



OSIsoft®

# REGIONAL SEMINAR 2012

E M E A

The Power of Data



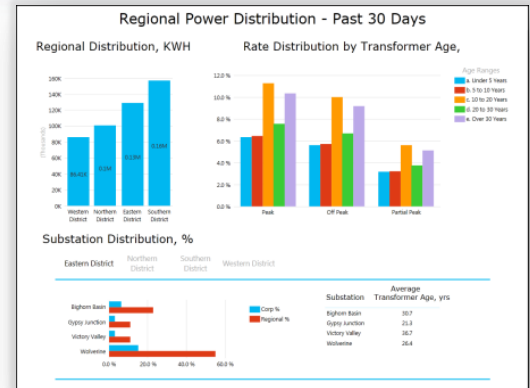
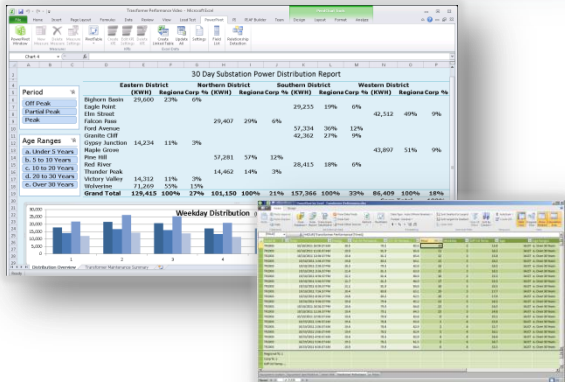
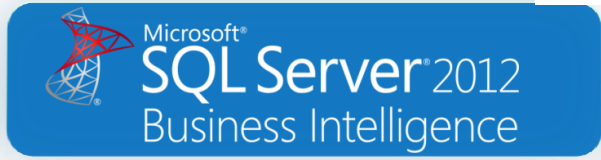
# Business Analytics with Microsoft SQL Server 2012 and the PI System

Presented by **Yves Gauthier**  
Customer Support Engineer  
OSIsoft Europe GmbH, Frankfurt / Germany

# Overview

- Business Analytics Toolkit
- Example: “*Substation Power Distribution Profile*”
  - ***Business Context*** - PI Asset Framework (PI AF)
  - ***Data Access*** - PI OLEDB Enterprise
  - ***Analytic Reporting*** - PowerPivot for Excel 2010
  - ***Ad Hoc Analytics and Reporting*** - Power View
- Power View Integration with PowerPoint
- Additional Resources

# Business Analytics Toolkit

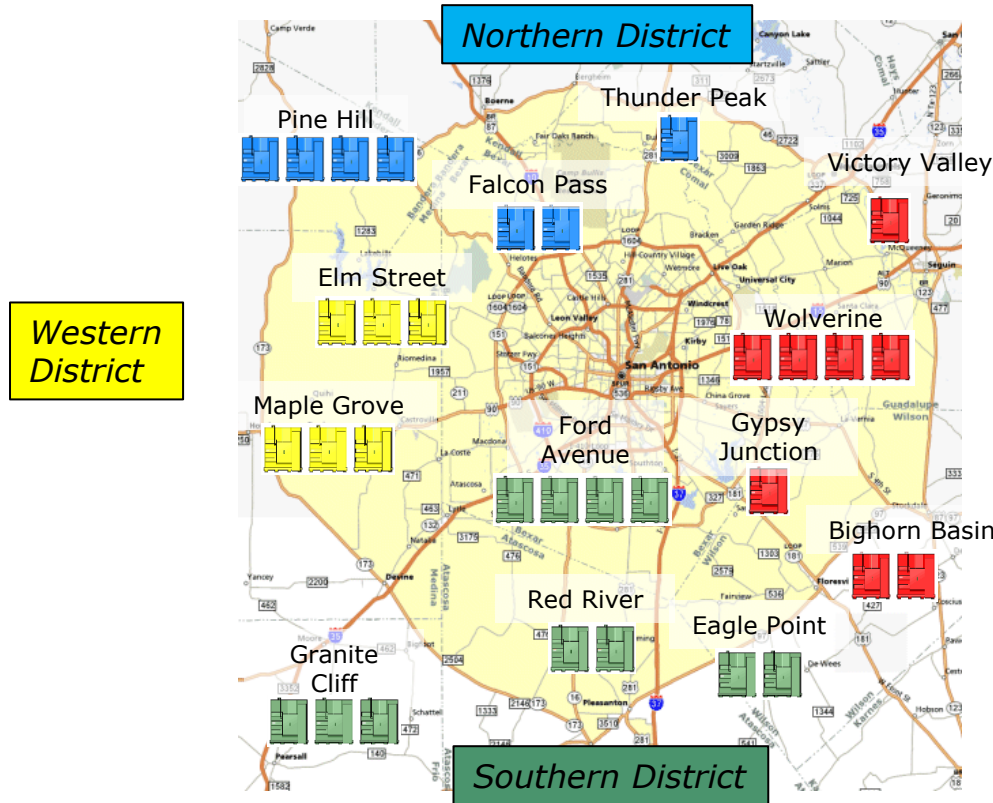


## PowerPivot for Excel 2010



## Power View

# Example: Substation Power Distribution Profile



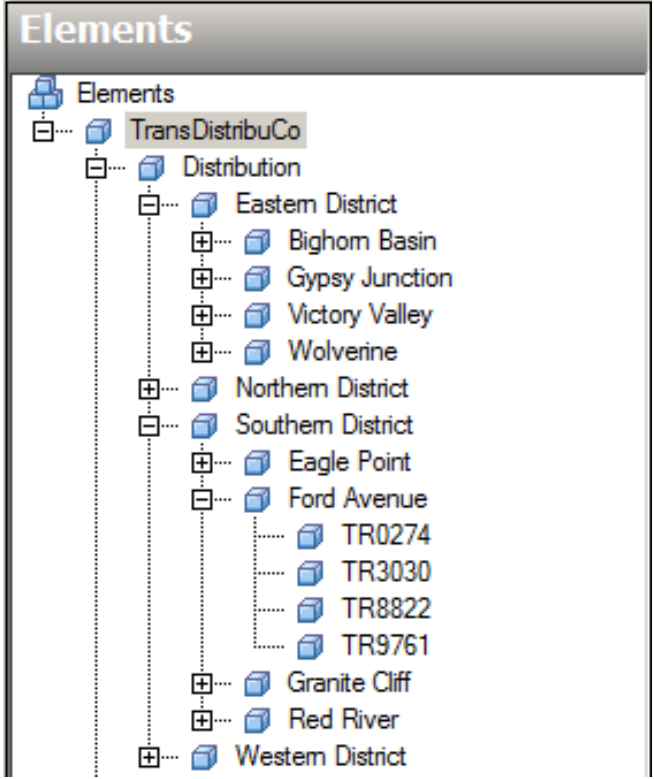
## My Objectives

- Regional and Rate Period Power Distribution
- Aging Asset Risk Assessment
- *Want to do it myself !*

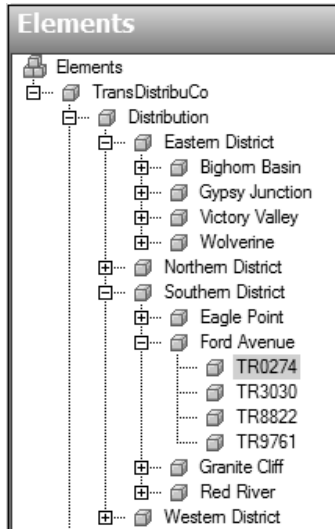
# PI Server – PI Asset Framework (PI AF)

## Asset Hierarchy

- District
- Substation
- Transformer



# PI Server – PI Asset Framework (PI AF)



TR0274

General | Child Elements | Attributes | Ports | Version

Filter

Name	Value
Category: Current DGA Analysis	
Acetylene	4 ppm
Carbon Dioxide	3004 ppm
Carbon Monoxide	123 ppm
Ethane	190 ppm
Ethylene	38 ppm
Hydrogen	294 ppm
Methane	121 ppm
Nitrogen	22698 ppm
Oxygen	2340 ppm
Category: Load Tap Changer	
LTC Oil Temperature	65.0885009765625 °F
LTC Oil Temperature - 1H A...	62.7173211853571 °F
Category: Performance	
Energy	20.6299715201975 MWh
Load	20.1319046020508 MW
Category: Specifications	
Installation Date	6/10/1992 12:00:00 AM
Manufacturer	PowerMaster
Model	PM-56
Category: Tank	
Bottom Oil Temperature	48.3781089782715 °F
Top Oil Temperature	79.2328872680664 °F
Top Oil Temperature - 1H A...	83.2808045109946 °F

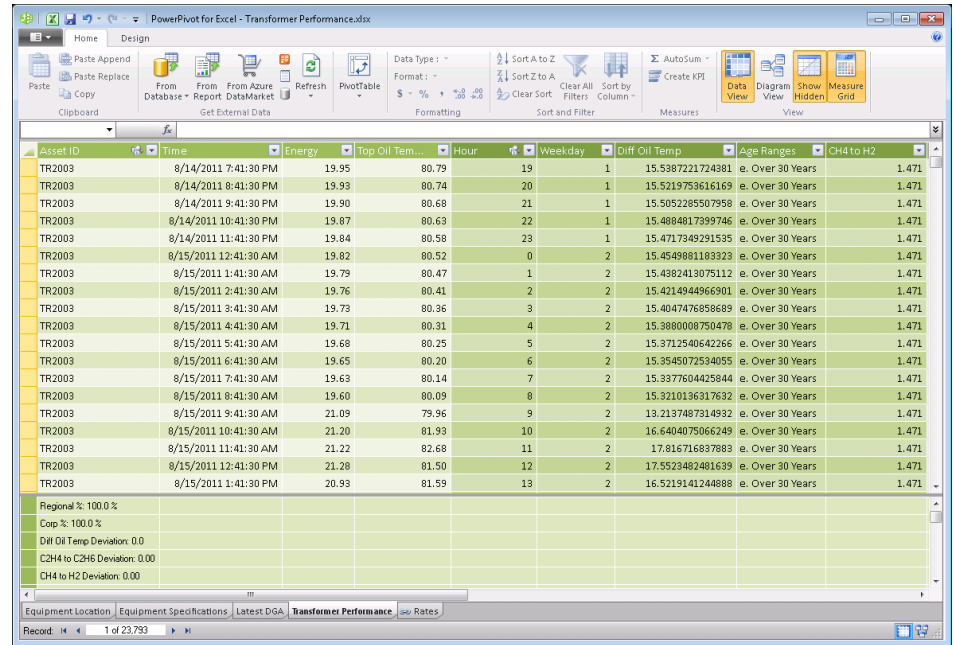
## Transformer Attributes

- PI System Data
- Equipment Specifications
- DGA analysis

# PI OLEDB Enterprise

## Important Considerations

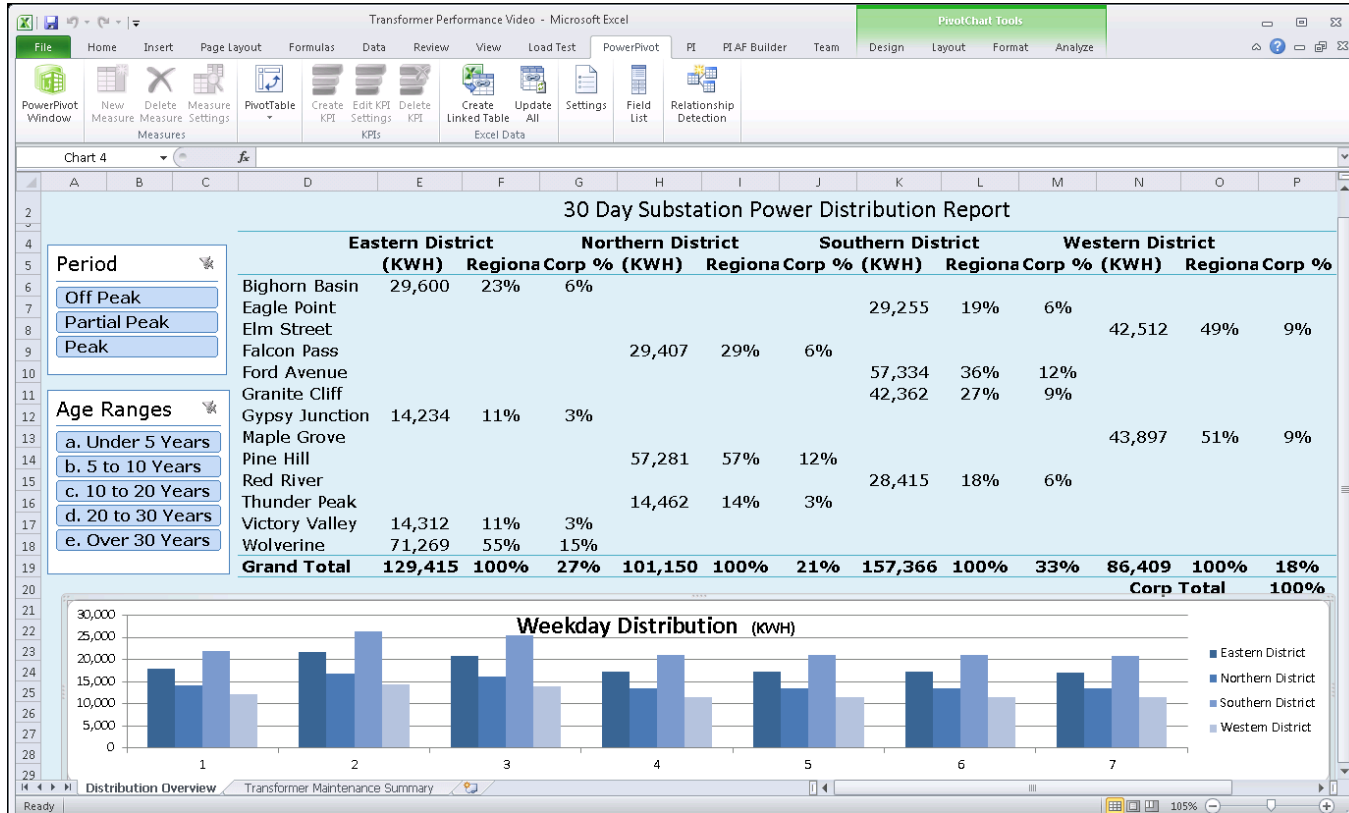
- Leverage structure used throughout your PI System infrastructure
- Insure accurate aggregation of real-time events
- Scale-up by adding PI AF Structure
- Access PI Event Frames in next release



Asset ID	Time	Energy	Top Oil Tem...	Hour	Weekday	Diff Oil Temp	Age Ranges	CH4 to H2
TR2003	8/14/2011 7:41:30 PM	19.95	80.79	19	1	15.5387221724381	e. Over 30 Years	1.471
TR2003	8/14/2011 8:41:30 PM	19.93	80.74	20	1	15.5219753616169	e. Over 30 Years	1.471
TR2003	8/14/2011 9:41:30 PM	19.90	80.68	21	1	15.5052285507958	e. Over 30 Years	1.471
TR2003	8/14/2011 10:41:30 PM	19.87	80.63	22	1	15.4884817399746	e. Over 30 Years	1.471
TR2003	8/14/2011 11:41:30 PM	19.84	80.58	23	1	15.4717349291535	e. Over 30 Years	1.471
TR2003	8/15/2011 12:41:30 AM	19.82	80.52	0	2	15.4549881183323	e. Over 30 Years	1.471
TR2003	8/15/2011 1:41:30 AM	19.79	80.47	1	2	15.4382413076112	e. Over 30 Years	1.471
TR2003	8/15/2011 2:41:30 AM	19.76	80.41	2	2	15.4214944966901	e. Over 30 Years	1.471
TR2003	8/15/2011 3:41:30 AM	19.73	80.36	3	2	15.4047476858689	e. Over 30 Years	1.471
TR2003	8/15/2011 4:41:30 AM	19.71	80.31	4	2	15.3880008750478	e. Over 30 Years	1.471
TR2003	8/15/2011 5:41:30 AM	19.68	80.25	5	2	15.3712540642266	e. Over 30 Years	1.471
TR2003	8/15/2011 6:41:30 AM	19.65	80.20	6	2	15.3545072534055	e. Over 30 Years	1.471
TR2003	8/15/2011 7:41:30 AM	19.63	80.14	7	2	15.3377604425844	e. Over 30 Years	1.471
TR2003	8/15/2011 8:41:30 AM	19.60	80.09	8	2	15.3210136317632	e. Over 30 Years	1.471
TR2003	8/15/2011 9:41:30 AM	21.09	79.96	9	2	13.2137487314932	e. Over 30 Years	1.471
TR2003	8/15/2011 10:41:30 AM	21.20	81.93	10	2	16.4040075066249	e. Over 30 Years	1.471
TR2003	8/15/2011 11:41:30 AM	21.22	82.68	11	2	17.816716937883	e. Over 30 Years	1.471
TR2003	8/15/2011 12:41:30 PM	21.28	81.50	12	2	17.5523482481639	e. Over 30 Years	1.471
TR2003	8/15/2011 1:41:30 PM	20.93	81.59	13	2	16.5219141244888	e. Over 30 Years	1.471



# PowerPivot for Excel 2010



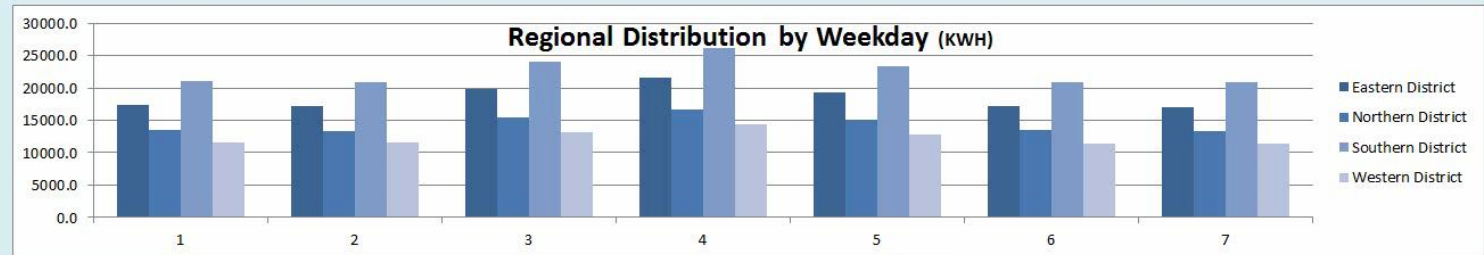
## Power Distribution Report

File Home Insert Page Layout Formulas Data Review View Add-Ins PowerPivot PIAF Builder

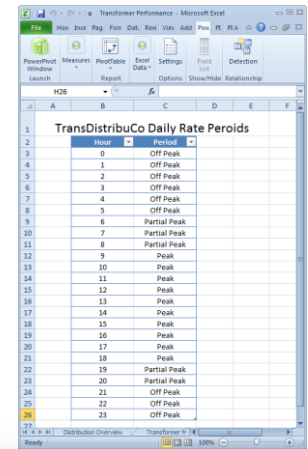
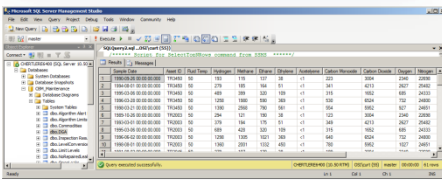
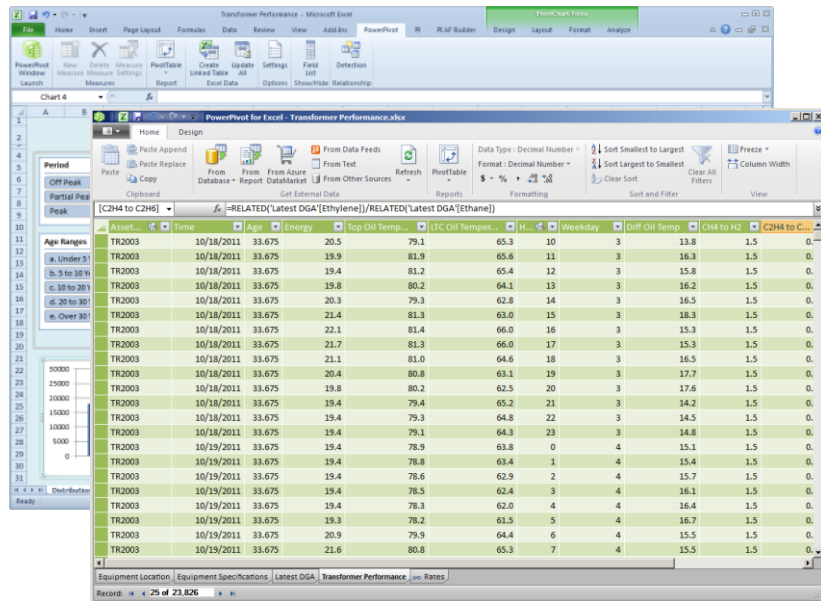
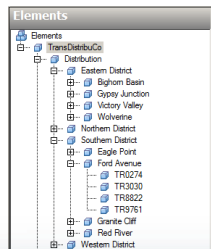
Clipboard Font Alignment Number Styles Cells Editing

### 30 Day Substation Power Distribution Report

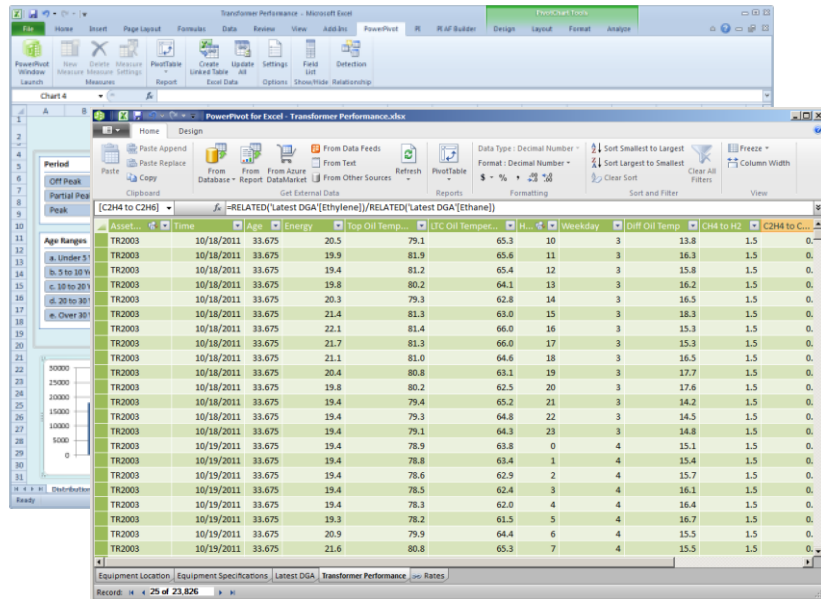
Period	Eastern District			Northern District			Southern District			Western District		
	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %	(KWH)	Regional %	Corp %
Off Peak	Bighorn Basin	29,606	22.9%	6.2%								
Partial Peak	Eagle Point						29,275	18.6%	6.2%			
Peak	Elm Street									42,377	49.2%	8.9%
	Falcon Pass				29,263	28.9%	6.2%					
	Ford Avenue						57,612	36.5%	12.1%			
	Granite Cliff						42,389	26.9%	8.9%			
	Gypsy Junction	14,135	10.9%	3.0%								
	Maple Grove									43,763	50.8%	9.2%
	Pine Hill				57,428	56.8%	12.1%					
	Red River						28,365	18.0%	6.0%			
	Thunder Peak				14,405	14.2%	3.0%					
	Victory Valley	14,417	11.1%	3.0%								
	Wolverine	71,315	55.1%	15.0%								
	<b>Grand Total</b>	<b>129,473</b>	<b>100.0%</b>	<b>27.3%</b>	<b>101,097</b>	<b>100.0%</b>	<b>21.3%</b>	<b>157,641</b>	<b>100.0%</b>	<b>33.2%</b>	<b>86,140</b>	<b>100.0%</b>
										<b>Corp Total</b>	<b>100.0%</b>	



# PowerPivot Enables Data Integration



# PowerPivot Enables Data Integration



## Can I use DataLink?

- Manual refresh step required to copy and paste values
- Limited to ~1 million rows
- No support for upsizing to SQL Analysis Services 2012



# PowerPivot Enables Extended Analysis

## DAX – Data Analysis Expression Language

Transformer ID	Installation Date	Age	Age Range
TR0001	30/06/2011 12:00:00 AM	29.9	a. Under 5 Years
TR0002	30/06/2011 12:00:00 AM	19.4	a. Under 5 Years
TR0003	30/06/2011 12:00:00 PM	19.4	a. Under 5 Years
TR0004	30/06/2011 3:00:00 PM	20.1	a. Under 5 Years
TR0005	30/06/2011 3:00:00 PM	21.4	a. Under 5 Years
TR0006	30/06/2011 6:00:00 PM	22.1	a. Under 5 Years
TR0007	30/06/2011 9:00:00 PM	22.7	a. Under 5 Years
TR0008	30/06/2011 9:00:00 PM	23.0	a. Under 5 Years
TR0009	30/06/2011 9:00:00 PM	24.4	a. Under 5 Years
TR0010	30/06/2011 9:00:00 PM	24.4	a. Under 5 Years
TR0011	30/06/2011 9:00:00 PM	24.4	a. Under 5 Years
TR0012	30/06/2011 9:00:00 PM	24.4	a. Under 5 Years
TR0013	30/06/2011 9:00:00 PM	24.4	a. Under 5 Years
TR0014	30/06/2011 9:00:00 PM	24.4	a. Under 5 Years
TR0015	30/06/2011 12:00:00 AM	19.4	a. Under 5 Years
TR0016	30/06/2011 12:00:00 AM	19.4	a. Under 5 Years
TR0017	30/06/2011 12:00:00 AM	19.4	a. Under 5 Years
TR0018	30/06/2011 12:00:00 AM	19.4	a. Under 5 Years
TR0019	30/06/2011 3:00:00 AM	19.4	a. Under 5 Years
TR0020	30/06/2011 3:00:00 AM	19.4	a. Under 5 Years
TR0021	30/06/2011 6:00:00 AM	19.4	a. Under 5 Years
TR0022	30/06/2011 6:00:00 AM	19.4	a. Under 5 Years
TR0023	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0024	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0025	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0026	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0027	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0028	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0029	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0030	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0031	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0032	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0033	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0034	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0035	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0036	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0037	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0038	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0039	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0040	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0041	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0042	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0043	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0044	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0045	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0046	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0047	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0048	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0049	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years
TR0050	30/06/2011 9:00:00 AM	20.9	a. Under 5 Years

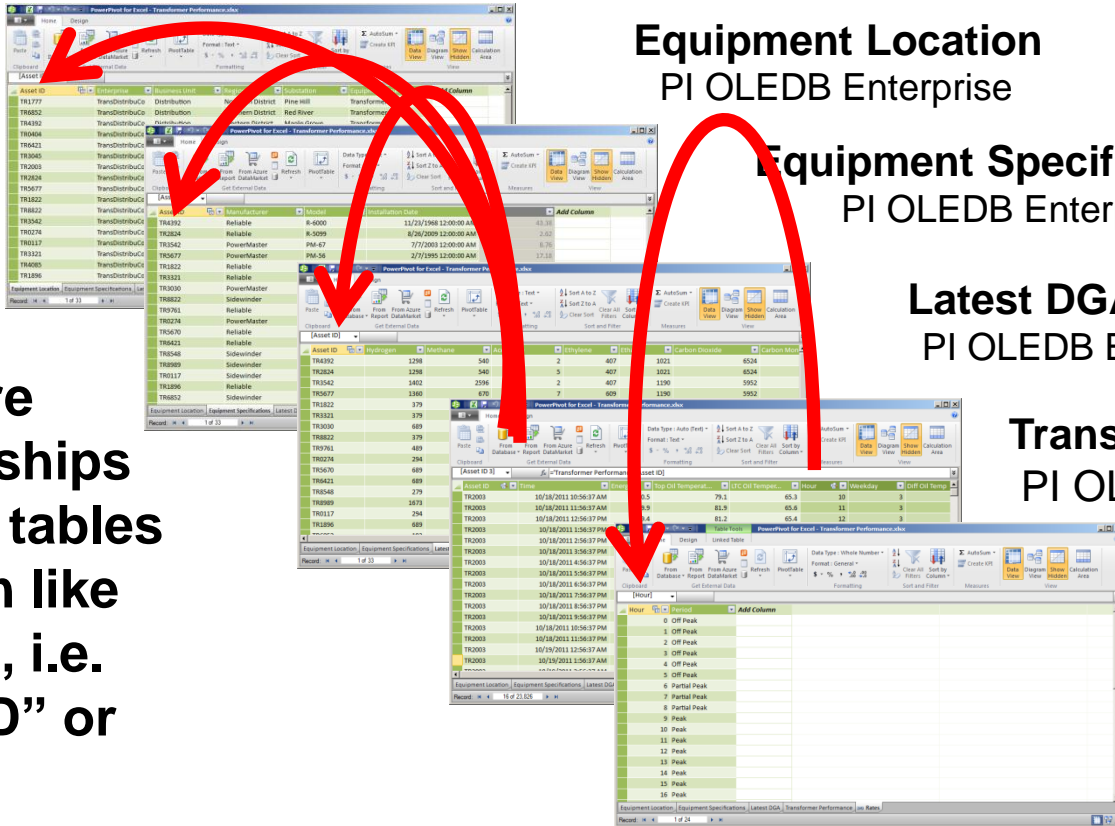
### Transformer Age Column

=YEARFRAC('Equipment Specifications'[Installation Date],NOW())

### Transformer Age Ranges Column

=IF('Transformer Performance'[Age]>30,"e. Over 30 Years", IF('Transformer Performance'[Age]>20,"d. 20 to 30 Years", IF('Transformer Performance'[Age]>10,"c. 10 to 20 Years", IF('Transformer Performance'[Age]>5,"b. 5 to 10 Years", "a. Under 5 Years"))))

# PowerPivot Creates the “Cube”



**Equipment Location**  
PI OLEDB Enterprise

**Equipment Specifications**  
PI OLEDB Enterprise

**Latest DGA**  
PI OLEDB Enterprise

**Transformer Performance**  
PI OLEDB Enterprise

**Rates**  
Excel Linked Table

**Configure Relationships between tables based on like columns, i.e. “Asset ID” or “Hour”**

# SharePoint 2010 Enterprise – PowerPivot Gallery

Transformer Performance  
Last Modified By: Curt Hertler, Date: 1/11/2012  
Created By: Curt Hertler

**Distribution Overview**

**Regional Distribution by Weekday (KWH)**

Day	Eastern District	Northern District	Southern District	Western District
1	15,000	18,000	12,000	10,000
2	18,000	22,000	15,000	12,000
3	12,000	15,000	10,000	8,000
4	15,000	18,000	12,000	10,000
5	18,000	22,000	15,000	12,000
6	12,000	15,000	10,000	8,000
7	15,000	18,000	12,000	10,000

### 30 Day Substation Power Distribution Report

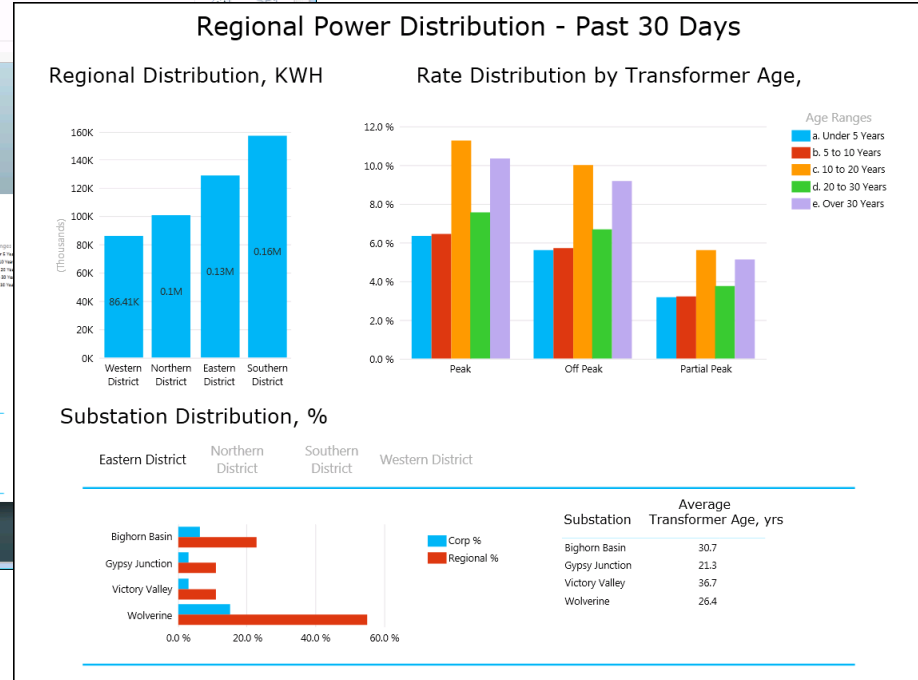
Substation	Eastern District (KWH)			Northern District (KWH)			Southern District (KWH)			Western District (KWH)		
	KWH	Regional %	Corp %	KWH	Regional %	Corp %	KWH	Regional %	Corp %	KWH	Regional %	Corp %
Bighorn Basin	29,600	22.9%	6.24%									
Eagle Point							29,255	18.6%	6.17%			
Elm Street										42,512	49.2%	8.96%
Falcon Pass				29,407	29.1%	6.20%						
Ford Avenue							57,334	36.4%	12.09%			
Granite Cliff							42,362	26.9%	8.93%			
Gypsy Junction										43,897	50.8%	9.25%
Maple Grove	14,234	11.0%	3.00%									
Pine Hill							57,281	56.6%	12.08%			
Red River							28,415	18.1%	5.99%			
Thunder Peak												
Victory Valley	14,312	11.1%	3.02%	14,462	14.3%	3.05%						
Wolverine	71,269	55.1%	15.02%									
<b>Grand Total</b>	<b>129,415</b>	<b>100.0%</b>	<b>27.28%</b>	<b>101,150</b>	<b>100.0%</b>	<b>21.32%</b>	<b>157,366</b>	<b>100.0%</b>	<b>33.18%</b>	<b>86,409</b>	<b>100.0%</b>	<b>18.22%</b>
										<b>Corp Total</b>	<b>100.0%</b>	

**Regional Distribution by Weekday (KWH)**

# SharePoint 2010 Enterprise – Power View

The screenshot shows a SharePoint 2010 Power View report titled "Distribution Profile" with the following content:

- Page Header:** "Distribution Profile", "Last Modified By: Curt Hertler, Date: 1/13/2012", "Created By: Curt Hertler".
- Left Navigation:** Home, Libraries, Site Pages, Shared Documents, PowerPivot Examples, Backups, Dave's Reports, Lists, Calendar, Tasks, Discussions, Team Discussion, Recycle Bin, All Site Content.
- Main Content:**
  - Regional Power Distribution - Past 30 Days:** A bar chart showing KWH distribution across four districts: Western (86.41K), Northern (0.1M), Eastern (0.13M), and Southern (0.16M).
  - Rate Distribution by Transformer Age:** A grouped bar chart showing rates for Peak, Off Peak, and Partial Peak across five age ranges (a-e).
  - Substation Distribution, %:** A horizontal bar chart comparing Corp % and Regional % for four substations: Bighorn Basin, Gypsy Junction, Victory Valley, and Wolverine.





PowerPivot Gallery - Windows Internet Explorer  
 http://74.217.101.216/PowerPivot%20Gallery/Forms/Carousel.aspx

Site Actions | Browse | Documents | Library | Curt Hertler

Main Site > PowerPivot Gallery  
 Share a document with the team by adding it to this document library.

Main Site | PI Fundamentals | Product Demos | Storyboard Demos

Search this site...

Recycle Bin | All Site Content

# Transformer Performance

Last Modified By: Curt Hertler, Date: 4/6/2012  
 Created By: Curt Hertler

Server Performance Dashboard | Distribution Overview | Transformer Maintenance Summary

OSsoft Corporate Server Performance

Average CPU Use %

Average Memory Use %

Free Disk Space TB

### 30 Day Substation Power Distribution Report

Regional %	Corp %	Northern District (KWH)		Southern District (KWH)		Western District (KWH)					
		Regional %	Corp %	Regional %	Corp %	Regional %	Corp %				
22.9%	8.34%			29,255	18.6%	6.17%	42,512	49.2%	8.96%		
		29,487	25.1%	6.20%	57,834	36.4%	13.09%				
				42,362	26.9%	8.93%	43,897	50.8%	9.25%		
11.0%	3.00%			57,281	56.6%	12.08%					
		34,462	14.3%	3.05%	26,413	18.1%	5.99%				
17.11%	3.02%										
19.55.1%	25.02%										
19.100.0%	27.28%	181,150	100.0%	21.32%	557,366	100.0%	33.58%	86,409	100.0%	18.22%	
										Corp Total	100.00%

### Regional Distribution by Weekday (KWH)

Transformer Maintenance Summary

Differential Oil Temperature

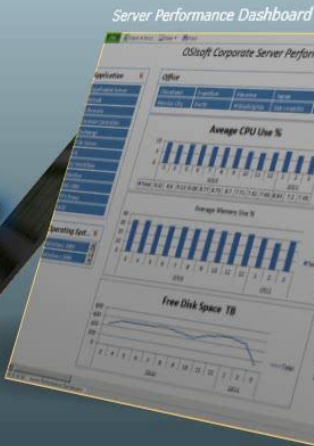
Thermal Fault

Conditions by Manufacturer

# Transformer Performance

Last Modified By: Curt Hertler, Date: 4/6/2012  
 Created By: Curt Hertler

## Distribution Overview



30 Day Substation Power Distribution Report

Regional %	Corp %	Northern District (KWH)		Southern District (KWH)		Western District (KWH)						
		Regional %	Corp %	Regional %	Corp %	Regional %	Corp %					
22.3%	8.34%			29,255	18.6%	6.17%	42,512	49.2%	8.96%			
		29,487	25.1%	6.20%	57,834	36.4%	12.09%					
				42,362	26.9%	8.93%	43,897	50.8%	9.25%			
11.0%	3.00%			57,281	56.6%	12.08%						
		34,462	14.3%	3.00%	26,413	18.1%	5.99%					
17	11.1%	3.02%										
18	15.1%	15.02%										
19	100.0%	27.28%	181,150	100.0%	21.32%	157,366	100.0%	33.18%	86,409	100.0%	18.22%	
											Corp Total	100.00%

Regional Distribution by Weekday (KWH)

## Transformer Maintenance Summary

Transformer Maintenance Summary

Differential Oil Temperature

Thermal Fault

Conditions by Manufacturer

Manufacturer	Age	Oil Temp	Insulation	Oil %	Oil % OK	Oil % Bad
10000	10	100	100	100	100	0
10001	10	100	100	100	100	0
10002	10	100	100	100	100	0
10003	10	100	100	100	100	0
10004	10	100	100	100	100	0
10005	10	100	100	100	100	0
10006	10	100	100	100	100	0
10007	10	100	100	100	100	0
10008	10	100	100	100	100	0
10009	10	100	100	100	100	0
10010	10	100	100	100	100	0

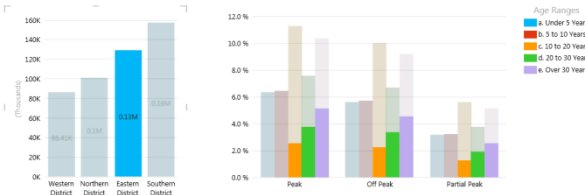
# Microsoft SQL 2012 Power View

## Interactive Analysis

Regional Power Distribution - Past 30 Days

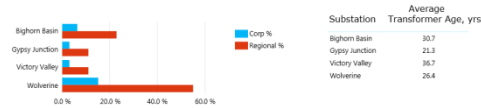
Regional Distribution, KWH

Rate Distribution by Transformer Age,



Substation Distribution, %

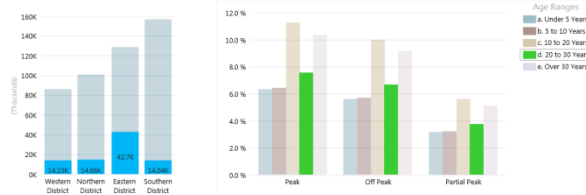
Eastern District



Regional Power Distribution - Past 30 Days

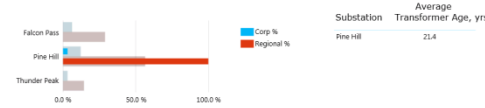
Regional Distribution, KWH

Rate Distribution by Transformer Age,



Substation Distribution, %

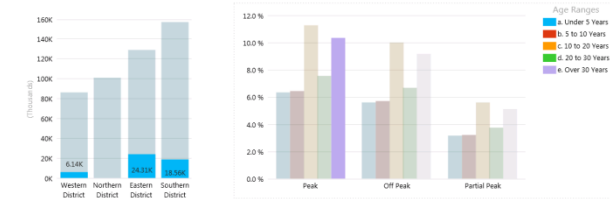
Northern District



Regional Power Distribution - Past 30 Days

Regional Distribution, KWH

Rate Distribution by Transformer Age,



Substation Distribution, %

Southern District



## Distribution by District

## Distribution by Transformer Age

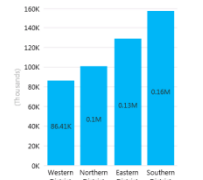
## Distribution by Age and Rate

# Microsoft SQL 2012 Power View

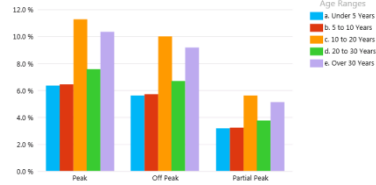
## Multiple Views \ Pages

Regional Power Distribution - Past 30 Days

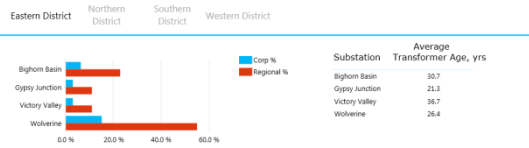
Regional Distribution, KWH



Rate Distribution by Transformer Age,

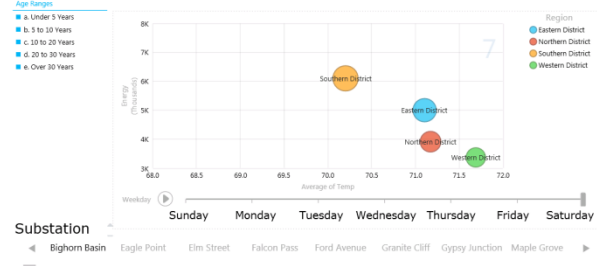


Substation Distribution, %

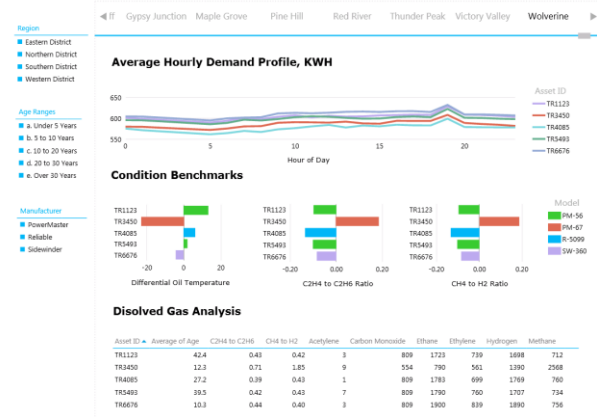


Power Distribution Profile - Past 30 Days

Regional Distribution by Weekday vs. Substation Temperature



Substation Transformer Condition and Benchmarking



## Aging Asset Risk Assessment

## Weekday Distribution Profile

## Equipment Condition Benchmarking

# Power View Reports in PowerPoint

**Power View**  
Microsoft SQL Server Reporting Services  
Version 11.0.2100.60  
© 2012 Microsoft Corporation. All rights reserved.

File: Save, Save As, Print, **Export to PowerPoint**, Help

Diagnosics  
[Sync diagnostic information with the server.](#)  
Not synced during this session.

**Substation Distribution, %**

Substation	Under 5 Years	5 to 10 Years	10 to 20 Years	20 to 30 Years	Over 30 Years
Western District	~1000	~1000	~1000	~1000	~1000
Northern District	~1000	~1000	~1000	~1000	~1000
Eastern District	~1000	~1000	~1000	~1000	~1000
Southern District	~1000	~1000	~1000	~1000	~1000

**Average Transformer Age, yrs**

Substation	Average Transformer Age, yrs
Big Horn Basin	20.7
Grady Junction	22.4
Valley Valley	28.7
Warnerne	28.4

Power View Slides - Microsoft PowerPoint

File Home Insert Design Transitions Animations Slide Show Review View Add-Ins

Clipboard Slides Paragraph

1. Regional Power Distribution - Past 30 Days  
Regional Distribution, kWh  
State Distribution by Transformer Age, %

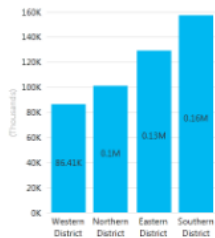
2. Power Distribution Profile - Past 30 Days  
Regional Distribution by Weekday vs. Substation Temperature

3. Substation Transformer Condition and Benchmarking  
Average Hourly Demand Profile, kWh  
Condition Benchmarks  
Detailed Site Analysis

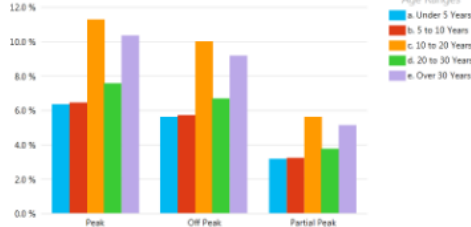
# Power View Reports in PowerPoint

## Regional Power Distribution - Past 30 Days

Regional Distribution, KWH

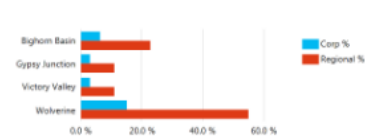


Rate Distribution by Transformer Age, %



Substation Distribution, %

Eastern District Northern District Southern District Western District



Substation	Average Transformer Age, yrs
Bighorn Basin	30.7
Gypsy Junction	23.3
Victory Valley	36.7
Wolverine	26.4

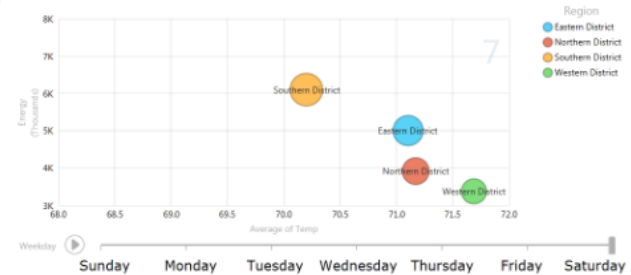
click to interact

## Power Distribution Profile - Past 30 Days

Regional Distribution by Weekday vs. Substation Temperature

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



Substation

Bighorn Basin Eagle Point Elm Street Falcon Pass Ford Avenue Granite Cliff Gypsy Junction Maple Grove

Average Daily Power, KWH



Average Daily Substation Temperature, F



click to interact

# Additional Information

## Coming up next !

- “Insightful Reporting with the PI System”,  
Todd Brown and Chris Nelson

## OSIsoft Resources

- “Business Analytics with your PI System Data using Microsoft PowerPivot”
- PI T&D Users Group Site [extranet.osisoft.com](http://extranet.osisoft.com)
- OSIsoft vCampus [vcampus.osisoft.com](http://vcampus.osisoft.com)

## Microsoft Resources

- [www.microsoft.com/en-us/bi/powerpivot.aspx](http://www.microsoft.com/en-us/bi/powerpivot.aspx)

## Helpful Books

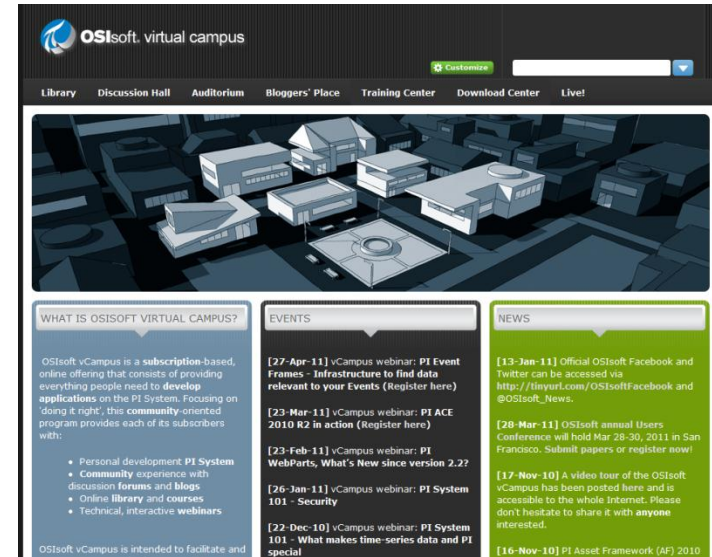
- “PowerPivot for the Data Analyst”, Bill Jelen
- “Practical PowerPivot & DAX Formulas for Excel 2010”,  
Art Tennick





# OSIsoft Virtual Campus (vCampus)

- **Online, community-oriented** program
  - Software + Resources + Collaboration
  - Focus on development and integration
  - Partners, customers and OSIsoft
  - Exclusive contents (CTPs, Betas, technical papers)
- Personal **development PI System**
  - Development licenses for PI Data Access products (for developers and integrators)



<http://vCampus.osisoft.com>  
[vCampus@osisoft.com](mailto:vCampus@osisoft.com)





# vCampus Live! 2012

WHERE PI GEEKS MEET



**Week of November 26<sup>th</sup>**

**Grand Hyatt Union Square, San Francisco**



# THANK YOU

Brought to you by  **OSIsoft.**