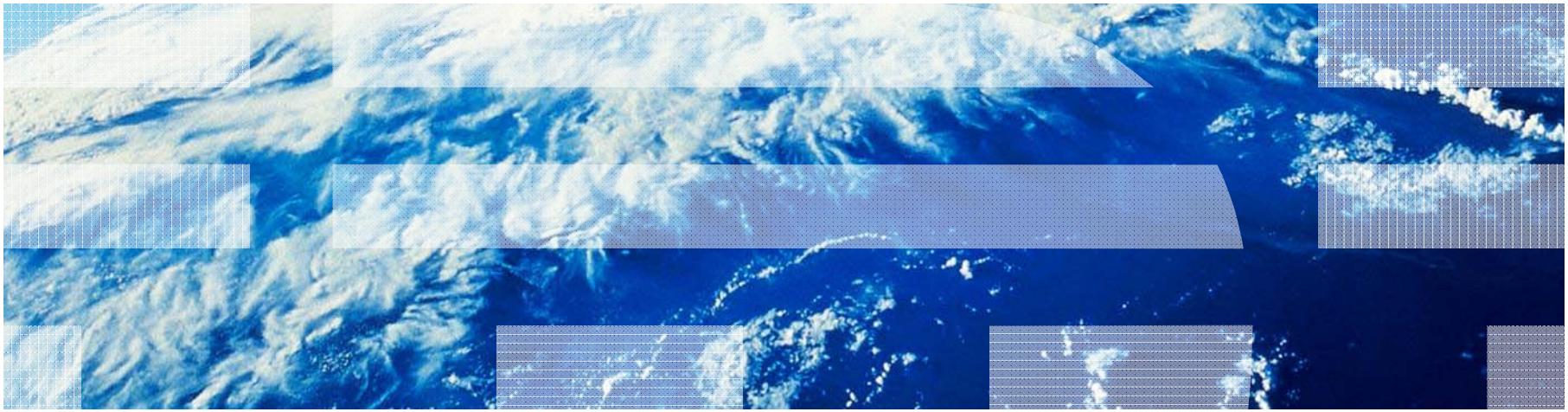
IBM and Energy Efficiency
Improving the environment and supporting our competitiveness

October, 2013
Yves Veilleux
Manager Energy and Environmental programs



Overview

- IBM energy program, an ISO 50001 system
- Corporate monitoring and reporting tools
  - –Utility Accountant (UA)
  - –Enterprise Energy Monitoring System (EEMS)
  - –Business Intelligence @ IBM (BI @IBM)
  - –Corporate energy management dashboard
- Corporate energy management checklists
- Tririga solution
  - –Smarter Building monitoring system
- Corporate results summary

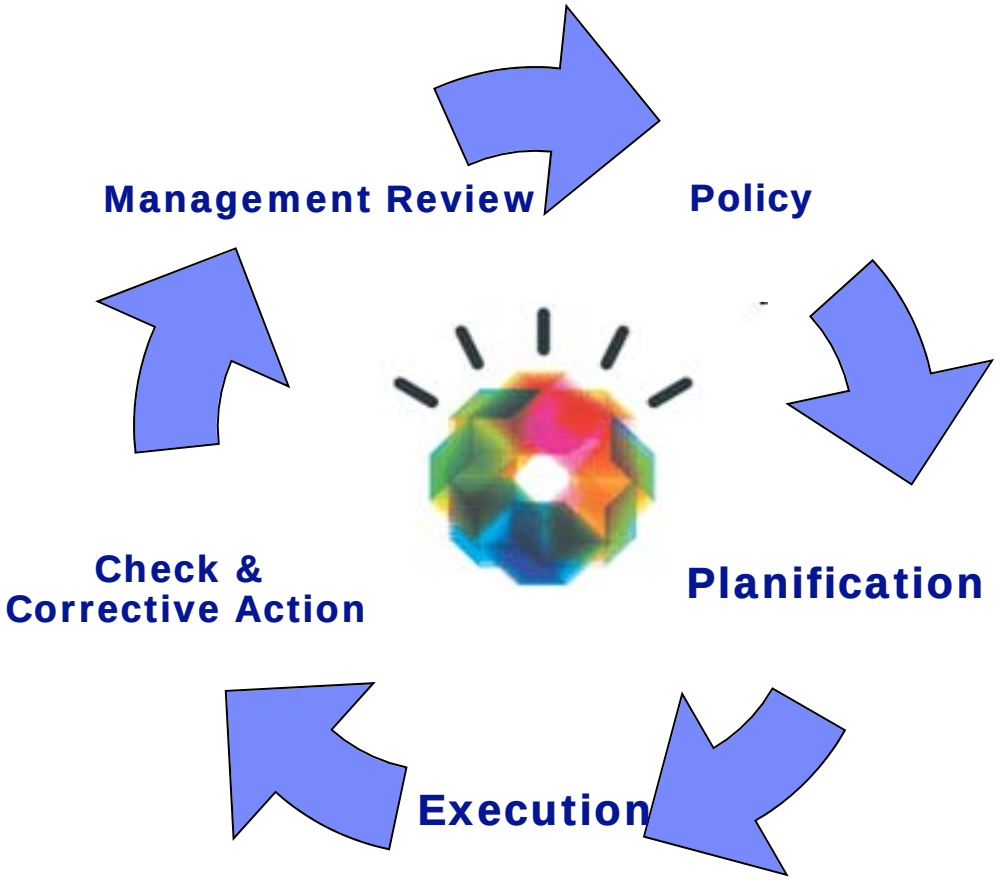
IBM environmental policy summary

IBM is committed to environmental affairs leadership in all its business activities....the following are examples of corporate policy objectives:

- Provide a safe and healthful workplace
- Be an environmentally responsible neighbor
- **Conserve natural resource by reusing, recycling, purchase recycled materials, and using recyclable packaging and other materials**
- **Use development and manufacturing processes that do not adversely affect the environment, prevent air, water, and other pollution**
- **Ensure responsible use of energy**
- Assist with worldwide solutions to environmental problems
- Meet or exceed all applicable government requirements
- Conduct rigorous audits and self assessments
- Strive to continually improve IBM's EMS and performance

EVERY EMPLOYEE AND EVERY CONTRACTOR on IBM premises is expected to follow this policy and report EH&S concern to IBM Management. Managers are expected to take PROMPT action.

Environmental Management System



BUREAU VERITAS
Certification

Certification
Awarded To

IBM CORPORATION
23, BOULEVARD DE L'AÉROPORT, BROMONT, QUÉBEC, CANADA J2L 1A3

SEE APPENDIX PAGE FOR ADDITIONAL CERTIFIED LOCATIONS

Bureau Veritas Certification North America, Inc. certifies that the management system of the above organization has been audited and found to be in accordance with the requirements of the management system standards and scope of supply detailed below

STANDARDS

ISO 14001:2004

SCOPE OF CERTIFICATION

THE ACTIVITIES AND SERVICES INCLUDING FACILITIES OPERATIONS, MAINTENANCE, AND ENVIRONMENTAL MANAGEMENT PROGRAMS WHICH SUPPORT THE PACKAGING AND TESTING OF SEMICONDUCTORS AT THE BROMONT LOCATION AND THE RESEARCH ACTIVITIES AT THE C2MI LOCATION.

Original IBM Global Certificate Approval Date: 9 DECEMBER 1997
Original Approval Date for IBM Bromont: 15 OCTOBER 1998

Subject to the continued satisfactory operation of the Organization's Management System, this certificate will remain valid until: 25 OCTOBER 2015

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization.

Sub-Certificate to: 43820 No: 43820.20
Issue Date: 24 OCTOBER 2012
Revision Date: 15 APRIL 2013

For Bureau Veritas Certification North America, Inc.
390 Benmar Drive, Houston, Texas, USA
www.us.bureauveritas.com/bvc

ANAB ACCREDITED
UKAS ENVIRONMENTAL MANAGEMENT

Page 1 of 2

ISO14001
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ISO50001
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Scope of IBM's Global Environmental Management System

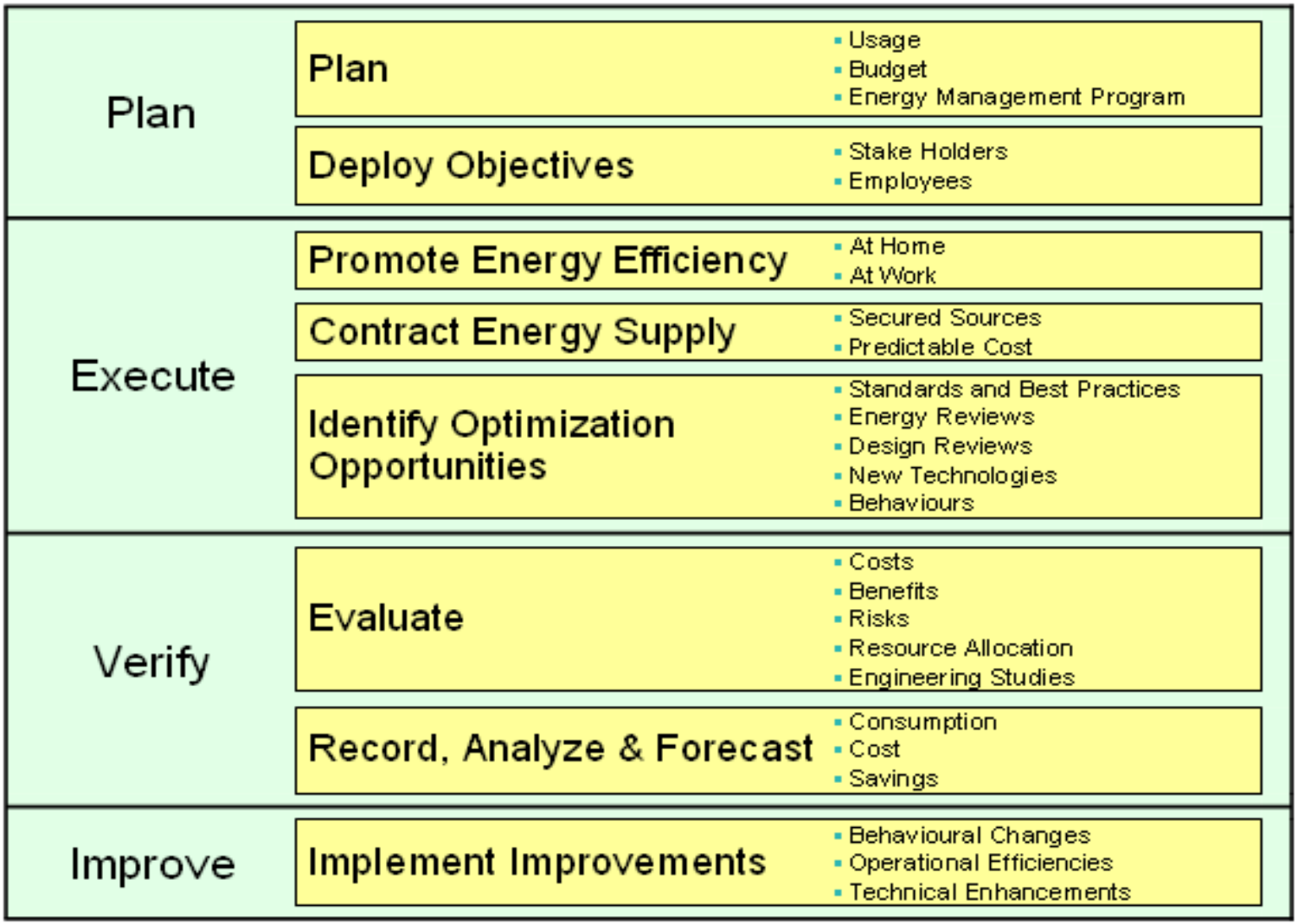
- Covers all aspects of IBM's business operations that intersect with environmental sustainability, including energy and chemical management, encompassing:
  - ✓ Research
  - ✓ Product development
  - ✓ Manufacturing
  - ✓ Real Estate Management
  - ✓ Procurement
  - ✓ Logistics
  - ✓ Services
  - ✓ Software
- Defines roles & responsibilities, establishes framework for establishing voluntary goals, measurement, reporting and disclosure requirements.
- Defines IBM's global requirements and practices regarding, but not limited to:
  - ✓ Air emissions
  - ✓ Water management and discharges
  - ✓ Waste management
  - ✓ Secondary containment
  - ✓ Soil and groundwater protection
  - ✓ Energy management and conservation
  - ✓ Environmental due diligence
  - ✓ Product stewardship and design-for-environment
  - ✓ Process environmental impact assessment
  - ✓ Chemical management
  - ✓ Environmental requirements involving procurement
  - ✓ Supplier requirements
  - ✓ Environmental incident reporting

ISO 50001 Certification Strategy

- Obtain ISO 50001 certification of IBM's energy management program at the corporate level

- Obtain ISO 50001 certification of energy management programs at ISO 14001 registered locations that are Top 100 energy consuming locations
  - Location energy management program will be audited by BVC during ISO 14001 surveillance audits in 2013 and 2014

Corporate energy management plan



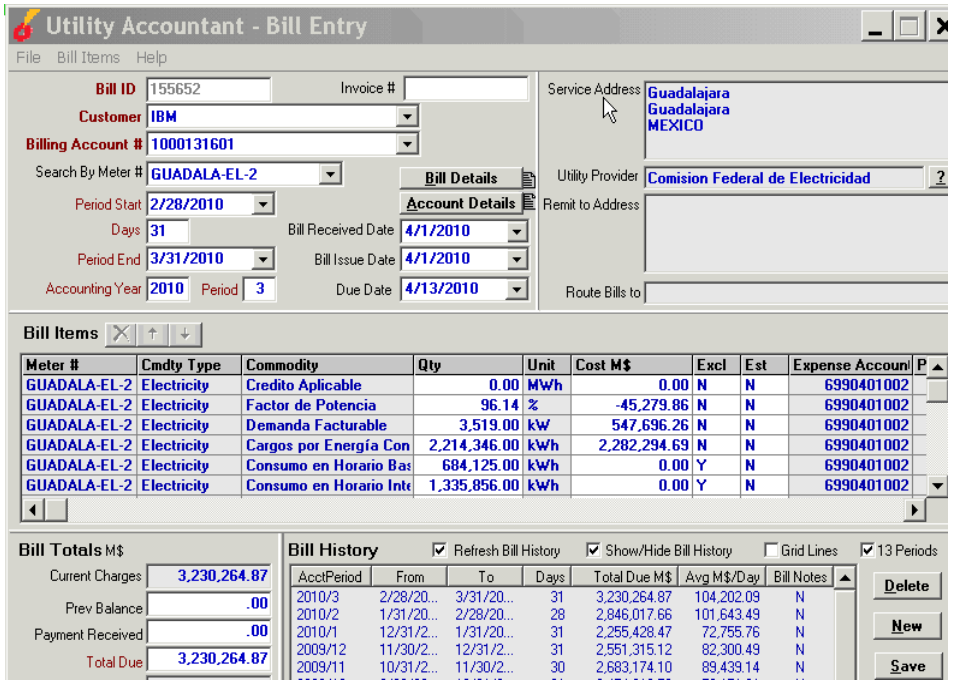
Corporate Energy Management tools: Energy Accounting System

- Four energy accounting system categories
- Natural progression of capabilities

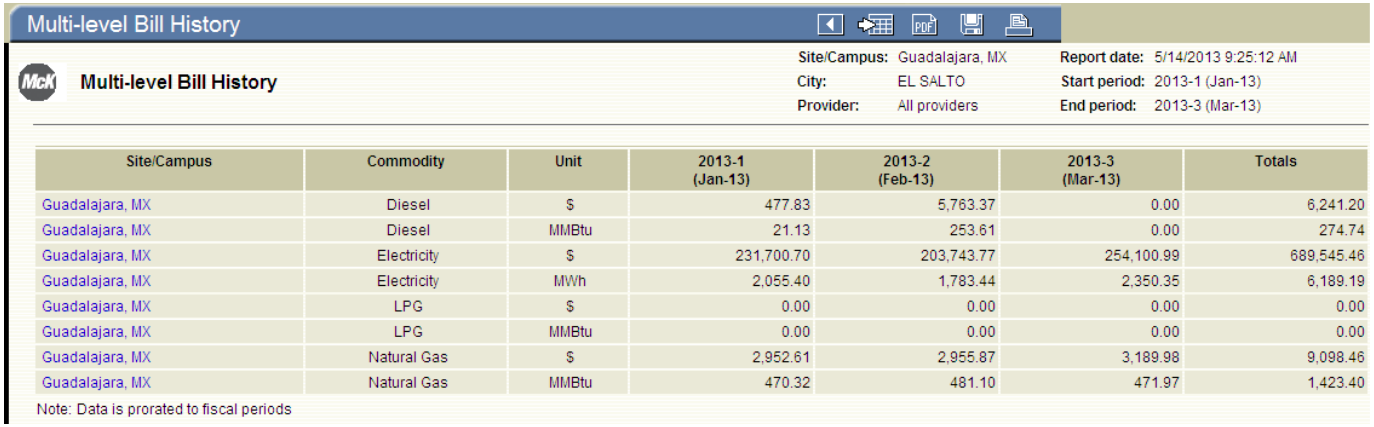
Level	Accounting Category	Energy Accounting	IBM's Energy Accounting Systems
4	Engineering Accounting	1. Energy consumption compared to accurate engineering models 2. PUE, EUI and ECI benchmarking	Energy Management Dashboard (3Q 2013)
3	Historical Accounting	1. Effective cost center management 2. Comparison to historical data 3. Complete variance reports and reasons for variations	BI@IBM Portal
2	Cost Accounting	1. Calculation of energy flows 2. Requires substantial energy metering 3. Efficient use of cost centers	Enterprise Energy Monitoring System (EEMS) Measures Application
1	General Accounting	1. Basic site energy metering 2. Development of reports 3. Calculation of energy KPIs	Utility Accountant (UA) Bill Entry

General Accounting (Level 1)

- Bill Entry and Utility Accountant (UA) provide our core capabilities



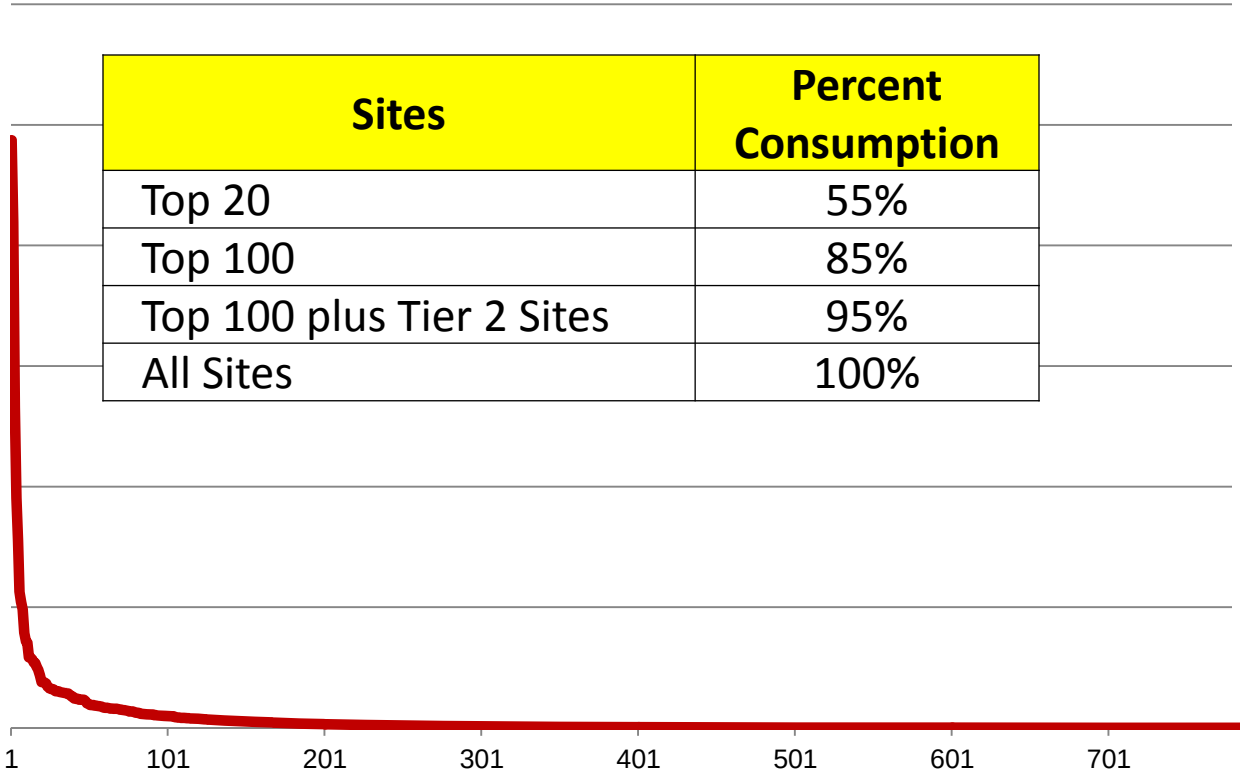
- 250 worldwide users
- 9 energy commodities
- Over 40 currencies
- Over 25 energy units of measure
- Seamless conversion to any currency or units of measure for reporting purposes



Pareto Analysis (Level 1)

- Utility Accountant gathers data from 64 countries and 903 active sites
- Top 20 sites consume 55% of IBM's energy
- Top 100 sites consume 85% of IBM's energy
  - WW EnMP's Significant Energy Consumption

Sites	Percent Consumption
Top 20	55%
Top 100	85%
Top 100 plus Tier 2 Sites	95%
All Sites	100%



1	East Fishkill, NY
2	Burlington Plant, VT
3	Poughkeepsie, NY
4	Raleigh, NC
5	Boulder, CO
6	Rochester, MN
7	Bromont, QC
8	Austin, TX
9	Montpellier, FR
10	TJ Watson Research, NY
11	Hortolandia, BR
12	Tucson, AZ
13	Ehningen, DE
14	Portsmouth, UK
15	Sterling Forest, NY
16	Southbury, CT
17	Gaithersburg, MD
18	Warwick, UK
19	Makuhari, JP
20	Embassy Manyata, Bangalore, IN

Tabular Analysis (Level 1)

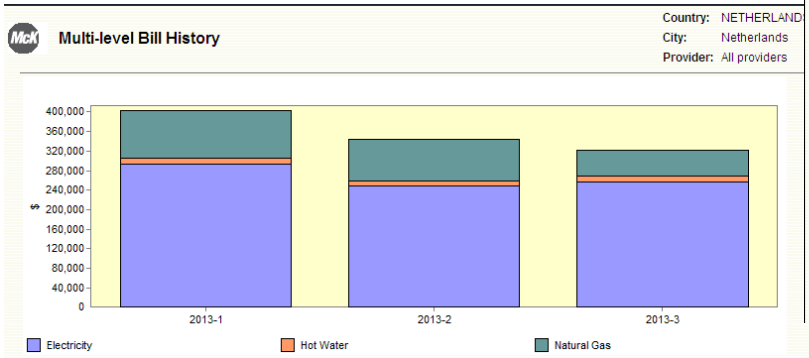
- Segment energy use by building cluster and energy system
  - WW EnMP's Significant Energy Use (globally)
  - Site specific Significant Energy Use (similar type of analysis)

	Building Clusters				
Energy Systems	Manufacturing & Research	Data Centers	Office Spaces	Hardware Development & Labs	Total Use
Data Center Load	10%	55 %	- - -	25 %	30 %
HVAC	30 %	15 %	50 %	30 %	28 %
Central Utility Plant (CUP)	25 %	25 %	- - -	20 %	18 %
Lighting	5 %	5 %	25 %	10 %	10 %
Plug Load	- - -	- - -	25 %	15 %	7 %
Manufacturing Processes and Tools	30 %	- - -	- - -	- - -	7 %
Total Use	22 %	47 %	25 %	6 %	100%

Million Square Feet (MSF)	10.2	5.1	72.1	8.4	95.8
MSF %	10.6%	5.3%	75.3%	8.8%	100%

Corporate monitoring tools: Cost Accounting (Level 2)

- Systems allow data deep dives and top level analysis
  - Selectable time periods
  - Powerful data conversions and aggregation
- Data can be segmented in a variety of ways which allows for:
  - Energy system analysis
  - Major initiative reporting



Country	Site/Campus	Commodity	Unit	2013-1 (Jan-13)	2013-2 (Feb-13)	2013-3 (Mar-13)	Totals
NETHERLANDS	All Site/Campus	Electricity	$	294,163.39	248,033.24	256,894.39	799,091.02
NETHERLANDS	All Site/Campus	Hot Water	$	10,996.83	11,581.22	11,296.51	33,874.56
NETHERLANDS	All Site/Campus	Natural Gas	$	98,434.67	83,991.25	52,642.56	235,068.48
NETHERLANDS	Almere, NL	Electricity	$	59,397.18	46,928.32	49,409.88	155,735.38
NETHERLANDS	Almere, NL	Hot Water	$	10,996.83	11,581.22	11,296.51	33,874.56
NETHERLANDS	Amsterdam Dynatos	Electricity	$	35,483.66	30,642.19	31,269.33	97,395.18
NETHERLANDS	Amsterdam Dynatos	Natural Gas	$	30,900.50	26,403.56	620.82	57,924.88
NETHERLANDS	Amsterdam HQ, NL	Electricity	$	61,313.18	55,922.81	56,563.99	173,799.98
NETHERLANDS	Amsterdam HQ, NL	Natural Gas	$	54,463.82	48,997.91	43,635.06	147,096.79
NETHERLANDS	Amsterdam, J.Huizingalaan	Electricity	$	72,814.33	60,099.55	63,232.67	196,146.55
NETHERLANDS	Cognos Weert	Electricity	$	1,281.82	1,404.73	1,371.51	4,058.06
NETHERLANDS	Cognos Weert	Natural Gas	$	644.96	632.50	617.54	1,895.00
NETHERLANDS	Woerden, Wyrda, NL	Electricity	$	63,873.22	53,035.64	55,047.01	171,955.87
NETHERLANDS	Woerden, Wyrda, NL	Natural Gas	$	12,425.39	7,957.28	7,769.14	28,151.81

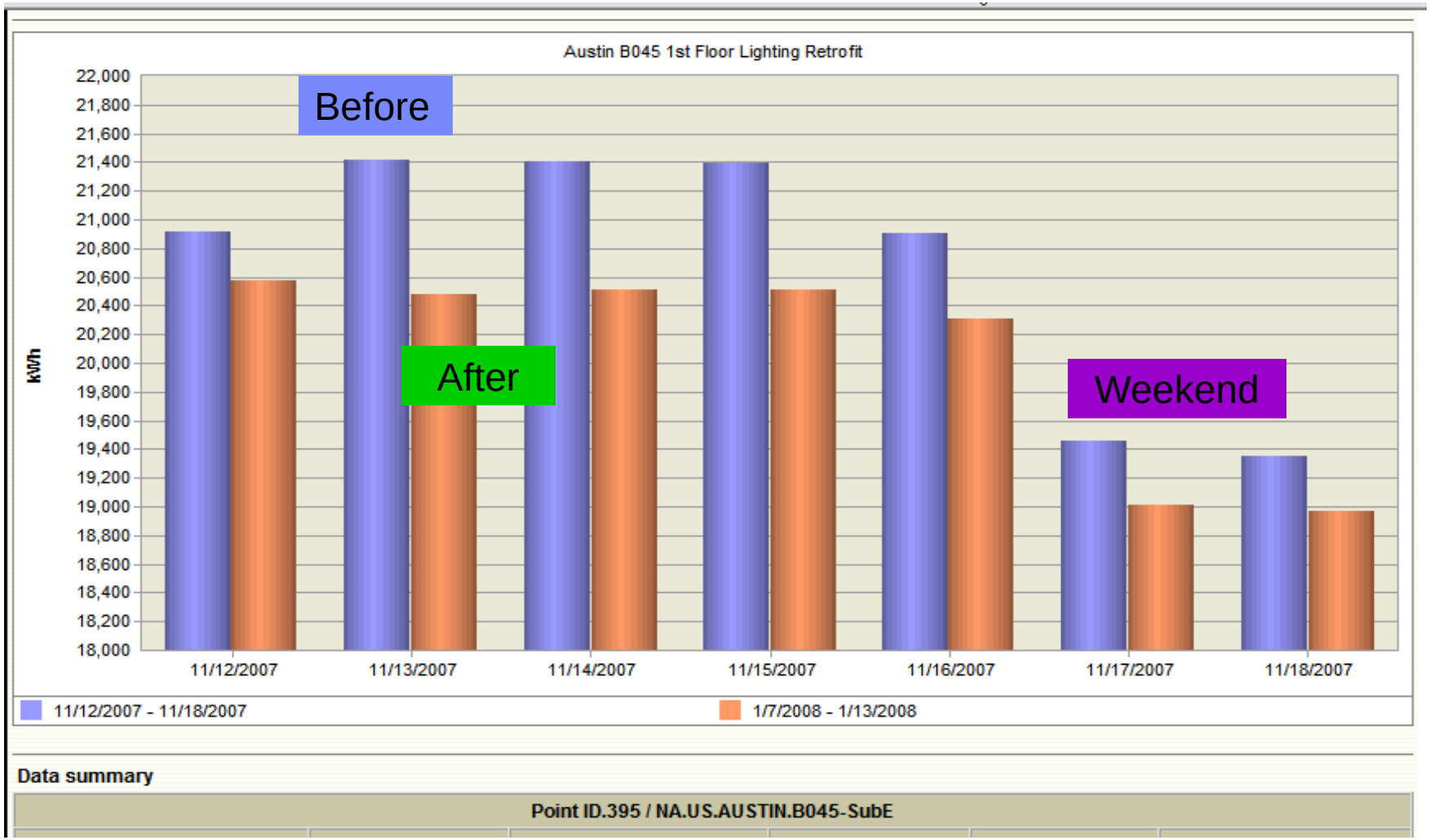
Use, Cost and Conservation

Enterprise: All members
Measure type: Conservation Initiatives
Funding Source: ITD 2012 Chairman's Initiative
Report date: 5/14/2013 10:17:45 AM
Start period: 2012-7 (Jul-12)
End period: 2012-12 (Dec-12)

Enterprise	Geography	Commodity	Unit	Measure Category/Name	2012-7 (Jul-12)	2012-8 (Aug-12)	2012-9 (Sep-12)	2012-10 (Oct-12)	2012-11 (Nov-12)	2012-12 (Dec-12)	Totals
Savings from Conservation Initiatives											
IBM	All Geographies	Electricity	$	All	300,453.55	320,276.16	439,692.13	465,870.20	505,882.98	538,549.34	2,570,724.35
IBM	All Geographies	Electricity	MWh	All	2,848.15	3,042.85	4,193.08	4,334.48	4,600.20	4,910.91	23,929.67
IBM	Asia Pacific	Electricity	$	All	59,756.65	69,192.75	73,150.20	72,078.55	74,733.96	72,633.93	421,546.05
IBM	Asia Pacific	Electricity	MWh	All	380.32	408.73	483.04	453.28	471.35	473.09	2,669.81
IBM	Europe, Middle East and Africa	Electricity	$	All	110,026.96	111,186.21	188,887.74	210,931.96	229,730.38	242,957.98	1,093,721.23
IBM	Europe, Middle East and Africa	Electricity	MWh	All	919.19	943.03	1,393.74	1,524.38	1,650.75	1,713.92	8,145.02
IBM	Latin America	Electricity	$	All	38,401.98	38,817.07	40,523.27	52,382.94	52,582.51	63,294.53	286,002.30
IBM	Latin America	Electricity	MWh	All	307.36	320.98	336.31	412.14	415.22	467.01	2,259.03
IBM	North America	Electricity	$	All	92,267.96	101,080.13	137,130.91	130,476.75	148,836.12	159,662.90	769,454.77
IBM	North America	Electricity	MWh	All	1,241.28	1,370.11	1,979.98	1,944.67	2,062.88	2,256.89	10,855.82

Advanced Energy Metering Solution (Level 2)

- Visualize and measure daily before and after impact of the project



Corporate monitoring tools: Historical Accounting (Level 3)

- Basic Year to Date (YTD) Variance Report
  - Supplementary comments assist in understanding the situation

YTD Total Energy Consumption Report

				Previous Year YTD Usage (MWh)	Current Year Usage MWH (MWh)	Year to Year % Change
1	East Fishkill, NY	NORTH AMERICA IOT	UNITED STATES	220,568	227,969	3.4%
2	Burlington Plant, VT	NORTH AMERICA IOT	UNITED STATES	175,998	182,510	3.7%
3	Poughkeepsie, NY	NORTH AMERICA IOT	UNITED STATES	93,343	91,207	-2.3%
4	Raleigh, NC	NORTH AMERICA IOT	UNITED STATES	53,485	56,116	4.9%
5	Boulder, CO	NORTH AMERICA IOT	UNITED STATES	56,809	51,021	-10.2%
6	Rochester, MN	NORTH AMERICA IOT	UNITED STATES	42,732	44,191	3.4%
8	Austin, TX	NORTH AMERICA IOT	UNITED STATES	34,031	31,800	-6.6%
12	Tucson, AZ	NORTH AMERICA IOT	UNITED STATES	18,013	16,350	-9.2%
93	Costa Mesa, CA - Filenet	NORTH AMERICA IOT	UNITED STATES	2,859	2,812	-1.7%

- 260 worldwide users
- Top 100 Sites monitoring and reporting capabilities support the WW EnMP

		Comments
1	East Fishkill, NY	
2	Burlington Plant, VT	Fuel oil #6 increase due to prolonged curtailments of natural gas and boiler compliance testing.
3	Poughkeepsie, NY	Fuel oil #2 increase due to change in reporting policy. 1Q13 fuel oil #6 consumption was zero.
4	Raleigh, NC	Natural gas increased due to 40% increase in Heating Degree Days and fifth coldest March on record.
5	Boulder, CO	
6	Rochester, MN	Natural gas increased due to 15% increase in Heating Degree Days.
8	Austin, TX	
12	Tucson, AZ	
93	Costa Mesa, CA - Filenet	

Data Quality (Completeness & Accuracy) (Level 3)

- Data quality is a pillar of our energy accounting system
- Leverage a variety of embedded tools and processes to ensure reporting integrity
- Comprehensive
- Easy to use

Commodity	Geography/IOT	Country	Location Name	Number of Months Missing Data
Chilled Water	CENTRAL AND EASTERN EUROPE GMT	BULGARIA	Sofia, Business Park Sofia	2
Diesel	GROWTH MARKETS UNIT	INDIA	Netsol, Bangalore, Grape Garden	2
Electricity	CENTRAL AND EASTERN EUROPE GMT	BULGARIA	Sofia, Business Park Sofia	2
			Sofia, Porsche Center	1
		HUNGARY	Budapest Duna Tower	2
			Budapest Koeztelek	2
			Budapest/Infopark	1
			Szekesfehervar Aszalvoelgyi	1
			Szekesfehervar Berenyi	1

Missing Data Report

Range Low: 30
Range High: 300

Rate Diagnostic Report

				2013		
				3 (MAR)	2 (FEB)	1 (JAN)
				$ / MWh	$ / MWh	$ / MWh
EUROPE IOT	UNITED KINGDOM AND IRELAND IMT	UNITED KINGDOM	Sampson House, UK	$111.83	$120.45	$126.89
			Sheffield	$341.26	$379.49	$362.76
			South Quay Plaza	$7.23	$149.54	$149.51
			Southbank, UK	$103.34	$127.71	$135.33

Energy Conservation Data Quality Report

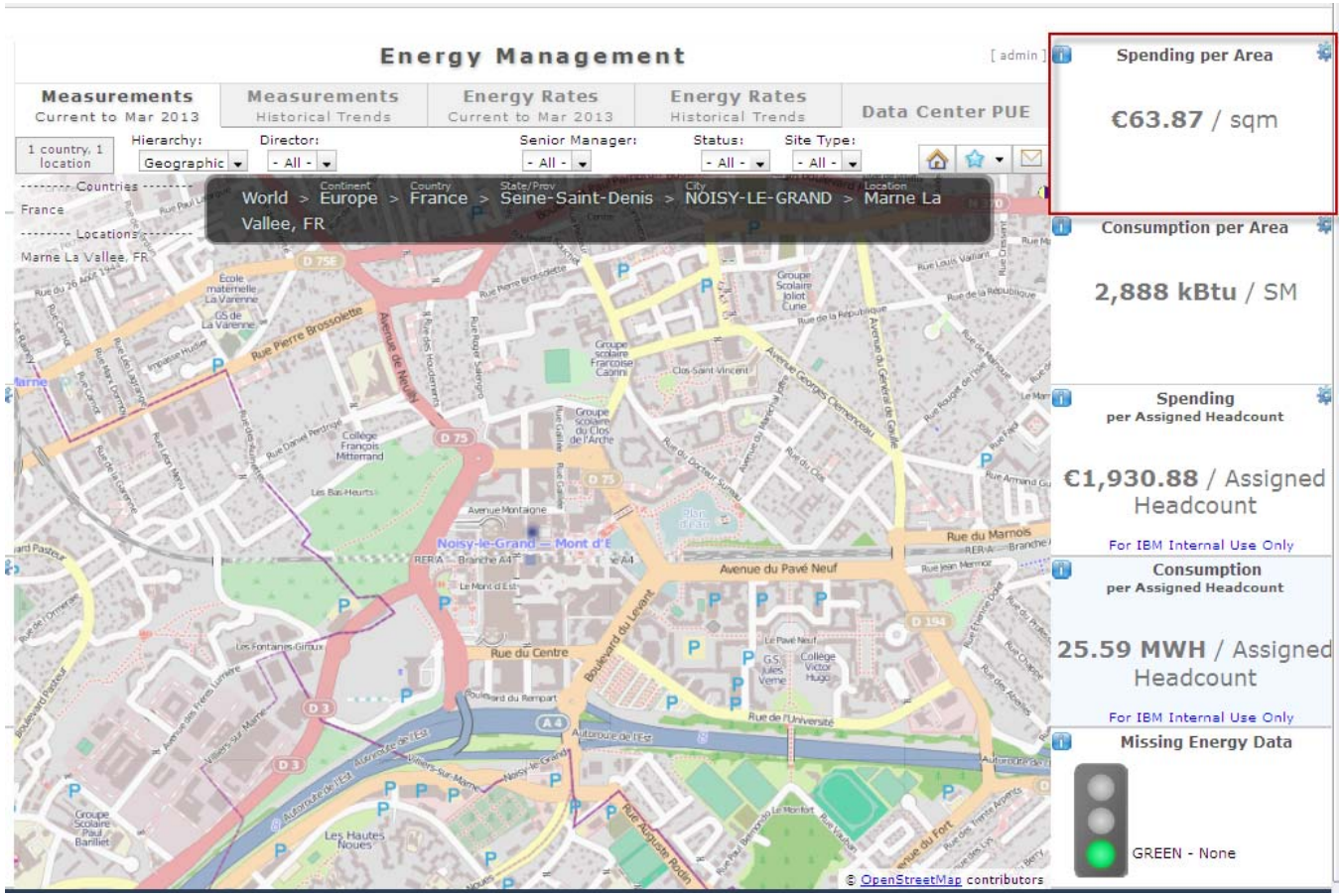
		2013 March					
		Electric Use Rate ($/MWh)	Electric Savings Rate ($/MWh)	Electric Rate Difference (%)	Fossil Fuel Use Rate ($/MMBtu)	Fossil Fuel Savings Rate ($/MMBtu)	Fossil Fuel Rate Difference (%)
1	East Fishkill, NY	$82.54	$81.91	-0.8%	$6.03	$5.50	-8.9%
7	Bromont, QC	$46.10	$46.02	-0.2%	$9.90	$9.06	-8.5%
13	Ehningen, DE	$189.95	$190.12	0.1%	$21.81	$31.15	42.8%
19	Makuhari, JP	$160.44	$160.54	0.1%	$66.46	$92.95	39.9%
21	Boeblingen Laboratory, DE	$190.63	$190.76	0.1%	$27.17	$36.90	35.8%
57	Global Switch, Madrid, ES	$149.32	$172.05	15.2%	$0.00	$0.00	0.0%
75	Atlanta, GA - Barfield Rd	$60.62	$65.09	7.4%	$0.00	$0.00	0.0%

Corporate energy management tools: Level 4 Energy dashboard

- Worldwide coverage
- Easy access and comparison data
- Energy consumption comparisons and calculations
  - Energy »Cost Index (ECI)
  - Energy Use Intensity (EUI)
  - Power Usage Effectiveness (PUE)

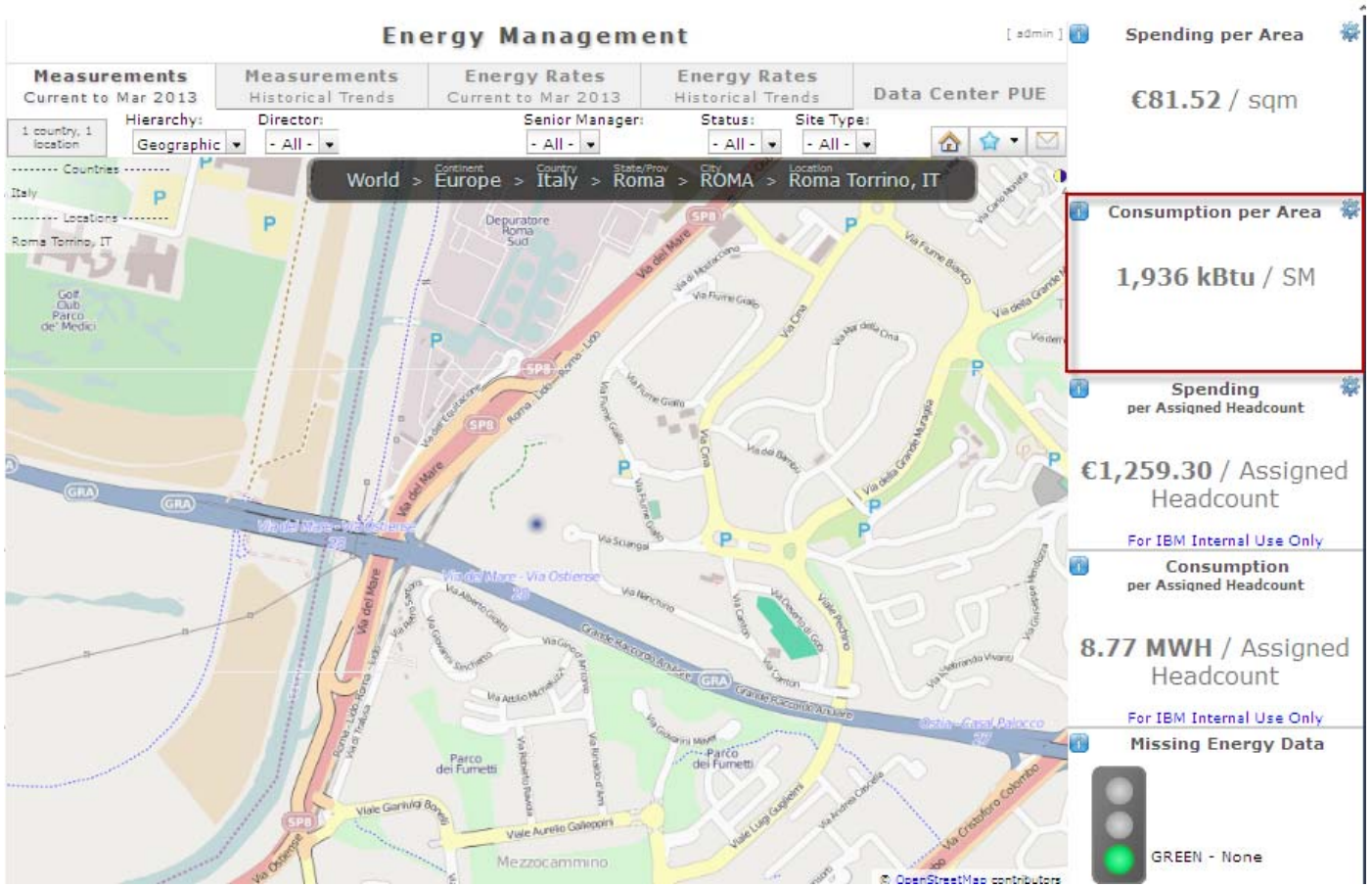
Energy Cost Index (ECI) Benchmarking (Level 4)

- Not an indicator of efficiency since it does not normalize for energy rates
- High ECI values may point to key issues:
  - High consumption during peak hours
  - Power factor charges indicates reactive power usage



Energy Use Intensity (EUI) Benchmarking (Level 4)

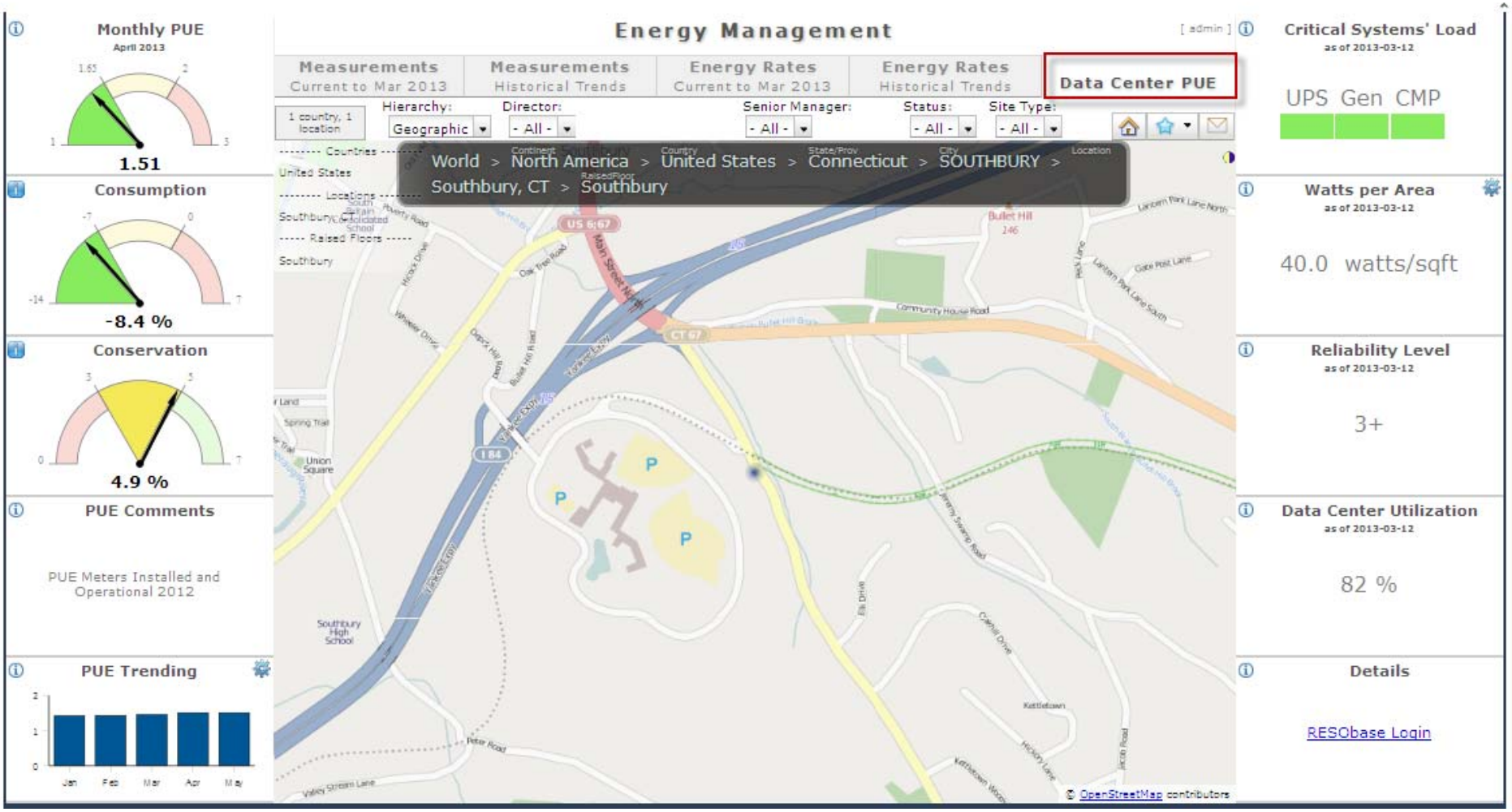
- Based on engineering models and statistical methods
  - Normalizes for construction era, climatic group and building use
- Abnormally high EUI values is an indicator of uncompetitive energy use



Proceedings of the 13th International Conference for Enhanced Building Operations, Montreal, Quebec, October 8-11, 2013

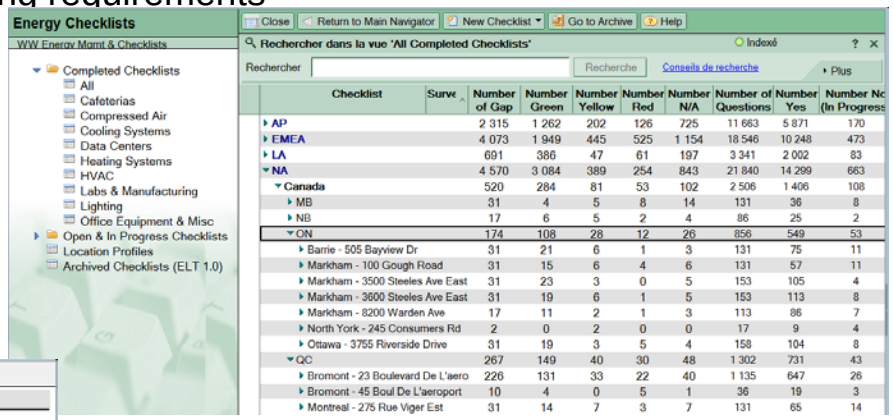
Power Usage Effectiveness (PUE) Benchmarking (Level 4)

- PUE is the industry standard benchmark for data center operations
- IBM's PUE performance measure is 1.65 or less



Corporate Energy Management Tools: The Energy Checklists

- Coverage : Cooling systems, Heating systems, Data centers, HVAC, Lighting, Cafeterias, Compressed air, Labs & Manufacturing, Office equipments and Misc.
- Best practices for each listed in question format with guidelines and help available for each question
- Document action plans, energy savings and funding requirements
- All sites with major energy usage
- have to complete
  - Tier 1 sites (Top 100) Every two years
  - Tier 2 sites Every three years
  - Other sites Every 5 years



- Cooling System Questionnaire Example

Close | Technical Feedback | Help

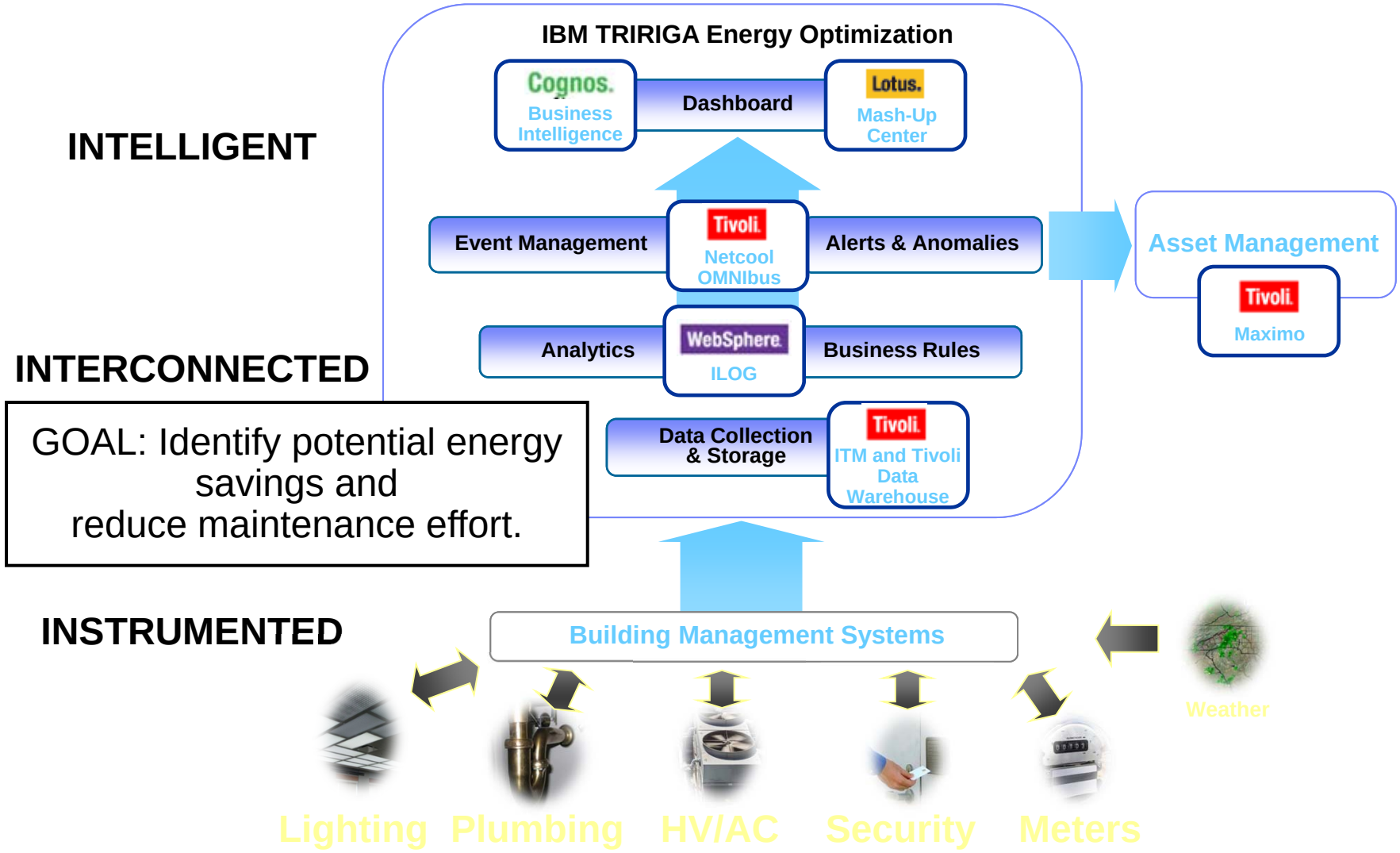
System Design	* Answer	Comments
14. Is a Variable Frequency Drive (VFD) chiller (or a smaller - pony chiller) available and in use for reduce loads?	Yes	Chilled water optimization project completed. Chiller 805 performing modulation with VFDs on compressor and evaporator pump. Other chillers are operated in their most effective range of operation. Chiller 803 and 808/9 has also VFD on evap pumps
15. Is free cooling optimized to extend the season?	Yes	Chilled water optimization project completed to extend free cooling period - Chilled water pump speed reduced to maintain supply temp and extend free cooling period
16. Is continuous chiller performance with alarming enabled either in the stand alone chiller panel or in a Programmable Logic Controller (PLC) for the chilled water plant?	Yes	Efficiency dashboards in place to follow chiller efficiency as part of Energy Management Program.
17. Has the system been assessed for the use of variable speed chillers with a primary variable pumping?	Yes	Chilled water optimization project completed Chiller 805, 803 and 808/9 have VFD on evap pumps Evaluate Chilled Water Demand Flow solution for additionnal chiller plant efficiency opportunities
18. Have all pumps been assessed for Variable Frequency Drives (VFD's) potential?	Yes	Chilled water optimization project completed Chiller 805, 803 and 808/9 have VFD on evap pumps Evaluate Chilled Water Demand Flow solution for additionnal chiller plant efficiency opportunities
19. If pumps do not have Variable Frequency Drives (VFD's), is there a method other than control valves to vary the differential pressure created?	No (not feasible)	Evaluation completed based on Hydro site survey. No acceptable payback for VFDs on these pumps

- Cooling System - Work Plan Example

Commitment to Action and Work Plan

Nr	Project, Action or Activity (Current Year plus one) *	Estimated Cost ($K)	Estimated MWH Savings	Estimated Completion *
1	Modify the sequence of operation to reduce the capacity of the free cooling when the load is lower than the free cooling capacity			
2	Conduct client assessment to ensure highest return temperature as possible and verify possibility to supply at higher temperature			
3	Implement Smarter Building new rules for Chiller plant as part of Corporate deployment plan			
4	Evaluate Chilled Water Demand Flow solution for additionnal chiller plant efficiency opportunities			

IBM TRIRIGA ENERGY OPTIMIZATION (ITEO)' Smarter building

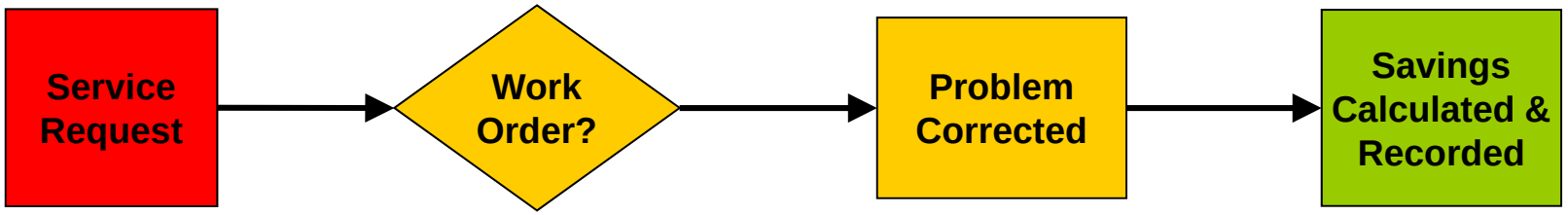


– EXAMPLES

Business rules alert when equipment is operating sub-optimally

- Simultaneous Heating & Cooling
- Hot Call / Cold Call – High / Low Building Temperature
- Temperature Sensor Drift
- Operating in Override Mode
- Operating Outside of Regular Schedule
- VFD Excessive Loading Supply or Return Fan
- Cooling or Heating Valve Passing – Leakage Detection
- Heating when Warm Outside / Cooling when Cold Outside
- Not in Optimal Mechanical Cooling Mode, with CO2 Sensing
- Perimeter Heater Detected Operational when Warm Outside
- Simultaneous Humidification and Dehumidification
- Humidifying when Humid Outside / Dehumidifying when Dry Outside
- Chiller Low Supply Temperature
- Chiller Efficiency
- Chiller Free Cooling not being Utilized

PROCESS FLOW



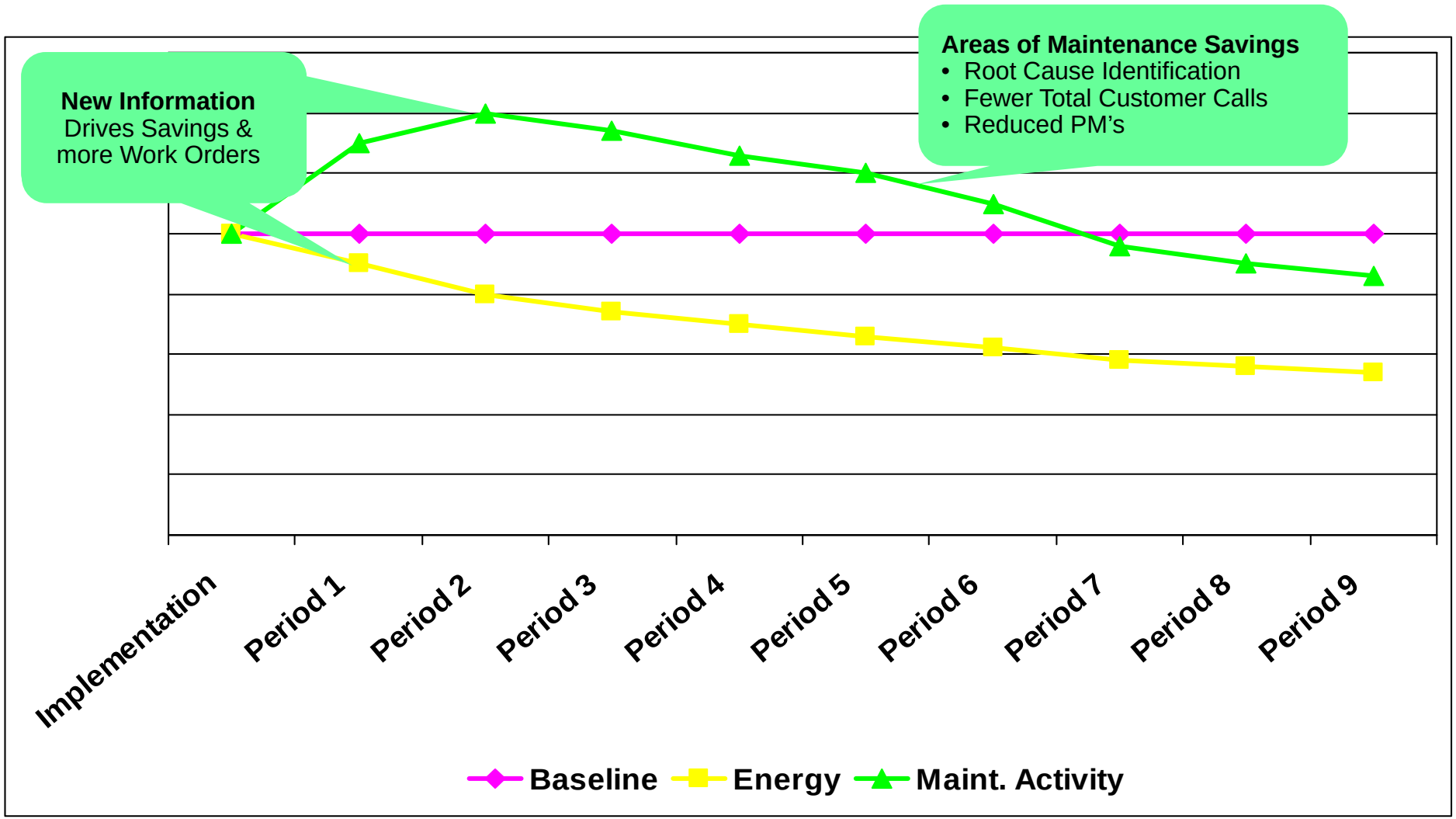
- Analytics Detect an Issue
- Email Notification is Sent
- Maximo Service Request is Created

- Triage by HVAC or Control System Technician, including Analysis of Supporting Data
- Create Maximo Work Order for Repair

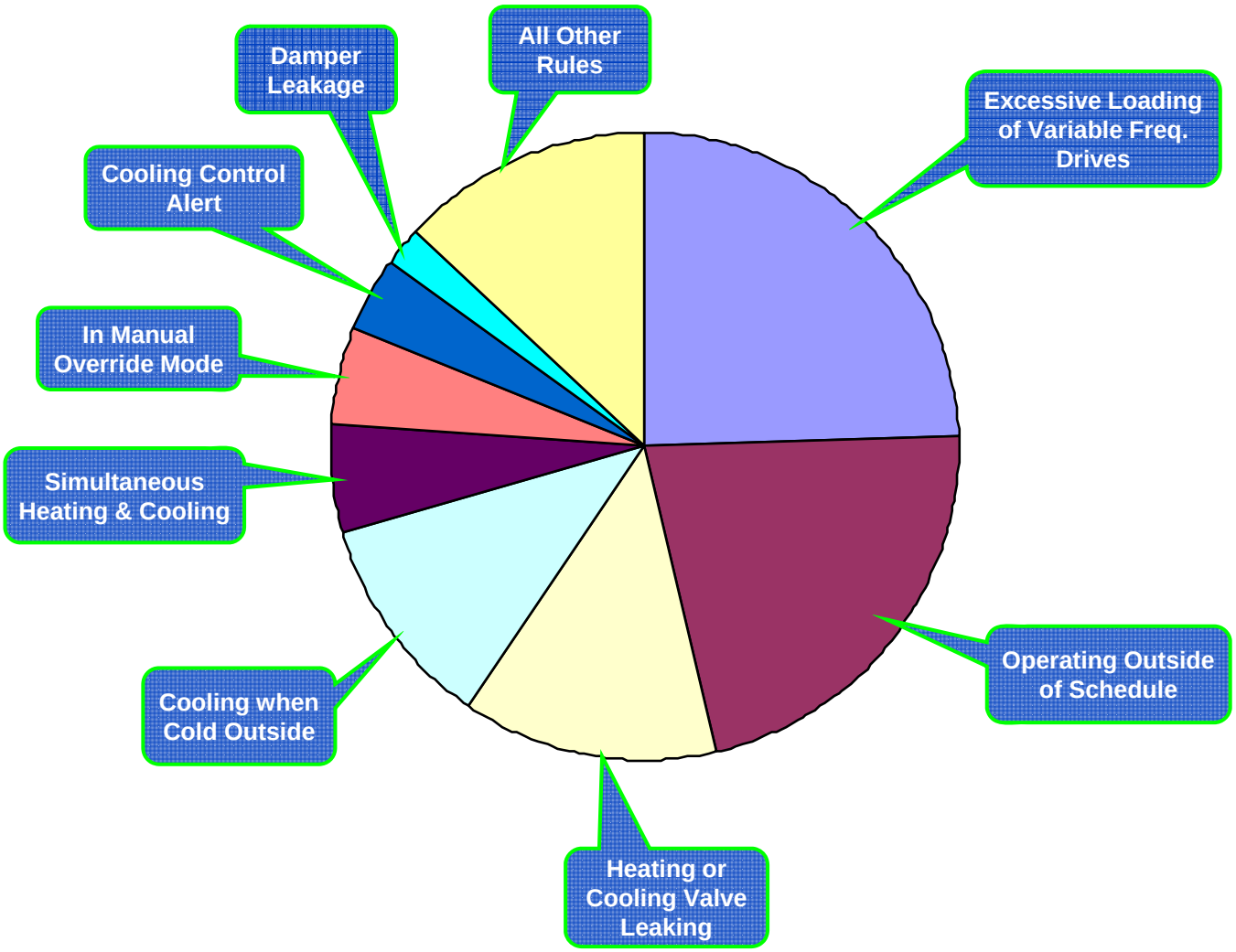
- Field Technician Makes Repair
- Feeds Back Problem Resolution via Maximo

- Energy Coordinator Determines Savings
- Results Recorded in Maximo

SMARTER BUILDINGS SAVINGS MODEL



SAVINGS RESULTS BY RULE



Corporate Energy Program results

- **Annual conservation target 3.5%**
- **Between 1990 and 2012, IBM**
  - **saved 6.1 billion kWh of electricity consumption**
  - **Avoided 3.9 million metric tons of CO2 emissions (equal to 57 percent of the company's 1990 global CO2 emissions)**
  - **Saved $477 million through its annual energy conservation actions.**

Year	Annual Energy conservation
2008	6.1%
2009	5.4%
2010	4.9%
2011	7.4%
2012	6.5%

Conclusions

- IBM has a comprehensive energy accounting system
  - Enables monitoring, measurement and benchmarking capabilities
- Excellent results for energy conservation and benefits for the corporation
- ISO registered system both in ISO 14001 and ISO 50001
- Future developments with the dashboard and will enable continual improvements of our management system and our performance results