Hydrocarbon Refrigerants the Jamaican Experience

The Natural Energy Saving Alternative

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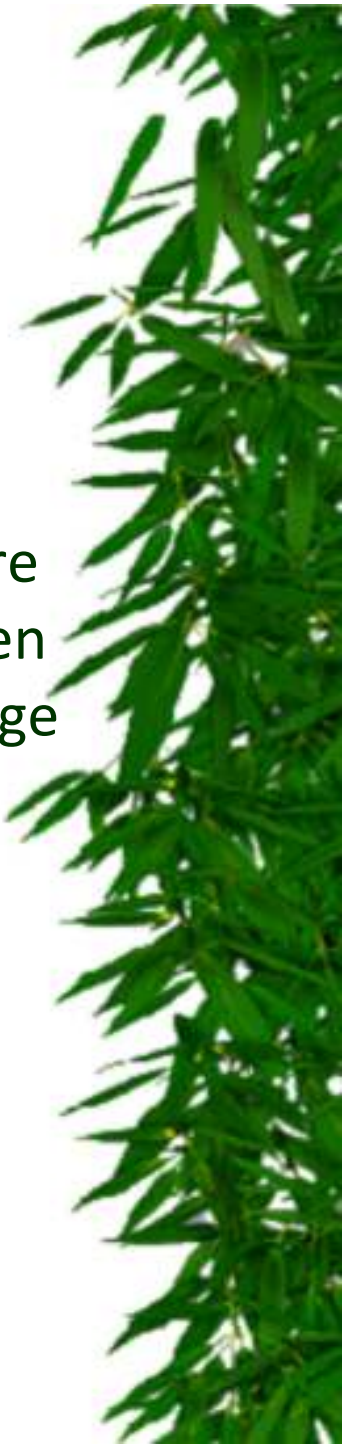
Introduction to HC Refrigerants (The Jamaica Experience.)

Most of the Caribbean countries have low Ozone Depleting Substances (ODS) consumption, but anyway we have a commitment to Montreal Protocol to phase-out the CFCs by 2010.

Many refrigerants are available to replace CFCs. R-22 and other HCFCs are not long term replacement for CFCs, because they will phased out in the near future.

Hydrocarbons are naturally occurring substances that are obtained from refineries after distillation. They have been used as refrigerants for many decades, mostly in very large industrial plant.

The hydrocarbon refrigerants can be used in:
New technologies and
Substitute in current technologies.



National Potential for Energy Saving, Using Hydrocarbon Refrigerants

- This year, Jamaica will spend at least US$1.00 billion on imported oil.

- JPSCo. uses about a quarter of this, and about 60% of that goes into cooling and refrigeration.

National Potential for Energy Saving, Using Hydrocarbon Refrigerants

- i.e., US 1 billion x 0,25 x 0.6 = US$150.00 million of foreign exchange is used for cooling.

- If we save only 20% of that amount, we save US$30.00 million per year.

Duracool®
12a

Duracool®
6 oz. Cans

Duracool®
12a Recharge Kit

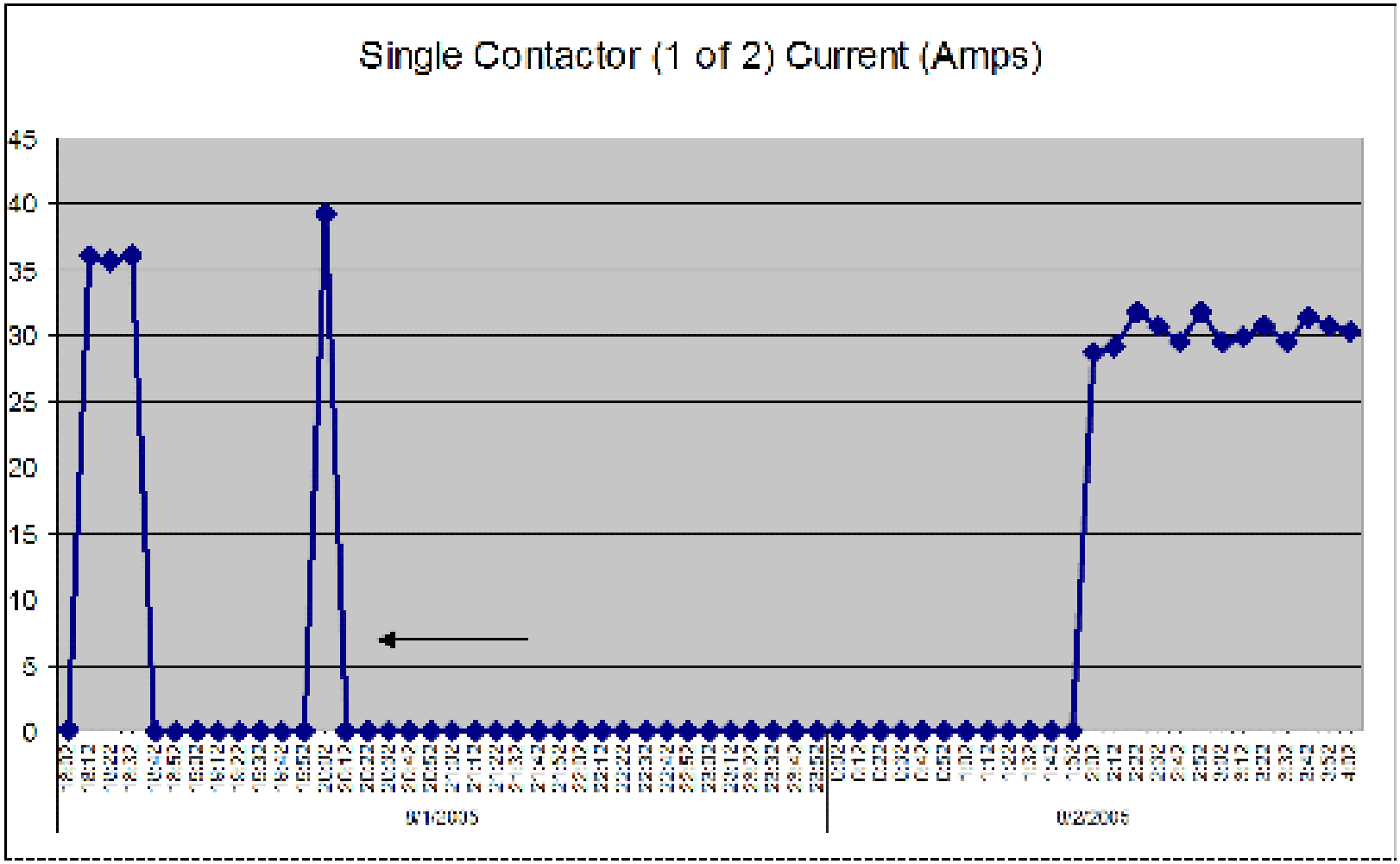
Duracool®
12a Cylinder

HC Technician

- Is carrying out pioneering work in the application of HC Refrigerants.
- Developing new ways in utilizing alternative refrigerants.

Monitoring Hookup

Hotel Chiller Change-out Exercise Current Log

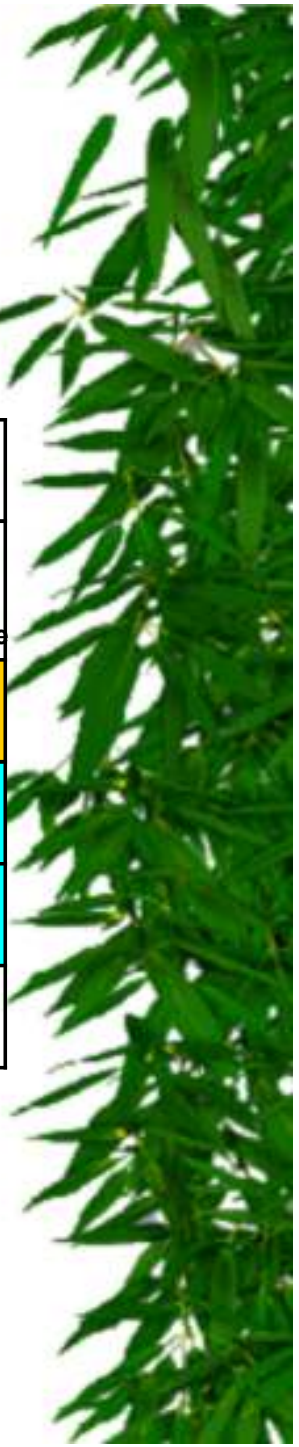


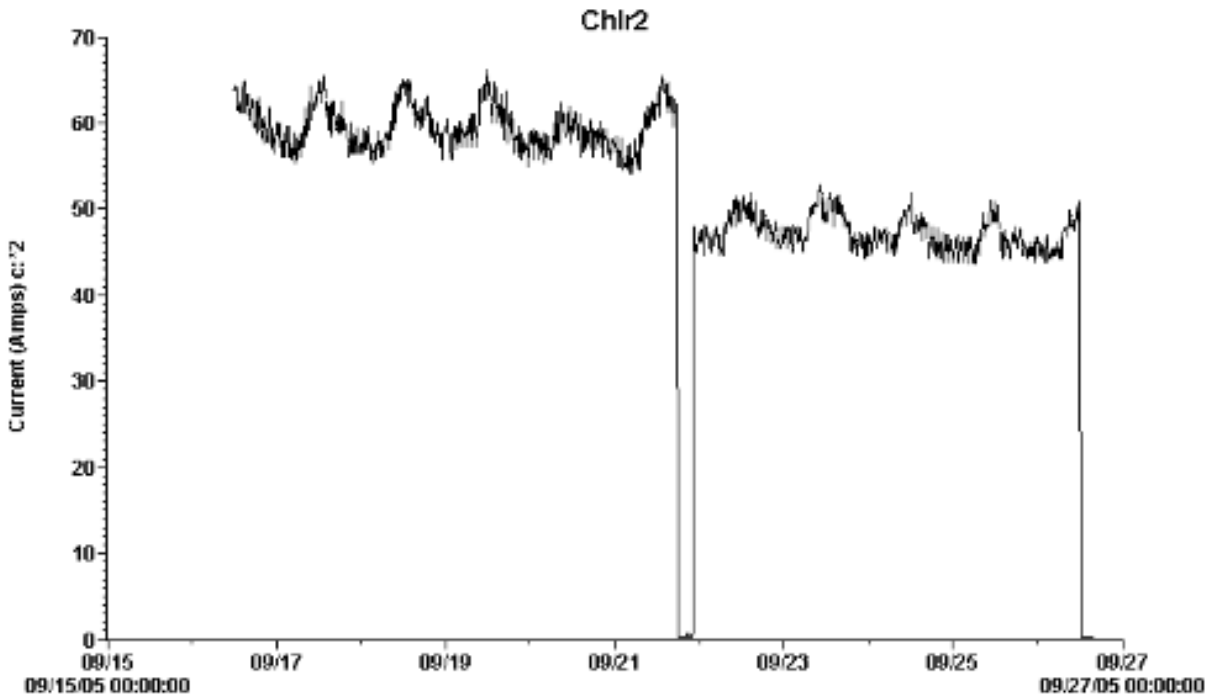
50-ton Chiller Data.

DESCRIPTION							
UNIT TYPE & MODEL #		REF. CHARGE (lb)	VOLTS	AMPS	INPUT POWER (kVA)	Head Pressure	Suction Pressure
	BEFOR	105	400	72	50	360	70
	AFTER	42	400	60	42	260	60
	DIFF.			12	8.3	100	10
Chiller #3 Comp #2 .	% Diff.,			17%	17%	28%	14%

CHILLER PROJECT

DESCRIPTION								
UNIT TYPE & MODEL #		REF. CHARGE (lb)	VOLTS	AMPS	PHASE	INPUT POWER (kVA)	Head Pressure	Suction Pressure
	BEFORE	105	400	72	3	50	360	70
	AFTER	42	400	60	3	42	260	60
	DIFF.			12		8.3	100	10
Chiller #3 Comp #2	. % Diff.,			17%		17%	28%	14%

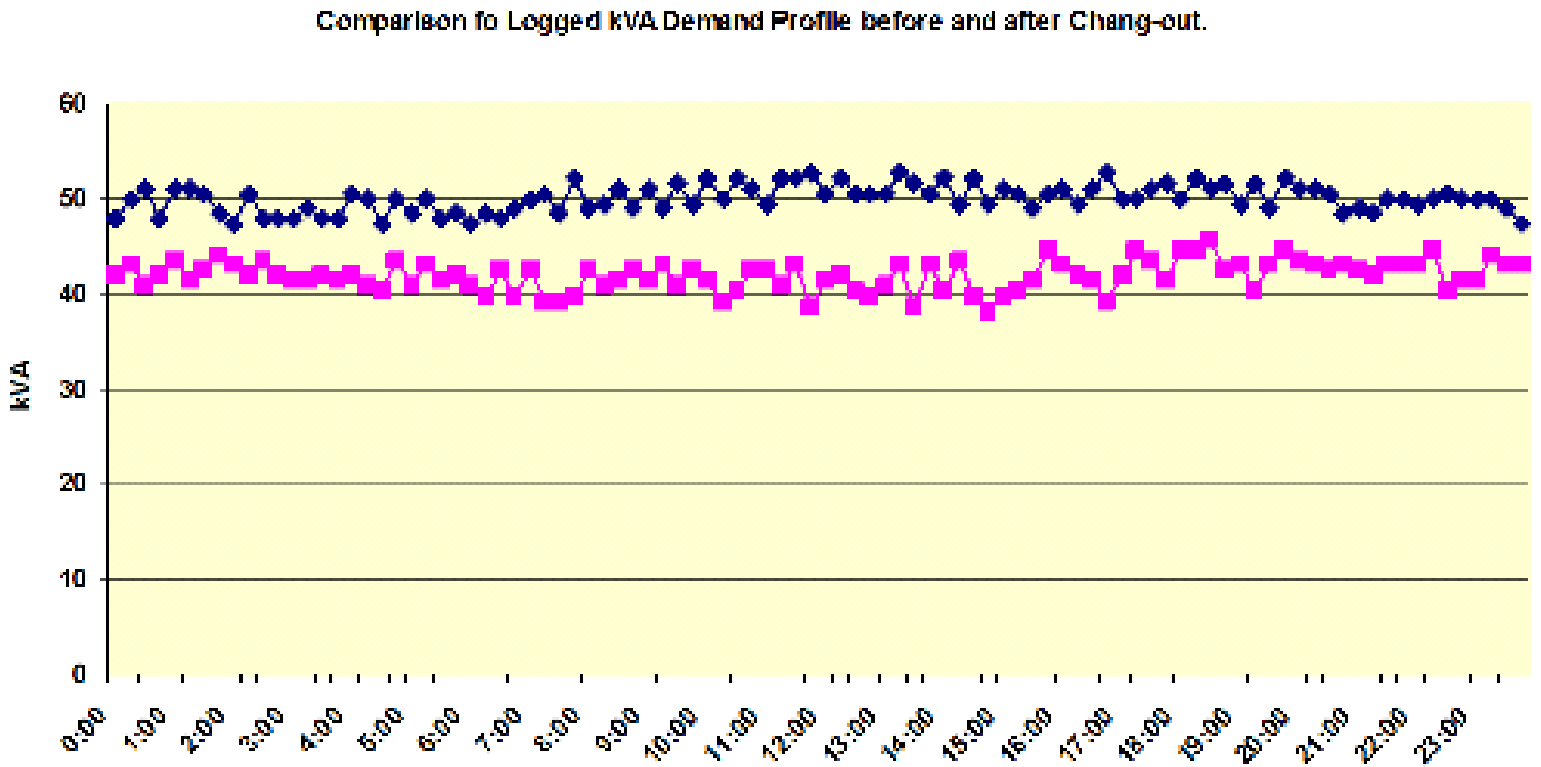




DESCRIPTION

UNIT TYPE & MODEL #		REF. CHARGE (lb)	AMPS	COIL TEMPS COND	COIL TEMPS EVAP	DISCH. PRESS.	SUCTION PRESS	INPUT POWER (K.W)
	BEFORE		64	106	64	325	65	47.6
	AFTER	29	46	90	63	249	60	34.2
Chlr # 2	% Diff.,		28%	15%	2%	23%	8%	28%

Comparison of kVA Demand before and after R-22 Change-out to R22a.



Change-out Technical and Financial Analysis

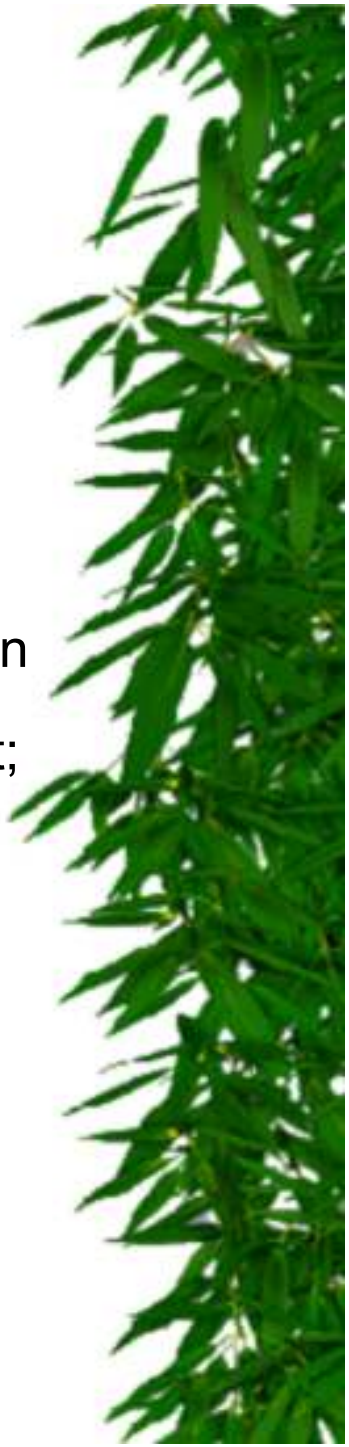
Breezes Runaway Bay											
							JPS Co Service rate				
							Demand Rate ($/kW)		$12.00		
							Energy Rate ($/KWh)		$0.13		
ECO # 1: Chiller with Duracool Refrigerant											
BASE EQUIPMENT INSTALLED (LOGGED): 1 of 2 X 50-ton circuits with R-22											
Type	Quan	Capacity	Compressor	kVA/ton	Average	Op., hrs	Energy	Demand	Energy	Operating Cost	
		tons	EER		kVA	hrs/yr.	kWh	kVA	kWh/yr	US$/yr	
Trane Chiller 4 S	1	50	12	1	50	8500	425,000	50	425,000	62,450	
Total Existing		50						50	425,000	62,450	
REVISED EQUIPMENT: Recover R-22 and Recharge with Dura-cool R22a											
Type	Quan	Capacity	EER	kVA/ton	kVA	Op., hrs	Energy	Demand	Energy	Operating Cost	
Trane Chiller 4 S	1	50	14	0.8	42	8500	357,000	42	357,000	52,458	
Total Projected								42	357,000	52,458	
Measure Costs											
		Unit Cost	Total tons	Cost							
Recharge with HC Refrigerant.											
Service, refrigerant leak test and changeout		100.00	50	5,000							
Maintenance savings				$ (800)							
Total first year cost				$ 4,200							
	Project Cost			$ 5,000	J$310,000.00						
	Measure Savings										
	Demand	Energy	Cost	Payback							
	kVA	kWh/yr	US$/yr	yr.							
	9	68,000	$9,982	0.5							
	19%	16%	J$ 619,904								

New 4-ton Split Systems R22/R22a Change-out Data

REF. CHARGE (KG)	VOLTS	AMPS	PHASE	COND	EVAP	DISCH. PRESS.	SUCTION PRESS	TXV	INPUT POWER (K.W)	EVAP. TEMP IN	EVAP. TEMP OUT	COND. TEMP. IN	COND. TEMP. OUT
				COIL TEMPS									
113	220	18.5	1	112		210	60	12	4.07	78	57	80	117
45.2	220	14.4	1	90		175	59	15	3.168			80	117
67.8		4.1		22	0	35	1		0.902	78	57	0	0
60%		22%		20%	#DIV/0!	17%	2%	21%	22%	100%	100%	0%	0%
113	220	21.2	1	114		260	70	10	4.664	80	0	91	111
	220	14.4	1	107		220	60	15	3.168	80		91	107
		18.2		7	0	40	10		1.496	0	0	0	4
		32%		6%	#DIV/0!	15%	14%	47%	32%	0%	#DIV/0!	0%	4%
113	220	23.3	1	107	56	230	80	9	5.126	73	57	82	105
	220	19.2	1	100	54	190	59	11	4.224	71	44	02	99
		4.1	0	7	2	40	21		0.902	2	13	0	6
		18%		7%	4%	17%	26%	21%	18%	3%	23%	0%	6%
113	220	22.8	1	107	56	230	80	10	5.016	73	57	83	110
	220	19.2	1	100	54	190	59	11	4.224	73	44	83	99
		3.6	1	7	2	40	21		0.792	0	13	0	11

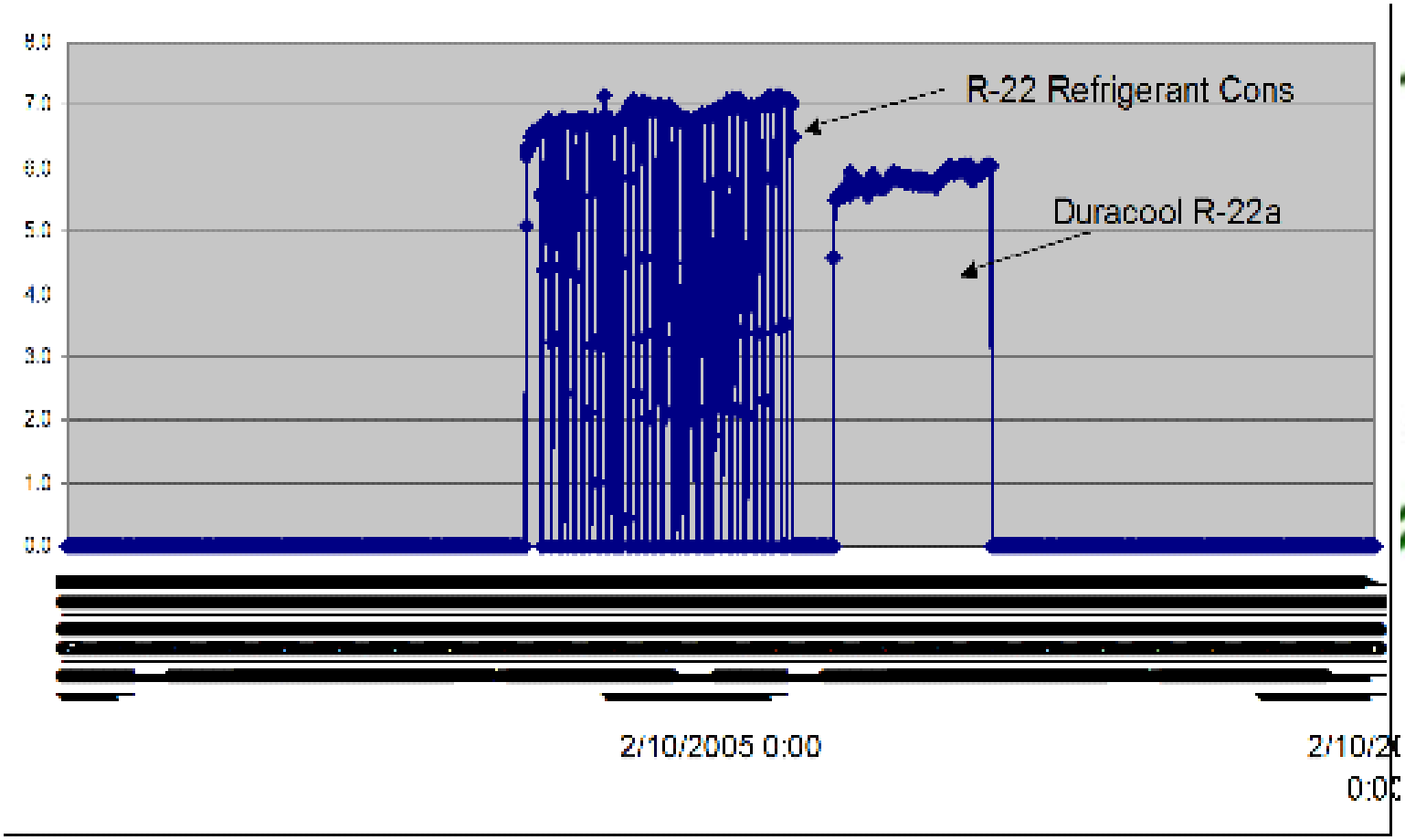
Solutions, Accomplishments and Success Stories

- A solution was found for reducing the high levels of electrical energy being consumed by the Air Conditioning Units on the Mona Campus. This was accomplished by the implementation of an energy conservation measure to change out CFC, HFC and HCFC refrigerants with the more efficient HC Refrigerant; DURACOOL R22A. This change provided an average projected enhancement in efficiency of 15% to 20 % that would also be reflected in savings to the Electrical Utility Budget.
- The advantage of using Hydrocarbon Refrigerant is that it is environmentally friendly and little or no changes are required to be made to the Air Conditioning Units being retrofitted.




Ineffcient Ways of Using Air
Conditioning Units on The
Mona Campus

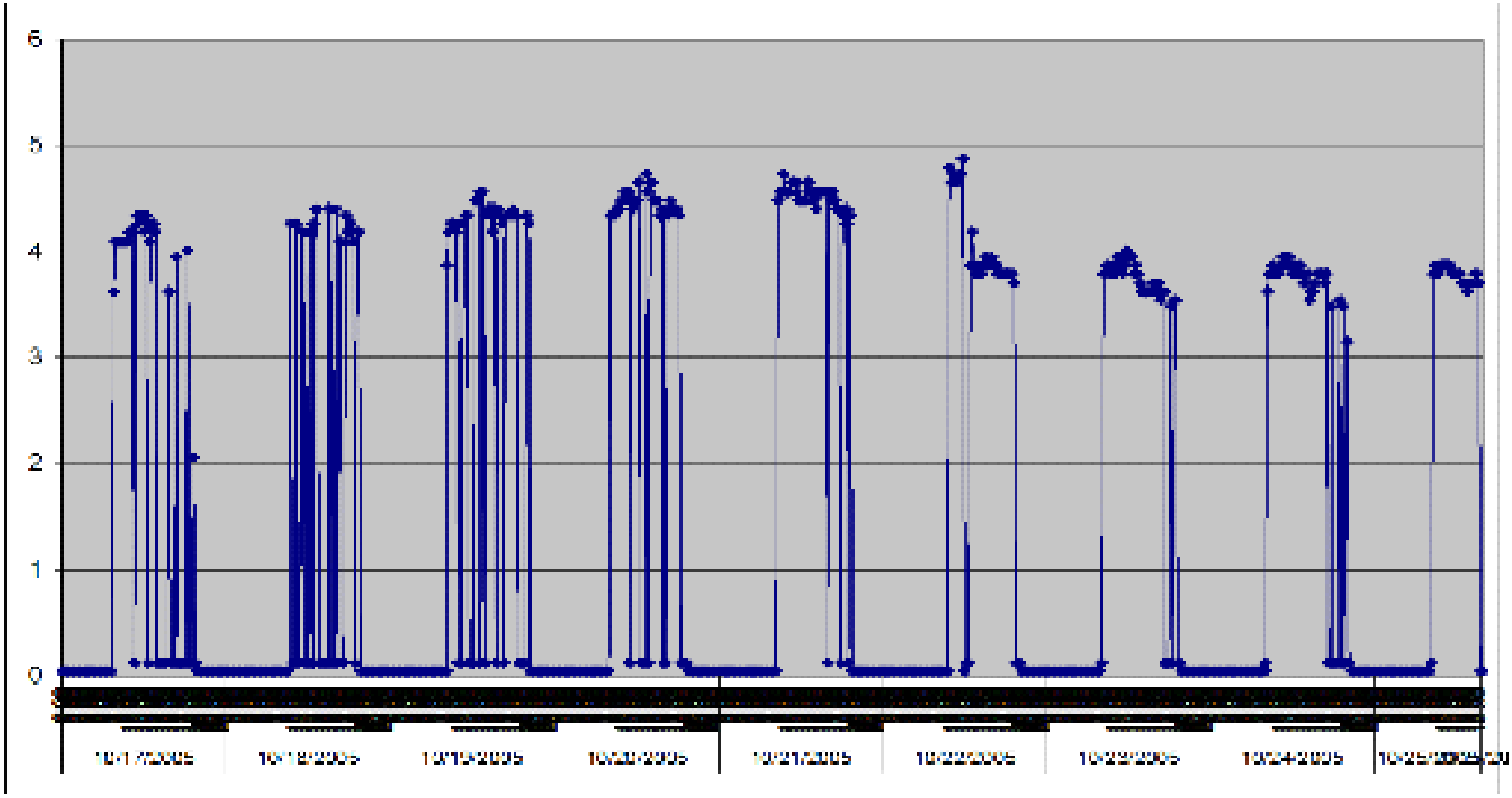
Mini-split System Duracool Retrofit



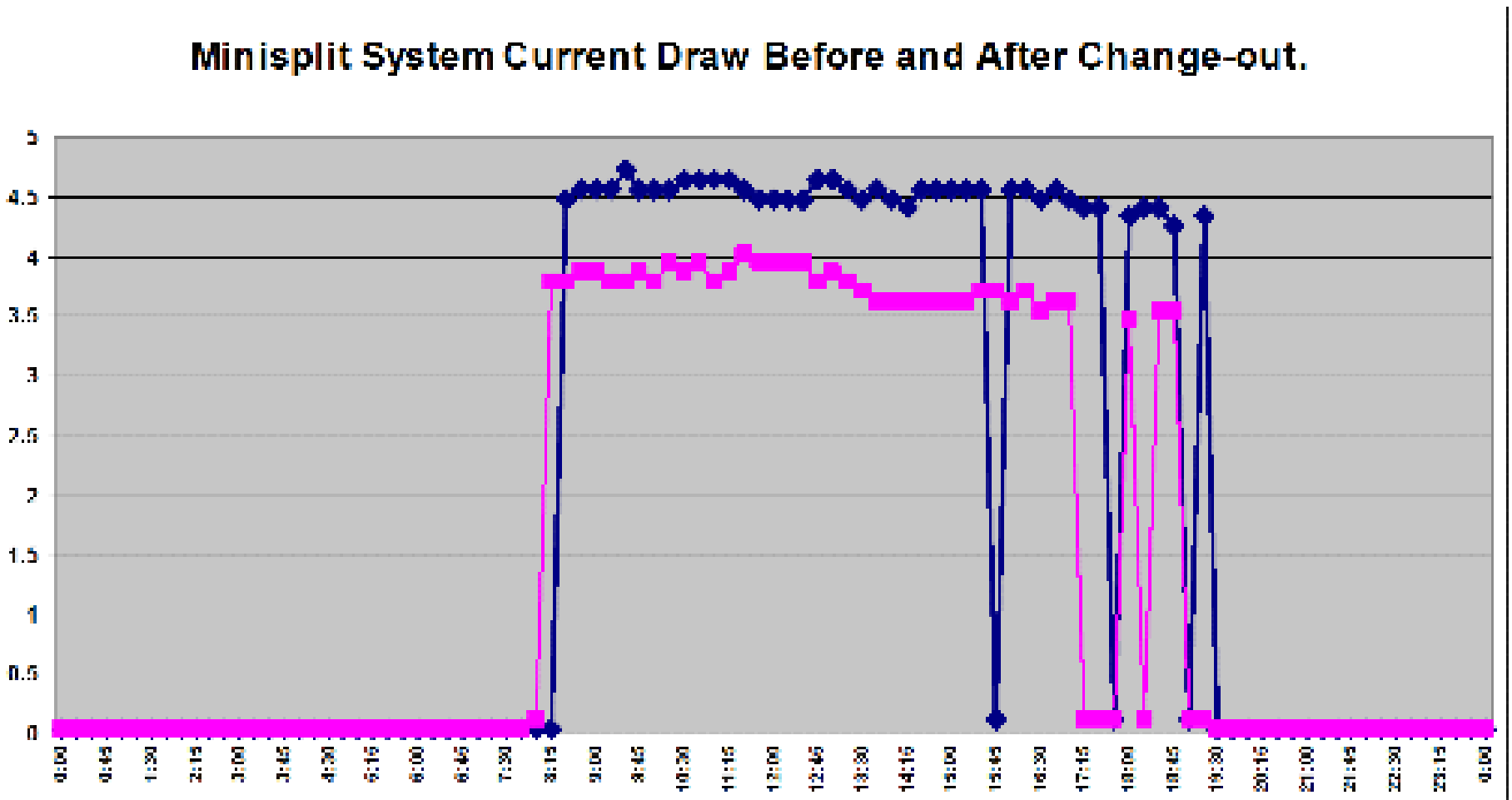
Mini-split Duracool Retrofit Test Data

UNIVERSITY OF THE WEST INDIES									
AIR CONDITIONER REFRIGERANT RETROFITTING REPORT									
LOCATION: ELECTRICAL MAINTENANCE DEPARTMENT									
DATE:23/02/05									
UNIT TYPE								CONDENSER TEMPERATURE °F	
PANASONIC 24000Btu DUAL ZONE MINISPLIT UNIT		VOLTAGE	AMPERAGE	DISCHARGE PRESSURE	SUCTION PRESSURE	INPUT POWER (KW)	EER	ENTERING	LEAVING
UPPER UNIT CIRCUIT	BEFORE		6.12	125	65	1.11	11	120	105
	AFTER		3.68	70	35	0.89	17	105	93
			40%	44%	46%	38%		13%	11%
LOWER UNIT CIRCUIT	BEFORE		5.6	113	63	1.07	11	121	107
	AFTER		3.09	62.5	36	0.74	16	106	86
			45%	45%	43%	31%	-45%	12%	20%

Comparison Profile of Office AC Daily (9-days) Current Draw



Comparison of 24-hr Current Profile



Minisplit Analysis

DESCRIPTION						COIL TEMPS				EVAP. TEMP	
UNIT TYPE & MODEL #		REF. CHARGE (OZ)	VOLTS	AMPS	PHASE	COND	EVAP	SUCTION PRESS	INPUT POWER (KW)	IN	OUT
	BEFORE		220	4.5	1	112	60	69	0.99	83	56
	AFTER		220	3.5	1	105	57	62	0.77		50
	DIFF.			1		7	3	7	0.22	83	6
Minisplit	% Diff.,			22%		6%	5%	10%	22%	100%	11%

UWI REFRIGERANT CHANGEOUT DATA SHEET

DATE: December 8-9, 2005

LOCATION: Natural Products Institute / Mona Institute of Applied Science

No.	DESCRIPTION UNIT TYPE, MODEL # & Serial #.		COOLING CAPACITY (BTU/hr)	VOLTS	AMPS	POWER (Watts) BEFORE	POWER (Watts) AFTER	SUCTN PRESS (psi)	UNIT CONDITION	KW/ton BEFORE	KW/ton AFTER	REMARKS
1	Sanyo	BEFORE	9,000	220	4.2	924	678			1.23	0.90	
		AFTER			3.08							
		DIFF.			1.12							
		% DIF.,			27%							
2	Toshiba	BEFORE	12,000	220	5.2	1,144	902			1.14	0.90	
		AFTER			4.1							
		DIFF.			1.1							
		% DIF.,			21%							
3	Toshiba	BEFORE	9,000	220	3.9	858	660			1.14	0.88	
		AFTER			3							
		DIFF.			0.9							
		% DIF.,			23%							
4	Panasonic	BEFORE	24,000	220	14.9	3,278	2,706			1.64	1.35	
		AFTER			12.3							
		DIFF.			2.6							
		% DIF.,			17%							
5	Panasonic CUC18BKPS 58135196	BEFORE	18,000	220	6.49	1,428	1,327			0.95	0.88	
		AFTER			6.03							
		DIFF.			0.46							
		% DIF.,			7%							
6	Panasonic CUC12BKPS 58031467S	BEFORE	12,000	220	4.55	1,001	664			1.00	0.66	
		AFTER			3.02							
		DIFF.			1.53							
		% DIF.,			34%							
7	Panasonic CUC18BKP50 58131455S	BEFORE	18,000	220	6.84	1,505	1,353			1.00	0.90	
		AFTER			6.15							
		DIFF.			0.69							
		% DIF.,			10%							
8	Panasonic CUC12BKPS 508031473	BEFORE	12,000	220	4.87	1,071	814			1.07	0.81	
		AFTER		"	3.7	814	741					
		DIFF.			1.17							
		% DIF.,			24%							

RESULTS OF REFRIGERANT CHANGE - 2

	Faculty of Pure and Applied Scien	No. of units	Total Cooling Capacity (Tons)	% Reduction in Power (Kilowatts)	Estimated Annual Savings (KwH)
1	Department of Life Sciences - 1	11	23.5	0.181143335	4,031
2	Department of Life Sciences - 2	6	16	0.19126381	3,041
3	Depertment of Life Sciences - Preliminary Laboratory	4	9.58	0.15675813	1,357
4	Depertment of Life Sciences - Block A	7	9.5	0.171609403	2,088
5	Depertment of Life Sciences - Botany	6	9	0.12973798	1,122
6	Depertment of Life Sciences - Electron Microscopy	6	17	0.183933115	2,226
7	Depertment of Life Sciences - Office	20	28	0.201334881	7,632
8	Depertment of Life Sciences - Basic Medical Sciences	41	88.25	0.150703916	18,576

Total number of units	101
Total Cooling Capacity changed (Tons)	200.8
Weighted Average Reduction in Power	16.8%
Total Reduction in Power (Kilowatts)	40.1
Estimated Annual Savings (Kilowatt-Hours)	40,074
Estimated Annual Savings (J$)	J$641,184

Note: Estimated Savings assume

(1) 1000 hours operation for each A/C unit
(2) Electricity cost of J$16 per Kilowatt-hour

UWI REFRIGERANT CHANGEOUT DATA SHEET

DATE: January 4, 2006

LOCATION: Department of Life Sciences

No.	DESCRIPTION UNIT TYPE, MODEL # & Serial #.		COOLING CAPACITY (BTU/hr)	VOLTS	AMPS	POWER (Watts) BEFORE	 AFTER	SUCTN PRESS (psi)	UNIT CONDITION	Kw/Ton BEFORE	 AFTER	REMARKS
1	1. Panasonic CU-C18CKE 7227300742	BEFORE	18,000	220	6.16	1,355	1,098	65		0.90	0.73	
		AFTER			4.99			65				
		DIFF.			1.17							
		% DIff.			19%							
2	2. Carrier No Nameplate	BEFORE	9,000	220	4.46	979	869	66		1.31	1.16	
		AFTER			3.95			66				
		DIFF.			0.5							
		% DIff.			11%							
3	3. Carrier No Nameplate	BEFORE	9,000	220	4.55	1,001	834	66		1.33	1.11	
		AFTER			3.79			66				
		DIFF.			0.76							
		% DIff.			17%							
4	4. Panasonic CW-1202FE 141112429	BEFORE	12,000	220	5.26	1,155	988	65		1.16	0.99	
		AFTER			4.49			65				
		DIFF.			0.76							
		% DIff.			14%							
5	5. Carrier 38CK060960 4204E49830	BEFORE	72,000	380	9	5,923	4,824	66		0.99	0.80	
		AFTER			7.33			66				
		DIFF.			1.67							
		% DIff.			19%							
6	6. Carrier 38CK060960 4204E49867	BEFORE	72,000	380	9.6	5,487	4,247	66		0.91	0.71	
		AFTER			7.43			66				
		DIFF.			2.17							
		% DIff.			23%							

Number of units			
6	Total Tons		16.9
	Total Power Before	(Kilowatts)	15.9
	Total Power After	(Kilowatts)	12.9
	Difference	(Kilowatts)	3.04
	% Difference		19.1%

CONDITION:
1 = NEW/EXCELLENT
2 = PREVENTIVE MAINTENANCE REQUIRED
3 = CORRECTIVE MAINTENANCE REQUIRED
4 = REPLACE

RESULTS OF REFRIGERANT CHANGE - 1

(i) Administration (ii) Faculty of Pure and Applied Science	No. of units	Total Cooling Capacity (Tons)	% Reduction in Power (Kilowatts)	Estimated Annual Savings (KwH)
1 Administration	36	72.0	27.0%	19,518
2 International Centre for Nuclear Sciences	29	48.3	15.0%	10,762
3 Natural Products Institute	19	22.3	19.3%	4,807
4 Caribbean Agricultural Research and Developmenet Inst.	16	21.3	18.2%	4,070
5 Mathematics and Computer Science - 1	11	39.5	26.1%	10,306
6 Mathematics and Computer Science - 2	5	11.6	21.1%	2,988

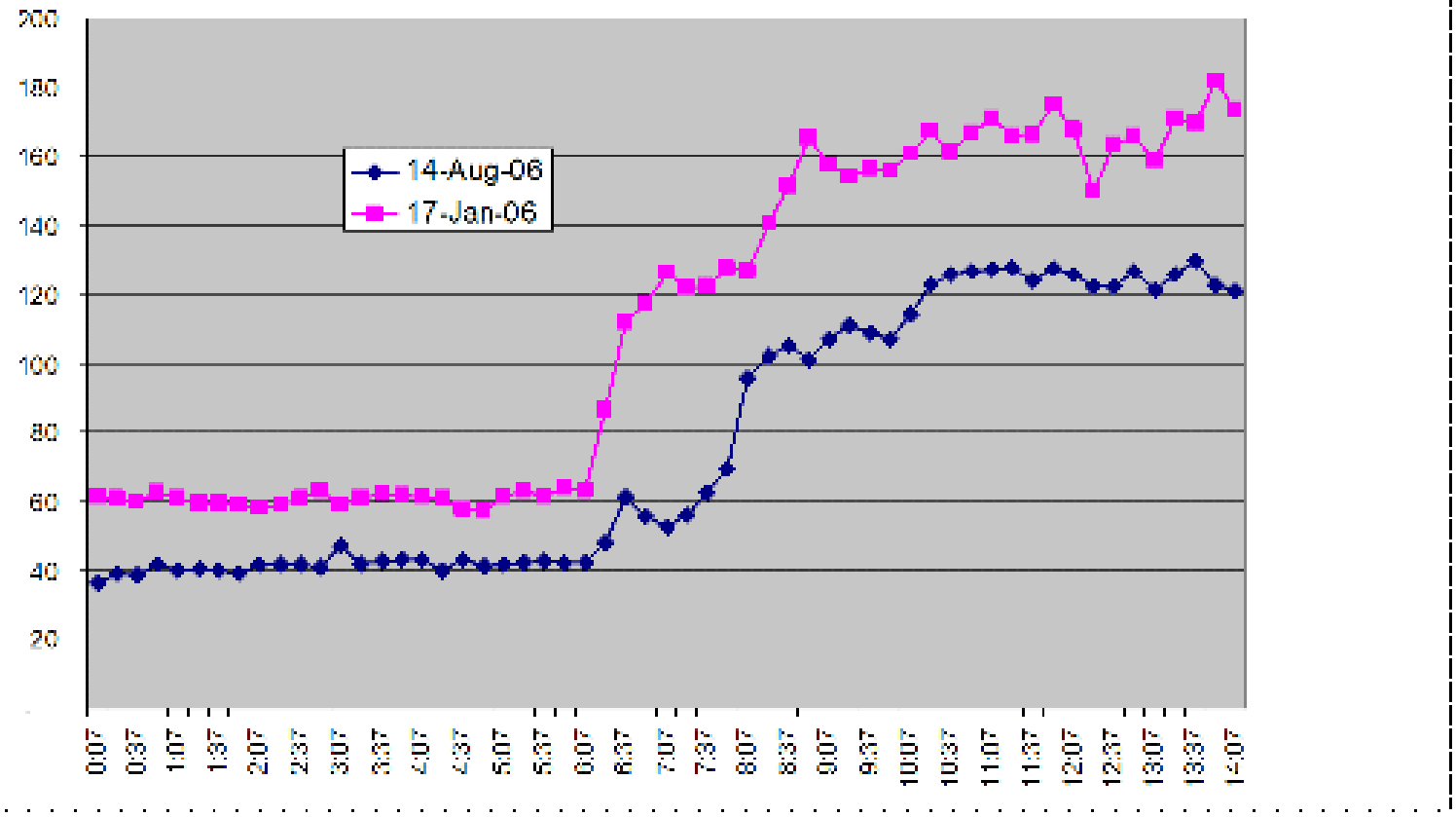
Total number of units	116
Total Cooling Capacity changed (Tons)	214.9
Weighted Average Reduction in Power	22%
Total Reduction in Power (Kilowatts)	52.5
Estimated Annual Savings (Kilowatt-Hours)	52,452
Estimated Annual Savings (J$)	J$839,226

Total KW Before	202.3	KW/Ton Before	0.94
Total Kw After	155.0	KW/Ton After	0.72

Note: Estimated Savings assume

(1) 1000 hours operation for each A/C unit
(2) Electricity cost of J$16 per Kilowatt-hour

UWI BIO-TECH DEPT



UWI - TOTAL RESULTS OF REFRIGERANT CHANGE

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

CARIBBEAN ESCo LTD.
Seville Industrial Complex, P.O. Box 4451, St Ann's Bay, Jamaica W.I.
(876) 919-7090, (876) 818-5045.

PROFORMA INVOICE

GEDDES REFRIGERATION LTD. — 10-Aug-88
22d SPANISH TOWN ROAD
P.O. BOX 49
KINGSTON 11
JAMAICA

Item	Part Number	Description	Size	Quantity	Unit	Unit US$D	Price Per	Total	
1	DC 0015	Duracool A/C Oil Chill	4 oz Cans	5	12 /case	92.30	case	461.50	
2	DC 0011	Duracool SealQuick	4 oz Cans	5	12 /case	85.84	case	1,030.08	
3	DC 0009	DuracoolDuraclip	4 oz Cans	5	12 /case	135.13	case	675.65	
4	DC 0013	Duracool Systemseal	4 oz Cans	5	12 /case	155.93	case	779.65	
5	DC 0023	Duracool A/C Oil Chill	8 oz Bottles	5	12 /case	106.31	case	531.55	
6	DC 0017	Tune Up And Sealant Kit	KIT	6	6 / case	269.94	case	1,613.64	I
7	.....	Consumer Recharge Kits	KIT	10	144 /case	25.15	each	3,521.00	II
8	F 0006	8 oz Cans Of Refrigerant	6 oz cans	200	12 /case	39.95	case	6,389.50	III
9	.....	Duracool 12a Refrigerant	30 lb eq. Cy	32	cylinder	140.65	cylinder	4,500.80	
10	...	Duracool 22a Refrigerant	50 lb eq. Cy	10	cylinder	171.90	cylinder	1,719.00	
11	DC 0401	Brass Installation Kits	KIT	10	12 /case	35.69	each	5,139.36	IV

I	This is the Kit with three cans (moisture remover / sealant) and A/C Oil Chill it can be added into any system and will stop Leaks and restore cooling - Complete with instructions - Low side pressure gauge and conversion fittings & Charging Hose
II	This is a kit that contains 2 cans of Refrigerant / charging hose - 1 low side and High Side conversion Fittings
III	These are the single cans of refrigerant that are packed 12 to a case and are the best sellers
IV	This is the brass installation to be used with the 6 oz cans of Refrigerant & the A/C Solutions / It is a must and a great seller The price calculations on these kits reflect 15 cases of 12 = 180 Kits @ 30.50 each less 20 % = 31.31.36

All Prices are in U$D and payable TT or WT
I realize that this order is larger then the one you generated - But the overall price per piece for freight will be reduced with this suggestion
Freight Prepaid To Canadian Port of Destination

Total Value of Order excluding Freight and Clearance Charges
$28,381.73 U$D

Advantages of hydrocarbon technology

1. No ozone depletion. No ozone depleting is a very important requisite of all other CFCs substitutes.
2. No global warming. The global warming effect is negligible
3. No second conversation. Any second conversion, like in the case of the refrigerants with halogens (e.g.HFC-134a) that will require it in the long run.
4. Energy saving. There is an energy-saving effect with an optimized refrigeration system of up 10% over CFC and HCF-134a. This means a further lifelong contribution to not to accelerate global warming.
5. Quiet refrigerators. When a refrigerator use hydrocarbon, it became in a quitter ”whispering refrigerator.

Advantages

6. More availability. The HCs will probably (contrary to, e.g. HCF-134a be available in most Article 5 country and other self-relying countries if there is a definite market for them.
7. Technically simple to adopt. They are compatible with the materials used in CFC systems- with the copper and the mineral oils-facilitating their application and diminishing the conversation cost. When it used HFC-134a the hygroscopic oils could caused problems. This sensitivity towards humidity is greatly increased in the tropical or subtropical climates.
8. 5. No patents, no license, no dependence. This technology offers independence at national level, and applies, to the company level as wall.

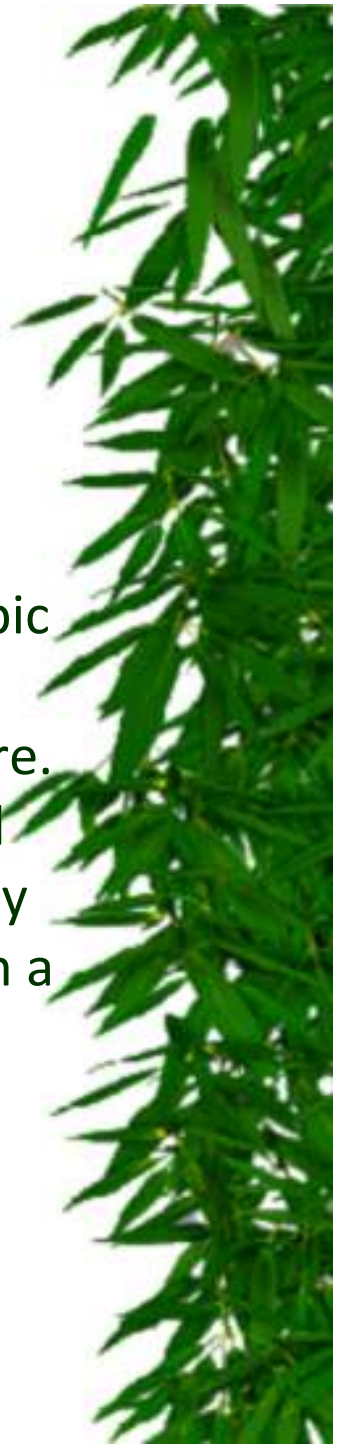
HYDROCARBON PROPERTIES AS REFRIGERANT

- They have zero ozone –depleting potential (ODP) and a negligible global warming potential (GWP).
- Their efficiency is slightly better than other leading alternative to CFC-12.
- They have low viscosity and high thermal conductivity that allow a good performance of the system.
- They are miscible with oils.
- Their latent heat of vaporization is very much higher in comparison to CFC-12.
- They possess high chemical stability.
- They are compatible with the materials used with traditional refrigerant: metal components and oils.
- Their density is approximately one-third of CFC-12, thereby it requires low charge.
- They are not toxic.
- They are flammable substances.

Propane –isobutane mixtures (R-290/R-600a)

- They can be used with compressors designed for CFC-12, with only minor changes needed to electrical components to maintain safety. The mixture possesses very high latent of vaporization and low value of density (one –third of CFC-12), which makes the mixture attractive. The charge levels are approximately 40% that CFC-12.
- They give capacity similar to CFC-12. They operate with pressures similar to R-12, but at condensing conditions, the pressure of the mixtures will be lower. The HC blends, therefore, operate with a lower compression ratio, thus improving the operation of compressor.
- The discharge temperature of HC mixture is similar to CFC-12 and R-134a at the same evaporating and condensing temperatures.

The propane/isobutane mixture is a zeotropic blend. All zeotropic blends have temperature glide, that in practice, it will the difference in the bubble and dew temperatures at same pressure. The temperature glide for propane/isboutane blend is around 8ºC. When a zeotrope boils, the composition of the vapour may not be the same as the liquid. The zeotropic must be taken from a cylinder as liquid to keep the right composition.



At the start of the evaporator, the temperature of the refrigerant will be higher than the bubble point because some refrigerant will have flashed off already during expansion. As the blends flows through the evaporator, its boiling point raises as the composition of the liquid phase changes. The evaporating temperature increase as the refrigerant flows through evaporator and more of the blends evaporates. The same occurs in the condenser. In this case, the condensing temperature decrease through condenser

General safety considerations

- Hydrocarbons like propane and isobutane are flammable. The safety principle for the use of HCs is a basic idea: the coincidence of air and flammable mixture and ignition source has to be avoided. To generate a flammable mixture in a room with around 16 m (2.5x2.5x2.5) is necessary 670 grams of isobutane or propane assuming even dispersion.
- You should eliminate ignition sources by using only sealed or non-sparking electrical components. (the experience shows that problems with conventional refrigeration components are unlikely) and by eliminating naked flames.
- Besides, it takes into account that refrigerators are often repaired in developing countries, either in domestic workshops or in appliance centres. To avoid the risk of explosions during repair or resulting from faulty repair, the following measures are proposed:
  - Reducing the possibilities for faults;
  - Leak testing as part of routine maintenance; and
  - Training programmes for technicians.

For eliminating ignition sources:

- Replace electrical component with sealed type;
- Replace electrical component with solid state;
- Enclose electrical component (s) in a sealed box;
- Re-locate electrical component (s) away from the refrigeration circuit;
- Ensure all wiring connections can not work loose.

Storage and transport of hydrocarbon refrigerant

Hydrocarbon refrigerant should be transported and be stored in the same way as flammable gasses. It is best to store these gases outside as follows:

- In a secure, locked compound protected from weather and direct sun;
- There should be no ignition sources and no smoking in 2m of the cylinders;
- The cylinder valves should be closed and capped; in case the hydrocarbon refrigerant has to be stored inside these additional guidelines should be followed:
- The cylinders must be store at ground level;
- A flammable gas alarm should be fitted next to the cylinder.

Simple workplace precautions

You must take these simple precautions when working with HC refrigerants:

- Work in a well ventilated area, or outside;
- No smoking
- No flames in 2 m of the charging/venting area'
- Do not use switches in 2 m of the charging /venting area;
- Have a fire extinguisher (dry powder type);
- Wear gloves, goggles and clothing which cover you.

If hydrocarbon refrigerant must be decanted:

- This should be done outside or in a well-ventilated area;
- The cylinder that is being filling must be weighed. Note that the weight of the same volume of HC refrigerant is 40% of the weight of other refrigerants-the same volume of refrigerant will weigh 60% less (e.g. a cylinder which can safely contain 14 kg of CFC-12, will only be able to contain 5.6 kg of HC)
- The transfer hose should be as short as possible to minimise loss and risk;
- The transfer hose should be evacuated or carefully purged before transferring refrigerant;
- When decanting a blend, it must be removed from the supply cylinder as liquid;
- Aerosol can type (sometimes used for servicing) should never be refilled

Charging the appliances with hydrocarbon refrigerant

Refrigerant should be only charge in a clean, dry and leak free system.

When charging hydrocarbon refrigerant:

- The charging area must be well ventilated;
- The charging equipment must be safe for use with hydrocarbon refrigerants;
- As little refrigerant as possible must be vented to the air;
- There should be a dry powder type fire extinguisher in the charging area;
- The hydrocarbon blend must be removed from cylinder as liquid

Charging by weight

- The amount of hydrocarbon refrigerant should be marked on appliances.
- The weights of hydrocarbons refrigerant are approximately 40% that of CFC-12 and 45% that of HFC-134a
  - For example, if any appliance used to be charged with 150 grams of CFC-12, it will need only 60 grams of hydrocarbon blend.

Charging by Volume

- The same volume of hydrocarbon refrigerant as R-12 must be used, but it will weigh less.
- If any appliance used to be charged with 150 grams of R-12, the charging still must be filled HC refrigerant to the level that indicated 150 grams of R-12. It will weigh 60 g, but will have the same volume as 150 grams of R-12

Conversion Procedure

The normal drop-in conversion procedure is simple and it should not add much time to normal service/repair. Follow these steps:

- Recover the R-12 (R134a);

1. Make the necessary repairs to the system;
2. Pressure and leak test the system;
3. Replace, reposition or enclose electrical components as necessary to make the system safe;
4. Evacuate the system;
5. Charge with HC blend refrigerant;
6. Seal the process tube.

CONCLUSIONS

- Demand for natural refrigerants will increase worldwide.
- Customer satisfaction is easily achieved with Duracool Products.
- Test Results shows an average 20% savings in air conditioning cost.

CONCLUSIONS

- Natural Refrigerants will create significant cost reduction to hotels, hospitals, industrial and commercial facilities.
- Natural Refrigerants will create significant cost reduction for homes and mobile refrigeration and air conditioning.
- The use of natural refrigerants will create significant economic benefits to the Jamaican economy.

CONCLUSIONS

- Annual cost savings of approximately $1.00M per 100-ton of cooling can be realized with a change from R-22 to R22a.
- Duracool HC refrigerants can replace CFC, HCFC, and HFC refrigerants.
- Refrigerant change-out to HC projects, would realize a payback period within 6 – 8 months.
- Equipment maintenance cost would be reduced with a change to HC refrigerants, due to reduced discharge pressures.

Effect on the environment of refrigerants

	Ozone 	Global Warming 	
CFC	High	Very High	x
HFC	Zero	High	x
HC	Zero	Negligible	✓
CO_2	Zero	Negligible	✓
Stirling Cycle	Zero	Zero	✓

Questions And Answers