2013
May 21

Aaron DeYonker – VP of Products – eMeter, A Siemens Company

AMI Data Management and Analysis

Lecture Overview

Bio

Aaron DeYonker brings more than 15 years of IT product development experience to eMeter, a Siemens business. Aaron manages the entire product portfolio and global roadmap for the leading Smart Grid software platform, geared towards more efficient use of our natural resources. As the VP of Products, he leads R&D teams across the world on eMeter's overall product strategy, design, engineering and usability to deliver a best-of-class enterprise platform and application suite for managing and using meter data. He serves as the primary representative for the eMeter product line, interacting with press, analysts, standards bodies, regulatory entities and user groups on a regular basis. He speaks at leading industry conferences. Aaron is proud to have achieved lead 'Visionary' status in Gartner Magic Quadrant 2 years in a row for eMeter's enterprise software platform. Prior to eMeter, Aaron led product and program management teams for companies such as Microsoft and WebTV in domains ranging from telecommunications to consumer electronics. He is a graduate of the Honors Program in the College of Literature, Sciences and Arts at the University of Michigan, Ann Arbor

Abstract

Investments in broader and more precise measurement of consumption by electric, gas, and water utilities in recent years have set the wheel turning on the largest industry transformation since its inception at the turn of the last century. Aging infrastructure, increased global demand, distributed generation sources, and environmental legacy… the driving factors may vary but remain comprehensively global in the need for better measurement at the consumption end-point. After a decade-long focus on network build out and smart meter (read: "sensor") installation, the data has finally started flowing. This lecture will address the state of the industry as it relates to Advanced Metering Infrastructure as it heads into Wave 2 of its immense transformation. What practical and theoretical challenges do utilities face as they struggle to make sense of new data sets? What opportunities arise for service providers? How will innovation and faster R&D cycles lead to unprecedented business transformation within the organizations? How will the geo-political landscape help/hinder momentum? This lecture serves as a broad and critical assessment of the state of AMI.

All you need to know about Aaron

- Product Manager at core
- 12 Years in Consumer Internet/Electronics/Entertainment Technology and Gaming
- 4 years in Mission Critical Enterprise Software for Electric/Gas/Water Utilities
  - (?!!!)
- Certified “Engineer Whisperer”
- Strong promoter of Agile Software Development

Today

I provide:

- Brief context setting of Siemens and Smart Grid
- Overview of eMeter and AMI (Advanced Metering Infrastructure)
- Observations on the industry
- Operational insight into what’s happening with AMI data

You walk away with:

- Better sense of the business of the Utility
- What’s actually happening operationally with utilities
- Some key gaps that need some mindshare from smart people
- A sense of the challenges facing the “Vision of the Smart Grid”

Siemens Sectors and Divisions

Energy

Divisions

- Fossil Power Generation
- Wind Power
- Solar & Hydro
- Oil & Gas
- Energy Service
- Power Transmission

Healthcare

Divisions

- Imaging & Therapy Systems
- Clinical Products
- Diagnostics
- Customer Solutions

Industry

Divisions

- Industry Automation
- Drive Technologies
- Customer Services

Infrastructures & Cities

Divisions

- Rail Systems
- Mobility and Logistics
- Low and Medium Voltage
- Smart Grid
- Building Technologies

The Problems

Challenges in changing energy systems

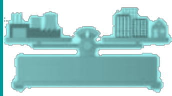
- Renewable and distributed generation
- Limited generation and grid capacity
- Aging and/or weak infrastructure
- Cost and emissions of energy supply
- Revenue losses, e.g. non-technical losses

SIEMENS

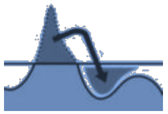
The Solutions

Smart Grid Solutions

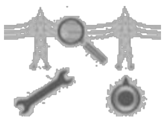
Balancing generation & demand, new business models



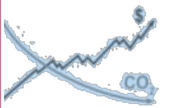
Load management & peak avoidance



Reliability through automatic outage pre-vention and restoration



Efficient generation, transmission, distri-bution & consumption



Full transparency on distribution level and automated loss prevention

What is AMI?

Advanced Metering Infrastructure components:

- Smart Meters
- Communication Networks
- Data Processing and Delivery

What does it mean?

What is AMI?

Advanced Metering Infrastructure components:

- Smart Meters
- Communication Networks
- Data Processing and Delivery

What does it mean?

We finally measure end-point consumption at a frequency that gets us closer to a true ‘sensor’ network for distribution of energy/water

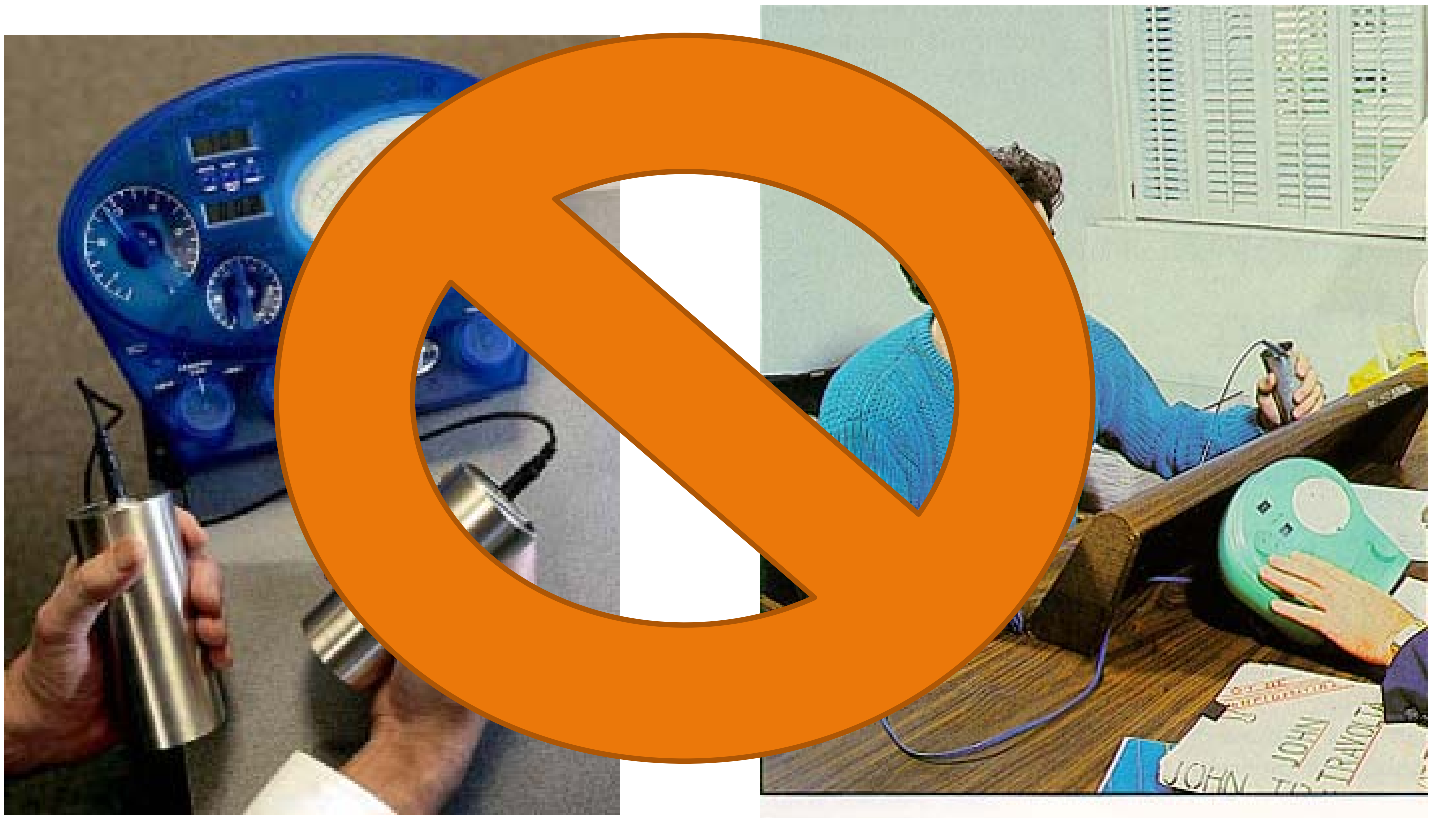
What is eMeter?

SIEMENS

What is eMeter?

John Travolta - Actor, OT III, currently on his False Purpose Rundown counselling.

What is eMeter?



John Travolta - Actor, OT III, currently on his False Purpose Rundown counselling.

What is eMeter?

eMeter supplies a data integration platform (EnergyIP®) for electric, gas and water utilities to collect and process consumption data from AMI systems.

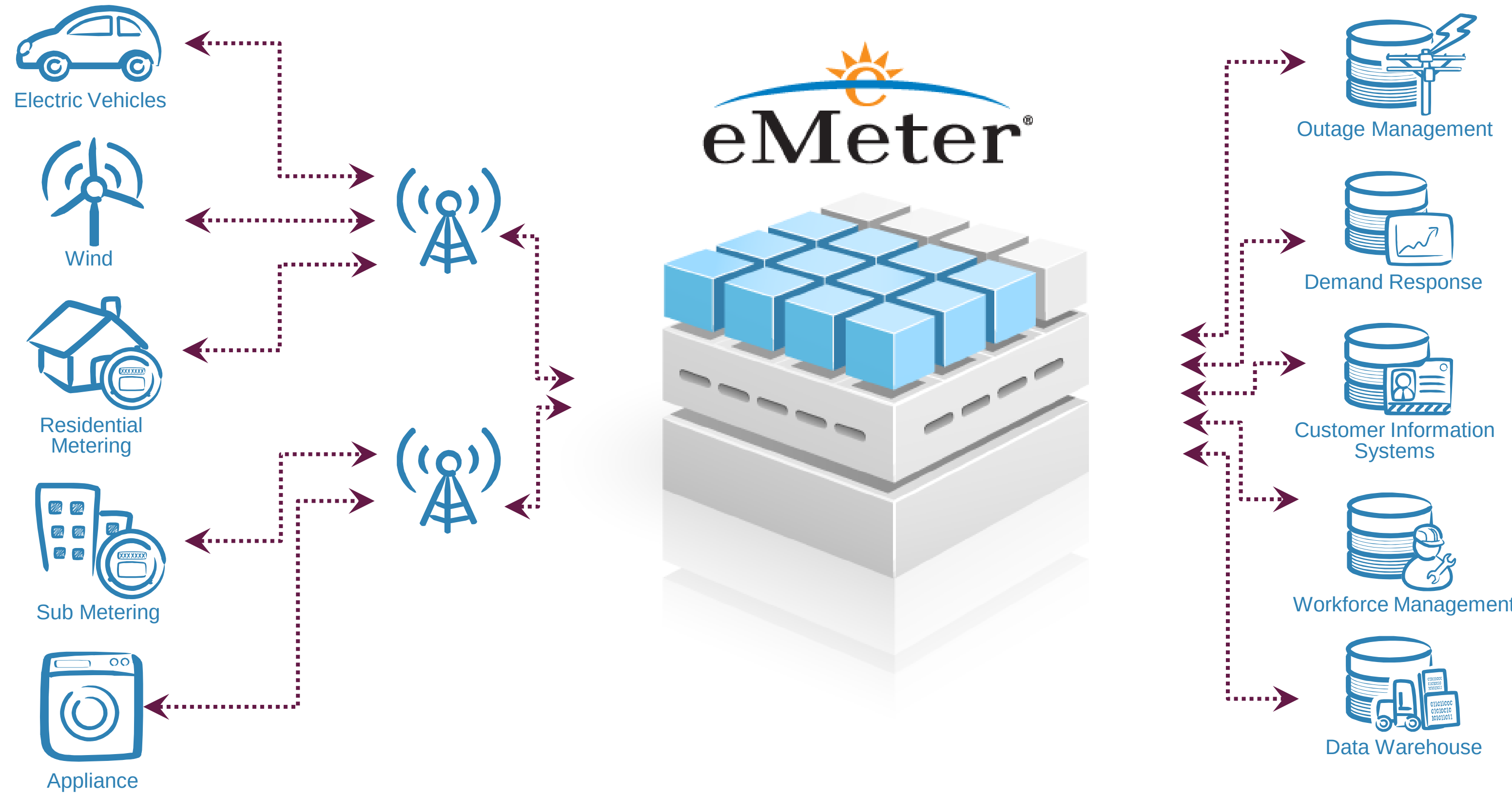
- The EnergyIP repository is the "Source of Truth" for revenue-grade consumption data within the utility.
- The platform also manages complex relationships between consumption data and accounts/devices/services/

The platform makes revenue-grade data available to:

- All enterprise and operational systems within the utility
- Consumers
- Authorized service providers outside the utility.

eMeter also creates applications built on top of the platform to solve business problems not addressed by legacy enterprise systems.

AMI/Enterprise Integration Landscape



Application Example: Consumer Presentment

Today’s Practical Business Value

Register Billing

Interval Billing

Consumer Data Access

Remote Connect Disconnect

Automated Market Settlements

Outage Event Management

Customer Service Tools

Prepayment Support

Network Loss Management

Analytics

Warning:

Obligatory Marketing Slides Approaching

eMeter – Proven Worldwide

Kansas City Board of Public Utilities
KCP&L energizing life
toronto hydro electric system
SaskPower
eandis
infrax
Salzburg AG
Black Hills Corporation
LIPA Long Island Power Authority
Central Vermont Public Service
ieso Power to Ontario. On Demand.
EnBW
VATTENFALL
umetriq
Westar Energy
City of Fort Collins
npower
NRGi Altid til stede
FirstEnergy
WPPI energy
ANAHEIM
ALLIANT ENERGY
EDeMa
City of Burbank Water and Power
Silicon Valley Power
SP AusNet
ITRI
CenterPoint Energy
Wabash Valley Power
SMECO Southern Maryland Electric Cooperative
City of Princeton Illinois
Vector
essential energy
cps ENERGY
Bluebonnet
JEA
OUC The Reliable One

Partnering for Success

Enterprise Applications

Convergys — Outthinking Outdoing
IBM
Intergraph
Oracle
SAP
TailorMade

Managed Services

verizon

AMI Providers

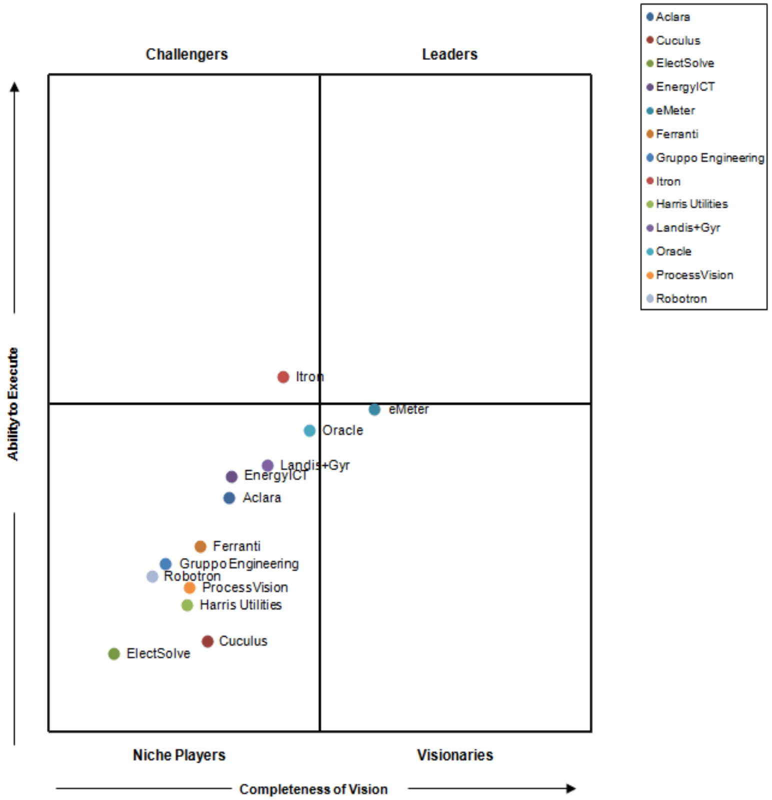
Aclara
Badger Meter
Echelon
EDMI
eka systems
elster
Iskra — Iskra MIS, d.d.
IskraEmeco
Itron
Landis+Gyr
Sensus Metering Systems
SilverSpring Networks
SmartSynch
Trilliant Networks

SI's & Resellers

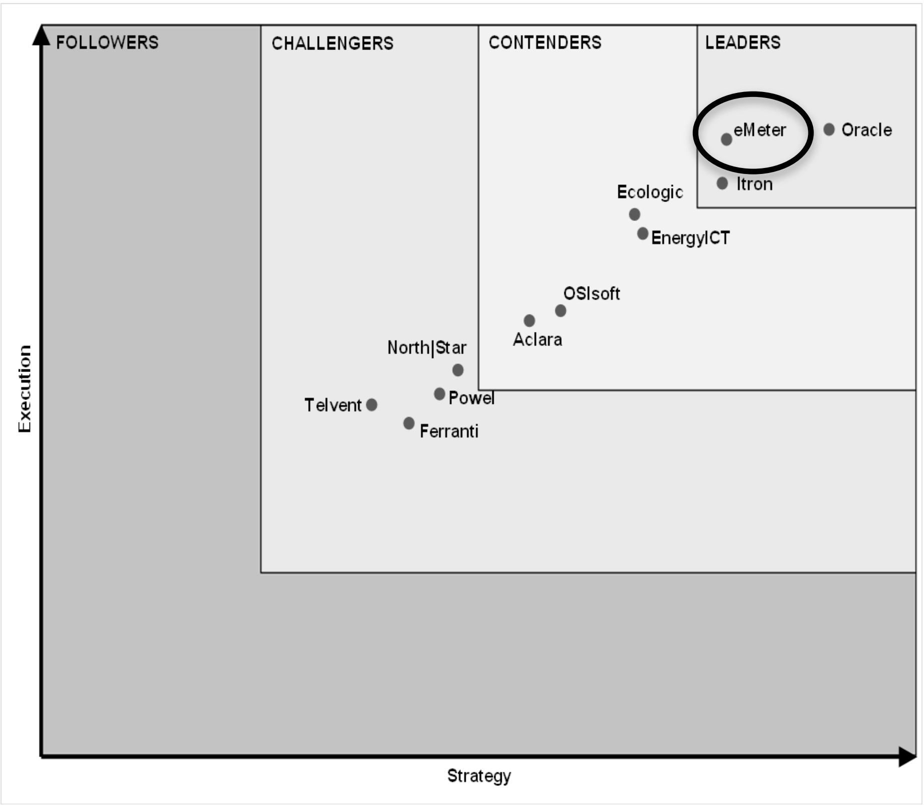
acando
accenture
CSC
ciber
Eltel
ELO
HCL
enspiria solutions
IBM
HD Supply
Samsung
Siemens
Sky Energy Consulting
UISOL
Wipro — Applying Thought

Industry Recognition

Gartner December, 2012 Magic Quadrant for Meter Data Management Products



2011 Pike Pulse Report: Meter Data Management



SIEMENS

No more marketing slides!

SIEMENS

Key challenges in the 'Utility' Industry

"Typical" Smart Grid talking points…

- Carbon emissions
- Aging Infrastructure
- Peak load reduction imperatives
- Data Privacy
- Etc…

Less talked about…*

- Increasing occurrence of abnormal weather events
- Decrease in customer satisfaction
- Aging work force
- Lack of sophisticated IT staff
  - Over dependence on integrators = Spaghetti architecture
  - Asset management – where are the Transformers?!
- Firewalls between the Grid and Back-office teams
- Death grip on customer data
- Odd market forces
  - Regulatory uncertainty
  - Energy price volatility
  - Developing world electrification
- Lack of competence for Usability/User Experience

*Source = Aaron's head

Global policy summary

Policymakers common vision of Smart Grid benefits:

- Society
  - **Financial savings and higher reliability** via improved load factor and system efficiency
  - Faster and wider adoption of **renewable energy and electric vehicles**
  - **Primary policy tool to achieve policy goals** of reliable supply, energy savings, renewable portfolio standards, and emission reductions
- Energy consumers – empowerment “triad”
  - Access to detailed **energy information**
  - Voluntary **time-based pricing options**
  - Widespread availability of **automated appliances and devices**

Typical policy measures

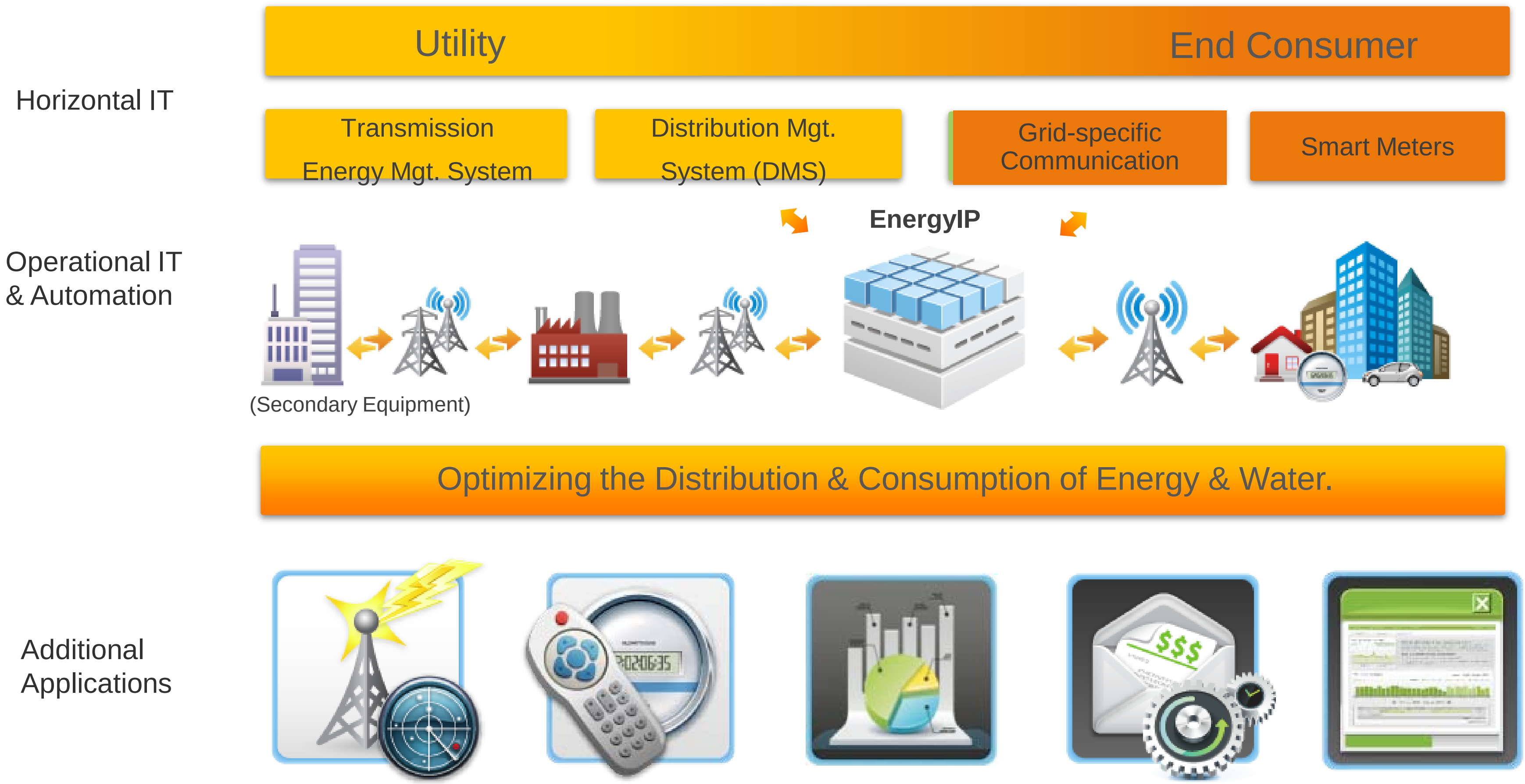
- Installation targets – e.g., 80% of meters in European Union by 2020, 100% by 2022
- Meter functionality – two-way communications, interval data, daily reads, HAN interface, disconnect switch, voltage & outage alerts
- Regulators promote but not mandate standards
- Central data hub in some jurisdictions

Biggest industry speed bumps

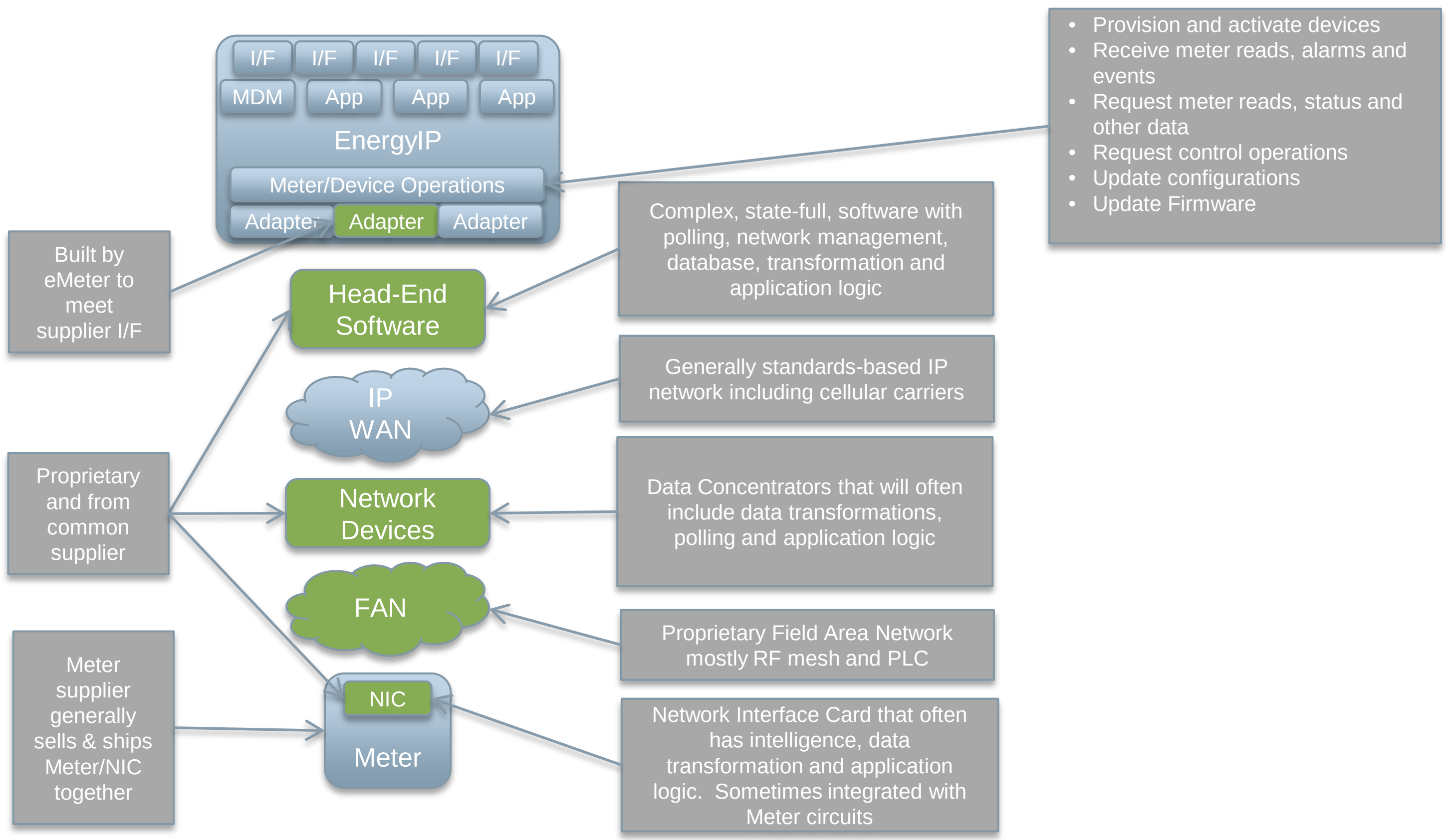
- Deregulation/Re-regulation/Re-deregulation 1990’s/early 2000’s
- Financial Crisis 2008
- U.S. Stimulus program 2009-2010
- Pending: Drilling technology

Data is (always) at core of Smart Grid Value Proposition

SIEMENS



Today’s Solutions Pattern



SIEMENS

Performance Mandates

Meter reading:

- Volumes!
  - 50 million meters, 30 minute intervals, 1 day of data = 2.4 billion intervals
- Cleansing!
  - Processing through VEE, framing, etc. in 6-8 hours, which equates to 300-400 million records per hour, or about 100k intervals/second
  - 2 percent estimation, or 1 million meter days, 48 million intervals, processed during that same 6-8 hours. Estimations are historical based on 30 days of interval data

Billing:

- Calculating billing determinants for 10% of the population (a double day – would otherwise be 5%), or 5 million meters
- Summing daily usage for each meter, running about 650 requests/second

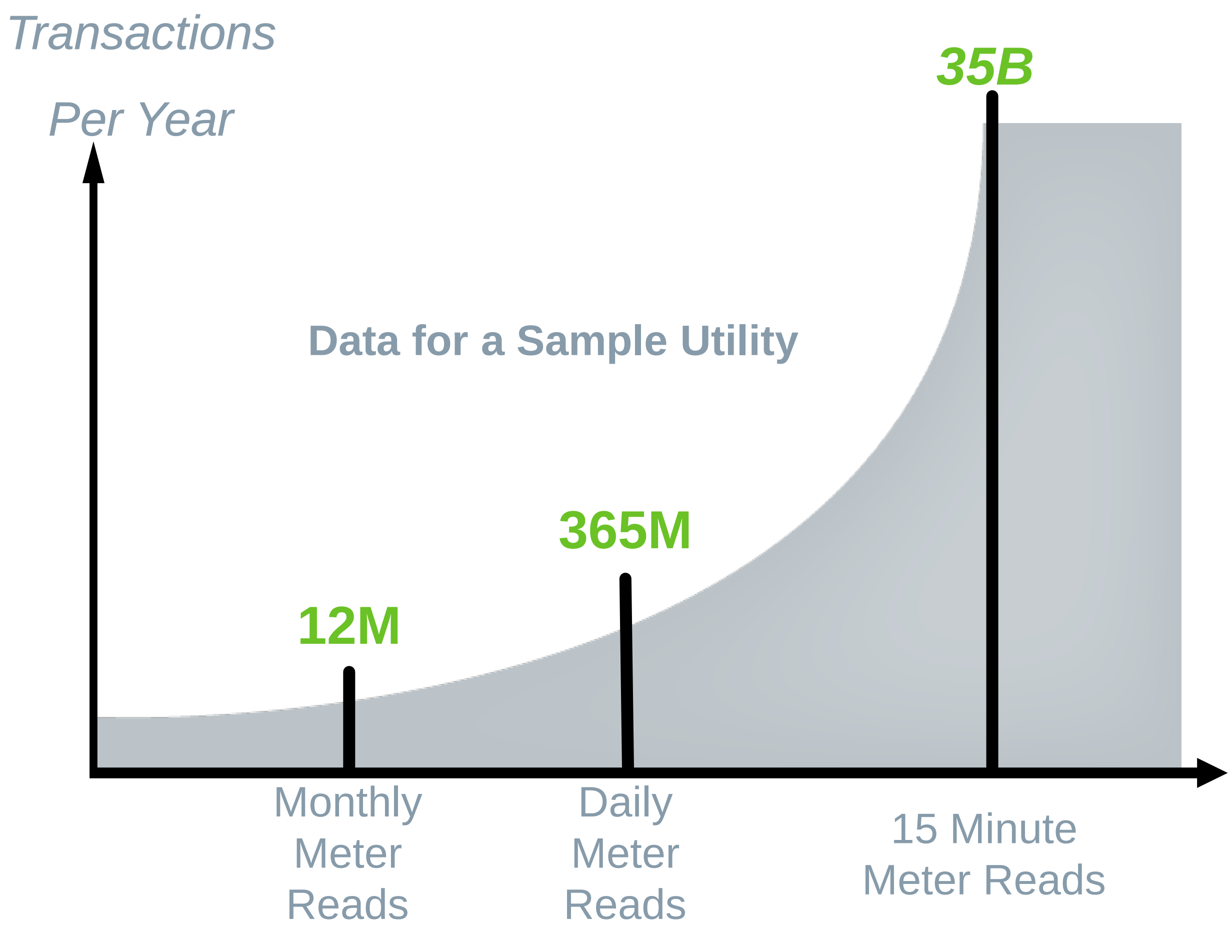
Environment:

- 4 apps servers, each with 80 cores, although so far we've only been using a little more than half
- We are using 2 database server nodes, 16 cores on each

Message Payload:

- 10k for a Tibco message with 1 day of 30 minute interval data. A lot of it is the XML tag names if someone wants to know why it's so big.

Utilities have a data growth problem



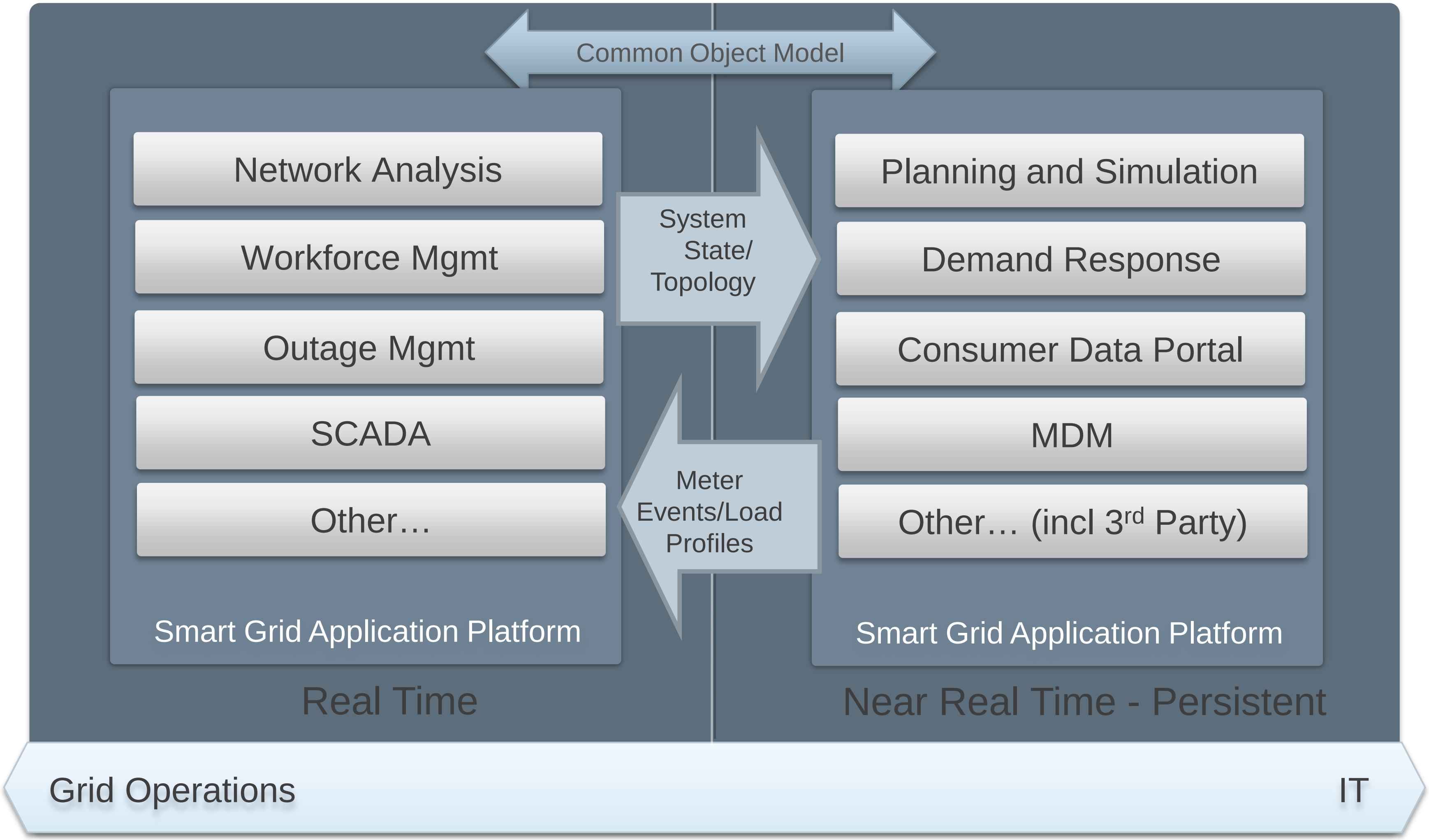
Data Multipliers

* No of copies of production db

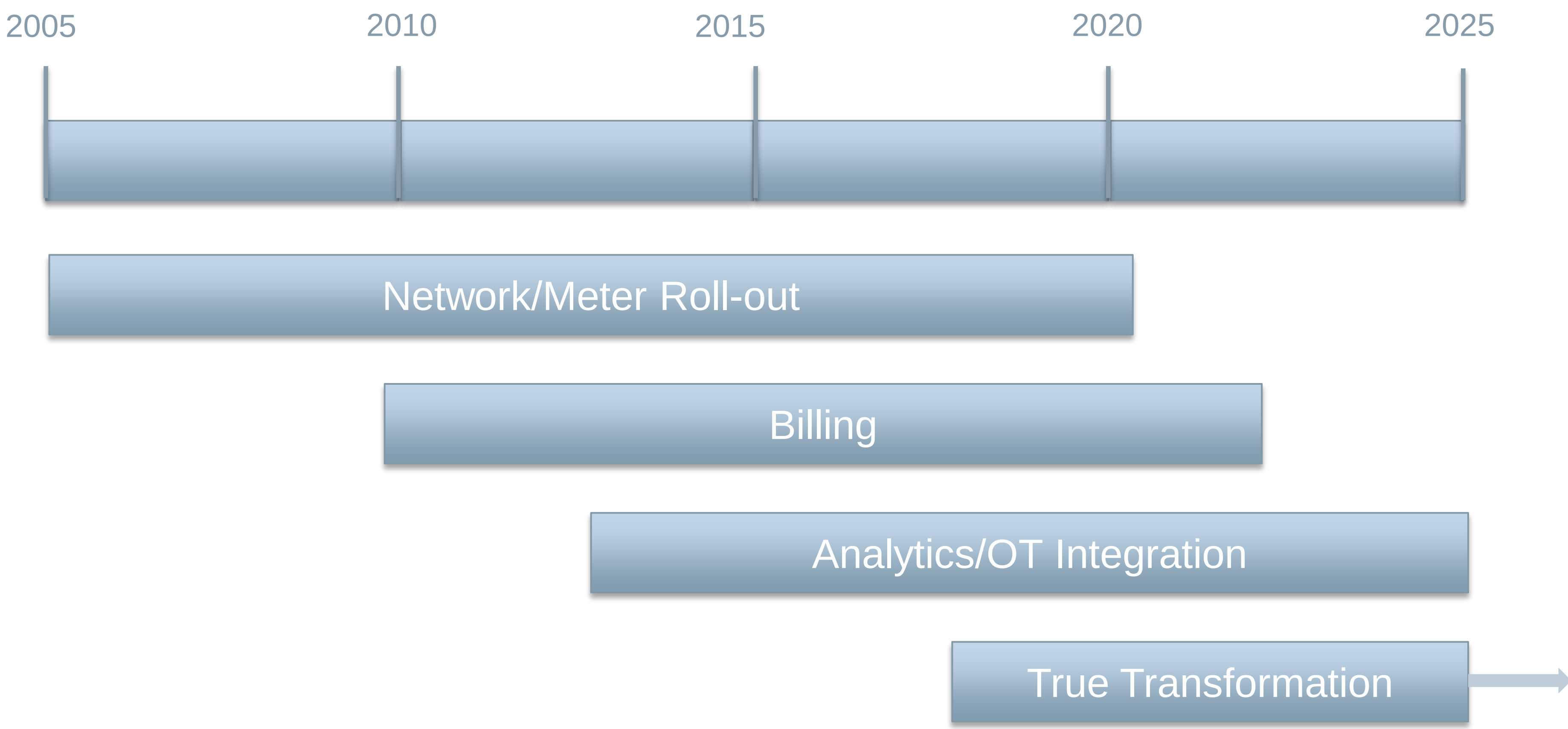
* No of channels in use

* No of applications using the data – example Analytics, Settlements

Breaking Silos

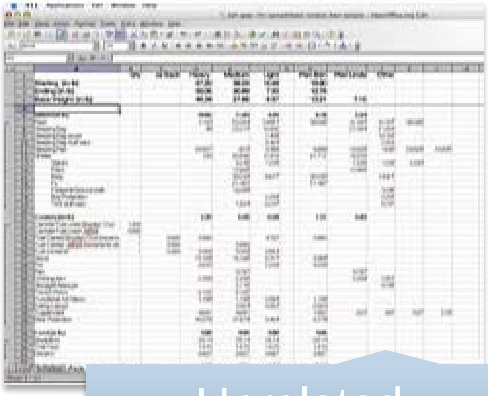


Mindshare Timeline



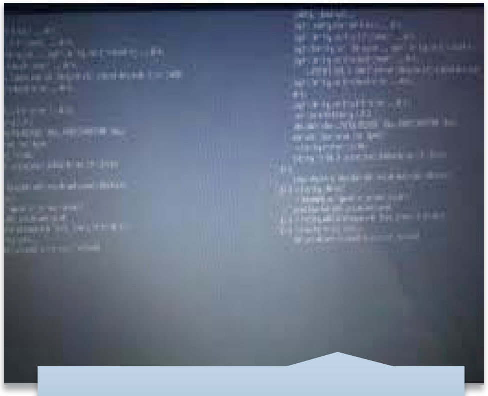
*Source: Aaron's Head

Analysts Challenges

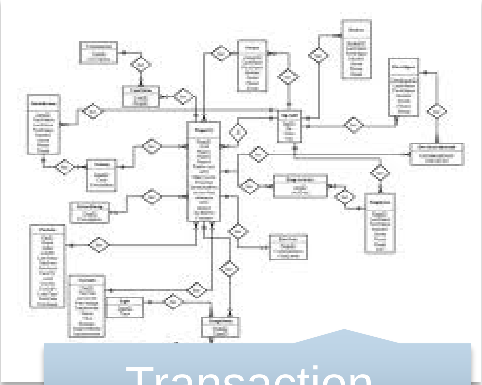


Unrelated Spreadsheets

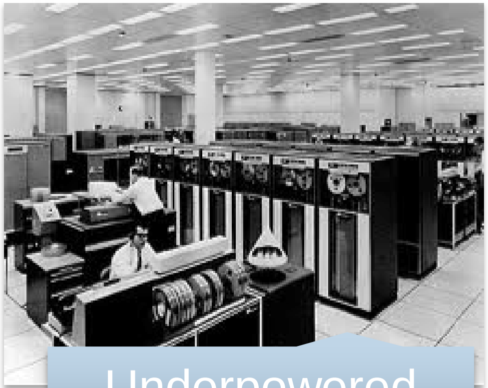
Data Ownership & Silos



Legacy Databases



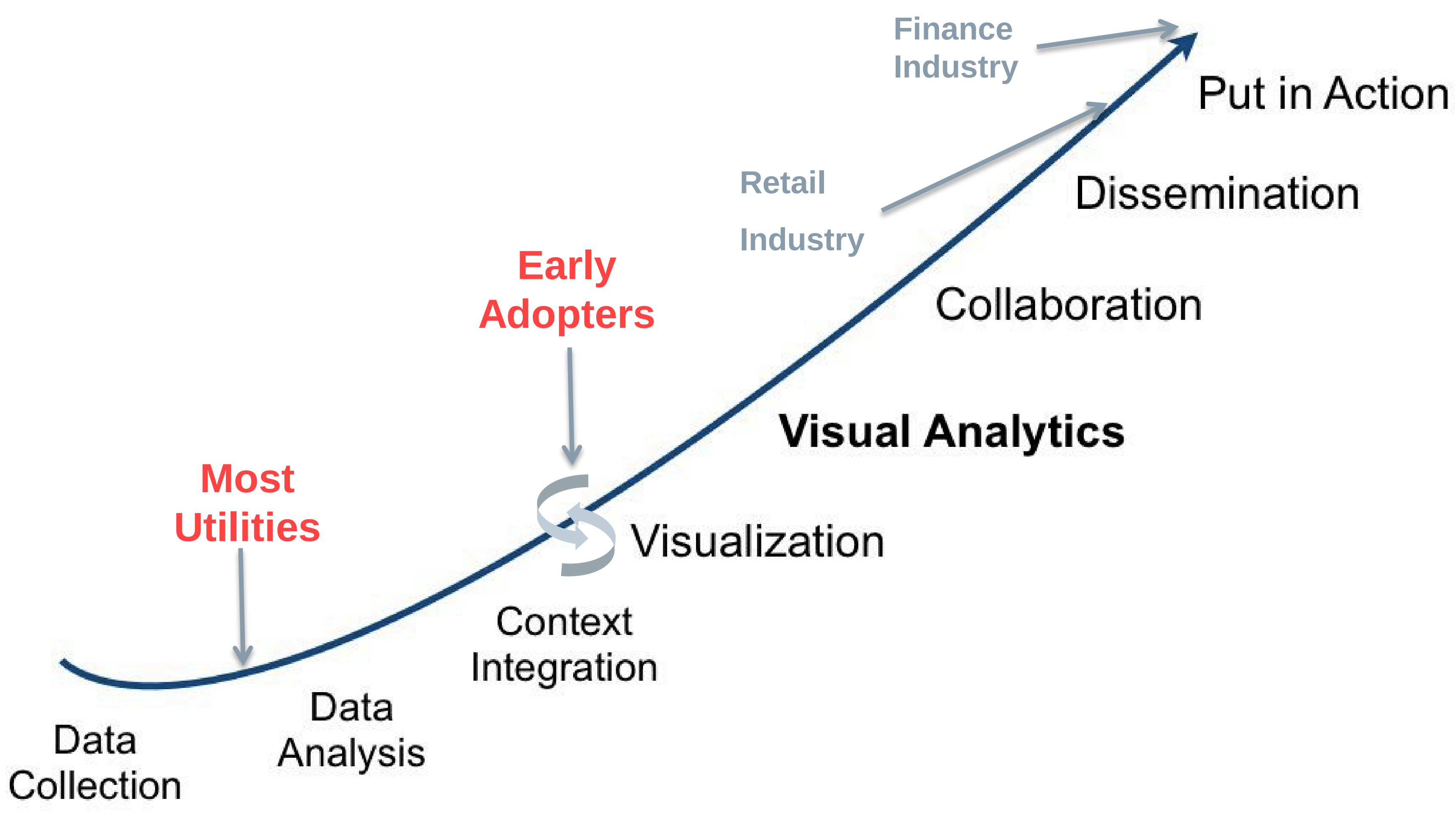
Transaction-Based Schemas



Underpowered Environments

Production Data Lockout

Utilities Access to Data




Trust
Assured reliance
confidence or faith is
the truth, worth,
dependence on
belief in the honesty,

Establishing Trust

1. Reliable Measurement and Collection
2. Ease of Access for Business Users
3. Efficient Feedback Loops

We all agree on use cases…

How can we deeply understand so many individual consumers?

Where am I losing Revenue to theft & network loss?

Who am I lending to, and how much?

How can I reduce peak loads profitably?

Is my AMI system performing as promised?

What investments make the biggest SAIDI/SAIFI impacts?

We don’t agree on everything…

- Which team owns the data? IT or OT?
- What is the end-to-end system architecture and data governance policy?
- How many copies of the data exist?
  - Is there a massive omniscient enterprise data warehouse?
  - If multiple copies, how often is it sync’d across systems? (Billing, Customer Service, Outage, DRMS)
- Who has access to the data?
- What skills do I need to hire to analyze data?
- When do I use powerful ad-hoc reporting tools versus an Analytics application (that solves a particular business problem)?
- What can be done in the cloud?
- How do I integrate analytics output into day-to-day operations?
- When can I have automated decision making on output?

Can we better understand our consumers?

Consumer Analytics

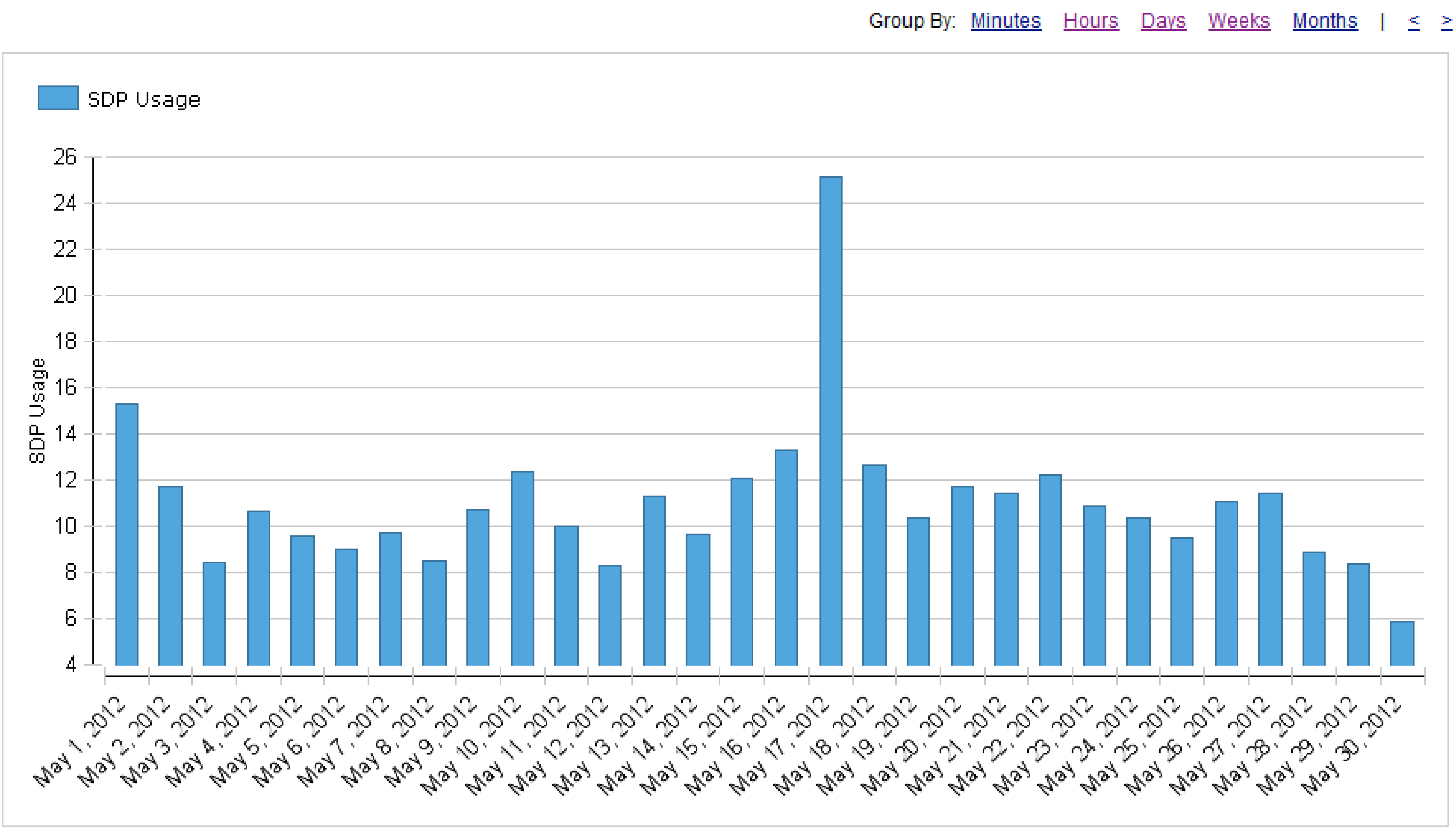
Methods:

- **Baselining:** Understanding patterns in consumer behavior
- **Profiling**: Modeling consumer demographics, psychographics, and behaviors
- **Segmentation**: Grouping customers for ‘what if’ and predictive analytics

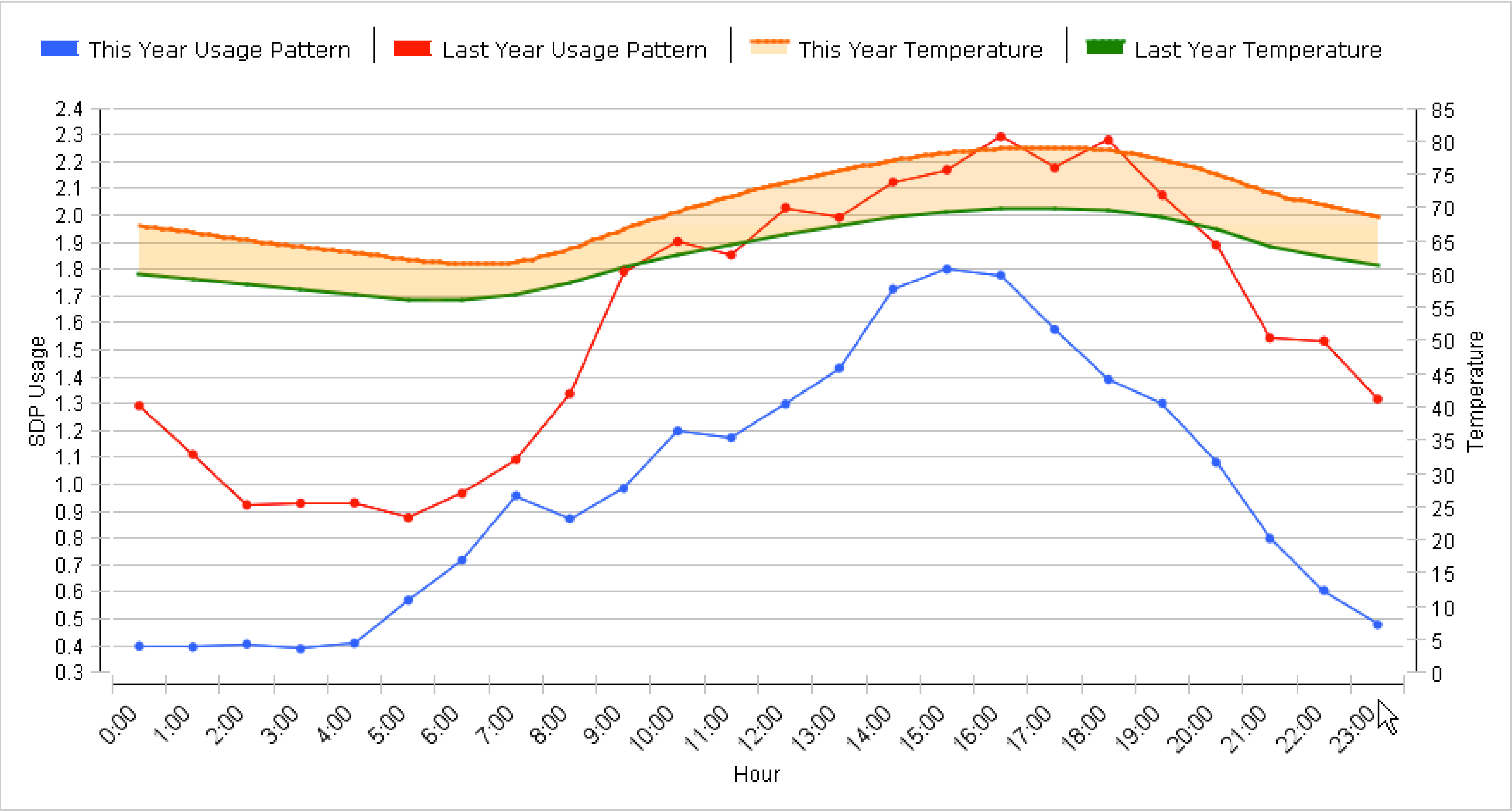
Benefits:

- **Understand** new program impacts on consumers & utility
- **Identify** lost revenue from theft or billing problems
- **Market** to best customers for new programs
- **Adjust** to customers changing behavior

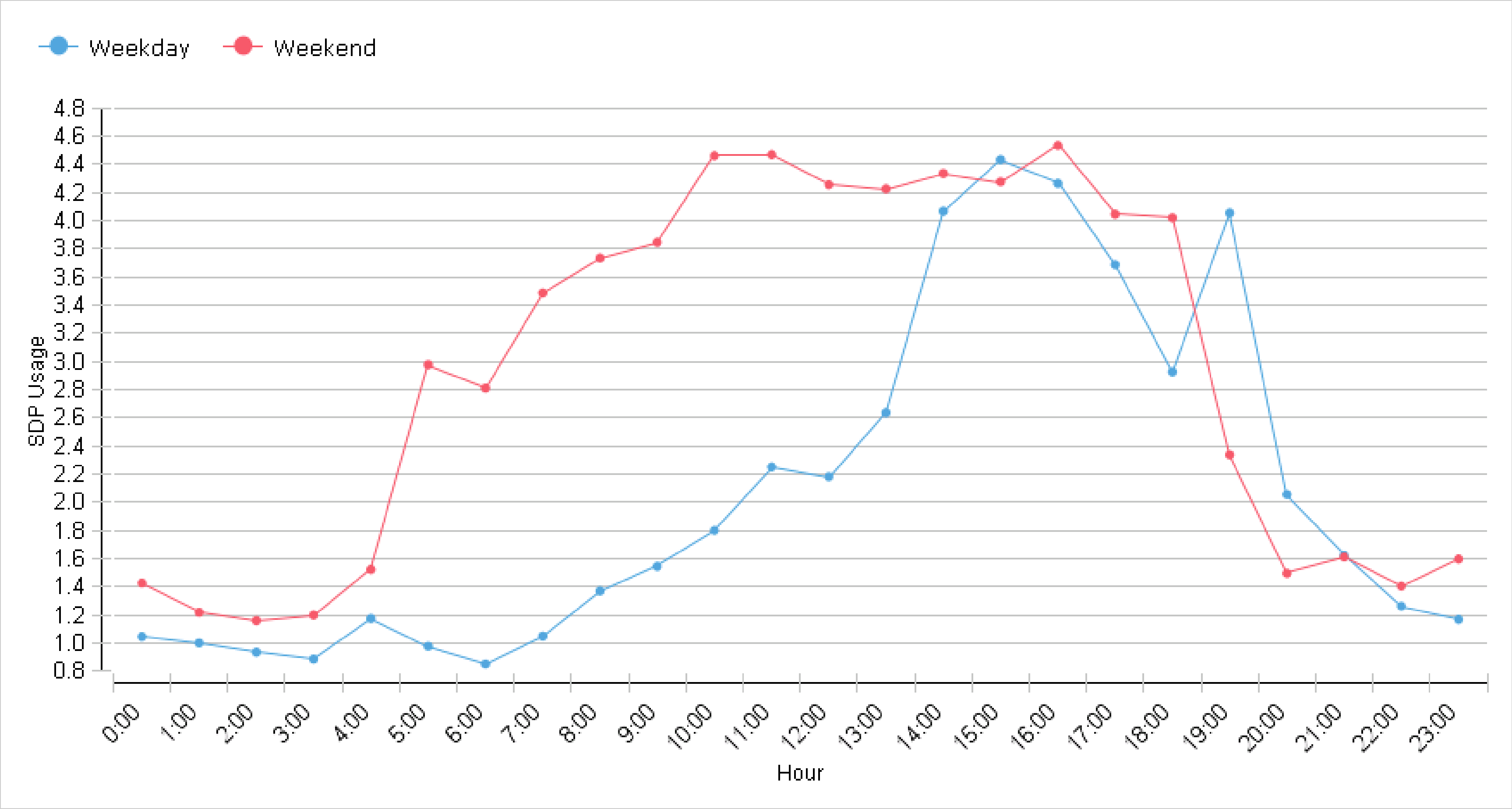
Baselining Individuals



Baselining Individuals (cont.)

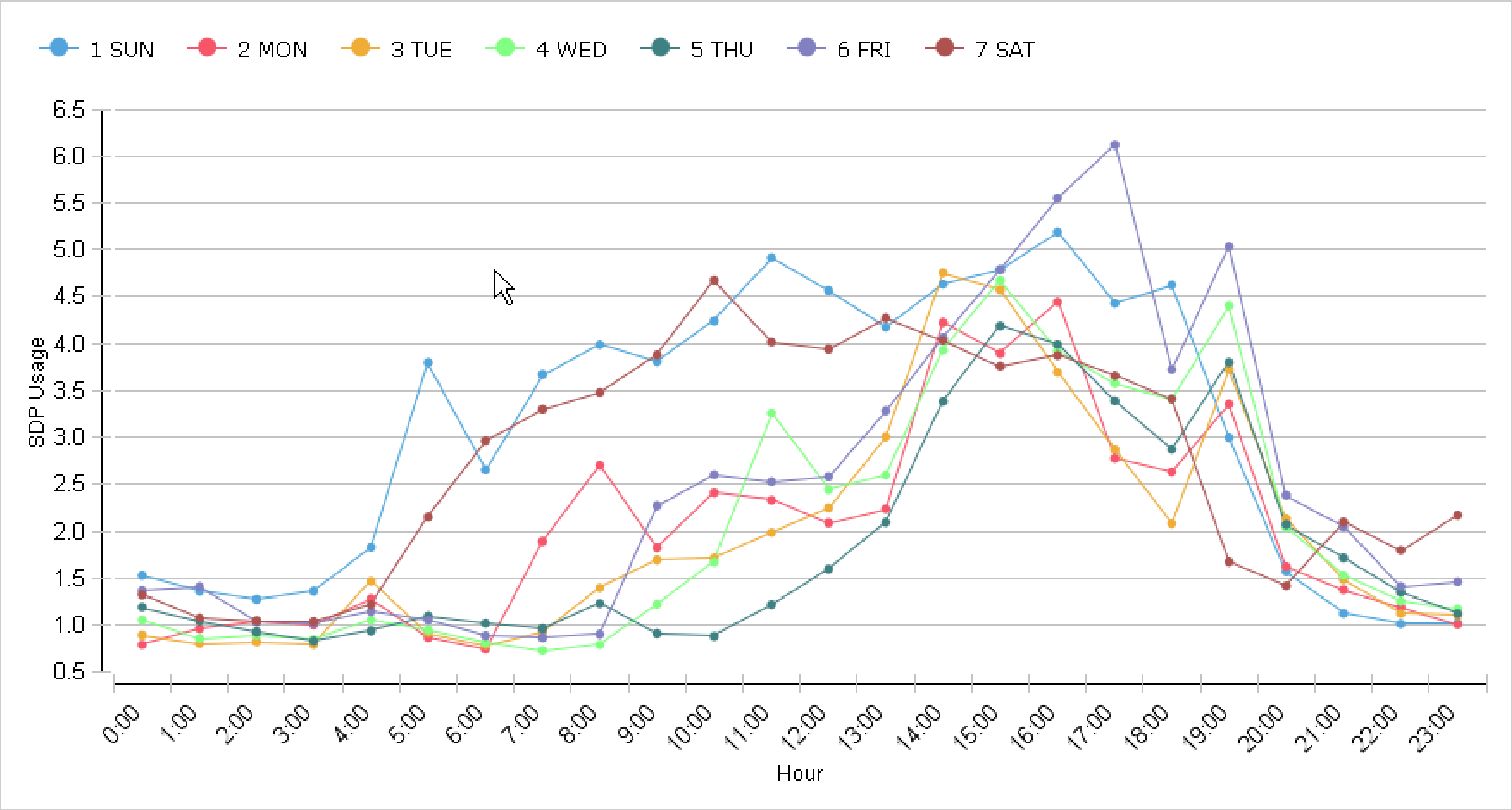


Baselining Individuals (cont.)



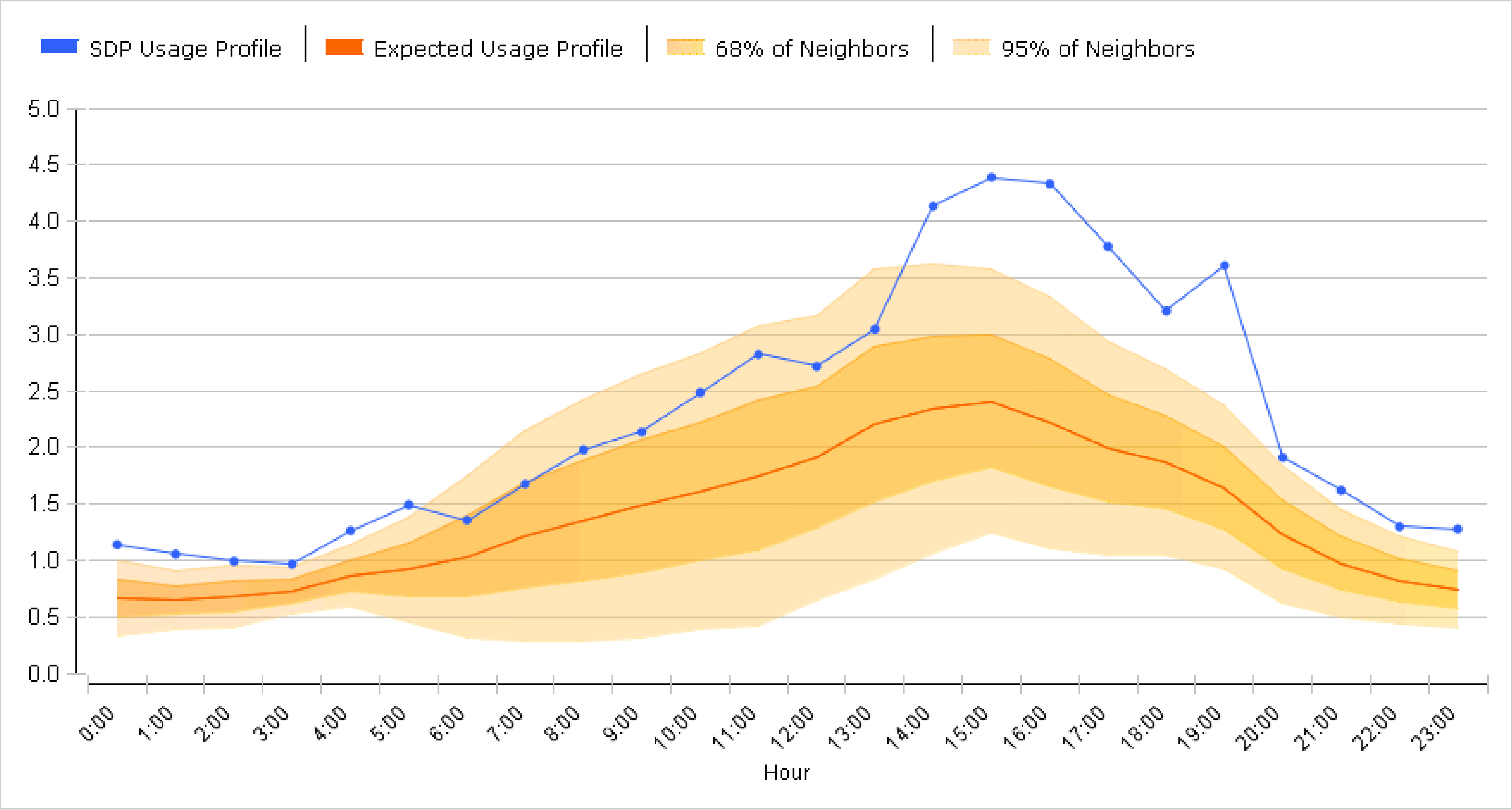
SIEMENS

Baselining Individuals (cont.)

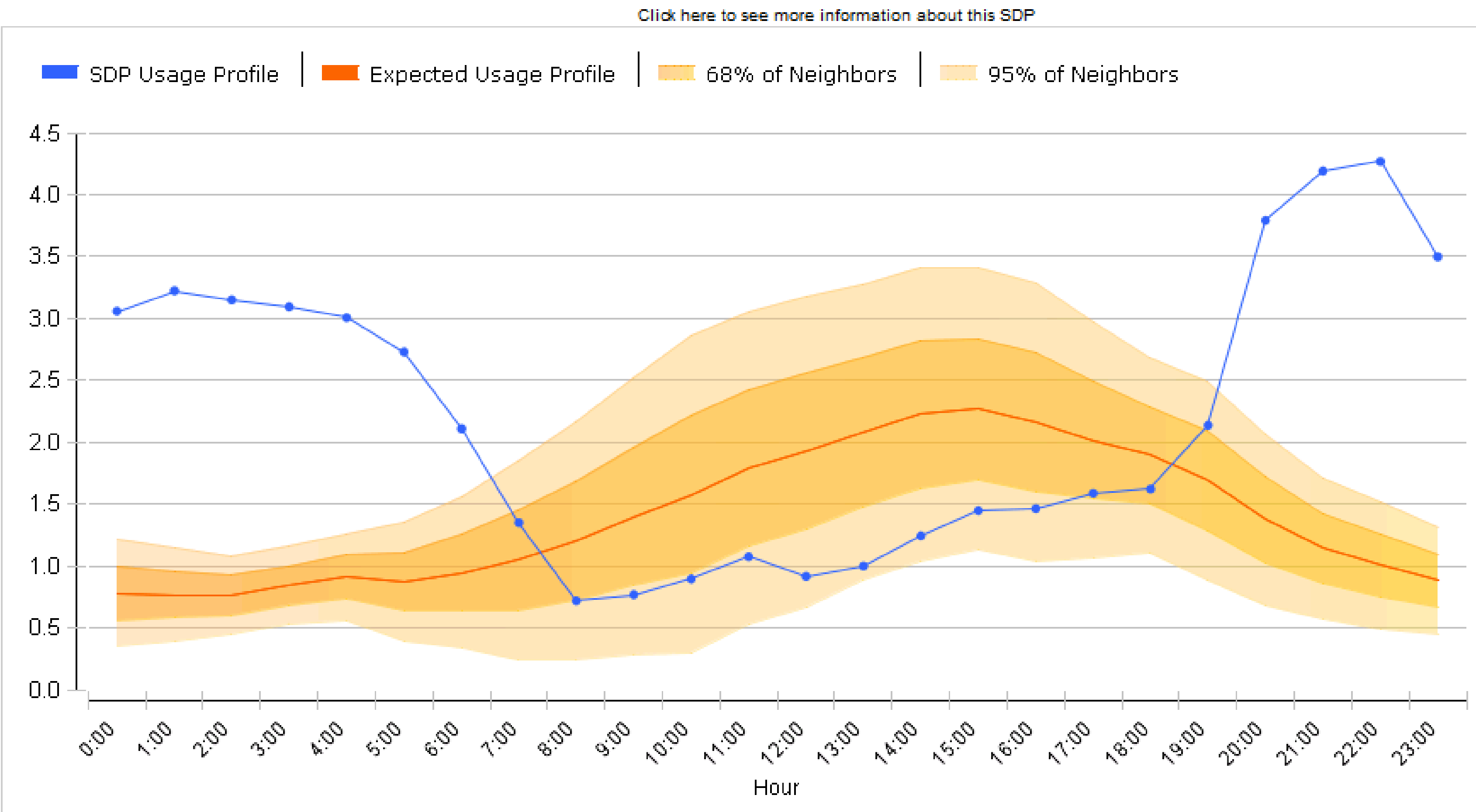


Profiling Load Patterns

Click here to see more information about this SDP

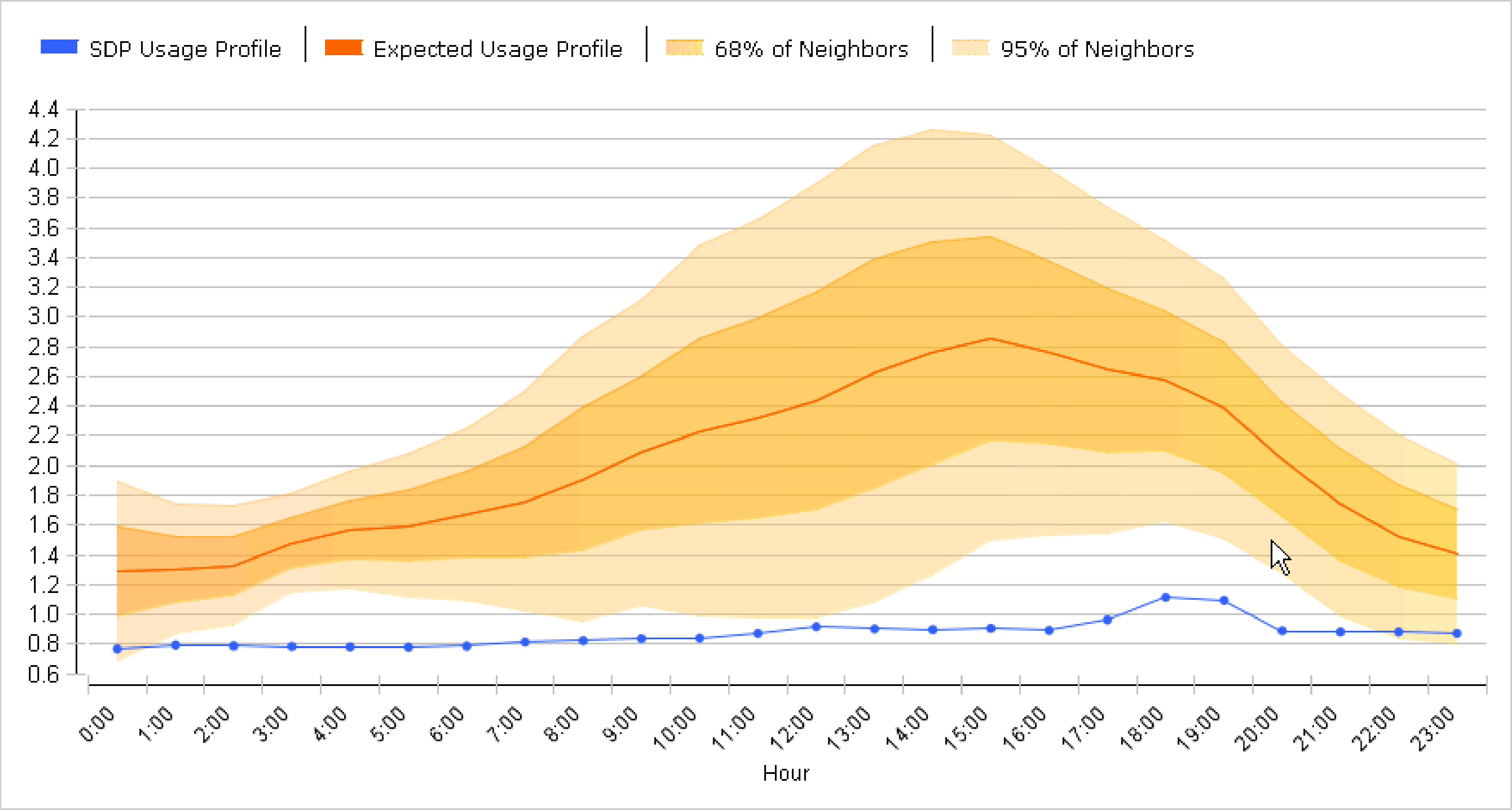


Profiling Load Patterns (cont.)



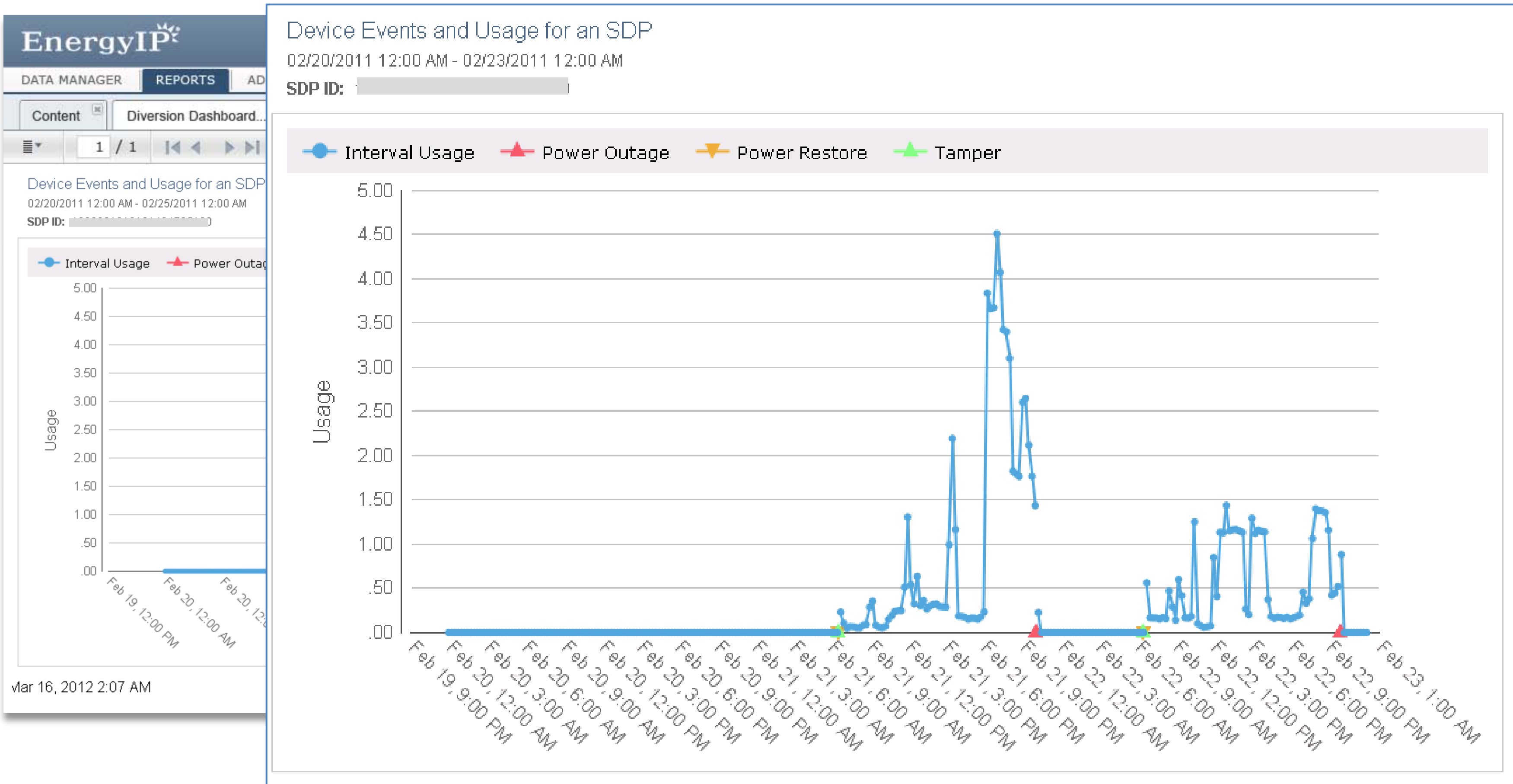
SIEMENS

Profiling Load Patterns (cont.)



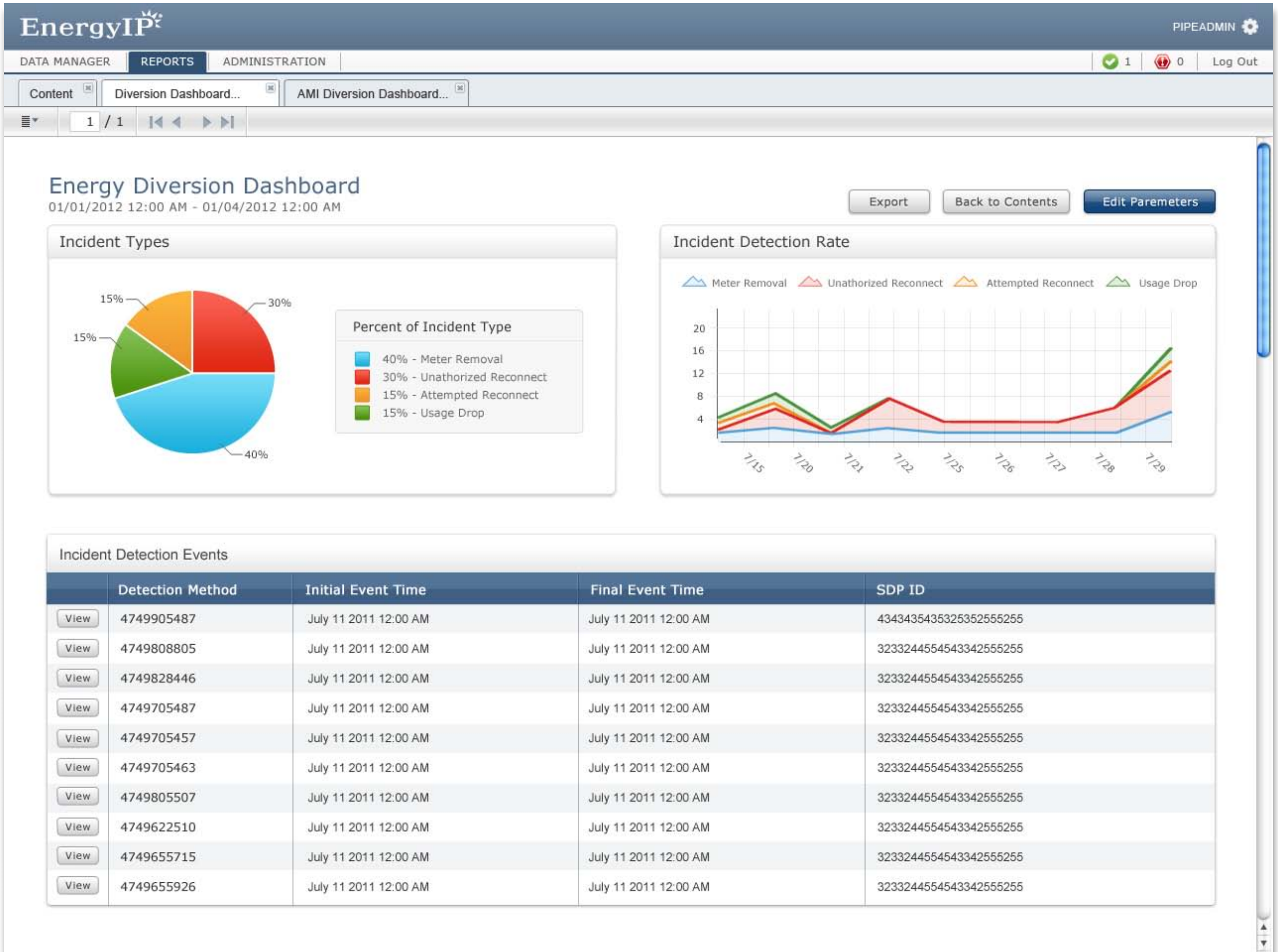

Who stole $6 Billion Last Year?

Energy Diversion

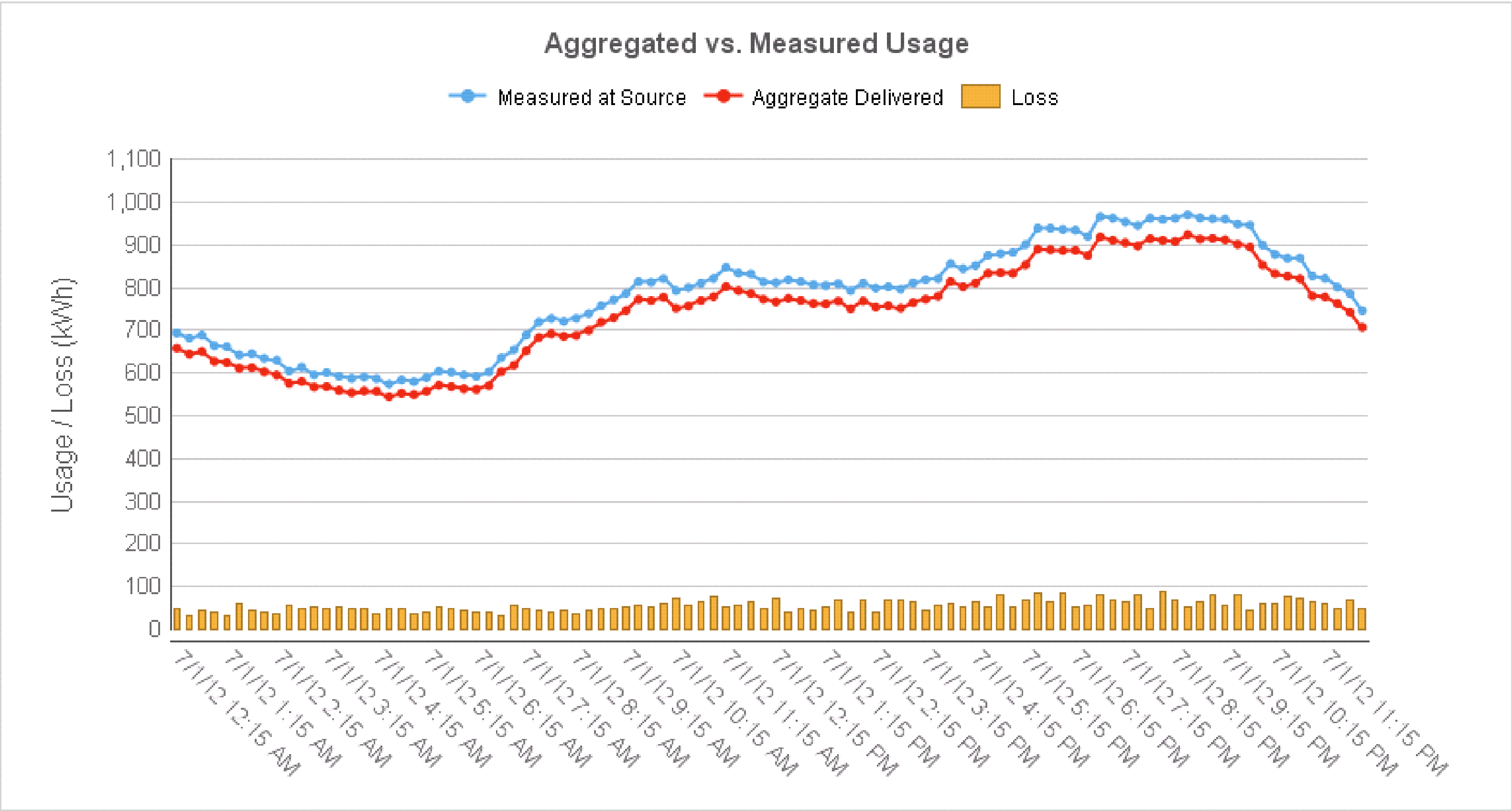


SIEMENS

Energy Diversion Dashboard



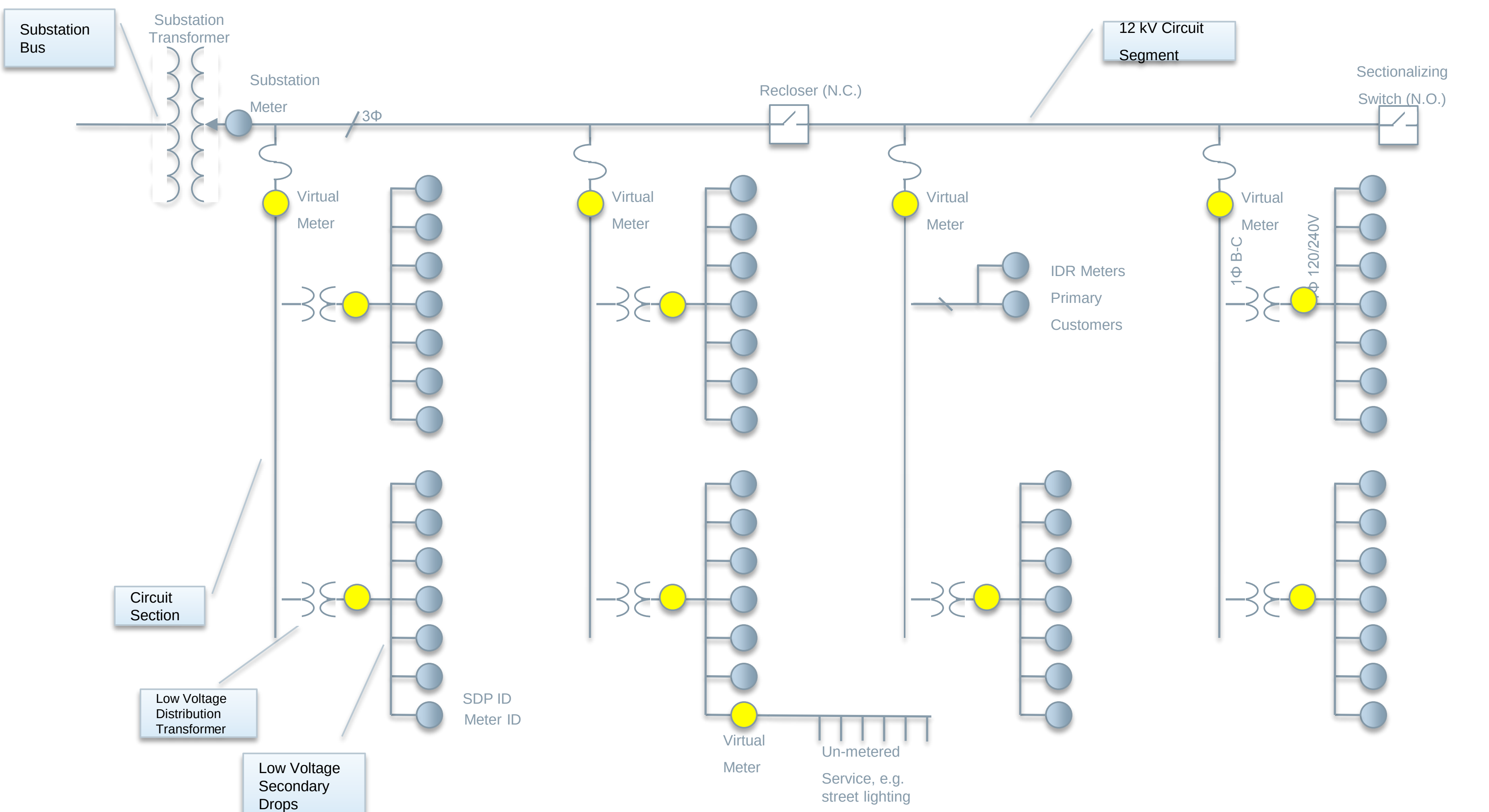
Network Loss



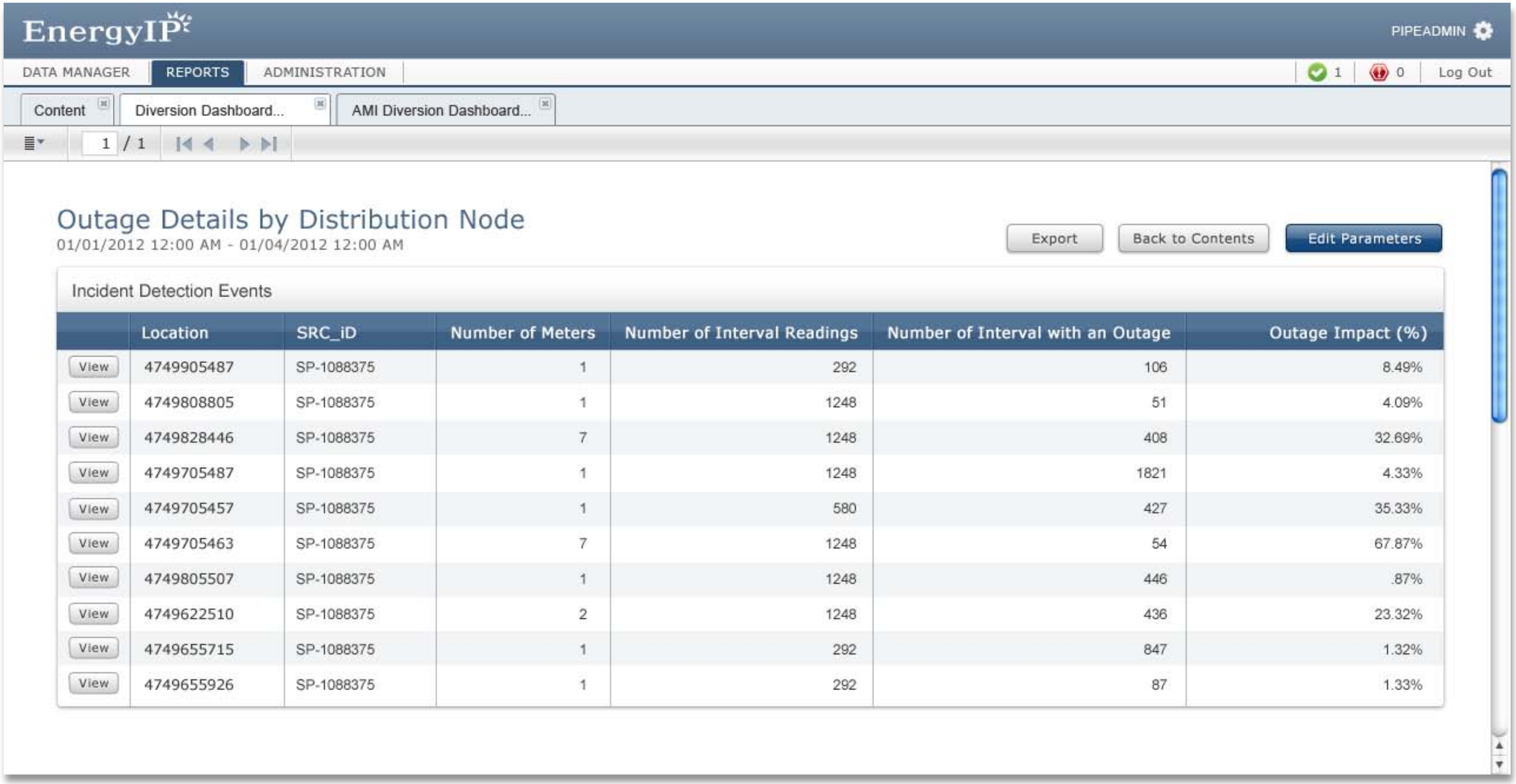
	Measured at Source (kWh)	Aggregate Delivered (kWh)	Loss (kWh)
Total	71,070	65,635	5,275


Can we prevent transformer failure?
© info@francisvachon.com - (www.francisvachon.com)

Applications for Grid Operations



Outage Details by Distribution Node



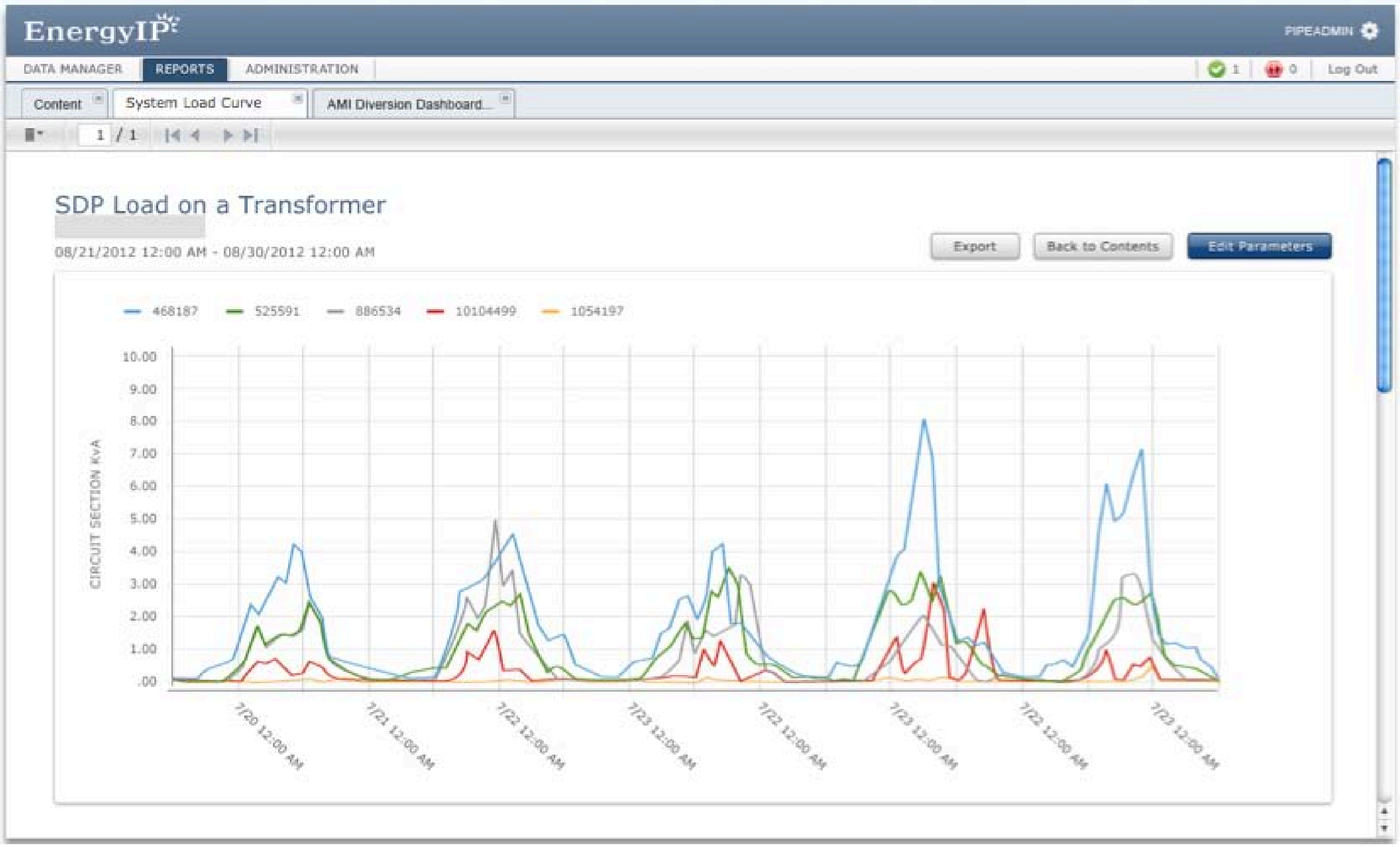
Outage Details by Distribution Node
01/01/2012 12:00 AM - 01/04/2012 12:00 AM

Incident Detection Events

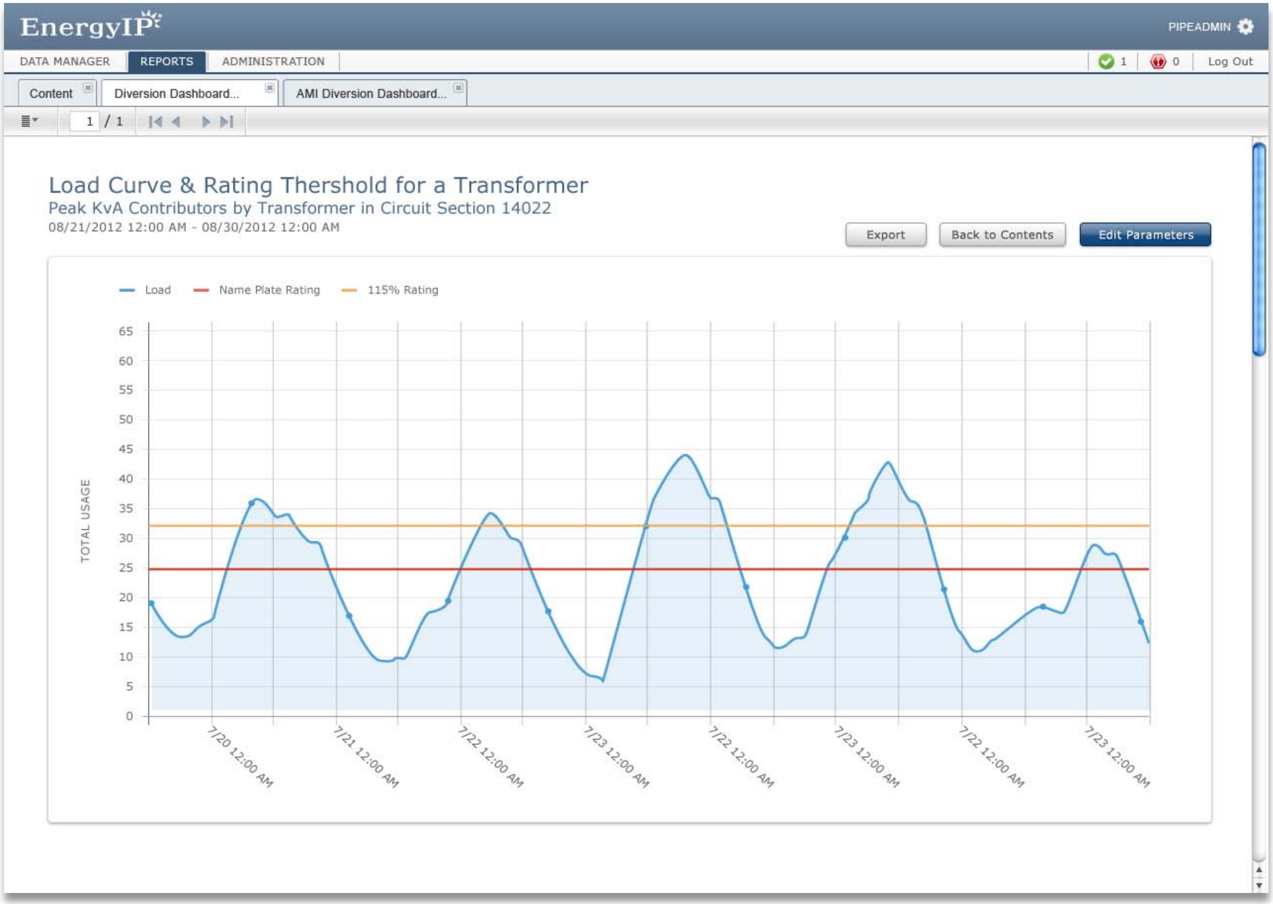
	Location	SRC_ID	Number of Meters	Number of Interval Readings	Number of Interval with an Outage	Outage Impact (%)
View	4749905487	SP-1088375	1	292	106	8.49%
View	4749808805	SP-1088375	1	1248	51	4.09%
View	4749828446	SP-1088375	7	1248	408	32.69%
View	4749705487	SP-1088375	1	1248	1821	4.33%
View	4749705457	SP-1088375	1	580	427	35.33%
View	4749705463	SP-1088375	7	1248	54	67.87%
View	4749805507	SP-1088375	1	1248	446	.87%
View	4749622510	SP-1088375	2	1248	436	23.32%
View	4749655715	SP-1088375	1	292	847	1.32%
View	4749655926	SP-1088375	1	292	87	1.33%

SIEMENS

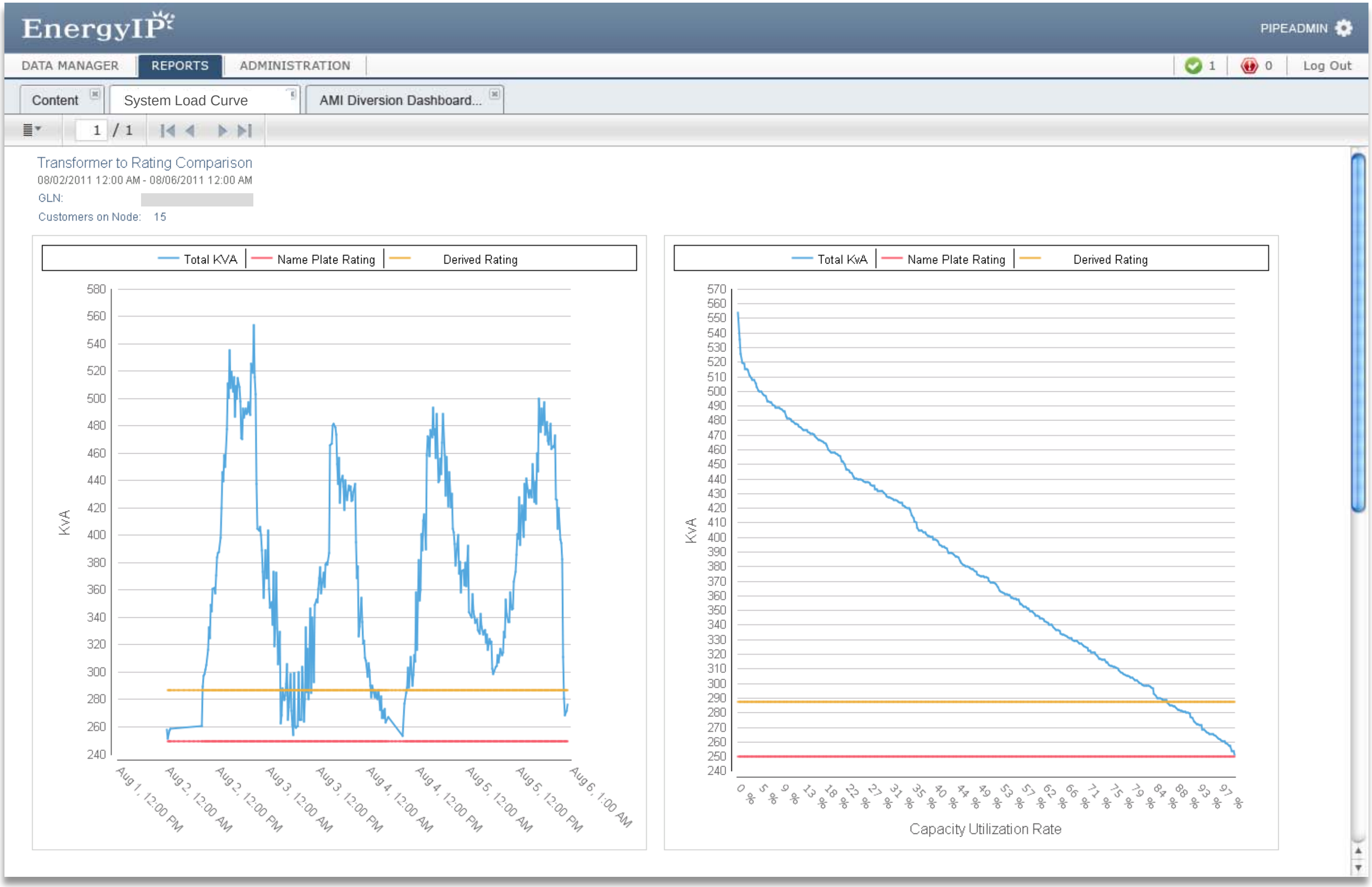
Service Point Metering



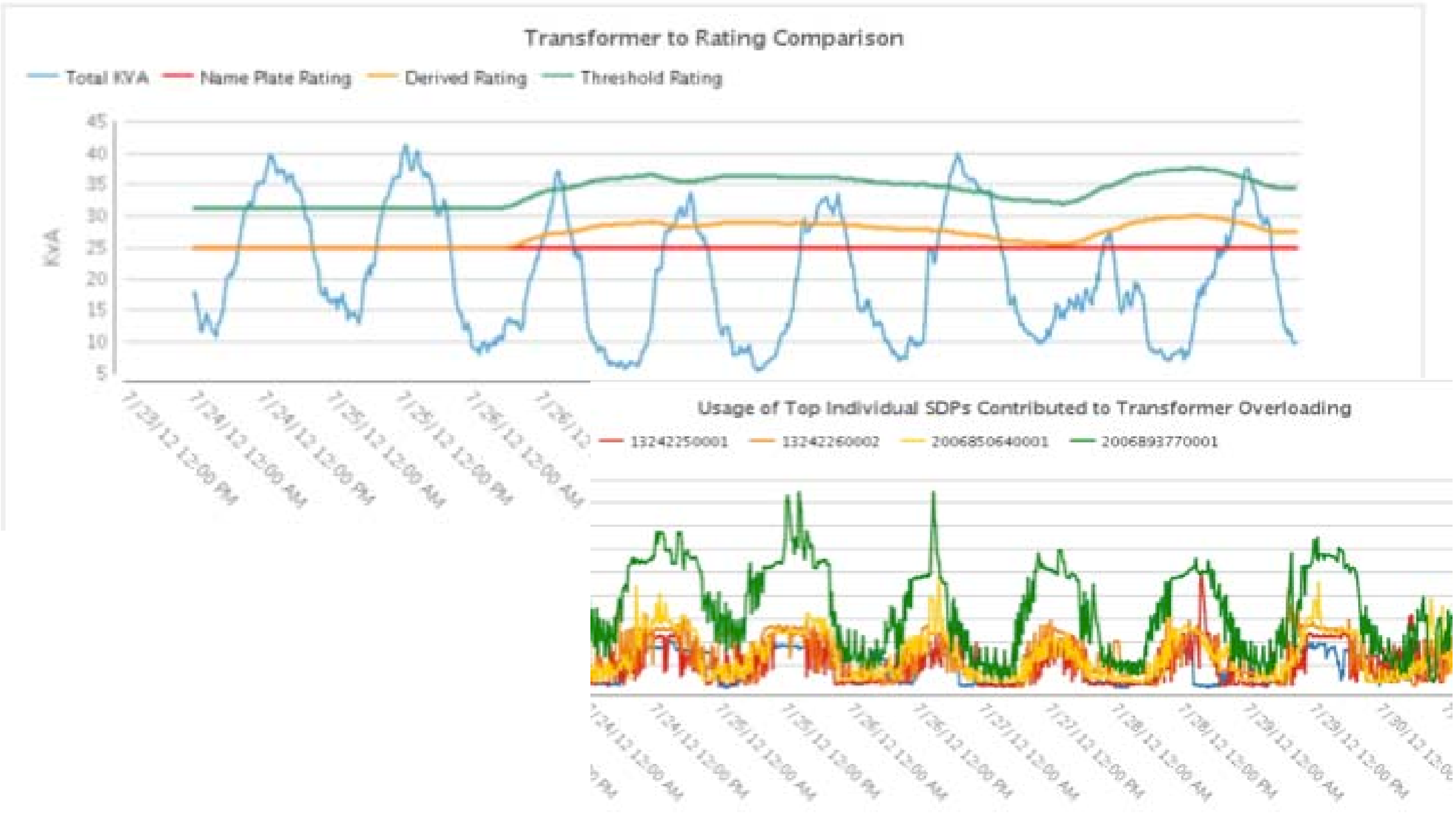
Virtual Metered Transformer



Identifying Overloaded Assets



Understanding Grid Impacts



SIEMENS

Transformer Overload Tracking

EnergyIP

DATA MANAGER | REPORTS | ADMINISTRATION

PIPEADMIN

1 | 0 | Log Out

Content | Diversion Dashboard... | AMI Diversion Dashboard...

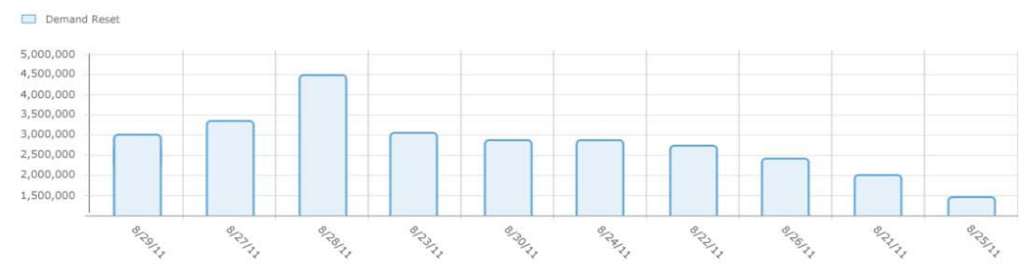
1 / 1

Transformers Load Monitoring Dashboard

08/21/2012 12:00 AM - 08/30/2012 12:00 AM

Export | Back to Contents | Edit Parameters

Transformer Intervals Over Rating



Transformer Interval Data

	Transformer ID	Date	Measured Intervals	Intervals Over Rating	Percent Overload	Name Plate Rating KvA
View	4749905487	8/29/2011	480	380	79.17%	47
View	4749808805	8/27/2011	480	380	79.17%	47
View	4749828446	8/28/2011	480	380	79.17%	47
View	4749705487	8/23/2011	480	380	78.13%	25
View	4749705457	8/30/2011	480	225	77.08%	47
View	4749705463	8/24/2011	480	370	77.08%	47
View	4749805507	8/22/2011	480	370	75.00%	25
View	4749622510	8/26/2011	96	72	75.00%	50
View	4749655715	8/21/2011	480	360	75.00%	50
View	4749655926	8/25/2011	480	480	75.00%	35


15% of infrastructure is used 1% of
time. What can we do about it?
http://earthdaytolucalake.wordpress.com/

Applications for Grid Operations

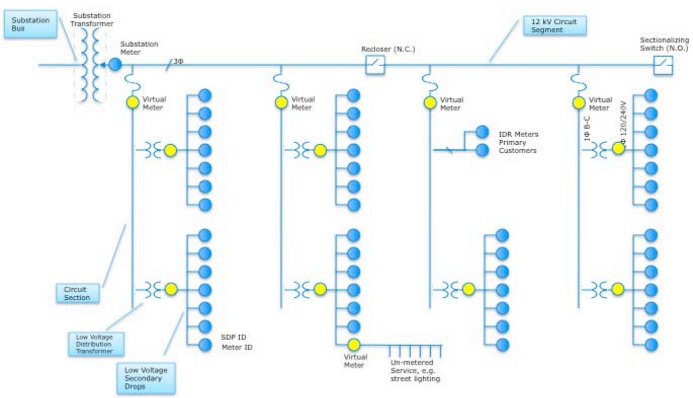
Update load summaries daily in minutes

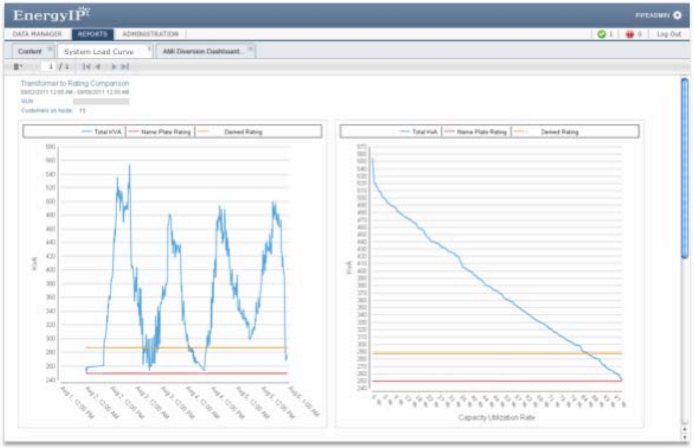
Make actual, accurate data available to:

- Asset utilization and maintenance models
- Validate and improve system load models
- Improve forecasting and planning

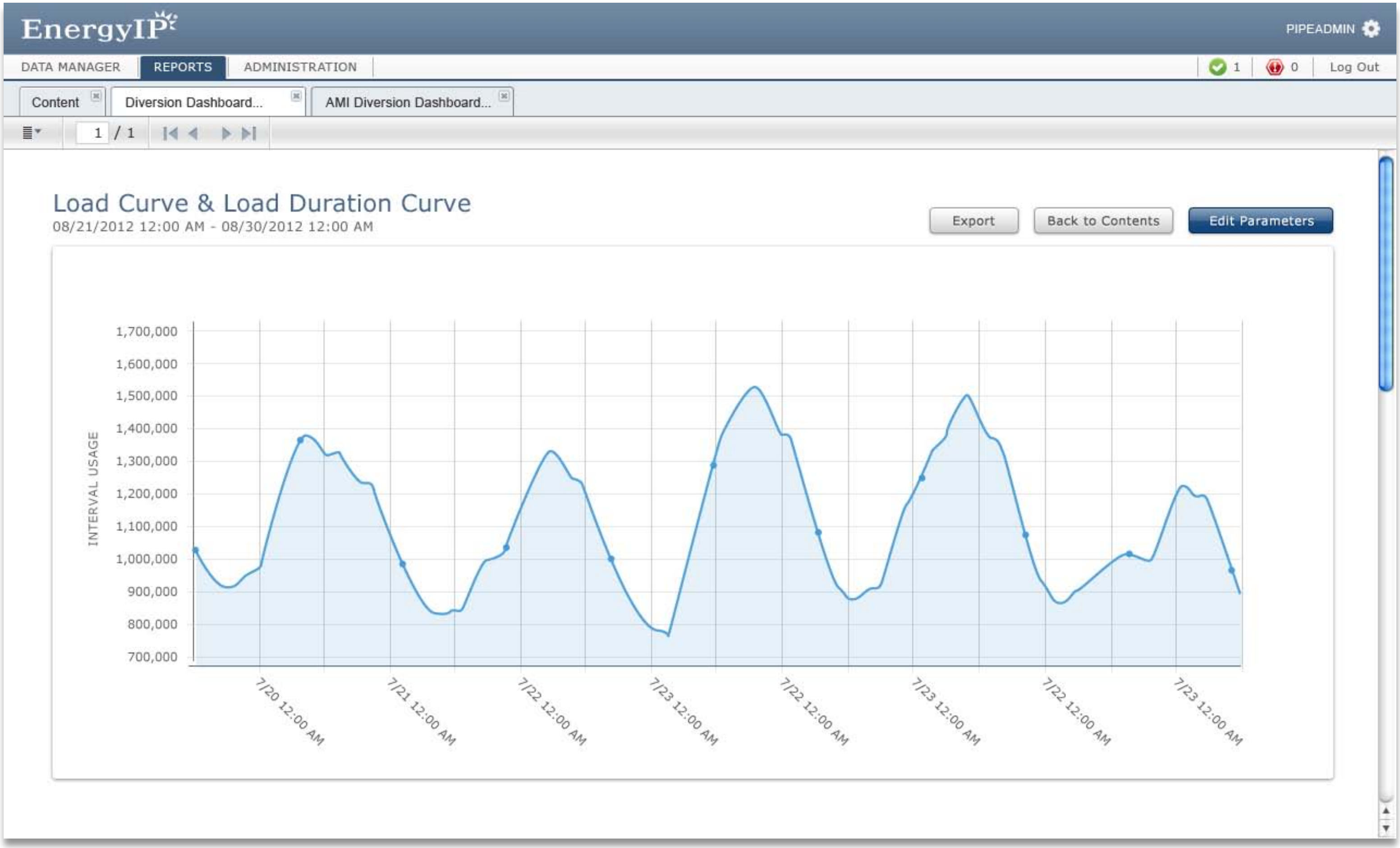
Test: Aggregate one day's 15 minute interval data by distribution transformer for 1.6m meters and 393k low voltage transformers.

Result: Over 200m records processed computing actual kVA demand and generating over 20m output records in under 120 seconds.





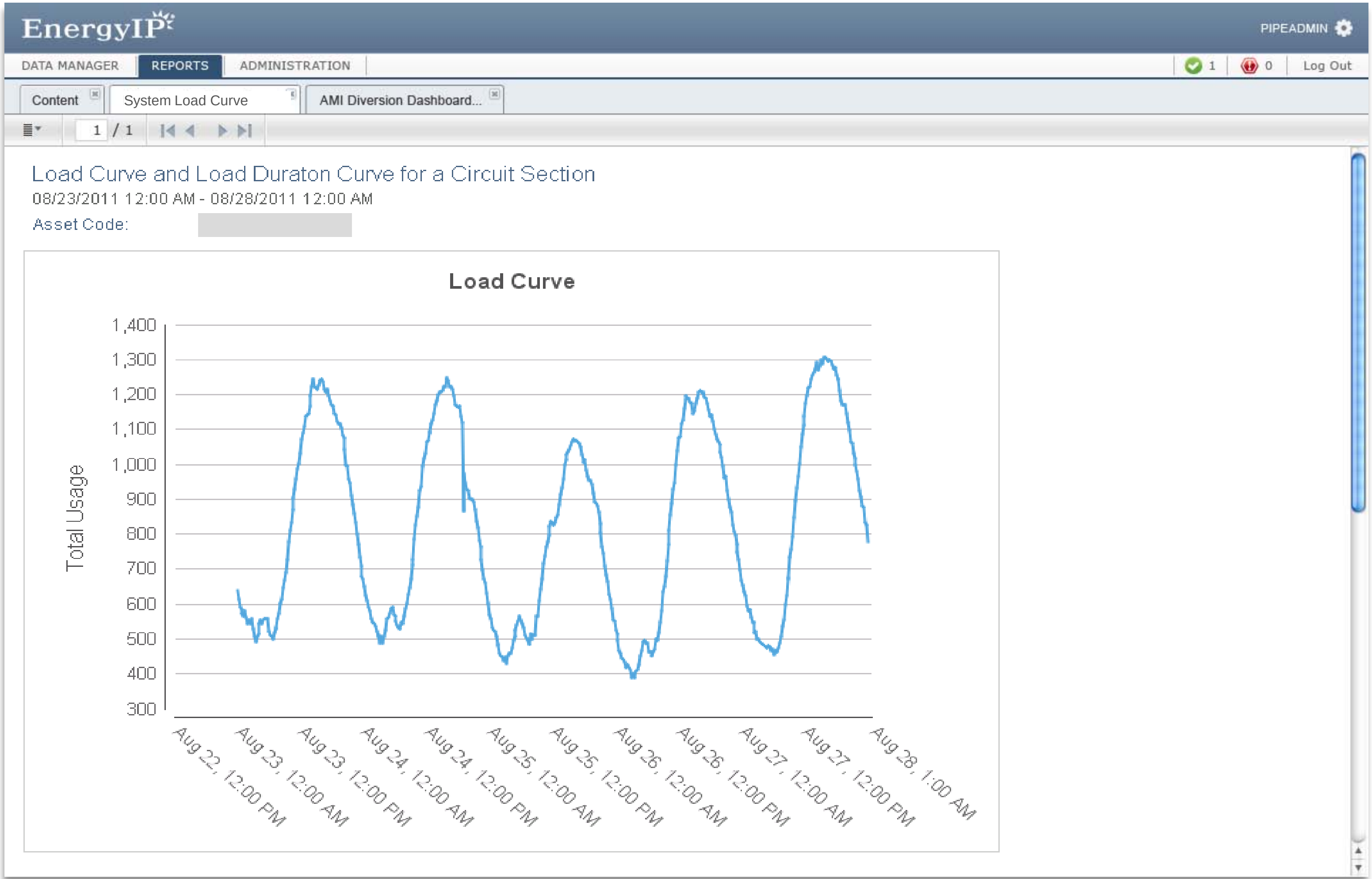
System Load


EnergyIP
PIPEADMIN
DATA MANAGER
REPORTS
ADMINISTRATION
1
0
Log Out
Content
Diversion Dashboard...
AMI Diversion Dashboard...
1 / 1
Load Curve & Load Duration Curve
08/21/2012 12:00 AM - 08/30/2012 12:00 AM
Export
Back to Contents
Edit Parameters
1,700,000
1,600,000
1,500,000
1,400,000
1,300,000
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
INTERVAL USAGE
7/20 12:00 AM
7/21 12:00 AM
7/22 12:00 AM
7/23 12:00 AM
7/22 12:00 AM
7/23 12:00 AM
7/22 12:00 AM
7/23 12:00 AM

SIEMENS

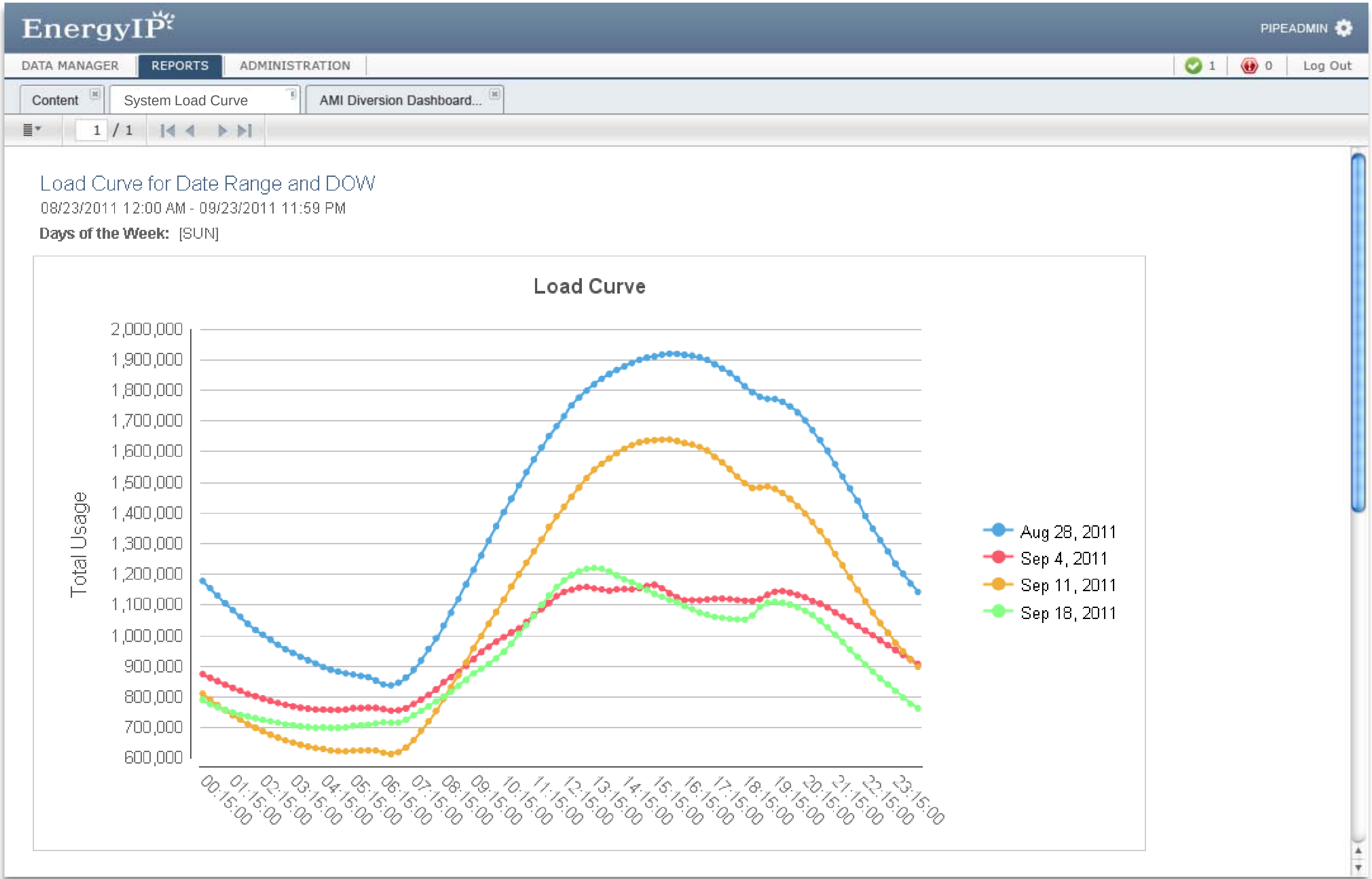
Applications for Grid Operations

System and Asset Loading Analysis – Circuit Section

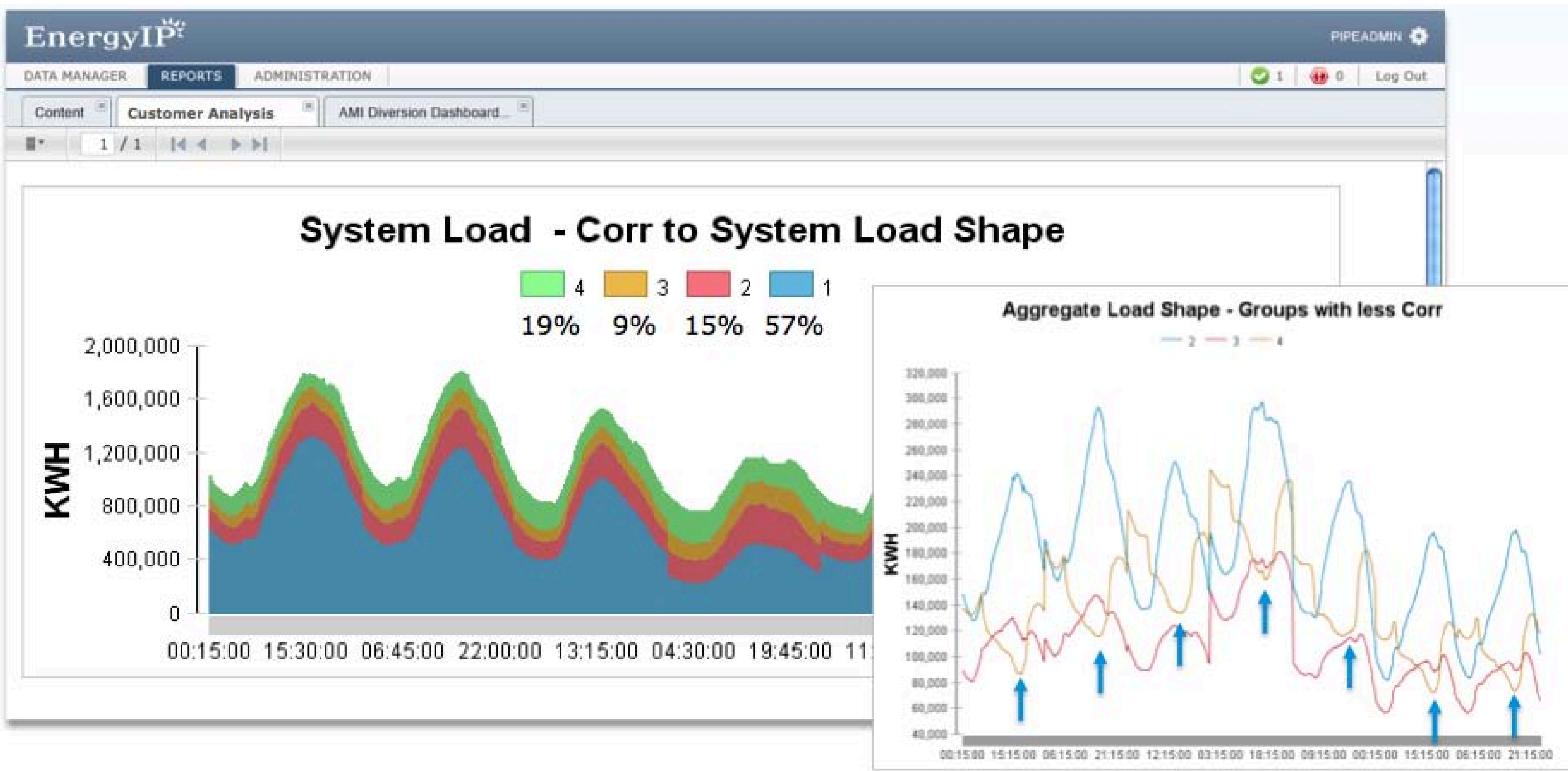


Applications for Grid Operations

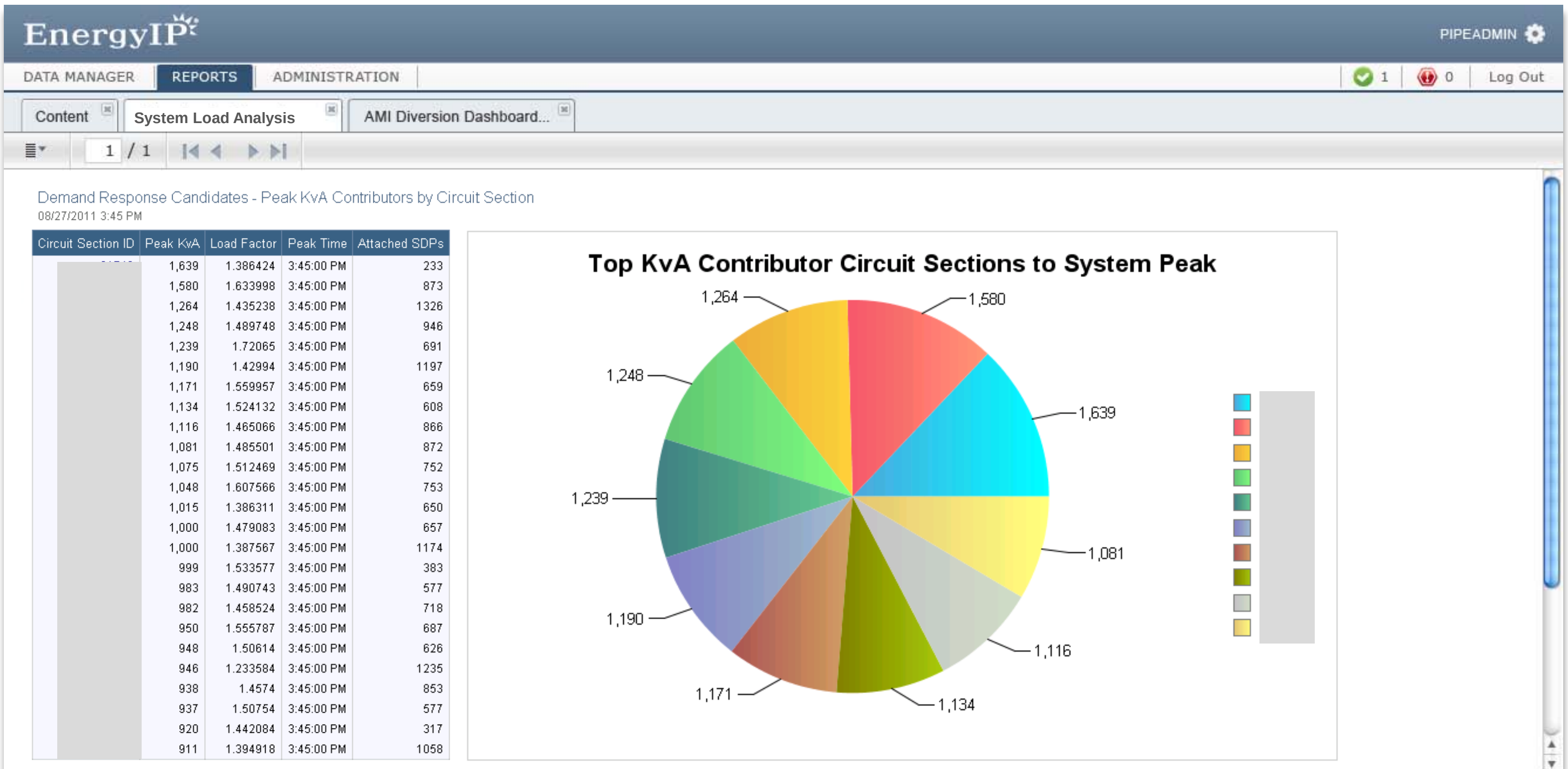
System and Asset Loading Analysis



Individual Peak Loads

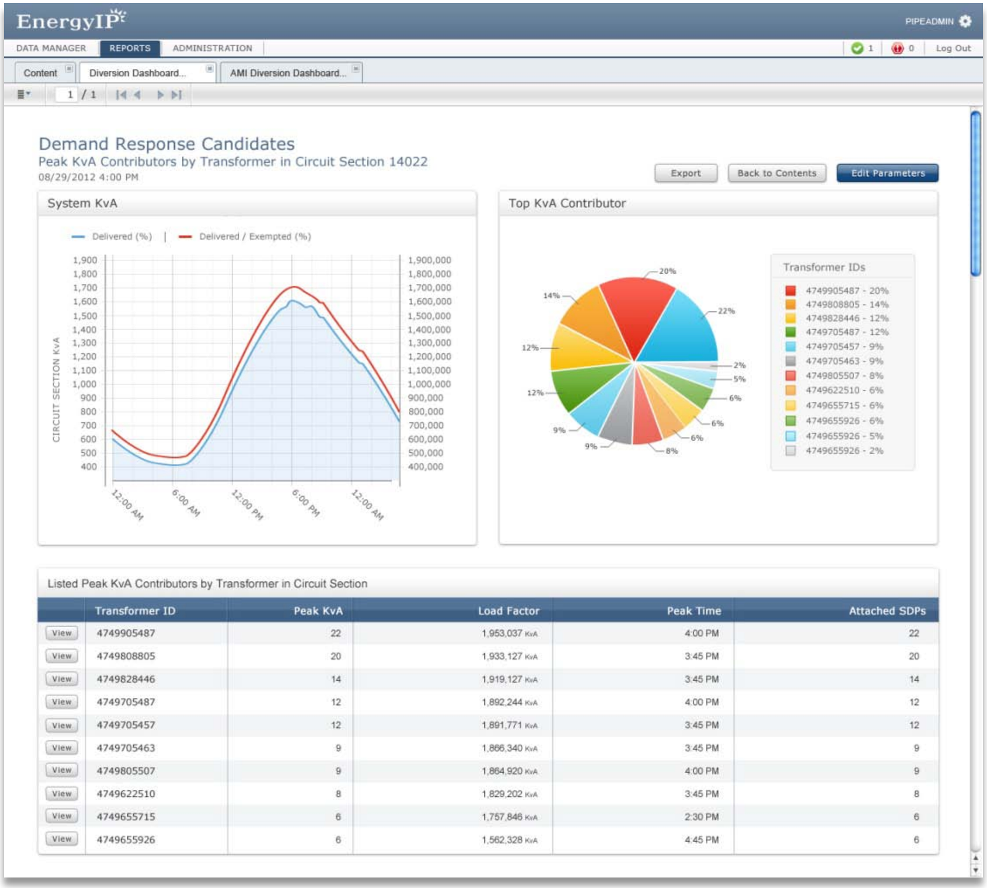


Applications for Grid Operations



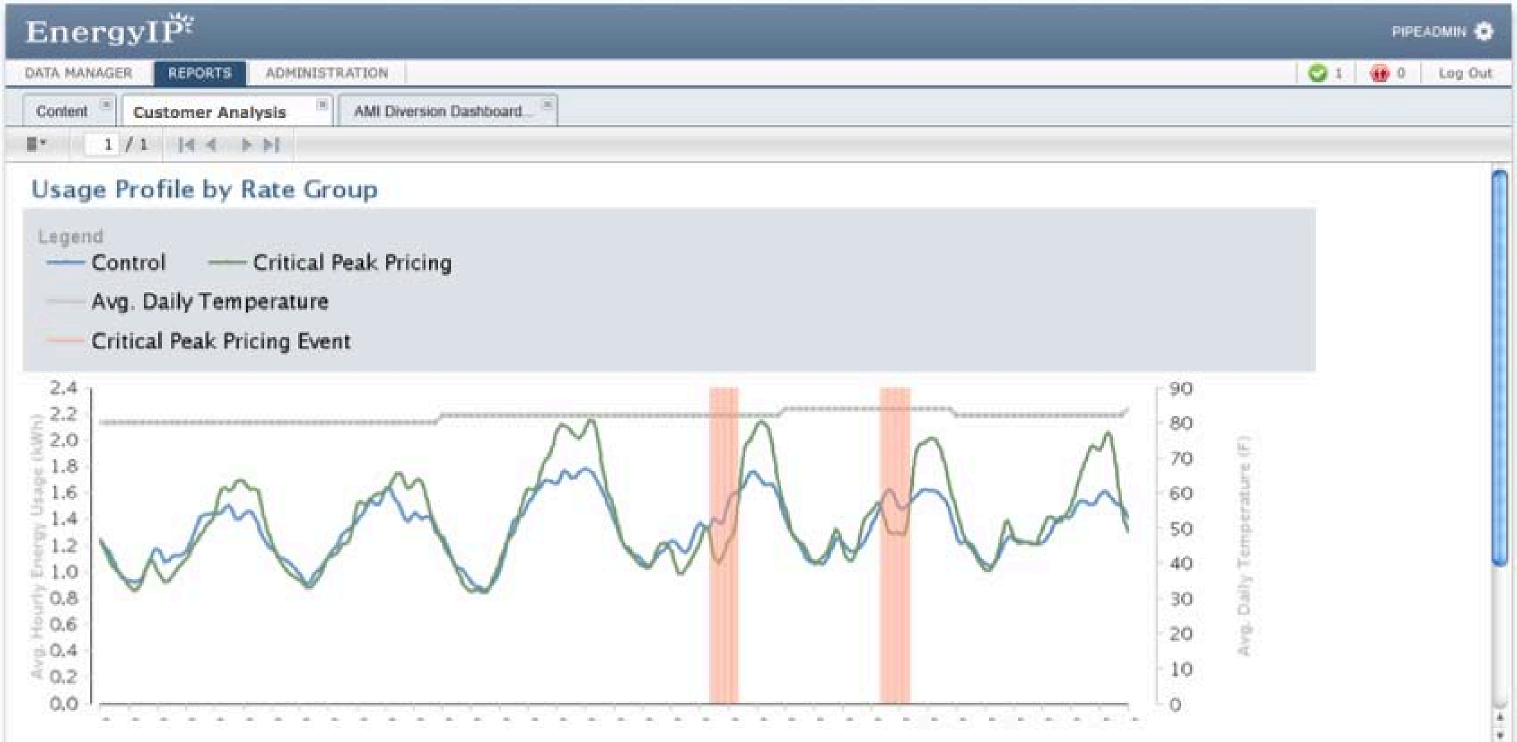
Circuit Section ID	Peak KvA	Load Factor	Peak Time	Attached SDPs
	1,639	1.386424	3:45:00 PM	233
	1,580	1.633998	3:45:00 PM	873
	1,264	1.435238	3:45:00 PM	1326
	1,248	1.489748	3:45:00 PM	946
	1,239	1.72065	3:45:00 PM	691
	1,190	1.42994	3:45:00 PM	1197
	1,171	1.559957	3:45:00 PM	659
	1,134	1.524132	3:45:00 PM	608
	1,116	1.465066	3:45:00 PM	866
	1,081	1.485501	3:45:00 PM	872
	1,075	1.512469	3:45:00 PM	752
	1,048	1.607566	3:45:00 PM	753
	1,015	1.386311	3:45:00 PM	650
	1,000	1.479083	3:45:00 PM	657
	1,000	1.387567	3:45:00 PM	1174
	999	1.533577	3:45:00 PM	383
	983	1.490743	3:45:00 PM	577
	982	1.458524	3:45:00 PM	718
	950	1.555787	3:45:00 PM	687
	948	1.50614	3:45:00 PM	626
	946	1.233584	3:45:00 PM	1235
	938	1.4574	3:45:00 PM	853
	937	1.50754	3:45:00 PM	577
	920	1.442084	3:45:00 PM	317
	911	1.394918	3:45:00 PM	1058

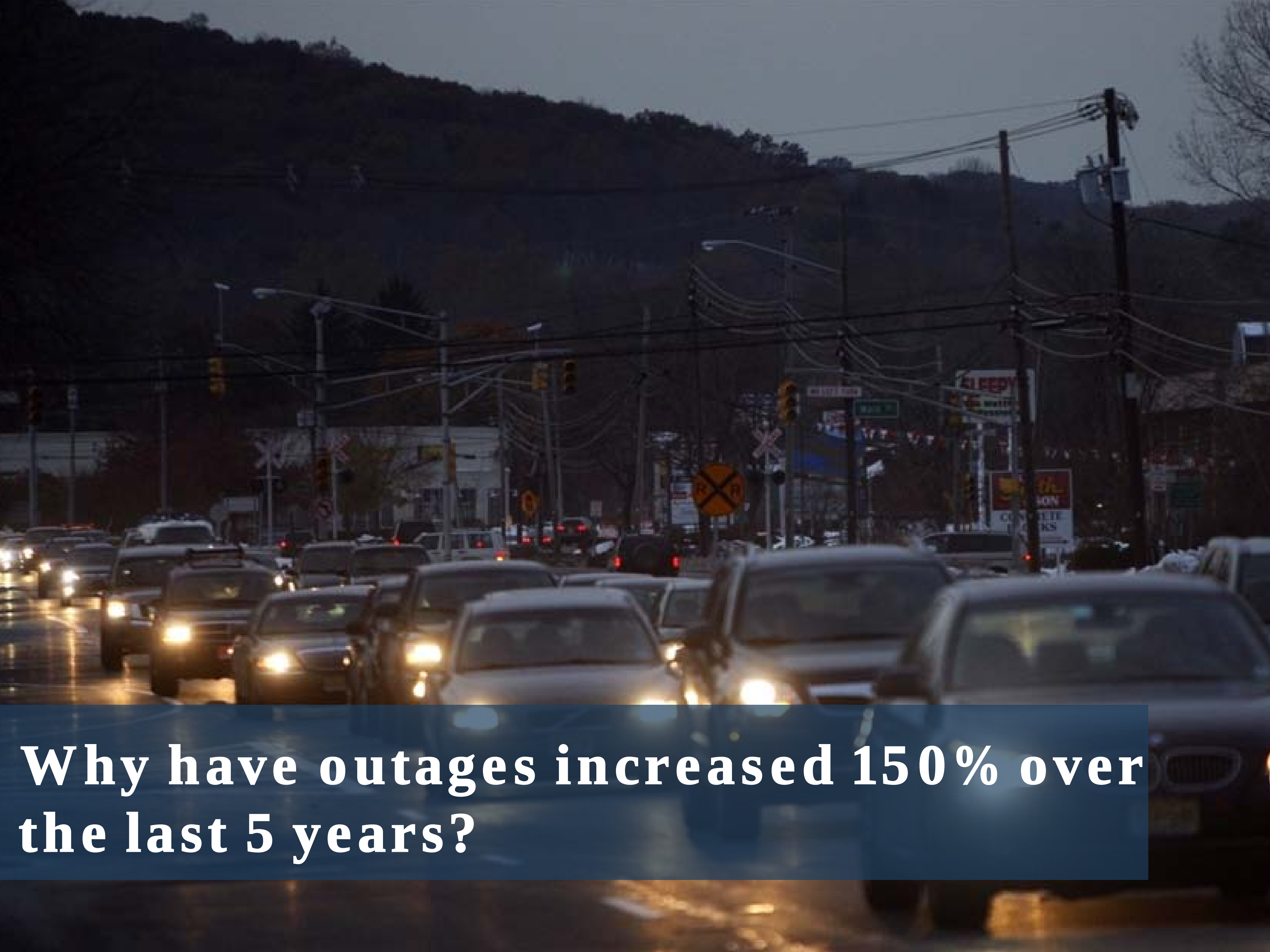
Targeted Demand Response



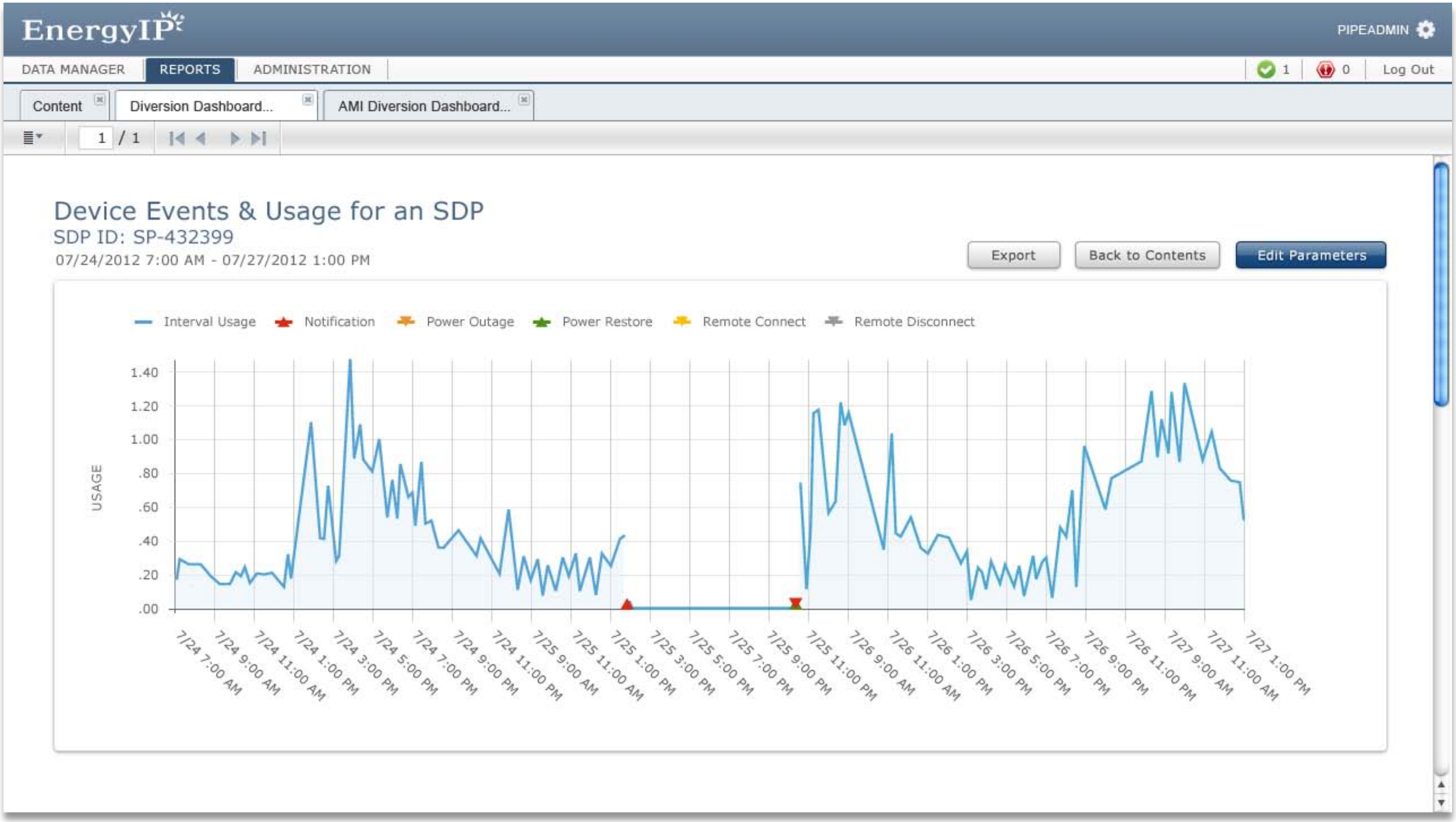
SIEMENS

Time of Use Analysis

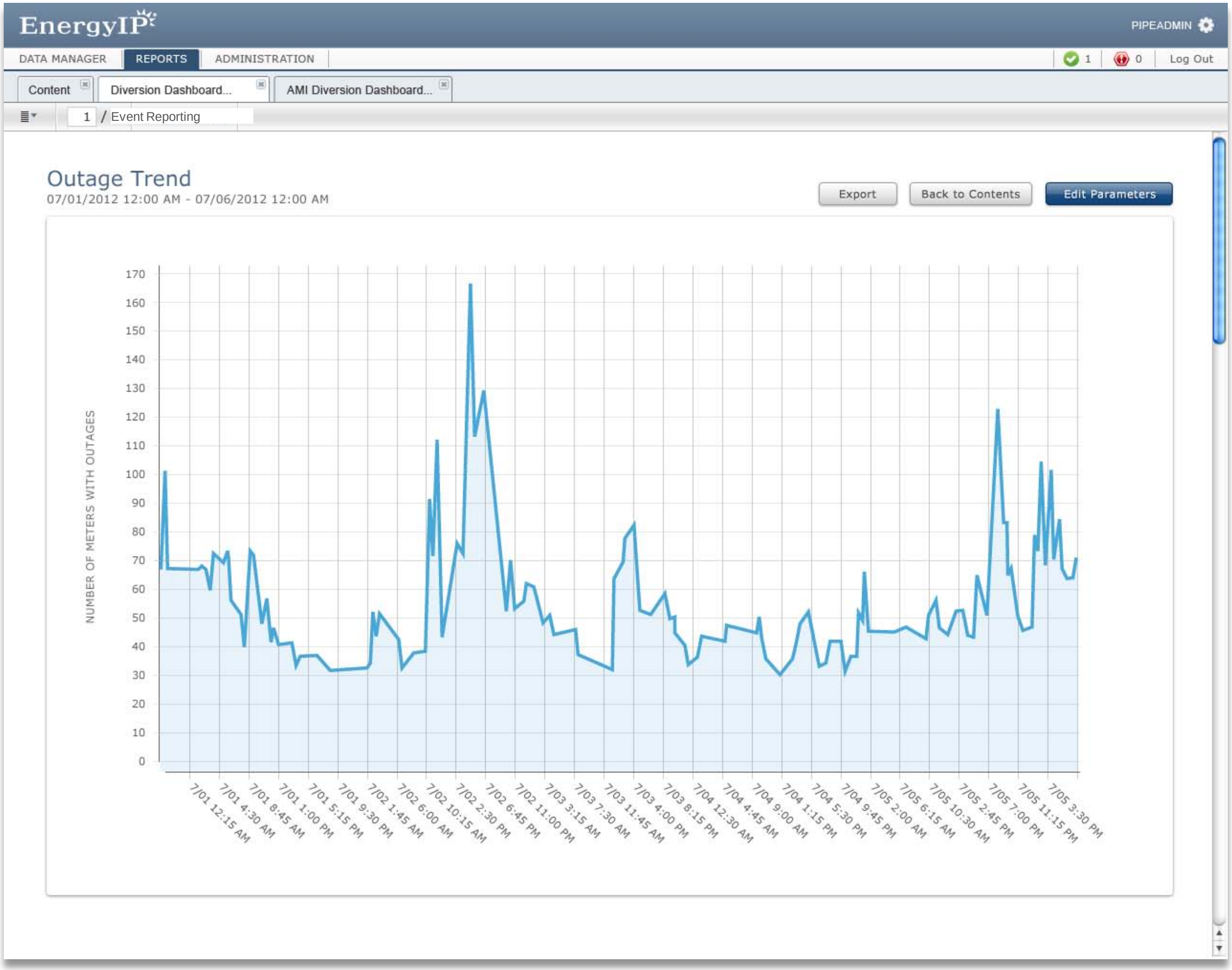



Why have outages increased 150% over
the last 5 years?

Outage Event Correlation



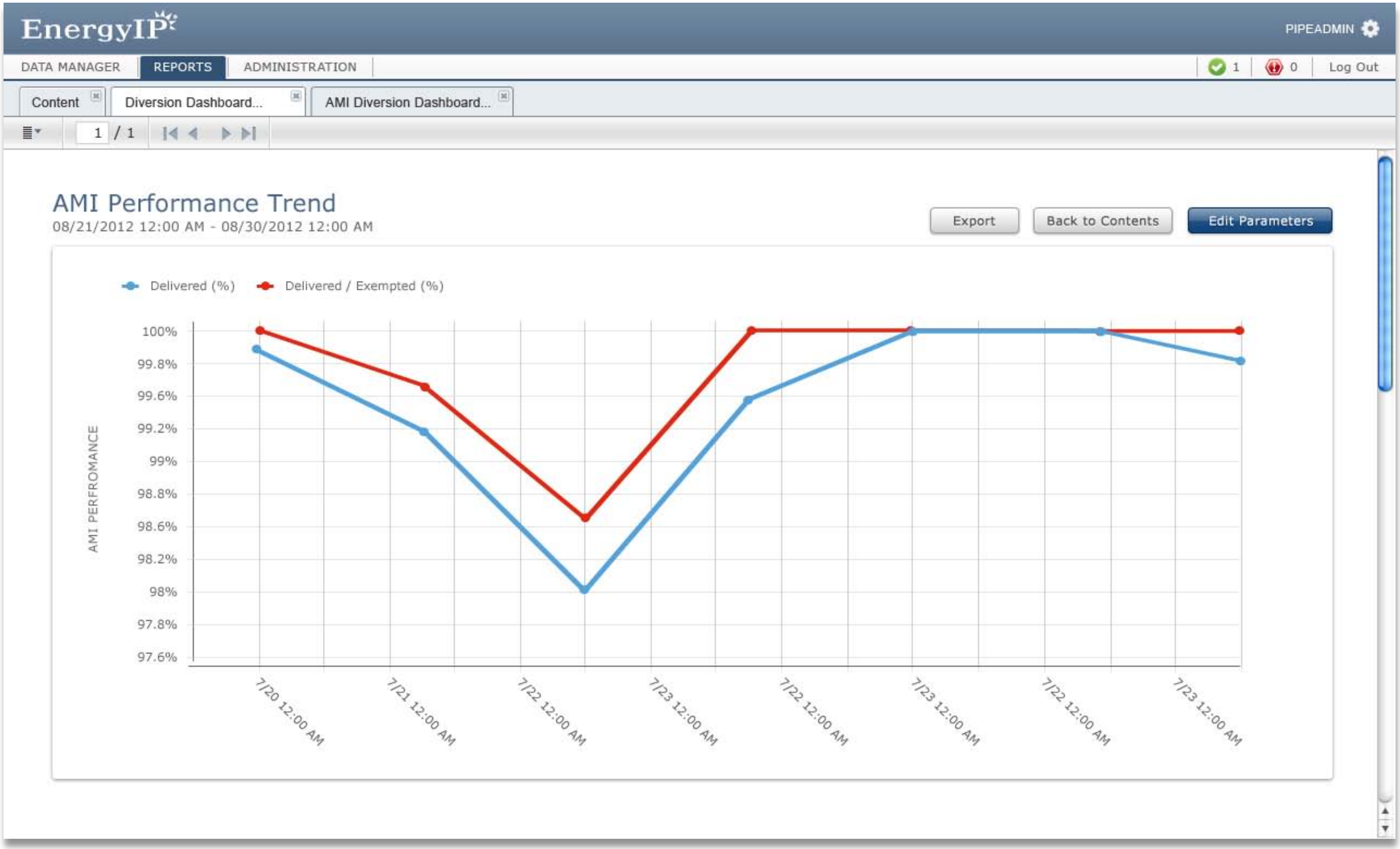
Outage and Momentary Analysis



Is my AMI Network performing like it should?

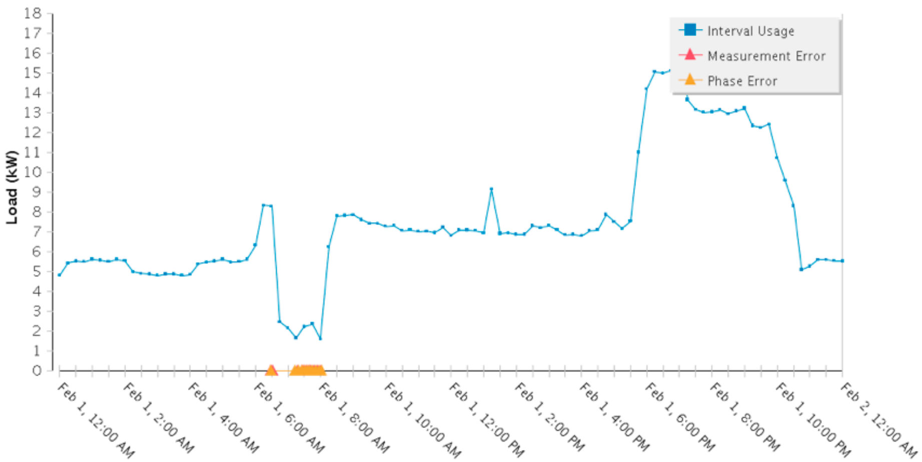
SIEMENS

AMI Performance & SLA Tracking

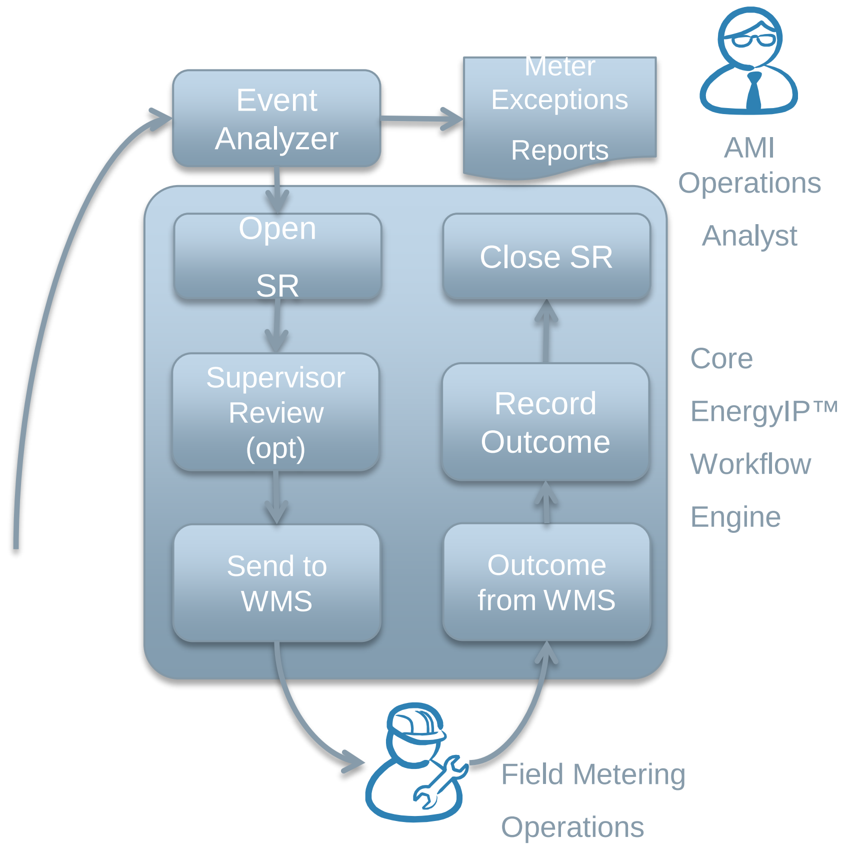


Applications for AMI Operations

Metering and Diagnostic Errors



Event Date-Time	Event Type	Event Description
Feb 2, 2011 1:53:16 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 2:21:55 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 2:25:41 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 2:36:47 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 3:30:22 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 3:59:51 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 4:39:29 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 5:22:44 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 6:11:19 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 2, 2011 6:22:35 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 3, 2011 10:35:10 AM	Phase Error	Source: History; Type: StatusEvent; Loss of Phase Restore
Feb 3, 2011 5:05:01 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 3, 2011 5:13:18 PM	Phase Error	Source: History; Type: StatusEvent; Loss of Phase Restore
Feb 3, 2011 5:31:46 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 3, 2011 5:42:13 PM	Phase Error	Source: History; Type: StatusEvent; Loss of Phase Restore
Feb 3, 2011 5:56:46 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 3, 2011 6:04:28 PM	Phase Error	Source: History; Type: StatusEvent; Loss of Phase Restore
Feb 3, 2011 6:11:51 PM	Measurement Error	Source: ; Type: LowLossPotential;
Feb 3, 2011 6:19:33 PM	Phase Error	Source: History; Type: StatusEvent; Loss of Phase Restore
Feb 3, 2011 7:19:28 PM	Measurement Error	Source: ; Type: LowLossPotential;

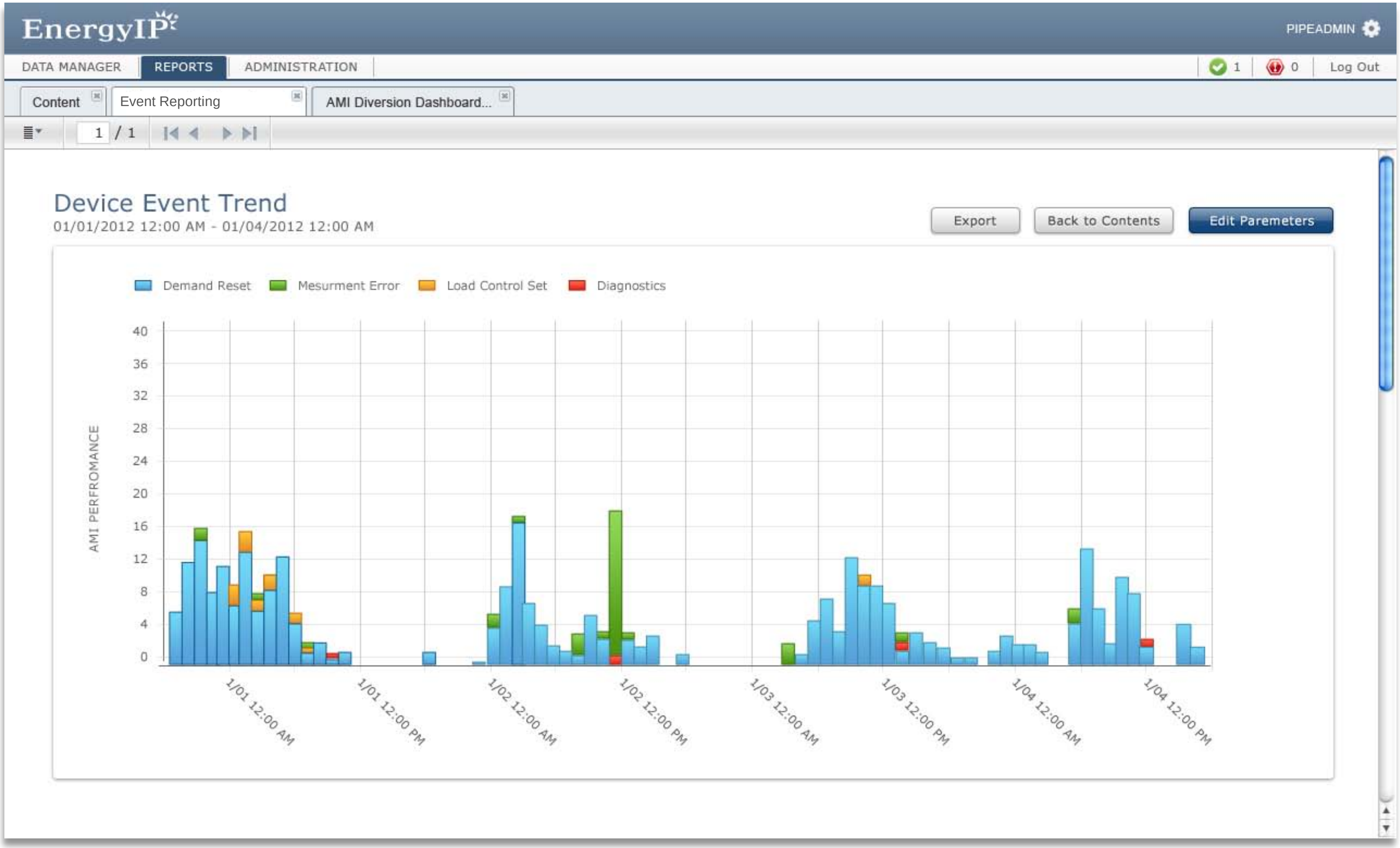


Meter failure indicators, communication failures, handled with automated action initiations.

Patterns and correlations with key meter type, age, service history, locations, etc.

Applications for AMI Operations

Device Event Trending



The Possibilities Are Endless…

- Grid Loss Identification
- Pricing Analysis
- Customer Profiling & Segmentation
- Load Modeling & Forecasting
- Demand Response Evaluation
- Distribution Planning