



École Française de Manille  
French School Manila



# ENERGY AUDIT AND PROPOSITIONS FOR ENERGY CONSERVATION MEASURES AT THE EUROPEAN INTERNATIONAL SCHOOL

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# 1. EXECUTIVE SUMMARY

An energy audit was undertaken in EIS between January and April 2009 by the Sustainable Development Committee of EFM. It consisted in a study of the schools facilities to determine how and where energy is used and to identify methods for energy savings.

Actions consisted in carrying out a complete inventory of electrical appliances (including individual power consumptions and annual use), implementing a survey amongst the EFM, GESM and EIS school staff, setting up a monitoring system and observing.

A professor in mechanical engineering from UP came over to make a presentation on climate change and energy and animated a practical workshop with 3ème and 2nde students of EFM.

The main results are as follows:

- The school average energy consumption over the last three years is 389 000 kWh per year corresponding to a 3.8 million pesos expense.
- The consumption has been stable over the last three years.
- Air conditioning accounts for 60% of expenses, lighting for 14% and IT equipment and pumps for 7%. Other appliances such as pumps, fridges, ovens and water dispensers are more marginal but should be taken in account as well in the process of energy conservation.

Different factors influencing energy use in the premises were studied such as the energy efficiency of the equipment, building specifications, energy management system, maintenance, education to environment and users' behaviour.

The main factors which inflate electricity consumption of the school are as follows:

- Insulation of buildings: some ceilings are not insulated at all, like a 270 m<sup>2</sup> area over the library, teacher's room and administration. So far, no insulation is planned for the new building.
- The school entrance is lit with numerous artificial lights. The gym lighting system, with mercury vapour lights is extremely costly as well. Actually, the gym and the school entrance hallway account for 37% of the lighting expenses of the whole school and if all busted tubes were replaced it would reach 52% of the lighting expenses.
- In general the lighting system is random with rooms overlit and underlit.
- Equipment: 1/3 of AC units is over 10 years old and has low energy efficiency. The power and number of AC units is not always matching the size of the room.
- Management: there is no existing management system for collective places and appliances (teachers' rooms, auditorium). In particular, in the teachers' room, it happens many times that computers remain turned on during nights and week ends. As no one is responsible for turning off lights and AC in these rooms, it is always the guards and cleaning staff who end up turning them off. Collective appliances such as water dispensers are most of the time only turned off during summer break.
- The hot water button of a water dispenser is convenient but is a permanent expense as well.
- The auditorium is often used for students' activities and meetings. As it is designed for an important audience (high heat load) and has a big volume, it has the most powerful cooling and therefore costly system of the school.
- The teachers' room is used most of the time during evenings, week ends and holidays by a very small number of users. As it is a large room, its cooling system is also powerful and costly.

- As far as behaviour is concerned, in general users have adopted common sense habits such as turning off their AC units and lights after their working time.

However, approximately 12% of the users do not feel any responsibility and do not wish to make efforts to save energy in the school. This translates in the following figure: during a 5 week monitoring period, the cleaning staff and guards had to turn off AC units 70 times.

Moreover there is underreporting of malfunctioning appliances (lost or broken remote are not reported to the maintenance staff which ends up in AC units running after class hours to be turned off several hours later by the cleaning staff or the night rowing guard). Lights are often turned on during the three breaks of the day.

It seems also that there is an existing habit by some teachers aids and cleaning staff (at the request of admin staff) which consists in turning on the AC units before working hours or school hours so that the rooms are cool when the staff or students arrive. In general, turning on AC, lights and computers is automatic and no one thinks of opening the windows and opening the curtains.

Although a majority of users set their AC around 25°C, it is not uncommon to find AC units set at 16° C.

Comprehensive and detailed recommendations were issued in part 5 of this report and their implementation is advised to obtain substantial savings on the electricity bill (at least 20%). The main recommendations include:

- As the consumption of AC units and insulation are closely linked it is advised to implement insulation works in several areas, including the ceiling of the right wing of the administration building, in the science laboratory and in the new building. A thorough insulation study of the new building and areas to be renovated (lobby) is strongly advised in view of future insulation.
- In order to carry out this study as well as other works in the school it is proposed to seek the help of a technical advisor. A proposal for technical support was sent by an Energy Company at a high cost. We could use the school internal resources if approved by the management Committees.
- To gradually replace 42 AC units older than 10 years by high energy efficiency models (EER 13).
- To undertake works in the entrance hall in order to benefit from natural light (glass roof, skylight, a study should be done to implement the most adequate renovation).
- To replace the lighting system in the gym.
- To enhance the use of the IT room after school hours, during week ends and holidays instead of the teachers' room as the IT room's AC units are always on anyway (because of the presence of servers).
- To use the study room in the library as a meeting room as much as possible, and to consider availing a meeting room with a 20 persons capacity in future building renovation.
- To set up and enforce simple guidelines to improve users behaviour.
- To install automatic systems to shut off the computers, lights and AC units in the teachers' room.
- To undertake several repairs and maintenance work as identified in the report (move switches, build shade over west exposed windows).
- To set up and enforce simple guidelines to improve users behaviour.
- To implement a study to evaluate the possibility to install skylights.
- To appoint one of two persons, including one administrative and one technical person to take the responsibility to manage energy use and conservation measures and following repairs and works.
- To use all the data collected through this audit as a basis to carry out an awareness campaign and to carry out education to environment activities.

- To consider energy and environmental factors when planning for renovation or construction and to work in coordination with the Sustainable Development Committee.
- To implement energy and environmental education activities with students in 2009 -2010 school year.
- In parallel, it is worth pointing out that the space above the library (270 m2) could probably host four classrooms and that there is a large area in the basement of the main building which could host the music room.

A Corporate Social Responsibility project for the free installation of one windmill and solar panels in favour of EFM was presented by the Company Alstom in mid April. To date, the data provided by Alstom do not make this project interesting from an energy production point of view and from an ecological perspective. Indeed, the project would produce enough energy for 10 fluorescent bulbs only and 10 batteries have to be renewed every 2 years with no information on recycling possibilities.

## 2. RATIONALE

### 2.1. PROJECT CONTEXT

#### 2.1.1. Setting up the Energy Audit as a priority

The proposed Implementation of an Energy Audit and of Energy Conservation measures at the European International School (EIS) is a project carried out by the Sustainable Development Committee (SDC) of the Ecole Française de Manille (EFM) in coordination with the German European School of Manila (GESM).

The SDC is a body of volunteers from the EFM, composed of the School Director, administration staff, teachers and parents<sup>1</sup>. It is headed by the school Director Mrs. Guillotin and coordinated by a parent member, Mrs Laborderie. Their role is to reduce the school's environmental impact in various fields such as for example energy, water, solid waste and transport. In the past, recommendations have been made to save on the school's water consumption and to reduce waste generation.

**For the school year 2008 – 2009, the SDC decided to focus on energy consumption only and to undertake an Energy Audit and Conservation Measures.**

This focus on energy assumes significance due to the fact that **the electricity bill reaches 3.8 million pesos / 60 000 euro per year**. Furthermore at the initiative of the SDC in 2007-2008, EFM joined the Eco Ecole movement in 2007 to ultimately obtain an environmental certification and energy is one of the components of the certification.

Prior to carrying out studies, a simple observation of the situation showed that significant efforts could be undertaken in order to use electricity more rationally and ultimately to cut electricity expenses. This includes behavioural changes such as turning of lights, cooling systems and IT appliances after use and improving infrastructure (e.g. ceiling insulation of the administration building).

At the same time, cutting energy expense would help reducing the environmental impact of the school (CO2 emissions).

The SDC also felt that it was important for the school to align pedagogical messages with concrete actions.

Indeed, school year 2007-2008's theme was the environment which was carried across by important pedagogical work (the song "elle pleure ma planète" taught to all the kinder garden and primary students, a letter written by the 4ème to the administration with recommendations, lessons on energy and electricity to the class of 3ème, CE2 class working on the school's waste management, etc.). This environmental dynamic created in the school urged for concrete actions to provide coherence to the teachers' work and to give the students a positive feedback.

The Sustainable Development Committee of EFM decided to take the lead in implementing this survey essentially because they had already provisioned funds in the EFM budget and had received a grant from the French Association of

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<sup>1</sup> List of SDC members is in annex

Foreign School (AEFE) to implement environmental related activities. However, the German counterpart was informed of our project and invited to participate in all the steps.

## **2.1.2. Modus operandi of the SDC**

### **SDC's meeting #1 29/09/2009**

The SDC's first meeting of the school year took place on September 29<sup>th</sup>, 2008. It focused mainly on analysing the preceding school year's actions. In spite of a strong motivation, involvement of the SDC members, and the implementation of several pedagogical projects, some frustration existed due to uneven support from the administration/ management. The departure of the former coordinator, Mr. Rochel and the disappointment of other active members left the committee without a coordinator after this first meeting.

Nevertheless two important decisions were taken. One was the full support of the new EFM director Mrs. Guillotin for the implementation of the SDC decisions for the current school year. The other was the establishment of the Energy Audit as the priority of the SDC for 2008 – 2009 with as a first step visit and proposals by professional companies.

### **SDC's meeting # 2 06/11/2008**

The main objective of this meeting was to evaluate the proposals delivered by companies which all carried out a walk through visit of the school premises in October<sup>2</sup>.

Four proposals were received by the SDC:

- 1 aiming at working on the lighting fixtures only, from the company OSP Honeywell: cost 756 000 php for 256 000 pesos annual savings (7 percent savings), with no technical details. This proposal was refused.
- Proposal from the company Trigen (536 000 Php), not very detailed and with a great number of working days (45 for the audit and 90 days for management and IEC). This proposal was refused.
- One proposal by an electrical engineer of UP aiming at grade 9 and 10 students (3eme and 2nde): presentation on energy and hands on workshop on electrical measurement, in line with the science curriculum. This proposal was accepted but responded only partially to the objectives as it tackled the education component but not the energy saving.
- One proposal by the company RNFA, which made free suggestions to save up to 20 percent on the electricity bill, and suggested we could implement one part of the audit by ourselves. They proposed to act as consultants on a retainer basis later on to help us on the technical implementation. This proposal was chosen by the SDC.

Hence, the school decided to undertake the implementation of the energy audit by the SDC internally, and Mrs. Laborderie proposed to lead this activity as coordinator. It was decided to search for the technical support from the company RNFA at a later stage, after the diagnosis phase.

A proposal to coordinate the activities related to the implementation of the Energy Audit and Conservation measures was delivered in December 2008 and accepted by the EFM Director and the Comité de Gestion. Detailed proposal in French is in annex.

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<sup>2</sup> Minute of meeting in annex.

## 2.2. OBJECTIVES, EXPECTED RESULTS AND METHODOLOGY

*What is an energy audit?*

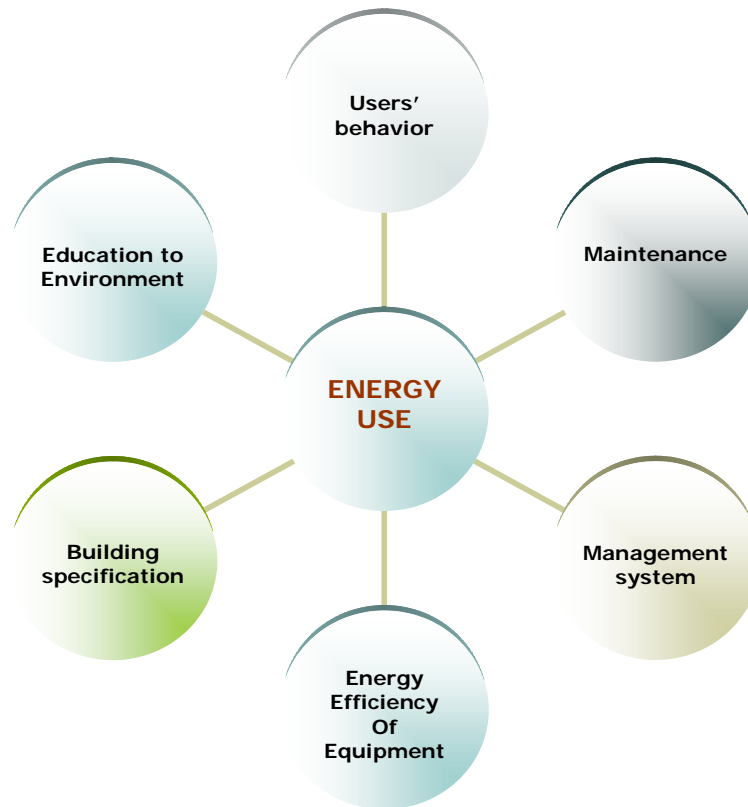
The Energy Audit consists in a study of the schools facilities to determine how and where energy is used and to identify methods for energy savings.

*What are our objectives?*

Objectives are to reduce the school's electricity expenses by 20% , to reduce the school's environmental impact (CO2 emission) and to promote education to environment among the students.

*What are the factors which determine our electricity consumption and related environmental impact?*

**Fig 1. The different factors influencing our energy consumption**



*How to influence these factors, decrease our electricity bill, our CO2 emissions and educate students to environment?*

**Change attitude of users through information**

**Improve maintenance**

**Educate students to rational use of energy in their school and daily life**

**Upgrade systems (air conditioning units, lights, insulation of buildings)**

**Set up or improve the management system to control energy use.**

*What are the steps?*

These steps are those described in the proposal in annex (in French).

**Step 1 - A baseline study is needed at first to gather data about all the factors influencing our energy consumption:**

- a. Electric consumption of the school
- b. Inventory of all electrical appliances with power and usage
- c. Knowledge of the maintenance and management system
- d. Survey of users attitudes, practices, readiness to change and ideas
- e. Status of the appliances and of the building

**Step 2 - Make recommendations for energy conservation measures**

- a. To upgrade equipment: carry out cost analysis and cost recovery (pay back period) for equipment and building upgrading.
- b. Make recommendations on software actions to change users' behaviour: for example issue guidelines and other communication events.
- c. To improve maintenance of the equipment
- d. To improve the management of energy in school: who is responsible for what, who will control? Who will monitor?
- e. Eventually to test some recommendations with pilots.
- f. To involve teachers so they can set up education projects in link with energy savings.

For this step we will search for the technical support of a specialised company.

**Step 3 – Implementation of measures**

- a. To undertake purchases and works.
- b. To communicate on guidelines and new management: posters? Emails? Meetings? Events?
- c. To implement projects with students.
- d. If pilot projects show good results, disseminate to other areas of school
- e. To monitor the good implementation of the new organisation.
- f. To monitor the impact of the whole system: (Follow up energy consumption, evaluate behaviour changes, assess the new management system, assess users' satisfaction)
- g. To communicate results.

### 3. BASELINE STUDY: ANALYSIS OF THE SITUATION

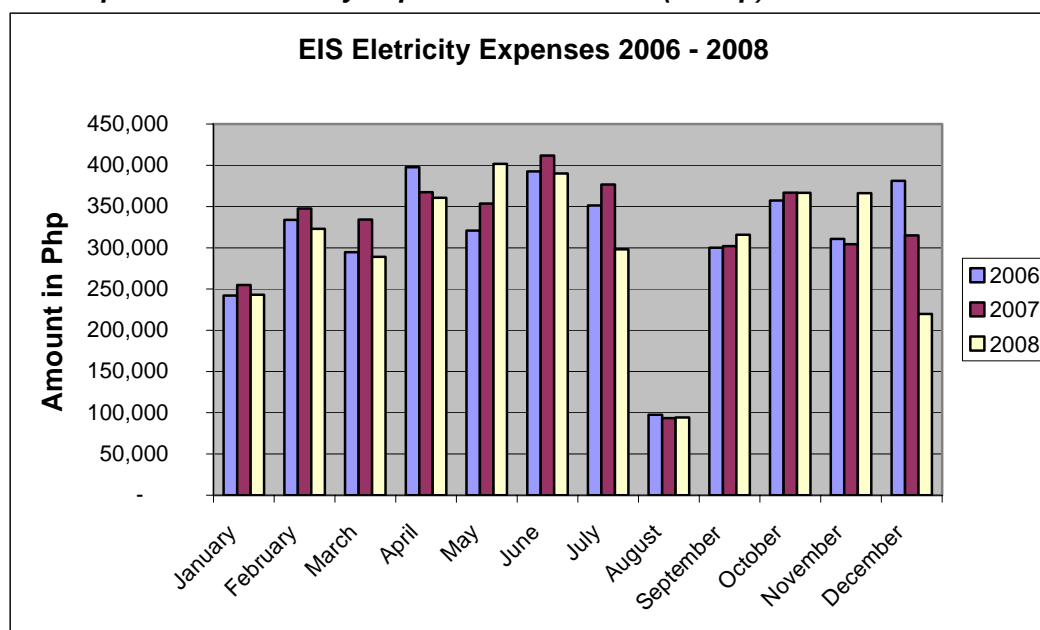
#### 3.1. ELECTRIC CONSUMPTION AND USAGE

##### 3.1.1. Current consumption

Monthly electricity bills for the last three years were consulted from the Accounting Department and compiled to draw general tendency and average. The school has two meters and therefore two electricity bills monthly, corresponding to the main buildings and the Surinam house which hosts the artistic activities.

Detailed statistics are in annex and are reflected in the graph below.

**Graph.1 EIS Electricity Expenses 2006 – 2008 (in Php)**



January electricity bill accounts for expenses from December 12<sup>th</sup> to January 12<sup>th</sup> and so on.

**Table 1. Important figures about electricity expenses, usage and environmental impact**

	2006	2007	2008	Average
Total expenses (Php)	3 779 954	3 827 659	3 668 458	<b>3 758 691</b>
Monthly average (Php)	314 996	318 972	305 705	<b>313 224</b>
School day average (Php) (38 weeks x 5 days)	19 894	20 146	19 308	<b>19 783</b>
Evolution		2,5%	-6,2%	
Total electricity usage (Kwh)	390 170	400 160	<b>376 706</b>	389 012
Monthly average (Kwh)	32 514	33 347	28 653	31 504
Average cost per KWh (Php)	9,69	9,57	<b>9,74</b>	9.66
Total Co2 emission (Tons)	232	238	224	231
Total trees equivalent	997	1,022	962	994

The main findings from data collection, underlined in graph.2 and table 1 show that:

- The cost of electricity remained stable during the last three years, between 9.69 and 9.74 pesos per Kwh. **As a rule of thumb we can remember that 1 kwh = 10 pesos.** Therefore electricity use and expenses run in parallel. If the electricity expenses of the school go up or down, it is not because of price variation but the direct effect of electricity use.
- **Electricity expenses have been stable over the last three years and even decreased by 6.2% between 2007 and 2008.**  
*This could be explained by the upgrading of the electrical system in the German classrooms and installation of heat exhaust pipes during summer 2007 but it was not possible to obtain precise data.*
- In average EIS spends 3.7 million pesos yearly for their electrical needs and 313 000 pesos monthly, with seasonal peaks reaching as high as 412 000 php (June 2007). August is generally the month where the least electricity is consumed (over 90 000 pesos). **In average, one school day (Monday to Friday over 38 weeks) costs 19 000 pesos in electricity charge.**  
With the German school starting on August 15<sup>th</sup>, next year, it is most likely that the electricity bill will increase in September 2009.
- **Expenses in July remain surprisingly high** and comparable to an average school year month (similar to October expenses).  
The administration explains that holiday season is the opportunity to undertake heavy maintenance and hard works.  
However, energy saving opportunities during the holiday could be looked at more closely.

### 3.1.2. New building consumption

With the construction of a new building which will be in use starting from September 2009, the electricity expenses will increase. It was planned with M. Kopitzke (planning committee), to install an individual meter to be able to isolate the energy consumption of this building.

The new building's electrical fixtures are planned as follows:

- **34 fluorescent tubes** (24 in the classrooms, 6 in the corridor and 4 in the toilets). With the use of T8 tubes (36 W), 8 hours per day during 38 school weeks the lighting fixtures of the new building will use approximately **1 860 kWh/year (18 600 php / year)**.  
On the blue prints of the building, it is planned to use HPF ballasts (electromagnetic). It is advised to install electronic ballasts instead. This is more energy efficient and also will raise the lifetime of the fluorescent bulb (to 16 000 hours instead of 10 to 12 000 years for the electromagnetic ones).
- **12 AC units using a new system called the inverter technology.** This new kind of AC units less greedy in energy (advertisement says up to 50% of savings), because the compressor runs smoothly and continuously instead of going through on and off cycles as traditional AC units.  
The Energy Efficiency Ratio of the inverter units is over 13, which is very good (EER 9 for units older than 10 years)<sup>3</sup>.  
As a standard, in a normally insulated room, the capacity of the cooling system should be 45W per m<sup>2</sup>. If we take 50W per m<sup>2</sup> and 60m<sup>2</sup> being the surface of each classroom, the capacity of AC units installed should be 3kW.

<sup>3</sup> Technical description in annex.

The planning committee and administration of EFM explained that 2 AC units are installed in each room in case one breaks down. In normal situation it is left at the discretion of teachers to operate the AC units wisely. The choice and capacity of the units is not set (meeting with the supplier is planned) so it is too early to announce figures in terms of cost.

- **An individual meter** to track down the energy consumption of the new building. First, it will allow to follow the evolution of consumption of the already existing building and to evaluate the impact of the energy conservation measures. Second, it will allow evaluating the energy efficiency of the new type of AC units.
- **Insulation:** to date there is no precise information on the insulation of the new building. It is part of the recommendation that a very efficient insulation system is set up.

## 3.2. INVENTORY OF ELECTRICAL APPLIANCES

### 3.2.1. Methodology of the inventory

#### Inventory and record of energy consumption

As no accurate and updated inventories of electrical equipment existed, a full and comprehensive inventory of all electrical appliances in the school was undertaken.

In fact we had to recount precisely, room by room, each electrical appliance and record or measure its capacity and its weekly use.

We had to share the work (because this part was a lot of work!) and it was assigned as followed:

- Light fixtures: fluorescent tubes, fluocompact bulbs, incandescent bulbs, mercury vapour lamps (*Cécile Laborderie*)
- Water dispensers (*Cécile Laborderie*)
- Pumps: submersible, pressure tank and swimming pool pumps (*Cécile Laborderie and Fernando Lopez*)
- Cooling appliances: refrigerators, coolers and chillers (*Cécile Laborderie and Fernando Lopez*)
- Warming appliances: oven, microwaves, food warmers, stoves (*Cécile Laborderie and Fernando Lopez*)
- HVAC (Heating Venting Air Conditioning): window type, split type (*Fernando Lopez*)
- IT equipment: computers, laptops, UPS, printers, copiers (*EFM computer room - Alain Chevalley, EIS computer room - Melchor San Jose, EIS and EFM IT equipment- Fernando Lopez*).

Even in the case such an inventory had existed, it was nevertheless necessary to identify each appliance precisely and to record its rated power input or in some cases to measure the power input of the appliance while in use.

Therefore at the same time, the rated power input (power indicated by the manufacturer directly on the appliance) was recorded (water dispensers, fridges, ovens etc.), or in the case of the air conditioners was measured with a multi meter.

**The measurement of the power of the 124 air conditioning units** was undertaken by M. Lopez, the electrician of EIS. This was a major work as the measurement has to be done at the level of the compressors, and many of them

are situated on the roof. The measurement was undertaken during the holidays after 15 minutes AC unit working time. In this condition, the measures taken reflect a higher consumption than the average consumption as the compressor is running at high capacity. In order to reflect the on/off cycle of the compressor throughout the whole day, a 70 % ratio was applied, meaning that we considered in average that the compressor was running 70 % of the time and was off during 30% of the remaining time.

Of course this ratio varies with the heating load of the room (number of students, number of computers running, sun exposure) and on the insulation of the roof and the ceiling. A bad ceiling insulation will have an impact of the compressors running time as the temperature will not remain stable.

For the fluorescent bulbs, the size of the bulb and indications of the manufacturer were used to know their power consumption.

### **Duration of electricity use**

The variety of activities and rooms occupation in a school added to the specific context of two schools operating on the same premises does not allow calculating the daily, weekly or monthly duration of electricity use in a linear way. Power consumption varies significantly from one room to another (e.g. a gym, a kinder garden class and an IB class) and from one month to another because of school breaks (during which the administration generally works).

Therefore, data as precise as possible were gathered in order to calculate a precise use of electrical appliances:

- the timetable of each classroom;
- survey of the schools staff;
- questionnaires and direct interviews with the users;
- annual occupancy periods of each school, number of legal holidays, breaks etc. ;
- a few data had to be estimated, such as the number of hours the water heaters of the canteen run, or the water pumps during heavy rains.

As a result the classrooms and offices occupancy considered is as follows:

**Table 2 Number of weeks for rooms utilisation**

<b>Rooms</b>	<b># weeks (average)</b>	<b>Means of calculation</b>
Servers	52	Are in use all year round.
Accounting	50	52 weeks minus 2 weeks (Easter and Christmas)
Administrations (EFM and GESM)	48	52 weeks minus 1 week (Easter), 1 week (Christmas), 1 week (other legal holidays), and 1 week to increment reduced activity during breaks.
Teachers room, CPE	44	48 weeks minus 4 weeks summer break
Canteen, common areas (music room, gym, toilets etc.)	38	Because not all breaks are taken together.
Library	39	Legal school period + 1 week in July
GESM classrooms	37	Legal school period
EFM classrooms	36	Legal school period
Water dispensers	46	52 weeks minus 8 weeks in summer

### 3.2.2. Qualification by end use

The comprehensive inventory of major electrical appliances in the school is appended to this report. The table hereunder provides a quick view of the type of appliances owned and used by the school.

**Table 3 Inventory of main electrical appliance**

QUALIFICATION				
Type of fixture	Breakdown	# of units	total # of units	Comments
Light fixtures	Fluorescent tubes	962	1158	Mercury vapor lights are situated in the gym. Others are halogens and incandescent lights.
	Fluocompact light	149		
	Mercury vapor	32		
	Others	15		
HVAC (Air conditionners)	Ducted	4	125	"Ducted" means centralised system
	Window	15		
	Split	106		
Water dispensers	Water dispenser	17	17	
Warming appliances	Stove (and oven)	3	15	The Kiln is a high temparture oven used for baking ceramics and other objects.
	Food warmer	2		
	Oven	3		
	Microwave	5		
	Rice cooker	1		
	Kiln	1		
Cooling appliances	Fridge	7	12	Chillers and freezers are in the canteen.
	Chillers	3		
	Freezers	2		
Motors (pumps)	Submersible	2	7	Submersible p. are used to pump water from the basement when it rains. Pressure t. are used to fill up the water tanks.
	Swimming pool	3		
	Pressure tank	2		
IT equipment	Central Unit	126	335	Other equipments are wifi, routers etc.
	Screen LCD (flat)	46		
	Screen CRT	80		
	Printers, copiers, scanner	32		
	UPS	20		
	Laptop	7		
	Hub	18		
	Other	6		

### 3.2.3. Quantification by end use

Data collected in the frame of the inventory were crossed with the time of use of the appliance per day/ week and year. Data were obtained through the administrations of both schools and through the survey.

**Table 4 - Quantification of energy consumption by type of appliances**

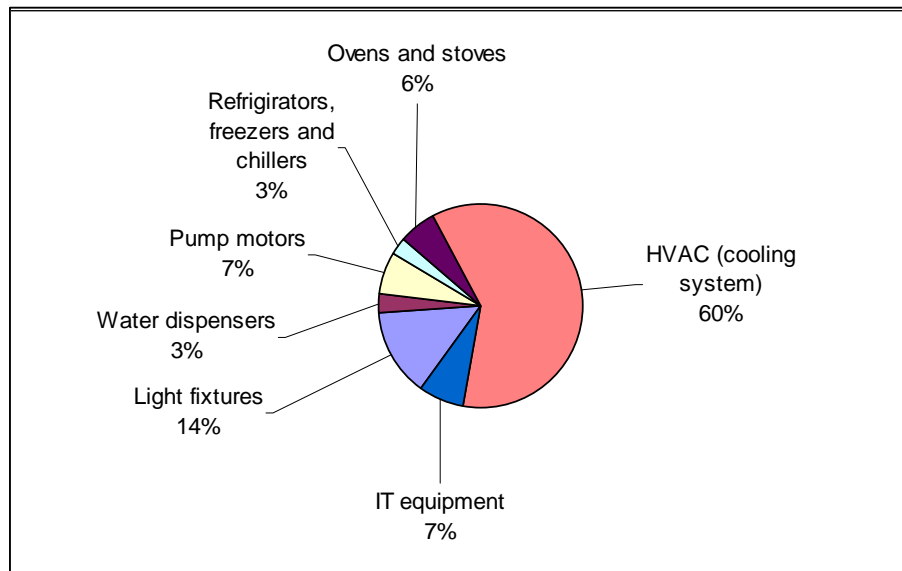
Calculated power usage	Electric usage (Kwh)	% of total electricity usage
Light fixtures	54 448	14%
Water dispensers	12 743	3%
Pump motors	26 301	7%
Refrigerators, freezers and chillers	11 165	3%
Ovens and stoves	22 840	6%
HVAC (cooling system)	239 889	61%
IT equipment	28 063	7%
<b>Total electricity usage per year (calculated)</b>	<b>395 449</b>	<b>Kwh</b>
<b>Total electricity usage, year 2008 (as per electricity bill)</b>	<b>376 706</b>	<b>Kwh</b>
<i>Difference</i>	<i>18 743</i>	<i>4,7%</i>

There are inevitably approximations in the calculations since some data were estimated, but at the same time the results give a fairly accurate idea of the energy use per type of electrical appliance as the difference between the calculated and the real energy use is 4.7 %.

This means that the consumption of some appliances is slightly over rated, probably due to the overestimation of the use of some appliance.

One difference spotted is for Surinam House, because the total electricity bill (102 000 php/year) is higher than the calculated power consumption (72 000 php). This could be due to the consumption of the kiln (oven for ceramics) for which weekly use is hard to establish.

**Graph 1: of the percentage of energy consumption by type of appliance**



The largest consumption of energy in the school is due to AC units (60%), followed by lighting fixtures (14%) and IT equipment (7%) and water pumping (7%).

This means that without neglecting any source of possible savings, the largest efforts should be concentrated on optimising the cooling of the buildings.

The lighting system comes second and recommendations will be issued as well to cut down expenses.

### 3.2.4. Unitary and geographic consumptions

The inventory allows playing with data and all kinds of calculations can be made. The excel data base in attachment may be used by the teachers for math and physics applications and data can be used for communication purposes. It can also be use to calculate unitary consumption such as the cost of one appliance used one hour each day per year, the cost of one classroom etc.

A few examples illustrate how the data base can be used, in particular it is helpful to establish priorities.

**Table 5 - Top ten consumptions for AC and lights (estimations)**

Lights			AC		
	ROOM	Yearly cost (php)		ROOM	Yearly cost (php)
1	Gym	99 932	1	Auditorium	144 108
2	School entrance hallway	99 270	2	EIS Library	135 888
3	Teachers' room	26 614	3	EIS Teacher's rm.	86 173
4	Library main room	20 952	4	Physics\ Chemistry	78 440
5	Parking main	18 638	5	EIS Canteen	72 854
6	Science laboratory	10 357	6	Arts room	66 144
7	Admin hallway	10 014	7	EIS Office hallway	65 126
8	Gate	8 737	8	Science Lab.	63 439
9	Kiga 1	8 290	9	DSM Kiga 2	48 180
10	EIS computer hallway	7 995	10	DSM IB 1	47 643
17	3ème	5 680			
90	1ère	379			

#### Lights:

The lights of the gym are mercury vapour and consume a lot of energy. Possibility of replacement with High Pressure Sodium lamps is currently being studied.

The entrance hallway is lit 24 hours a day in its front part and less consistently in the body of the hallway. The front part consists in 48 fluorescent tubes out of which only 23 are still working. Should the replacement of all busted tubes in the hallway be done, the yearly expenditure would be over 175 000 php per year.

The administration explained very well that the entrance hallway used to be very dark and that the lighting system was built to make the school welcoming.

This area should be targeted to save on lighting and at the same time to keep a welcoming atmosphere. A study should be made to provide more natural light to this area (transparent veranda, skylights, etc.). A technical support is needed to implement the study and undertake the work.

Costs related to lighting vary considerably from one room to another. For example, the 1ere classroom has 2 fluorescent tubes, one of which was busted at the time of the audit (379 pesos per year). On the other side of the scale, 18 fluorescent tubes installed in the 3ème room (cost 5680 pesos per year). This does not make sense because the 3eme room has windows on three sides. Curtains were installed in this room because the windows give too much heat to the room, with the consequence the 18 tubes are needed when the curtains are shut.

Generally all the rooms which have no windows (music, CPE, bilingual class maternelle, etc.) consume a lot of energy because both lights and AC have to run most of the time. A recommendation for future renovations is a) to avoid building blind rooms, and b) to install skylights whenever possible to allow natural light and ventilation to reach these rooms through the ceiling.

The new lighting system of the German classes uses T5, which are very economic but at the same time there are 24 tubes in each class, which makes this system not so interesting from an energy conservation point of view.

### AC units

The cooling system in the library, the teachers' room and the auditorium represent 15 % of the school energy expenses.

Savings should be made in these rooms in particular. Recommendations will be detailed later in this report, but we can already say that savings in the library and teachers' room will go through insulation of ceiling, with additional limitation of use in the teacher's room. The auditorium use should also be limited and avoided for meetings or small group activities. Setting the AC in the auditorium should be done by maintenance staff only.

AC units are very greedy in energy, from 8 php / hour for a small unit to 129 php per hour for the most powerful one. Extended to the school year, using one AC during 1 hour per day during 38 weeks cost from 1 000 php to 17 000 php per year.

It is possible to indicate on each AC unit, its hourly or yearly consumptions to enhance users' awareness. The SDC members should define what information should be stucked to the units (CO2 emission or energy consumption or cost) and who should prepare the information (SDC members themselves, work with students).

Examples of how the data of the inventory can be used:

- Running this AC unit during one hour every day costs 2000 pesos per year (class of CE1) and emits 122 kg of Co2 (plant 9 trees)
- Running all the AC units of this room during one hour every day costs 16 744 pesos per year (teachers' room).

## Water dispensers




**Table 6 – Comparison of yearly cost of selected water dispensers.**

Water dispensers		
Location	Yearly cost (php)	Comments
Teachers Room	38 643	Hot and cold, 24 hours a day, 48 weeks a year
Swimming pool room	4 817	Cold, 24 hours a day, 48 weeks a year
Mat. Hallway	948	Cold, systematically unplugged after class, 8 hours a day

Water dispensers only represent 3% of consumption but the way they are used impacts directly on the consumption.

Should you wish to compare other values, please report to the inventory in attachment.

### **3.2.5. Environmental impact**

Consumption	Emission	Compensation
389 000 Kwh	231 tons CO <sub>2</sub>	994 Trees / year during 18 years
		

To compensate the school's Co<sub>2</sub> emission we should plant 994 trees per year during 18 years.

The calculations were made on the following basis: 0.594 kg of Co<sub>2</sub> per kWh. This data is specific to the Philippines and depends on the sources used to make energy in a country.

Different sources give different data as far as CO<sub>2</sub> absorption capacity of trees is concerned, as many factors impact this capacity (age of tree, specie, life time). As a matter of fact there are several methods to calculate CO<sub>2</sub> absorption by trees. For this calculation it was considered that one tree in average 13 kg of Co<sub>2</sub> per year. Going further on the environmental impact and on Co<sub>2</sub> absorption could be the object of a course in science.

The children who attended the presentation by a UP teacher in February had a good introduction on climate change and Co<sub>2</sub>.

### 3.3. STATUS OF EQUIPEMENTS AND OF BUILDINGS

#### AC units

##### *Energy Efficiency*

**42 AC units (1/3 of all AC units of the school) are older than 10 years** and have a low energy efficiency compared to new models (EER of 9 v.s. 11 for new classic models, and EER over 13 for inverter technology).

Yearly consumption	221,505	kWh	
Yearly cost	2,157,454	Php	
Possible saving	20%	30%	
	431,491	647,236	Php/year
Investment (42 units inverter technology @52 000 Php per unit)	2,184,000	2,184,000	Php
Resselling old AC units (42 units @ 2500 php)	126,000	126,000	Php
Payback period	5	3	years

This new system should be tested in a few rooms to evaluate the impact in terms of energy consumption. In any case, it is recommended to choose AC units with and EER of 13. As a matter of comparison EER of 14 is the minimum standard for cooling systems in some European countries. The room of 4eme was identified for an immediate test.

##### *Building specification*

**The lack of proper insulation** also has a very important impact on the energy consumed by the AC because cool air escapes through the ceiling, causing the compressors to run continuously at high power. In particular, the ceiling over the right side of the administration building over the library, teachers' room, nurse office and canteen (approximately 270 sq. meters), is not insulated.

It seems that to date there has been no study to evaluate the cost and possible energy saving of insulation. There is also no trace of a study to build up classes over this area (270 sq. meters = 4 classes of 60 sq meters), which at the same time would resolve the problem of insulation and of classroom space in the school.

**Table 8 - Possible impact of insulation of the ceiling over library zone**

Yearly consumption of 18 AC units in non insulated rooms	64,186	kWh/ Year
Yearly cost	625,169	Php/ Year
Energy saving per year	6,400	kWh
Possible savings after insulation (10 %)	62,517	Php/ Year
Investment (fiber insulation + labor) Cost 1200 php / m2	34,672	Php
Payback period	7	months

The simulation here above is with fiber glass which is not a satisfactory solution. Research is currently done to see possibilities of insulation with natural fibers available in the Philippines, such as called Kapok. According to a recent

study kapok is a good heat insulator<sup>4</sup>, but up to now we have not found yet a supplier.

Insulation problems exist in other places like over the science lab (small space between the roofing and the ceiling, therefore the heat from the roof communicates to the ceiling. A possibility could be to install skylights which would provide at the same time natural lighting in the science lab and ventilation (exhaust of hot air). Another solution proposed by the maintenance team is to spray the roof with a rubber type material (cost 750 php / m2). A couple of years ago, external insulation of the roof of the gym was improved using this technique and was efficient. This is a good idea but does not seem to be cost effective in the case of the science lab.

**The windows of rooms with western exposures** (New Building and Tower), are exposed to an important heat load from direct sun light because the roof is not long enough to provide shade in the afternoon. Depending on the room, curtains or milk glass were installed but they are not effective to protect from the heat, only from the light (which is neither cost effective nor comfortable). Mrs. Marlene Po suggested the installation of media aqua.

The team leader of maintenance, M. Rolly Villanueva was approached about this and is currently working on designing and costing and external shading. If approved, the works could be undertaken during summer vacations

Lighting fixtures

The school mainly uses mainly fluorescent tubes T 8 (36 W), T12 (40 W) and T5 (28 W) in German grade school class rooms. When a T12 tube gets busted it is replaced by a T8 tubes which produce about the same amount of light at reduced wattage. The company RNFA suggested outright replacement to obtain savings right away. To date, there are 82 fluorescent tubes T8.

Yearly power use 82 units T12	5,932	kWh
Current yearly cost	57,779	Php
Yearly power use 82 T8 tubes	5,339	kWh
Yearly cost	52,001	Php
Saving	<b>5,778</b> <b>0.2 %</b>	Php / year
Cost per tube	95	php
Investment	7,790	php
Payback period	<b>1.3</b>	years

In spite of a short payback period, **I would not suggest replacing T12 tubes by T8 tubes right away** because the savings remain minimal compared to the total bill (0.2%) and this creates extra waste, which is not coherent with a sustainable development process.

For new fluorescent fixtures like in the new building we could consider T5 tubes which are ever more energy efficient. But it would be good to check if the level of light will be enough.

<b>Table 9. Possible impact of installing T5 tubes in the new building compared to T8 tubes</b>
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<sup>4</sup> <http://www.ucadjds.org/media1/JDSV8N1/Article%20Voumbo%20et%20AI%20.pdf>

Yearly consumption of 34 T8 tubes	1,767	kWh/ Year
Yearly consumption of 34 T5 tubes	1,375	kWh/ Year
Potential saving	3,818	Php/ Year
Difference of price T8 - T5	2,890	php (T5 = 180 php each) T8 = 95 php each
Payback period	0.76	year

The company RNFA also advised us to replace the electromagnetic ballast of the lighting fixtures by high quality electronic ballasts which consume less energy. This system is still being enquired at the moment (efficiency and price).

**The number of lighting fixtures in classes** and offices are is not always adapted to the illumination needed. Some classes appear overlit and other underlit. As we underlined earlier, there is little logic between the size and exposition of the room and the number of fixtures installed.

Whenever the respondents to the survey declared that the lighting in their room was not satisfactory (13%), the information was transmitted to M. Lopez. At the same time it was identified that in many rooms the busted tubes did not cause any discomfort to the users.

If we want to make a real evaluation and changes a professional company should make measurements with a lux meter. Or at least, the help from an external company could be searched for new buildings / renovated buildings to make sure the right level of light is installed. This activity could be done as a practical work with students (measuring the lumen of a room with a lux meter).

In some areas, natural light could be more taken advantage of, as in the hallway and in rooms situated under the roof, such as the biology lab. As we know the exact consumption of each area in terms of lighting fixtures, it is easy to calculate the payback period of any kind of work undertaken.

The biology lab and is close from the roof and has one roof embedded window which helps with natural light but does not seem to be sufficient. The installation of skylights could be studied.

In the entrance hallway, we should examine what kind of renovation could be done to use more natural light (replace fluorescent tubes by skylights, replace the roof by a transparent veranda?)

### 3.4. MAINTENANCE, MONITORING AND MANAGEMENT OF THE SYSTEM

#### 3.4.1. Maintenance

The maintenance of electrical appliances is done by M. Fernando Lopez, EIS electrician and by M. Rolly Villanueva, Team leader of the maintenance team. Repairs for request go through the maintenance book (at the entrance) or direct requests. Depending on the problem identified, the maintenance team undertakes the repairs or calls a specialised company.

#### Cooling system

**Checking the AC units and refilling with cooling liquid** is done three times a year through tenders. There are actually three bids each time to select the company who will clean the air conditioning units of EFM, of GESM and of EIS. The French school and the German school have different criterion to select the companies.

**Regular cleaning of filters** of all the AC units is done every Saturday by the electrician M. Lopez by batch of 50%. Therefore filters are cleaned every two weeks. The electrician often uses the switch positioned on the AC unit and not necessarily the remote. Due to unreported problems, it was advised to the electrician to check the remote controls at the same time as cleaning the filter.

Problems of maintenance or malfunctioning of AC units **are not systematically reported** to the electrician M. Lopez in particular when it does not cause any inconvenience to the user, although it might have a significant impact in energy consumption.

When remote controls are broken or malfunctioning (digital screen cannot be read), it can stay unreported for weeks. As a consequence, AC units are not turned off after class (they are turned off later by the janitors who use the direct switch or by the guards who use the circuit breaker outside) or the AC is being set at very cold temperature (since the screen cannot be read).

This problem was identified through the monitoring which was set up with the team of guards and with the janitors, as we could see that some classes did not turn off the AC several times a week. When we went to check the room, we found out it was a problem of unreported maintenance.

The impact is important as AC are very greedy in energy, from 8 php / hour for a small unit to 129 php per hour and per unit for the most powerful one. (cf. data in annex). Extended to the school year, using one AC during 1 hour per day during 38 weeks cost from 1 500 php to 24 600 php per year.

*In one of the rooms, it seems to be very cold. The remote control's digital screen does not work very well and it is not possible to see clearly the set temperature. At the time I looked at it, it seemed to indicate 10°C.  
Setting the temperature on 10°C has an important impact on energy consumption because the Air Conditioning unit will never manage to bring the room to such a low temperature. Therefore the compressor of the AC will run continuously at maximum power.*

Generally repairs with AC are done immediately, either by the electrician or through a specialised company. But for a failing remote control it can take several days between order and reception of the new one.

Discussing this with the electrician, the idea issued is to buy one remote control for each type of AC in the school. It can be used as a temporary replacement whenever a remote breaks down.

The availability of spare parts is an issue for maintenance. For example Panasonic is a good brand but it takes one month to receive the spare parts and undertake the repair.

#### Lighting fixtures

In several classrooms, offices and auditorium several fluorescent bulbs are busted. Outside on the school grounds, many fixtures are also busted and the lighting system of the kinder garden playground area needs repairing.

It is also noticeable that the light fixtures in the canteen and in the workshop require repairing.

**In fact 15% of the lighting fixtures of the school are busted or broken (984 out of 1159 units are functioning).**

The guards complain about this situation for security reasons, but for unknown reasons, outside lights have not been fixed yet. The administration of EFM was informed about this issue.

Apart from that, no teacher or other staff of the school reported lighting problems in the maintenance book. In most of the cases, it appears not to cause discomfort because the natural light is sufficient. In fact, it appears that many classes are overlit, so that when bulbs get busted it is not a problem for the users.

**However, busted lights do not give a very good global image of the school.**

**In the canteen and in the workshop, the fixtures are badly damaged with wires hanging from the ceiling and protective glass missing. They should be repaired for security reasons and to improve working conditions of the staff.**

In some rooms, the fluorescent tubes are noticeably dirty. However, the task of cleaning lighting fixtures is assigned to no one in particular. It would benefit the general lighting of each room and would allow in certain cases to reduce the number of fixtures.

Cleaning the tube will also help improving the global aspect of the classes.

#### **Recommendations to improve maintenance in relation to energy saving**

- To remind users to report problems in the maintenance book or speak to the electrician. People should be encouraged to communicate about defective items.
- To ask the janitors to report problems as well.
- To check the remote controls at the same time as cleaning the filters.
- To buy one spare remote for each type of AC used in the school.
- The replacement of broken lights is a more complex issue. On one side busted tubes should be replaced to maintain a good image of school management, on the other side, in most cases, replacement is not needed. Help from an outside company should be searched to evaluate the cost and cost recovery to modify the current lighting system so it matches the required lighting level.
- Twice a year, the electrician and janitors could clean all the fluorescent bulbs of the school to benefit general lighting and aspect of each room.

### **3.4.2. Monitoring of electricity use**

Since February a monitoring system was set up to track sources of energy waste in the school, mainly after class and office hours.

- Monitoring by the school's employees: janitors and guards

EIS outsources 4 janitors from the company KKI to clean the school premises. The four janitors, Eva Depetillo, Jovita Ampodia, Virgie Pelanggon and Bernard Gabarce, were given each a monitoring sheet, which they have to fill each day

and which identifies the electrical appliances which were left turned on when they arrive in a room for cleaning. This allows us to track daily the air-conditioning units, lights and computers which were forgotten by the users. Example of monitoring sheet is in annex.

The guards seem to be very much aware of energy savings on the school premises and the head of security, M. Marlene Baui was even able to tell me the amount the electricity bill!

Each night a rowing guard is in charge of inspecting the premises from 6 pm until 6 am and reports all events on a log book including switching off lights, air conditioning units and spotting late workers! M. Baui proposed to type down all comments related to energy and reports weekly.

Example of the head of guards' weekly report is in annex.

**Table 10 Results of monitoring by the guards over 6 weeks (1 week break, so 5 school weeks in total) in February and March 2009.**

Turn off lights	12 times	in Kiga, Gymnasium, sports room, teachers room, surinam house and auditorium
Turn off aircon units	25 times	
Teachers' room use after 9 pm	17 times	The teachers' room is used several evenings per week and every week end by 2 teachers (Saturday and Sunday, half or full day).

**Results of monitoring by the Janitors over 6 weeks (1 week break, so 5 school weeks in total) in February and March 2009.**

Turn off lights	15 times	Teachers room, CE2, CM1, multifunction, Surinam, Chemistry, Biology, KI 5, 6, 7, 8, 9, 10, IB2, DAZ, CP, 5ème, IB1, CM2.
Turn off aircon units	45 times	
Computers on	12 times	

Turn off lights total	27 times
Turn off aircon units total	70 times

**Over a period of 5 weeks the staff turned of 70 times the AC units, and this only partially reflects the reality** as some janitors report more systematically than others.

### Observation

#### *Teachers' room*

The monitoring by the guards and personal observation also shows that the teachers' room is occupied several evenings per week by one or two teachers, until late hours (until after midnight), and during the week ends. For this purpose, one powerful AC unit (Carrier brand, capacity 3.83 kW) is generally turned on. An evaluation of the cost is done below and shows that the use of teachers room during the evenings and week ends is costly, because it is a room with a big volume (and no ceiling insulation). Even if one AC unit is turned on only, the power used is strong because of the volume of the room. Actually one AC unit will never manage to cool the whole teachers' room at 22 or 23 degrees as set on the remote control. This means that the compressor will run at maximum capacity during the whole time.

It is also observed that the last users of the teachers' room every day and during the week end neither turn off the AC units nor the computers. At the same time there is no note or poster in this sense.

### **Recommendations for the teachers' room:**

- As the computer room (EIS) is always cooled because of the presence of servers, I would suggest that the teachers who wish to work in school after 6 pm, during the week ends and during the holiday use the EIS computer room. Renovation of the computer room is planned so it would be the opportunity to fit out an area for those teachers, where they can put their laptop and connect to internet.
- An immediate solution is to ask the same teachers to use the small room inside the teachers' room in the meantime, which is less costly to cool off.
- To install occupancy sensors in the teachers room to turn off the lights after 15 minutes, and to turn off the AC at 5 pm.
- To install a software on the computers with automatic shut down at 6 pm (warning one hour before and then every 15 minutes). The cost of this software is 20 USD. It should also be installed on all computers of the school.

### *Other rooms*

Observation shows that the monitoring of the guards and janitors give a good idea of the situation but it is not exhaustive. For example the biology room was found several times with AC on long after the last period, the boys and girls changing rooms near the gym are repeatedly found with lights and ventilation on, but it is never reported by the janitors.

### **Recommendation:**

- In rooms used by several persons or shared between schools, to put occupancy sensors (teachers' room, auditorium, science rooms)
- To put additional switches in the changing rooms (2 exists, only one set of switches). The maintenance staff is working on possibilities and cost at the moment.

### *Break times*

A few visits in the classrooms during break time, shows that in approximately 50% of the cases, the lights are not turned off during breaks. In some cases the door remains open with the AC running during the break.

### **Recommendation:**

- To put extra switch in three German classes (current switches are not by the door to facilitate switching off the lights)
- To remind everyone that not switching off the lights during breaks costs over 7 000 php per year to the school.
- To organise a contest between classes for ecological class management, including many other things (setting AC, turning off appliances, sorting waste etc.)

### *Temperature variation*

Another observation is that the temperature varies a lot between one room and another with AC units being set from 18 °C to 25°C in the same conditions (i.e. same building, same floor, same exposition to the heat).

Results of survey (cf. below) shows that a good share of respondents are opposed to setting the AC at a minimum of 25 but users should be encouraged to a more rational use of their appliance.

### *AC on and windows open!!!*

Several times, the AC is found running and the windows or door open, during break time, or after class, when students are unattended and using a classroom. The reason generally put forward is "bad smell", which is not surprising in confined environments. A good solution to prevent bad smell is to open the

windows (without the AC!) during 15 minutes every morning before class/ during early office hours. It will help renew the air and cool down slightly the room.

Example of impact

**Table 11 – A few examples of the impact of common behaviours on EIS electricity consumption (data from monitoring, observation and survey)**

Location	Common situation (exemples)	Cost per school year in Php
Teachers' room	Using 1 AC unit 5 days a week during 3 hours (eg. 5 to 8 pm)	<b>33,264</b>
Teachers' room	Using 1 AC unit every Sunday during 5 hours	<b>5,898</b>
Auditorium	Forgetting AC units one time a week during 3 hours	<b>10,621</b>
5eme	AC and lights turned off by the janitors (2 hours unnecessary use 2 days a week)	<b>4,758</b>
Klasse 9	AC and lights turned off by the janitors (2 hours unnecessary use 2 days a week)	<b>5,594</b>
Biology room	AC and lights turned off by the janitors (2 hours unnecessary use 5 days a week)	<b>5,092</b>
All classrooms	50% of lights are not switched off during breaks (total breaks = 60 minutes / day)	<b>7,525</b>
<b>Total bill</b>		<b>72 752 php/year</b>

Behaviours really have an impact on energy consumption. The sum of examples above already represents 2 % of the yearly expenses.

The monitoring set up is an efficient way to track all unnecessary use of electricity. It should continue on a regular basis. One person should be designated to do the checking.

What steps to take after monitoring? The results of the survey below will give us hints on how to approach the users. The approach should be discussed with the members of the SDC.

- Personal approach: one simple method is to approach individually the teachers of the rooms where AC and lights stay on to remind them about their responsibility. One person in each school should be designated to approach staff and teachers.
- Global approach: through mass information (posters, presentation)
- Technical approach: to put occupancy sensors, software for auto shut down.
- Management approach: to manage and control the energy use in a pro active manner.

### 3.4.3. Management of the system

One of the goals of the energy audit was to identify the management system and responsibilities to operate lights, AC units, computers etc., and to be able to propose a more efficient management system to control the appliances use.

Taking a picture of the current situation was done through the survey and direct interview with school staff and administration.

#### Lights and AC units

In the French class and administration, **there is no clear responsibility for turning on and off the lights and AC.** Generally it is done on a first in – last out basis. It is not so much a problem for the administration as for the classrooms.

Only one teacher mentioned that the students are forbidden to operate AC units and that a “note de service” was issued in this sense last year.

In some classrooms, there are laminated notes near light switches asking to turn of the appliances.

In some of GESM classes, it is mentioned that **the responsibility of turning on, off and adjusting the temperature of the AC units is given to 2 students for a period of time in all classes.**

But, the teachers arrive often in the classroom earlier than the students and turn on the AC by themselves so the system can not be used in all classes and at all times.

**However, this system looks very good as it gives responsibility to both students and teachers. Actually during the survey several people suggested that students should be given more responsibility.**

#### Recommendation:

- To discuss with teachers on how to involve the students in the management of energy and for those who find it adapted to their classroom, to adopt the system used in some of the German classrooms.

Some teachers also do not have their own classroom and may feel less responsible or might not know if there is a class later on during the room or not.

#### Recommendation:

- To put each classroom’s schedule on the wall of the classes (suggested by Mrs. Malay), so the teachers know whether they should turn off the appliances or not, would help improve energy management.

In Kiga, Maternelle and in German administration it seems that some teacher aids and staff turn on the AC units at 6.30 or 7 am so the room is cool when the students arrive and also to avoid bad smell (declarations in the survey). Acting as such leads to energy waste and does not keep a healthy environment for the children and the adults. Windows should be open every morning to ensure air renewal and AC units should be turned on when class starts only or working hours.

#### Recommendation:

- to include this recommendation in guidelines for everybody and suggest to users directly.

In the rooms shared by several users like the teachers’ room and the auditorium, there is no set responsibility. As a matter of consequence the AC lights and computers remain on, in particular in the teachers’ room where appliances are

left on all nights and during the week end. For the teachers' rooms, recommendations were made above.

The auditorium is also a big source of energy expense in the school because of its big volume and because the cooling system is made to cool high heat load (of hundreds of persons). In fact if the three AC units in the auditorium run together it costs 300 pesos / hour.

Several behaviours contribute to unnecessary spending such as:

- Using the auditorium for meetings of 20 persons or less.
- Turning on the 3 AC units even when there is a small number of users in the auditorium (small heat load)
- Leaving the appliances on after use and leaving it to the staff or guards to turn off (which they do, but not immediately)

#### **Recommendations:**

- To issue by the AC switches recommendations on how to use the AC (< 50 persons = 1 unit on, 50 to 100 persons = 2 units on, > 100 persons = 3 units on)
- The maintenance staff agrees to take more responsibility in managing the use of the AC in the auditorium. This means, a maintenance staff is always present when a class or an event starts in the auditorium and sets himself the temperature / number of AC units running.
- The maintenance staff takes the responsibility to turn off the appliances after use. But they wish to be informed of the non routine use of the auditorium in advance.
- If possible in future development of the school to avail a meeting room of 20 persons capacity.

In the library, the remote are within reach of the students and the librarian reports that there are often problems due to students setting the AC on very cold (on inexistent temperatures!).

#### **Recommendations:**

- the remote control should be kept by the persons in charge of the library and not accessible to the students.

Guards and janitors participate in managing the system which is good but upstream solutions such as the ones recommended above, should be taken.

The janitors were briefed on their responsibility to turn off all appliances (except computers) after they are done with the room.

The guards say that they already turn off all unnecessary electrical appliances except computers.

**For the air conditioners, they use the circuit breaker switch situated by the compressor to turn off the unit, without having to go inside the room.**

For the lights, the procedure consists in requesting for the key of the spotted room, signing, switching off the light and returning the key. However, the report from the guards never mentions turning off the lights. It appears that there were problems in the past which could explain the guards are hesitant to enter the classroom to turn off the lights.

#### **IT equipment**

Generally the users are responsible for turning on and off their IT appliances and there is no system of control. The janitors rarely find computers on but it is also hard to identify because the computers are in sleep mode.

In the EIS computers' room users are told to turn off the computers after use and it seems to be relatively well observed.

The main problem is in the teachers' room as computers remain on all night and during the week end. There is no sign in the teachers' room to turn off the computers after use and general behaviour consists in leaving the appliances on and leaving.

Contrary to AC and lights, it is not possible to ask the guards and the janitors to turn off the IT appliances.

#### **Recommendations:**

- A software with automatic sleep after 15 minutes and an auto shutdown system should be installed on all the computers of the school. First it should be tried in the teachers room to be tested and then installed on all the computers of the school. There are several options possible: auto shutdown after a set period of time (e.g. after 45 minutes) and auto shutdown at a set time (e.g. at 6 pm).

#### **Water dispensers**

Although they only account for 2% of the electrical consumption, very small changes in management could easily help saving energy.

Water dispensers remain turned on during nights and week ends, cooling water unnecessarily, except in French *maternelle* where the teacher aids unplugs the dispenser at 3 pm every day, with a great result, a cost of 948 php per year.

Water dispensers are generally unplugged during the holiday.

In the whole school only two dispensers use the function hot water: in the EIS administration hallway and in the Teacher's room. This is like if water was boiling constantly in the school in case someone would like a cup of tea at any time and it costs 39 000 php per year. Expensive for the sake of not waiting a few minutes for a cup of tea!

The two water dispensers at the canteen are also found sometimes with hot water plugged, and for security reasons, the electrician was asked to neutralise the hot water function.

#### **Recommendations:**

- The janitors unplug all the dispensers every day at 3.30 pm and turn them on between 7 and 8 am.
- It is proposed to turn off the hot water in the teachers' room and administration. People who wish to have hot water can turn it on and wait for the few minutes until it is hot (savings about 10 000 php per year)

#### **Other appliances**

All canteen appliances (including fridges and coolers) are unplugged during holidays. Water dispensers of the canteen are unplugged at 4 pm and turned on in the morning. It is well managed by the staff of the canteen.

Water pumping represents 7% of the electricity bill, for pumping the water of the deep well, filling up the tanks, pumping water in the basements when it rains. The main energy consumption of the pumps is at the level of the swimming pool with three pumps running from 6.30 am to 3.30 pm. The school will be soon connected to Maynilad water system, therefore putting an end to the use of one powerful submersible pump (>150 000 php / year). Pumps are activated by the maintenance staff. The guards turn off some pumps at night because leaks in

toilets and faucets lead to the pumps starting automatically several times to fill in the tanks.

The school will be soon connected to Maynilad water system, therefore putting an end to the use of one powerful submersible pump (5 HP, >60 000 php / year).

**Recommendations:**

- To clean the back part of the fridge every year (the dust accumulated on the pipes at the back reduce the energy efficiency of the system), to unfreeze the fridges and freezers regularly, and to ensure a slightly bigger space is availed at the back of the appliance for air circulation (in particular in the canteen stock fridge).
- Whenever possible to choose appliances which use less water, as water pumping also use energy (in school and later on to treat waste water). Quotations were provided for the use of water free urinals). M. Fournier and M. Kopitzke also enquired about water saving appliance (faucets and flushes).
- Recommendation was made and accepted (by the planning committee) to install one water free urinal in the boys' toilet (administration building) in replacement of a leaking unit.

**General management**

In general, the technical staff in charge of maintenance is dedicated to its tasks and is very prompt in making necessary repairs. However, their work suffers sometimes from clear guidelines both from and administrative and technical point of view.

For example they are requested by the guards to replace the outside lighting system but as this is costly they are also expecting a green light from the administration, which is not necessarily informed of the situation.

Moreover, the absence of an engineer or a technical supervisor is a problem as well in order to orient studies, quotations and ultimately works. The lady in charge of purchasing needs precise technical specifications for each item and is not in the position to carry out research for technical items.

**Recommendation:**

With this respect, it is recommended to appoint a technical person at least part time to help in the implementation of studies and the realisation of works. As stated in the recommendations (in summary and part 5 sections), the school would greatly benefit from studies for insulation, reorganisation of the lighting system, installing occupancy sensors etc.

An energy company consulted to support the school in undertaking energy conservation measures made a proposal for 280 000 pesos (cf. proposal in annex). In my opinion it would be more efficient to employ or appoint a person in the school able to take the lead in technical studies and renovation and to make the link with the administration / management committees for works approval.

### 3.5. USERS' BEHAVIOUR SURVEY OF ENERGY USE BY EFM, GESM AND EIS STAFF

A survey on the use of electrical appliances in EIS was carried out between January and March.

**The purpose of the survey was to know better the use of electrical appliances by the staff of the school, to identify behaviours, and to hear everyone's idea on how to decrease electricity expenses in the school.**

The survey's results are both quantitative as we obtained data and statistics and qualitative as some of the questions aimed at knowing people's opinion and ideas.

In fact the survey was a little long and it was not possible to draw conclusions from all the questions but generally it gave interesting information on the general use of electrical appliances, on "energyvore" behaviour, on what people in the school think, and on what people are actually ready to do.

Unfortunately the thermometers installed in each classroom are not accurate. So it was not possible to work on the temperature, which would have given interesting information on the insulation properties of each room.

Some data such as the number of hours spent in class were crossed with room usage and were helpful to make calculation on the weekly use of electrical appliances. Some the ideas suggested are interesting and are summarised below.

It also allowed us to characterise three different types of users and behaviours in the school which have to be approached differently if we want to enhance change.

Last but not least, the qualitative part of the survey was very instructive and all the suggestions to save energy in the school were taken in account.

All the statistical results of the survey are in annex of this document.

#### 3.5.1. Statistical results

69 persons were interviewed, 47 teachers and 22 administrative staff, 26 French, 22 Filipino, 18 German and 3 of other nationalities.

*1. The general attitude toward energy saving in school is positive ...*

	Yes	No / no answer
1.1 Sustainable development at school, is it important?	91 %	9 %
1.2 To set up actions in school to reduce our Co2 emissions is a good idea?	94 %	6 %
1.3 To save on the school electricity bill is a good idea?	99 %	1 %
1.4 To involve students in the process of reduction of energy consumption in school is a good idea?	99 %	1%

... and showed that the respondents are more sensitive to the economic argument than to ecological factors.

## 2. Cooling system

Operating:

In your class room / office, who generally turns the air conditioners? (several answers possible)	2.1 Turns on	2.2 Turns off
Teacher	45%	54%
Teacher aid	10%	10%
Admin staff	26%	23%
Cleaning staff	1%	1%
Student	22%	14%
Does not know	3%	3%

From the answers above, we can see that in total 4 % of the users declare either that they do not now who turns off the AC units or believe that it is the cleaning staff's duty to turn off the units. **This means that 4 % of the users do not turn off their units after use (estimated cost of this behavior is over 46 000 Php per year).**

The teacher aids are responsible for turning on and off appliances in *maternelle*. During the interview on the French *maternelle* side, it seems that the aids are very much aware of the energy issues but are also concerned by the comfort of the children. This sometimes leads to counter productive behaviors such as **turning on the AC units very early in the morning to do away with the bad smell and cool off the room and then turning it off**. During the interview other users declare doing the same.

**Recommendation was already given to open the widow for 15 minutes every morning to get rid of bad smell and cool off a room.**

Some users also declare that even in the cold season, it is important to run the AC units everyday for a while, otherwise they get busted. This is not true.

The information obtained through observation and interview around the questionnaire show that the *maternelle* aids unplug the water dispenser everyday after class and plug it back in the morning. The canteen also does this. This system should be disseminated to all the dispensers of the school.

The students also turn on and off the AC units (22 % on and 14% off). **In some German classes, it is a set system which makes a pair of students responsible for class management each week.** In the French side, students' turning on the AC units is sometimes seen as a problem. For example in the library, they have a tendency to set the temperature below existing settings (eg. <10 0).

A special case for turning on and off the **AC unit is in the EIS computer room**. As this room contains the servers of the school which have a high heating load, it needs to be always at a cool temperature. The AC unit of the room is left on purposefully by the IT manager Melchor San Jose and the rowing guard is in charge of turning off the unit at midnight and on again in the morning through the AC switch situated outside.

### Temperature:

Temperature feeling and setting depends on many factors such as the size of the AC unit compared to the room, the exposure of the room and the heating load (how many students/ computers etc.).

The survey's result show that 16 % of the respondents do not set the temperature of the AC units and out of those who do 18% set it lower than 23 C.

Do you agree to:	<b>Yes, already</b>	<b>Yes</b>	<b>No</b>
2.5 Adjust the air conditioner in your room at 25° during the hot season?	14%	51%	<b>29%</b>
2.6 Turn on the air conditioner only if needed during the cold season?	52%	33%	<b>10%</b>
2.7 Always close the door and the windows if the air conditioner is turned on	61%	30%	<b>4%</b>
2.8 Always turn off the air conditioner if your room is empty for more than one hour	38%	38%	<b>12%</b>

**12% of respondents are not willing to turn off the AC units when they leave the room for over an hour** (v.s. a wide majority of people already doing it or willing to do so). The impact of not shutting of the AC is important on the energy bill and is concentrated on a small number of people.

### **Recommendations:**

- To continue the monitoring to be able to approach people individually and remind them about the consequences of their behaviour. This should be done by each school.

### *3. Lighting*

**13% of the respondents also declared that they do not agree to systematically turn off the lights when they exit a room.** Some of them say that frequent switching causes more harm than good so the tubes should not be turned off. This is true if the tube is turned on and off very frequently (e.g. every 15 minutes) but the impact of turning of the lights during the breaks (3 times a day) is minimal. Moreover, the cost of electricity linked to the use of a fluorescent tube is much higher than the tube itself (one tube costs between 85 and 150 php).

#### **Frequent switching of fluorescent tubes:**

If the lamp is installed where it is frequently switched on and off, it will age rapidly. Each start cycle slightly erodes the electron-emitting surface of the cathodes; when all the emission material is gone, the lamp cannot start with the available ballast voltage. Source: Wikipedia

For example, the life duration of a 36 W fluorescent tube is divided by 3 if the light is switched on and off every 15 minutes compared to a 10 hours continuous use period. Source: <http://www-energie.arch.ucl.ac.be>

Many respondents recognise that they could pay more attention to turning off lights when they exit their room, and that they simply do not think about it on a daily basis. This confirms regular observation on the school premises.

The use of artificial light is also systematic, like a habit and the test carried out during the interview shows that **30% of the respondents who turned off lights during the test were satisfied.**

	Natural light satisfactory (result of test)	Natural light not satisfactory or no test
Lights initially turned on	17 answers (29 %)	42 answers (71%)
Lights initially turned off	9 answers (13%)	

(Total is 68 out of 69 because one person did not respond)

In both the German and French administration offices, it is important to keep a well lit environment to maintain a welcoming atmosphere for frequent visitors. At the same time these offices generally used the blinds to partially or completely obstruct natural light.

Opening the blinds would give the room a warmer light which is also nice for the visitors. It might be necessary to reposition the screen of the computers perpendicularly to the windows to avoid nuisance.

The same is valid for the EIS computer room, where the blinds are always down. This room could be lit with natural light (except for the IT person working station) and only 3 computers which are back to the window should be moved.

**The use of natural light should be encouraged as a unique or a complementary source of light.**

#### 4. Information Technology equipment

4.2 Do you turn your computer after use?	YES 74%	NO 33 %*	
		14% in sleep mode	19% leave it on

\*Percentage of computer users.

Actually the number of respondents who turn off the computers is higher than the number of users because 3 respondents do not use a computer but turn it off after their colleagues.

4.4 Do you turn your printer after use?	YES 49%	NO 55 %	
		29% in sleep mode	26% leave it on

What can be done about the printers? Most of them are in network. At least the IT could make sure they are all programmed for auto sleep after 15 or 20 minutes of use.

#### 5. Dynamic

	Yes	No / no opinion/ response
5.1 Are you interested in participating in a meeting about energy	72 %	35 %

5.6 Instead of working in your classroom, could you rather use the teachers' room? (17 persons who work in their room)	4 positive answers	13 negative answers
5.7 Would you agree to enhance awareness of your students on a more rational use of electrical appliances in the class room?	93 %*	7 %*

\*Percentage of teachers.

The use of the teachers' room to prepare lectures and courses could be a good way to make economies of scales, but in most cases is not possible because the teachers have specific needs of documents and materials which are in their classroom.

As a consequence it is not a solution to save energy in the school.

### 3.5.2. Classification of users: what kind of an energy user are you?

In the end the survey allowed to identify three types of energy users. This characterisation is interesting to help us determine how to communicate with users!

**HOMO ECOLOGISTUS:** approximately 14% of respondents.

Has already adopted careful attitudes, and already turns off lights, AC units, already thinks and acts to protect the environment and save energy.

- they should be contacted to promote good habits amongst their peers, run special projects (like IDD or TPE) or pilot activities in their classes.

**HOMO CONTEMPORARUS:** approximately 70% of respondents.

Is concerned about environment and is in favour of sustainable development but does not always act concretely as such. Most of the time, it is because of routine and habits.

- To issue simple guidelines and communication to help them evolve towards an ecologistus state.

**HOMO ENERGIVORUS:** Approximately 12% of respondents

Is generally in favour of sustainable development in theory but practically is acting in an opposite way and is not willing to make any efforts (such as turning off appliances after use).

- IEC will not have any impact on Energyvorus. A direct approach is needed to directly confronting Energyvorus to its acts.

### 3.5.3. Your ideas to save energy

To the question "Do you think you could save energy in your class room / office?" 64 % responded positively. Moreover, people expressed many ideas on how to save energy in the school in general, not only in their class room.

Some interesting ideas suggested by the persons interviewed, all the suggestions were carefully evaluated and several of them are part of the recommendations of this study.

This is a good start, but starting from here we will have to implement concretely some of the suggestions.

<b>Students and teachers involvement</b>	
In each class students should be responsible for	Propose this to the teachers.

lights and air conditioning each week. Give more responsibility to the students.	
The students are too hot but sometimes they wear long sleeves or too hot clothes.	Yes part of students involvement plan.
Last year many suggestions were already made by the former SDC. It is time to implement them!	
Do something about the salle des profs!	Yes: occupancy sensors + access to IT room in the evening + auto shut down computer + someone controlling.
To do a lot of daily awareness with the children. Only one day of information is not enough because people complain they lost time and forget everything.	
To inform the staff and make everyone more aware of energy conservation.	
A chart could be issued with guidelines for all the teachers.	Yes.
If the tables in the teachers room were clear of personal belongings, there would be more space to work for everyone.	This is at the border of this study's scope but information will be passed on.
<b>IT equipment</b>	
To use a software to shut down the computers automatically.	Yes
To have an automatic program so that all AC shut off at 4 pm and all computers at 6 pm.	
To set a screen saver after 10 minutes and an auto shutdown after 45 minutes for the computers.	
To turn off the computers during lunch break (and not only sleep mode).	Yes, will be in the guidelines.
Is it good for the computers to turn them on and off several times a day?	It is not a problem to turn them on and off a few times a day and it is better than letting run continuously.
Remind people that the sleep mode also consumes energy.	Yes. Will be in the guidelines
Sometimes people turn off the computer but forget to turn off the screen, it still consumes energy.	Yes. Will be in the guidelines
<b>AC units</b>	
To have a fan in their classroom / office.	To be discussed
To open windows to facilitate air circulation.	Yes. Will be in the guidelines.
To improve insulation in the classrooms.	Difficult to do so, even for a new building.
To set the AC units at 25 C.	In the survey a majority of people were against this measure. Should we enforce it nevertheless?
To centralise the ac system in the administration building.	Needs expert's appraisal.
To switch off the air conditioners 5 minutes before the end of class.	Yes. Will be in the guidelines.
In the auditorium, the 3 AC units are sometimes on with only one class. It is too cold. The three AC units should be turned on when the auditorium is full only.	Yes, an explanatory note should be printed in this sense.
Change the AC units, they are too old.	25 percent of the units are over 10 years old. Should be budgeted and planned.
To open the windows and to have mosquito	To be discussed

nets.	
To put automatic sensors to start the AC and the lights.	Should be done in Teachers' room and auditorium.
To have an electronic thermometer to control exactly the temperature of the room.	Will this really help?
Put media aqua over the windows of the seconde and on the classes in the tower.	
In Surinam house the ceilings are very high so it takes more energy to cool off the place.	
There should be no more than 5 degrees difference between the inside of a room and the outside temperature.	Yes but survey's result show that people are not ready to follow this. But the person who made this suggestion should promote this idea.
In the computer room the AC is set on very cold even in the evening, it could be set to a higher temperature.	Yes
<b>Lights</b>	
Is it really good to turn off the lights for a short period of time? Doesn't it wear them out?	Yes, it does but it has to be done many times. But switching on and off the lights 4 times a day will most likely have no impact on the tubes lifetime.
Turning off the lights during breaks and during lunch time.	Yes.
The switches are not well positioned in some German classes. They should be repositioned next to the exit.	True.
Switching one set of lights only instead of all.	Yes and this is possible because there are several switches in most rooms.
Milk glass windows are not so good because there is not enough light.	
Opening the curtains to have more natural light.	Yes, especially in administration offices, computer room and biology room.
<b>Energy management</b>	
To check that appliances are turned off at night.	
To pay someone to control each day and turn off all unnecessary appliances.	
Some staff turn on the AC units 30 minutes of 1 hour before working time. Stopping this habit would help save energy.	Definitely, advise staff not to do so!!!
Ask the janitors to unplug water dispensers every day.	Yes
To turn on the appliance only when needed and not automatically.	Yes, will be in the guidelines.
Make sure the maintenance is well done.	Yes but users have to inform the maintenance as well.
The cold water at the dispenser is too cold. Children don't like it.	This remark was made in maternelle. Ask the technician to check and modify the temperature
Close doors during break time.	
In the German office, we could turn off the lights on the window side and open the blinds, that would give the room a much warmer light and that would also be good for the parents.	

Even if it was out of scope of this questionnaire, respondents made other remarks linked to sustainable development:

Several people, German and French mentioned that the use of plastic cups should be banned.	Waste management could be back on the agenda again?
Students should bring their own bottle or cup.	yes
To recycle waste	This is already done in the school. The staff is sorting all the waste. It could be one at class level to encourage a general environmental behaviour and to facilitate the process.
To use different quality of paper (scratch paper)	Same as above
To replace paper towels in the toilet with cloth towels which can be washed.	
Plant trees	
Go to River Pasig and show the waste to children.	We plan to do IDD next year with field visit. (maybe la Mesa ecopark)

## 4. EDUCATION AND STUDENTS PARTICIPATION TO ENERGY CONSERVATION

### February: Workshop with a professor from UP

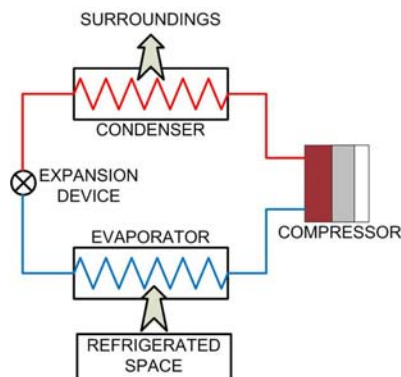
On February 9<sup>th</sup>, M. Reyes, a professor of mechanical engineering of the University of the Philippines gave a presentation on Energy Efficiency and the Environment. The workshop as compulsory for classes of 3eme and 2nde accompanied by their teachers M. Alviz and Mrs. Po and open to any one else interested in the subject.

The professor gave examples of climate change and explained the process of greenhouse effect. The students were surprised to learn that water is a green house gaz!

Unfortunately man's activities are responsible for producing green house gazes and amongst other, our use electricity. To produce electricity, we burn fuel in power plants and this produces a lot of CO<sub>2</sub>.

Students then got to know better domestic electrical appliances and in particular learned that air conditioners are in fact refrigerators!

**Fig 2. How does a fridge or AC unit function?**



After the presentation in the auditorium, students got to have a hands on experience and measured the voltage and intensity of an AC unit, in order to calculate the power used. Actually this is very useful and in the course of this audit, the electrician did the same to the 124 units of the school!

An article on this workshop was written in the EIS News letter by M. Banes.

### March: Earth Hour

In March the school participated in the Earth Hour a big banner was displayed in front of the school. A student also visited each classroom to encourage everyone to observe one hour without electricity on Saturday evening.

In the school, even the guards tuned off the electricity of the outside areas. Only the teachers' room remained lighted and airconditionned.

**April:** An article on the Energy Audit was written for the year book.

A beautiful exhibition on energy, ordered by M. Banes has now arrived to the school. It will be displayed by the end of the year.

## 5. RECOMMENDATIONS FOR IMPLEMENTATION OF ENERGY CONSERVATION MEASURES

At this stage of reporting, some studies are still going on. The most important recommendations in order to make savings in electricity are highlighted in red.

### 5.1. ENERGY EFFICIENCY AND BUILDING CHARACTERISATIONS

		Current expenses	Investment	Yearly saving	Yearly saving	Payback period
<b>1</b>	To insulate the ceiling of the administration building (right side) either with classic “fiber insulation” (but can cause problems of toxicity, allergies, and fumes in case of fire) or with other more performing materials such as kapok. (study ongoing). In general to carry out insulation studies in all the buildings.	625 169 (18 AC units of non insulated rooms)	35,000	10%	62,516	7 months
		<i>A study should be carried out to assess the availability of other materials which are more natural and safer for security and health</i>				
<b>2</b>	The maintenance staff requests the roof insulation of the science laboratory with the same material as the roof of the gym. The first prices given do not make is very efficient. But other options should be explored as the science lab has a high AC consumption.	63,439	97,500	10%	6,344	15 years
<b>3</b>	To replace the AC units older than 10 years. For the replacement of the 42 AC units, it could be decided to extend to renewal over 3 of 4 years depending on budget constraints. The inverter system will be tested as soon as possible in the class of 4eme.	221,505	1,995,000	20%	44,301	5 years
		221,506	1,995,000	30%	66,452	3 years
<b>4</b>	To consider modifying the lighting system of the entrance (48 tubes) of the hallway to favour natural light (skylights or transparent veranda)	70 000 to 147 000		100%	70 000 to 147 000	

		<b>Current expenses</b>	<b>Investment</b>	<b>Yearly saving</b>	<b>Yearly saving</b>	<b>Payback period</b>
<b>5</b>	To replace the mercury vapour lights in the gym by less energy greedy lights like High Pressure Sodium ones.	99, 932	currently under evaluation	20%?	20 000	?
<b>6</b>	To consider installing skylights in all "blind rooms"					
	Annual cost of lighting library	23,000	to be evaluated	80%	18,400	
	Annual cost of lighting all rooms in the center of admin building (which will be renovated)	15,000	to be evaluated	80%	12,000	
<b>7</b>	To have a proper meeting room, able to fit 20 persons, in order to avoid doing meetings in the auditorium.	149,808		1100 php per meeting (3 hours)	41,800 (1100 * 38 weeks)	
<b>8</b>	In the meantime, to use the study room for meetings as much as possible.		0	1100 php per meeting (3 hours)	41,800 (1100 * 38 weeks)	
<b>9</b>	To fit out a space in the EIS computer room for teachers to work after 6 pm, during the week ends, and during vacations. New rule for the use of the school premises?	308,185	0	min 20 hours weekly	45,550 (minimum)	Immediate
<b>10</b>	In the meantime use the small room inside the teachers' room for after 6, week end and vacations activities.	308,185	0		45,550 (minimum)	Immediate
<b>11</b>	To install occupancy sensors in the teachers room, in the auditorium and in all science rooms (biology, physics and chemistry and science laboratories). Or to install a "programmation par courant porteur) system.		needs technical support for quotations	at least one hour per day		

		<b>Current expenses</b>	<b>Investment</b>	<b>Yearly saving</b>	<b>Yearly saving</b>	<b>Payback period</b>
<b>12</b>	To install another light switch (three ways) in the girls and the boys changing rooms by the gym or install occupancy sensors.	3,000	currently under evaluation	50%	1,500	
<b>13</b>	To move/ put additional light switches in Klass 1, class 2 and grade ½ so they are positioned by the door.	12,610	currently under evaluation	1 hour per day	934	
<b>14</b>	To install mosquito nets in some rooms (if the teacher makes the request)		To be evaluated			
<b>15</b>	To unblock windows in classrooms to allow air flow ((if the teacher makes the request).					
<b>16</b>	To consider in future buildings development the area of approximately 270 m2 on the second floor of the administration building. It would be interesting to at least undertake a real engineering / architectural study to see if it is possible to build classrooms / offices and at what costs. As one classroom is roughly 60 m2, there is enough room for 4 classrooms. This recommendation is directly linked to #1 as laying out the second floor is also a good way to insulate the first floor.		<i>A study should be carried out</i>			
<b>17</b>	To consider environmental norms and factors in all projects undertaken by the school such as constructing a new building or purchasing equipment, upstream, at the level of the technical specifications.			30%		
<b>18</b>	To install water free urinals in the boys toilet (administration building) in replacement of a leaking unit to test the system. If proven successful, then it could be used to replace all defective units. (planning committee gave an ok for one unit).		9500 + 1000 /year (succeeding units cheaper)	3500 liters water / unit/year		

## 5.2. MANAGEMENT, MAINTENANCE, MONITORING

		Current expenses	Investment	Yearly saving	Yearly saving	Payback period
	<b>Management</b>					
<b>1</b>	To install a software for auto sleep (15 minutes) and auto shutdown (at 6 pm), first in the teachers room, in one office and one classroom, then disseminate to all computers if test proves successful. <a href="http://www accuratesolution.net/purchaseforasd.htm">http://www accuratesolution.net/purchaseforasd.htm</a> .	31216 in teachers room	800	50%	15,608	Immediate
<b>2</b>	To ensure that water dispensers are turned off everyday after 3 pm and turned on starting from 7.30 am.	60,573	0	30,583	29,990	Immediate
<b>3</b>	To turn on hot water of the dispenser when needed only	60,573	0	minimum 20 000	20,000	Immediate
<b>4</b>	To give the team leader of the maintenance staff, the responsibility to turn on and off the AC units when the auditorium is used and to set the temperature of the AC units.	144,108	0	5%	7,205	Immediate
<b>5</b>	To appoint or designate one or two persons in charge of managing energy (or sustainable development?) issues, monitoring and checking the good implementation of measures including a technical person.					
<b>6</b>	To check that the gardener turns off the dispensers during the holiday as planned.					
<b>7</b>	To remind regularly the janitors and the guards of their responsibility to turns off AC units and lights (cf. #20)					
	<b>Maintenance</b>					
<b>9</b>	To check the remote controls at the same time as cleaning the filters (person in charge electrician), ie every two weeks					

10	To clean once a year all the fluorescent bulbs of the school (one janitor + one member from the maintenance team) and the cooling system behind the fridges, coolers and freezers.
11	To buy one spare remote for each type of AC used in the school.
	<b>Monitoring</b>
12	To continue monitoring bills, consumption, behaviours, implementation of energy conservation measures, works etc. (cf #19)

### 5.3. USERS' BEHAVIOUR

1	To print out in each classroom the schedule of the room and remind users to turn off the AC and lights after the last period.
2	To print out in the auditorium a guideline on how to use the AC units and to put a note by the door to explain where the switches are.
3	To print out in each classroom guidelines on a good management of energy and organise at the beginning of next school year a meeting to present these guidelines (mainly for teachers, administration and support staff).
4	To keep the remote controls at the library desk (not accessible to the students).
5	To turn off the hot water in the teachers' room and administration. People who wish to have hot water can turn it on and wait for the few minutes until it is hot. But can users stand it?
6	To carry out an awareness campaign with posters (involvement of the children)
7	To print out on AC units of each class data on energy consumption of the unit and CO2 emission (which data is to be defined by the SDC)
8	To approach directly users who do not turn off their appliances regularly
9	To issue guidelines (to be discussed and validated by the SDC / guidelines could be also issued by the students themselves)

#### 5.4. EDUCATION TO ENVIRONMENT

1	To implement IDD and TPE with students on the basis of useful information in this report
2	To organize a contest between classes for environmental class management (including waste, energy, water)
3	To carry out other actions as per teachers' proposals
4	To involve the students in the production of guidelines / protocols for energy use in class
5	To involve the students in the elaboration of a communication and awareness campaign
6	To use the exhibition on energy which was ordered by the library
7	To create a student Sustainable Development Committee
8	To carry out other actions as per teachers' proposals

#### 5.5. RECOMMENDATIONS FOR THE NEW BUILDING AND RENOVATIONS

1	To install electronic ballast for lighting fixtures instead of electromagnetic ones (HPF) as planned on the blue prints. It is more energy efficient and extends the life time of fluorescent tubes.
2	To use 36 W (T8) tubes and to enquire about the possibility to use 27 W (if lumen level is enough).In any case the match the lighting system with the room's size and exposition to natural light.
3	To consider the use of skylights to favour the flow of natural light.

4	To install 2 light switches or more. As tubes are often mounted by 2, to install one switch for one side and another switch for the other side.
5	To install the best possible insulation even if it is more expensive, as the payback period of insulation is quick: study possibilities for ceiling, roof and windows (double panes)
6	The school already intends to install energy efficient AC units and is currently enquiring about the inverter technology. <u>Recommendation is to match the capacity of the AC unit to the size of the room.</u> From an energy conservation point of view, it is not good to double the number of units to prevent discomfort in case of break down. In case a AC unit breaks down it could be planned to use fans.
7	In the choice of brand for AC units, the availability of spare parts should be taken in account in order to reduce delay in repair. <u>The electrical technician in the school should be associated to the choice of the units.</u>
8	Whenever possible compressors should not be situated on the roof (no access to circuit breaker, difficult maintenance)
9	Recommendation was made install water free urinals. A system using little water was chosen instead. It was accepted to install one water free urinal in the boys toilet (administration building) in replacement of a leaking unit.
10	To consider the basement of the administration building for future buildings development. It would be interesting to at least undertake a real engineering / architectural study to see if it is possible to install a ventilation and a drainage system and at what costs. This area could be a good option for a music room.
11	To install a separate meter for the building in order to track respective consumptions of existing and new buildings.

## ACCRONYMS

<b>AC</b>	Air Contionning
<b>EER</b>	Energy Efficiency Ratio. It is the ratio of the cooling capacity to the power input. The higher the number the more cooling is achieved for each watt of electricity.
<b>EFM</b>	Ecole Française de Manille
<b>EIS</b>	European International School
<b>GESM</b>	German School of Manila
<b>IEC</b>	Information Education Communication
<b>IT</b>	Information Technology (computers, printers etc.)
<b>SDC</b>	Sustainable Development Committee (EFM)

## **LIST OF ANNEXES**

1. A few photos
2. List of SDC members
3. Minute of SDC meeting #2
4. Proposals received by four companies for the implementation of the energy audit.
5. Detailed proposal for coordination of the energy audit
6. Electricity bills 2006 – 2008
7. Full inventory of electrical appliances (different calculations on soft copy only)
8. Inventory with consumptions sorted
9. Monitoring sheet of janitor
10. Weekly report of the head of guards
11. Survey results (data base in the soft copy)
12. Presentation on climate change and energy conservation by M. Reyes (only soft copy)
13. Draft guidelines for energy conservation in school
14. Draft energy management tasks
15. Proposal for technical assistance by the company RNFA