Gaining Insight from PI System Data Using New Tools for Operational Intelligence

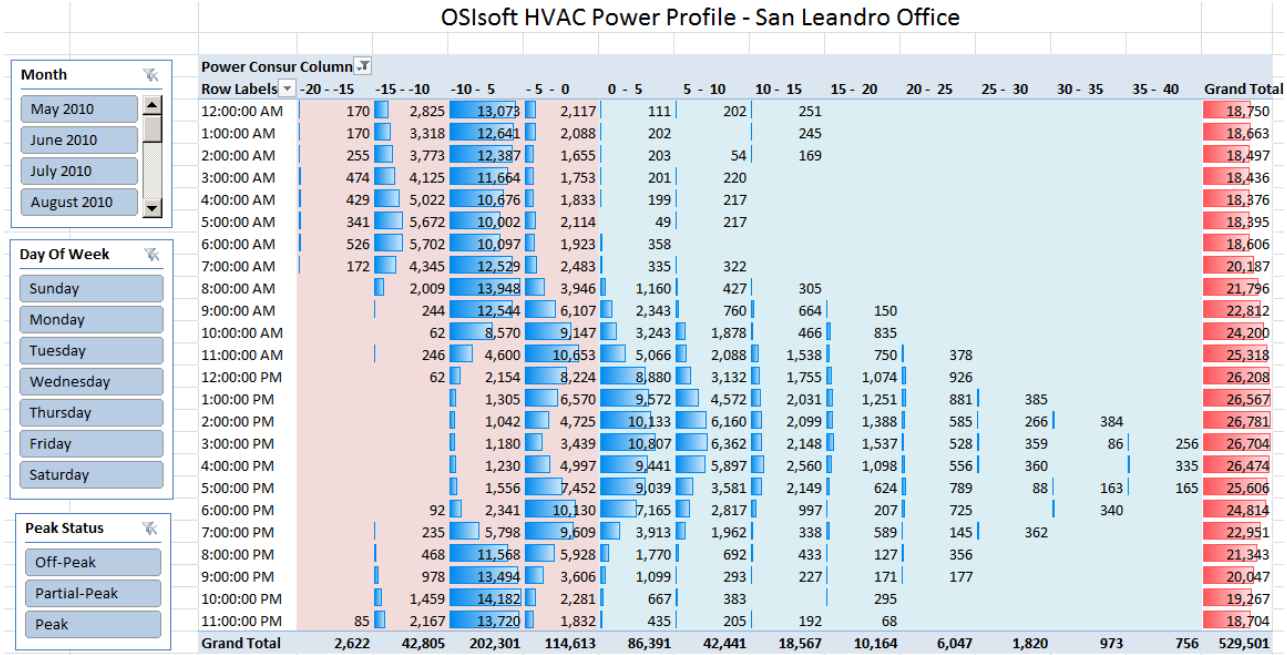
Presented by

Curt Hertler, Marketing Manager, OSIsoft

Agenda

- Business Intelligence (BI) Technologies
  - Multidimensional Data Analysis
  - Operational Intelligence
- Introduction to “Self-service BI”
  - PI AF
  - PI OLEDB Enterprise 2010
  - Microsoft PowerPivot for Excel 2010
  - Microsoft SharePoint 2010 Enterprise
- Example Walk Through
- Other Examples and Additional Information

Business Intelligence (BI) Technologies

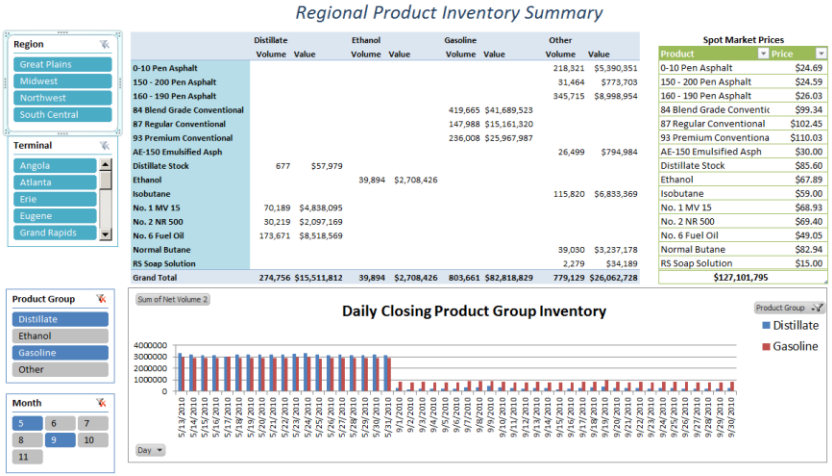


Power Consur Column

Row Labels	-20 - -15	-15 - -10	-10 - 5	-5 - 0	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 - 30	30 - 35	35 - 40	Grand Total
12:00:00 AM	170	2,825	13,073	2,117	111	202	251						18,750
1:00:00 AM	170	3,318	12,641	2,088	202		245						18,663
2:00:00 AM	255	3,773	12,387	1,655	203	54	169						18,497
3:00:00 AM	474	4,125	11,664	1,753	201	220							18,436
4:00:00 AM	429	5,022	10,676	1,833	199	217							18,376
5:00:00 AM	341	5,672	10,002	2,114	49	217							18,395
6:00:00 AM	526	5,702	10,097	1,923	358								18,606
7:00:00 AM	172	4,345	12,529	2,483	335	322							20,187
8:00:00 AM		2,009	13,948	3,946	1,160	427	305						21,796
9:00:00 AM		244	12,544	6,107	2,343	760	664	150					22,812
10:00:00 AM		62	8,570	9,147	3,243	1,878	466	835					24,200
11:00:00 AM		246	4,600	10,653	5,066	2,088	1,538	750	378				25,318
12:00:00 PM		62	2,154	8,224	8,880	3,132	1,755	1,074	926				26,208
1:00:00 PM			1,305	6,570	9,572	4,572	2,031	1,251	881	385			26,567
2:00:00 PM			1,042	4,725	10,133	6,160	2,099	1,388	585	266	384		26,781
3:00:00 PM			1,180	3,439	10,807	6,362	2,148	1,537	528	359	86	256	26,704
4:00:00 PM			1,230	4,997	9,441	5,897	2,560	1,098	556	360		335	26,474
5:00:00 PM			1,556	7,452	9,039	3,581	2,149	624	789	88	163	165	25,606
6:00:00 PM		92	2,341	10,130	7,165	2,817	997	207	725		340		24,814
7:00:00 PM		235	5,798	9,609	3,913	1,962	338	589	145	362			22,951
8:00:00 PM		468	11,568	5,928	1,770	692	433	127	356				21,343
9:00:00 PM		978	13,494	3,606	1,099	293	227	171	177				20,047
10:00:00 PM		1,459	14,182	2,281	667	383		295					19,267
11:00:00 PM	85	2,167	13,720	1,832	435	205	192	68					18,704
Grand Total	**2,622**	**42,805**	**202,301**	**114,613**	**86,391**	**42,441**	**18,567**	**10,164**	**6,047**	**1,820**	**973**	**756**	**529,501**

Multidimensional Data Analysis

Quick, ad hoc, aggregation of large amounts of interesting data (facts), based on user-selected criteria (dimensions), to identify opportunities for improvement.



Critical HX Monitoring

Exchanger	Water Velocity Feet/Sec	Skin Temp Deg. F	CW Flow GPM	U-Value BTU/(hr/ft2/deg F)	Heat Load MMBTU	Heat Flux BTU/hr/ft2
E-163-A	3.70	77	2237	45.5	5.1	352.1
E-163-C	3.80	78	2298	48.0	5.8	401.1
E-191-A	2.31	101	4360	62.8	36.6	2782.4
E-191-B	3.08	80	4360	52.1	13.7	1027.2
E-256-A	2.46	97	1726	117.8	6.4	1082.2
E-256-B	2.47	89	1732	130.8	5.4	911.8
E-256-C	2.46	84	1728	141.9	8.0	1362.3
E-271	4.43	132	1930	153.3	40.9	9922.5
E-343	1.79	97	249	63.3	2.6	2443.0
E-38-A	1.81	105	3752	50.9	34.2	2378.9
E-38-B	1.95	82	3731	48.6	13.1	980.1
E-77-A	2.23	105	4204	61.8	36.4	2768.5
E-77-B	2.16	84	4246	57.1	19.0	1391.1
E-98-A	1.58	108	2986	47.3	29.3	2227.0
E-98-B	1.54	86	3013	45.3	15.6	1141.8

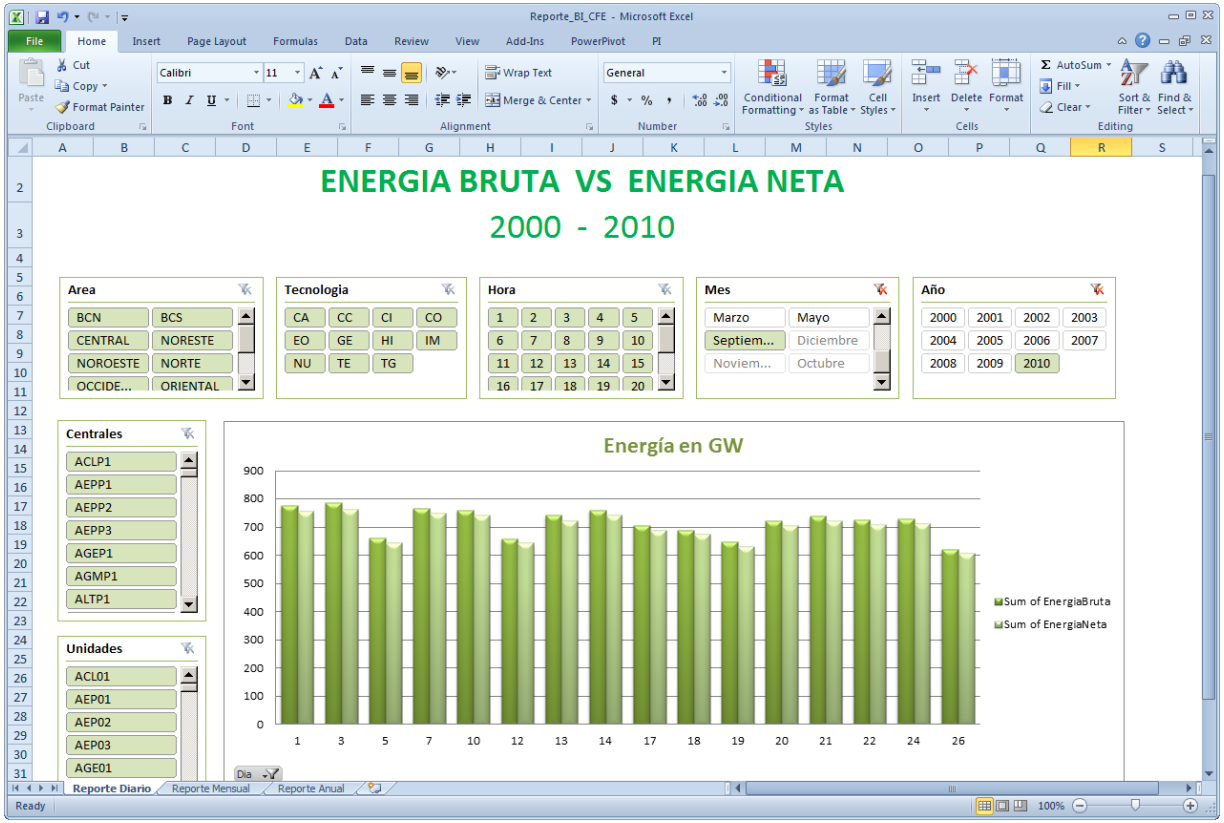
Operational Intelligence

Equipment Benchmarking: Fuel Gas Efficiency and Maintenance

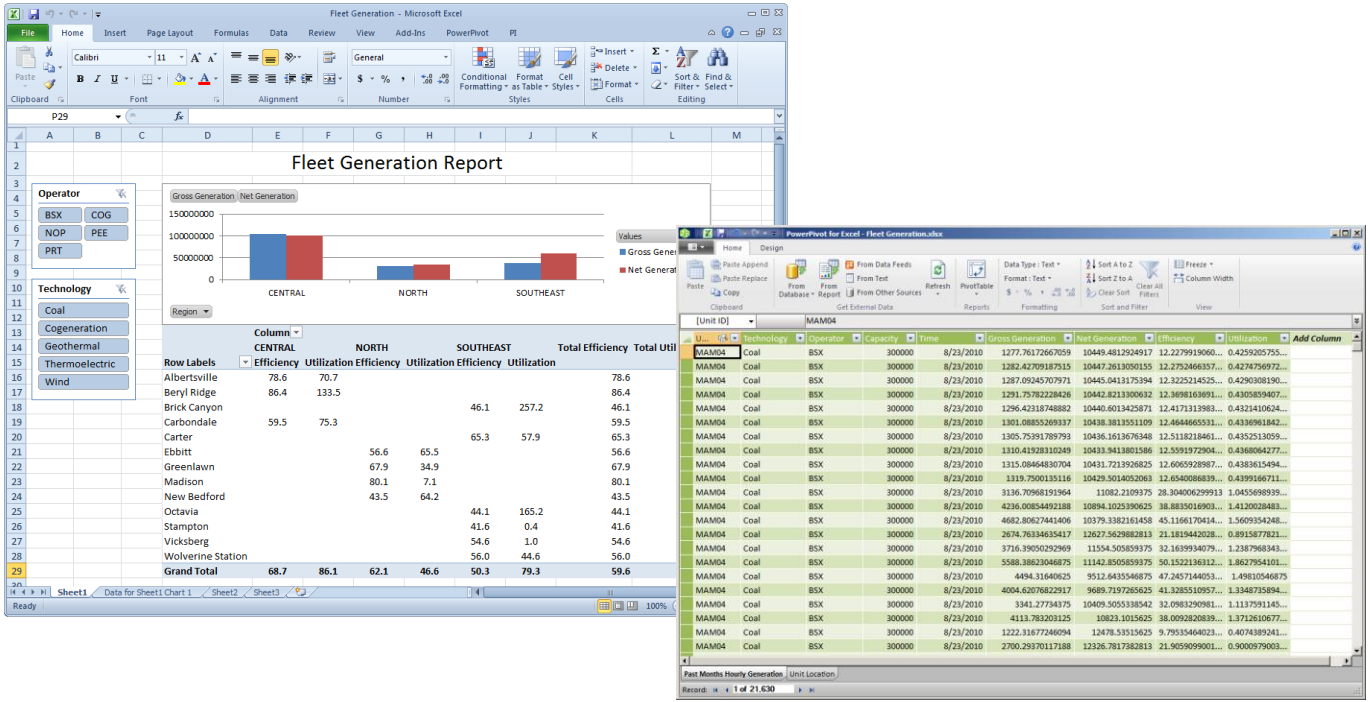
	Cracking Process		Distilling Process		Extruding Process		Milling Process	
	Fuel Ratio	No. W.O.	Fuel Ratio	No. W.O.	Fuel Ratio	No. W.O.	Fuel Ratio	No. W.O.
Borne Engineering								
BX-003	1,716		629	1	614	1		
BX-414	1,913						1,000	1
Flame-On								
FO-009	589	1	131				319	5
Hot Spot								
HS-345	511	1			797		2,322	2
HS-444			623		2,705	1		
Inferno								
I-27					1,446	4	1,226	1
I-56	401	3	741	2			6,129	8
KPC, Limited								
KPC-X36	2,539	1			180	3		
KPC-X87	1,841	1	658				877	1
Swift Brothers								
STM-305	3,853	4			631	1		
STM-900			286	2			2,621	5
Grand Total	**1,408**	**11**	**562**	**5**	**1,062**	**10**	**1,904**	**23**

Houston | Little Rock | Tucson | Wichita

Customer Example: CFE Mexico



Introduction to “Self-Service” BI

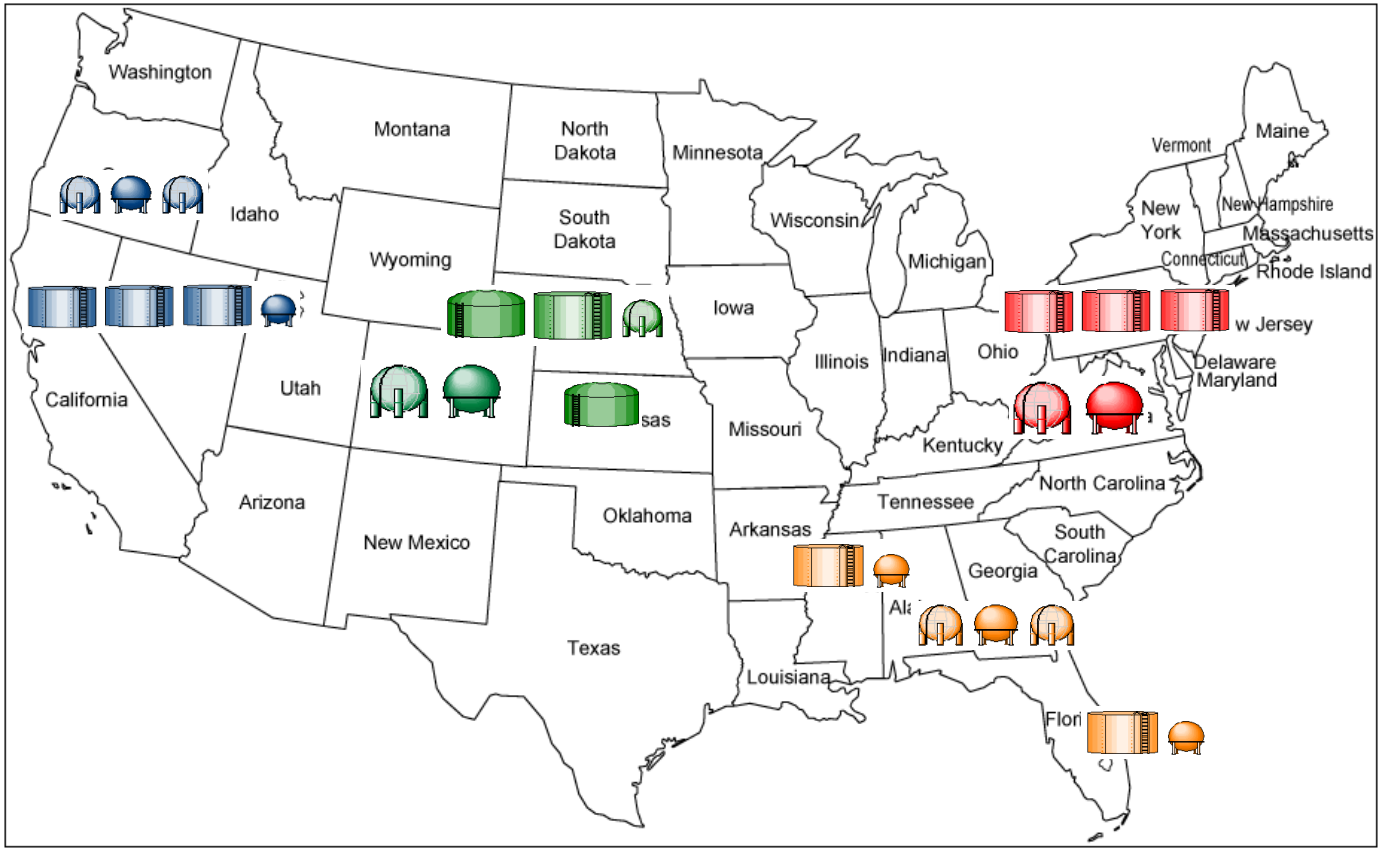


OSIsoft / Microsoft BI Stack

Self-service BI Toolkit for the PI System

- Facts and Dimensions
  - PI AF (PI System 2010)
- Datasets for BI Data Extraction
  - PI OLEDB Enterprise 2010 (PI for Office 2010)
- Desktop Analysis and Cube Configuration
  - Microsoft PowerPivot for Excel 2010
- Enterprise Accountability
  - Microsoft PowerPivot for SharePoint 2010
  - Microsoft SharePoint 2010 Enterprise
  - Microsoft SQL Server 2008 R2 Enterprise or above

Example: Product Inventories



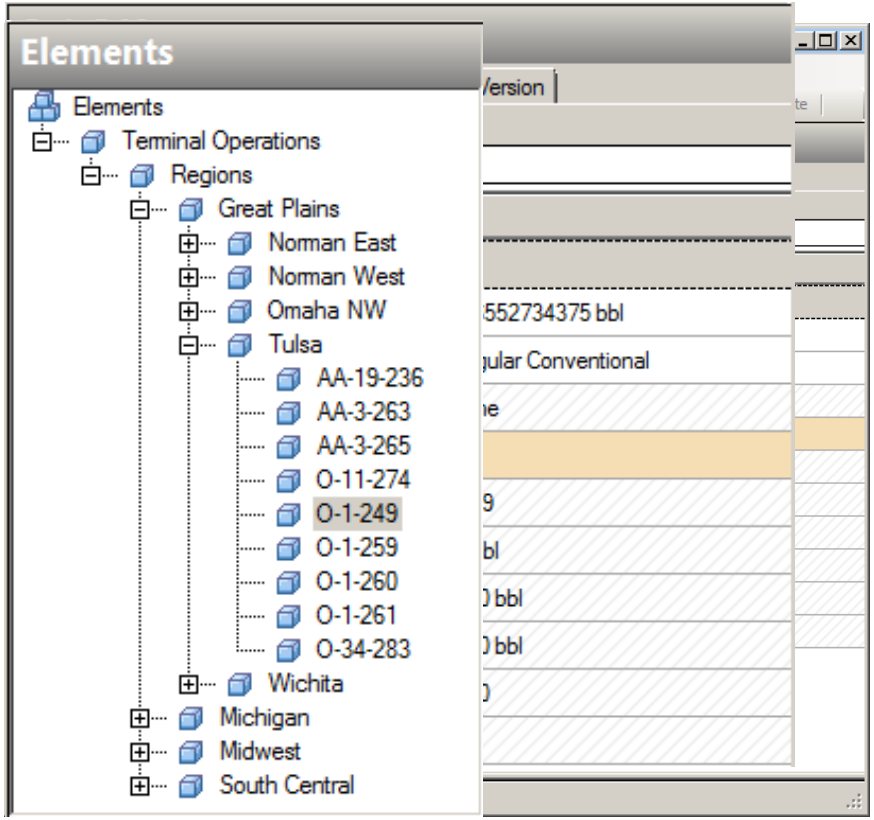
PI AF Associates Facts and Dimensions

Facts

- AF Attributes
  - Value
  - PI Point
- Terminal
- Product
- Tank
- Product
- Other

Dimensions

- Hierarchy
- Templates
- Categories



PI OLEDB Enterprise 2010

Dimensions – *AF Attributes*

Facts – *Hierarchy*

PI SQL Commander

	Tank ID	Time
000001	T-14	9/20/2010 5:58:.
000002	T-14	9/20/2010 6:58:.
000003	T-14	9/20/2010 7:58:.
000004	T-14	9/20/2010 8:58:.
000005	T-14	9/20/2010 9:58:.
000006	T-14	9/20/2010 10:58
000007	T-14	9/20/2010 11:58
000008	T-14	9/21/2010 12:58
000009	T-14	9/21/2010 1:58:.
000010	T-14	9/21/2010 2:58:.
000011	T-14	9/21/2010 3:58:.
000012	T-14	9/21/2010 4:58:.
000013	T-14	9/21/2010 5:58:.
000014	T-14	9/21/2010 6:58:.
000015	T-14	9/21/2010 7:58:.
000016	T-14	9/21/2010 8:58:.
000017	T-14	9/21/2010 9:58:.
000018	T-14	9/21/2010 10:58

Ready

	Tank ID	Type	Region	Terminal
001	23-373	Tank	Great Plains	Norman East
002	12-372	Tank	Great Plains	Norman East
003	24-374	Tank	Great Plains	Norman East
004	24-375	Tank	Great Plains	Norman East
005	24-376	Tank	Great Plains	Norman East
006	40-370	Tank	Great Plains	Norman East
007	41-371	Tank	Great Plains	Norman East
008	52-377	Tank	Great Plains	Norman East
009	15-11	Tank	Great Plains	Omaha NW
010	35-1	Tank	Great Plains	Omaha NW
011	35-2	Tank	Great Plains	Omaha NW
012	35-9	Tank	Great Plains	Omaha NW
013	55-12	Tank	Great Plains	Omaha NW
014	55-3	Tank	Great Plains	Omaha NW
015	55-7	Tank	Great Plains	Omaha NW
016	80.4	Tank	Great Plains	Omaha NW
017	80.6	Tank	Great Plains	Omaha NW
018	T-1-3	Tank	Great Plains	Omaha NW
019	AA-10-2	Tank	Great Plains	Omaha NW
020	T-8-1	Tank	Great Plains	Omaha NW
021	RB-10-1	Tank	Great Plains	Omaha NW
022	AA-19-236	Tank	Great Plains	Tulsa

Nominal Volume
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250
50250

Ch 1 INS

Introducing PowerPivot for Excel 2010

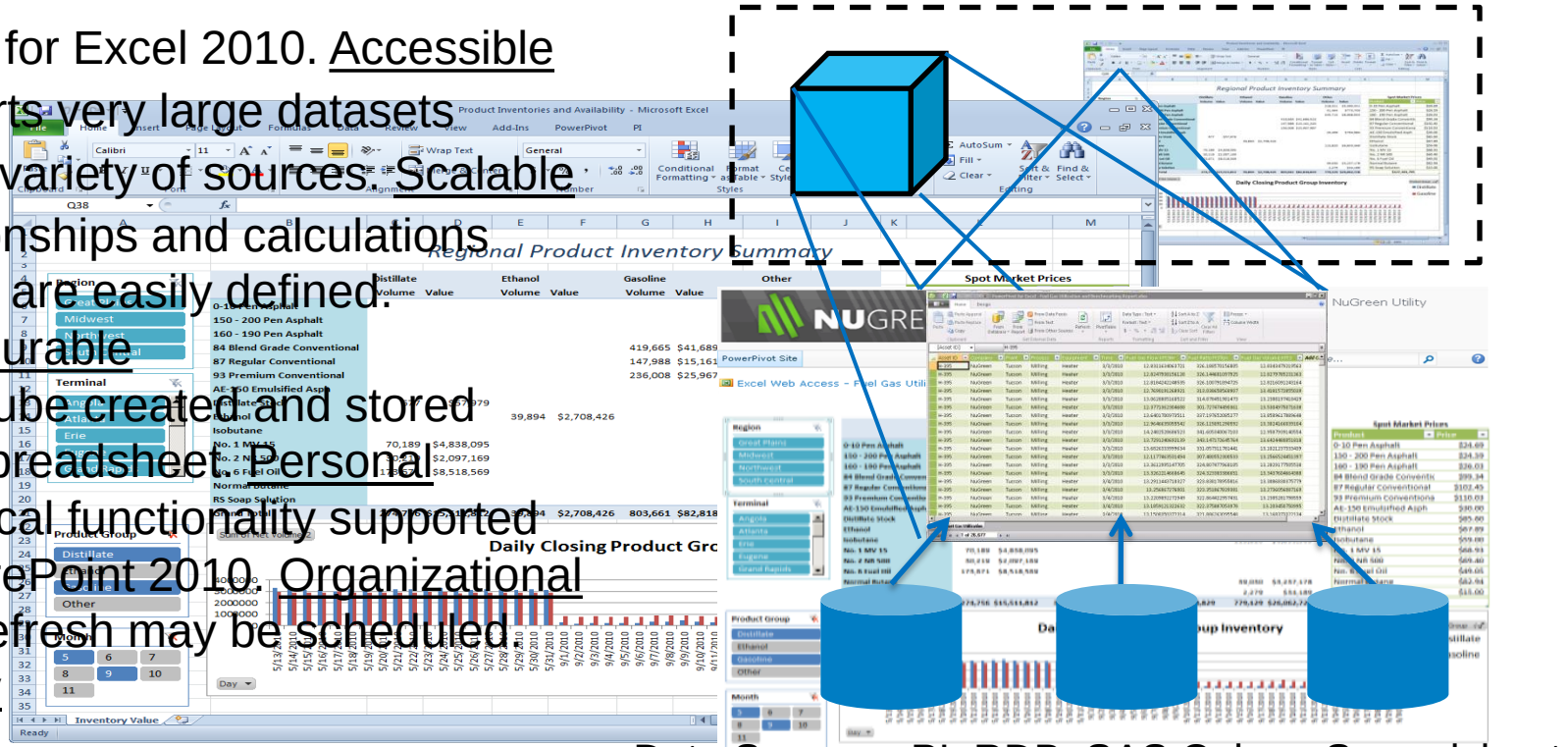
Microsoft® Excel® 2010

Empowering The End User

- Enable users to perform self-service analysis and intuitively build their own BI solutions
- Allow users to interactively explore and perform calculations on large data sets
- Integrate data from multiple sources
- Minimize dependence on IT support

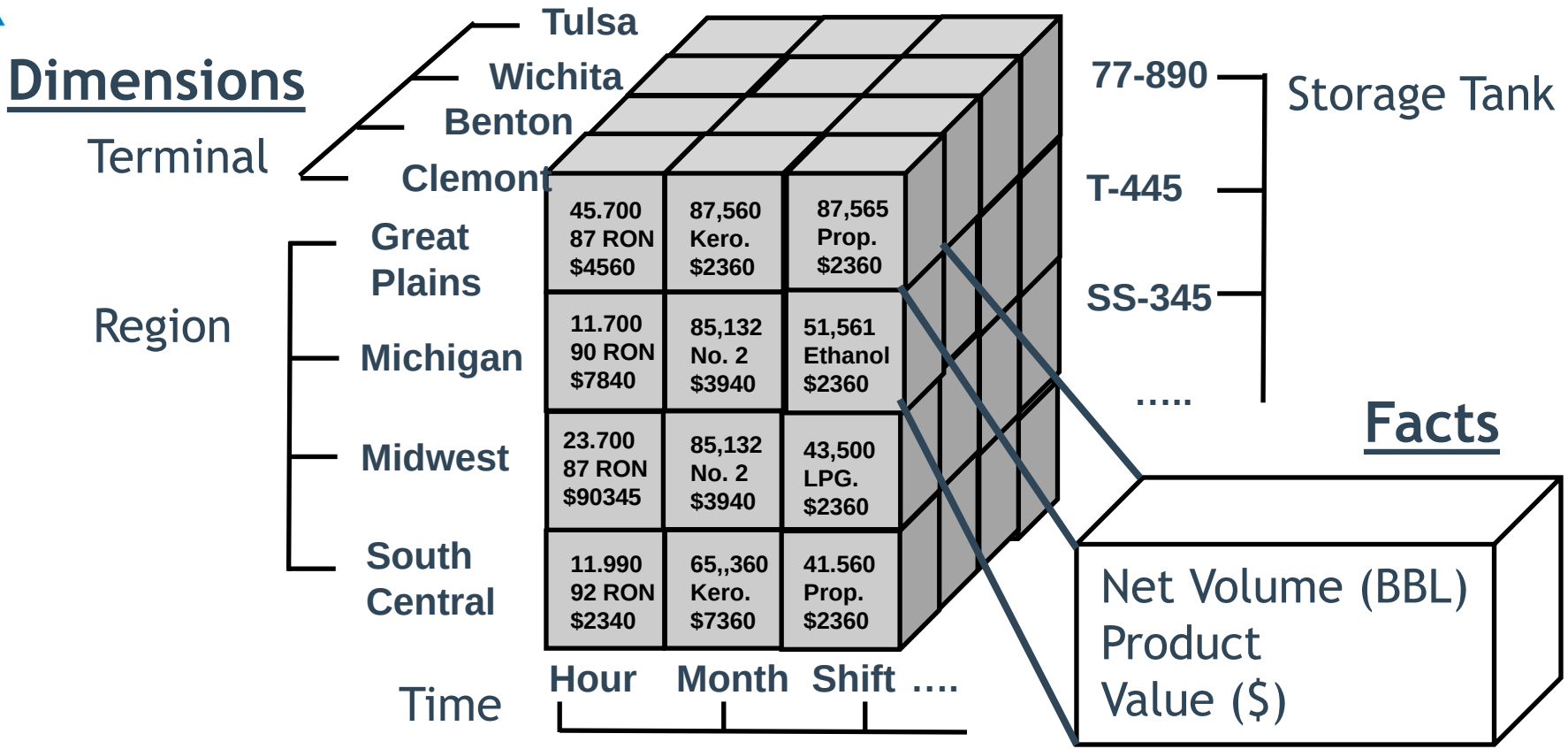
Microsoft PowerPivot for Excel 2010

- Add-In for Excel 2010. Accessible
- Supports very large datasets from a variety of sources. Scalable
- Relationships and calculations (DAX[1]) are easily defined. Configurable
- Data cube created and stored with spreadsheet. Personal
- Analytical functionality supported in SharePoint 2010. Organizational
- Data refresh may be scheduled. Timely



1. Data Analysis Expression Language

Multidimensional Data “Cube”



Example Walk Through

Regional Product Inventory Summary

Region

- Great Plains
- Midwest
- Northwest
- South Central

Terminal

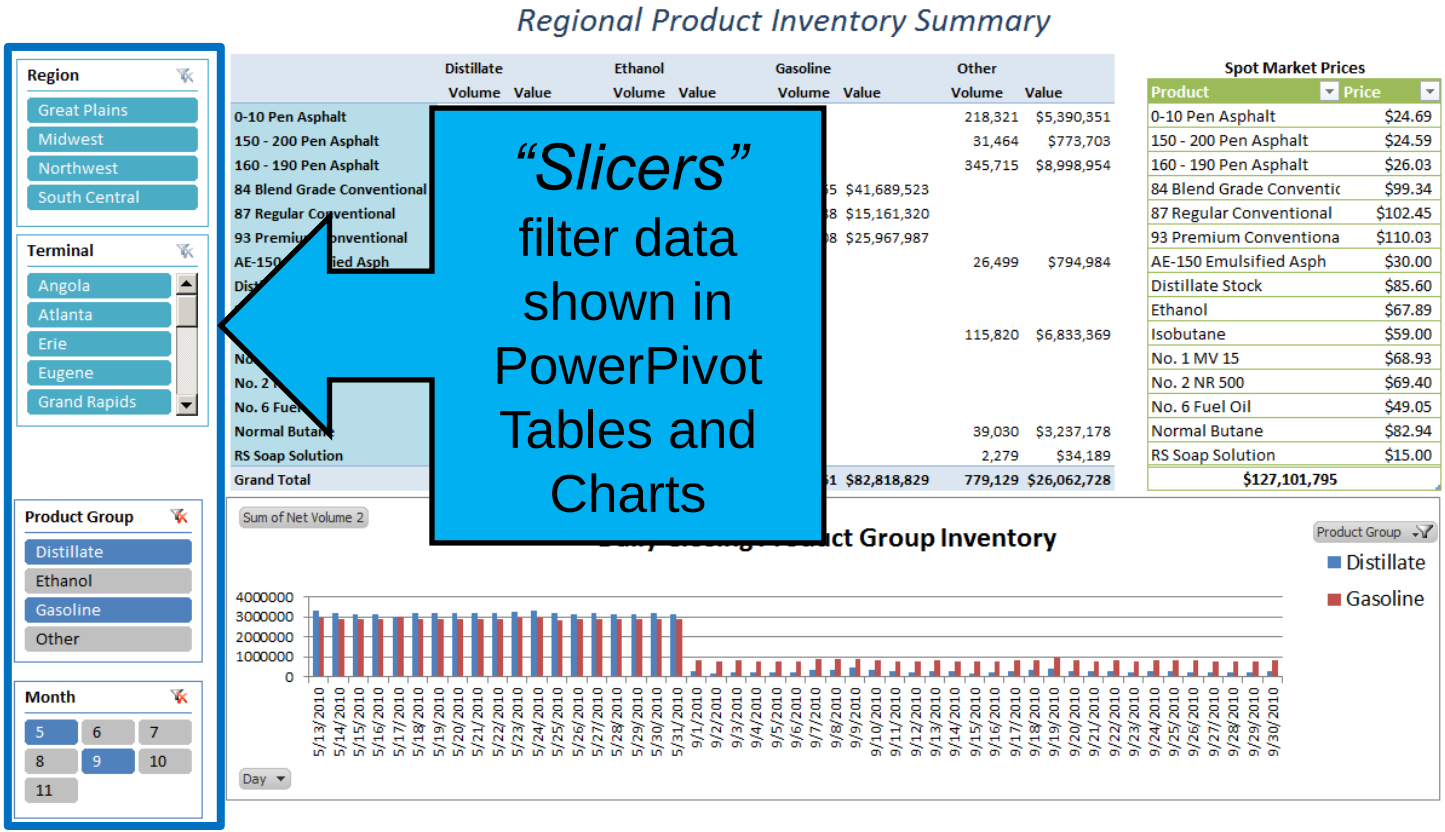
- Norman East
- Norman West
- Omaha NW
- Tulsa
- Wichita

	Distillate		Ethanol		Gasoline		Other	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value
0-10 Pen Asphalt							1,059	$26,139
150 - 200 Pen Asphalt							12,737	$313,195
160 - 190 Pen Asphalt							18,736	$487,711
84 Blend Grade Conventional					3,451	$342,778		
87 Regular Conventional					14,256	$1,460,555		
93 Premium Conventional					13,154	$1,447,356		
AE-150 Emulsified Asph								
Distillate Stock								
Ethanol			5,423	$368,142				
Isobutane							104,040	$6,138,333
No. 1 MV 15								
No. 2 NR 500								
No. 6 Fuel Oil	128,444	$6,300,192						
Normal Butane								
RS Soap Solution								
Grand Total	128,444	$6,300,192	5,423	$368,142	30,861	$3,250,690	136,571	$6,965,378

Spot Market Prices

Product	Price
0-10 Pen Asphalt	$24.69
150 - 200 Pen Asphalt	$24.59
160 - 190 Pen Asphalt	$26.03
84 Blend Grade Conventic	$99.34
87 Regular Conventional	$102.45
93 Premium Conventiona	$110.03
AE-150 Emulsified Asph	$30.00
Distillate Stock	$85.60
Ethanol	$67.89
Isobutane	$59.00
No. 1 MV 15	$68.93
No. 2 NR 500	$69.40
No. 6 Fuel Oil	$49.05
Normal Butane	$82.94
RS Soap Solution	$15.00
$16,884,402	

Product Inventories and Valuation



Product Inventories and Valuation

Regional Product Inventory Summary

Region

- Great Plains
- Midwest
- Northwest
- South Central

Terminal

- Angola
- Atlanta
- Erie
- Eugene
- Grand Rapids

	Distillate		Ethanol		Gasoline		Other	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value
0-10 Pen Asphalt							218,321	$5,390,351
150 - 200 Pen Asphalt							31,464	$773,703
160 - 190 Pen Asphalt							345,715	$8,998,954
84 Blend Grade Conventional					419,665	$41,689,523		
87 Regular Conventional					147,988	$15,161,320		
93 Premium Conventional					236,008	$25,967,987		
AE-150 Emulsified Asph							26,499	$794,984
Distillate Stock	677	$57,979						
Ethanol			39,894	$2,708,426				
Isobutane							115,820	$6,833,369
No. 1 MV 15	70,189	$4,838,095						
No. 2 NR 500	30,219	$2,097,169						
No. 6 Fuel Oil	173,671	$8,518,569						
Normal Butane							39,030	$3,237,178
RS Soap Solution							2,279	$34,189
Grand Total	274,756	$15,511,812	39,894	$2,708,426	803,661	$82,818,829	779,129	$26,062,728

Spot Market Prices

Product	Price
0-10 Pen Asphalt	$24.69
150 - 200 Pen Asphalt	$24.59
160 - 190 Pen Asphalt	$26.03
84 Blend Grade Conventic	$99.34
87 Regular Conventional	$102.45
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Distillate Stock	$85.60
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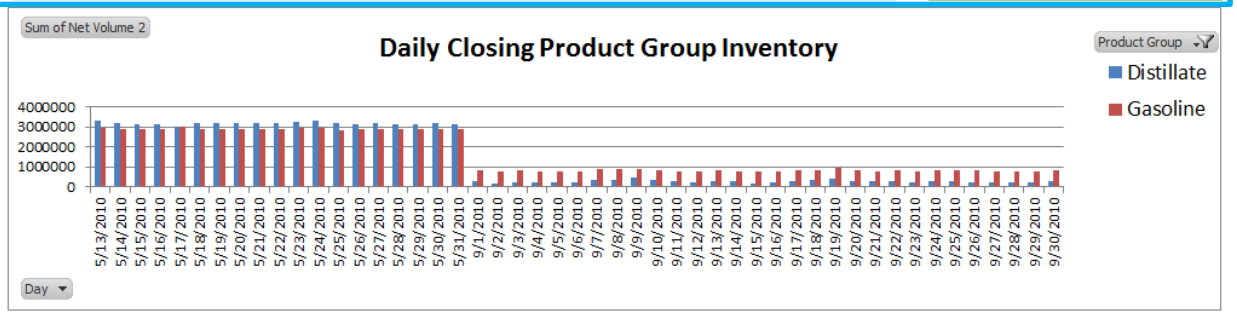
No. 2 NR 500	$69.40
No. 6 Fuel Oil	$49.05
Normal Butane	$82.94
RS Soap Solution	$15.00
	$127,101,795

Product Group

- Distillate
- Ethanol
- Gasoline
- Other

Month

5	6	7
8	9	10
11		



Product Inventories and Valuation

Regional Product Inventory Summary

Region
- Great Plains
- Midwest
- Northwest
- South Central

Terminal
- Norman East
- Norman West
- Omaha NW
- Tulsa
- Wichita

	Distillate		Ethanol		Gasoline		Other	
	Volume	Value	Volume	Value	Volume	Value	Volume	Value
0-10 Pen Asphalt							1,059	$26,139
150 - 200 Pen Asphalt							12,737	$313,195
160 - 190 Pen Asphalt							18,736	$487,711
84 Blend Grade Conventional					3,451	$342,778		
87 Regular Conventional					14,256	$1,460,555		
93 Premium Conventional					13,154	$1,447,356		
AE-150 Emulsified Asph								
Distillate Stock								
Ethanol			5,423	$368,142				
Isobutane							104,040	$6,138,333
No. 1 MV 15								
No. 2 NR 500								
No. 6 Fuel Oil	76,524	$3,753,525						
Normal Butane								
RS Soap Solution								
Grand Total	76,524	$3,753,525	5,423	$368,142	30,861	$3,250,690	136,571	$6,965,378

Spot Market Prices

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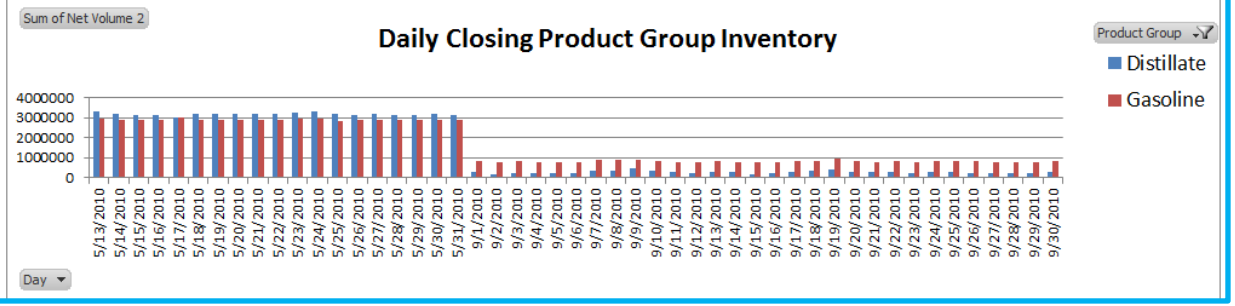
RS Soap Solution	$15.00
	$14,337,735

Product Group
- Distillate
- Ethanol
- Gasoline
- Other

Month

5	6	7
8	9	10
11		



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Normal Butane								
RS Soap Solution								
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RS Soap Solution	$15.00
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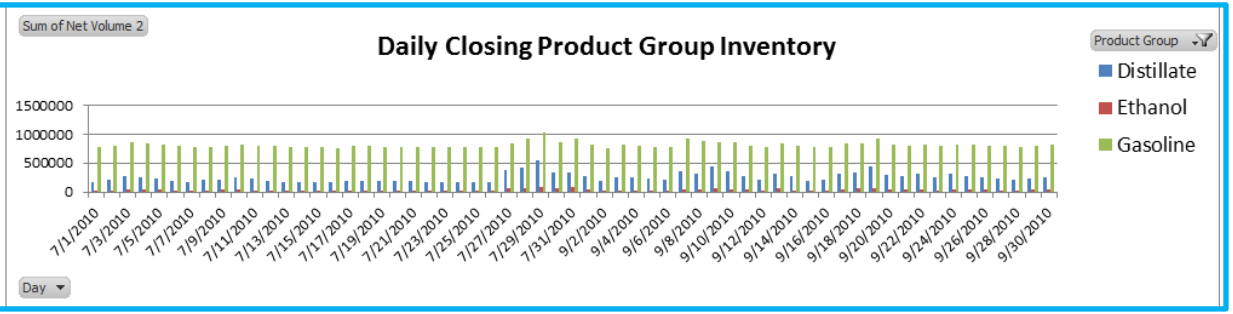
Product Group

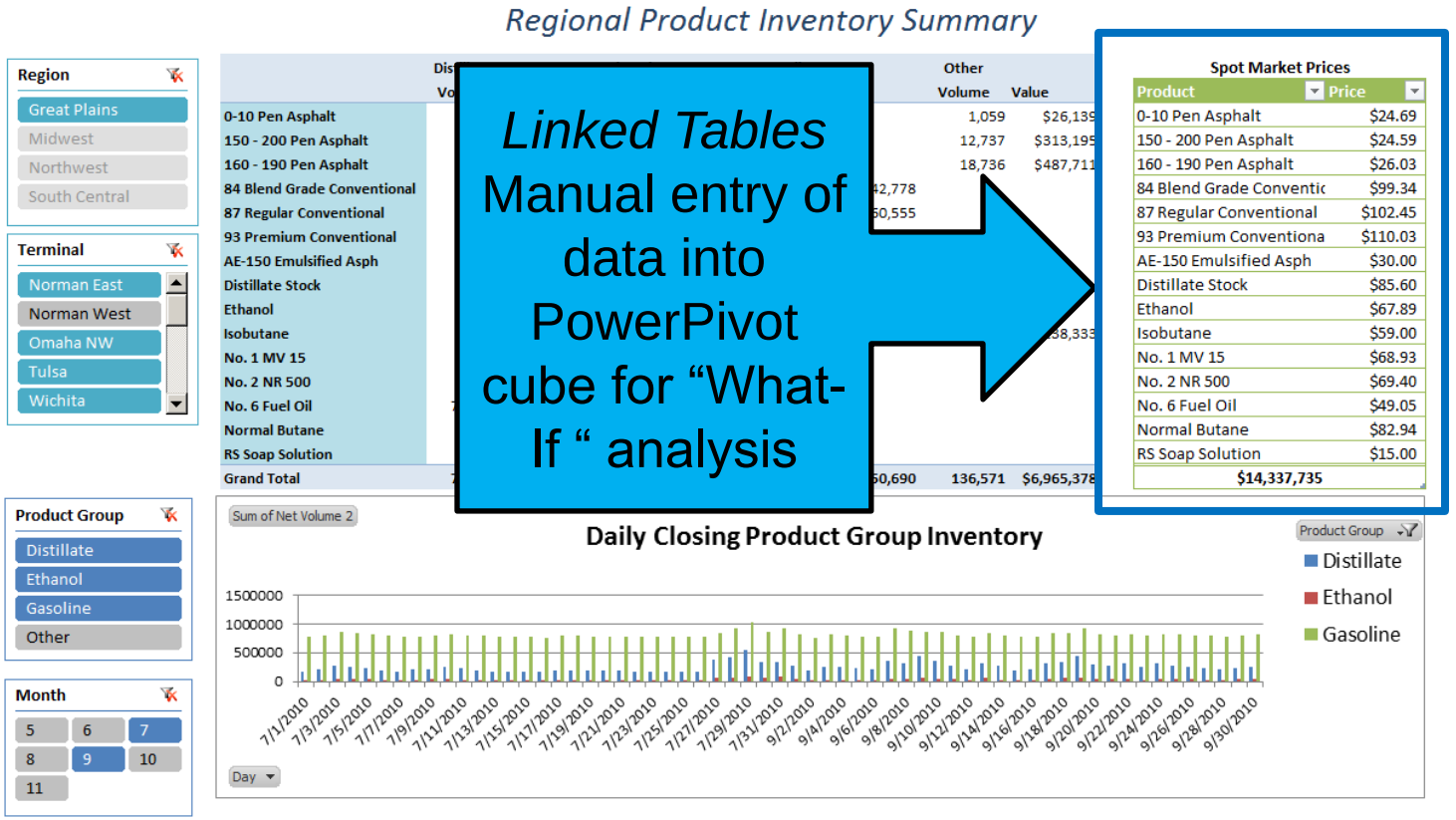
- Distillate
- Ethanol
- Gasoline
- Other

Month

5	6	7
8	9	10
11		



Product Inventories and Valuation



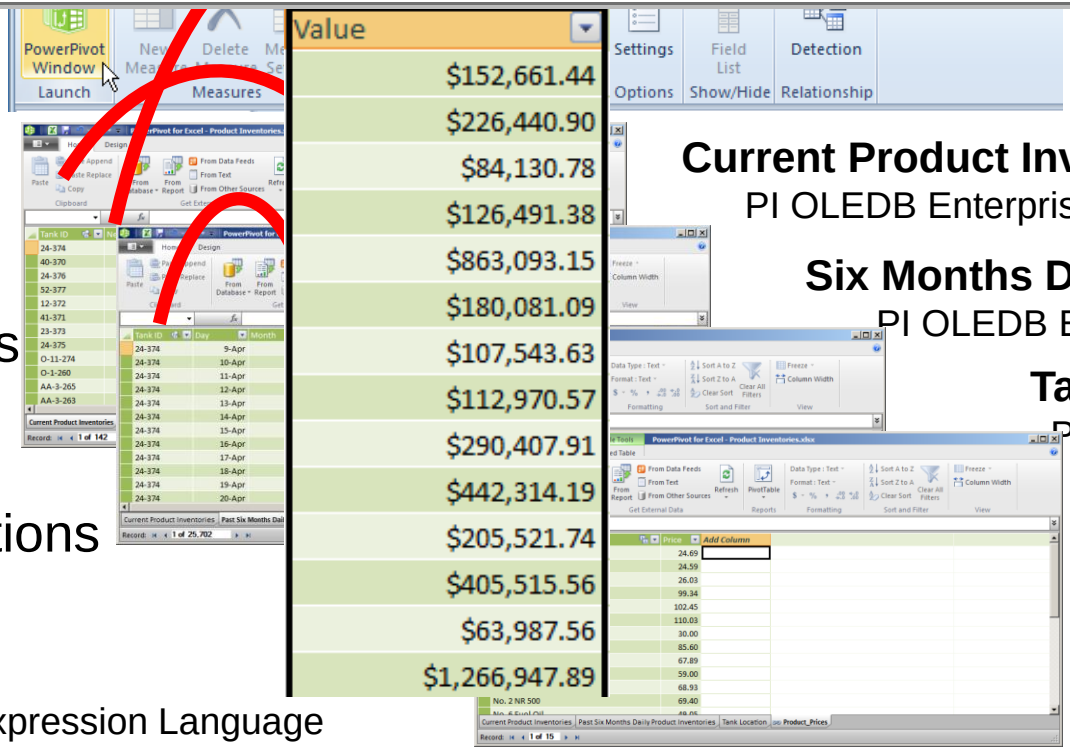
Import Data into PowerPivot

=='Current Product Inventories'[Net Volume]*RELATED(Product_Prices[Price])

PowerPivot Add-In for Excel 2010

Configure Relationships

Add Calculations Using DAX[1]



Current Product Inventories
PI OLEDB Enterprise 2010

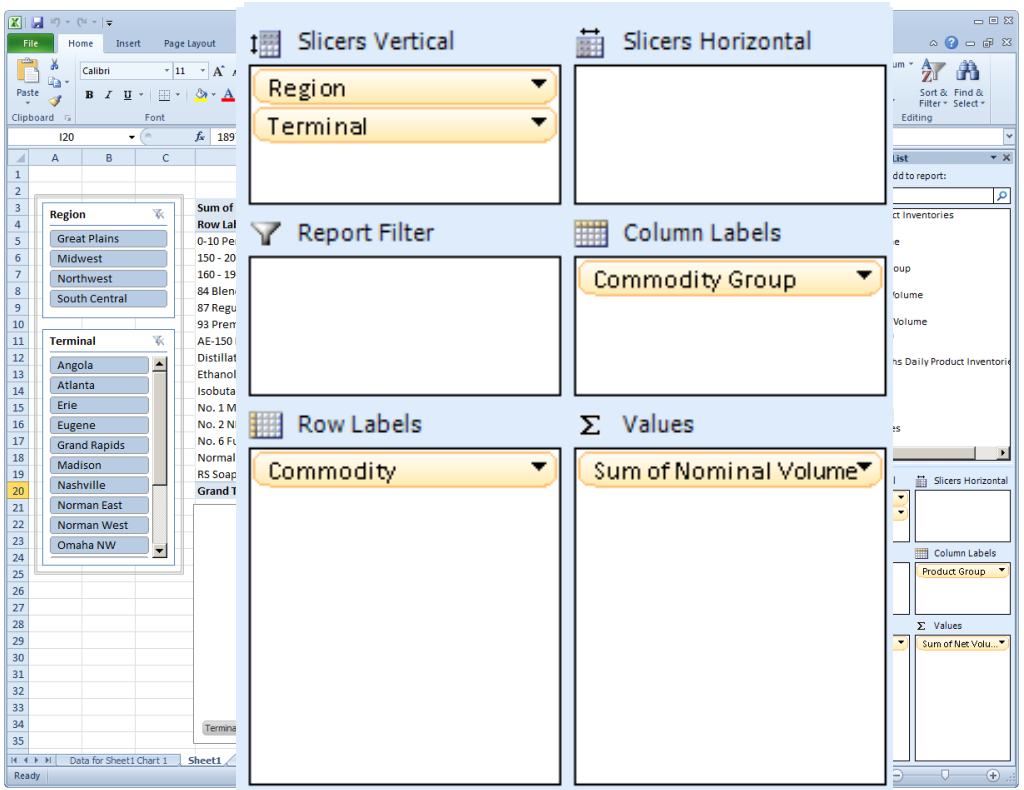
Six Months Daily Inventories
PI OLEDB Enterprise 2010

Tank Location
PI OLEDB Enterprise 2010

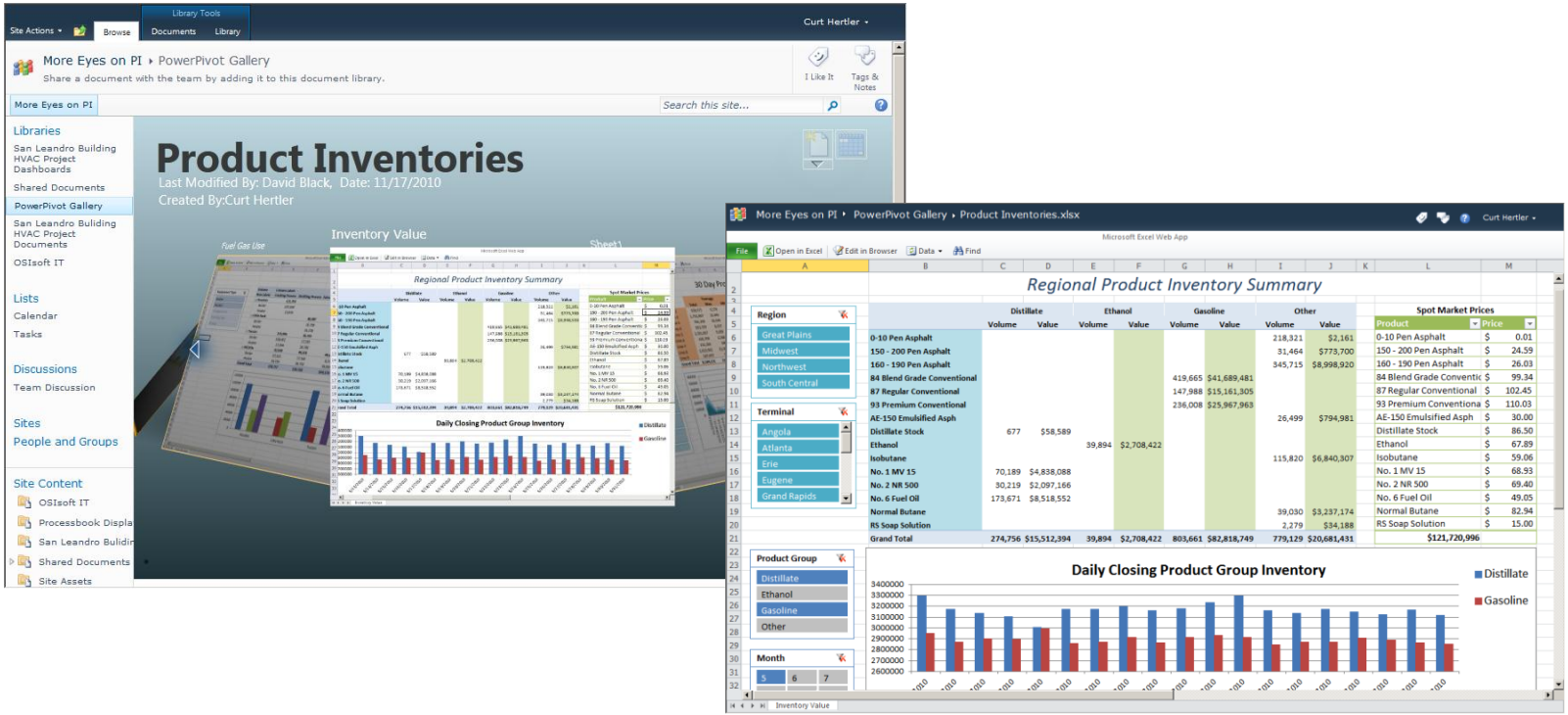
Commodity Prices
Excel Linked Table

1. Data Analysis Expression Language

Build PowerPivot Tables and Charts



SharePoint 2010 Enterprise



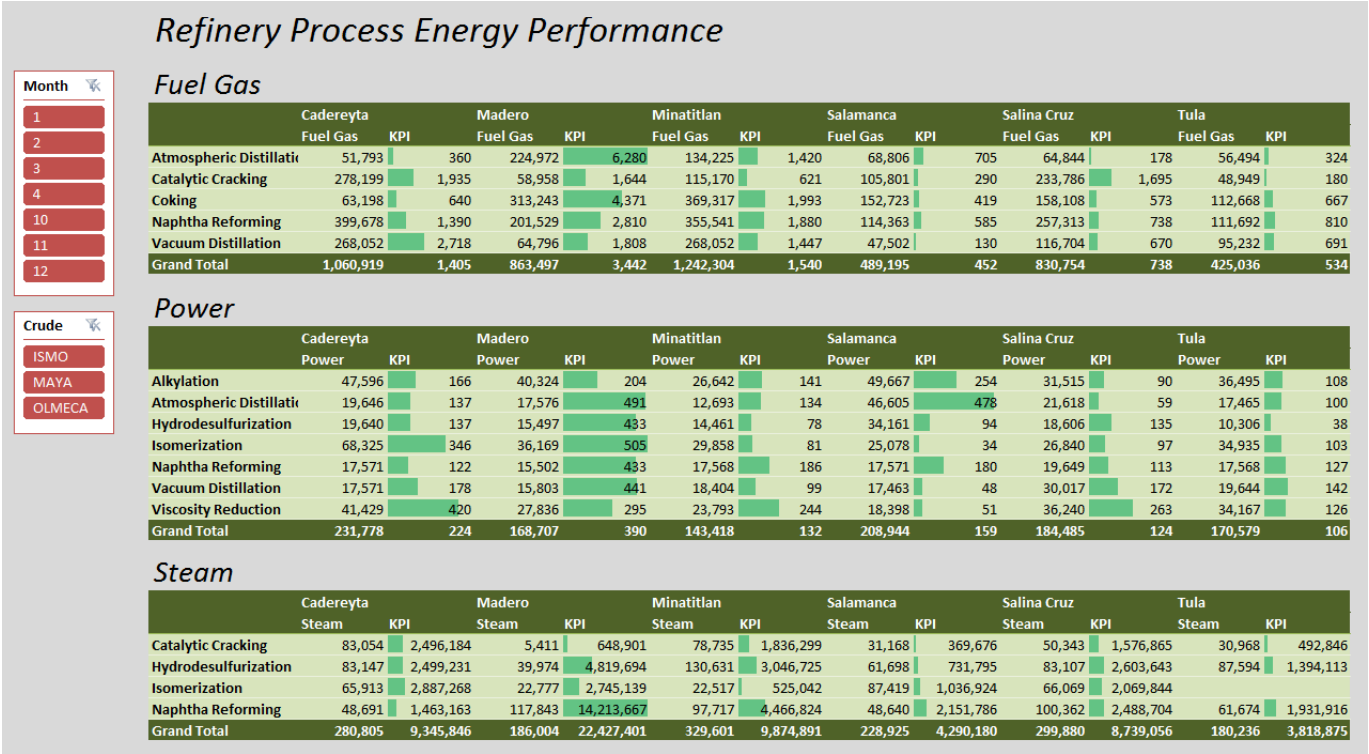
Other Examples and Additional Information

WWW.PowerPivot.com

Energy Benchmarking

Utility consumption comparison between refineries by process.

Filter performance by month or crude type



Refinery Process Energy Performance

Month: 1, 2, 3, 4, 10, 11, 12

Crude: ISMO, MAYA, OLMECA

Fuel Gas

	Cadereyta		Madero		Minatitlan		Salamanca		Salina Cruz		Tula	
	Fuel Gas	KPI	Fuel Gas	KPI	Fuel Gas	KPI	Fuel Gas	KPI	Fuel Gas	KPI	Fuel Gas	KPI
Atmospheric Distillati	51,793	360	224,972	6,280	134,225	1,420	68,806	705	64,844	178	56,494	324
Catalytic Cracking	278,199	1,935	58,958	1,644	115,170	621	105,801	290	233,786	1,695	48,949	180
Coking	63,198	640	313,243	4,371	369,317	1,993	152,723	419	158,108	573	112,668	667
Naphtha Reforming	399,678	1,390	201,529	2,810	355,541	1,880	114,363	585	257,313	738	111,692	810
Vacuum Distillation	268,052	2,718	64,796	1,808	268,052	1,447	47,502	130	116,704	670	95,232	691
Grand Total	1,060,919	1,405	863,497	3,442	1,242,304	1,540	489,195	452	830,754	738	425,036	534

Power

	Cadereyta		Madero		Minatitlan		Salamanca		Salina Cruz		Tula	
	Power	KPI	Power	KPI	Power	KPI	Power	KPI	Power	KPI	Power	KPI
Alkylation	47,596	166	40,324	204	26,642	141	49,667	254	31,515	90	36,495	108
Atmospheric Distillati	19,646	137	17,576	491	12,693	134	46,605	478	21,618	59	17,465	100
Hydrodesulfurization	19,640	137	15,497	433	14,461	78	34,161	94	18,606	135	10,306	38
Isomerization	68,325	346	36,169	505	29,858	81	25,078	34	26,840	97	34,935	103
Naphtha Reforming	17,571	122	15,502	433	17,568	186	17,571	180	19,649	113	17,568	127
Vacuum Distillation	17,571	178	15,803	441	18,404	99	17,463	48	30,017	172	19,644	142
Viscosity Reduction	41,429	420	27,836	295	23,793	244	18,398	51	36,240	263	34,167	126
Grand Total	231,778	224	168,707	390	143,418	132	208,944	159	184,485	124	170,579	106

Steam

	Cadereyta		Madero		Minatitlan		Salamanca		Salina Cruz		Tula	
	Steam	KPI	Steam	KPI	Steam	KPI	Steam	KPI	Steam	KPI	Steam	KPI
Catalytic Cracking	83,054	2,496,184	5,411	648,901	78,735	1,836,299	31,168	369,676	50,343	1,576,865	30,968	492,846
Hydrodesulfurization	83,147	2,499,231	39,974	4,819,694	130,631	3,046,725	61,698	731,795	83,107	2,603,643	87,594	1,394,113
Isomerization	65,913	2,887,268	22,777	2,745,139	22,517	525,042	87,419	1,036,924	66,069	2,069,844		
Naphtha Reforming	48,691	1,463,163	117,843	14,213,667	97,717	4,466,824	48,640	2,151,786	100,362	2,488,704	61,674	1,931,916
Grand Total	280,805	9,345,846	186,004	22,427,401	329,601	9,874,891	228,925	4,290,180	299,880	8,739,056	180,236	3,818,875

Power Distribution and Asset Condition

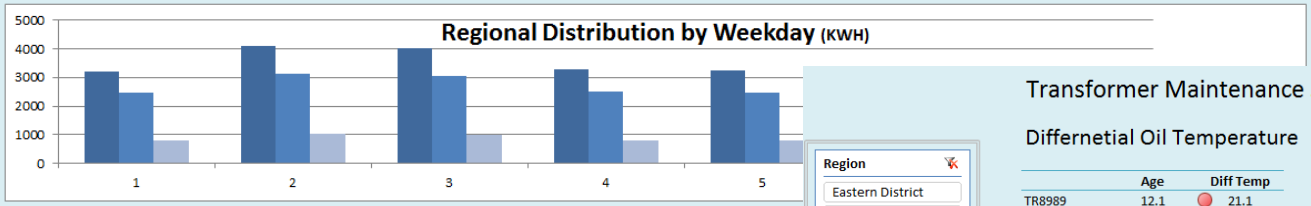
Substation power distribution by rate period and transformer age.

30 Day Substation Power Distribution Report

Period
Off Peak
Partial Peak
Peak

Age Ranges
a. Under 5 Years
b. 5 to 10 Years
c. 10 to 20 Years
d. 20 to 30 Years
e. Over 30 Years

	Eastern District			Northern District			Southern District			Western District		
	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %
Bighorn Basin	6,261	25.8%	1.3%									
Eagle Point							12,296	66.3%	2.6%			
Elm Street												
Falcon Pass												
Ford Avenue							6,261	33.7%	1.3%			
Granite Cliff												
Gypsy Junction												
Maple Grove										6,138	100.0%	1.3%
Pine Hill												
Red River												
Thunder Peak												
Victory Valley	5,989	24.6%	1.3%									
Wolverine	12,063	49.6%	2.5%									
Grand Total	24,314	100.0%	5.1%				18,557	100.0%	3.9%	6,138	100.0%	1.3%
											Corp Total	10.3%



Region
Eastern District
Northern District
Southern District
Western District

Transformer Maintenance Summary

Differnetial Oil Temperature

	Age	Diff Temp
TR8989	12.1	21.1
TR0274	19.3	21.1
TR0117	0.5	16.5
TR6852	16.3	16.5
TR8822	31.0	16.2
TR8548	19.0	11.4

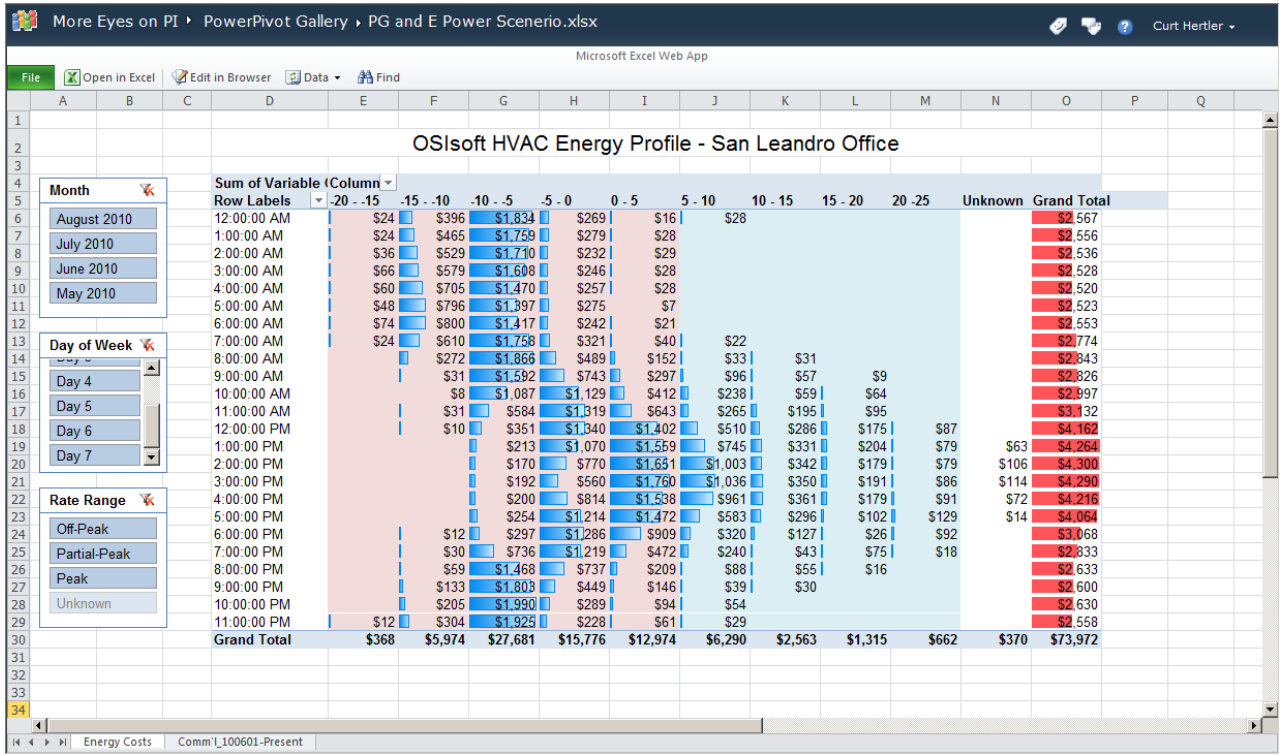
Thermal Fault

	Age	C2H4/C2H6
TR3030	28.9	1.15
TR6421	31.4	1.15
TR5670	36.3	1.15
TR8822	31.0	0.62
TR8989	12.1	0.43
TR0117	0.5	0.37

Identify transformer condition risk.

Facility Energy Management

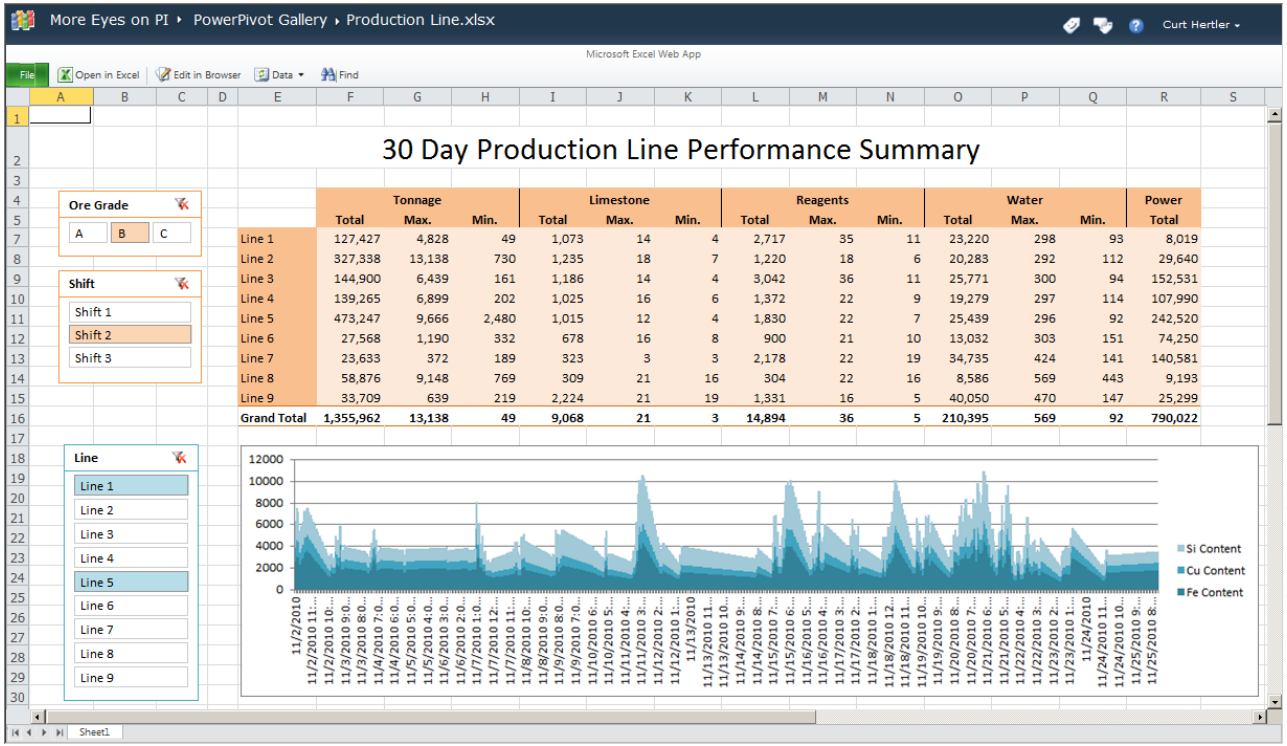
Hourly energy expense based on time of day and outside temperature.



Raw Material Processing and Yield Improvement

Analyze process conditions against product yield.

Filter performance by ore grade, shift or processing line

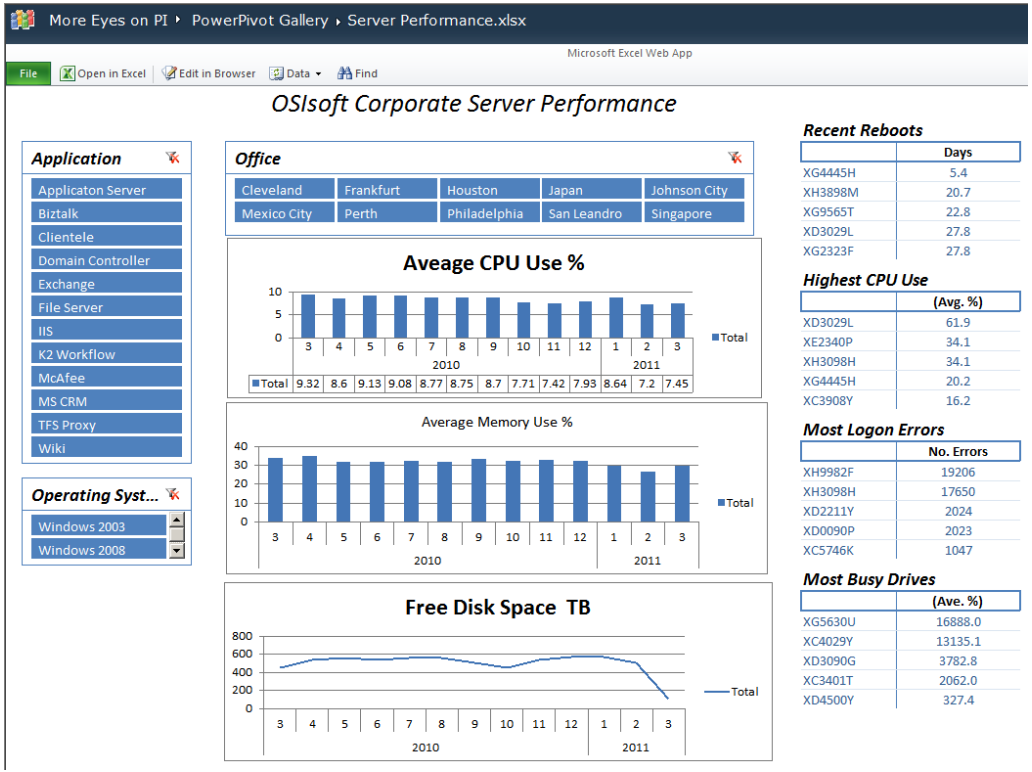


	Tonnage			Limestone			Reagents			Water			Power
	Total	Max.	Min.	Total	Max.	Min.	Total	Max.	Min.	Total	Max.	Min.	Total
Line 1	127,427	4,828	49	1,073	14	4	2,717	35	11	23,220	298	93	8,019
Line 2	327,338	13,138	730	1,235	18	7	1,220	18	6	20,283	292	112	29,640
Line 3	144,900	6,439	161	1,186	14	4	3,042	36	11	25,771	300	94	152,531
Line 4	139,265	6,899	202	1,025	16	6	1,372	22	9	19,279	297	114	107,990
Line 5	473,247	9,666	2,480	1,015	12	4	1,830	22	7	25,439	296	92	242,520
Line 6	27,568	1,190	332	678	16	8	900	21	10	13,032	303	151	74,250
Line 7	23,633	372	189	323	3	3	2,178	22	19	34,735	424	141	140,581
Line 8	58,876	9,148	769	309	21	16	304	22	16	8,586	569	443	9,193
Line 9	33,709	639	219	2,224	21	19	1,331	16	5	40,050	470	147	25,299
Grand Total	1,355,962	13,138	49	9,068	21	3	14,894	36	5	210,395	569	92	790,022

IT Resources Dashboard

Overview of corporate computing efficiency and resource utilization .

Quantify resource use by application



Avoid potential server problems

Resources

- OSIsoft Resources
  - Recorded Users Conference 2010 and 2011 Presentations
  - Recorded vCampus Presentations
  - Prescriptive Architecture Guides
- Books
  - “PowerPivot for the Data Analyst”, Bill Jelen
  - “Practical PowerPivot & DAX Formulas for Excel 2010”, Art Tennick
- Microsoft Resources
  - PowerPivot (www.PowerPivot.com)
  - CFE Case Study (www.microsoft.com/casestudies/Microsoft-Sharepoint-Server-2010/Comisi-n-Federal-de-Electricidad-CFE/Mexico-s-Electrical-Utility-Sees-Saving-Millions-of-Dollars-through-Collaborative-BI/4000007996)
  - Windows Azure DataMarket (datamarket.azure.com)

Thank you