



Activity Report

In-House Seminar Workshop on Energy Efficiency and Conservation: Building Energy Audit
City of Santa Rosa, Laguna

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List of Acronyms

AC	Air conditioning
BEA	Building Efficiency Accelerator
BMS	Building management system
CENRO	City Environment and Natural Resources Office
CEO	City Engineering Office
DOE	Department of Energy
EE&C	Energy Efficiency and Conservation
EECD	Energy Efficiency and Conservation Division
EMS	Energy management system
EUMB	Energy Utilization and Management Bureau
GEF	Global Environment Facility
GEMP	Government Energy Management Program
HRMO	Human Resources and Management Office
ICLEI SEAS	ICLEI – Local Governments for Sustainability Southeast Asia Secretariat
LED	Low-emitting diode
NEECP	National Energy Efficiency and Conservation Program
OBO	Office of the Building Official
OCR	Office the Civil Registrar
PESO	Public Employment Service Office
SEA	Southeast Asia
SEforALL	Sustainable Energy for All
UNEP	United Nations Environment Programme
WRI	World Resources Institute

Building Efficiency Accelerator

The Building Efficiency Accelerator (BEA) is a private-public collaboration aiming to advance the implementation of building efficiency policies and practices. BEA is anchored upon the Global Energy Efficiency Accelerator Platform that advocates for sustainable buildings. The Platform is one of the six energy efficiency accelerators of the United Nations Sustainable Energy for All (SEforALL) that calls for reducing energy carbon emissions alongside improving energy access.

BEA is supported by the Global Environment Facility (GEF) and is implemented by the United Nations Environment Programme (UNEP) through the World Resources Institute (WRI). In Southeast Asia (SEA), WRI engaged ICLEI – Local Governments for Sustainability Southeast Asia Secretariat (ICLEI SEAS) to lead collaboration with BEA cities, namely, Da Nang, Vietnam; Iskandar, Malaysia; and Mandaluyong, Science City of Muñoz, Pasig, and Santa Rosa in the Philippines.

ICLEI SEAS' current engagement with BEA runs from April to December 2019. During this period, BEA intends to capacitate Philippine cities to further green building best practices and policies such as kick-starting the process of developing a local green building code and encouraging them to implement energy efficiency and conservation (EE&C) practices.

I. City of Santa Rosa

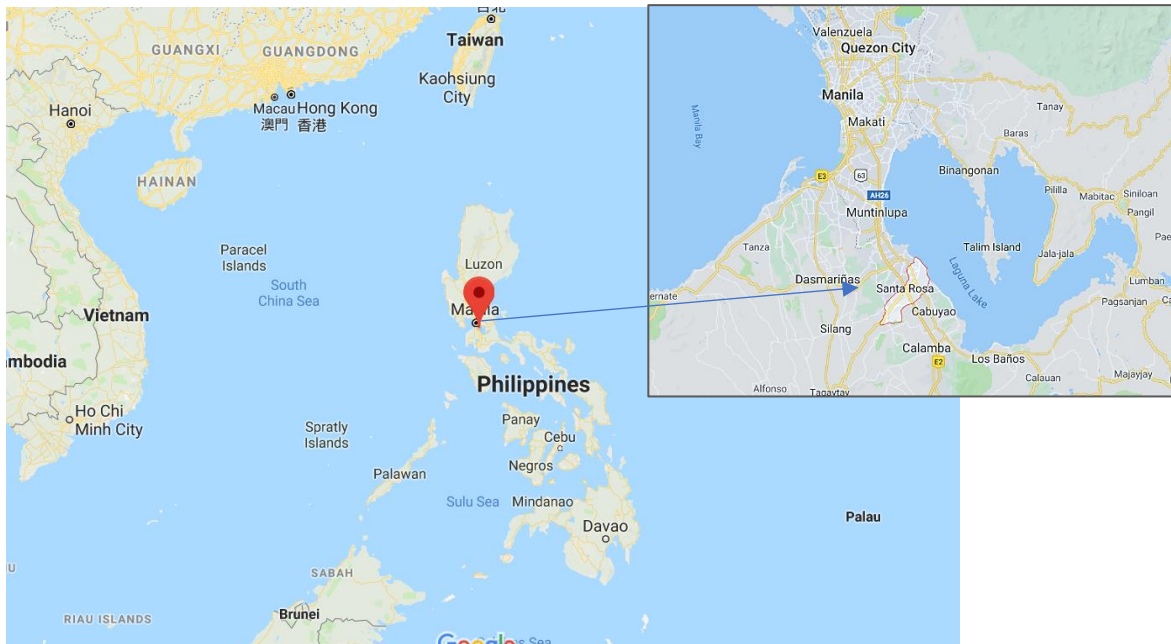


Figure 1. The location map of Santa Rosa City, which is located more than 30 kilometers south of Manila.

Sourced from Google maps

The City of Santa Rosa, home to more than 300,000 residents, is a first-class city¹ in the Province of Laguna. Santa Rosa is an urbanized city characterized by a vibrant economy driven by four Philippine Economic Zone Authorities. The City is also dubbed as the “Motor City of the Philippines” or “Little Detroit” due to the presence of several car manufacturers.

The City’s economy has propelled significant land use change since 1990s and agricultural lands were transformed to residential, commercial, and industrial uses. The presence of economic opportunities and Santa Rosa’s proximity to the National Capital Region also resulted to a booming residential sector. The residential sector occupies 3,061 hectares or 55% of the City’s total land area of 5,552 hectares, followed by the industrial sector at 1,053 hectares or 19%.²

Being a member city of the Building Efficiency Accelerator (BEA), Santa Rosa sets an example to other local governments in entwining economic growth with sustainable development through green building policies and practices. The first step to which is to localize a green building code and implement the Green Building City Challenge, which are the city’s commitments to the BEA.

¹ A city is classified as first class if its annual income is at least PHP 300M. Source: Philippine Statistics Authority, 2019 <https://psa.gov.ph/classification/psgc/?q=psgc/cities&page=3>

² Source: <https://www.santarosacity.gov.ph/about-sta-rosa/local-economy/>

This report documents the outcomes of a one-day workshop held in Santa Rosa last 29 April 2019. The workshop was envisioned to facilitate Santa Rosa’s mainstreaming of building energy efficiency and conservation (EE&C) policy and practices. Likewise, it was carried out to foster appreciation of fundamental green building practices which could feed into the local green building code slated to be enacted towards the fourth quarter of 2019.

II. Workshop Summary

The seminar-workshop on EE&C centered on building energy audit. The workshop was the BEA’s second collaboration with the Philippines’ Department of Energy (DOE) through its Energy Utilization and Management Bureau (EUMB) – Energy Efficiency and Conservation Division (EECD). The workshop was conducted to capacitate the City Government of Santa Rosa, specifically its City Engineering Office (CEO) and Office of the Building Official (OBO) as lead offices for future building EE&C initiatives. The workshop was also an opportunity for the city to learn DOE’s standard procedure on basic building energy audit.

Below is the summary of workshop attendees’ profile, i.e., the city government participants.

Table 1. Number of participants disaggregated by gender

Gender	Number of attendees
Male	14
Female	5
Total	19

Participants were mostly engineers by profession. Most participants were male as they dominate the engineering profession in the Philippines; however, it is noteworthy that the female participants actively joined in the discussion especially City Environment and Natural Resources Officer Ms. Erlinda Creencia who is also BEA’s point-of-contact of BEA in Santa Rosa.

Table 2. Participants disaggregated by office in the City Government of Santa Rosa

Offices/Division of Participants	Number
City Engineering Office	14
Office of the Building Official	3
City Environment and Natural Resources Office	2
Total	19

EUMB-EECD sent six technical employees to lead the discussion on building energy audit. The morning session focused on the presentation while the afternoon session centered on the demonstration of building energy audit.

1. Introductory remarks

Ms. Anna Dominique Ortiz, Project Officer of ICLEI Southeast Asia Secretariat presented an overview of the BEA and explained its significance with local action and international agenda such as the Sustainable Development Goals.

Engr. Antonio Nabong, Energy Audit Team Leader of EUMB-EECD, delivered DOE's message on EE&C. He emphasized the vital role that local governments must play in the anticipated enactment of the Energy Efficiency and Conservation Act³. "Should the Act become a national policy, it will institutionalize local governments to develop a local energy plan identifying energy efficiency and conservation measures", according to Engr. Nabong. Likewise, the Enercon Officer and the Energy Efficiency and Conservation office must be set-up by each local government.



The organizers and participants of the first building energy audit in Santa Rosa. ICLEI SEAS represented by Project Officers Anna Dominique Ortiz and Jose Bernardo Gochoco III (seated 1st and 2nd from the right) along with representatives of EUMB-EECD headed by Team Leader Tony Nabong (center) and the City Government of Santa Rosa with City Environment and Natural Resources Officer Erlinda Creencia (seated 3rd from left) as point-person for BEA initiatives in the City)

³ As of 08 May 2019, media sources reported that the Energy Efficiency and Conservation Act is now law, i.e. Republic Act No. 11285. Please see https://news.mb.com.ph/2019/05/07/energy-efficiency-conservation-now-mandated-by-law/?fbclid=IwAR2UJUHq-Uc-jBoTD9ExQXNDXpuFI5_B4wi-w1MTvAj8QH2g6i3nTspEB3M

2. Conducting the Building Energy Audit

Engr. Aaron Premacio of EUMB-EECD discussed the requirements in conducting a building energy audit. He also enumerated some EE&C best practices to differentiate it from conventional practices. Below are the points of his discussion.

- *Energy Conservation Officer (Enercon Officer)*. Designating an Enercon Officer is the first requirement of the building energy audit. The Enercon Officer will lead the implementation of EE&C measures in the local government buildings and facilities.
- *Efficiency vs. conservation*. Although both concepts aim to reduce energy consumption and costs, they differ on the means. “Conservation is changing or influencing the behavior of energy users, whereas efficiency is employing a technology to reduce losses in the system”, according to Engr. Premacio.
- *Efficient technologies*. Low-emitting diode (LED) lamps, LED displays, appliances with inverter technology such as air conditioning (AC) units are some efficient technologies cited. Engr. Premacio also highlighted that the auditor must determine whether the AC is an inverter or non-inverter type. An inverter AC is more energy efficient compared to conventional AC.
- *Conservation measures*. Conserving energy through daylight due to its high luminosity, which is the relative quantity of energy emitted by the sun or level of brightness radiated, is encouraged. Limiting usage hours of AC, for instance from 9:00 AM to 4:00 PM, also exemplifies energy conservation; however, comfort must be prioritized over conservation, especially when it may affect productivity.

Although employing conservation measures is cost-free as it does not require purchase of a technology, it could be difficult to apply because it involves change in attitude and behavior. Resistance to conservation measures is also possible.

- Fuel conservation (for vehicles) is included in the building energy audit. EUMB-EECD recommends to implement a fuel conservation program that includes measures such as carpooling, restricting idling of vehicles, measuring and monitoring of particulate matter emitted, and purchasing fuel-efficient vehicles. Engr. Premacio furthered that fuel-efficiency must be part of the criteria when a local government buys a vehicle.
- In terms of documentation, the LGU must keep an inventory of its lighting, air conditioning, office equipment, and list of service vehicles.

3. Energy conservation and efficiency tips

Engr. Christian Harris Hernaez presented energy efficiency opportunities. “A city must weigh first the benefits of shifting to energy-efficient technologies”, according to Engr. Hernaez. Below are the conservation and efficiency points he cited.

- Installing external shading on buildings to prevent unwanted heat from the sun and retrofitting of lights to LED are among simple efficiency measures that a local government may employ.
- Encouraging the use of stairs whenever possible, instead of using the elevator is another means to conserve energy consumption.
- *Installing and optimizing of new energy efficient chiller.* Although energy efficient chillers are rare in city halls as they just use AC units, it may be economical for commercial and manufacturing buildings.
- *Installing building management system (BMS) and energy management system (EMS).* BMS includes automated controls in the elevator, lighting and fire system, whereas EMS involves monitoring of energy consumption and savings and identifying conservation and efficiency measures.

4. Energy conservation tips on electricity and transport

Engr. Marc Vension Chua outlined some energy conservation tips for electricity and transport, and the advocacy effort of DOE through its National Energy Efficiency and Conservation Program (NEECP). Likewise, he briefly explained climate change and how much savings a global energy conservation activity like the Worldwide Fund for Nature’s Earth Hour can obtained.

- *Front-loading washer consumes less electricity than top-loading washers.* “The front-loader makes use of the gravitational pull, thus, it is more economical,” as explained by Engr. Chua.
- *Shifting to an inverter AC as its compressor operates on variable speed as compared to a non-inverter AC that runs on a single speed.* To illustrate, when setting the AC at 25°C, the compressor in an inverter AC slows down when it reaches the desired temperature, whereas a non-inverter type switches off. When the room eventually warms, the non-inverter AC re-activates at maximum speed. The constant shift in speed in non-inverter AC forces the compressor to work more, thus consuming more energy.
- *Refrigerator-care.* The refrigerator must not be overcrowded; air must be allowed to circulate. Its door must also be left closed all the time. To test whether a refrigerator’s door is working properly, a bill or paper remain in place when pinned between the magnetic strips.

- *Avoid phantom load.* Around 14% of home energy use comes from phantom load resulting from leaving turned off or in stand-by mode appliances plugged to electric sockets. “When the indicator light of an appliance is flashing red, it is hinting to be on phantom load”, added Engr. Chua.
- *Room size must match an AC’s cooling capacity.* AC units need to work harder to achieve the desired temperature if their capacity is inappropriate for the room size. The larger the area of a room, the more cooling capacity an AC must have. EUMB-EECD recommended the required cooling capacity for various room sizes as follows:

Table 3. Appropriate cooling capacity of air conditioning units according to room size in square meters

Room size (Sq. m.)	Manufacturer’s Equivalent Cooling Capacity Rating (kJ/hr.)	Manufacturer’s Equivalent Cooling Capacity Rating (Btu/hr.)	Approximate rating (HP)
14 to 16	7,385 – 8,440	7,000 – 8,000	¾
19 to 21	9,495 – 10,550	9,000 – 10,000	1.0
25 to 26	12,660 – 13,290	12,000 – 12,600	1.5
38 to 40	18,990 – 20,045	18,000 – 19,000	2

5. Actual Building Energy Audit

5.1. Building Energy Audit Equipment

Prior to conducting the building energy audit, EUMB-EECD introduced the equipment to be used. These included:

- **Lux meter** is used to measure brightness radiated by lighting in a room. The brightness or illumination in a room should be not lower than 250-300 lux⁴ to avoid eyestrain. “Although the eyes will adjust according to room lighting, the effects of a poorly [or overly] lit room would be felt in the long run. Thus, pushing for energy efficiency must not cost the health of the users,” as Engr. Hernaez emphasized. The suggested minimum lux is for safety reasons so as not to pose occupational health risk to persons occupying an area.
- **Thermostat** is used to measure average air temperature and relative humidity (RH), i.e., the amount of moisture mixed with air. The higher the moisture, the more energy is required to make it cooler or warmer, thus an AC needs to work harder at higher RH levels. “When using the thermostat, avoid placing it on the air flow of the air conditioning as it will fail to measure the average temperature in the room”, according to Engr. Chua. The ideal temperature in a room is around 25°C, whereas the ideal RH is 25.

⁴ Lux is a unit of illumination

- **Power quality analyzer**, consisting of probe and voltage analyzer, is used to measure the quality of power in Watt or kilowatts. It is also used to check the balance of voltage and power factor. The equipment costs around PHP 500,000 (around USD 9,000).
- **Power meter** is used to monitor the electricity consumption of an appliance. EUMB-EECD suggested to attach it to an AC to monitor electricity consumption.
- **Thermal scanner** measures thermal energy hotspots or heat radiated of an object in a certain area. The same device is used in airports to check the temperature of arriving airline passengers. The scanner cost around PHP800,000 (around USD16,000).

5.2. Building Energy Audit Demonstration

EUMB-EECD also demonstrated how to do a building energy audit, which centered on lighting and AC. A lux meter to measure brightness and a thermostat for temperature were used.

The offices audited were the Public Employment Service Office (PESO), Office the Civil Registrar (OCR), and the Human Resources and Management Office (HRMO). The three offices were observed to have a lux below the standard range of 250 to 300. As for temperature, some parts of the offices were warmer due to open doors or gaps in the office envelope, i.e., the office wall or windows. The OCR, for instance, have holes in their glass window for transaction causing cool air to leak outside. Although some areas have a warmer temperature, i.e., above the 25°C minimum suggested temperature, as in the case of the HRMO, the employees remained comfortable. The Chief of HRMO chided that the staff were “*lamigin*” or easily feel cold, prompting them to turn off the air conditioning.⁵

Overall, the building energy audit involving three City Government offices resulted to a passing score of 73.7% which entailed room for improvement on implementing EE&C measures. The energy audit also raised the awareness of the offices on their lapses and potentials in EE&C. Likewise, it served as an opportunity for the CEO and OBO to discuss potential improvements in lighting and AC especially within the city government buildings.

6. Responses to the workshop

- **Designating an Enercon team.** In response to the query of the CEO on the qualifications of an Enercon officer, Engr. Nabong did not specify a particular educational background, but he noted that the officer must be capable of leading the energy audit. He stressed, however, that the City Government may designate an Enercon team instead. For him, an ideal Enercon team consists of one electrical engineer, one mechanical engineer, one civil engineer or architect, an employee familiar with AutoCAD, financial managers to oversee budget and financing, and one who is adept in report or project proposal writing.

⁵ Note: It can be surmised that the ideal minimum standard of 25°C temperature in buildings may be relatively cold for some.

- **Establishing an audit standard.** According to Engr. Nabong, once the EE&C law is enacted, the DOE can set-up a building energy use index⁶, which can be used to monitor and measure whether a building is adhering to EE&C standards.
- **Setting up a baseline.** Engr. Nabong also advised the City Government of Santa Rosa to establish their baseline energy consumption as comparison for succeeding energy audits. The City Engineering Office of Santa Rosa requested for a template that they can use for conducting their building energy audit. DOE will furnish them a copy that is being used for the Government Energy Management Program (GEMP), which aims to reduce energy consumption among government agencies.
- **Updates on the EE&C Act.** According to Engr. Nabong, the 30-day requirement for the Philippine President to sign the Energy Efficiency and Conservation Bill had already passed. He hopes that it is now a law; however, he prefers to wait for the official pronouncement from the Office of the President. If passed as a law, the DOE will consult local governments and other stakeholders on developing the Implementing Rules and Regulations. l b

⁶ In kilowatt hours per square meter per year (kWh/sqm./yr.)

III. Appendices

1. Workshop Photos



Engr. Aaron Premacio explains the requirements in conducting a basic building energy audit



Engr. Christian Harris Hernaez shares the results of the lighting and temperature audit with the Public Employment Service Office



Engrs. Hernaez and Marc Venson Chua demonstrate the equipment needed for the building energy audit.



Engr. Tony Nabong shares his opinion regarding the qualifications of the Energy Conservation Officer and Energy Conservation Office

2. List of Participants

CENRO	DESIGNATION
Creencia, Erlinda C.	City Environment and Natural Resources Officer
Moral, Lea Nina	EMS II
CEO	
Solatan, Albertini S.	City Engineer Officer
Adduru, Gerwin U.	Engineer II
Almira, Roy D.	Engineer I
Amarante Jr., Angel P.	Engineer
Ambas, Peter Paul K.	Engineer I
Celedio, Haidee	Laborer
Delada, Jauntee Jo C.	Engineer II
Delfin, Bernaldo Jim	Engineering I
De Roxas, Arman H.	Engineer
Pedroso II, Lauro Q.	Engineer I
Reyes, Corinth Rhyan	ORAFTS MAN II
Ronquillo, Ramir R.	PDO II
Sy, Shefrine A.	Engineer II
Tumaming, Vicente	Engineer IV

OBO	DESIGNATION
Lijauco, Melody	Engineer I
Repato, Omnafe I.	Engineer I
Tardeo, Rodel	Engineer I

EUMB-EECD	DESIGNATION
Nabong, Antonio	Supervising Science Research Specialist (SRS) / Energy Audit Team Leader
Hernaes, Christian Harris T.	SRS II
Premacio, Aaron R.	SRS II
Escalona, Joan C.	Senior SRS
Agagas, Thelma P.	SRS
Chua, Marc Vension D.	SRS II
Nina, Gary	Driver