GOVERNMENT OF ST. LUCIA
MINISTRY OF PLANNING

ENERGY AUDIT OF

GREAHAM LOUISY BUILDING

CASTRIES ST. LUCIA

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Lewis Engineering Inc.

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1.0 OVERVIEW

1.1 GENERAL DESCRIPTION

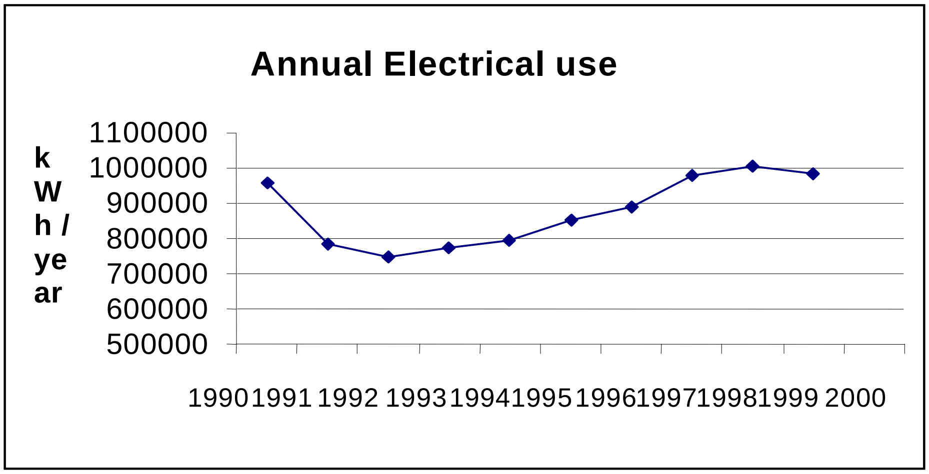
The Greaham Louisy Building is located in Castries, Saint Lucia. It is part of a multiple building complex that is owned and occupied by the government of Saint Lucia. This office building is 6 stories tall, with air conditioning throughout. All windows are fully externally shaded to minimize the solar load.

This is an office building, with typical equipment loads (computers, photocopiers, fax machines) and is generally occupied from 6am to 6pm Monday to Friday. Outside of these hours, the lighting and larger air conditioning systems are turned off. The interior has open-concept offices, and the exterior has smaller, private offices.

1.2 ENERGY ANALYSIS

Electricity is supplied to the building by LUCELEC, the National electric company of Saint Lucia. They are billed for the use of metered kWh, including a fluctuating rate based on the cost of diesel fuel as most of the power in the country is generated from diesel. There is no charge for peak electrical demand (kW or KVA).

In this study, a rate of 0.382 $EC /kWh plus 0.10 $EC/kWh (diesel surcharge) was used to estimate energy savings.



Annual energy use for the last ten years is shown above. The obvious reduction in use starting in 1991 is due to a staff initiative to shut off lights and equipment over night. Energy use began to rise again towards the end of the 1990s, likely reflecting an increase in office equipment (computers etc.) and more people in the building.

The building has a diesel generator to provide emergency power in case of a power outage.

1.3 SUMMARY OF RECOMMENDATIONS (EC $)

	Cost	Payback
• repair insulation on rooftop refrigerant piping	$ 2,205	3.7 yrs
• relocate thermostats for central a.c. units	$ 2,150	2 yrs
• repair duct insulation	$ 2,680	4 yrs
• install new light switches	$33,750	7 yrs

2.0 AIR CONDITIONING

2.1 EXISTING

The interior area of each floor is cooled by a 15 Ton refrigeration system, with two such systems on the ground floor. The evaporator and air handling unit are in the mechanical room on each floor. Cooled air is provided to the interior office area via short duct runs and wall mounted grilles. Air is returned through grilles in doors to the mechanical room. Each unit has a new Trane compressor/condenser unit located on the roof. A time clock turns each unit ON during office hours, from 6:30am to 7pm, 5 days a week, and the supply air temperature is controlled based on a thermostat located in the mechanical room, which provides a measure of the return air temperature.

These systems appear large enough to meet the cooling requirements, and we observed that they may be providing too much cooling in some cases.

It was observed that the refrigerant suction lines on the rooftop had damage to their insulation.

The perimeter office areas have thru-the-wall terminal cooling units. There are 150 such units located throughout the building, each with approximately 12000 Btu of direct expansion cooling, controlled with a local thermostat. In addition, there are 15 mini-split units of 30000 Btu each, also locally controlled. No problems were noted with either the capacity, or control of these units. Not all units were in working order, however, and some were improperly located based upon the furniture layout in the space they serve. A private service contractor provides regular service to all units in the building but there was some question from building occupants about the quality and level of service provided.

2.2 POTENTIAL RETROFITS (ALL VALUES IN EC$)

2.2.1 15 Ton Interior Units

The running hours of these units are already well controlled to minimize energy use. During off-hours, there will be no people or equipment to generate heat in this area, so the cooling is not needed.

It is recommended to repair the insulation on the refrigerant suction lines on the roof. The new exterior insulation covering should be a light colour and be UV-resistant. Similarly, the supply ductwork on each floor should be insulated.

Energy Saving:	$602 ($^{1}/_{3}$% of annual usage of this system)
Estimated Cost:	$2205
Simple Payback:	3.7 years

The control thermostats for the central units should be moved from the mechanical rooms into the conditioned spaces served by each unit. This will allow better control of the space temperature. Currently, the space temperature control is inconsistent.

Energy Saving:	$1061 (1% of annual usage of this system)
Other Benefits:	Better control of space temperature; better occupant comfort
Estimated Cost:	$2150
Simple Payback:	2 years

The ductwork carrying cool air should have its insulation repaired. This will ensure that the air cools the office space rather than gaining heat from the service areas. It will also eliminate problems with condensation forming on the ductwork. Energy savings will result if the space temperature is better controlled by the retrofit listed above.

Energy Saving:	$670
Estimated Cost:	$2680
Simple Payback:	4 years

2.2.2 Terminal Wall Units

Larger air conditioning units are generally more efficient than small ones. However, in a building of this size, it is not economically nor aesthetically feasible to put in a central system after-the-fact. In addition, the existing units with local control provide a high level of user comfort.

Consideration was given to upgrading the units with more efficient ones, but the estimated 7% savings do just justify the capital cost. Whenever it is necessary to replace units, consideration should be given to the efficiency (EER) of the new unit. EER of the existing units averages 8- 8.5 while best in class units have an EER of 10.

“Soft” savings should be achievable by educating users about the units. For instance, by raising the set-point when there is no one in the space. User education is discussed elsewhere.

3.0 LIGHTING SYSTEM

3.1 EXISTING

The lighting in this office building is supplied by fluorescent, ceiling mounted fixtures, providing an average light level of 20 to 40 foot-candles as measured during our visit. There was concern expressed by some building occupants about inadequate light levels, and we observed shadows and dark areas (uneven light).

On floors one through five, two foot by two foot fixtures are mounted in indentations in the precast concrete slab that forms the ceiling. Each fixture (approx. 140 per floor) has two 24 inch fluorescent T12 tubes (F20T12) and one magnetic ballast, estimated to use 44W per fixture.

On the ground floor, where the ceilings are higher, four foot fixtures have been chain hung to provide lighting closer to the work areas. Each of these fixtures (approx 50) has two 48 inch fluorescent T12 tubes (F40T12) and one magnetic ballast, estimated to use 88W per fixture.

The ground floor lobby and core areas of each floor have 40 and 54 watt fluorescent light fixtures respectively. The ground floor lobby has 10 fixtures while each core area of floors 1 – 5 has 11 fixtures. The building has 2 stairwells, each containing 13 20 watt O tube wall mounted fixtures.

This general overhead lighting is wired to a twenty circuit breaker panel in the mechanical room on each floor. Maintenance staff are responsible for turning lights OFF each night and ON each morning, so that hours of use of the lighting system is minimized (estimated at 52.5 hours/week.) Stairway and lobby lighting is left on at all times. All on/off switching of lights is done at these panels.

An assortment of other lighting fixtures are in use, but they are few and scattered and have not been considered in this preliminary analysis.

The estimated energy use of the building lighting is 150,000 kWh, about 15% of the annual total electricity use, and energy use per square foot of office space.

3.2 POTENTIAL RETROFITS

3.2.1 Reducing Hours

The simplest way to reduce the energy used by the lighting system, is to reduce the amount of hours that the lighting is on. This is being done now, with lights being turned off at night and on weekends. It is recommended to install wall switches to accomplish this rather than continue to use the circuit breakers. Circuit breakers are designed to protect the electrical system from overload, and resulting electrical fires. They are not intended to be used in their current manner as switches. It is recommended to locate the new wall switches in public areas, and to educate the building occupants to turn lights off when not in use. Staff will continue to confirm that all lights are OFF at the end of the day. If lights are turned off when areas are not in use (about 25% of offices were not in use during our visit) and perimeter office lighting turned off when there is sufficient outdoor light, additional savings will be realized.

Energy Savings:	10,000 kWh; $4820 (10% of annual overhead lighting usage)
Estimated Cost:	$33750 (install 20 x 6 new wall switches)
Simple Payback:	7 years
Other Benefits:	Reduced wear on breakers; Easier access to switching

3.2.2 Effectiveness of Lighting System

The existing lighting system could be retrofitted to use less energy (explained in retrofits below) and continue to deliver the same amount of light. However, the existing system is not satisfactory to the users, generally having low and uneven light levels.

Therefore, it is recommended that a more thorough analysis be undertaken of the building lighting requirements. An agent for a reputable lighting manufacturer will be able to determine the optimum type and distribution of fixtures to achieve the best light levels at the lowest energy cost. We can provide the names of agents who service the Caribbean region if requested. Any changes should provide appropriate light levels for all workers and incorporate energy efficient technology, while also being sensitive to the limitation of the ceiling configuration, and the local availability/affordability of lamps.

The retrofits below are shown to give an idea of the magnitude of what is possible. They are not recommended without a more in depth lighting study.

3.2.3 Energy Efficient Lamps and Ballasts

The fluorescent lamps in use at the facility now (T12) are no longer in wide use in North America or Europe. Instead, users are going with newer options that use less energy but provide similar light output. The best option (reasonable availability and energy savings) would entail replacing the T12 lamps with new, thinner T8 lamps, and replacing magnetic ballasts with electronic ones. These components are available in St Lucia, and the T8 lamps are at only a small premium over those currently in use. This upgrade in technology will also require new fixtures, specifically designed for these lamps and with reflectors to maximize light output.

Replacing the two foot fixtures would reduce their energy use by more than 20%. However, these savings would not be enough to cover the estimated cost of such an upgrade. The simple payback is more than 15 years.

The four foot fixtures on the ground floor, each with higher energy use and more savings potential (30%), could be retrofit with new T8 fixtures. The simple payback would be eight years.

3.2.4 Daylight Dimming

Often during the daytime, perimeter areas get a lot of light from outside. A light level sensor could be installed in representative spaces, and the lights automatically dimmed when there is sufficient light from outside. This requires dimmable electronic ballasts, a sensor/controller and an appropriate group of interconnected fixtures. Such a modification is not economical at this time, due to the current light fixture layout and circuiting arrangement, but should be considered as part of an overall re-design.

4.0 OTHER CONSERVATION OPPORTUNITIES

4.1 OFFICE EQUIPMENT

Office equipment uses electricity in two ways: first, each computer or copier requires electricity to run; second, while in use these devices generate heat that increases the load on the air conditioning system. Therefore, it is important that equipment not be on more than necessary. As part of any energy conservation project, education of the building users in things such as this must be a key component.

Such an education campaign would also advise users about water conservation, turning off lights, and strategies to reduce the use of the smaller a/c systems.

4.2 UPGRADING ROOF INSULATION

Upgrading the insulation in the roof would reduce the heat gain on the upper floor. Although this would reduce energy use, it is not a modification that could pay for itself through the resultant savings. The only practical way to add insulation to the roof would be to remove the existing asphalt roofing material, install new insulation over the existing, and then install new roofing over the insulation. The existing roofing material appears to be in good condition and will not require replacement for a number of years. Once the roofing material is in need of replacement, however, adding additional insulation at this time would be recommended.