Asia-Pacific
Economic Cooperation

FOLLOW-UP PEER REVIEW ON ENERGY EFFICIENCY IN THE PHILIPPINES

Final Report

21 November 2014

Endorsed by the APEC Energy Working Group

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PREFACE

The APEC Peer Review on Energy Efficiency (PREE) objectives, as endorsed by APEC Leaders at their 2007 meeting are to:

- Share information on energy efficiency performance as well as on policies and measures for improving energy efficiency;
- Provide opportunities for learning from the experiences of other economies and for broadening the network among energy efficiency policy experts;
- Explore how energy efficiency goals on an overall and /or sectorial basis and action plans could be effectively formulated in each economy under review, taking into account the range of possible strategies that could be used, according to the circumstance of each economy;
- Monitor progress attaining energy efficiency goals on an overall and/or sectorial basis and implementing action plans, if such goal and action plans have been already formulated at the time of the review; and
- Provide recommendation for voluntary implementation on how implementation of action plans could be improved with a view to achieving energy efficiency goals.

Two activities form the PREE:

a) **Peer Review** of volunteer member economies; and

b) The **Compendium of Energy Efficiency Policies** of APEC member economies based on either the APEC voluntary PREE or energy efficiency aspects of the IEA Energy Policy Review.

Follow-up PREEs are a secondary phase of the first activity. Follow-up PREEs form part of the monitoring process. It helps previous PREE-hosting economies implement recommendations from a previous report, or provides a more detailed analysis with recommendations for a particular sector or sectors.

The Philippines volunteered to undertake a Follow-up Peer Review on Energy Efficiency, following the ninth PREE in the Philippines held in 2012. This is the second Follow-up PREE exercise for an APEC Economy. Viet Nam hosted the first Follow-up PREE in February 2012. It was a workshop on assisting Viet Nam to implement the energy data collecting and monitoring recommendations from the Viet Nam PREE Report in 2009.

This Follow-up PREE focuses on the industrial sub-sectors of sugar, cement and glass, and the commercial buildings sector in the Philippines. This report presents the results from the peer review of energy efficiency conducted by the Follow-up PREE Review team, which consisted of eight experts (see Appendix A). The team visited the Philippines from 15-19 September 2014. The host economy and the Review Team share the accountability for each APEC peer review.

During the visit, the Follow-up PREE Review Team held comprehensive discussions on energy efficiency with representatives and experts from Government ministries and agencies, industries, companies, consultants and research institutions (see Appendix B). The PREE Review Team also participated in site visits related to each subject matter. The Review Team wishes to thank all the presenters, site visit companies and those who participated in the discussions, especially the representatives of the Philippine Department of Energy ('DOE') (see Appendix B).

EXECUTIVE SUMMARY

With just under 100 million people, the Philippines is the twelfth most populous country in the world and the fifth most populous APEC economy. It is a net energy importer producing oil, natural gas and coal and generating electricity from geothermal, hydropower and other renewable sources.

With its large population and high oil import dependency the Philippine Department of Energy notes that energy is a crucial commodity factor for economic growth necessitating both energy stability and energy conservation. As a fast growing economy, its industrial and commercial sectors are the first and third fastest growing sectors respectively. This means managing existing and increased energy demand through energy efficiency is crucial for the sustainable growth of the sectors.

The Peer Review on Energy Efficiency Report from 2012 ('the 2012 PREE Report') made 54 recommendations on the following topics: the institutional context; energy efficiency goals, targets and strategy; the industry sector; the electricity sector; the commercial and residential sectors; the transport sector; energy management mechanisms and training and appliances and equipment efficiency. The Government has made progress on many of the recommendations, however, this report ('the Follow-up PREE Report' or 'the Report') focuses exclusively on the sugar, glass and cement industries and the commercial buildings sector. This is due to the fast growing and high-energy intensity nature of these areas. Please refer to the 2012 PREE Report for analysis and recommendations on other sectors. It is available on the APERC website: http://aperc.ieej.or.jp/publications/reports/pree.php.

The Follow-up PREE Review Team found that the Philippine Government, industries and companies had a positive attitude towards energy efficiency. It has made excellent groundwork towards establishing the economy as an energy efficient economy. This Report highlights 25 Achievements, which shows the progress that the Philippine Government has made towards energy efficiency in the Philippines since the 2012 PREE Report.

The Report makes 35 recommendations to the Philippine Government covering overarching recommendations and recommendations for each sector cover. The Review Team tailored these recommendations made in this Report are tailored towards aligning policy options under a unified framework, and sharing best practices and innovative approaches from around the world. The Review Team hopes that the recommendations will help the economy to realise its energy efficiency potential and achieve its EE goals.

The recommendations are listed below.

RECOMMENDATIONS

Overarching

Recommendation 1: The Government should work to pass the Energy Efficiency and Conservation Act.

Recommendation 2: The Government energy efficiency targets are commendable however, constant revision will ensure that the Government is constantly striving to achieve optimal energy efficiency. Additionally, encouraging companies to set their own short term and long-term targets will encourage companies to adapt government goals to their own corporate agenda.

Recommendation 3: The Government should continue improve existing and add additional programs to their National Energy Efficiency and Conservation Program.

Recommendation 4: Encourage faster adoption of the ISO 50001 Energy Management Framework, look into certification and implementation programs, and adopt a voluntary certification program.

Recommendation 5: Encourage energy intensive industries and commercial buildings to adopt best practice and benchmark against other plants globally.

Recommendation 6: The Government should start programs for energy efficiency financing, low interest loans, tax incentives and fast track permitting to minimise the upfront cost of implementing energy efficiency projects in the industrial and commercial buildings sectors.

Recommendation 7: The Government should continue to work to improve and stabilise energy supply both through expanding and strengthening power generation capacity and the power grid system, and through introducing alternative energy sources. This could include natural gas for the industrial sector.

Recommendation 8: The Government and sub-sector organisations such as the Cement Manufacturers Association of the Philippines (CeMAP) and the Philippines Sugar Millers Association should coordinate a large energy users' forum where industry can share best practice, and technological developments. Use the forum as a platform for the Don Emilio Abello Energy Efficiency Award.

Recommendation 9: Companies should promote energy efficiency on-site through posters and signage, in a similar way that they promote maintenance and safety in industrial facilities.

Sugar Industry

Recommendation 10: Improve sugar cane crop quality to increase sugar production yield. Sugar cane quality directly correlates with sugar cane production; the higher the quality, the higher the sugar production yield. Cooperation with the Department of Agriculture is necessary to achieve this recommendation, which has a mandate to help improve the quality of the sugar cane *crop.*

Recommendation 11: Sugar cane farmers should supply unburnt sugar cane to sugar refineries, which will require changes to the agreements between the Farmers' Cooperative and the Sugar Milling Plant.

Recommendation 12: Improve the refining process by processing the sugar directly after the sugar crystalizes, without producing raw sugar, as illustrated in Figure 2.5 and compared with Figure 2.2.

NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.

Recommendation 13: Improve the refining process by using anaerobic treated wastewater from the plant to produce biogas that can be used as fuel for the thermal process or generating electricity via an internal combustion energy. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.

Recommendation 14: Improve the refining process in the long term by applying a new separation technology and process thermal integration technology that can significantly reduce energy consumption within the sugar industry. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.

Recommendation 15: Improve fuel management to enable more efficient steam generator use. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit recommendations for the sugar industry sector.

Recommendation 16: Reduce sugar cane burning by using sugar cane harvesting machinery to not only improve the quality of the sugar cane, leading to higher sugar production yields, but also allowing for leaves to be used as a biomass fuel source. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.

Recommendation 17: Increase research and development in the sugar industry. Research areas should include sugar cane cultivation and harvesting; process improvement, heat integration technique, energy efficiency in sugar processing; biomass and bagasse management; anaerobic wastewater treatment and biogas treatment; biomass power plants; and electrical grid management.

Glass Industry

Recommendation 18: Increase the percentage of cullet used in the manufacturing process, where possible. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the glass industry sector.

Recommendation 19: Consider pure oxygen boosting to increase furnace thermal efficiency. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the glass industry sector.

Recommendation 20: Consider onsite electricity generation options through waste heat recovery. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the glass industry sector.

Recommendation 21: Consider using electricity as a booster in glass melting, which can be more efficient than fuel fired furnaces. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit recommendations for the glass industry sector.

Recommendation 22: Work with the Government to try to establish a natural gas or LNG pipeline supply to the site to improve efficiency and lower carbon emissions. NB: Based on this recommendation, should it be implemented, the DOE aim to provide LNG in areas where manufacturing plants are concentrated.

Cement Industry

Recommendation 23: Prioritise energy efficiency despite the competing priorities to increase cement production. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the cement industry sector.

Recommendation 24: Encourage sector wide cooperation on energy efficiency initiatives.

Recommendation 25: Consider onsite electricity generation options through waste heat recovery where applicable. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the cement industry sector.

Commercial Buildings

Recommendation 26: The Philippine Government should 'lead by example' to set the commercial buildings energy efficiency standard that the private sector can follow.

Recommendation 27: Encourage development that focuses on multi-family high-rise buildings and the university sector.

Recommendation 28: Increase the use of ESCOs in the commercial building market by utilizing strong policy and private sector financing mechanisms where appropriate.

Recommendation 29: Promote building operation improvements, such as commissioning, in commercial facilities.

Recommendation 30: Develop a comprehensive Government based data collection/survey for commercial building energy consumption.

Recommendation 31: The Philippines Department of Energy should prepare a roadmap of all necessary steps to quickly implement building energy codes once the Enercon Bill becomes law.

Recommendation 32: Further promote District Cooling programs throughout the economy.

Recommendation 33: Research and pilot other less common, but energy saving, cooling technologies for hot, tropical climates.

Recommendation 34: Adopt Cool Roofs as a commercial building energy efficiency strategy.

BACKGROUND INFORMATION

The Philippine Government has contributed the background information contained in this report. This information provides some context to the recommendations made by the Follow-Up PREE Review Team. More detailed background information is contained in the 2012 Philippine PREE Report.

1. INTRODUCTION

1.1 TRENDS IN ENERGY SUPPLY

The Philippines has modest proven fossil fuel reserves of more than 100 million barrels of oil including condensate, 33.3 billion cubic metres of natural gas and 458 thousand tonnes of coal, mainly lignite [APERC 2013].

In 2012, the total primary energy supply was 42.09 million tonnes of oil equivalent (MTOE). This is 7.2 per cent higher than 2011 levels of 39.80 MTOE. Of that 42.90 MTOE, 26.39 MTOE or 62 per cent comes from fossil fuels. The remaining 16.51 MTOE comes from geothermal, hydro, biomass, biofuels, solar and wind energy sources. Geothermal energy supply was 8.81 MTOE in 2012 or just under 21 per cent of the total energy supply [DOE 2014] (Fig. 1).

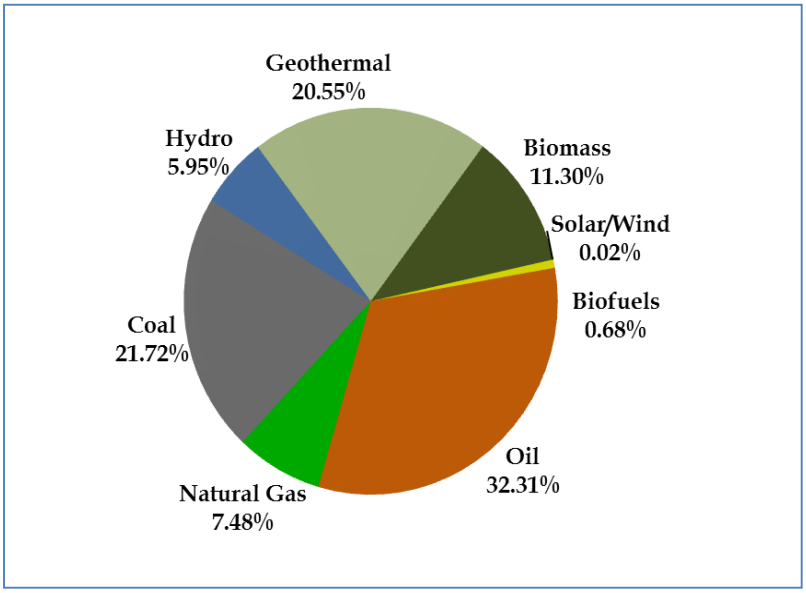


Figure 1 - 2012 Primary Energy Mix [DOE 2014].

Due to its modest proven fossil fuel reserves, the Philippines is dependent on imports and is susceptible to price shocks from volatility in world oil prices. While the Government is making efforts to increase its energy supply self-sufficiency, it has declined from 60 per cent in 2009 to 56 percent in 2012. Increased coal imports is the cited reason for the recent decline in energy supply self-sufficiency [DOE 2014].

1.2 TRENDS IN POWER GENERATION

Total power generation in 2012 reached 72,922 GWh. This is 5.14 per cent higher than 2011's level of 69,175 GWh. Of this, 39 per cent came from coal, 26 per cent from natural gas, 6 per cent from oil based, and the remaining per cent from renewables [DOE 2014] (Fig.2).

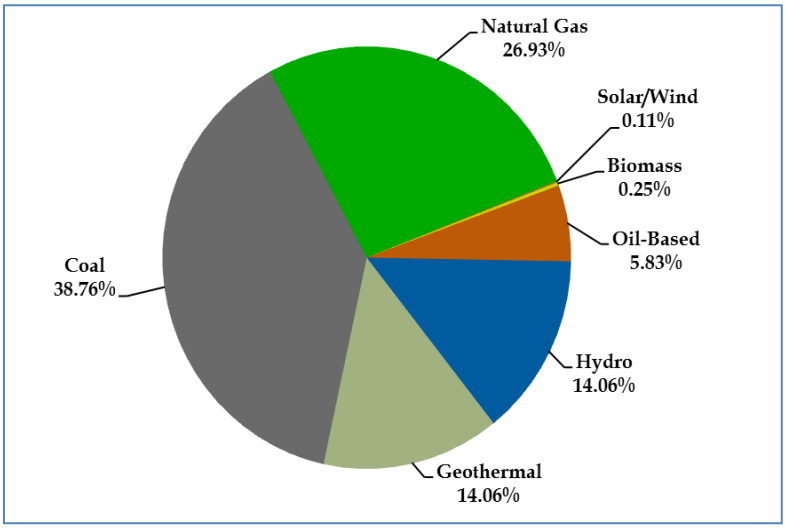


Figure 2 - 2012 Power Generation Mix [DOE 2014].

Electricity generation self-sufficency has also decreased from 65 per cent in 2009 to 59 per cent in 2012. This is attributed to increased coal and oil imports [DOE 2014]

1.3 TRENDS IN ENERGY CONSUMPTION

The total energy demand for the Philippines for 2012 was 23.3 MTOE [DOE 2014] (Fig.1). At 8.4 MTOE, the transport sector is the largest energy consuming sector in the Philippines. It will likely continue to absorb one-third of the economy's total final demand for some time. It is followed by the residential (6.0 MTOE), industrial (5.8 MTOE), and commercial sectors (2.8 MTOE) respectively [DOE 2014] (Fig 3).

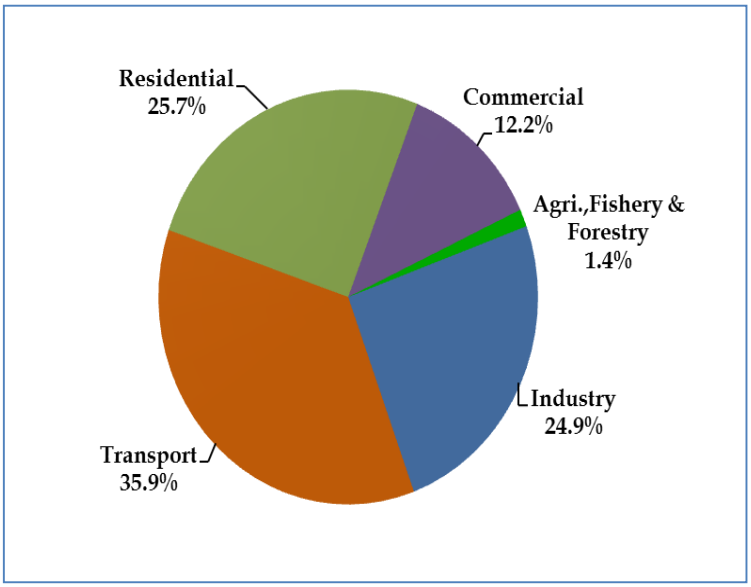


Figure 3 - 2012 Final Energy Demand by Sector [DOE 2014].

The industrial sector will have the highest growth in energy demand out of any sector. It is projected to grow a minimum of 5.2 per cent on average per year to 2030. It is followed by the commercial sector at 4 per cent average growth per year to 2030. Total energy demand is expected to grow at minimum of 3.5-3.6 per cent on average per year to 2030 (DOE, 2014).

It is unclear whether decreasing energy intensity over the last 10 years in the industry and commercial sectors is directly correlated with ongoing improvements in energy efficiency. Table 1 shows an analysis of energy intensity improvements in the industry and commercial sectors. Since 2000 the Philippines' economy has grown, meanwhile energy consumption has decreased. This has led to considerable improvements in final energy intensity.

Table 1: Energy Intensity Indicators - Gross Domestic Product (GDP) and Gross Value Added (GVA) by Sector [NSCB 2013]**, and Final Energy Consumption (FEC) by Sector** [DOE 2014] **in the Philippines 2000-2012.**

Indicators	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
GDP(BPh)	3,581	3,684	3,819	4,008	4,277	4,481	4,716	5,028	5,237	5,297	5,702	5,909	6,312
GVA: Industry(BPh)	1,234	1,246	1,282	1,336	1,406	1,465	1,533	1,621	1,699	1,667	1,860	1,893	2,023
GVA: Services*(BPh)	1,847	1,921	2,113	2,287	2,287	2,419	2,565	2,759	2,869	2,966	3,179	3,336	3,590
FEC: Total FED(KTOE)	23,532	23,472	23,416	23,692	23,826	23,219	22,589	23,350	23,166	23,526	24,522	24,964	25,539
FEC: Industry (KTOE)	4,830	4,807	4,611	5,148	5,085	5,302	5,400	5,640	6,171	5,778	6,364	5,949	5,808
FEC: Services*(KTOE)	1,685	1,852	1,867	1,940	1,869	1,853	1,927	1,988	2,044	2,413	2,664	2,741	2,832

*Services Sector includes Commercial Sector.

From 2008 energy intensity has decreased as shown in Figure 4. This could potentially be attributed to the Philippine Department of Energy's increased efforts to improve energy efficiency and conservation through the associated policies that are briefly outlined in the next section.

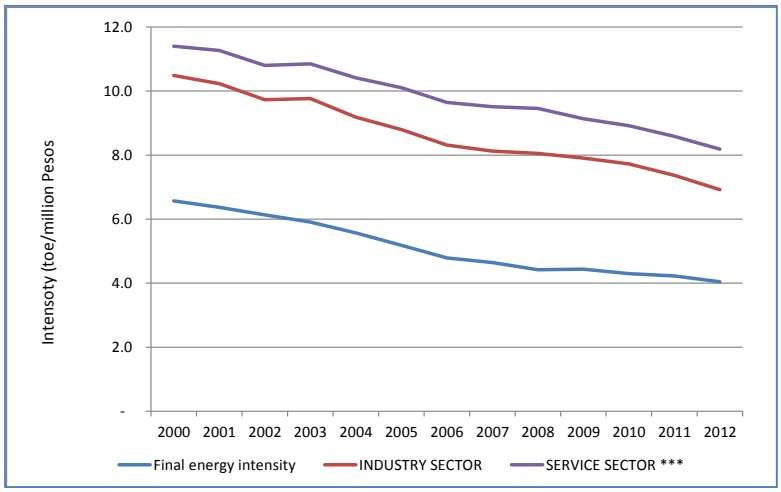


Figure 4– Energy Intensity from 2000-12 [DOE].

1.4 ENERGY EFFICIENCY INSTITUTIONS, POLICIES AND MAJOR PROGRAMS

For an understanding of energy efficiency institutions policies and major programs in the Philippines, please see the 2012 PREE Report available for download here: http://aperc.ieej.or.jp/publications/reports/pree.php.

FOLLOW-UP PREE REVIEW TEAM REPORT

This part of the Report presents the Follow-up PREE Review Team's conclusions and recommendation about energy efficiency in the sugar, glass, cement and commercial buildings sectors in the Philippines.

1. OVERARCHING FINDINGS

1.1 ACHIEVEMENTS AND CHALLENGES

The Philippine Government has made considerable progress with its energy efficiency programs and policies. In line with other APEC economies, it is working towards an ambitious goal of reducing energy intensity by 45 percent by 2035 (using 2005 as a baseline year).

Achievement 1: *Progress with the Energy Efficiency and Conservation Bill 2012.*

On 1 July 2013, the legislature filed the Energy Efficiency and Conservation Act of 2013 ('the Enercon Bill') at the 16th Congress of the Philippines as Senate Bill No. 167. Once enacted, the Bill will institutionalise energy efficiency and conservation, to enhance the efficient use of energy, granting incentives to energy efficiency and conservation projects and for other purposes. If passed it will be a huge milestone for energy efficiency improvement in the Philippines. If passed in its current form, amongst other things, it will require large energy users to:

- Employ an energy conservation officer;
- Prepare a periodic energy audit;
- Collect energy data;
- Monitor energy use; and
- Prepare a semi-annual periodic energy consumption report.

It is currently undergoing review *[Senate of the Philippines 2013].*

The Government should aim to implement the Energy Efficiency and Conservation Law fully. Noting, however, that it may take a few years to do so.

Achievement 2: *Enhanced average annual energy savings target.*

In the 2012 PREE Report, the Government had set a target for 3.46 MTOE in average annual energy savings from 2011 through to 2030. The new short-term target is to achieve 5.60 MTOE in average energy savings from 2013 to 2016 *[DOE, Progress on the Philippines' Energy Efficiency and Conservation Roadmap 2013]*. This will also translate to an annual average emissions reductions equivalent.

The enhanced average annual energy savings demonstrates the success of the Government's initiatives and energy using companies' energy efficient technologies and mechanisms to date.

Achievement 3: *Continued savings through the National Energy Efficiency and Conservation Program ('NEECP').*

The Energy Utilization Management Bureau (EUMB) DOE administers the NEECP. Several programs sit beneath the NEECP. They are:

- The information, education and communication campaign.
- Voluntary Agreements.
- Energy Standards and Labelling.
- The Government Energy Management Program.
- The Energy Management Program.
- The Philippine Energy Efficiency Project.

The NEECP has led to consistent savings. In 2013 the total saving were 4.64 MTOE, this is a 9 per cent increase from the total savings in 2012, which was a saving 4.22 MTOE. The savings have been relatively consistent since NEECPs implementation in 2010 *[DOE 2014]*.
The challenge will be to maintain the consistent aggregate annual savings.

Achievement 4: *Progress with the Philippine Industrial Energy Efficiency Project ('PIEEP') – implementing the ISO 50001 Energy Management System Framework along with System Optimisation approach for improvement of industrial energy efficiency in the Philippines.*

Most industries in the Philippines are already ISO certified (ISO 9001:2008) for quality management and safety. The PIEEP is a multilateral technical facility that reported in the 2012 PREE Report and that began in 2011. It is a cooperative project run by the Philippine Government, with assistance from the United Nations Industrial Development Organisation and the Global Environmental Fund. Stakeholders include industry employees, equipment vendors and suppliers, consultants, and Government entities, who are all involved in training workshops and plant assessments. Of note, the 'Project Training Program' offers training on energy management systems and systems optimisation for both specialised energy efficiency personal and more general training for factory personnel [DOE, The Philippine Industrial Energy Efficiency Project (PIEEP) 2014].

To date the PIEEP's targets and current accomplishments are:

- 19 trained individuals as local experts in the ISO 50001 Energy Management System. The target is 40 local experts by 2016;
- Completed the early stages of ongoing training to individuals as local experts on Systems Optimisation. The target is 40 local experts by 2016;
- More than 200 factories with awareness training on the Energy Management System. The target is 300 trained factories by 2016;
- Completed the early stages of implementing ISO 50001 in 40 factories. The target is 40 ISO 50001 factories by 2016;
- 300 factory personnel trained on Systems Optimisation. The target is 400 trained factory personnel by 2016;
- Completed the early stages of training 40 vendors in Systems Optimisations. The target is 40 trained vendors by 2016; and
- Completed the early stages of implementing 40 Systems Optimisation Projects. The target is 40 implemented projects by 2016 *[DOE, The Philippine Industrial Energy Efficiency Project (PIEEP) 2014]*.

The challenge will be to achieve the 2016 targets set by the PIEEP and to build on those targets into the future.

Achievement 5: *Continuation of the Don Emilio Abello Energy Efficiency Award.*

This award is an annual award given to companies that achieved significant energy savings through implementing energy efficiency and conservation technologies and measures. In 2012, 58 establishments and 27 energy managers received honours for their significant contribution to energy efficiency initiatives. The savings identified by the awards equate to 54.09 MTOE in energy savings and PHP 2.2 billion in monetary savings or just under USD 50,000.

It is an excellent platform for energy efficient industries and companies to receive recognition for their work on energy efficiency and encourages the private sector to further their efforts.

1.2 RECOMMENDATIONS

Recommendation 1: *The Government should work to pass the Energy Efficiency and Conservation Act.*

The Government is working hard to pass this bill. However, the sooner the legislature enacts the bill; the sooner the Act's provisions will come into effect, which will trigger significant improvements in energy efficiency across the Philippines.

Recommendation 2: *The Government energy efficiency targets are commendable however, constant revision will ensure that the Government is constantly striving to achieve optimal energy efficiency. Additionally, encouraging companies to set their own short term and long-term targets will encourage companies to adapt government goals to their own corporate agenda.*

Recommendation 3: *The Government should continue improve existing and add additional programs to their National Energy Efficiency and Conservation Program.*

The Government, and in particular the DOE, is the arm that guides energy consuming companies to conserve energy. Continued efforts to add additional programs and enhance existing programs will help to update the National Energy Efficiency and Conservation Program in light of the progress from recent years.

Recommendation 4: *Encourage faster adoption of the ISO 50001 Energy Management Framework, look into certification and implementation programs, and adopt a voluntary certification program.*

While the Philippine DOE is rolling out the ISO 50001 Energy Management Framework through the PIEEP, a voluntary certification system would extend beyond the global energy management standard, ISO 50001, by adding a verification component to ensure energy savings and quality management. Certification provides assurance that companies are continually improving on energy efficiency and can provide them with a roadmap to achieve ongoing energy improvements. Third-party independent verification has the added benefit of providing reliable data for company management and external stakeholder to use.

Example: The United States' DOE *Superior Energy Performance* ('SEP') Programme certifies industrial facilities that implement an energy management system that meets the best practice ISO 50001 global energy management standard and achieves improved energy performances. To achieve certification companies must conform to ISO 50001 and achieve energy performance improvement levels that correspond to the ANSI/MSE 50021 standard for SEP. Depending on their level of energy performance, certified facilities can earn a silver, gold or platinum designation. [US DOE 2013].

Recommendation 5: *Encourage energy intensive industries and commercial buildings to adopt best practice and benchmark against other plants globally.*

Adopting best practice can achieve significant improvements in energy efficiency. If the Philippines were to benchmark their industries and commercial buildings against other APEC economies, then it would not only increase the energy savings, but also the competitiveness of the industries against global competitors through decreased energy costs and increased competitive advantages from price, energy and climate conscious consumers. Providing benchmarking and best practice goals visibly to site personnel has the added benefit of providing them with a challenge, and a sense of pride when achieving a top ranking or global benchmark.

Example: The United States' DOE *Superior Energy Performance* ('SEP') has identified that implementing best practice to earn SEP certification can improve energy performance by more than 25 per cent from 6 per cent over three years. Additionally nine of the first 16 SEP accredited facilities saved, on average, more than USD 500,000 per year from operational improvements with little or no associated capital cost expenditure. Further, organisation with annual total energy costs of more than USD 3 million were typically able to recoup costs for adopting the SEP framework in less than one year [US DOE 2013].

Recommendation 6: *The Government should start programs for energy efficiency financing, low interest loans, tax incentives and fast track permitting to minimise the upfront cost of implementing energy efficiency projects in the industrial and commercial buildings sectors.*

One of the major barriers to energy efficiency improvement within the industrial and commercial sector is the upfront cost of energy efficient technology and projects. Many industries in the Philippines use second hand machinery and boilers, which results in decreased energy efficiency. This is because new and more efficient types of machinery are outside the budget of industries in the Philippines. Employing energy efficient technology will result in significant reductions in energy consumption and increased energy efficiency.

The Philippine Government can use several financing strategies to incentivise the uptake of energy efficient technologies. These include:

- An energy efficiency fund or grant for programs or technology;
- Energy efficiency investment program for low interest loans; and
- Tax incentives and breaks.

To further encourage energy efficient technology, buildings and developments, the Government should offer a fast track permit system for any building or industrial developments that include energy efficient design and technologies. This will cut planning costs and time for developers, and encourage the uptake of energy conservation.

Example: In 2003 the Royal Thai Government established Thailand's Energy Efficiency Revolving Fund to provide financing for energy efficiency projects and to help commercial banks develop streamlined procedures for project appraisals and loan disbursements. The fund provides capital to Thai banks to fund energy efficiency projects, and the banks provide low interest loans to the energy efficiency projects in the industrial and commercial buildings sectors. The fund underwent five phases of funding, and the fifth phase ended in 2013. The fund will not receive further government funding for new projects for a sixth phase as the participating banks are now investing their own capital in energy efficiency projects as they saw returns on investment over the prior five stages[Frankfurt School - UNEP Collaborating Centre for Climate & Sustainable Energy Finance 2012].

Recommendation 7: *The Government should continue to work to improve and stabilise energy supply both through expanding and strengthening power generation capacity and the power grid system, and through introducing alternative energy sources. This could include natural gas for the industrial sector.*

The Government's Energy Reform Agenda on Energy Security Measures is working to address energy supply stabilisation, however this report notes that continued effort is required.

While energy efficiency should be a primary concern for the industrial and commercial buildings sectors, a stabilised power supply will help them to maintain their energy efficiency programs instead of using costly and inefficient back-up diesel generators, which detract from gains in energy efficiency.

If LNG pricing is rationalised and/or the ASEAN Gas Pipeline connects to the Philippines, then natural gas will be a very attractive source of energy for industry (see Recommendation 22).

The secondary benefit of natural gas, LNG pipeline supply and geothermal heat pumps is that they not only improve efficiency but also lowers carbon emissions.

Recommendation 8: *The Government and sub-sector organisations such as the Cement Manufacturers Association of the Philippines (CeMAP) and the Philippines Sugar Millers Association should coordinate a large energy users' forum where industry can share best practice, and technological developments. Use the forum as a platform for the Don Emilio Abello Energy Efficiency Award.*

The benefit of a large energy users' forum is that it can bring together industry and commercial personnel to network, share knowledge and expertise around energy use. It is an environment where there is usually no commercial conflict as participants are from various sub-sectors, but they use cross-purpose technologies that can translate to other sectors.

It would help sub-sector organisations such as CeMAP to make the industry more efficient for the sector and provide a forum for them to lobby their sub-sector's interests to the government. It would in turn help the industry organisations to prioritise energy efficiency within the industry organisation.

The Philippine DOE can then share any successful energy efficiency programs, technologies or methodologies through fact sheets and case studies. Site visits of highly efficient plants can occur to demonstrate the programs, technologies or methodologies covered by the fact sheets and show them in action.

For the Government, it is an environment where it could award the Don Emilio Abello Energy Efficiency Award. The award would then receive maximum impact for promoting the high achievers on energy efficiency, as it would be after a forum that demonstrates not only why energy efficient practices are important but how they can implement them too.

Recommendation 9: *Companies should promote energy efficiency on-site through posters and signage, in a similar way that they promote maintenance and safety in industrial facilities.*

During the site visits to the cement, glass, sugar and commercial building sites, the experts noted the large amount of signage throughout the sites emphasising health and safety. While this was commendable, only one of the sites visited had comparable signs emphasising energy efficiency.

It is important that like health and safety, energy efficiency is also visible to all personnel on industrial and commercial building personnel on-site. Further, participation from all levels of staff is crucial from CEO level and executive committee, to plant managers to workers and even front-end contractors. To ensure that the front-end staff understand the significance of energy efficiency their company, information, through signs, workshops and fact sheets should be prevalent to maintain awareness of energy conservation. These mediums should be in Tagalog and English, as while English literacy is high in the Philippines, many seasonal or local employees may only read or understand Tagalog fluently to a technical level.

2. SUGAR INDUSTRY

2.1 ACHIEVEMENTS AND CHALLENGES

In 2014, sugarcane production was the largest agricultural product in the Philippines. It accounted for 32 million tons in 2012 or USD 927 million [FAO Stat 2014]. The Philippines is the eighth largest sugar cane producer in the world, the second largest among ASEAN countries, and the fourth largest APEC economy after China, Thailand and Mexico respectively [FAO Stat 2014]. It is one of the most energy intensive processes in the food and chemical industry.

On average, sugar cane production is around 31.2 million tons per year (Fig. 2.1). The production rate fluctuates slightly depending on climate conditions. The total sugar cane plantation area is about 422,384 ha with the average production yield is about 58 ton cane/ha [SRA 2014]. The area of 90 per cent of the farms is about 10 hectares or below [SRA 2014]. Half of the total sugar cane grows on Negros Island and the harvest season is between October and May.

It is one of the major industries in the Philippines. The average sugar and refined sugar production are about 2.2 and 1 million tons per year respectively (fig 2.1). The Sugar Regulatory Administration of the Philippines reported that the yield of sugar production is about 1.99 Lkg/ton_{cane} (99.5 kg_{sugar}/ton_{cane}) [PSMA 2014]. There are 28 raw sugar mills with the total capacity of 202,500 ton_{cane}/day, and 14 sugar refineries with the total capacity of 8,000 ton/day [PSMA 2014].

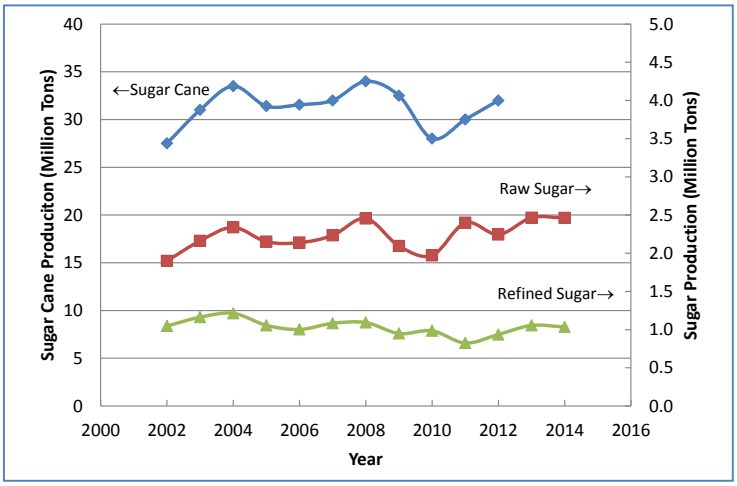


Figure 2.1 Sugar Cane and Sugar Production.
Plotted from FAO Data, 2014 (Sugar Cane) and PSMA, 2014 (Sugar).

Achievement 6: *One of the most economical agricultural products in the Philippines as it produces many products and utilises almost all waste from the process.*

With current technology, various types of products come from sugar cane including syrup, sugar, molasses, ethanol, and electricity, as shown in Figure 2.2. This makes sugar cane one of the most economical agricultural products in the world. Almost all waste from the process can be utilized e.g. bagasse can be used as a fuel for boiler, wastewater can be treated by anaerobic system producing biogas, and molasses can be used for ethanol production. There is potential to promote the use of bio-ethanol as a renewable energy sources because it can be made from several agricultural products including sugar syrup and molasses.

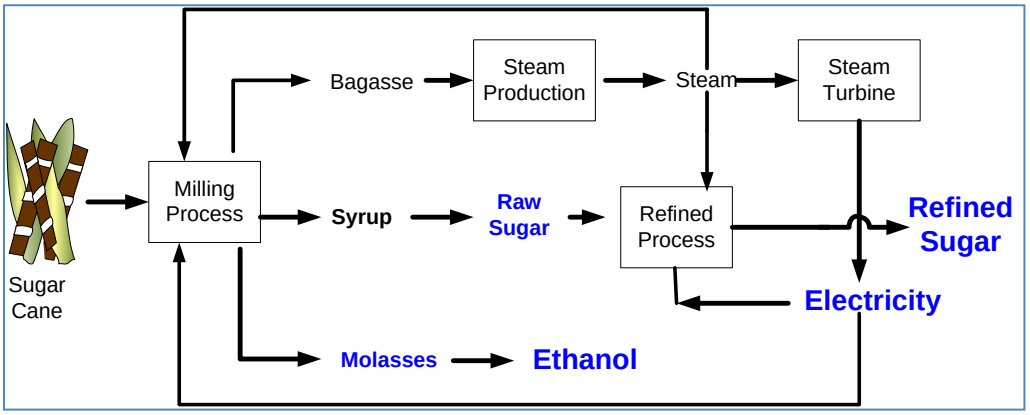


Figure 2.2 Sugar and Sugar Cane Products.

However, a challenge is to ensure that energy intensity stabilises or reduces for energy consumption in the sector.

According to the Philippines Department of Energy (DOE, 2014c), the average specific energy consumption (SEC) for raw sugar and refined sugar production between 2005 and 2009 were about 678 and 262 LOE/ton$_{sugar}$, respectively.

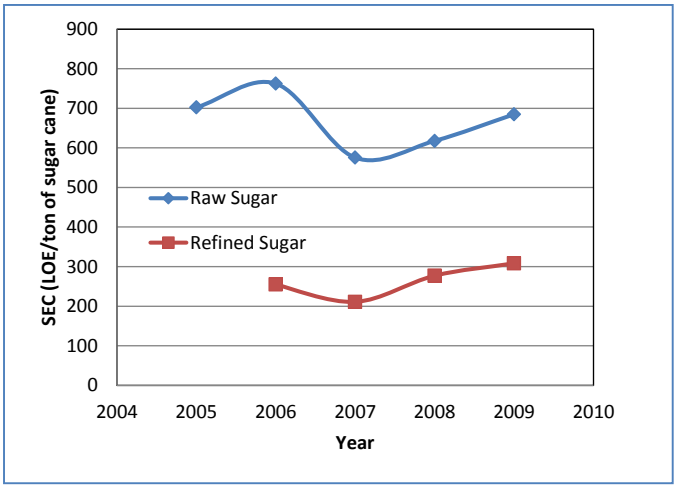


Figure 2.3 Specific Energy Consumption for Sugar Industry [DOE 2014]**.**

Achievement 7: *The use of biomass in sugar production.*

The 2012-2030 Philippines Energy Plan aims for total renewable energy capacity to be at about 8,902 MW by 2030. The DOE announced this plan in 2011 when the renewable energy consumption was about 16.15MTOE and accounted for 41 per cent of the primary energy consumption as shown in Figure 2.4.

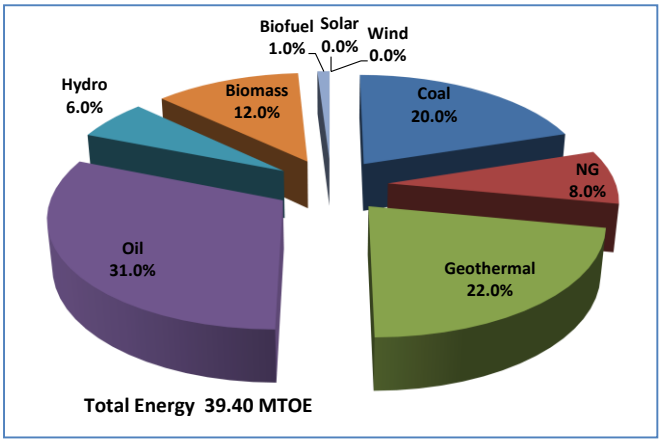


Figure 2.4 Primary Energy Mix in 2011[DOE 2014].

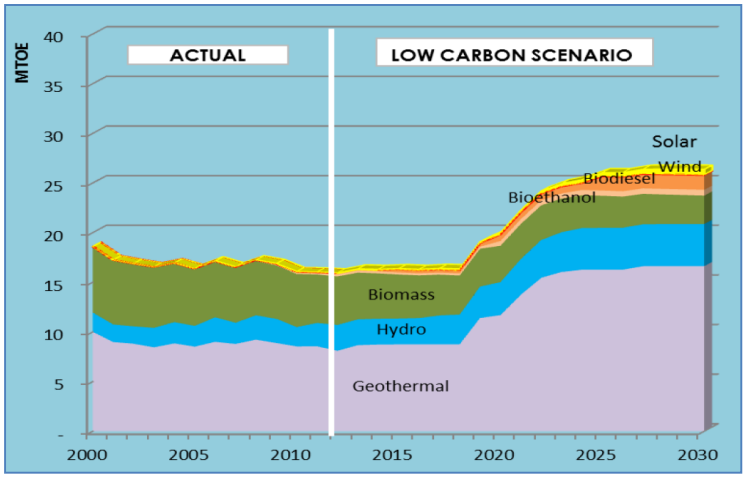


Figure 2.5 Renewable Energy Outlook [DOE 2014].

In 2011, the share of biomass in primary energy utilization was about 12 per cent and accounted for 52.7 MTOE, as shown in Figure 2.4. The Philippines Energy Outlook forecasted that, the biomass share of total renewable energy sources will be about81 MW [DOE 2014]. Figure 2. Most biomass systems were developed during 2011 – 2015, as shown in Figure 2.5 and Table 2.1. Bagasse from sugarcane plants is one of the main sources for biomass.

Table 2.1 Potential Renewable Resources in the Philippines in 2011 – 2030 [DOE 2014]

Sector	Potential Renewable Resource (MW)			
	2012 - 2015	**2016 - 2020**	**2021 - 2030**	**Total**
Geothermal	50	940	175	1165
Hydropower	310	3125	1892	5327
Biomass	**81**	-	-	**81**
Wind	678	865	432	1975
Solar	269	5	10	284
Ocean		36	35	71
Total	1388	4971	2544	8903

Achievement 8: *More energy efficient sugar refining plants (i.e. award winning) generally, continue to improve the sugar refining process to reduce energy consumption and operate efficiently compared with other countries.*

Case Study: The experts toured one energy efficiency award winning sugar refining plant in the Philippines. The plant produces both raw sugar and refined sugar; it has been in operation for many decades. The raw sugar and refined sugar production capacities are about 1,400 tons per day and 900 tons per day respectively. The factory produces about 20 per cent of the sugar within the Philippines' sugar market. The sugar cane comes from nearby farms that have an approximate area of about 33,000 ha. About 35 – 40 per cent of the sugar cane supplied is burnt cane.

This particular plant has made continuous energy efficiency improvements and has received several Don Emilio Abello Energy Efficiency Awards in recognition for its efforts.

Table 2.2 shows the yield and energy consumption for sugar production. The raw sugar yield is about 0.11 $ton_{raw\ sugar}/ton_{cane}$. Bagasse is utilised as fuel for the boilers. The milling process and the electricity generators then use the steam generated from the boiler. The generated electricity drives any electrical equipment in the plant. This generated electricity is, however, not enough for the process. Therefore, the plant must buy some electricity from the grid. The thermal energy and electricity consumption are about 240 $kWh/ton_{raw\ sugar}$ and 16 kWh/ton_{cane}, respectively. These numbers show that the plant operates efficiently compared with thermal energy and electricity consumptions of plants in other countries.

Table 2.2 Yield and Energy Consumption for Sugar Processes[#] [PDTI 2011][*][UNICA 2007].

	Unit	Philippine Case Study	Thailand[#]	Brazil*
Sugar Cane Productivity	ton_{cane}/Ha	70	63	~85
Yield	$ton_{raw\ sugar}/ton_{cane}$	0.11	0.08 – 0.10	0.14 (incl. Ethanol and sugar)
Thermal Energy	$ton_{steam}/ton_{raw\ sugar}$	4.8 (~30 bar)	3.7 – 7 (~30 bar)	
	$kWh/ton_{raw\ sugar}$	240	200 - 350	330
Electricity	kWh/ton_{cane}	16.08	16-27	12

A challenge will be to update plants with currently available and more efficient technology; for example, steam driven motors could be replaced by electric motors. By using the more efficient steam driven electric generator, the energy in the bagasse can be utilised more efficiently. This however will require a high degree of investment (see Recommendation 6 above).

2.2 RECOMMENDATIONS

Recommendation 10: *Improve sugar cane crop quality to increase sugar production yield. Sugar cane quality directly correlates with sugar cane production; the higher the quality, the higher the sugar production yield. Cooperation with the Department of Agriculture is necessary to achieve this recommendation, which has a mandate to help improve the quality of the sugar cane crop.*

Recommendation 11: *Sugar cane farmers should supply unburnt sugar cane to sugar refineries, which will require changes to the agreements between the Farmers' Cooperative and the Sugar Milling Plant.*

Sugar concentration is greater in fresh sugar cane compared with burnt sugar cane. Moreover, the sucrose structure in the burnt sugar cane is denatured into dextran, a kind of non-crystalized sugar, which is a product of bacteria breaking down the sucrose. Both of which lowers the sugar production rate. In many cases, sugar refineries in the Philippines use burnt sugar cane.

Sugar cane leaf mass is usually about 20 per cent of the total sugar cane mass. Therefore, the leaves have significant heating value at about 17 MJ/kg, which is higher than the energy obtained from an equivalent amount of bagasse [DEDE 2014]. However, any application to an individual sugar refinery would require an assessment of additional transport costs that may occur from transporting an extra 20 per cent of mass.

Recommendation 12: *Improve the refining process by processing the sugar directly after the sugar crystalizes, without producing raw sugar, as illustrated in Figure 2.5 and compared with Figure 2.2. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.*

Due to the short sugar cane growing and harvesting season (November-May), many refineries utilise all resources for producing raw sugar first and only undertake the refining process later. However, this increases energy consumption through the drying process.

Through good production planning and some process modification, many plants are able to avoid the drying process required to recreate raw sugar, and avoid the raw sugar stage altogether (Fig. 2.5).

Extending the harvest period would facilitate this process, however extending the harvest period in turn requires research and development and plantation planning (see Recommendation 16).

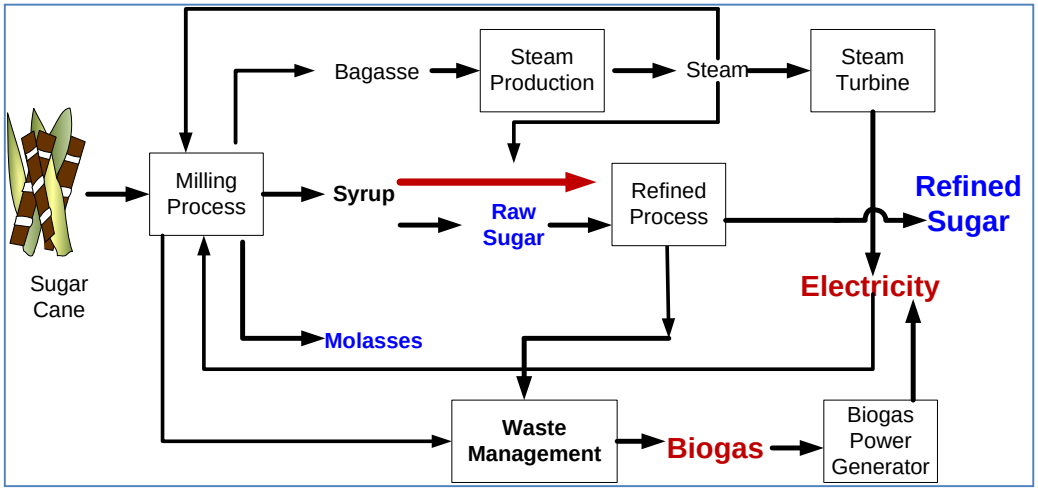


Figure 2.5 Sugar Refining Process Improvement

Recommendation 13: *Improve the refining process by using anaerobic treated wastewater from the plant to produce biogas that can be used as fuel for the thermal process or generating electricity via an internal combustion energy. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.*

Recommendation 14: *Improve the refining process in the long term by applying a new separation technology and process thermal integration technology that can significantly reduce energy consumption within the sugar industry. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.*

Based on this recommendation, the DOE will include it in the DOE's future energy audit recommendations for the sugar industry sector.

Example: Nanofiltration with reverse osmosis is a technique that uses reverse osmosis to drive filtration through the sugarcane membrane to extract remaining sugar syrup of about two nanometres or larger [Madaeni , Zereshki 2010] [Mirza 2008]. This technology concentrates the thin juice instead of using the conventional evaporation process. Madaeni reported that a two-stage reverse osmosis system for syrup pre-concentration (from 15° to 20°) could save the energy consumption about 33 per cent. The cost of membrane technology including reverse osmosis and nanofiltration is now a lot lower, thus the Philippines should consider this technology for Philippine sugar plants in the future [Madaeni , Zereshki 2010].

Recommendation 15: *Improve fuel management to enable more efficient steam generator use. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit recommendations for the sugar industry sector.*

Steam generators are more efficient when operated year round. However, during the non-crop season, bagasse is not available as fuel for the steam generator. This presents a major challenge for efficient steam generator use.

One way to resolve that is to adopt techniques that preserves bagasse, so that plants use it in the non-cane season. Another is to improve bagasse quality by reducing the moisture in the bagasse. One way

to do this, is to dry the bagasse using the flue gas from the boiler. However, drying bagasse is expensive and is not widely adopted. Further research and develop could yield improvements in this area.

As noted in Recommendation 10, biomass from sugar cane includes bagasse and leaves, which accounts for 6 per cent and 20 per cent of the cane respectively. If farmers do not burn the sugarcane, then the leaves are a potentially valuable biomass fuel sources.

A secondary benefit is the potential to use bagasse as a renewable energy source. Figure 2.6 shows the estimated electricity generation of a bagasse power plant. The graph makes the following assumptions that:

(1) The raw sugar production information is from the Philippine Sugar Millers Association (PSMA, 2014);

(2) The yield of the sugar production from the sugar cane supplied to the factory is 10 per cent;

(3) The bagasse heating value is 6,886 kJ/kg (Sugar Engineers, 2014, at 50 per cent moisture content); and

(4) The electricity generation efficiency is 25 per cent.

It assumes that the factory uses 70 per cent of the total electricity generation internally and the rest sold to the grid. The potential electricity generated is about 167 kWh/ton$_{cane}$. With the current sugar cane production rate (2.1 million tons/year), if all factories equipped with the steam generator, then the electricity generated and supplied from bagasse to the grid would be at a rate of about 1,000 GWh/year, as shown in Figure 2.6. With such a large amount of energy produced for the grid, ESCOs and Government grid management officials would be key stakeholders in any developments for a bagasse power plant.

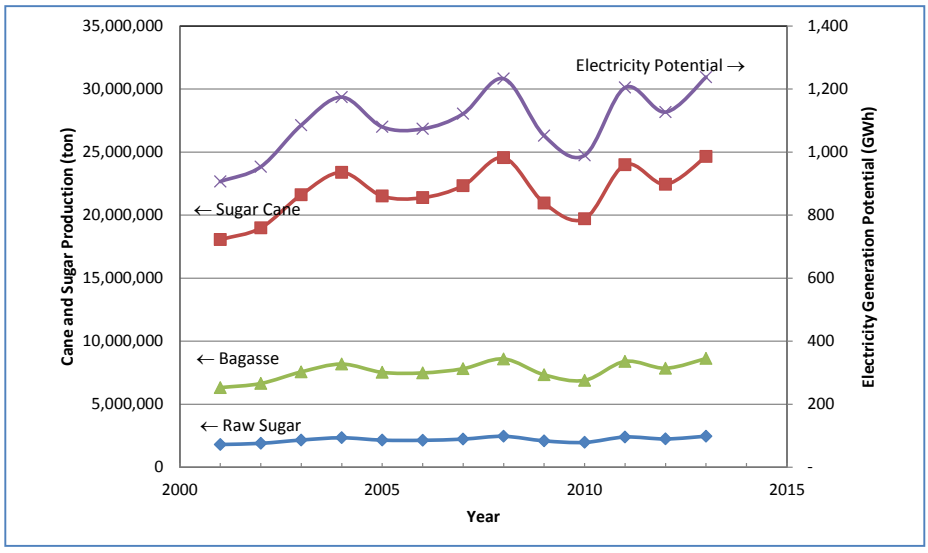


Figure 2.6 Estimated Electricity Generation by Bagasse Power Plant

Recommendation 16: *Reduce sugar cane burning by using sugar cane harvesting machinery to not only improve the quality of the sugar cane, leading to higher sugar production yields, but also allowing for leaves to be used as a biomass fuel source. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the sugar industry sector.*

Recommendation 17: *Increase research and development in the sugar industry. Research areas should include sugar cane cultivation and harvesting; process improvement, heat integration technique, energy efficiency in sugar processing; biomass and bagasse management; anaerobic*

wastewater treatment and biogas treatment; biomass power plants; and electrical grid management.

3. GLASS INDUSTRY

3.1 ACHIEVEMENTS AND CHALLENGES

Glass manufacturing involves six basic steps: raw material selection; batch preparation (weighing and mixing raw materials); melting and refining; conditioning; forming; and post-processing (annealing, tempering, polishing and coating). Figure 3.1 visually represents the process.

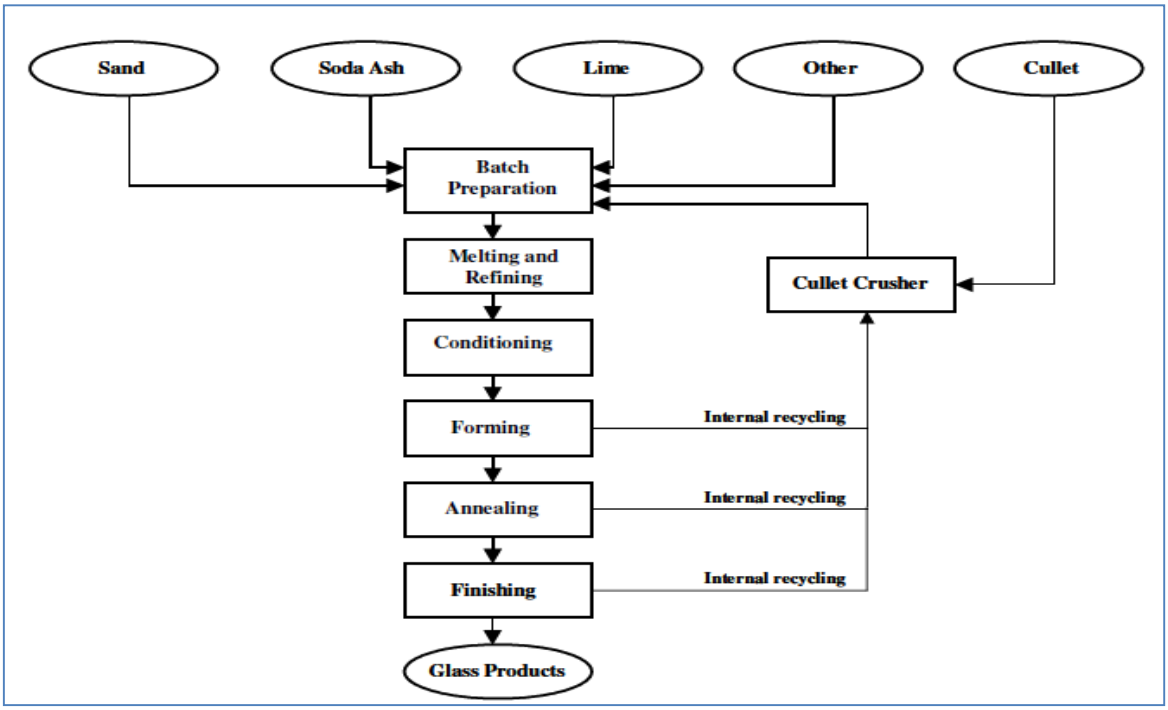


Figure 3.1 Simplified process schematic of glass manufacturing process

The glass manufacturing industry is an energy intensive industry that has received a lot of focus in other APEC economies regarding energy efficiency improvements. There are four sub-sectors within the glass manufacturing industry. They are container, flat, specialty and fiberglass.

The major challenge for the industry is its energy intensity. Approximately 50 per cent of the cost of producing glass in the Philippines is energy, this is compared with 15 per cent in the US [AGC 2014] [Almeida 2012]. Additionally, the fuel required for the furnace makes up 75 per cent of that energy cost in the Philippines [AGC 2014].

Achievement 9: *High level of staff involvement. Due to the potentially dangerous and highly energy intensive nature of the glass manufacturing industry, staff are made aware of the need for team work, and adhering to quality and safety standards within plants.*

Achievement 10: *High level of executive committee commitment.*

The executive committee have a vested interest in increasing the energy efficiency of plants due to the highly energy intensive nature of the industry. There is high potential to reduce overheads through energy efficiency improvements and so they have a strong focus on key inputs of the manufacturing process.

Achievement 11: *The visited site had demonstrated energy savings, for example upgrading lights from metal halides to LEDs.*

The experts visited an energy efficiency award winning glass manufacturing plant in the Philippines. The site had implemented a range of energy efficiency initiatives from lighting replacement, to installing inverters for the pumps, fans and compressed air. All together, the initiatives have led to a 3 per cent saving in bunker fuel oil and 10 per cent saving in electricity.

Achievement 12: *Good data tracking and reporting.*

The glass manufacturing plant that the experts visited had established systems for tracking energy use and reporting it that includes investment costs, accumulated savings and projected returns on investment.

Achievement 13: *Plans for improving and maintaining energy efficiency.*

The site visit at the glass manufacturing plant demonstrated the plant's clear vision for improving the facility's energy efficiency and maintaining the plant. For example, the new design furnace is more than half way into the 9 years its 15 year refractory life, however management is continually exploring opportunities to optimise furnace efficiency.

3.2 RECOMMENDATIONS

Recommendation 18: *Increase the percentage of cullet used in the manufacturing process, where possible. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the glass industry sector.*

Cullet is recycled glass added to the raw material batch. It is one of the most promising technologies available to improve energy efficiency. It involves dissolving the cullet into the molten batch, to both aid the melting process and reduce fuel and oxygen consumption by up to 26 per cent in oxyfuel furnaces [EIA 2000].

However there are limitations to the amount of cullet used depending on the type of glass being made and the process also involves crushing, cleaning, sorting and transporting the cullet [Almeida 2012].

Recommendation 19: *Consider pure oxygen boosting to increase furnace thermal efficiency. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the glass industry sector.*

Pure oxygen boosting can boost energy efficiency by 10 per cent. Furnaces that are nearing the end of their lifespan can have problems with regenerator plugging or collapse. Damage to the regenerator can lead to increased furnace pressure, and therefore exacerbated furnace pressure. By using oxygen boosting, the furnace pressure decreases to a more efficient operating rate [The BOC Group 2004].

Recommendation 20: *Consider onsite electricity generation options through waste heat recovery. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the glass industry sector.*

There is a considerable amount of waste heat from furnaces that could be used for electricity generation through emerging technologies such as Organic Rankine Cycle ('ORC') plants. Up to 50 per cent of the furnace heat is usually wasted. Organic refrigerant hydrocarbon fluid can capture the low-grade heat and convert it into electricity.

Recommendation 21: *Consider using electricity as a booster in glass melting, which can be more efficient than fuel fired furnaces. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit recommendations for the glass industry sector.*

The electricity generates heat, which is held within the molten glass and thus the furnace can operate at a lower temperature. The main drawback to consider is the cost of the electricity supply, which can be prohibitive in some economies. There are many advantages and disadvantages when considering whether to employ electric glass melters, however the main benefit is energy efficiency improvement and lowered GHG emissions [Sevast'yanov 1994].

Recommendation 22: *Work with the Government to try to establish a natural gas or LNG pipeline supply to the site to improve efficiency and lower carbon emissions. NB: Based on this recommendation, should it be implemented, the DOE aim to provide LNG in areas where manufacturing plants are concentrated.*

Natural gas is a suggested way of stabilising the electricity supply and adopting alternative energy sources. If LNG pricing is rationalised and/or the ASEAN Gas Pipeline connects to the Philippines, then the glass manufacturing industry is a key sub-sector that would benefit from a gas or LNG supply to improve energy efficiency.

Example: In the United States, the main source of fuel for glass manufacturing is natural gas, dominating 73 per cent of the overall fuel use. In 2010 US glass manufacturing facilities use 146 trillion Btu of natural gas [EIA 2013]. Fuel costs in the US will likely further decrease as the shale gas revolution in the states comes on line.

4. CEMENT INDUSTRY

4.1 ACHIEVEMENTS AND CHALLENGES

Three industrial processes are involved in the cement manufacturing process, illustrated in Figure 4.1. A large amount of energy is required at all stages of cement manufacturing.

The first process is grinding the raw material in the crusher. Usually the raw material is a combination of limestone, clay, silica and other minerals. It is crushed and ground into a fine powder called raw meal or mix.

The second process is clinker burning. The raw meal is heated in a preheater and then in a rotary kiln up to about 1,450 degrees centigrade to form an artificial mineral called clinker.

The third process is cement grinding. The clinker is ground and a certain percentage of gypsum is added into the finish mill to make cement.

Given the energy intensity of the cement manufacturing process, many cement manufacturers have sought to implement energy savings wherever possible.

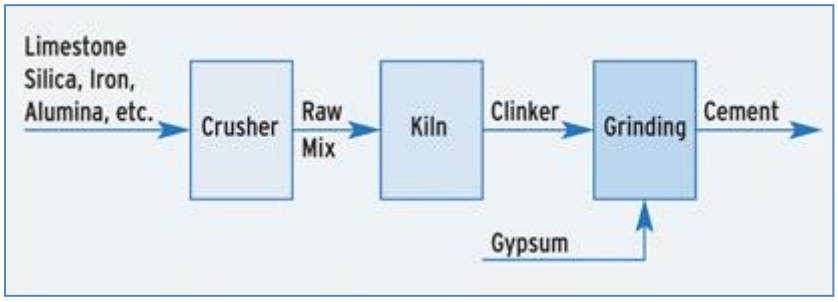


Figure 4.1 Cement Manufacturing Process [NRC 2008]**.**

Achievement 14: *High level of executive committee commitment.*

The executive committee have a vested interest in increasing the energy efficiency of plants due to the highly energy intensive nature of the industry. There is high potential to reduce overheads through energy efficiency improvements and so they have a strong focus on key inputs of the manufacturing process.

At the plant studied by the experts, the Plant Manager, who provides strategic direction to encourage energy efficiency regardless of the market situation, leads the management team.

Achievement 15: *High level of cooperation among the plant's teams.*

Due to the potentially dangerous (operating heavy machinery etc.) and highly energy intensive nature of the cement manufacturing industry, staff are then aware of the need for teamwork, and adhering to quality and safety standards within plants.

The plant the experts saw demonstrated a clear cross-sectional approach to cooperation between employees. Instead of defined silos, employees were encouraged to work together.

Achievement 16: *Visible signage promoting and encouraging energy efficiency and making energy efficiency data available to all staff.*

The energy efficiency award winning plant that the experts visited made energy efficiency highly visible by displaying signage throughout the plant. Each section had access to their energy savings and had signs displaying achievements, encouragement or ways to conserve energy.

Achievement 17: *The cement industry has made steady improvements to conserve energy.*

Overall energy conservation in the cement industry in the Philippines is improving year by year.

Achievement 18: *Demonstrated use of alternative fuel sources and admixtures.*

The energy efficiency award winning plant that the experts visited used agricultural biomass, rice husk and municipal waste as alternative fuels sources and admixtures. Luzon Island's rice producing industry supplies the rice husk, and the municipal waste comes from metro Manila.

Flyash is also added to reduce energy consumption per ton of cement.

4.2 RECOMMENDATIONS

Recommendation 23: *Prioritise energy efficiency despite the competing priorities to increase cement production. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the cement industry sector.*

Cement is in high demand in the Philippines due to the high levels of construction and development. This can have the unfortunate effect of making maximum production the first priority over energy conservation.

Recommendation 24: *Encourage sector wide cooperation on energy efficiency initiatives.*

In the Philippines, cement manufacturers can be reluctant to share their energy efficiency achievements for fear of losing competitive advantage. Recommendation 7 suggests one way to improve sector wide cooperation by establishing a multi-industry large energy users' forum. The forum can also enable sector groups to share more confidential information on behalf of individual cement manufacturers.

Recommendation 25: *Consider onsite electricity generation options through waste heat recovery where applicable. NB: Based on this recommendation, the DOE will include it in the DOE's future energy audit material measures for the cement industry sector.*

There is a considerable amount of waste heat from furnaces that could be used for electricity generation through emerging technologies. Some plants in the Philippines have already implemented waste heat recovery technology and there are multiple methods for doing so including steam rankine cycle, organic rankine cycle and the Kalina cycle [EB 2014]. The technology has a typical payback of 3 to 4 years.

5. COMMERCIAL BUILDINGS

5.1 ACHIEVEMENTS AND CHALLENGES

The population of the Greater Metropolitan Manila Area ('GMMA') grows at approximately 2 per cent per year as more and more citizens moved from the rural areas to the urbanized GMMA. With the Philippines population close to exceeding 100 million, the GMMA contains a quarter of the population or about 25 million. Coupled with the foreseeable growth, the infrastructure needed to meet the building demand is significant. In addition, future energy demand is projected to spiral upwards; already the President of the Philippines has sought approval from Congress to purchase additional electric supply from private establishments as a severe shortage of electricity is predicted for the summer of 2015 [WSJ 2014]. Considering the already high cost of electricity in the Philippines (among the highest in Asia) [WSJ 2014], the additional cost of the purchased electricity will drive that even higher.

Therefore, in order to mitigate the need to purchase high priced electricity and avoid brown- or black-outs next year and into the future, the Government of the Philippines, among other actions, must implement a multi-faceted building energy efficiency program to reduce the energy (electricity) consumption in the commercial buildings sector.

Over the years, the Government of the Philippines has initiated a number of energy efficiency and conservation programs in the commercial and residential buildings sector. One good measure to see those achievements in the proper light is to compare what the DOE has accomplished since the 2012 PREE Report. Although the 2012 PREE Report set strong efficiency targets, it did recognize that while the economy desires to dampen the demand for energy, it is clear that that there will be an increasing demand in all sectors due to the strong GDP growth. In fact, a government edict set forth a goal for continuous growth in GDP of greater than 3.6 per cent per year to ensure the economic well-being of the Philippines economy.

Achievement 19: *Continued application of the Government Energy Management Program (GEMP).*

The Government is continuing to apply Administrative Order No 110, which directs government buildings to reduce their monthly consumption of electricity in kilowatt-hours and petroleum products in litres by at least 10 per cent. The savings from September 2005 to March 2013 are equivalent to USD 46.4 million. This represents a significant achievement for the commercial buildings sector *[DOE, Progress on the Philippines' Energy Efficiency and Conservation Roadmap 2013]*.

Achievement 20: *Decreasing energy intensity in the commercial buildings sector.*

The Philippines has exceeded its GDP growth target since 2012 as shown in Figure 5.1.

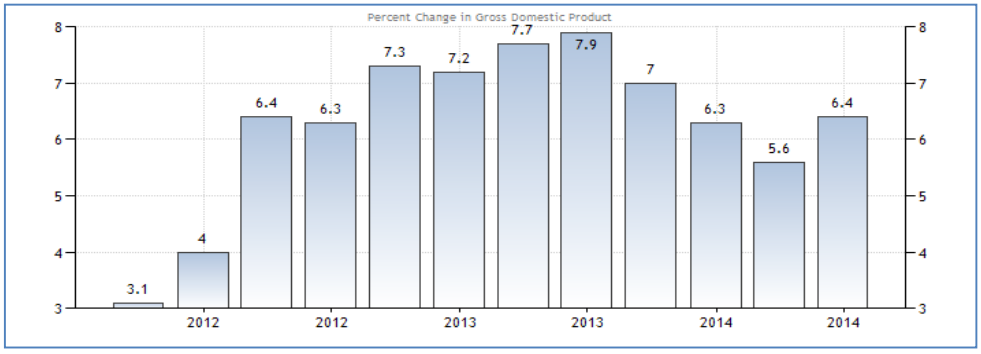


Figure 5.1 Philippines Annual GDP Growth Rate from 2012 to 2014[Trading Economics 2014]

Meanwhile, its energy consumption growth in the commercial buildings sector (of 4 per cent per year) is less than its GDP growth, so the economy's energy productivity is increasing (or in other words, its energy intensity is decreasing). This is a sign of an economy whose energy efficiency programs are having a positive effect across the economy.

This is a marked improvement since the 2012 PREE Report.

Achievement 21: *Meeting the Goal 1 target of 10 million CFL replacements – to date 8.6 million have been replaced as reported in the 2012 PREE Report.*

The 2012 PREE Report commended the Philippine Government for its planed initiative to install CFLS. The Government is now close to meeting this target.

This is important from the energy efficiency perspective as high efficiency lighting (CFL or LED) reduces lighting energy consumption by 70 per cent.

Additionally, high efficiency lighting also reduces the heat load in the buildings, thereby reducing the air-conditioning load. More importantly, since lighting in Asian economies comprise an average of 19 per cent of a building's energy demand – lighting retrofits in buildings can result in a significant reduction in a building's overall energy consumption.

Achievement 22: *Utilising Energy Service Companies (ESCOs) more fully in the Government building retrofit program and establishing and expanding the Accreditation Registry of ESCOS.*

The Goal 3 Target from the 2012 PREE Report was for the Government to promote and strengthen ESCOs and establish and expand the Accreditation Registry of ESCOs and to utilise them fully in the government building retrofit program.

The Philippines has seen achievements in both of these areas.

The Philippine DOE successfully launched a registry of Accredited Energy Service Companies under Departmental Circular–DC-2008-09-20004. The accreditation intends to promote ESCOs as an emerging business industry in the local market, creating more jobs that will help contribute in the Philippines' economic development and poverty alleviation, and accelerate the implementation of the Government's energy efficiency and conservation initiatives.

There are currently 13 accredited ESCO companies that are fully active and participating in various projects throughout the economy. Table 5.1 lists these companies:

Table 5.1: Accredited ESCOs in the Philippines[DOE 2014]

Cofely Philippines	Design Science, Inc. - Powerboss
Electro-Systems Industries Corporation	Energy and Aviation Support Corporation
Filairco, Inc/TRANE Philippines	Hi-Cool Engineering Corporation
Meralco Energy Inc	MVCP Engineering Corporation
OSP-Esco International, Inc	PhilCarbon, Inc
Renaissance Pacific Energy Solutions Asia (REPESA)	Schneider Electric Philippines, Inc
Thermal Solutions, Inc.	

The Philippine DOE also created an ESCO accreditation process and established guidelines for those companies applying for accreditation see Figure 5.2 below:

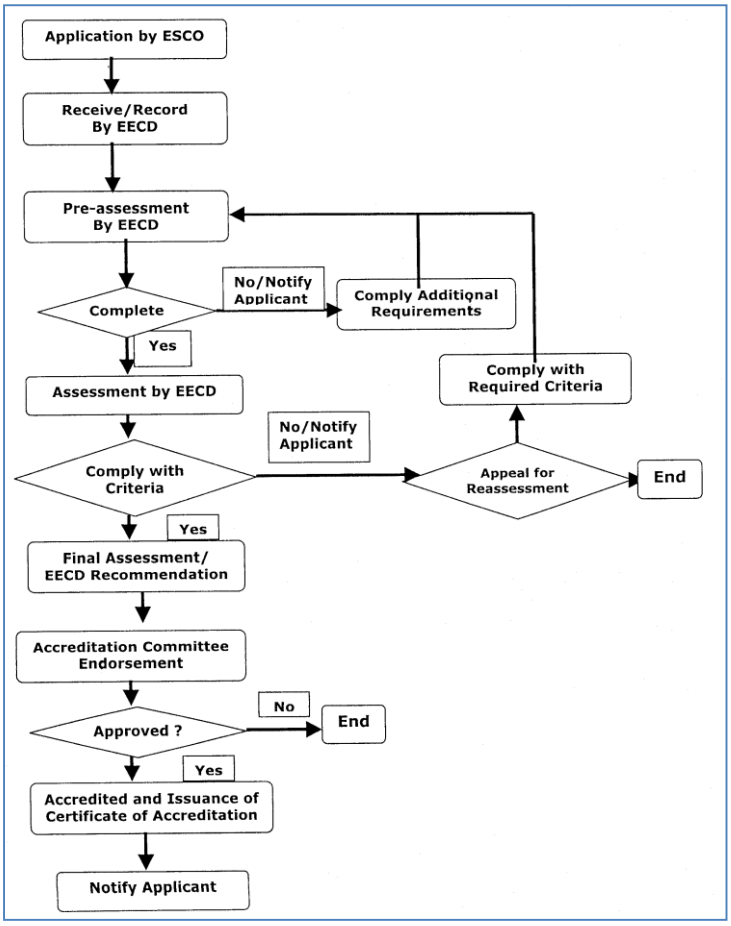


Figure 5.2 ESCO Accreditation Process [DOE 2014]**.**

Achievement 23: *Establishing a green buildings ratings system involving 10 pilot buildings.*

This was the Goal 4 Target in the 2012 PREE Report.

The Philippines has developed the *Building for Ecologically Responsive Design Excellence* (BERDE) rating system, specifically designed for its hot tropical climate [PGBC 2014]. New and existing buildings have implemented and beta tested BERDE since 2010. However since 2012, the first BERDE rated building has been certified (at the four star level) and 20 buildings have been registered.

The Philippines is also an emerging member of the World Green Building Council (a LEED rating system). This is important as commercial building developers may choose to utilize one rating system as opposed to the other. The ability for the Philippine's real estate industry to have choices in labels will likely result in more green buildings in the economy.

Case Study 1: During the Follow-up PREE team's visit, the experts met with NET Group, a leading Green Building developer. NET Group is committed to building its next five buildings under the BERDE rating. NET Group is also piloting new energy efficiency technologies in its buildings, e.g.

passive solar design, sun shading on outer glass, variable refrigerant flow (VRF) air system, unique curtain walls and water optimization. The VRF system is a dynamic system that varies the refrigerant flows based on meeting the actual load requirement. Energy savings accrue because the system only delivers the amount of refrigerant needed to match the indoor load requirement. The VRF also allows for independent control in multiple zones within a building. Together, these measures/technologies lead to more energy savings.

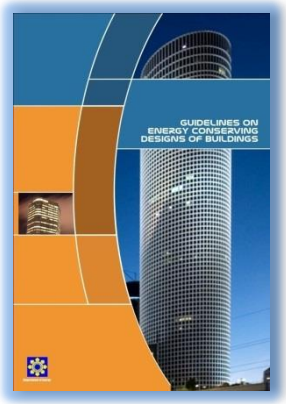
Case Study 2: The Follow-up PREE experts met with the AYALA group, which is implementing high efficiency District Cooling Systems (DCS) in its leading green buildings complexes. They have five DCS systems currently in operation, including the Technohub, a 16 building complex covering 20 hectares of land area. The experts visited the Glorietta Mall where its DCS uses 9,000 cubic meters of chilled water as the basis for its cooling power. The DCS currently cools both the mall and an adjacent hotel; the company plans to add two more buildings and another mall to this DCS. Cooling comprises 47 per cent of energy load in the two buildings and the DCS saves 17 per cent in total energy consumption (and even greater monetary savings through chilling the water the off-peak periods). The group also is piloting a new non-linear differential drive to optimize its motors and pumps; the technology responds to load requirement by maintaining a constant speed but varying the Voltage to Hertz ratio to maintain the torque required to drive the load; measured energy savings are in excess of 30 per cent.

Both companies are also employing many commercial building practices that are critical for green building ratings, including advanced building management systems, variable frequency drives, variable air volume controls, low water fixtures, pervious pavers and smart landscaping.

Achievement 24: *Progress with the integrating the currently voluntary 'Energy Conserving Design Guidelines for Buildings' in to the National Building Code by 2015.*

While work is moving along to integrate these guidelines into the National Building Code, it is moving slowly. For example, in 1994, the DOE incorporated voluntary energy efficiency standards into the National Building Code, which was last updated in 2005. These standards applied to commercial buildings and covered building envelope, lighting, HVAC, and water heating systems [OCEAN 2013]. However, even with the advent of the "*Energy Conserving Design Guidelines for Buildings and Utility System*", the voluntary energy codes have yet to be incorporated into the mandatory building codes.

As noted in the 2012 PREE report, creating a mandatory building energy code will require foundational legislation. That legislation is only one of the challenges related to developing a robust building energy code program. In addition, that challenge is still to be met. The Energy Efficiency Conservation ('Enercon') Bills now in the 16th Congress could provide the legislative basis for the voluntary energy efficiency codes becoming part of the mandatory National Building Codes, but only if it becomes law [Senate of the Philippines 2013].



Other challenges include an implementation program and an enforcement program, both requiring trained personnel and funding. To achieve energy savings with building codes they must be implemented and enforced. In addition, it will also be necessary to set forth a process that will transparently engage all stakeholders in a public review of all energy efficient codes, in order to ensure buy-in from all key stakeholder groups.

And then moving to a Best Practice in building energy efficient codes, the codes program would be designed so that every 'x' number of years, the codes would be publically

reviewed with the goal to increase the efficiency measures coincident with pushing beyond the current efficiency of products/construction techniques being employed as business-as-usual at that time. As an example of this public engagement In the United States, every three years the national model energy building code is reviewed and updated. All stakeholders participate during the three year cycle and in the 2009 and 2012 cycles, the U.S. model energy code (MEC) increased energy efficiency by 30% (in total). While this was a significant increase in efficiency, the work of having the state and local jurisdictions to adopt, implement, and enforce the new measures in the MEC continues. Nonetheless, this process continues to move the codes into lowering energy consumption in buildings every three years.

Achievement 25: *Launching a website and phone application 'Watt Matters' to increase awareness of energy efficiency in residences and small-scale businesses.*

In 2013, the Philippines DOE launched WattMatters.org.ph. It is an interactive energy efficiency website and phone application for residential and small-scale commercial appliances. It aims to educate residences and small-scale businesses about how much energy their appliances are consuming in watts and pesos. It also provides consumers with a list of efficient and inefficient appliances and brands.

5.2 RECOMMENDATIONS

Recommendation 26: *The Philippine Government should 'lead by example' to set the commercial buildings energy efficiency standard that the private sector can follow.*

The Government should accelerate its retrofit program (currently 175 buildings) to condition the green building market to accept high efficiency 'green' buildings. By being a 'first adopter' it can push the technology envelope, which will mitigate the inherent first adopter risks associated with adopting new technologies.

In doing so, the Government would expand public awareness of green building rating systems (e.g. BERDE, PGBC) and work with the industry to develop educational opportunities for green building professionals.

A way to adopt this recommendation could be to issue a challenge to the public based on the government goals - this can accelerate the green technology industry throughout the economy.

Recommendation 27: *Encourage development that focuses on multi-family high-rise buildings and the university sector.*

Like commercial office space, multi-family high-rise buildings and university buildings (both classroom and dormitory) have significant energy consumption; reducing the energy demand saves the consumers' money and makes their home/room more comfortable.

The Government should encourage developers to employ commercial building energy efficiency technologies where appropriate in multi-family high-rise buildings and universities. Existing efficiency programs, such as those promoting high efficiency lighting products and appliances, can reduce energy consumption in these parts of the building sector.

The DOE should partner with both the universities and the owners of multi-family high rise buildings to develop case studies of successful energy efficiency measures employed in these types of buildings.

Recommendation 28: *Increase the use of ESCOs in the commercial building market by utilizing strong policy and private sector financing mechanisms where appropriate.*

The Government should create partnerships with financial institutions to provide financing mechanisms for improving energy efficiency in existing commercial office buildings. These can be as straightforward as financial incentives to lower interest rates on loans to ESCOs that will implement energy efficiency measures in buildings, or creating a loan loss reserve to mitigate risk in lending by a financial institution for an ESCO project.

The Government can also institute innovative education programs for the financial institutions, e.g. training of financial loan officers on identifying 'bankable' energy efficiency projects. In many economies, bankers are unfamiliar with energy service performance contracts and need to be educated on what investment grade audits are and why these types of projects are generally low risk. This is a key to increasing the funding available to the ESCO community.

Recommendation 29: *Promote building operation improvements, such as commissioning, in commercial facilities.*

Often the operational aspect of running a building, green or otherwise, at its optimal performance levels is not the highest priority for a facility manager. The managers, while extremely competent, often respond to the daily demands of the building occupants without considering the optimal ranges in which to operate the building's HVAC and related systems. Moreover, because today's highly sophisticated control systems often lead to equipment and system integration, even small changes in one component can have big performance impacts across the entire system. Consequently, systems and equipment need to be installed and operating as designed or the building will not perform optimally. The Government can take certain actions to help building owners and operators ensure the building operates as intended include:

- Creating a catalogue of Best Practices in commercial building management and operations. Facility managers can use is as a tool to ensure that 'green buildings' with high efficiency technologies and controls are operating within the optimum range.
- Promoting the implementation of the continuous commissioning program to improve building performance significantly.

Recommendation 30: *Develop a comprehensive Government based data collection/survey for commercial building energy consumption.*

Benchmarking buildings can be a key to improving the overall building stock of an economy. A transparent and open data collection and analysis system can lead to a healthy building community – no building owner wants to be at the bottom of a list of high-performing buildings.

Consequently, the Government of the Philippines should institute a data collection and survey vehicle in an open and transparent form for all commercial building owners and developers to benchmark their buildings against all others.

Example 1: An open system such as the U.S. EIA's Commercial Buildings Energy Consumption Survey (CBECS) provides valuable information to the commercial building community and provides for energy consumption and expenditures among building types.

Example 2: The U.S. EPA's Portfolio Manager provides a rating system on a variety of building types based on a 100 point scale, in which a score of 75 means that a building is in the top 25 per cent of energy efficient buildings of a certain type.

Recommendation 31: *The Philippines Department of Energy should prepare a roadmap of all necessary steps to quickly implement building energy codes once the Enercon Bill becomes law.*

While the Philippines DOE has supported the Enercon Bill strongly over the years, it should have in place a step-wise plan of all the actions that need to be done to integrate the new energy codes into the National Building Codes for the commercial buildings market. Such a plan will prevent delays in putting the energy codes in place.

The "…[to be] reformulated group…" cited in the Short Term (2014 – 15) column of the "Energy Efficiency Roadmap for the Philippines"[DOE 2014], should take, under the direction of the DOE, the lead to develop a specific set of actions to hasten the implementation, enforcement, and updating process of the building energy codes once the Enercon Bill becomes law.

Recommendation 32: *Further promote District Cooling programs throughout the economy.*

District Cooling is a technology that can significantly reduce commercial building energy demand. More importantly it can cut energy expenditures significantly as well in that the cooling is performed at off-peak electric rate periods (e.g. at nights when demand is lowered) and the cooling is stored until needed during the days (when demand is high and electricity rates are at their highest). District cooling for multiple buildings is ideal for municipal governments with many public sector buildings.

The Philippine DOE notes that district cooling has been used in commercial buildings, universities and college to date.

The DOE can help accelerate District Cooling by developing a promotion and education campaign to inform the public and particularly the building community about the significant benefits of District Cooling. The campaign should focus on energy savings, monetary savings, and the lowering of peak demand that has a positive impact on the economy as a whole (i.e. avoidance of electricity shortages during peak periods).

Recommendation 33: *Research and pilot other less common, but energy saving, cooling technologies for hot, tropical climates.*

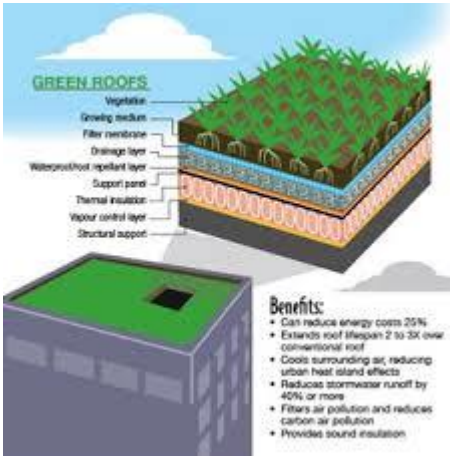
The DOE should work with commercial building owners to research and pilot high efficiency cooling technologies that may prove effective in reducing energy consumption and save on utility costs. For example, there are water cooled high efficiency roof top cooling units (e.g. chillers) that can replace existing lower efficiency air cooled older units and save substantial amounts of energy. While the majority of commercial building cooling equipment is comprised of air-cooled units [EMSD 2013], these air-cooled systems require more electricity and larger heat exchange surfaces compared to water cooled systems. Cold water systems have a higher coefficient of performance (COP) and therefore use less energy. They also work in hot, humid climates and Hong Kong, China uses them extensively. Piloting such water cooled systems in the Philippines and developing case studies can help bring such technologies into the mainstream commercial building market in the Philippines.

The DOE could help sponsor and showcase innovative cooling technologies with commercial building owners, operators or developers to demonstrate prime examples of those technologies in operation in the commercial building market.

The DOE can also develop educational materials geared to building owners and operators that highlight the fact that more efficient lighting (CFLs or LEDs) installed in buildings also lowers the heat load in the building, thereby lowering the cooling load. (Too often the reduction in cooling loads is not recognized as a direct consequence of using high efficiency lighting products in a building).

Recommendation 34: *Adopt Cool Roofs as a commercial building energy efficiency strategy.*

Cool Roofs are most effective in tropical and sub-tropical climates and can reduce energy consumption up to 15 per cent of total A/C loads. A study of cool roofs in India showed 7+ per cent reduction in new buildings and much greater in existing buildings, therefore:



The DOE should initiate a multi-media education campaign to promote "Cool Roofs" for all low rise buildings, but also high rise buildings.

The DOE should also promote Cool Roofs as an energy efficiency option as part of Building Energy Codes.

Appendix A: Peer Review Team Members

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Geosphere Technologies, Inc.

Jones Lang La Salle

Joy-Nostalg Center/Oakwood Premier

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Sugar Regulatory Administration

Philippine Sugar Millers Association

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