Overview

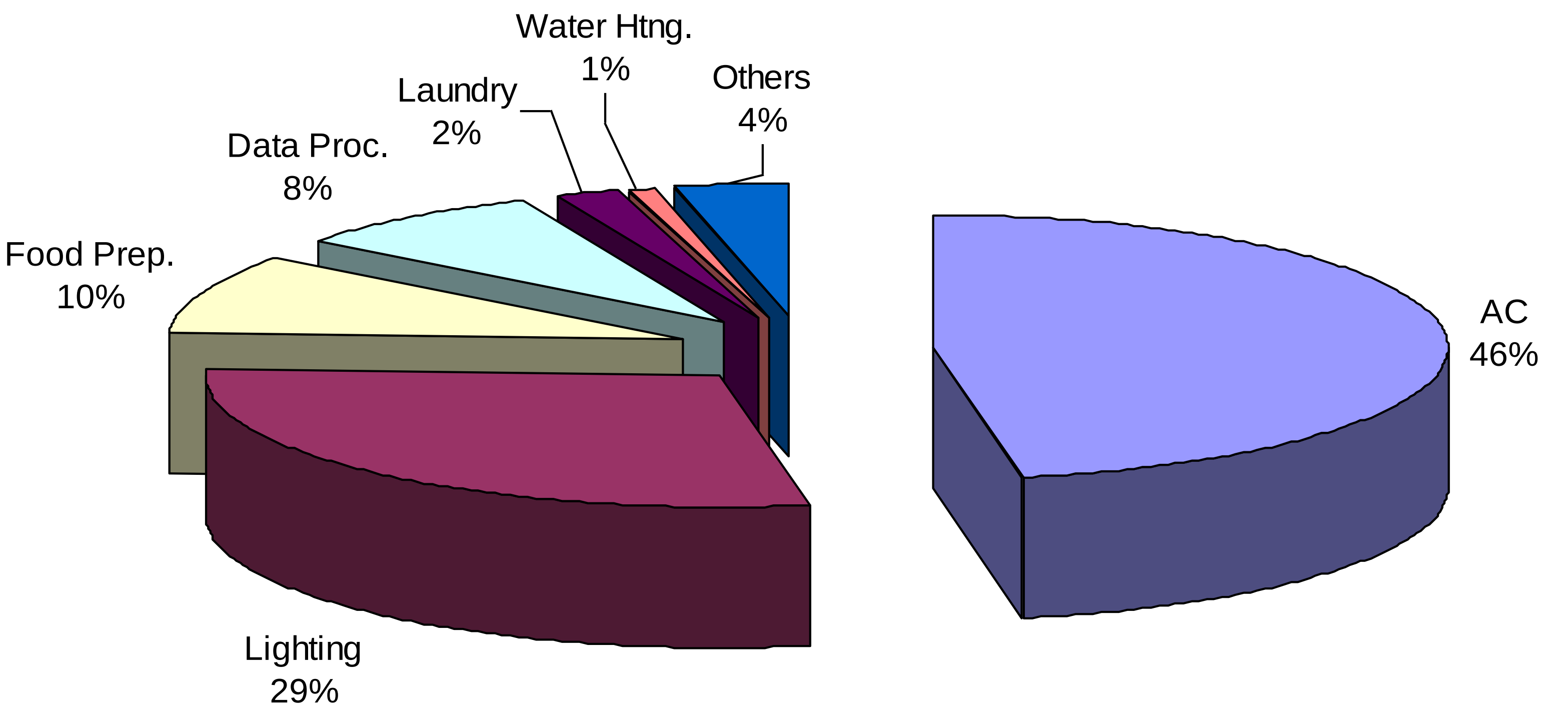
- The Energy Conservation Project Office of the University of the West Indies, Mona (ECPO) was spawned out of a need to curb the high costs that results from running the campus' day-to-day operations
- It was the Utilities Committee, chaired by the Campus Bursar Mrs. Elaine Robinson, that spearheaded its Implementation
- The ECPO was mandated to find ways to efficiently monitor and manage energy consumption measures on this very large University facility which is located on 653 acres of land without upsetting the daily status quo and also without effecting unwarranted changes in the educational product.

ECP
The University of the West Indies, Mona
Energy Conservation Project

UWI Energy Audit

- An Energy Audit of UWI was undertaken by Caribbean ESCo Ltd and it facilitated insight and accurately identified areas in which energy is used.

Estimated Electricity End Use (kWh) Consumption Breakdown



ECPO Project Management

Energy Management at UWI, Mona

Prudent Implementation of Energy Conservation Measures (ECMs)

- ECMS
  - Energy Conservation Opportunities (ECOs)
  - Social Marketing (SMs)
  - Renewable Energy Technologies (RETs)
- Faced with financial constraints the ECPO uses a planning strategy and financial prioritization in identifying the ECMs to be implemented in pursuit of sustainable and efficient energy use
- The following ECMs have been pursued with Caribbean ESCo:

Efficient Energy Management of Energy Conservation Opportunities (ECO)

- **ECO 1.** Improved AC Units' Energy Efficiency Ratio (EER).
  - Retrofitted 646 mini-split AC units, an equivalent of 1413 Tons, with Natural Hydrocarbon Refrigerant
  - AC Chiller optimization and UWI AC Service Park
  - Implementation of Campus AC Policy
- **ECO 2.** Improved Campus Power Factor from 0.88 to 0.96
  - Installed variable Power Factor Correction Capacitor Banks
  - Replaced Magnetic Ballast with efficient Electronic Ballast
- **ECO 3**. Improved Lighting Efficiency in buildings:
  - Replaced 40W T12 lamps with 32W T8 lamps using electronic ballast
  - Replaced 20W T12 lamps with 18W T8 lamps using electronic ballast
  - Installed Occupancy Sensors
  - Carried out pilot project on LED lighting for select operations

ECO 1A – Refrigerant Retrofit

- **ECO 1.** Improved AC Units' Energy Efficiency Ratio (EER).
  - Retrofitted 646 mini-split AC units, an equivalent of 1413 Tons, with Natural Hydrocarbon Refrigerant

November 6, 2006	No. of units	Total Cooling Capacity (Tons)	% Reduction in Power (Kilowatts)	Estimated Annual Savings (KwH)
1 Administration & Special Agencies	116	291.4	23.3%	49,235
2 Department of Life Sciences	101	184.3	16.5%	53,754
3 Faculty of Social Science	219	368.9	22.4%	101,050
4 Faculty of Pure & Applied Science	67	302.0	27.4%	67,767
5 Humanities and Education	143	266.2	27.1%	78,233

Total number of units	646
Total Cooling Capacity changed (Tons)	1413
Weighted Average Reduction in Power	23.8%
Total Reduction in Power (Kilowatts)	350.0
Annual Reduction in Energy (Kilowatt-Hours)	350,039
Value of Power Savings	J$2,671,496
Value of Energy Savings	J$5,600,621
Total Annual Savings	J$8,272,117
Cost of Project @ US$70 per ton	J$6,507,548
Payback Period (Years)	0.8

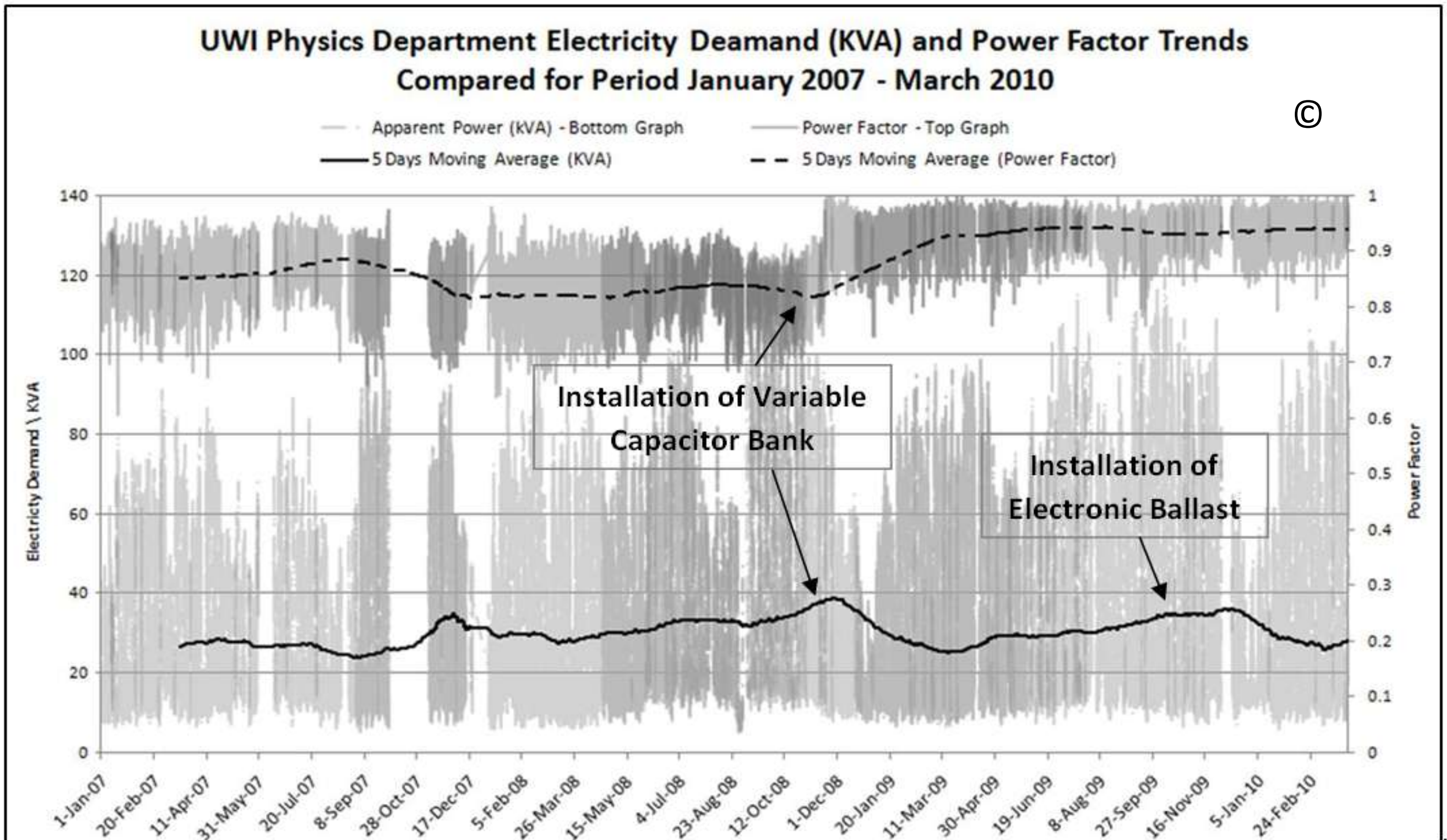
Note: Estimated Savings assum (1) 1000 hours operation for each A/C unit
(2) Electricity cost of J$16 per Kilowatt-hour
(3) Demand charge of J$636 / KVA per month

ECO 1B – AC Optimization Project

- Implementation and Operationalization of Campus AC Policy, towards the sustainable and efficient management of Air Conditioning in: Procurement, Installation, Usage, Servicing and Retirement.
- Assess the condition of all existing central AC chiller systems and effect repairs and consolidate accordingly
- Proposed Construction of an AC Service Park / District Cooling where several Central chiller systems, complete with thermal energy storage (Ice-Cells) and electricity generators will be used to provide / distribute cooling to several different facilities from a single point

ECO 2 - Improve Campus Power Factor from 0.88 to 0.96 (Department of Physics Pilot Project)

- Installed variable Power Factor Correction Capacitor Banks
- Replaced Magnetic Ballast with efficient Electronic Ballast



Actual Savings From Power Factor Correction Project for Physics Department

Before		
Highest Measured Demand (Oct. 2008)	109	kVA
Measured Power Factor	0.73	
Actual Power Calculation	80	kW
Reactive Power Calculation	75	kVAr
After		
New Highest Measured Demand	82	kVA
New Measured Power Factor	0.97	
New Reactive Power Calculation	20	kVAr
Reactive Demand Differential	55	kVAr
The Financial Benefit		
Measured Power Factor	0.73	
New Power Factor	0.97	
Measured Demand	109	kVa
New Highest Measured Demand	82	kVa
Reduction in Demand	27	kVa
Demand Rate (yr. 2008)	J$1,160.17	/kVa
Demand Savings-	J$31,324.59	per month
	J$375,895.08	per annum
Power Factor Correction Capital Cost	J$277,000.00	
Simple Payback (months)	9	months

ECO 2 - Benefits of Power Factor Correction Project

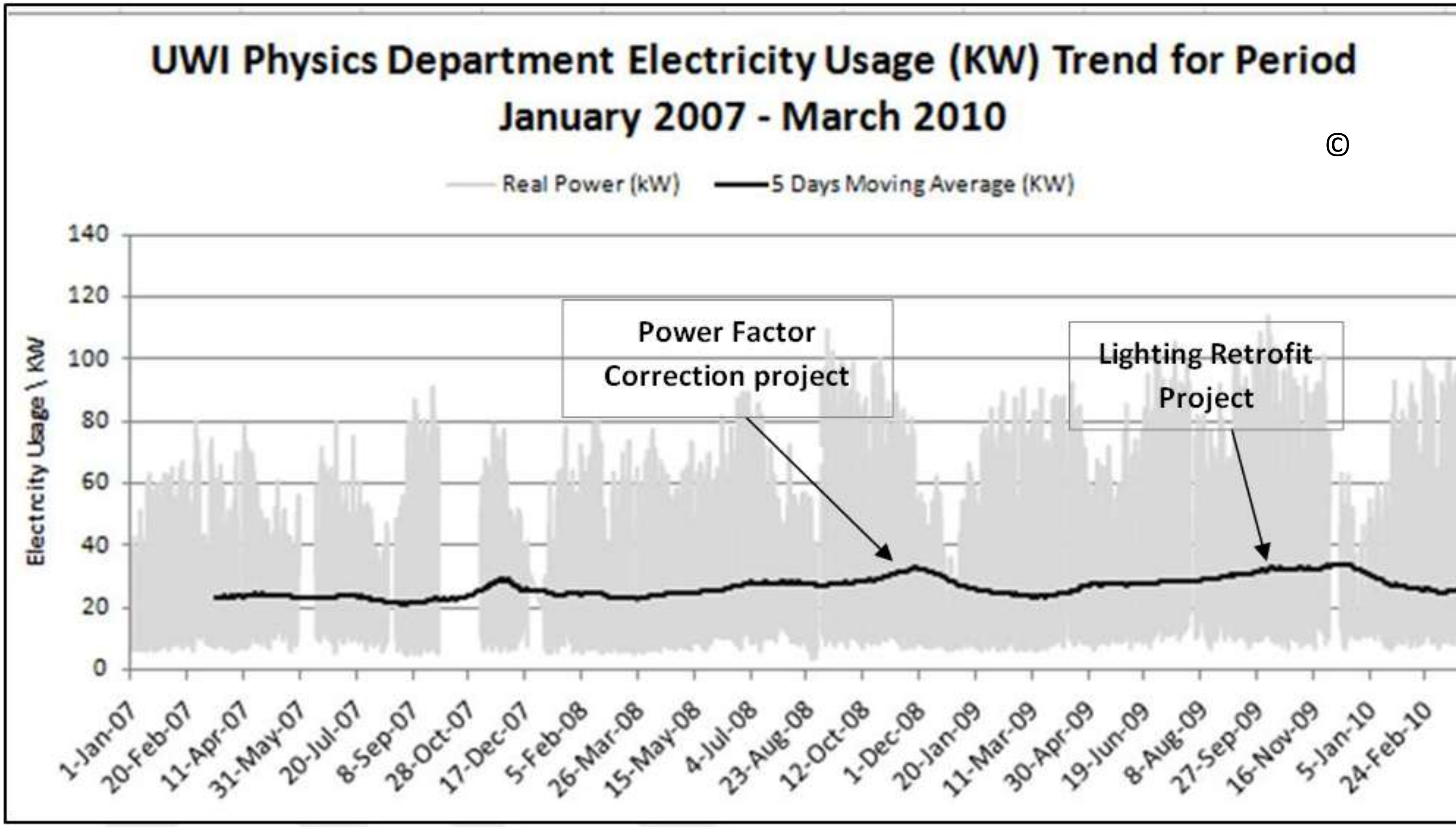
- Improvement in energy efficiency; that is, reduction in energy demand and energy usage
- Improvement in power factor
- Improvement in power quality, hence protection for equipment
- Improvement in usable life of power transformers as reduction in load demand will allow more capacity for future expansion without the need to buy a new power transformer

ECO 3 - Improve Lighting Efficiency in buildings (Department of Physics Pilot Project)

- Replaced 40W T12 lamps with 32W T8 lamps using electronic ballast
- Replaced 20W T12 lamps with 18W T8 lamps using electronic ballast
- Installed Occupancy Sensors
- Carried out pilot project on LED lighting for select operations
  - 160 LED linear tubes were installed during December 21 -22 , 2009
  - Objectives: (1) to determine the reduction in energy consumed when LEDs replace Fluorescent lighting systems, (2) to determine the impact of LEDs on lighting levels for area and task lighting, (3) to assess the reliability and maintenance requirements for LEDs, (4) to assess other learning targets such as determining price were LED will become a viable alternative to fluorescent tubes based on its payback period.

ECP
The University of the West Indies, Mona
Energy Conservation Project

Proof of Performance – Lighting Retrofit Project



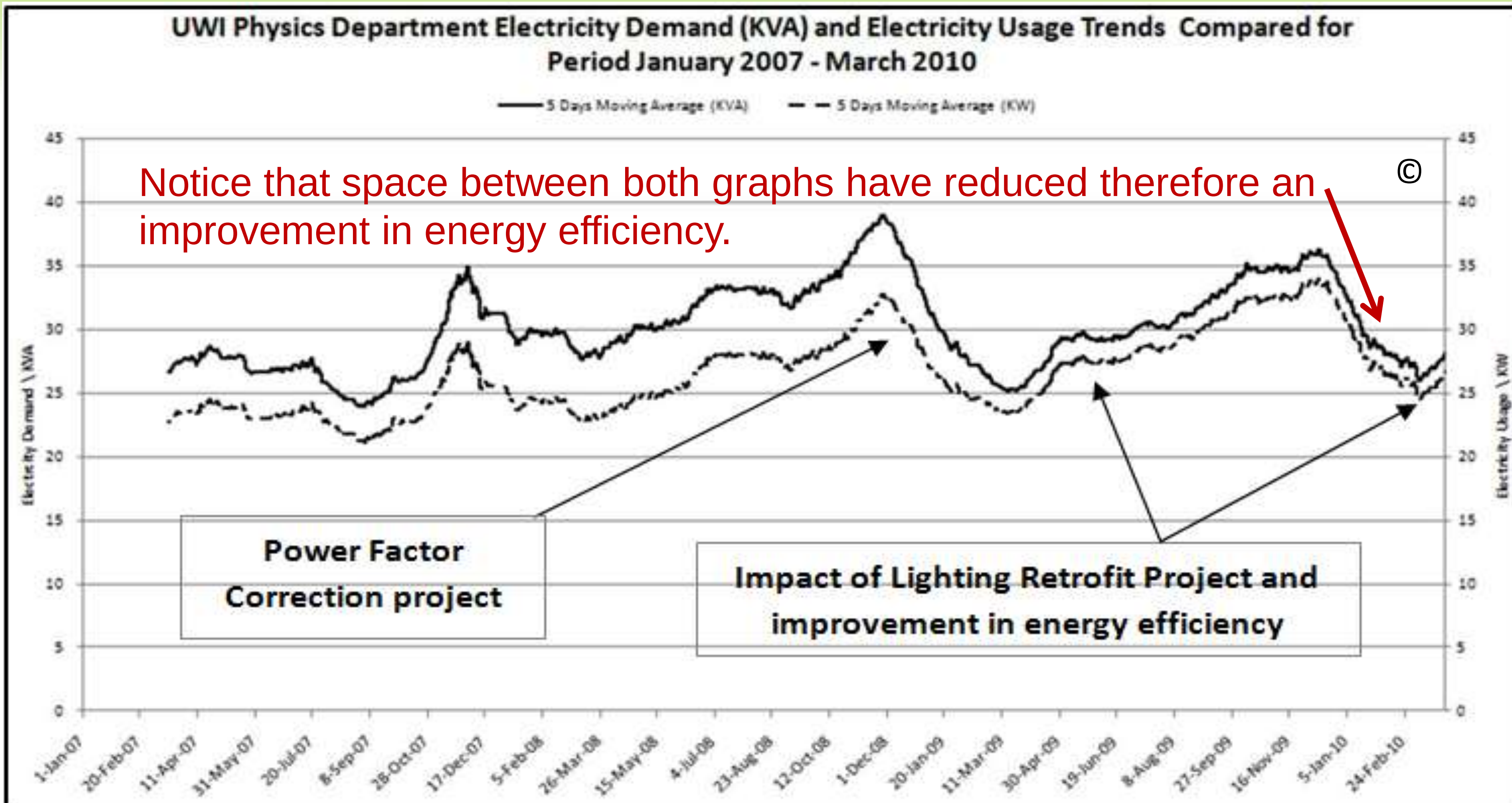
Benefits of Lighting Retrofit Project

- **Lighting Retrofit Project**
  - Improvement in energy efficiency; that is, reduction in energy consumption and energy demand
  - Reduction in carbon emissions
  - Improvement to building lighting infrastructure
  - Improvement in lighting levels and quality
  - Improvement in power factor
  - Reduction in operating cost
  - Reduction in AC heat loading due to reduced operating temperature
  - Reduction in maintenance cost and inventory levels because of improved fluorescent tubes and ballast lifetime from 10,000 hours to 20,000 hours

Impact at Physics Department

- Physics benefited from both ECOs
- Physics has been experiencing a lot of development over the past two years:
  - new educational products
  - increase in student enrolment
  - expansion/renovation of facilities
  - New virtual computer lab and several new AC units
  - Outreach programmes during periods that are usually Christmas or Summer breaks (changes in patterns of use)
- Even though Physics added load its energy consumption and demand was shown to decrease.

Combined Effect of Both ECO 2 and ECO 3 – Improvement in Energy Efficiency (Department of Physics Pilot Project)



ECO 4 - Installed and Applied a Computerized Energy Management and Monitoring System (UWICEMMS)

- UWICEMMS does the following:
- Implemented
  - Monitor, record and store all electrical parameters of buildings, systems and facilities
  - Provide the capability to substantiate the consumption levels of electricity and water of various departments and facilities
  - Verify, through analysis, the operation of the energy efficiency measures and programs and eventually verify levels of energy savings.
- To be Implemented
  - Manage the operation of central AC units, lighting, and allow for integration with emergency and access control systems.
  - Curriculum component for undergraduate and postgraduate degree programmes.

ECP
The University of the West Indies, Mona
Energy Conservation Project

People Component and Social Marketing (SM)

- **SM 1.** Developed and implemented UWI AC Policy and UWI Green Buildings Guidelines and Policy documents
- **SM 2.** Pursuing a Staff Energy Coordinators Programme for each Department
- **SM 3**. Pursuing a Student Energy Coordinators Programme for Halls of Residence

ECP
The University of the West Indies, Mona
Energy Conservation Project

Renewable / Alternative Energy Technologies (RETs)

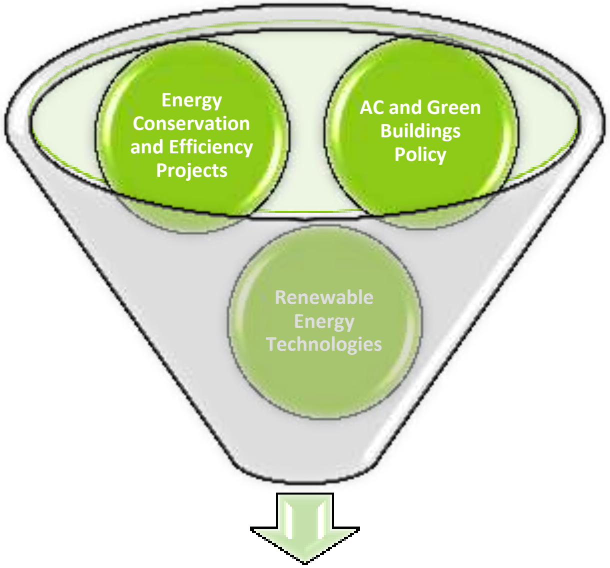
- **RET 1**. Tertiary Wastewater Treatment Plant (TWTP)
  - Provides 80,000 gallons of tertiary treated wastewater daily to playing fields (football, cricket, etc) at Mona Bowl (large sporting facility).
  - Curriculum component allows environment science students to use the TWTP for instruction, research and field trips.
- **RET 2**. Plans to Implement a Cogeneration Plant
  - Move forward based on results of completed feasibility study
  - Thought to be the best response to the existing challenges of: huge budget cuts, increasing competition from other tertiary institutions, offset substantial increase in electricity demand and energy consumption resulting from expansion and construction of new of facilities, and annual increases in utility electricity charges

ECP
The University of the West Indies, Mona
Energy Conservation Project

Success Stories

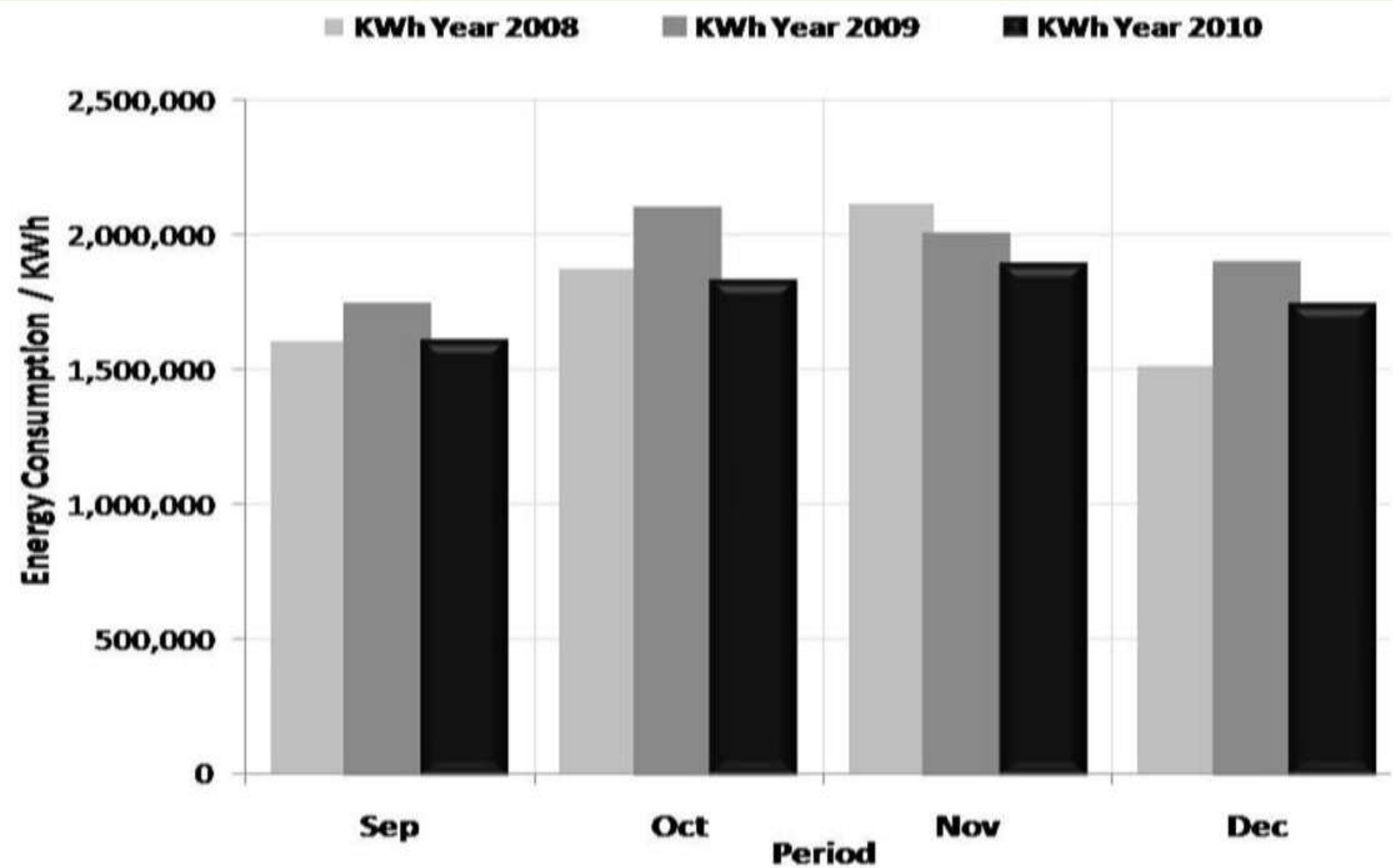
PROJECTED CAMPUS-WIDE IMPACT

- The Success at Physics was replicated campus-wide and in some cases with even better results



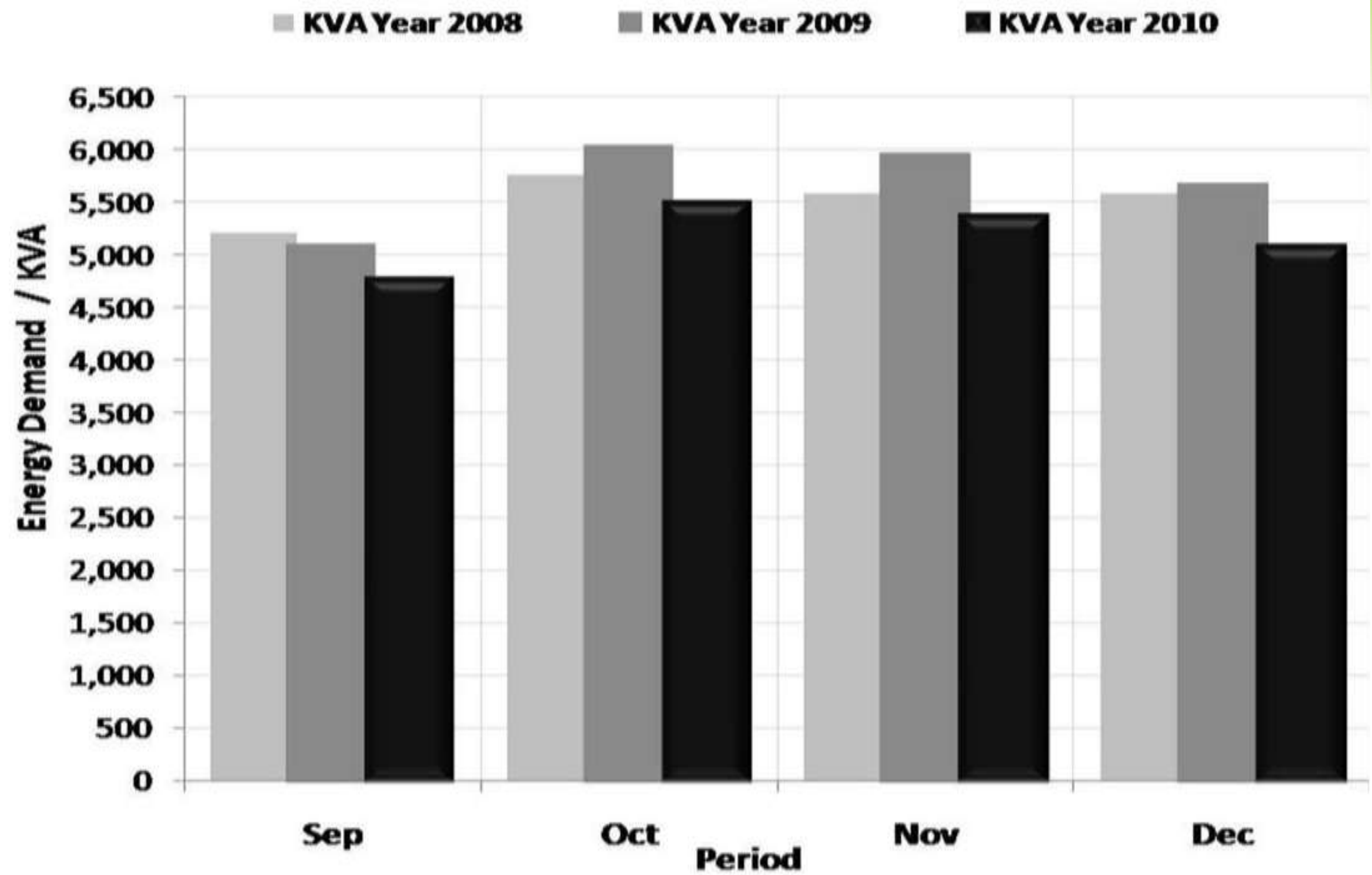
Savings in UWI Electric Utility Bill

Success – Reduction in KWh



By: Stanley G. Smellie

Success – Reduction in KVA



By: Stanley G. Smellie

ECP The University of the West Indies, Mona Energy Conservation Project

A Closer Look and Reductions in KWh and KVA

- Year-over-year comparison of UWI power demand (KVA) and energy consumption (KWh) for the billing period August – December and the years 2005 -2010

Period (Aug – Dec) Year	Avg. KVA/Month	Avg. KWh/Month	Avg. JPSCo Unit $/KVA	Avg. JPSCo Unit $/KWh	Avg. JPSCo Unit $/Fuel&IPP	Total Billing Days
2005	5,049.6	1,654,416.0	$670.20	$1.64	$6.51	153
2006	5,227.2	1,723,536.0	$729.00	$1.80	$8.43	153
2007	5,371.2	1,755,936.0	$755.00	$1.94	$13.17	153
2008	5,472.0	1,800,624.0	$822.00	$2.18	$13.70	149
2009	5,611.2	1,938,295.8	$880.71	$2.39	$13.70	153
2010	5,169.6	1,767,700.8	$1,165.75	$3.39	$14.82	153

Success – Monthly Savings

- Average Monthly "Dollar Value" savings in Electricity cost for period Aug. Dec 2010 is **$3,621,330.15**

NB:

$\langle \square \rangle$ **Means 'average'**

Δ **Means 'change'**

Dollar Value

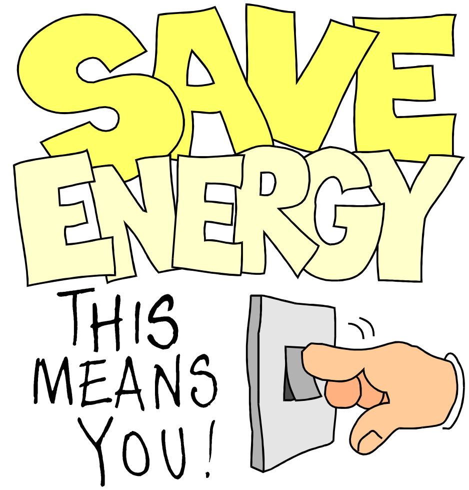
$$= (\langle KVA\ \Delta\rangle \times \langle Unit\ \$/KVA\rangle) + (\langle KWh\ \Delta\rangle \times \langle Unit\ \$/KWh\rangle) + (\langle KWh\ \Delta\rangle \times \langle \$/Fuel\&IPP\rangle)$$

$$= Demand\ Charge + Energy\ Consumption\ Charge + Fuel\&IPP\ Charge$$

NB: This is identical to how JPSCo do their monthly calculations when billing UWI with the addition of a variable F/E Adjust and a fixed customer a charge.

Period Aug -Dec Year	Avg. KVA Change (Current period - previous period)	Avg. KWh Change (Current period - previous period)	Avg. JPSCo Unit $/KVA	Avg. JPSCo Unit $/KWh	Avg. JPSCo Unit $/Fuel&IPP	Total Billing Days	Dollar Value
2008	(base year)						
2009	139.20 KVA	137,671.80 KWh	$880.71	$2.39	$13.70	153	**$2,337,734.09**
2010	-441.60 KVA	-170,595.00 KWh	$1,165.75	$3.39	$14.82	153	($3,621,330.15)

ECP
The University of the West Indies, Mona
Energy Conservation Project



The End

Stanley G. Smellie
Energy Engineer,
Energy Conservation Project Office
University of the West Indies, Mona
stanley.smellie@uwimona.edu.jm
Tel: 876-970-6427