



Energy Management at Toronto Pearson Airport

GREATER TORONTO AIRPORTS AUTHORITY

By Ronak Patel, P.Eng. CEM



Presentation Agenda


- **About Greater Toronto Airports Authority**
- **About Toronto Pearson International Airport**
- **Energy Management at Toronto Pearson**
 - *What we consume/ Where we consume*
 - *What we manage/ How we manage*
 - *Why we conserve/ How we conserve*
 - *What we could achieve*
- **Energy Efficiency Challenges for Airports**



About Us



Greater Toronto Airport Authority

- **Created under the federal government's National Airport Policy**
 - **Non-share capital corporation**
 - **Responsible for operation, maintenance and development of Toronto Pearson International Airport since 1996**
 - **60-year ground lease with 20-year renewal option**
- 

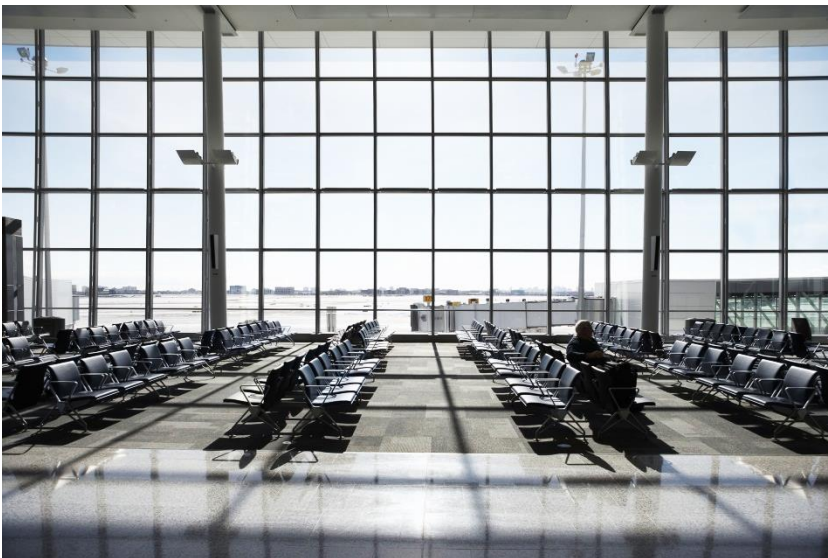
Quick Stats: Toronto Pearson Int. Airport

- **Canada's largest airport with over 35% of total air traffic**
- **Fourth largest entry point into North America**
- **Seventh largest port of entry in the U.S.**
- **Second largest airport in North America in terms of international passenger traffic**
- **Over 70 airlines authorized to operate at Toronto Pearson, 180 destinations worldwide**
- **67% of world economy accessible from TPIA**
- **41 million passengers (Canada's population 35.7 million)**



Our Building Stock

- **Terminals (5,828,679 SQ.FT)**
- **Parking Garages (5,516,278 SQ.FT)**
- **Hangers and Cargos (3,296,135 SQ.FT)**
- **Office Buildings (315,070 SQ.FT)**



What we consume

- **287 Gigawatt Hours of Electricity a year**
- **123 eGigawatt Hours of Natural Gas a year**
- **40 MW of Demand**
- **Equal to 13,800 Homes**

This makes us a large neighbor to our surrounding communities and a large user of power!



Where we consume!

**Toronto
Pearson
Airport**

334 eGWh

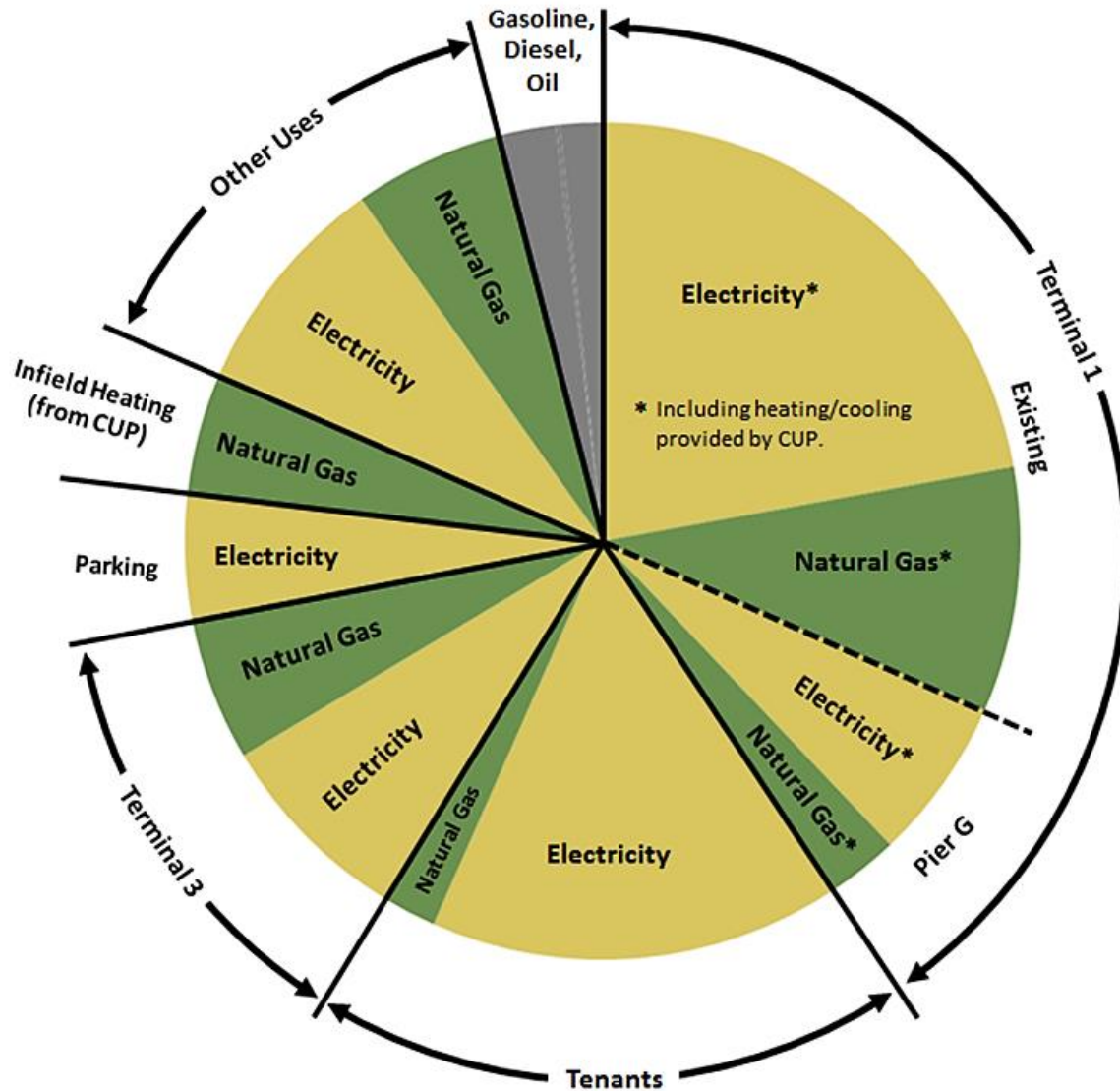
(2015)

**Our
Tenants**
76 eGWh

(2015)



Total Energy Breakdown



Terminal 1



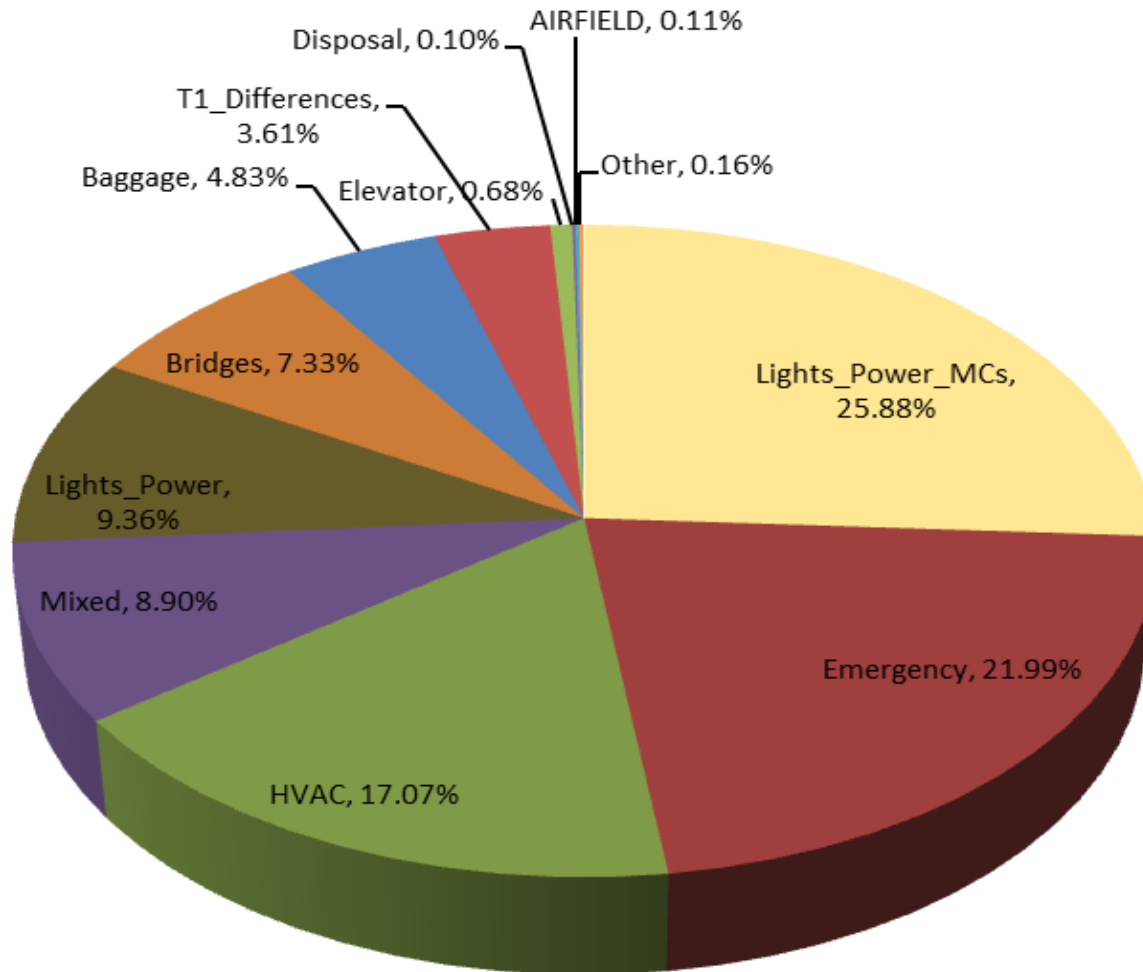
Terminal 3 and Parking



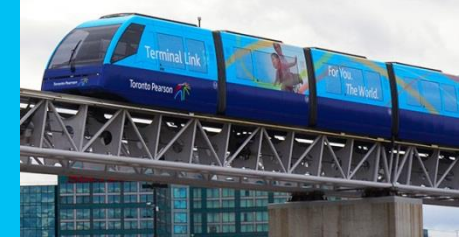
Central Utilities Plant (CUP)

Terminal Electricity Breakdown

2015 Electricity Usage Breakdown



Energy Loads at Pearson Airport



- 1) Heating, Ventilation And Air Conditioning
- 2) Interior/Exterior Lighting
- 3) Airfield Lighting
- 4) Baggage Systems
- 5) Aircraft Support Systems
- 6) IT and Security
- 7) Domestic Hot Water
- 8) Navigation Systems
- 9) De-icing Pumps
- 10) Catering Kitchens
- 11) Automated People Movers



What we manage

5 Commodities to track

Electric



Gas



Water



Hot Water



Chilled Water



14M+ Square-foot area

90+ Utility accounts

800+ Sub-meters

250+ Buildings

250+ Chargeback accounts

How we manage



Energy Management Information System

Save Energy and Cost

Electric



Gas



Water



Hot Water



Chilled Water



Customizable Dashboard

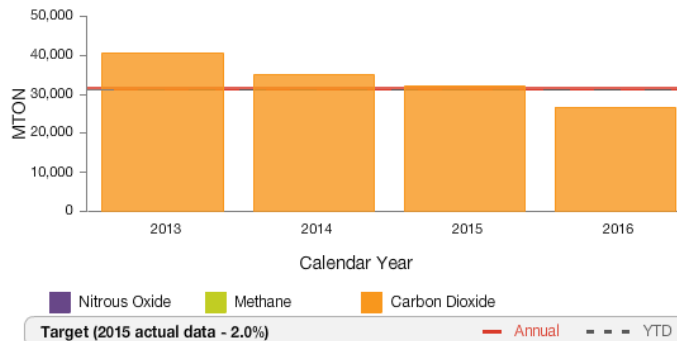


Home

- Dashboard
 - Cost Trend
 - Cost Avoidance Trends
 - Program to Date Cost S
 - Bill Problems
 - Top 10 Meters by Cost
 - Top 10 Buildings by Co
 - Top 10 Building Cost A
 - Bottom 10 Building Cos
 - ENERGY STAR
 - Getting Started
 - Unit Cost Summary
 - Latest News

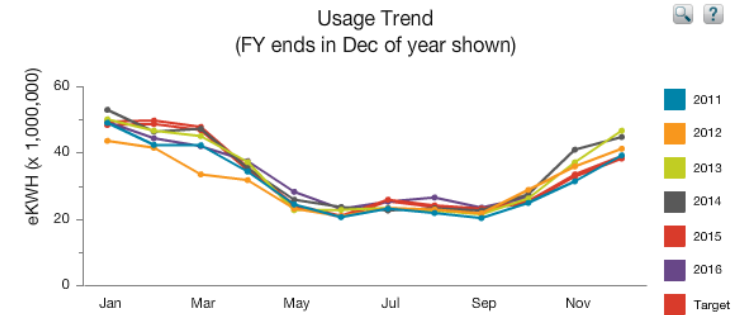
Carbon Footprint

Data from: GTAA



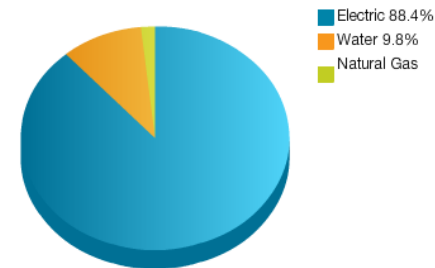
Usage Trend

Data from: GTAA



Cost Summary

Data from: GTAA



Bill Processing

Number of Accounts	872	
Number of Meters	871	
Bills Processed:		
	Number of bills	Cost
Last FY	7,713	\$174,454,076.21
Current FY	8,005	\$125,020,610.49
Last Month	1,060	\$17,757,668.13
This Month	471	\$2,536,222.49

- Buildings & Meters
 - Home Dashboard
 - Buildings & Meters
 - Groups & Benchmarking
 - Customers & Chargebacks
 - Accounts
 - Vendors & Rates
 - Bill Processing
 - Reports
 - Administration

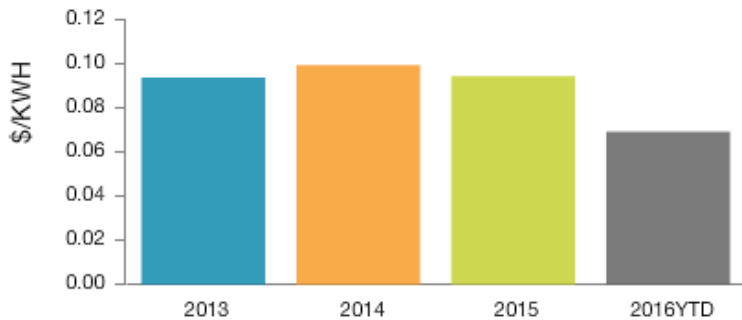
Electricity Use/Cost Profile/ Toronto Pearson

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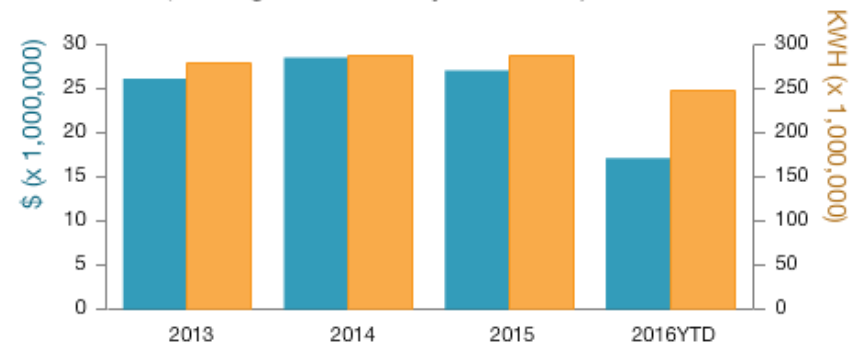
Actual Data | Calendarized Data | Normalized Data | Savings | Meter Properties

Summary | Trends | Monthly | Bills | Greenhouse Gas | Demand | Channels

Unit Cost Summary
(FY begins in Jan of year shown)



Total Use & Cost Summary
(FY begins in Jan of year shown)



Daily Average Cost

Percentage Change from
Previous Year To
Current Year



27.3 %

Current Year:
Nov 2015 - Oct 2016
\$56,517.94

Previous Year:
Nov 2014 - Oct 2015
\$77,778.79

Daily Average Usage

Percentage Change from
Previous Year To
Current Year



2.4 %

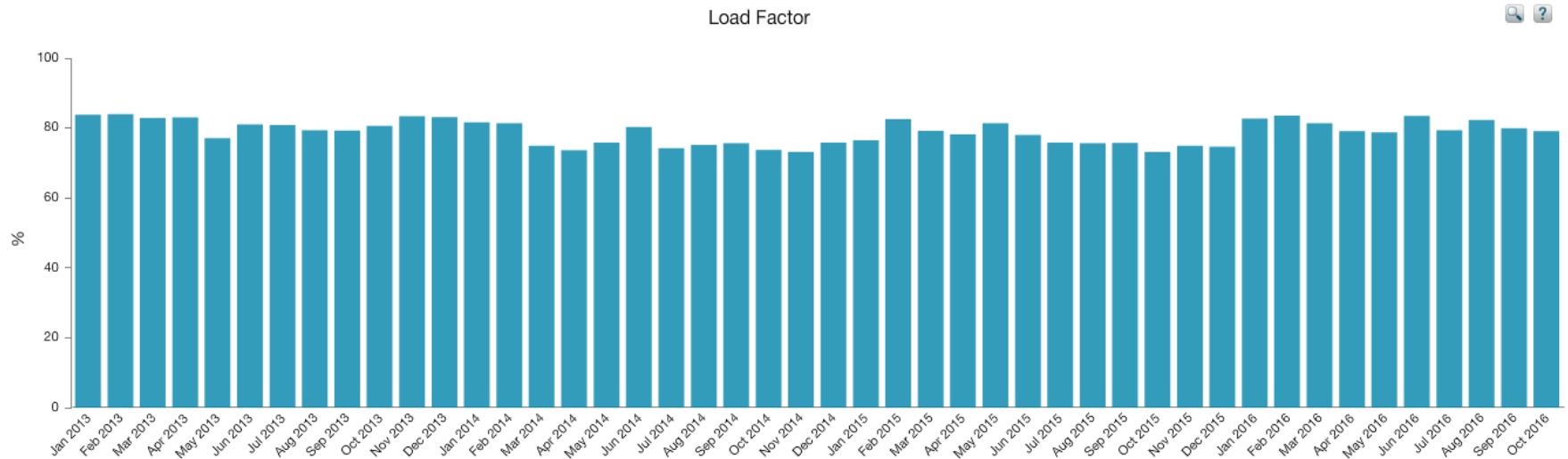
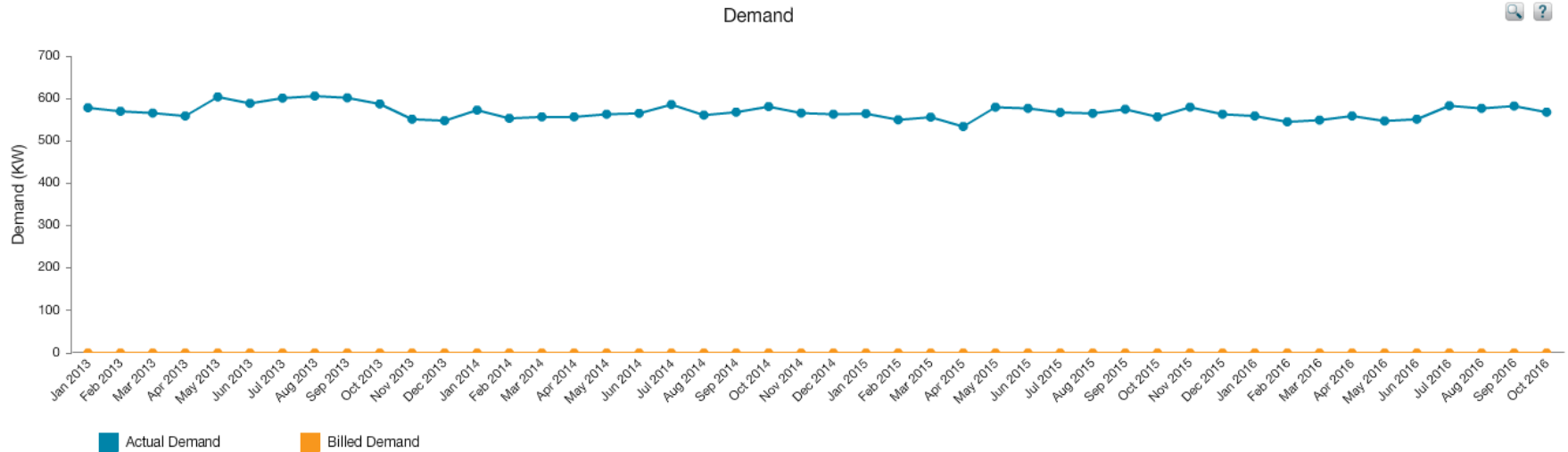
Current Year:
Nov 2015 - Oct 2016
809,521.89 KWH

Previous Year:
Nov 2014 - Oct 2015
790,014.05 KWH

Demand Profile

Calendarized Data | Normalized Data | Savings | Meter Properties

Summary | Trends | Monthly | Bills | Greenhouse Gas | Demand | Channels



Monthly Profile

Actual Data

Calendarized Data

Normalized Data

Savings

Meter Properties

Summary

Trends

Monthly

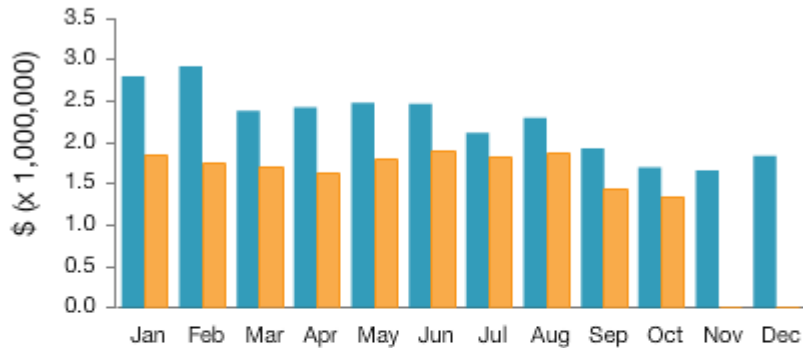
Bills

Greenhouse Gas

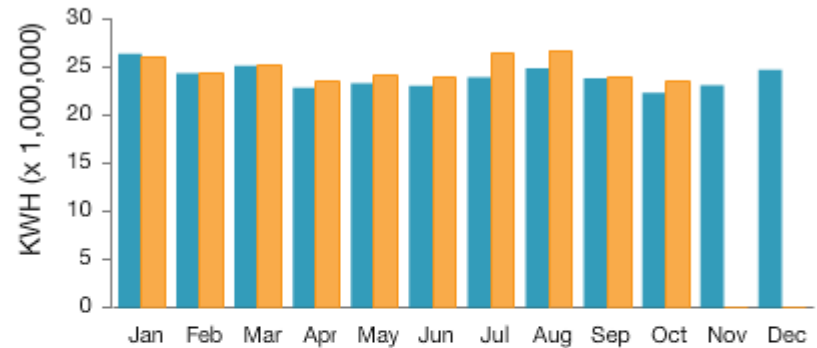
Demand

Channels

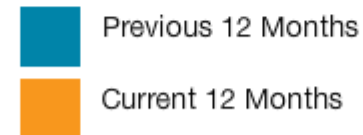
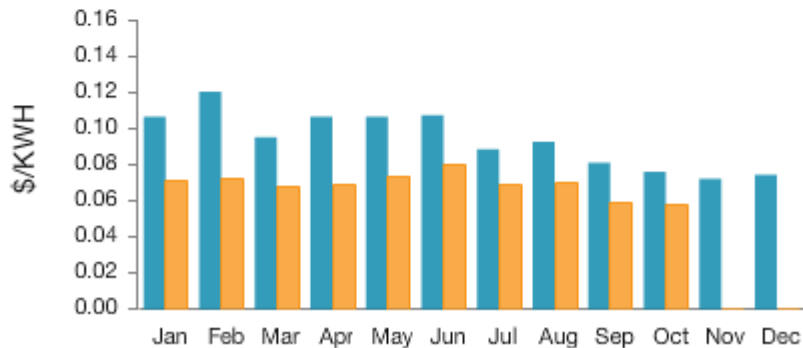
Monthly Cost



Monthly Use



Monthly Unit Cost

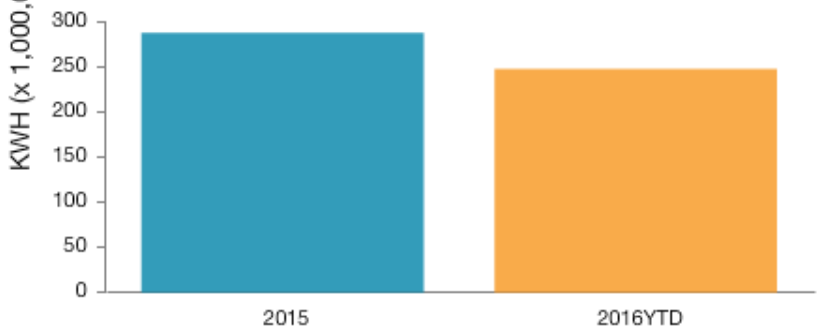


Weather Normalized Usage Profile

Actual Data | Calendarized Data | **Normalized Data** | Savings | Meter Properties

Summary | Monthly

Total Use Summary
Normalized to 2015
(FY begins in Jan of year shown)



Daily Average Usage

Percentage Change from
**Previous Year To
Current Year**



2.9 %

Current Year:
Nov 2015 - Oct 2016
808,168.70 KWH

Previous Year:
Nov 2014 - Oct 2015
785,349.10 KWH

Monthly Use Trend
Normalized to 2015
(FY begins in Jan of year shown)

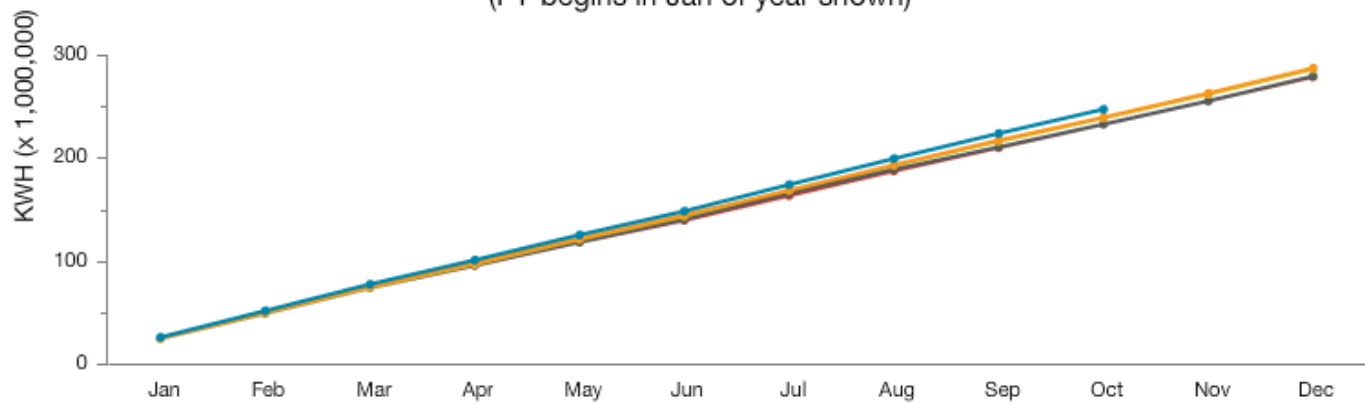


Chart Options

Monthly

Cumulative

Turn data on/off

- 2016
- 2015
- 2014
- 2013
- 2012
- 2011
- 2010
- 2009
- 2008

Monthly bills

Actual Data | Calendarized Data | Normalized Data | Savings | Meter Properties

Summary | Trends | Monthly | Bills | Greenhouse Gas | Demand | Channels

Filter Settings: Meter = GTAA-ELE-TOT [GTAA-ELE-TOT]

Total Cost All Bills: \$263,863,510.77

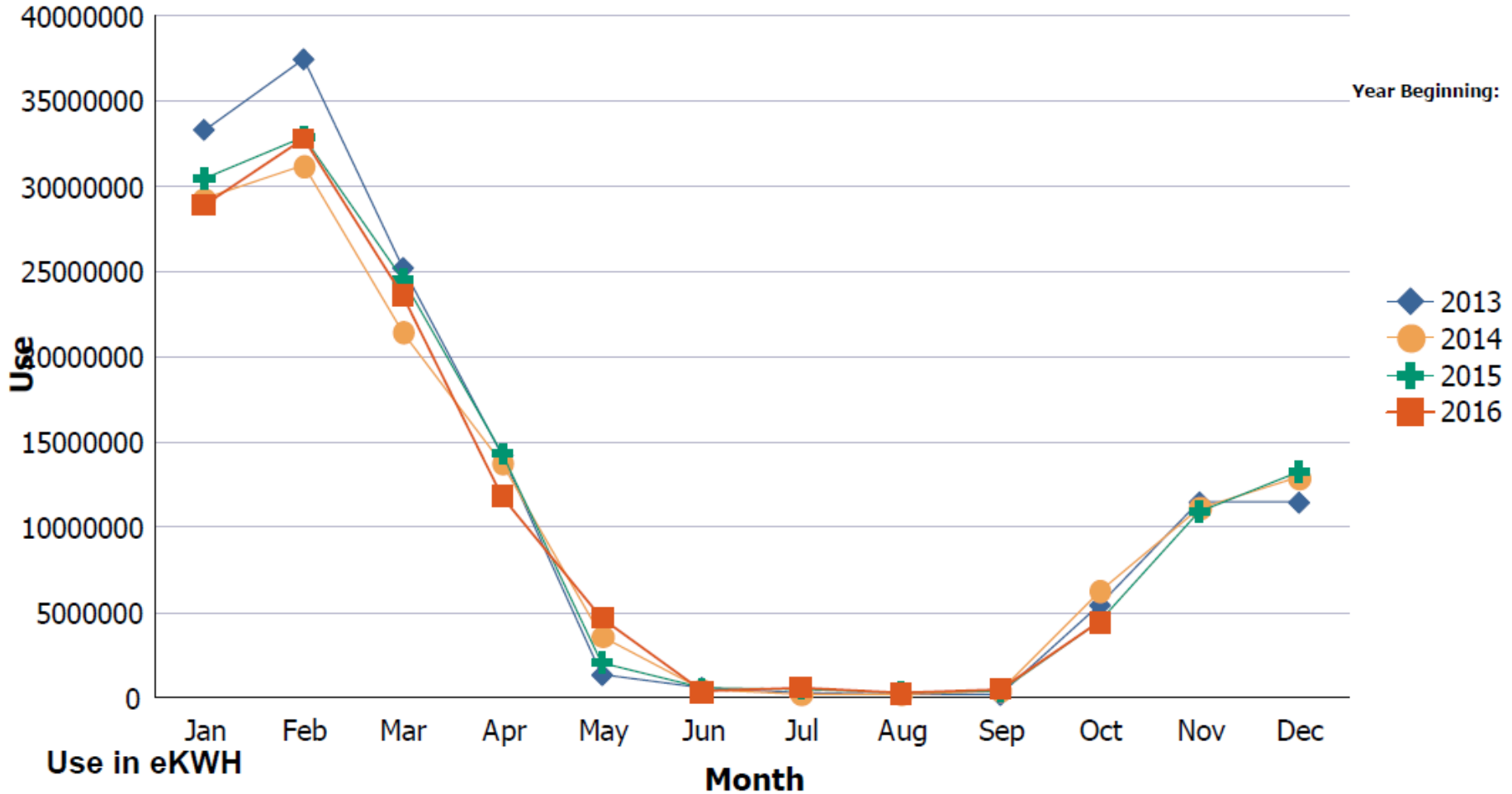
Displaying 1 To 130 of 130

<input type="checkbox"/>	Account Code	Billing Period	Begin Date	End ¹ ▼	Total Cost	Usage	Usage Unit	Use/Day
<input checked="" type="checkbox"/>	GTAA-ELE-TOT	Oct 2016	10/01/2016	11/01/2016	\$1,348,067.60	23,460,425	kWh	756,787.91
<input type="checkbox"/>	GTAA-ELE-TOT	Sep 2016	09/01/2016	10/01/2016	\$1,427,273.20	23,973,303	kWh	799,110.09
<input type="checkbox"/>	GTAA-ELE-TOT	Aug 2016	08/01/2016	09/01/2016	\$1,870,038.60	26,725,366	kWh	862,108.57
<input type="checkbox"/>	GTAA-ELE-TOT	Jul 2016	07/01/2016	08/01/2016	\$1,828,656.90	26,461,337	kWh	853,591.50
<input type="checkbox"/>	GTAA-ELE-TOT	Jun 2016	06/01/2016	07/01/2016	\$1,905,418.50	23,842,546	kWh	794,751.54
<input type="checkbox"/>	GTAA-ELE-TOT	May 2016	05/01/2016	06/01/2016	\$1,792,757.40	24,220,912	kWh	781,319.75
<input type="checkbox"/>	GTAA-ELE-TOT	Apr 2016	04/01/2016	05/01/2016	\$1,630,152.60	23,592,308	kWh	786,410.26
<input checked="" type="checkbox"/>	GTAA-ELE-TOT	Mar 2016	03/01/2016	04/01/2016	\$1,714,270.40	25,089,386	kWh	809,335.04
<input type="checkbox"/>	GTAA-ELE-TOT	Feb 2016	02/01/2016	03/01/2016	\$1,756,829.70	24,292,441	kWh	837,670.39
<input type="checkbox"/>	GTAA-ELE-TOT	Jan 2016	01/01/2016	02/01/2016	\$1,850,465.90	26,074,169	kWh	841,102.22
<input type="checkbox"/>	GTAA-ELE-TOT	Dec 2015	12/01/2015	01/01/2016	\$1,839,403.84	24,687,303	kWh	796,364.60

Account: GTAA-ELE-TOT

Natural Gas Normalized Usage Profile/ Toronto Pearson

Executive Energy Profile



Natural Gas

Normalized Usage Data/ CUP

Location: Buildings-> Toronto Pearson Airport-> GTAA-UTILITY-CUP-> NG-20-EN [CUP]

[Copy Data](#)

Time: 12/08/2016 8:46:10 AM

Commodity: Natural Gas

Created By: gtaa

Month	2016 (CUB)	2015 (CUB)	2014 (CUB)	2013 (CUB)	2012 (CUB)	2011 (CUB)	2010 (CUB)	2009 (CUB)	2008 (CUB)
Jan	1,619,418.80	1,217,710.37	1,328,156.37	1,644,751.77	1,463,493.00	1,342,001.19	1,595,472.76	1,251,812.62	1,473,645.36
Feb	1,780,905.28	1,272,624.85	1,186,840.13	1,594,088.50	1,816,928.25	1,513,885.57	1,734,773.78	1,459,395.50	1,349,569.96
Mar	1,315,540.27	1,294,180.03	937,644.615	1,300,380.05	1,221,925.30	1,256,868.24	1,250,045.72	1,038,912.36	962,475.304
Apr	730,167.837	719,584.588	722,882.727	769,672.770	689,123.550	708,807.760	631,308.720	504,947.048	521,281.023
May	186,157.367	144.000	158,567.743	29,232.280	97,934.800	163,200.600	85,658.820	102,021.045	242,622.627
Jun	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jul	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2,419.354
Aug	0.000	0.000	0.000	0.000	0.000	0.000	0.000	173.309	75,080.645
Sep	2,155.352	1,948.491	5,960.430	0.000	0.000	0.000	0.000	5,199.290	76,876.405
Oct	221,863.477	216,005.302	395,629.663	355,031.534	477,301.750	327,827.880	481,769.960	456,193.800	342,029.954
Nov		585,002.221	710,487.946	571,814.943	675,265.650	697,070.960	719,608.260	556,860.000	463,149.985
Dec		918,357.885	934,625.183	629,568.857	926,754.400	833,747.840	872,227.640	910,621.800	862,375.321

Normalized

Month	Previous 12 Months (CUBICM)	Current 12 Months (CUBICM)
Jan	1,228,770.00	1,388,112.00
Feb	1,257,492.00	1,251,388.00
Mar	1,318,886.00	1,083,113.00
Apr	753,116.00	876,830.00
May	144.00	257,499.00
Jun	0.00	0.00
Jul	0.00	0.00
Aug	0.00	0.00
Sep	0.00	0.00
Oct	198,150.00	198,150.00
Nov	569,703.00	
Dec	920,805.00	

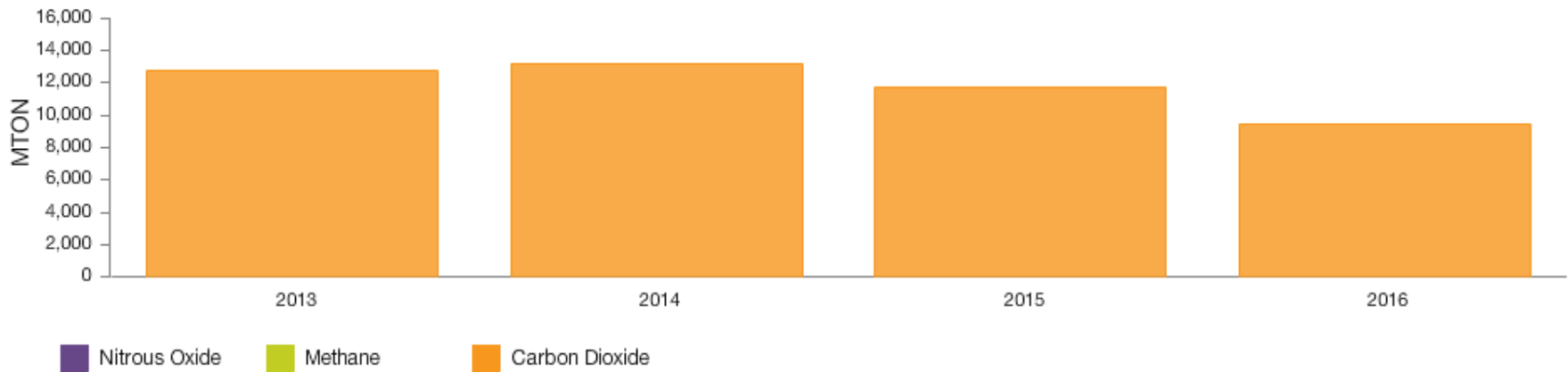
Actual

Natural Gas GHG Emission/ CUP

[Actual Data](#) | [Calendarized Data](#) | [Normalized Data](#) | [Savings](#) | [Meter Properties](#)
[Summary](#) | [Trends](#) | [Monthly](#) | [Bills](#) | [Greenhouse Gas](#) | [Channels](#)

Calendar Year Emissions

Calendar Year Emissions - CO2 Equivalent



Factors Linked

Start Date	End Date	Factor Type	Factor	CO2 Equivalent	Source
01/01/1980	01/01/3000	Carbon Dioxide	0.176494	1.000000	GTAA_NG
01/01/1980	01/01/3000	Methane	0.000004	21.000000	GTAA_NG
01/01/1980	01/01/3000	Nitrous Oxide	0.000003	310.000000	GTAA_NG

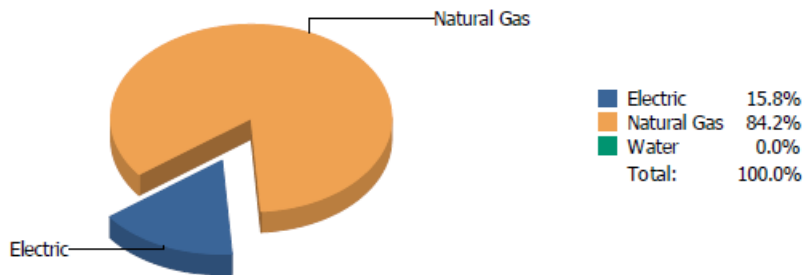
Automatic E-mail Batch Report/ CUP Facility

Cost Avoidance Chart
Facility Management Reports

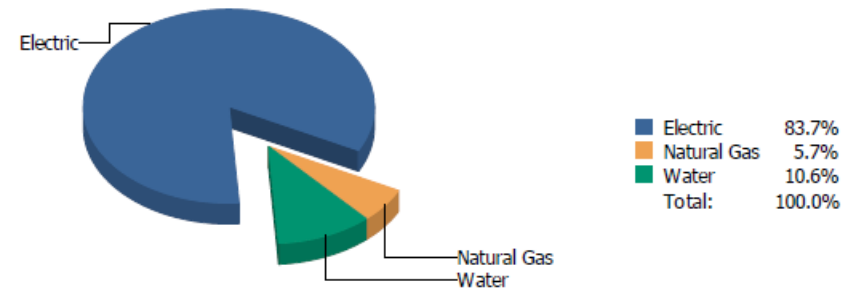
Executive Summary by Commodity BL - 12

All Places
Floor Area: 12,328,237 SqFt

Use Percentage



Cost Percentage



Billing Period between Jan 2015 and Dec 2015

Commodity	Common Unit		Energy Use		Energy Percentage	Cost	Cost Percentage
	Common Use	Cost/Unit	eKWH	Cost/eKWH			
Electric	12,358,426kWh	\$0.0960 / kWh	12,358,426	\$0.0960 / eKWH	16%	\$1,186,370.23	82.16%
Natural Gas	6,247,066M3	\$0.0172 / M3	65,719,134	\$0.0016 / eKWH	84%	\$107,534.54	7.45%
Water	105,769M3	\$1.4190 / M3				\$150,082.84	10.39%
Grand Totals:			78,077,561			\$1,443,987.61	

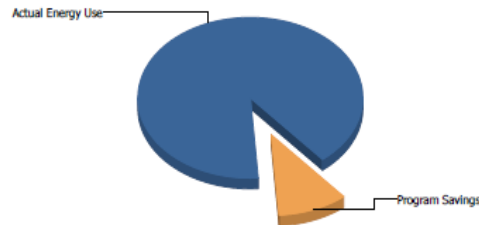
Energy Conservation Program Report/ AMF

Energy Conservation Program - Energy Summary CAP - 19A

Cumulative Energy Savings

October 2016

Expected Energy Usage	5,798,636	EKWH
Actual Energy Usage	5,221,279	EKWH
Program Savings	577,357	EKWH
Percent Savings	10.0%	



Expected Energy Usage

Anticipated usage without energy management.

Base year usage after adjustments for such variables as changes in weather, equipment, schedules, occupancy and prices.

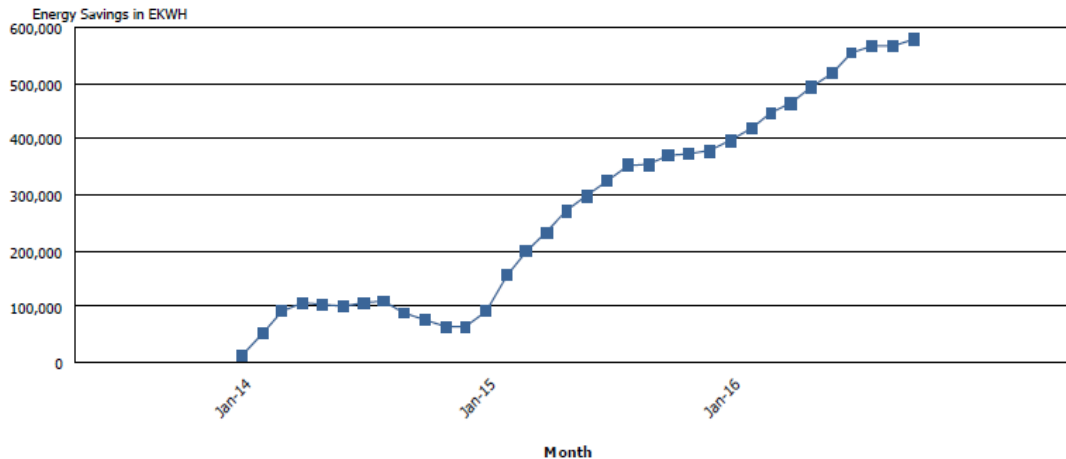
Actual Energy Usage

Actual energy usage for electricity, gas, etc. obtained directly from utility bills.

Program Savings

The difference between Expected and Actual Usage, calculated in accordance with the International Performance Measurement & Verification Protocol.

Cumulative Energy Savings



Cumulative Greenhouse Gas Reduction

Energy Reduction Impact:

577,357 EKWH

6 equiv. metric tons of CO₂

This is equivalent to the following:



Electricity Cost Avoidance/ Terminal 1

Cost Avoidance Manager

Code: locate M2T1
Info: M2T1

Savings Start: 1/1/2016
BaseLine Start: 1/1/2015

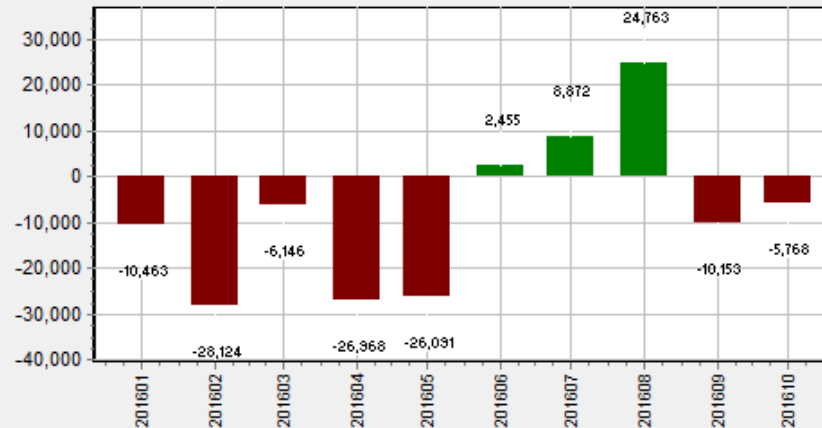
Months: 12
Electric

Include meter in Cost Avoidance Track Demand



COST AVOIDANCE							
Period	Year	Without CAP Cost	Actual Cost	Cost Avoidance	W/thr Htg	W/thr Clg	CA%
Oct	2016	\$567,909	\$573,677	(\$5,768)	x	x	-1.0
Sep	2016	\$547,052	\$557,205	(\$10,153)	x	x	-1.9
Aug	2016	\$733,567	\$708,804	\$24,763	x	x	3.4
Jul	2016	\$621,964	\$613,092	\$8,872		x	1.4
Jun	2016	\$704,232	\$701,777	\$2,455	x	x	0.3
May	2016	\$621,586	\$647,677	(\$26,091)	x	x	-4.2
Apr	2016	\$672,423	\$699,391	(\$26,968)	x		-4.0
Mar	2016	\$658,947	\$665,093	(\$6,146)	x		-0.9
Feb	2016	\$611,038	\$639,162	(\$28,124)	x		-4.6
Jan	2016	\$716,029	\$726,492	(\$10,463)	x		-1.5

Cost Avoidance Graph



Meter Code: **M2T1**
Meter Name: **M2T1**

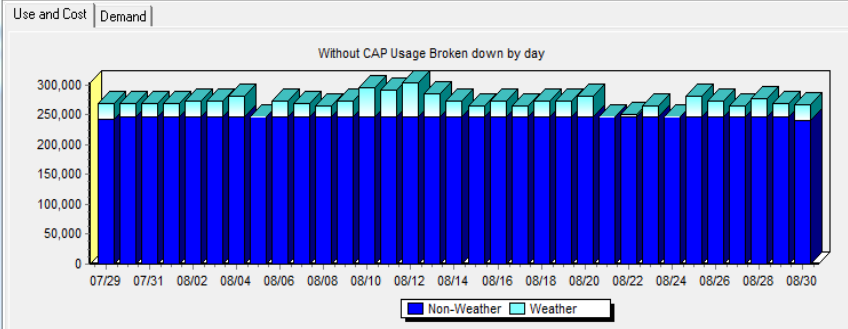
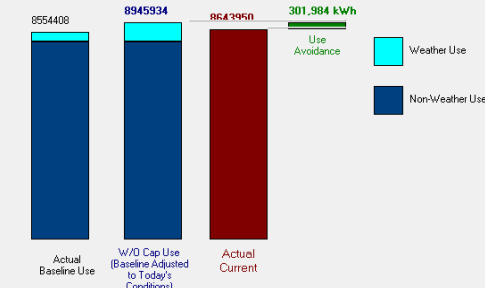
W/O CAP Non-Weather Use: 8136780 kWh
W/O CAP Weather Use: 809154 kWh
Total W/O CAP Use: 8945934 kWh
Actual Use: 8643950 kWh
Total W/O CAP Cost: \$733566.58
Minus Actual Cost: \$708803.90
Savings: \$24762.68

Explanation of Day-by-Day Baseline Adjustments
BaseLine AUC: 0.096
----- 7/29/2016 -----
Non Weather Use: 242639.7/day
Weather Use: 26101.7/day
W/O CAP Cost: \$22036.80/day
Daily AUC: \$0.082/day
B4 Baseline usage adjusted for cooling degree days.
----- 7/30/2016 -----
Non Weather Use: 246908.6/day
Weather Use: 21751.4/day
W/O CAP Cost: \$22036.13/day

Meter: **M2T1**
W/O CAP Use: **8,945,934** (minus) Actual Use: **8,643,950** (equals) Use Avoidance: **301,984**

Weather Sensitivity Use/Degree R2
Summer: 4.360.29 0.7287
Winter: 2.505.24 0.9606

Start Date: 07/29/2016
End Date: 08/31/2016
Units: kWh



W/O CAP Cost: **\$733,567** (minus) Actual Cost: **\$708,804** (equals) Cost Avoidance: **\$24,763**
Savings!
\$24,763



Conservation Program

20-Year Strategic Framework “Our Connection”



VISION

The best airport in the world:
Making a difference, connecting the world.

STRATEGIC GOALS

- Passenger & Customer Service
- Safety
- People
- Financial Sustainability
- Aviation Growth
- Corporate Responsibility

RULES OF THE RUNWAY

- Results First - Safety Always
- Act Now - Be Transparent - Be Accountable
- Win As A Team
- Relationships Matter



VALUES

Respect ♦ Integrity

BEHAVIOURS

Execute Flawlessly ♦ Lead People ♦ Improve and Innovate ♦ Influence



For You. The World.



Social License to Operate/Grow

Local community's acceptance or approval of a company's project or ongoing presence in an area.

It is increasingly recognized by various stakeholders and communities as a prerequisite to development.

Not obtaining a social license can lead to conflict, delays or costs

'You don't get your social license by going to a government ministry and making an application or simply paying a fee... It requires far more than money to truly become part of the communities in which you operate.'

- Pierre Lassonde, President of Newmont Mining Corporation.

Social License to Operate/Grow

The development of social license:

- Intangible and informal
- Occurs outside of formal permitting or regulatory processes
- Requires sustained investment by proponents to acquire and maintain social capital within the context of trust-based relationships.
- Can be realized through a **robust suite of actions centered on timely and effective communication, meaningful dialogue, and ethical and responsible behavior.**





Energy Conservation / GHG Road map

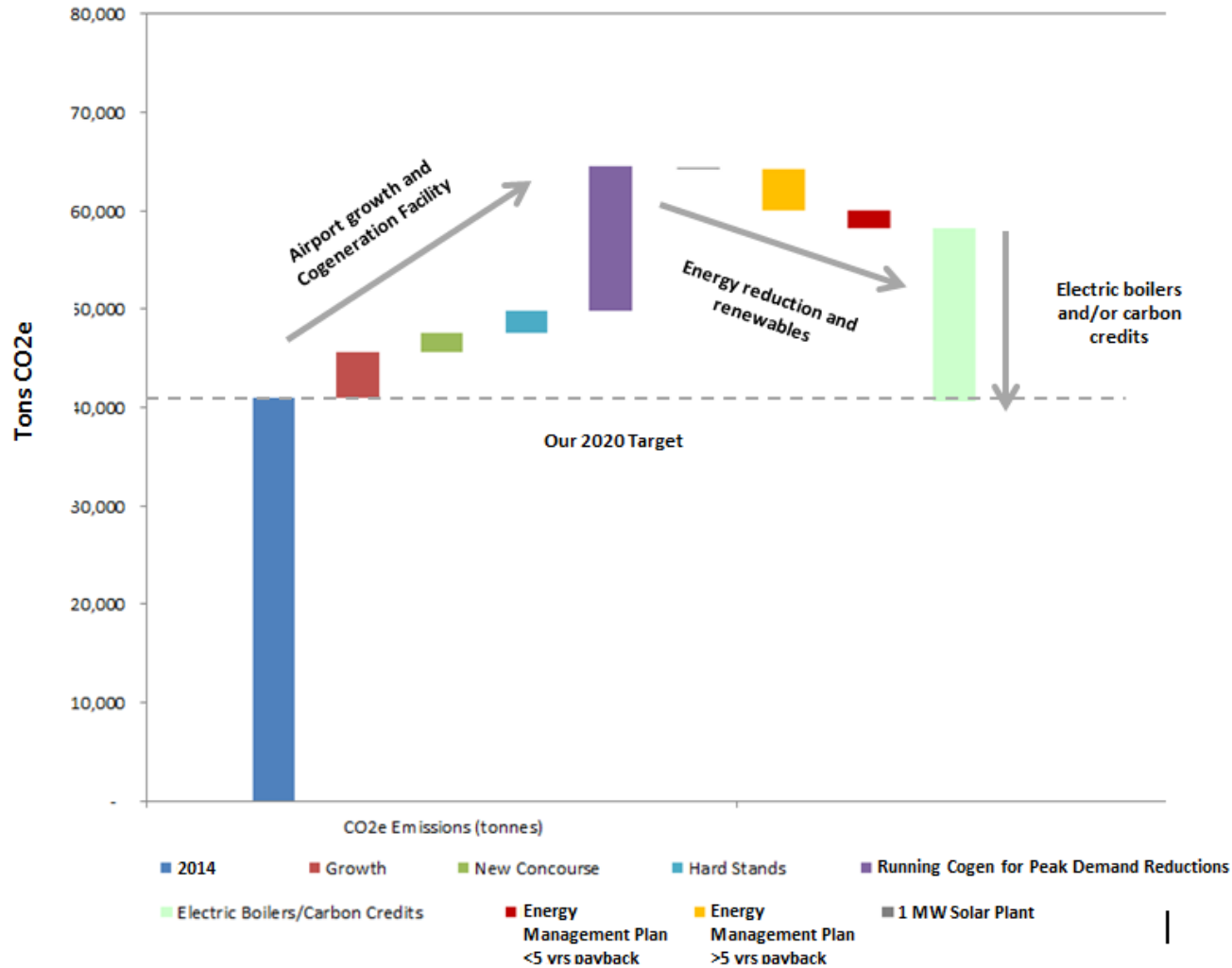


For You. The World.



Toronto Pearson
International Airport | Aéroport International

Projected GHG Growth and Reduction Strategy



Road Map - 5 yr. Plan

Road Map Budget (5yrs)

Measure (in Thousands)	2012	2013	2014	2015	2016
Campus Wide - Enhancements to Energy Management Program	\$ 642.9	\$ 642.9	\$ 642.9	\$ 642.9	\$ 642.9
T1 Energy Audit and Recommissioning (No Cost Measures)	\$ 308.3	\$ 308.3	\$ 308.3		
T1 Low-Cost Measures			\$ 462.5	\$ 462.5	
T3 Enhancements \ Ongoing Commissioning	\$ 183.3	\$ 183.3	\$ 183.3		
T1 Pier G - Improved EE Design \ System Commissioning			\$ 1,166.7	\$ 1,166.7	\$ 1,166.7
Total (in Thousands)	\$ 1,134.5	\$ 1,134.5	\$ 2,763.7	\$ 2,272.1	\$ 1,809.6
			Cummulative Total	\$	9,114.4

- **Continue funding annual energy efficiency program (\$2-3M/Yr)**
- **Incremental benefits regarding avoided energy cost of \$15.8M**
- **GHG reduction of 7,123 tonne at an average price of \$25 per ton (Carbon Tax) equals \$178,075 per year in tax avoidance**

Energy Efficiency Measures / Opportunities

Table 11 Summary of Emission Reduction Opportunities – Conservative Case

Opportunity	Annual Energy Cost Savings	NPV	Discounted Payback Period (years)	Annual Emission Reduction Potential (t CO ₂ e) ¹⁵	Total Emission Reductions (10 years)	Cost (-NPV) / t CO ₂ e
Terminal 1 - Recommissioning and Energy Study, correct deficiencies, no-cost measures (A1)	\$693,889	\$3,022,468	3.3	2,334	18,670	-\$162
Terminal 1 - Low-Cost Measures (A2)	\$531,749	\$2,327,499	3.2	1,711	14,547	-\$160
Terminal 1 - Capital Investments (A3)	\$540,403	-\$2,731,404	13.5	1,731	14,713	\$186
Pier G - Improved Design / Best Practice Commissioning (B1)	\$438,858	-\$1,061,551	11.0	1,426	9,981	\$106
Pier G - Additional Energy Upgrades / Best Practice Design (B2)	\$296,883	-\$2,172,500	16.5	1,106	7,745	\$281
Tenants – Commissioning / Recommissioning and/or Energy Audits (C1)	\$0	-\$4,212,364	n/a ¹⁶	2,998	20,985	\$201
Tenants - Subsidize Low-Cost Upgrades (C2)	\$0	-\$6,318,546	n/a	2,774	19,415	\$325
Terminal 3 - Enhanced Recommissioning including Comprehensive Energy Audit (D1)	\$302,323	\$1,185,917	3.8	1,137	9,097	-\$130
Terminal 3 - Additional "Low-Cost" Upgrades (D2)	\$181,314	-\$750,642	12.5	713	6,057	\$124
Terminal 3 - Capital Intensive Upgrades (D3)	\$181,314	-\$1,659,270	18.0	713	6,057	\$274
General Campus - On-Going	\$823,401	-\$307,583	9.5	2,368	14,205	\$22

¹⁵ The MACC curve presents the maximum annual emission reduction potential achievable, by 2020.

¹⁶ Payback period for tenant reduction opportunities is not calculated as their associated energy cost savings do not provide a direct economic benefit to the GTAA. Refer to Section 3.2 for further discussion.

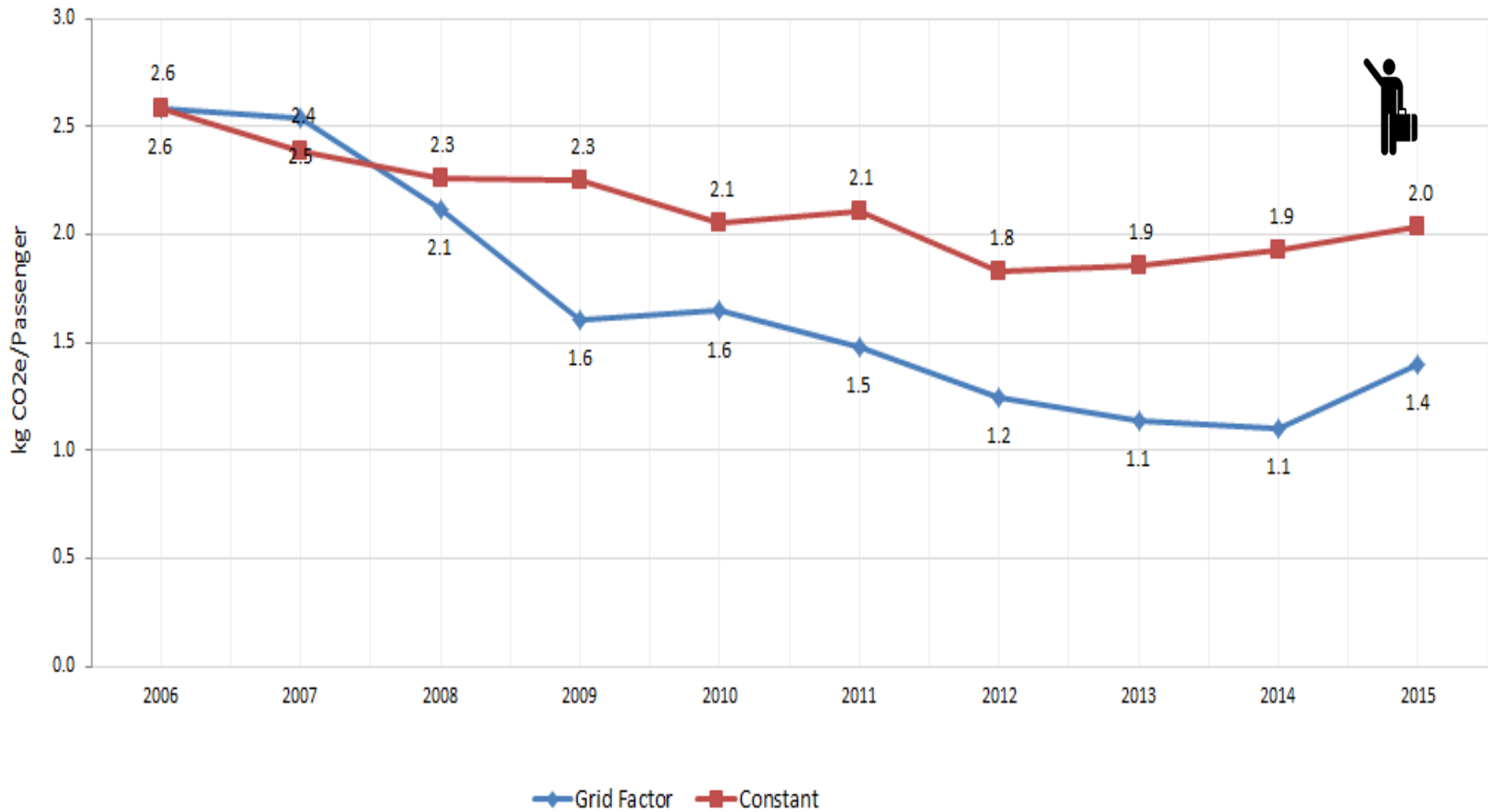
Energy Efficiency Measures / Opportunities

Opportunity	Annual Energy Cost Savings	NPV	Discounted Payback Period (years)	Annual Emission Reduction Potential (t CO ₂ e) ¹⁹	Total Emission Reductions (10 years)	Cost (-NPV) / tCO ₂ e
Terminal 3 - Capital Intensive Upgrades (D3)	\$181,314	-\$1,659,270	18.0	636	5,408	\$307
General Campus - On-Going Commissioning and Energy Management (E1)	\$823,401	-\$307,583	9.5	1,772	10,634	\$29
General Campus - Low-Cost Upgrades (E2)	\$307,902	-\$2,760,484	20.2	636	3,815	\$724
General Campus - 1 MWp Solar PV System (F)	\$80,000	-\$4,128,174	62.5	108	1,079	\$3,827

Energy Master Plan 2016 Projects

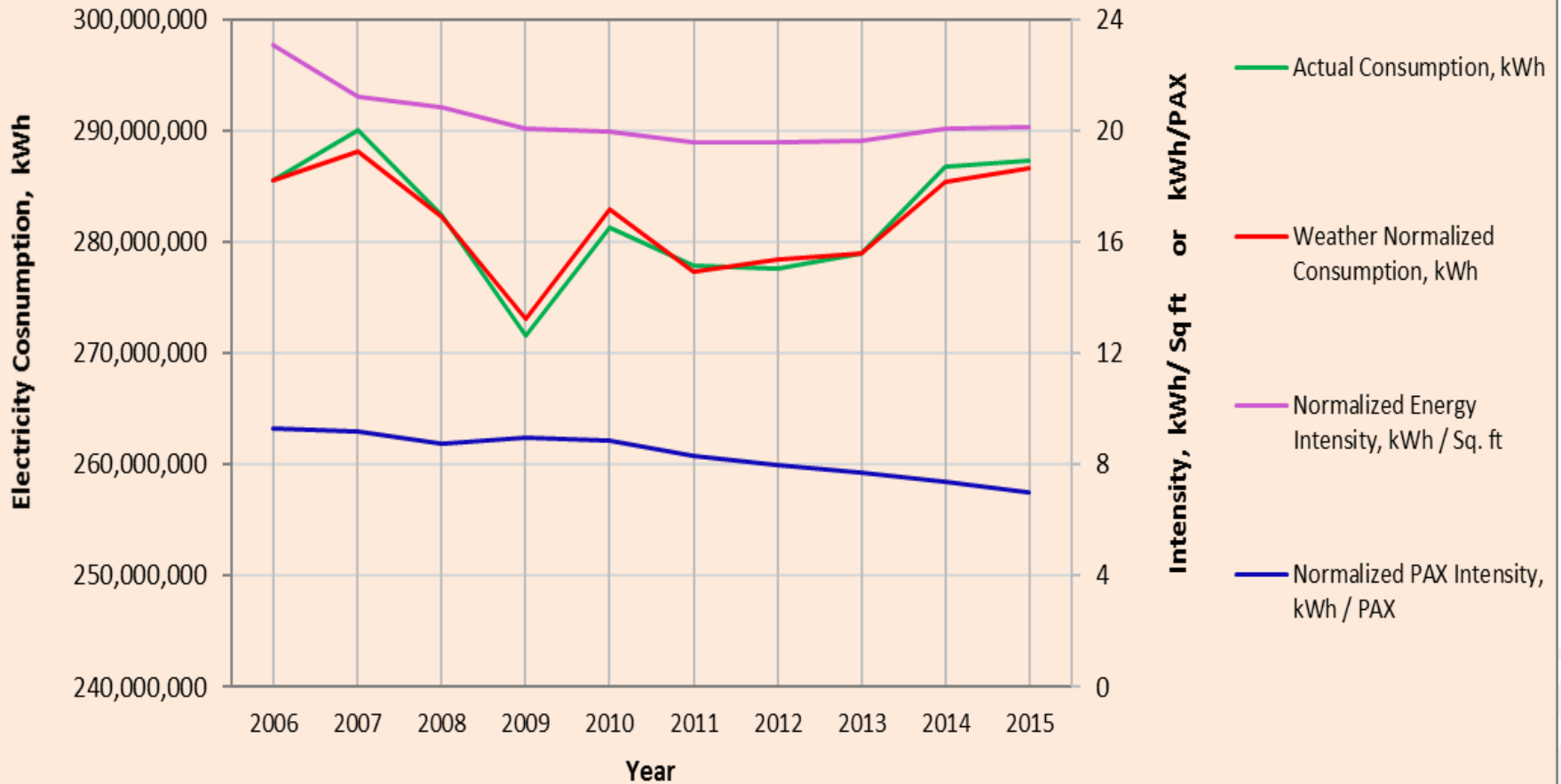
Project Name - O&M Initiatives	Type	Status	Completion	eKW/Hr Savings/Year	GHG (Tonnes)
T1 Parking garage 150w MH - LED bulb replacement Pilot	O&M	In progress	31-Aug-16	75,000	3
4000 LED Lamps replacement	O&M	Complete	30-Jun-16	420,480	17
CDF Wallpacks	O&M	Complete	31-Mar-16	10,000	0
T1 Gate Sign LED replacement	O&M	In progress	30-Sep-16	92,243	4
Control Tower RGB lights	O&M	In progress	15-Sep-16	12,000	0
T1 Lighting management - Photocells and scheduling	O&M	In progress	30-Sep-16	500,000	21
Sustainability Screen-Admin building	O&M	In progress	30-Sep-16	NA	0
AMF LED tubes replacement	O&M	In progress	31-Oct-16	600,000	25
T1 West elevator lobby lighting improvement	O&M	In progress	31-Oct-16	NA	
				1,709,723	70
Project Name - Asset Renewal Initiative	Type	Status	Completion	eKW/Hr Savings/Year	GHG (Tonnes)
T1 Curb canopy lights	Capital	Complete	30-Jun-16	800,000	33
409 High mast lights	Capital	In progress	31-Aug-16	300,000	12
T3 Apron lighting	Capital	In progress	30-Sep-16	256,000	11
T3, T-8/12 to LED tubes	Capital	In progress	30-Nov-16	91,000	4
T3 Baggage road	Capital	Complete	31-Jul-16	147	0
Infield Tunnel	Capital	In progress	31-Dec-16	900,000	37
T1 HVAC improvement	Capital	In progress	31-Dec-16	500,000	121
6A Parking lights LED replacement	Capital	In progress	31-Oct-16	425,000	17
				3,272,147	234
			TOTAL	4,981,870	305

GTAA GHG Trend



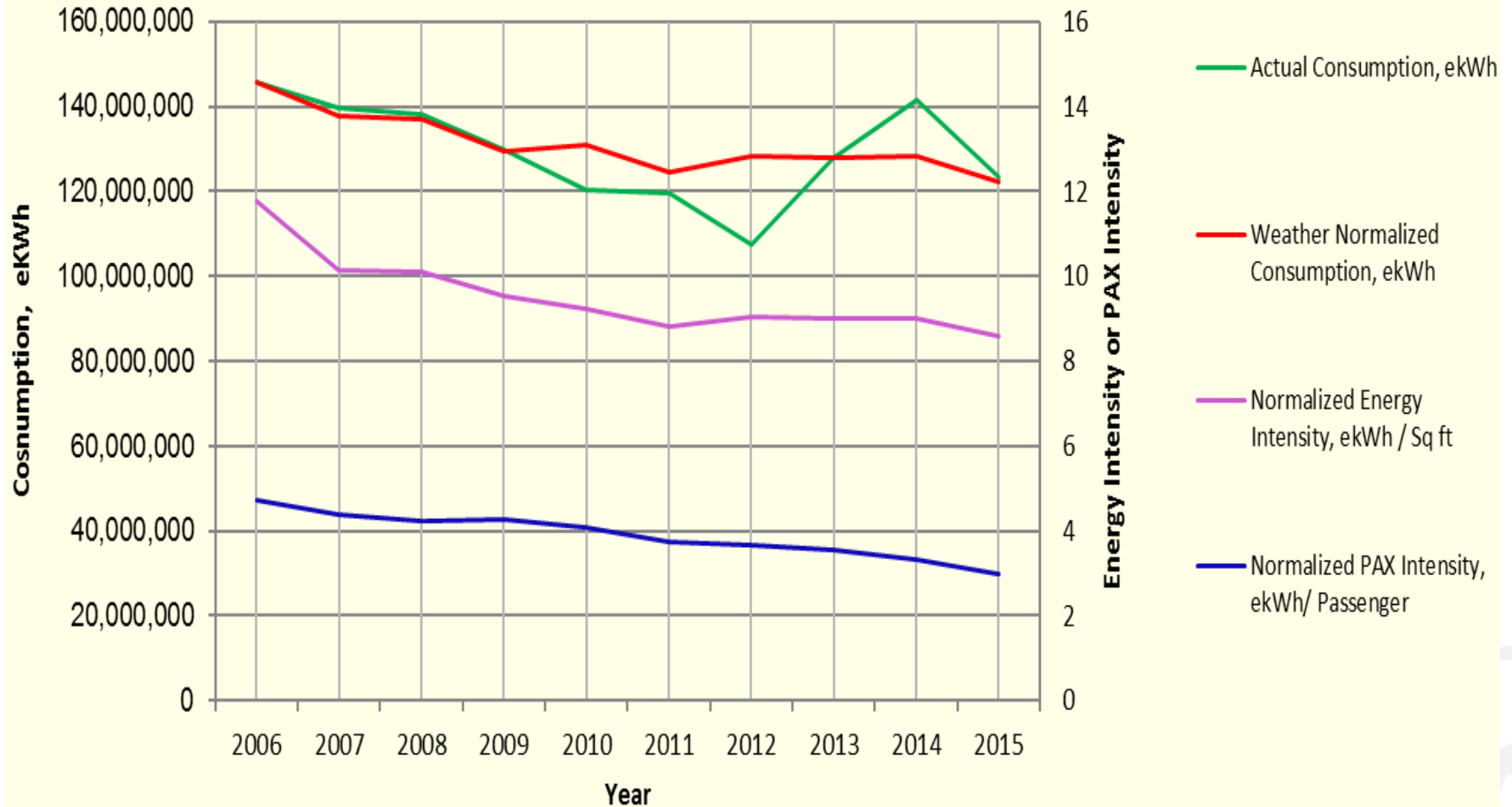
GTAA Electricity Trend

Toronto Pearson Airport Electricity Usage Report, Year over Year]



GTAA Natural Gas Trend

Toronto Pearson Airport Natural Gas Usage Report, Year Over Year



Energy Conservation \ GHG Program results

- Excess of 29,427,233 KWh savings from 2004
- Over \$2,741,309 per year in avoided energy spend
- Electricity usage per PAX from 2014 to 2015 was down by more than 10%





Conservation Projects

Brief Look at our Baggage System...



Statistics and Data are based on averages and for educational purposes only. For more information, visit TorontoPearson.com

Energy Conservation in the Baggage System

Measures	Savings (kWh)
Energy Efficient Belts	30,800
Improved Carousel Control	280,000
New Pusher Control	558,300
Install VFDs on Motors	248,800
Time Out Control	128,300



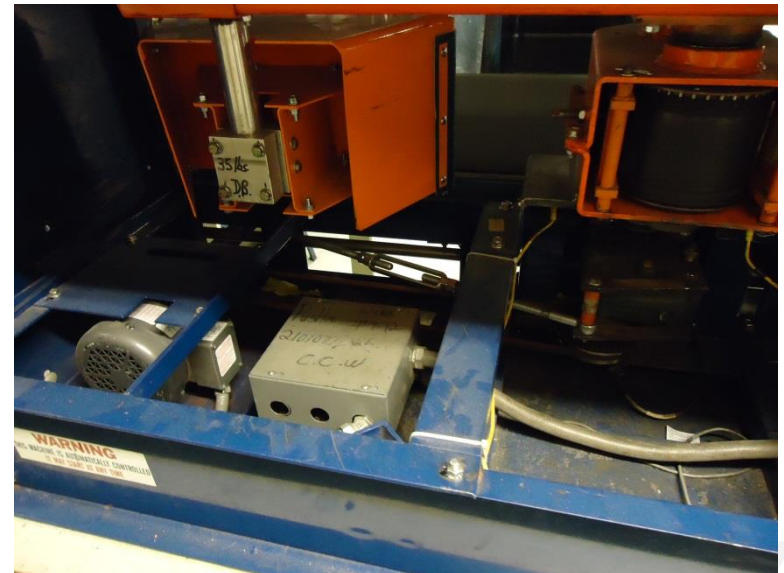
New Pusher Controls

PROBLEM:

182 Pushers within the baggage system, are used to transfer outbound baggage, idle constantly when not actively pushing (78% of the time)



Pusher arm activated

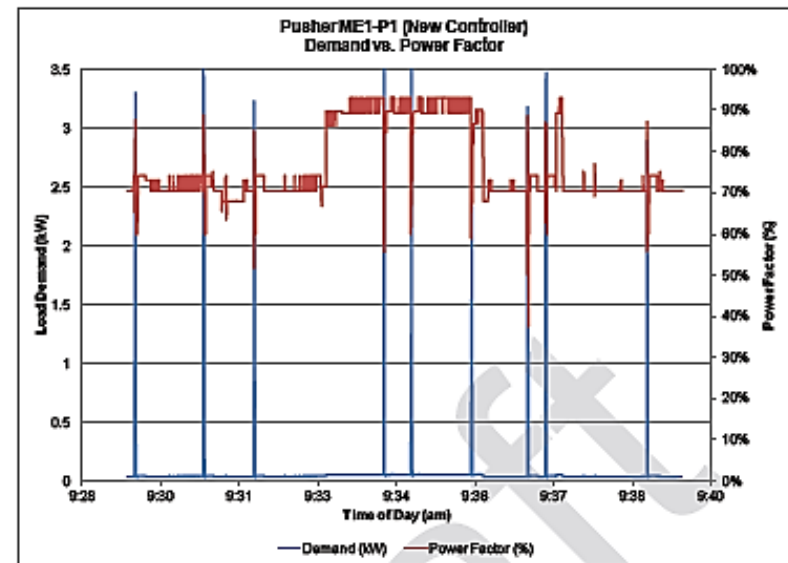
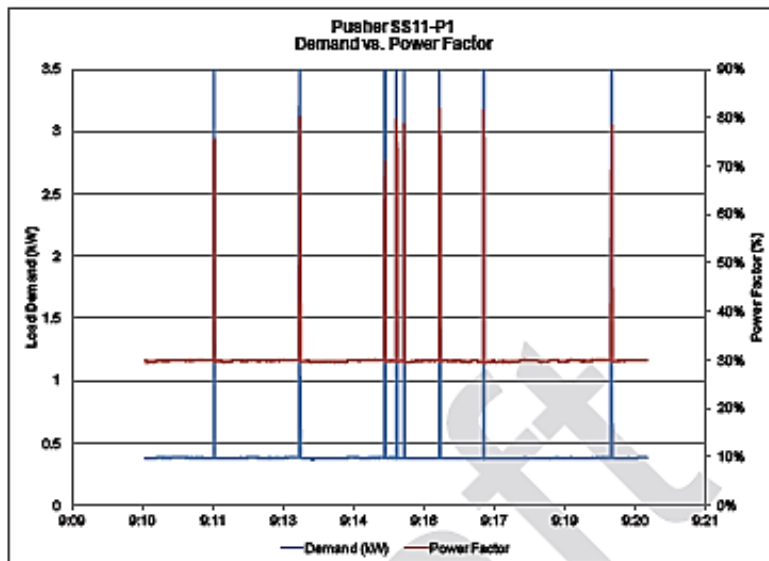


Motor behind the pusher

New Pusher Controls

SOLUTION:

To Save on the constant power draw; VFD controllers were added to turn off the motor when idling while also reducing the systems vibrations by 90%.



The project is expected to save **558,300 kWh** of electricity each year

Lighting: Terminal 3 Parking Garage

BACKGROUND:

1,591,724 SQ.FT garage with 2087 high pressure sodium and metal halide fixtures.



PROBLEM:

Majority of the fixtures were high pressure sodium with poor color rendition and low uniformity levels. Operational 24/7 with exception to few that are controlled through photo cells.

Terminal 3 Parking Garage

SOLUTION:

1900 x 50W LED Fixtures and the removal of 184 unnecessary HPS fixtures.
Improving the color and quality of light and achieving the target of 50 maintained lux.



Before

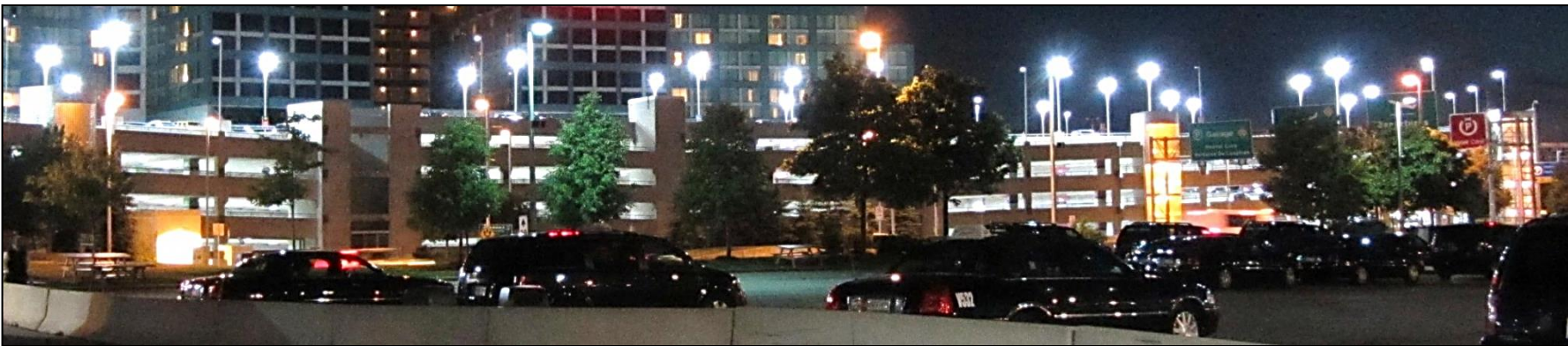


After

Terminal 3 Parking Garage

SAVINGS:

2,193,000 kWh/Year



Other Energy Efficient Lighting Projects

Terminal 1 Interior (Piers)

1017 LED Fixtures (30 kW Total) to replace Metal Halide spot lights with a savings of

630,000 kWh/Year



HVAC in Terminal Buildings

PROBLEM:

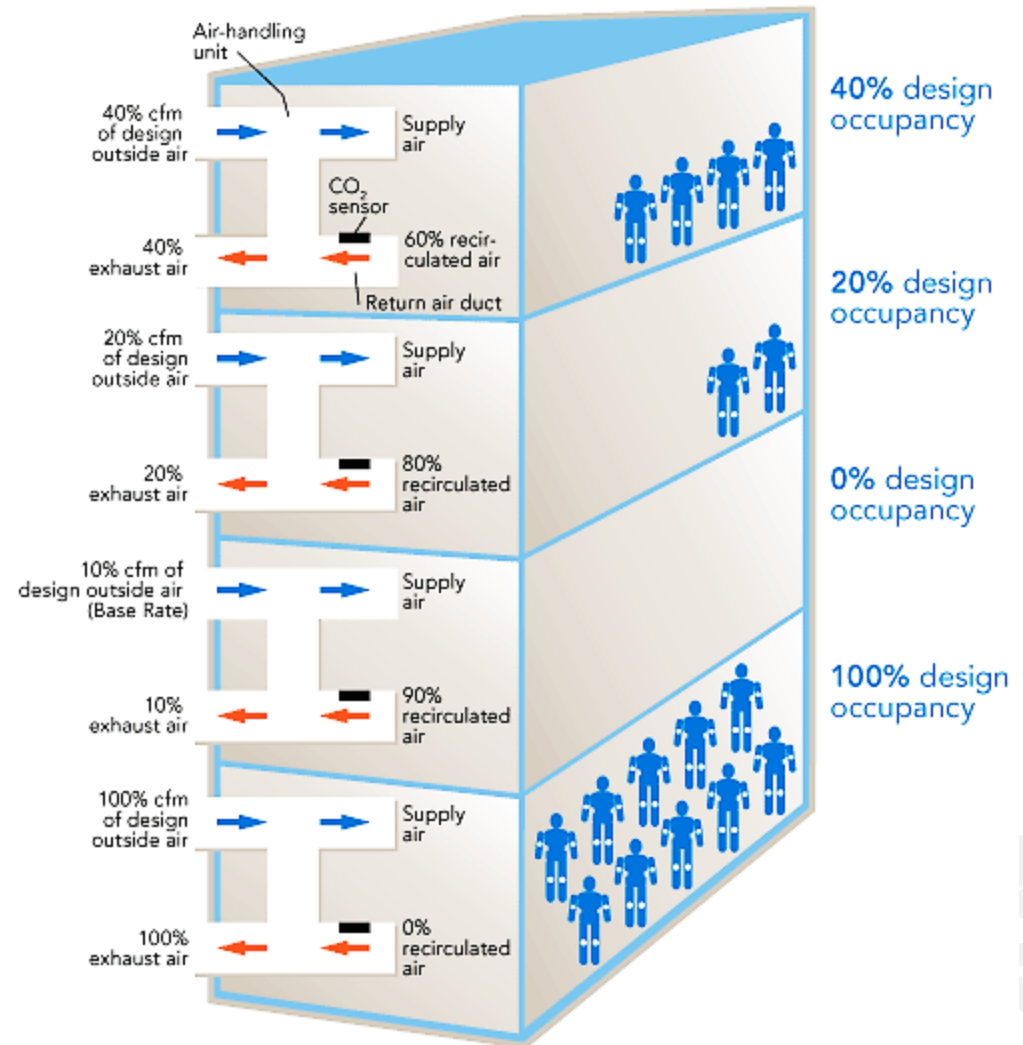
Constant Air Volume units worked to the 100% design occupancy.

SOLUTION:

CO2 sensors and VFD's controllers were added to operate these units on demand when the airport experienced low traffic.

SAVINGS:

5,719,537 kWh/Year



Roadway Lighting



**Converting all roadway lights to LEDs and
Experimenting with off grid applications**



Roadway Lighting

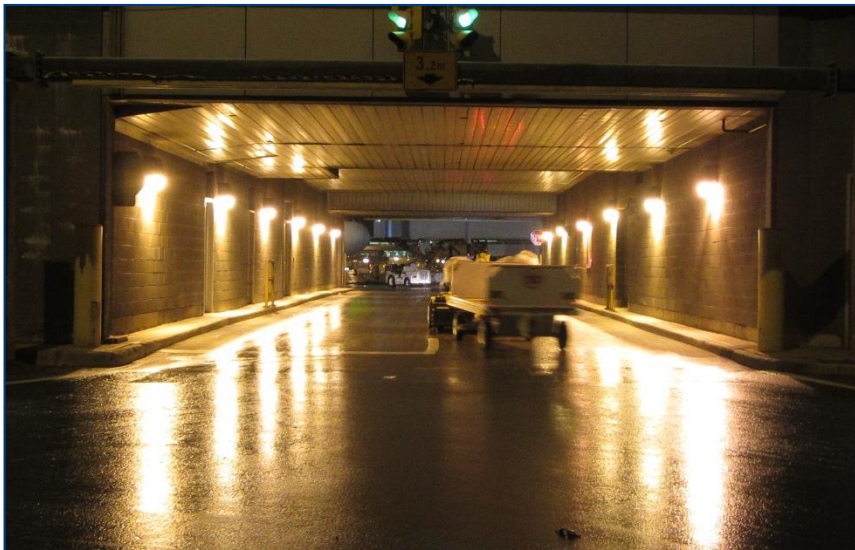


**Converting all roadway lights to LEDs and
Experimenting with off grid applications**



Smaller Lighting Projects

- **Terminal Underpass Lighting** (50,000 kWh)
- **High bay Lighting** (200,000 kWh)
- **Central Utilities Plant Lighting** (110,000 kWh)



Underpass



High bay

Solar powered stop signs

These stop signs were wired on the same circuits as the runway edge lights

Solar powered beacons were installed over stop signs made with reflective material, allowed to turn off the runway edge circuit when not in use



Runway Guard Lights

The runway guard lights (Wigwags) consist of two lamps of 100w (200 watt unit) replaced with the new LED unit is 50 watts



Red Obstruction Light Removal or Upgrade

Of these 605, 432 were deemed unnecessary and removed
The 173 remaining were converted to a 15w LED



Wash Bay lighting replacement



Traffic Lights Converted to LED

The red traffic lamp was 100w the green and amber were 69w
They have been changed to 13w and 9w

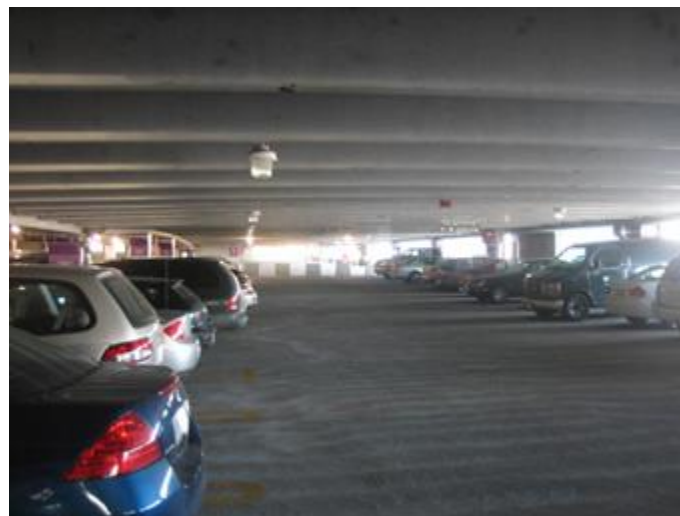


Circulation Pump at Co-Gen Facility

Operation requires a continuous circulation of water and chemicals through the system and used a large 520hp pump where high volume flow of water is only required while the generators are running or during cool down cycle
Installed a bypass pipe and 75 hp pump for when the Co-Gen is not running.
This resulted in a 371kw reduction for an average of 18.93 hours per day and an annual savings of **\$256,000**



Photocell

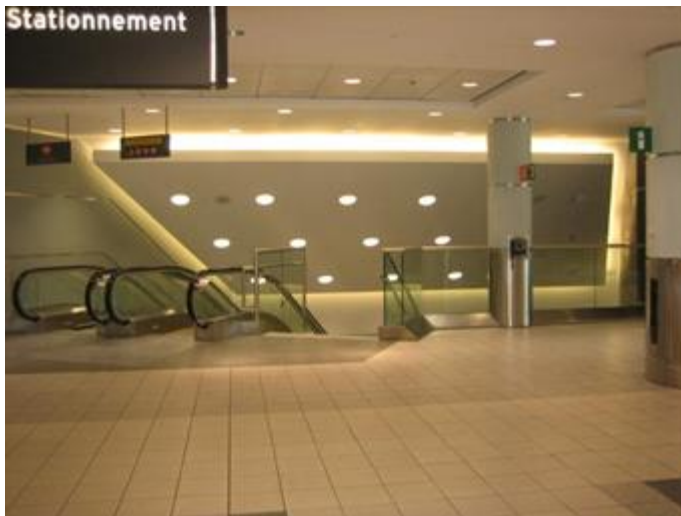


Re-circuiting for scheduling

Service Level



Cove lights



Re-circuiting for scheduling - Photocell

Perimeter lighting



Mechanical Rooms



Lighting Upgrade to regular T5 and to LED T5

- 400w MH replaced with 4 lamp T5 fixtures consuming 360w
- Equipped with occupancy sensors
- One in 4 fixtures is wired to have 2 of the 4 lamps on 24/7
- Payback of less than 2 years



High Bay LED Lighting Upgrade

1000w MH light fixtures replaced with 500w LED fixtures
64% energy reduction



Pole lighting LED replacement.



GREEN FLEET PROGRAM




The Future of Energy Conservation at YYZ

- **10 years of energy conservation projects identified**
 - Worth 40 GWh of avoided energy savings by 2025
 - Representing 15% of our total electricity consumption

Projects currently in progress (2016):

- Terminal 1 HVAC Retro-Commissioning
- T3 Energy Enhancement
- Terminal 1 all Interior Lighting to LED
- Infield Tunnel lighting
- Apron Lighting

Challenges

- **Airports as buildings,**
 - Continuously changing processes and occupancy levels
 - Peaks and valleys
 - Pressurization issues
 - Fresh air issues
 - Sudden demand changes
 - **Lighting Management**
 - Circuitry
 - Some activity always on
 - Hi-definition age
 - **Continuous changing perceptions and expectations**
- 

Challenges - Cont.

- **Airports are heavily regulated**
- **Various occupants with conflicting interests**
- **Pre-conditioned Air and Ground Power systems are unique to airports and deals with many airlines**
- **Different generation of building stocks**




Closing Remarks

Vision:

GTAA will endeavor to reduce its energy and environmental impact on nearby communities by implementing capital and operational initiatives in energy consumption, maintenance and life cycle economies.

The GTAA will use the methods of continuous improvement to constantly strive for community leadership in greenhouse gas and energy reductions in all new buildings, remodeling of existing GTAA buildings and the maintenance of GTAA and GTAA tenant buildings.





Thank you



Questions ? Discussion?



For You. The World.



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