered and experiences in the field of energy R&D activities:

- Considering that high investments are required for advanced energy technology development, industrialized countries dominate the energy R&D effort. High-end energy R&D technological development is a high risk area for investment, as well. With the limited financial resources available locally, energy R&D activity has been focused on the improvement of existing energy technologies for suitable local applications. For large-scale funding requirement of energy R&D activity, like the natural gas program and wind energy atlas, external financing institutions were

invited for joint R&D undertakings. This kind of practice will at least continue for the immediate R&D investment direction in the country.

- The extent of energy R&D expenditures has not drastically change through the years. The scale of national government support for energy R&D will still remain minimal due to other socio-cultural-economic priorities of the country. Thus, external funding support for joint R&D undertakings must be intensified.

- The energy R&D priority direction must still be aligned with the Philippine Energy Plan, particularly ensuring sustainable, secure, sufficient, accessible and reasonably-priced energy. In addressing international concerns on climate change and global warming, although a priority, can only be fully addressed through the solicitation mostly international/external-sourced funds.

- Although the expenditures in the energy R&D was limited, it has significantly contributed to the national program effort of providing alternative fuel supply in the country. Direct impact indicators for energy R&D expenditures needs to be determined clearly.

- The level of energy R&D expenditure as reported does not truly reflect the national effort. Monitoring of national R&D expenditures by all government institutions and all-related sectors in the national level, including private, non-government institutions and external support from international funding agencies, must be strengthened.

- The trend of energy R&D investments in the international scene tends to influence the local initiatives in areas of joint collaboration effort. But since there is no statistics to show the amount of foreign investment coming in to support joint collaborative energy R&D activity, this is something that can only be speculated.

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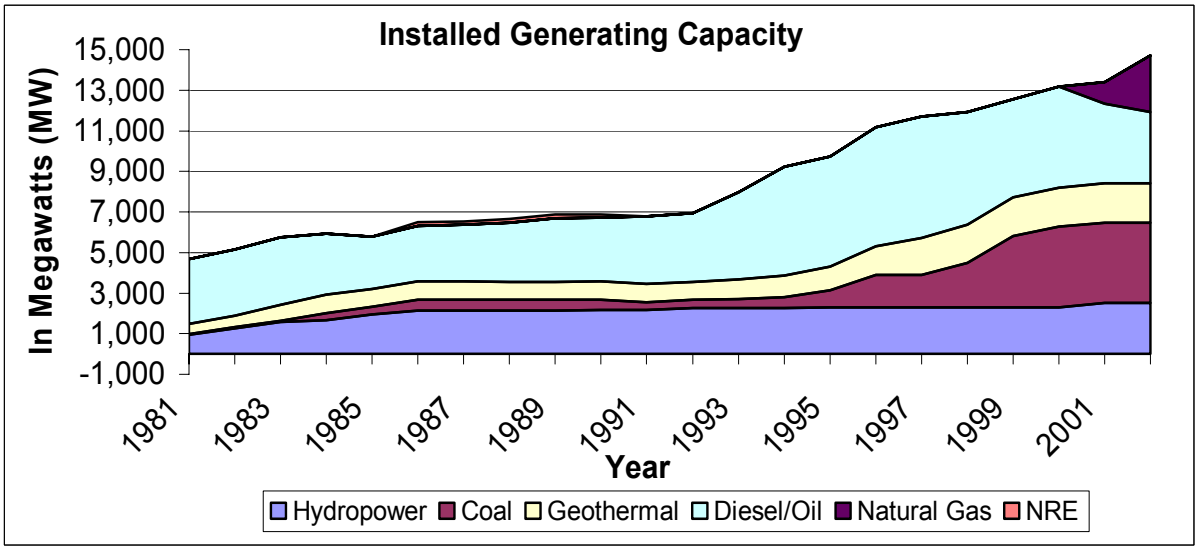
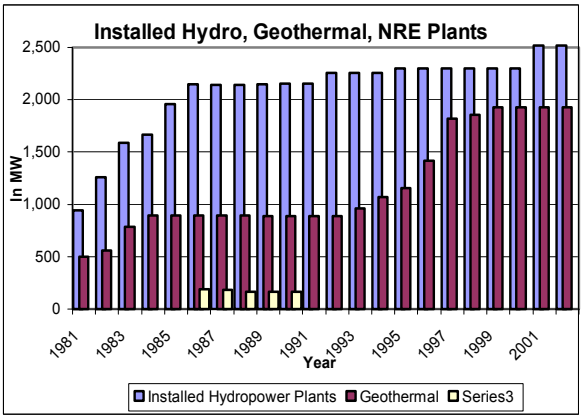
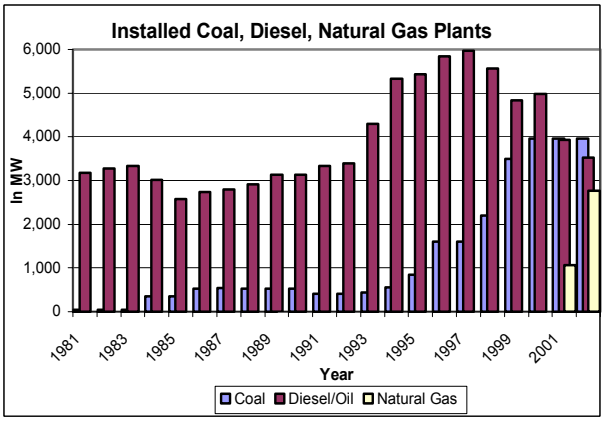
**Annex 2**
**INSTALLED GENERATING CAPACITY**
**(In Megawatts, MW)**

| YEAR | HYDROPOWER | COAL | GEOTHERMAL | DIESEL/OIL | NAT. GAS | NRE | TOTAL |
|---|---|---|---|---|---|---|---|
| **1981** | 940 | 50 | 501 | 3,176 | - | 0 | 4,667 |
| **1982** | 1,262 | 50 | 559 | 3,277 | - | - | 5,148 |
| **1983** | 1,585 | 50 | 784 | 3,338 | - | - | 5,757 |
| **1984** | 1,666 | 350 | 894 | 3,011 | - | - | 5,921 |
| **1985** | 1,961 | 350 | 894 | 2,578 | - | - | 5,783 |
| **1986** | 2,147 | 530 | 894 | 2,741 | - | 191 | 6,503 |
| **1987** | 2,142 | 535 | 894 | 2,790 | - | 184 | 6,545 |
| **1988** | 2,139 | 525 | 894 | 2,915 | - | 167 | 6,640 |
| **1989** | 2,147 | 525 | 888 | 3,136 | - | 167 | 6,863 |
| **1990** | 2,153 | 525 | 888 | 3,136 | - | 167 | 6,869 |
| **1991** | 2,155 | 405 | 888 | 3,341 | - | - | 6,789 |
| **1992** | 2,257 | 405 | 888 | 3,399 | - | - | 6,949 |
| **1993** | 2,259 | 441 | 963 | 4,296 | - | - | 7,959 |
| **1994** | 2,254 | 550 | 1,073 | 5,335 | - | - | 9,212 |
| **1995** | 2,301 | 850 | 1,154 | 5,425 | - | - | 9,730 |
| **1996** | 2,301 | 1,600 | 1,417 | 5,844 | - | - | 11,162 |
| **1997** | 2,301 | 1,600 | 1,819 | 5,973 | - | - | 11,693 |
| **1998** | 2,301 | 2,200 | 1,856 | 5,568 | 3 | - | 11,928 |
| **1999** | 2,301 | 3,493 | 1,931 | 4,839 | 3 | - | 12,567 |
| **2000** | 2,301 | 3,963 | 1,931 | 4,987 | 3 | - | 13,185 |
| **2001** | 2,518 | 3,963 | 1,931 | 3,927 | 1,063 | - | 13,402 |
| **2002** | 2,518 | 3,963 | 1,931 | 3,527 | 2,763 | - | 14,702 |



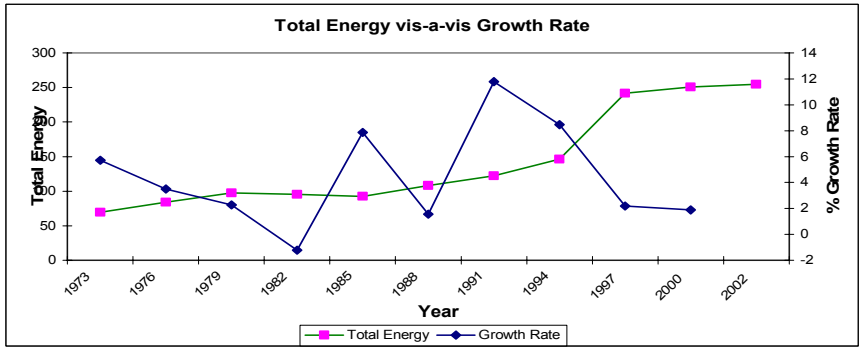



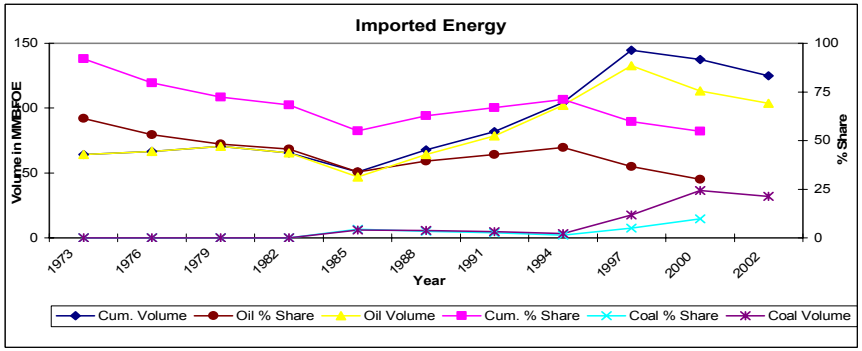

*Source : PEP 2004-2013*

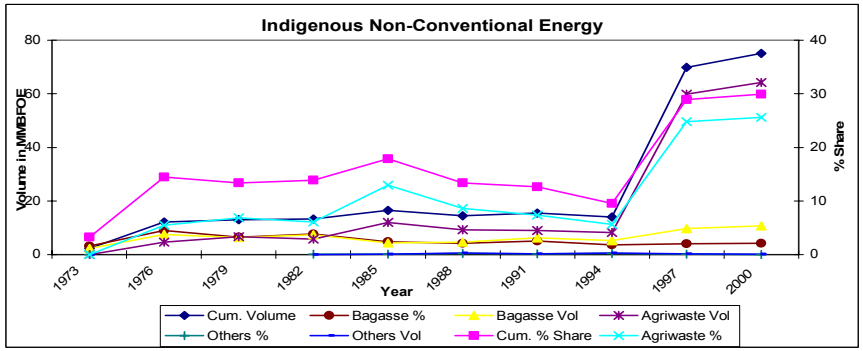
**Annex 1**
**ENERGY MIX**
(In Million Barrels of Fuel Oil Equivalent, MMBFOE)

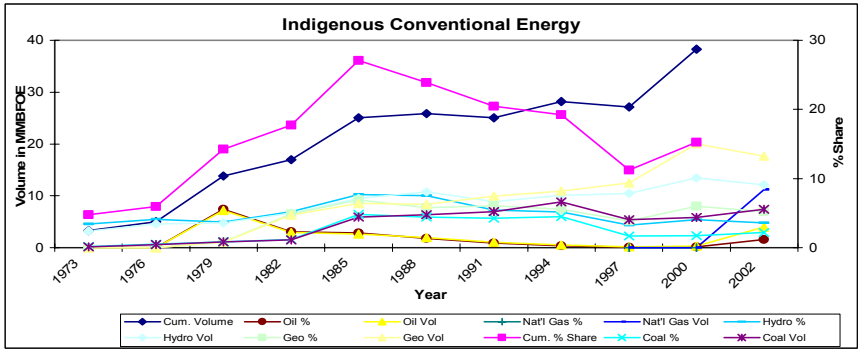
| | 1973 | | 1976 | | 1979 | | 1982 | | 1985 | | 1988 | | 1991 | | 1994 | | 1997 | | 2000 | | 2002 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share | Volume | % Share |
| **INDIGENOUS ENERGY** | **5.57** | **7.98** | **17.12** | **20.41** | **26.92** | **27.63** | **30.20** | **31.60** | **41.62** | **44.97** | **40.27** | **37.24** | **40.61** | **33.16** | **42.19** | **28.79** | **97.11** | **40.17** | **113.32** | **44.85** | **129.50** | **50.90** |
| I. CONVENTIONAL | 3.32 | 4.76 | 4.98 | 5.94 | 13.86 | 14.23 | 16.96 | 17.75 | 25.08 | 27.10 | 25.84 | 23.89 | 25.07 | 20.47 | 28.15 | 19.21 | 27.17 | 11.24 | 38.25 | 15.24 | | |
| OIL | - | - | - | - | 7.18 | 7.37 | 2.95 | 3.09 | 2.60 | 2.81 | 1.91 | 1.76 | 1.06 | 0.87 | 0.55 | 0.38 | 0.16 | 0.07 | 0.32 | 0.13 | 3.94 | 1.55 |
| NATURAL GAS | | | | | | | | | | | | | | | | | 0.02 | 0.01 | 0.03 | 0.01 | 11.20 | 4.40 |
| COAL | 0.13 | 0.19 | 0.43 | 0.51 | 0.82 | 0.84 | 1.11 | 1.16 | 4.45 | 4.81 | 4.78 | 4.42 | 5.21 | 4.26 | 6.59 | 4.50 | 4.05 | 1.68 | 4.40 | 1.75 | 5.53 | 2.17 |
| HYDRO | 3.19 | 4.57 | 4.55 | 5.42 | 4.80 | 4.93 | 6.65 | 6.96 | 9.50 | 10.26 | 10.80 | 9.99 | 8.87 | 7.24 | 10.11 | 6.90 | 10.46 | 4.33 | 13.45 | 5.36 | 12.13 | 4.77 |
| GEOTHERMAL | - | - | - | - | 1.06 | 1.09 | 6.25 | 6.54 | 8.53 | 9.22 | 8.35 | 7.72 | 9.93 | 8.11 | 10.90 | 7.44 | 12.48 | 5.16 | 20.05 | 7.99 | 17.66 | 6.94 |
| II. NONCONVENTIONAL | 2.25 | 3.22 | 12.14 | 14.47 | 13.06 | 13.41 | 13.24 | 13.85 | 16.54 | 17.87 | 14.43 | 13.35 | 15.54 | 12.69 | 14.04 | 9.58 | 69.94 | 28.93 | 75.08 | 29.93 | 79.04 | 31.07 |
| BAGASSE | 2.25 | 3.22 | 7.54 | 8.99 | 6.35 | 6.52 | 7.35 | 7.69 | 4.36 | 4.71 | 4.59 | 4.24 | 6.15 | 5.02 | 5.21 | 3.56 | 9.69 | 4.01 | 10.68 | 4.26 | | |
| AGRIWASTE | - | - | 4.60 | 5.48 | 6.71 | 6.89 | 5.82 | 6.09 | 12.00 | 12.96 | 9.33 | 8.62 | 9.03 | 7.38 | 8.28 | 5.65 | 59.94 | 24.80 | 64.22 | 25.60 | | |
| OTHERS | - | - | | | | | 0.07 | 0.07 | 0.18 | 0.19 | 0.52 | 0.48 | 0.36 | 0.29 | 0.55 | 0.38 | 0.31 | 0.13 | 0.18 | 0.07 | | |
| **IMPORTED ENERGY** | **64.22** | **92.02** | **66.76** | **79.59** | **70.50** | **72.37** | **65.37** | **68.40** | **50.94** | **55.03** | **67.87** | **62.76** | **81.85** | **66.84** | **104.35** | **71.21** | **144.61** | **59.82** | **137.57** | **54.83** | **124.93** | **49.10** |
| OIL | 64.22 | 92.02 | 66.76 | 79.59 | 70.50 | 72.37 | 65.37 | 68.40 | 46.96 | 50.73 | 64.13 | 59.30 | 78.58 | 64.16 | 102.19 | 69.74 | 132.76 | 54.92 | 113.30 | 45.16 | 103.62 | 40.73 |
| COAL | - | - | - | - | - | - | - | - | 3.98 | 4.30 | 3.74 | 3.46 | 3.28 | 2.67 | 2.16 | 1.47 | 11.85 | 4.90 | 24.28 | 9.68 | 21.31 | 8.38 |
| **T O T A L  E N E R G Y** | **69.79** | **100.00** | **83.88** | **100.00** | **97.42** | **100.00** | **95.57** | **100.00** | **92.56** | **100.00** | **108.14** | **100.00** | **122.46** | **100.00** | **146.54** | **100.00** | **241.73** | **100.00** | **250.89** | **100.00** | **254.43** | **100.00** |
| **GROWTH RATE, %** | | | **5.71** | | **3.50** | | **2.27** | | **(1.22)** | | **7.87** | | **1.55** | | **11.78** | | **8.47** | | **2.20** | | **1.88** | |

*Source : PEP 2004-2013*



**Annex 3**
**ELECTRIFICATION PROFILE**

| | 1986 | 1988 | 1990 | 1992 | 1994 | 1996 | 1998 | 2000 | 2002 |
|---|---|---|---|---|---|---|---|---|---|
| Total Number of Barangays | 41,995 | 41,995 | 41,995 | 41,995 | 41,995 | 41,995 | 41,995 | 41,995 | 41,995 |
| Cum. Barangays Energized | 23,639 | 24,810 | 25,786 | 26,785 | 28,087 | 29,400 | 31,599 | 33,647 | 36,578 |
| Electrification Level, (%) | 56.3 | 59.1 | 61.4 | 63.78 | 66.88 | 70.01 | 75.24 | 80.12 | 87.10 |