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The **Power** of **Data**



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

**Martin Freitag**  
Senior Developer  
OSIsoft Europe

Presented by

# Overview

- **Business Analytics Toolkit** – OSIsoft | Microsoft
- **Business Context** - PI Asset Framework (PI AF)
  - **Data Access** - PI OLEDB Enterprise
  - **Analytics and Reporting** - PowerPivot for Excel 2010
- **Demo**
- **Ad Hoc Analytics and Reporting** - PowerView
- **Additional Resources**

# Business Analytics Toolkit



Microsoft®  
Excel® 2010

30 Day Substation Power Distribution Report

Period	Eastern District	Northern District	Southern District	Western District	
Eighton Basin	25,000	23%	29,255	19%	
Eagle Peak	29,407	20%	6%	42,212	40%
Falcon Pass	42,362	27%	9%		
Granite Cliff	43,897	51%	9%		
Maple Grove	14,224	15%	3%		
Red River	15,283	37%	32%		
Thunder Park	14,462	14%	3%	28,115	18%
Wolverine Valley	71,269	11%	3%		
Subtotal	139,415	100%	37%	101,150	100%
Grand Total	240,834	100%	37%	139,366	100%

21 x 32 - Distribution Overview - Substation Northern District.xls

PowerPivot  
for Excel 2010



Microsoft®  
SQL Server® 2012  
Business Intelligence



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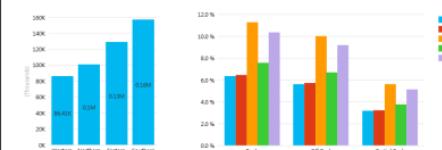
PI System  
PI OleDB Enterprise



Microsoft®  
SharePoint® 2010  
Enterprise

Regional Power Distribution - Past 30 Days

Regional Distribution, KWH      Rate Distribution by Transformer Age,



Substation Distribution, %



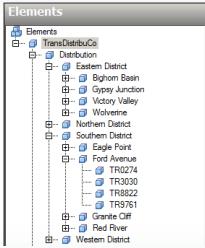
PowerView

# PowerPivot Enables Data Integration

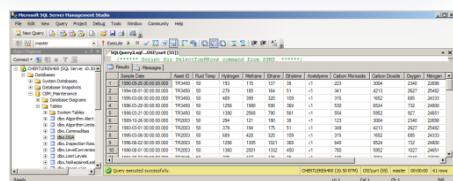


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PI Server  
PI OLEDB Enterprise



Microsoft®  
SQL Server® 2012  
Business Intelligence



A screenshot of Microsoft Excel showing the PowerPivot ribbon tab selected. A PivotTable is displayed with data from multiple sources, including 'From Database', 'From PowerPivot', and 'From Other Sources'. The data includes columns like Time, Age, Energy, Top Oil Temp., LTC Oil Temp., H., Weekday, Diff Oil Temp., CH4 to H2, CH4 to C2H6, and CH4 to CO. The PivotTable interface shows various filters and sorting options.

[www.powerpivot.com](http://www.powerpivot.com)



A screenshot of Microsoft Excel showing a PivotTable with data from the Windows Azure Marketplace. The table has columns labeled 'Period' and 'Period Type'. The data shows various peak periods: Off Peak, Partial Peak, and Peak, across different dates.

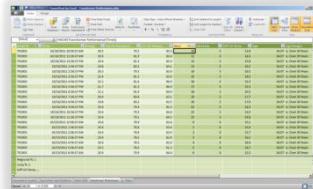


# PowerPivot Based on Gemini Technology

End Users



IT Professionals



Excel hosted client +



in memory BI engine

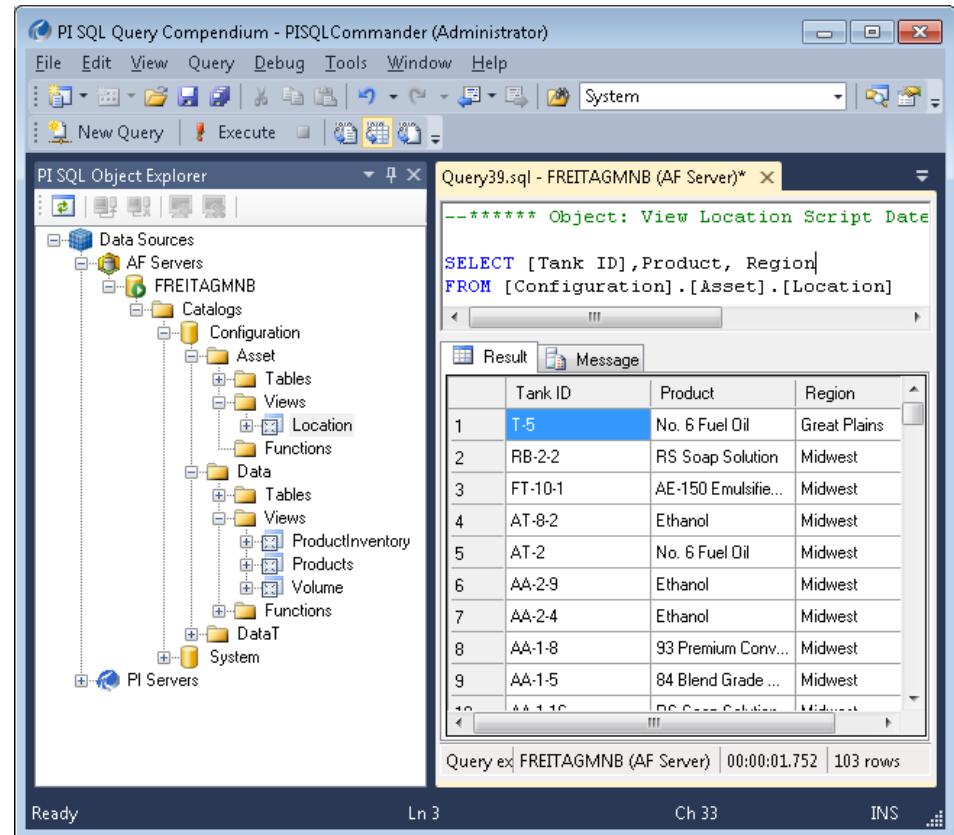


SharePoint for managed collaboration

# PI OLEDB Enterprise

## Important Considerations

- Allows looking at PI System databases as if they were a relational system
- Insures accurate aggregation of real-time events
- Scale-up by adding PI AF Structure
- Access PI Event Frames in next release

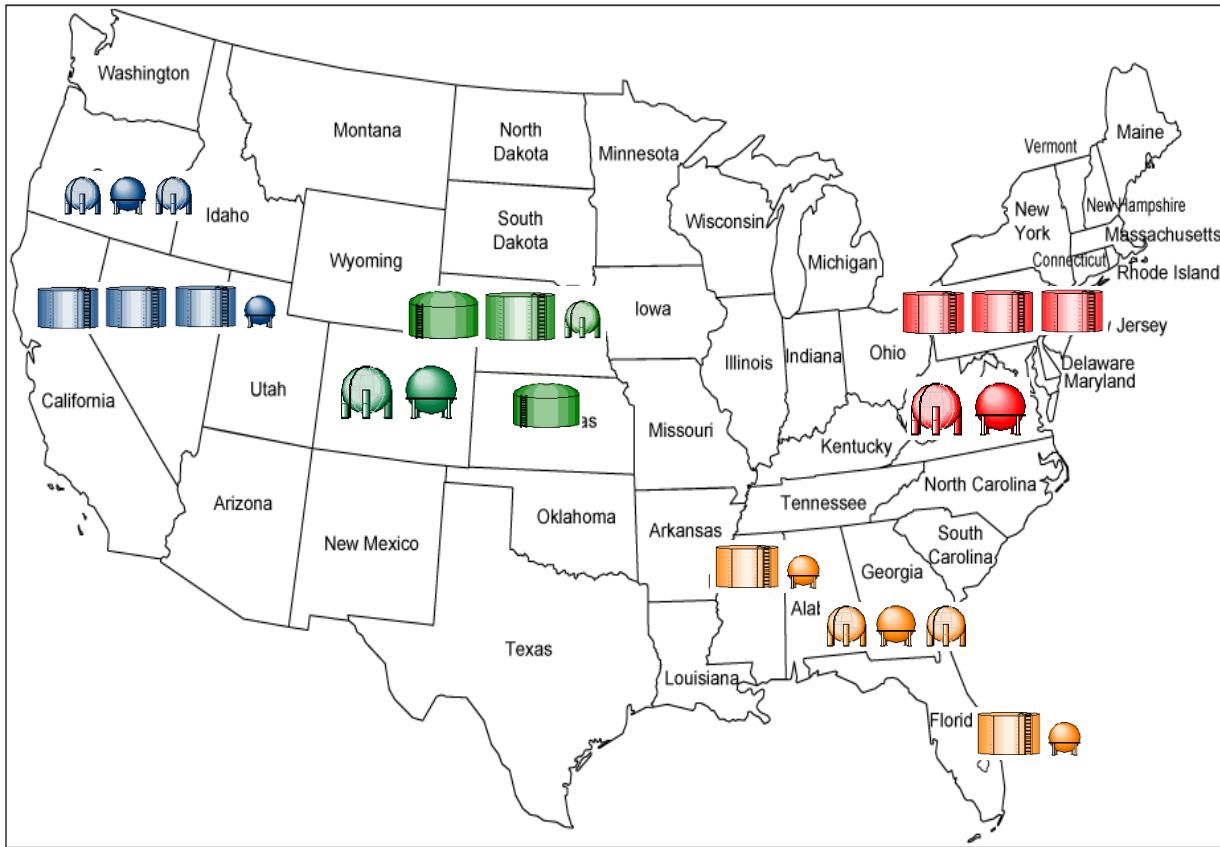


The screenshot shows the PI SQL Query Compendium application window. The menu bar includes File, Edit, View, Query, Debug, Tools, Window, and Help. The toolbar has icons for New Query, Execute, and various file operations. The title bar says "PI SQL Query Compendium - PISQLCommander (Administrator)". The main area has tabs for Object Explorer, Query, and Result. The Object Explorer shows a tree structure under Data Sources (AF Servers, FREITAGMNB, Catalogs, Configuration, Data, PI Servers) and PI Servers. The Catalogs node for FREITAGMNB contains Asset, Data, and System categories. The Asset category has Tables, Views, Location, and Functions sub-nodes. The Data category has Tables, Views, ProductInventory, Products, Volume, and Functions sub-nodes. The Result tab displays a query result grid:

	Tank ID	Product	Region
1	T-5	No. 6 Fuel Oil	Great Plains
2	RB-2-2	RS Soap Solution	Midwest
3	FT-10-1	AE-150 Emulsifie...	Midwest
4	AT-8-2	Ethanol	Midwest
5	AT-2	No. 6 Fuel Oil	Midwest
6	AA-2-9	Ethanol	Midwest
7	AA-2-4	Ethanol	Midwest
8	AA-1-8	93 Premium Conv...	Midwest
9	AA-1-5	84 Blend Grade ...	Midwest

Below the grid, the status bar shows "Query ex| FREITAGMNB (AF Server) | 00:00:01.752 | 103 rows".

# Business Context1: Product Inventories Profile



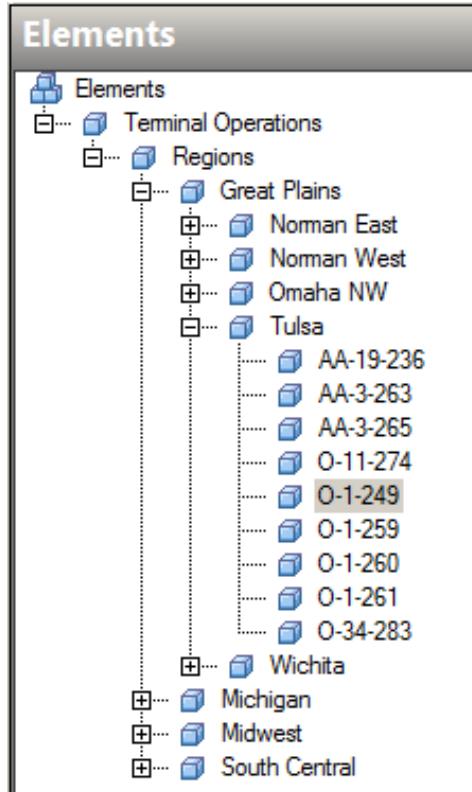
## My Objectives

- Product Inventory - aggregations
- Relate it to actual commodity prices
- ***Want to do it myself !***

# Business Context1: PI Asset Framework Structure

## Asset Hierarchy

- Region
- Refinery
- Tank

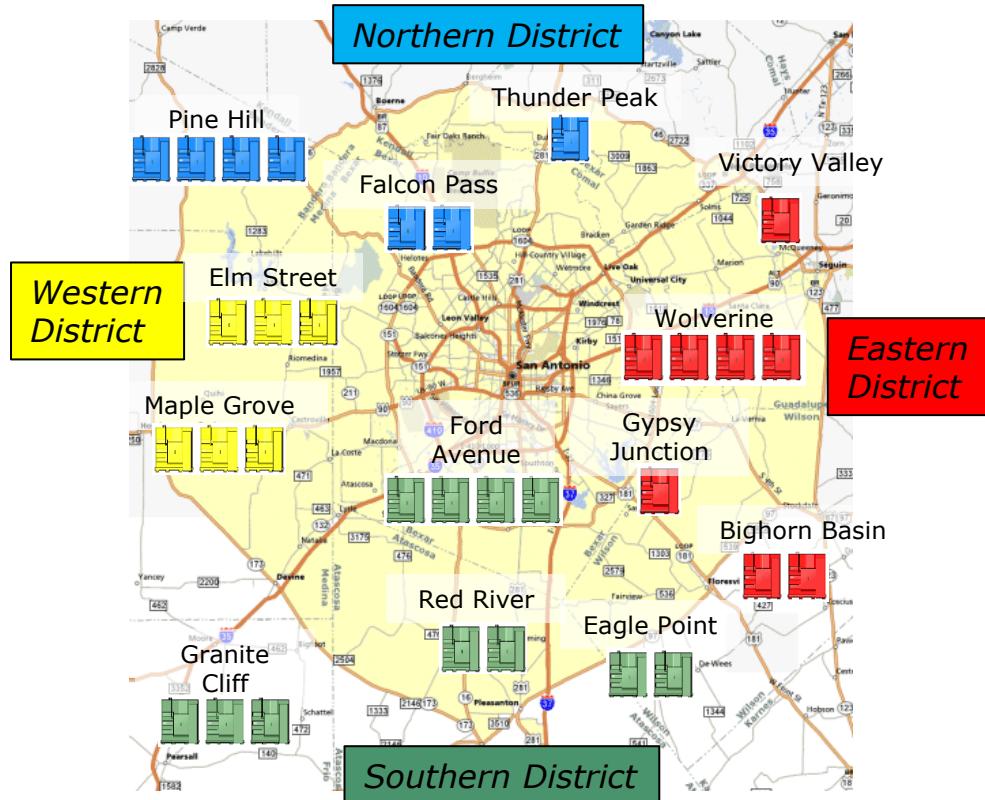


## Tank Attr.

- Equip. Spec.
- Actual and historical values

O-1-249														
General   Child Elements   Attributes   Ports   Version														
Filter														
<table border="1"><thead><tr><th></th><th>Name</th><th>Value</th></tr></thead><tbody><tr><td>Net Volume</td><td>5814.6552734375 bbl</td><td></td></tr><tr><td>Product</td><td>87 Regular Conventional</td><td></td></tr><tr><td>Product Group</td><td>Gasoline</td><td></td></tr></tbody></table>				Name	Value	Net Volume	5814.6552734375 bbl		Product	87 Regular Conventional		Product Group	Gasoline	
	Name	Value												
Net Volume	5814.6552734375 bbl													
Product	87 Regular Conventional													
Product Group	Gasoline													
Tank Specifications														
Asset ID	O-1-249													
Heel	2000 bbl													
Maximum	200000 bbl													
Nominal Volume	101000 bbl													
Range	198000													
Terminal	Tulsa													

# Business Context2: Substation Power Distr. Profile



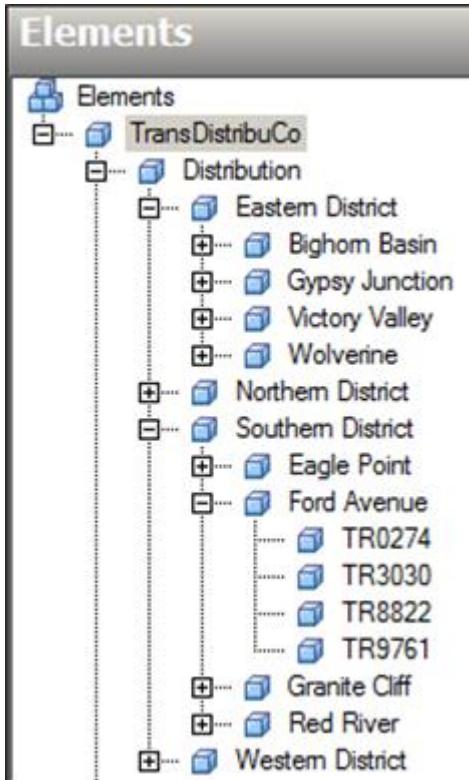
## My Objectives

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

# Business Context2: PI Asset Framework Structure

## Asset Hierarchy

- District
- Substation
- Transformer



## Transformer Attributes

- PI System Data
- Rich Equip. Spec.
- DGA analysis

TR0274		
	General	Child Elements
		Attributes
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

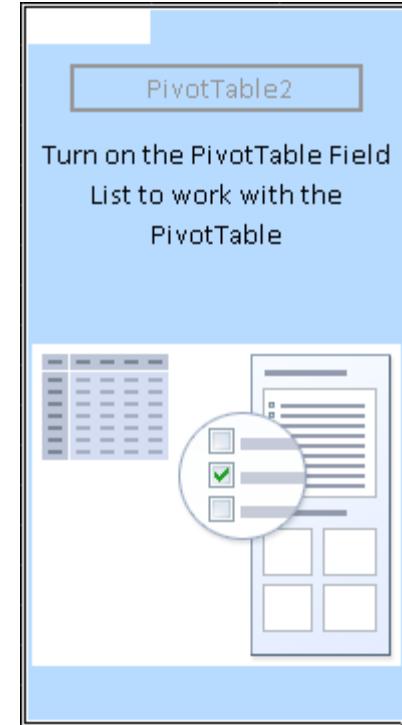
# Demo

## PowerPivots allow

- **Summarize and group** *raw, tabular* data
- *Categorical and Numeric* data in Excel
- *Contextual and Time Series* in PI

## Demo Environment

- Local PI Server with an AF Database representing oil inventories in various locations
- PI OLEDB Enterprise
- Excel 2010 with the PowerPivot AddIn



# SharePoint 2010 Enterprise – PowerView

Screenshot of a SharePoint 2010 site showing a PowerView dashboard titled "Regional Power Distribution - Past 30 Days".

The dashboard includes the following components:

- Distribution Profile:** A large section on the left containing:
  - A chart titled "Regional Power Distribution - Past 30 Days" showing "Regional Distribution, KWH" for Western, Northern, Eastern, and Southern Districts.
  - A chart titled "Substation Distribution, %" showing "Corp %" and "Regional %" for Bighorn Basin, Gypsy Junction, Victory Valley, and Wolverine substations.
  - A "Burner Performance" chart showing efficiency and power output for various burner types.
  - A "Transformer Age" chart showing the distribution of transformer ages across districts.
- Regional Distribution, KWH:** A bar chart showing regional power distribution in KWH for four districts: Western District (86.41K), Northern District (0.1M), Eastern District (0.13M), and Southern District (0.16M).
- Rate Distribution by Transformer Age:** A grouped bar chart showing rate distribution by transformer age range (a. Under 5 Years, b. 5 to 10 Years, c. 10 to 20 Years, d. 20 to 30 Years, e. Over 30 Years) across Peak, Off Peak, and Partial Peak times.
- Substation Distribution, %:** A bar chart showing the percentage distribution of substations by district: Eastern District, Northern District, Southern District, and Western District.
- Average Transformer Age, yrs:** A table showing the average transformer age in years for each substation.

# PowerView Reports in PowerPoint

Distribution Profile.rdx - Windows Internet Explorer  
http://74.217.101.216/\_layouts/ReportServer/AdHocReportDesigner.aspx?List=%7b42434F7A-2BC4-44CF-BE8D-00E0CB1D9A8B%7d

File Save Save As Print Export to PowerPoint Help

Power View

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

Diagnostics Sync diagnostic information with the server. Not synced during this session.

Regional Power Distribution - Past 30 Days

Substation Distribution - Past 30 Days

Transformer Age Distribution - Past 30 Days

Fields: Drag a field here

Done Trusted sites | Protected Mode: Off 100%

2

3

Power View Slides - Microsoft PowerPoint

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

Clipboard Slides Font Paragraph

1 2 3

Regional Power Distribution - Past 30 Days

Regional Distribution, KWH

Rate Distribution by Transformer Age, %

Substation Distribution, %

Average Daily Power, KWH

Power Distribution Profile - Past 30 Days

Regional Distribution by Weekday vs. Substation Temperature

Substation

Sunday Monday Tuesday Wednesday Thursday Friday Saturday

Average Daily Substation Temperature, F

Substation Transformer Condition and Benchmarking

Average Hourly Demand Profile, KWH

Condition Benchmark

Electrical Gas Analysis

Slide Sorter Office Theme

# Additional Information

## 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



Business Analytics with your PI System Data Using Microsoft PowerPivot

2011 OSIsoft T & D Users Group Meeting  
September 23, 2011, Philadelphia

Business Analytics with your PI System Data Using Microsoft PowerPivot  
2011 Chicago PI System Users Meeting Training  
September 23, 2011, Philadelphia

I. Overview  
The release of PI OLEDB Enterprise and Microsoft PowerPivot for Excel 2010 provide an exciting combination of new technologies supporting advanced data analysis for enterprise users. These include the ability to bring PI System data into Microsoft Excel for analysis to the benefit of every PI user's innovation within Microsoft Excel 2010. This document describes the steps needed to create an example PowerPivot report for analyzing substation power delivery. As we will see, PowerPivot offers many reporting and analytical features.

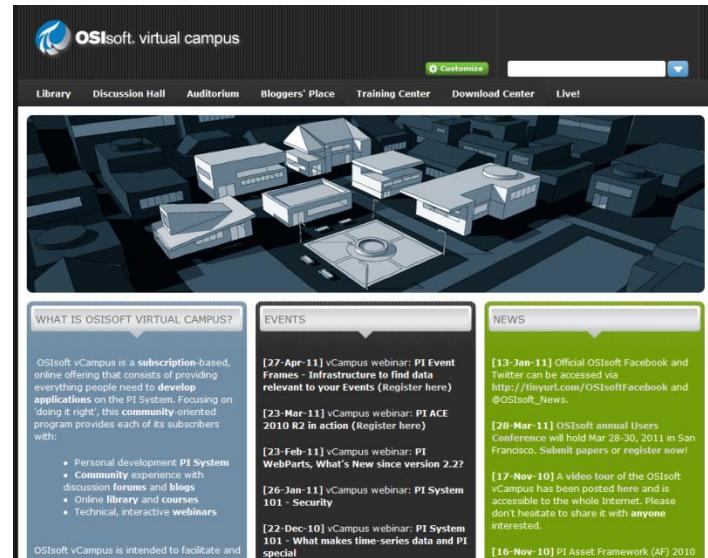
The document is organized in five sections. In section one, we describe the PI Asset Framework (AF) structure used to provide the contextual organization required to make the PI System data meaningful for multidimensional analysis. Next, the role of PI OLEDB Enterprise is discussed as the means of extracting PI System data in a tabular form, as datasets, that can be used by PowerPivot. Then, we will discuss how to use the PI OLEDB Enterprise API and PowerPivot to configure relationships between tables, to add calculated columns and calculated measures to the multidimensional data cube used for analysis. In section four, we will demonstrate how to use PowerPivot to create multidimensional reports and charts. Lastly, we will describe how PowerPivot reports developed in Excel 2010 can be posted in Microsoft SharePoint 2010 Enterprise to extend the analytical experience to others in the organization and across the business.

30 Day Substation Power Distribution Report

Regional Distribution by Weekday avg

# 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

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Week of November 26<sup>th</sup>  
Grand Hyatt Union Square, San Francisco

Martin Freitag

[Martin.Freitag@OSIsoft.com](mailto:Martin.Freitag@OSIsoft.com)

OSIsoft Senior Developer



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