RICHARD WERNSING

PSE&G

OSIsoft.

Regional Conference
LATAM
June 7-8, Sao Paulo

POR QUE GESTÃO DE ATIVOS É IMPORTANTE?

Agenda

- Introduction
- Asset Strategy Processes
- Accomplishments
- Future Direction

PSE&G Background

- Utility Overview
  - New Jersey Based
  - Total Assets ~ $17 Billion
  - Total Revenue ~ $8 Billion
- Service Territory
  - 323 Municipalities
  - 70% of New Jersey's population
  - 2.2 million Electric customers
  - 1.7 million Gas customers
  - 2,600 Square Miles

Asset Strategy Processes

PSE&G Centralized Maintenance Management System (CMMS)

Metric Driven Reliability

Focused *Investment to achieve* ***measurable*** improvements in reliability

DATA

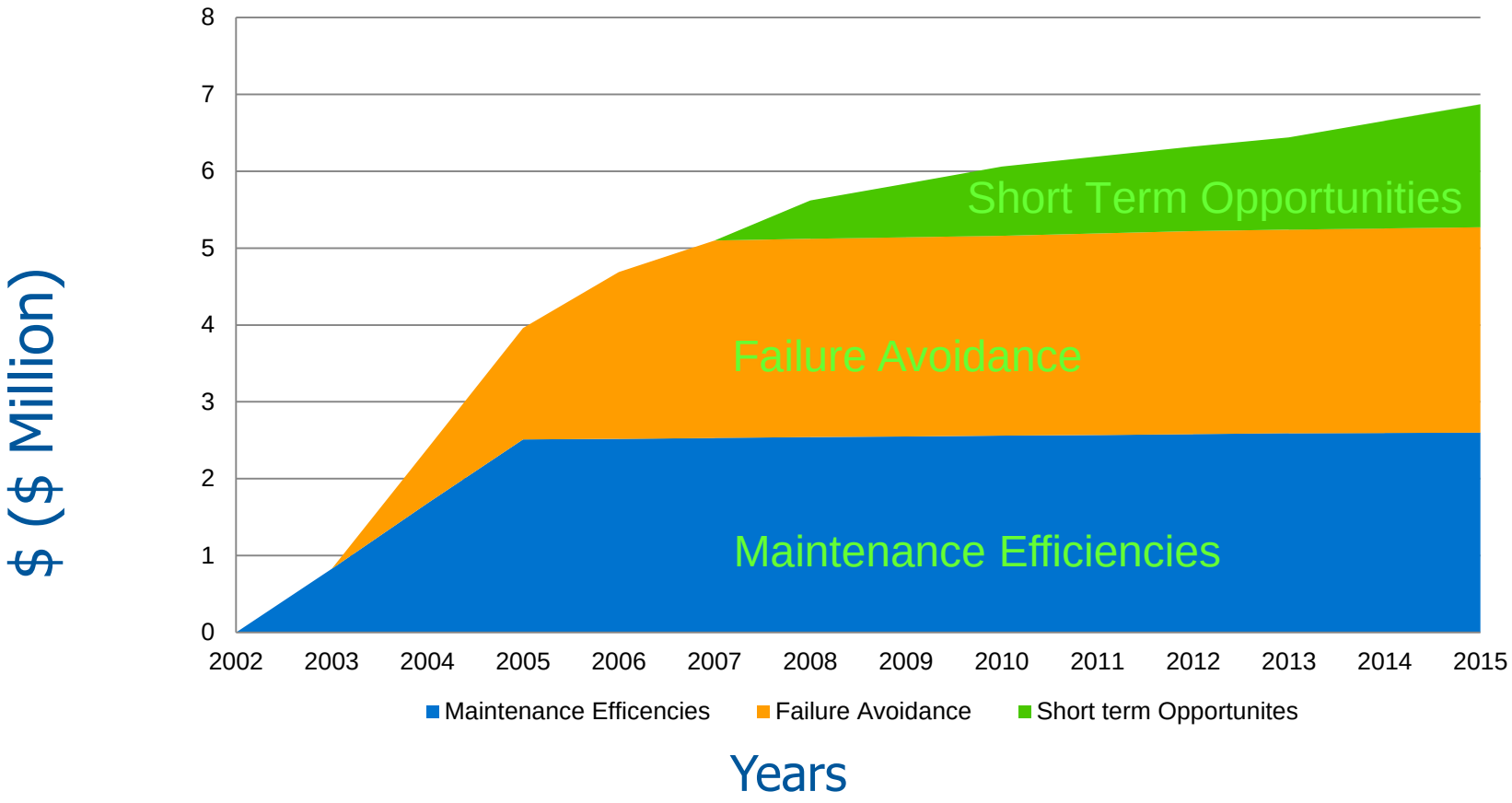
DATA

DATA

DATA

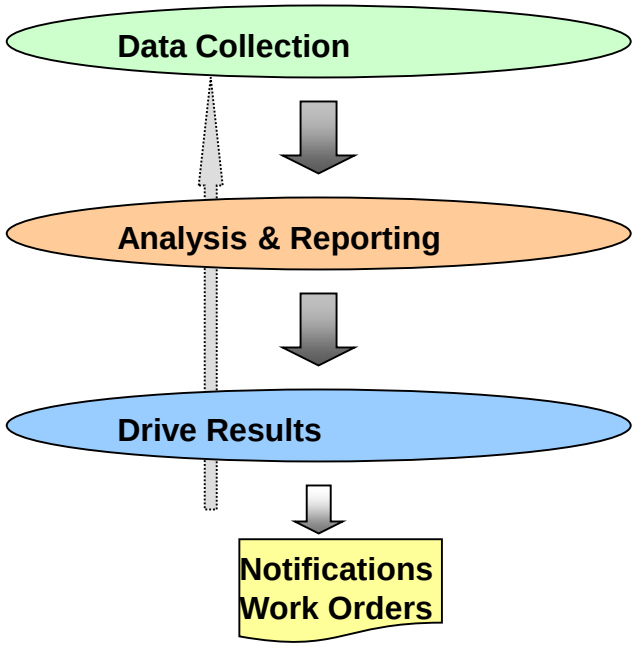
Why Asset Management?

Substation O&M Savings



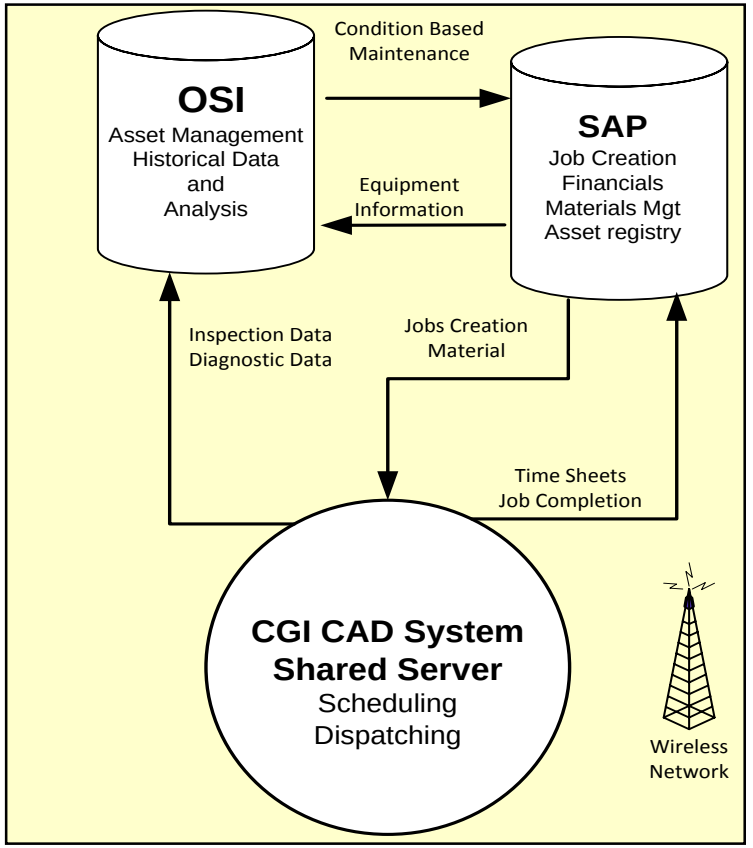
Asset Strategy Process

- Collect and Centralize Data
  - Diagnostic/Inspection
- Transform data into Actionable
  - Information
- Condition Based Maintenance
- SAIFI Optimization
- Criticality
- ***Drive Results***



Integrated Systems for Success

People

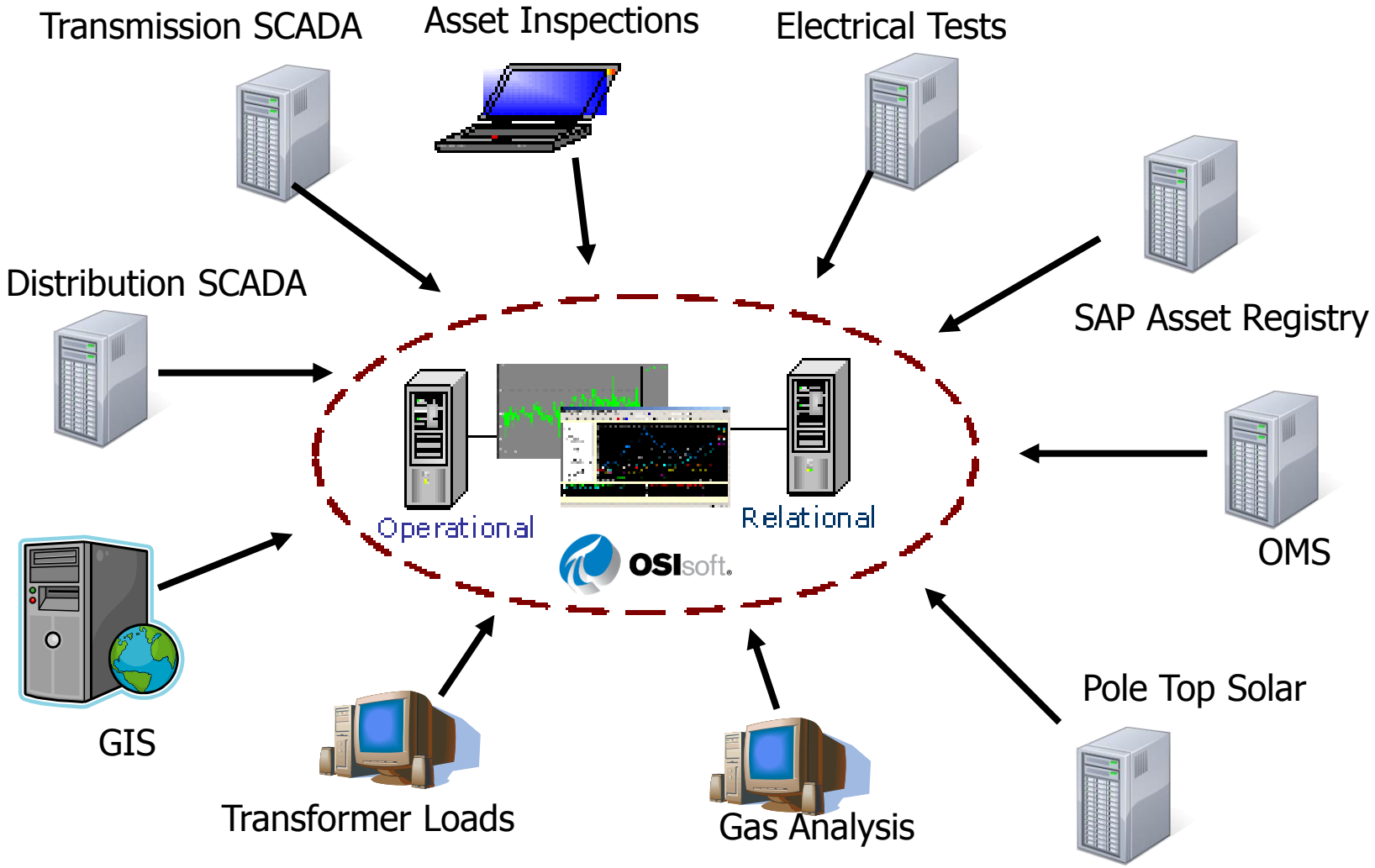


+ Process

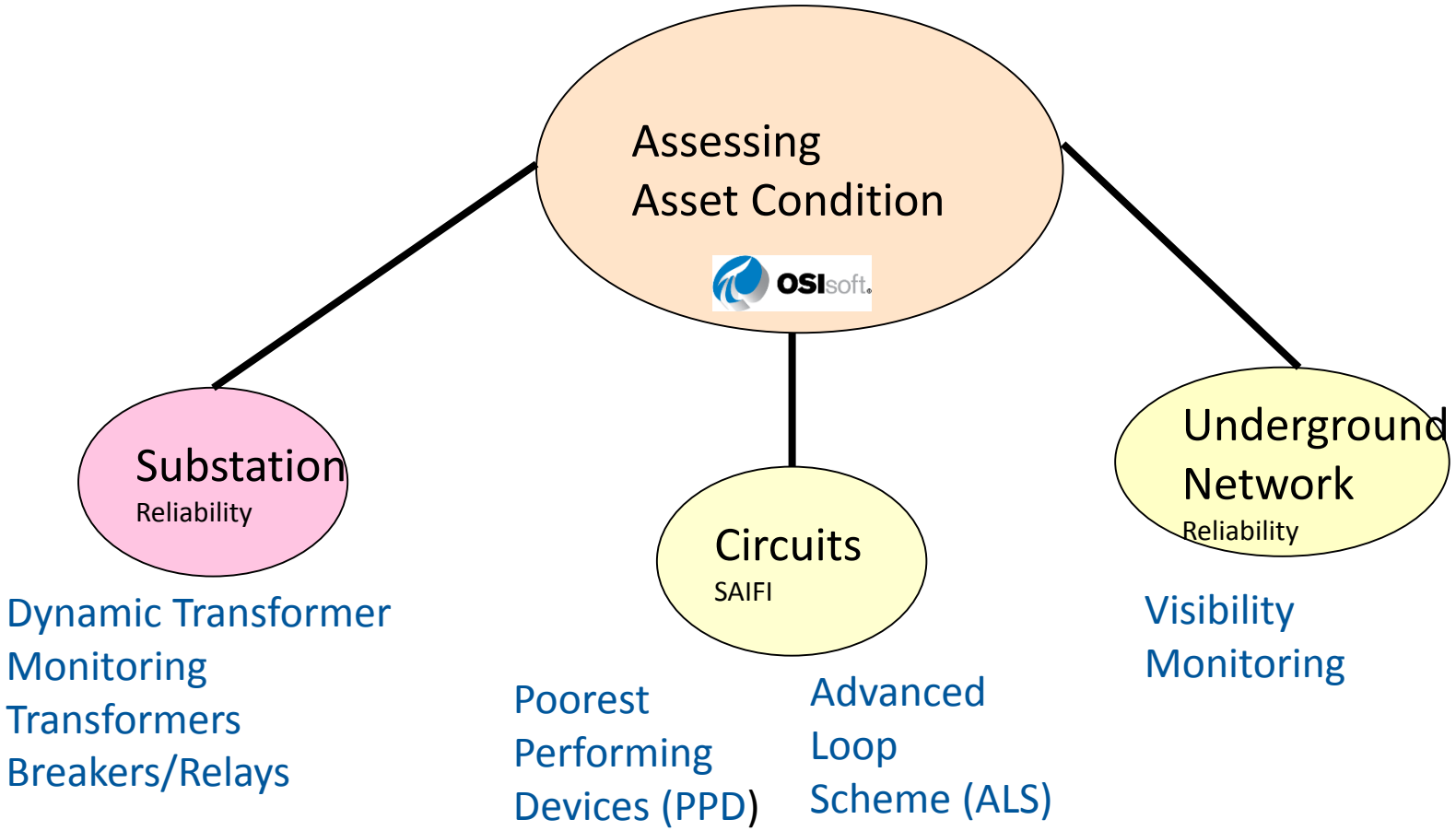
- Service Assurance (Outage Management)
- Work Management (Crew Management)
- Wireless Communications
- Graphic Information (AM/FM)
- Decision Support (Data driven decisions)

+ Systems

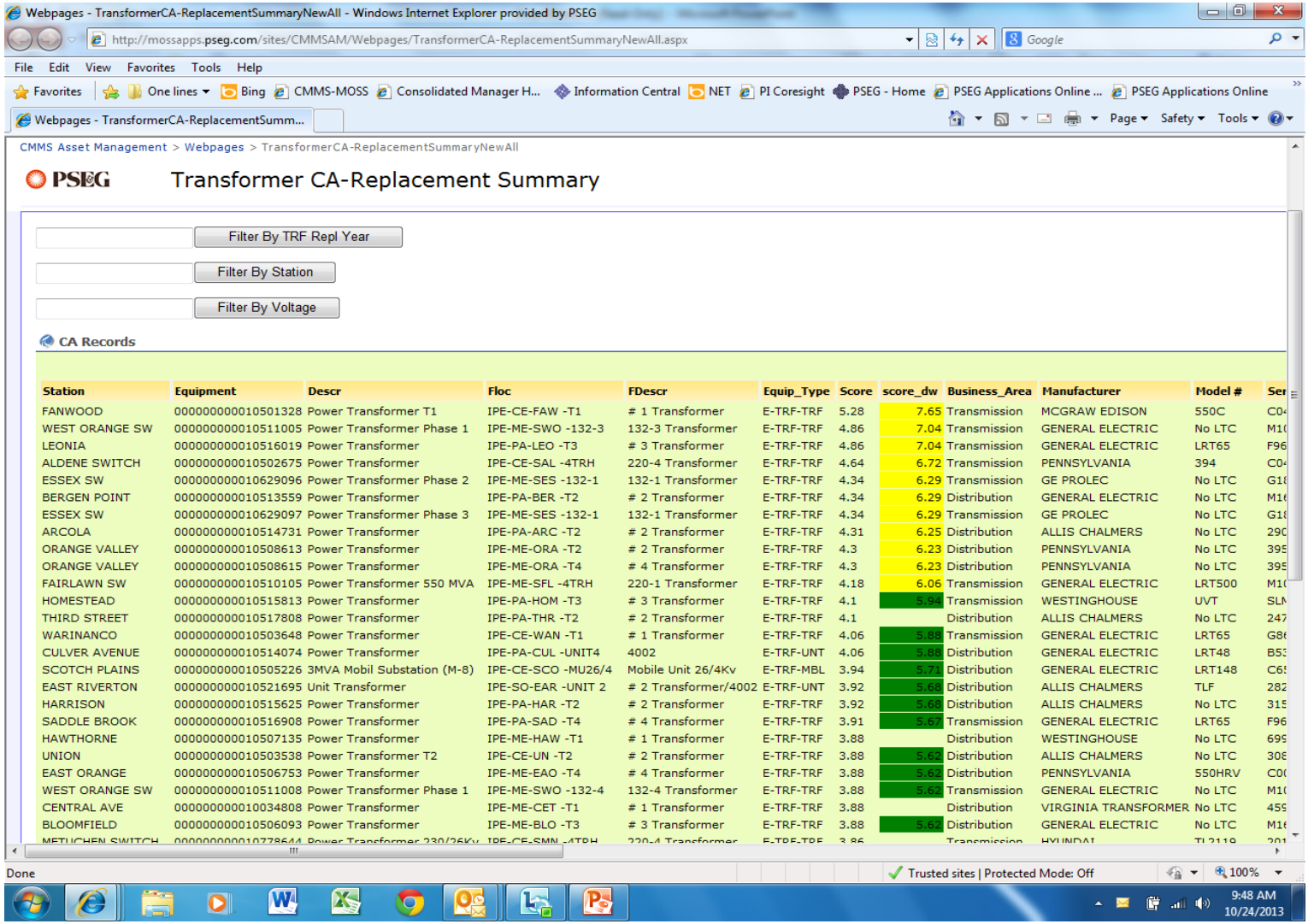
Correlation of information



Assessing Asset Condition

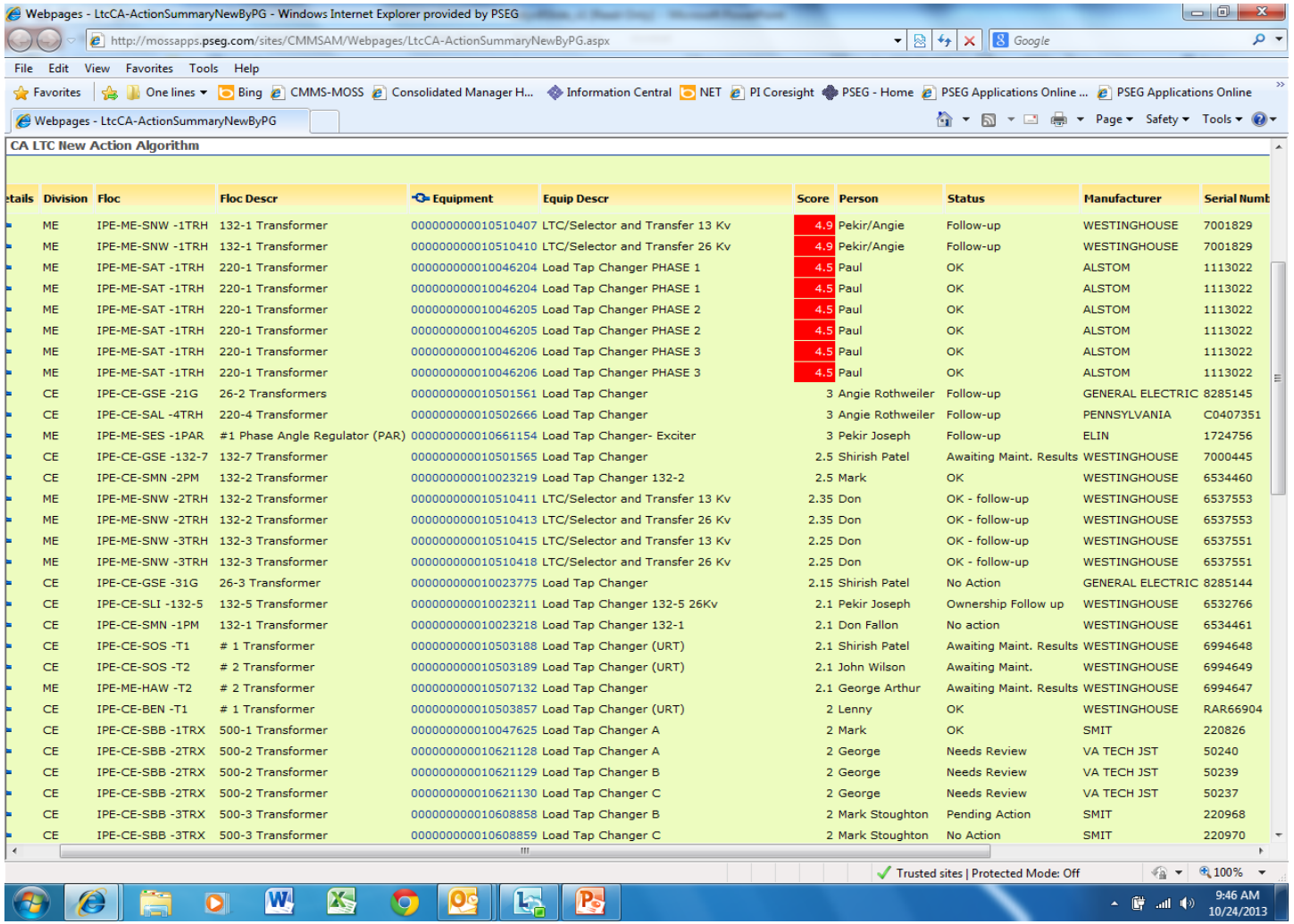


CA Replacement Score



Asset Health

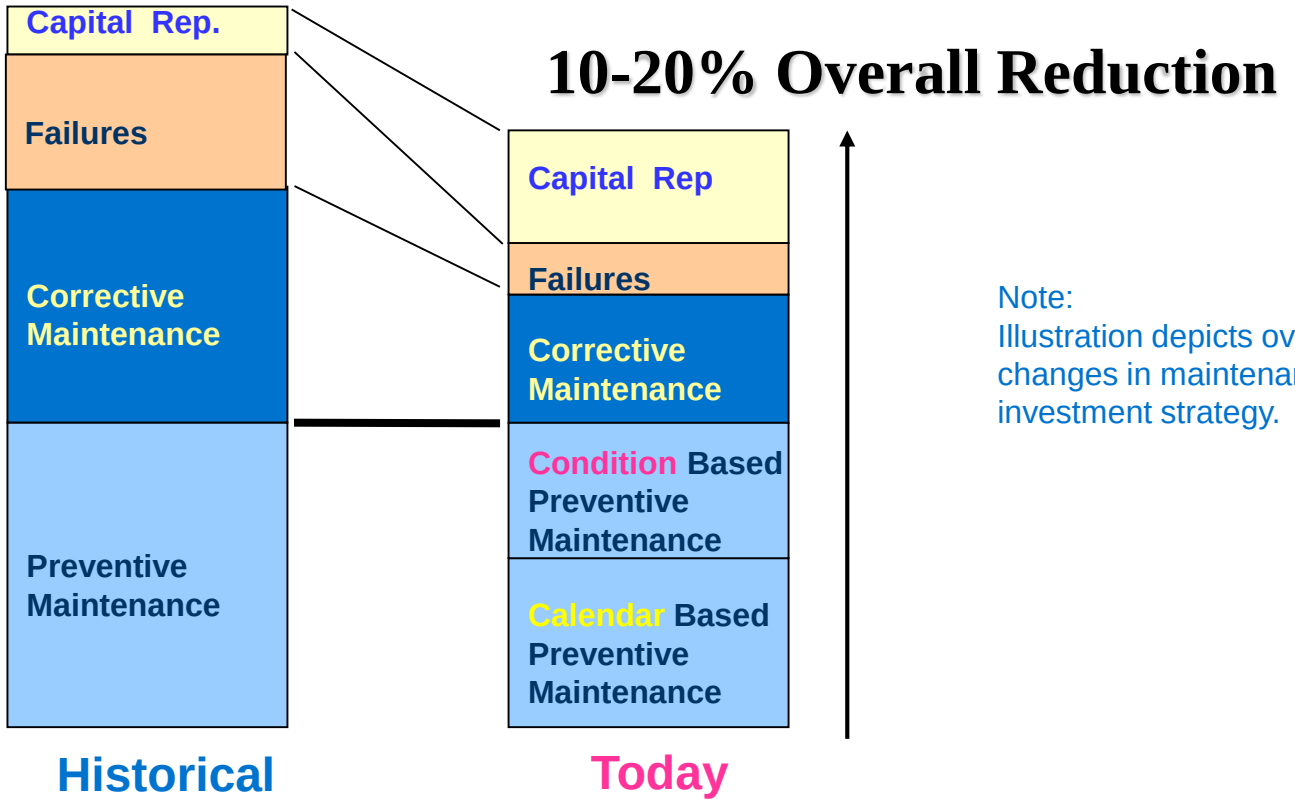
what should we fix next?



tails	Division	Floc	Floc Descr	Equipment	Equip Descr	Score	Person	Status	Manufacturer	Serial Numb
	ME	IPE-ME-SNW -1TRH	132-1 Transformer	000000000010510407	LTC/Selector and Transfer 13 Kv	4.9	Pekir/Angie	Follow-up	WESTINGHOUSE	7001829
	ME	IPE-ME-SNW -1TRH	132-1 Transformer	000000000010510410	LTC/Selector and Transfer 26 Kv	4.9	Pekir/Angie	Follow-up	WESTINGHOUSE	7001829
	ME	IPE-ME-SAT -1TRH	220-1 Transformer	000000000010046204	Load Tap Changer PHASE 1	4.5	Paul	OK	ALSTOM	1113022
	ME	IPE-ME-SAT -1TRH	220-1 Transformer	000000000010046204	Load Tap Changer PHASE 1	4.5	Paul	OK	ALSTOM	1113022
	ME	IPE-ME-SAT -1TRH	220-1 Transformer	000000000010046205	Load Tap Changer PHASE 2	4.5	Paul	OK	ALSTOM	1113022
	ME	IPE-ME-SAT -1TRH	220-1 Transformer	000000000010046205	Load Tap Changer PHASE 2	4.5	Paul	OK	ALSTOM	1113022
	ME	IPE-ME-SAT -1TRH	220-1 Transformer	000000000010046206	Load Tap Changer PHASE 3	4.5	Paul	OK	ALSTOM	1113022
	ME	IPE-ME-SAT -1TRH	220-1 Transformer	000000000010046206	Load Tap Changer PHASE 3	4.5	Paul	OK	ALSTOM	1113022
	CE	IPE-CE-GSE -21G	26-2 Transformers	000000000010501561	Load Tap Changer	3	Angie Rothweiler	Follow-up	GENERAL ELECTRIC	8285145
	CE	IPE-CE-SAL -4TRH	220-4 Transformer	000000000010502666	Load Tap Changer	3	Angie Rothweiler	Follow-up	PENNSYLVANIA	C0407351
	ME	IPE-ME-SES -1PAR	#1 Phase Angle Regulator (PAR)	000000000010661154	Load Tap Changer- Exciter	3	Pekir Joseph	Follow-up	ELIN	1724756
	CE	IPE-CE-GSE -132-7	132-7 Transformer	000000000010501565	Load Tap Changer	2.5	Shirish Patel	Awaiting Maint. Results	WESTINGHOUSE	7000445
	CE	IPE-CE-SMN -2PM	132-2 Transformer	000000000010023219	Load Tap Changer 132-2	2.5	Mark	OK	WESTINGHOUSE	6534460
	ME	IPE-ME-SNW -2TRH	132-2 Transformer	000000000010510411	LTC/Selector and Transfer 13 Kv	2.35	Don	OK - follow-up	WESTINGHOUSE	6537553
	ME	IPE-ME-SNW -2TRH	132-2 Transformer	000000000010510413	LTC/Selector and Transfer 26 Kv	2.35	Don	OK - follow-up	WESTINGHOUSE	6537553
	ME	IPE-ME-SNW -3TRH	132-3 Transformer	000000000010510415	LTC/Selector and Transfer 13 Kv	2.25	Don	OK - follow-up	WESTINGHOUSE	6537551
	ME	IPE-ME-SNW -3TRH	132-3 Transformer	000000000010510418	LTC/Selector and Transfer 26 Kv	2.25	Don	OK - follow-up	WESTINGHOUSE	6537551
	CE	IPE-CE-GSE -31G	26-3 Transformer	000000000010023775	Load Tap Changer	2.15	Shirish Patel	No Action	GENERAL ELECTRIC	8285144
	CE	IPE-CE-SLI -132-5	132-5 Transformer	000000000010023211	Load Tap Changer 132-5 26Kv	2.1	Pekir Joseph	Ownership Follow up	WESTINGHOUSE	6532766
	CE	IPE-CE-SMN -1PM	132-1 Transformer	000000000010023218	Load Tap Changer 132-1	2.1	Don Fallon	No action	WESTINGHOUSE	6534461
	CE	IPE-CE-SOS -T1	# 1 Transformer	000000000010503188	Load Tap Changer (URT)	2.1	Shirish Patel	Awaiting Maint. Results	WESTINGHOUSE	6994648
	CE	IPE-CE-SOS -T2	# 2 Transformer	000000000010503189	Load Tap Changer (URT)	2.1	John Wilson	Awaiting Maint.	WESTINGHOUSE	6994649
	ME	IPE-ME-HAW -T2	# 2 Transformer	000000000010507132	Load Tap Changer	2.1	George Arthur	Awaiting Maint. Results	WESTINGHOUSE	6994647
	CE	IPE-CE-BEN -T1	# 1 Transformer	000000000010503857	Load Tap Changer (URT)	2	Lenny	OK	WESTINGHOUSE	RAR66904
	CE	IPE-CE-SBB -1TRX	500-1 Transformer	000000000010047625	Load Tap Changer A	2	Mark	OK	SMIT	220826
	CE	IPE-CE-SBB -2TRX	500-2 Transformer	000000000010621128	Load Tap Changer A	2	George	Needs Review	VA TECH JST	50240
	CE	IPE-CE-SBB -2TRX	500-2 Transformer	000000000010621129	Load Tap Changer B	2	George	Needs Review	VA TECH JST	50239
	CE	IPE-CE-SBB -2TRX	500-2 Transformer	000000000010621130	Load Tap Changer C	2	George	Needs Review	VA TECH JST	50237
	CE	IPE-CE-SBB -3TRX	500-3 Transformer	000000000010608858	Load Tap Changer B	2	Mark Stoughton	Pending Action	SMIT	220968
	CE	IPE-CE-SBB -3TRX	500-3 Transformer	000000000010608859	Load Tap Changer C	2	Mark Stoughton	No Action	SMIT	220970

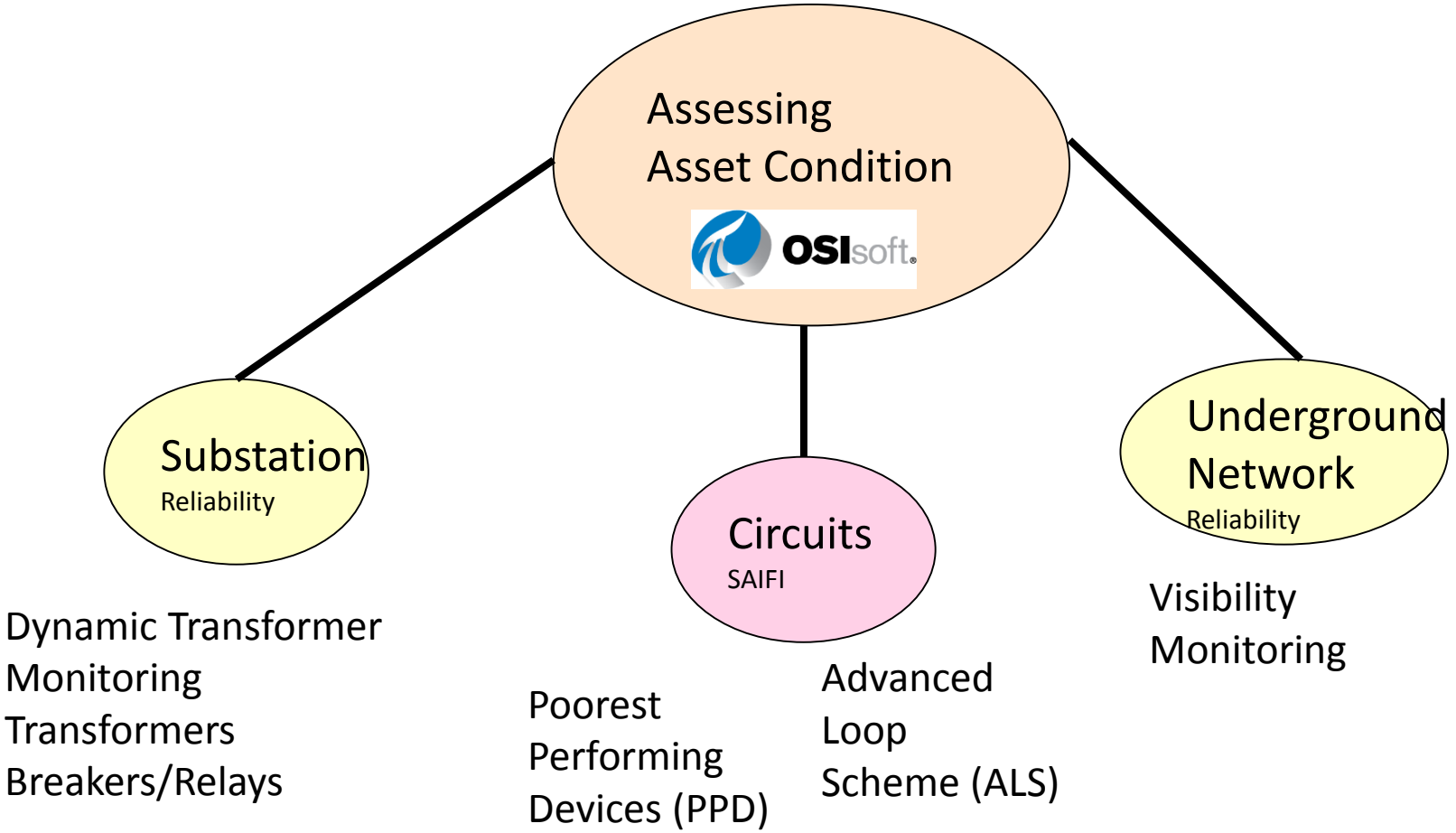
Benefits Breakdown

These annual expenditures protect $20.5 B of inside plant assets and full benefits after approximately five years.



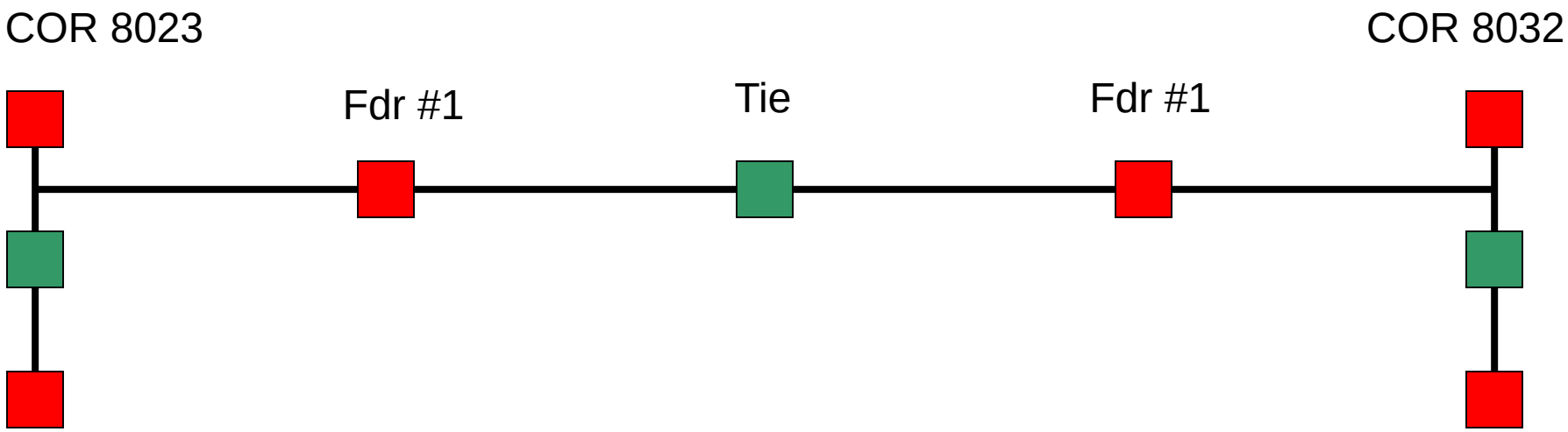
Note:
Illustration depicts overall changes in maintenance investment strategy.

Assessing Asset Condition

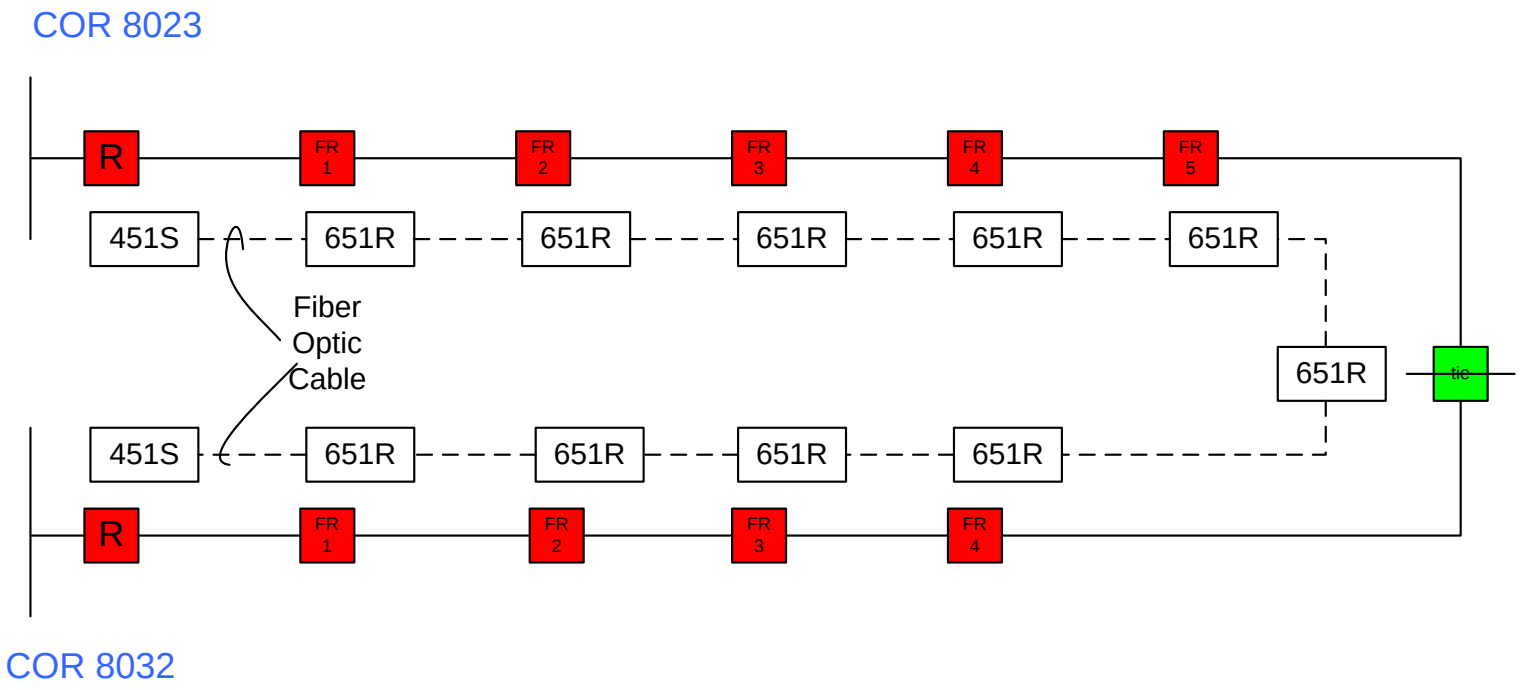


Traditional 13 kV Recloser Loop Scheme

Existing Configuration



Advance Loop Scheme (ALS)



Reliability Benefits

Innovations	Current System	Modernized Grid
Customer Segmentation	Average 1500 customers Impacted per outage	Average 500 Customers Impacted per outage
Single Phase Tripping	Not Implemented Average 1500 customers Impacted per outage	Average 167 single phase customers impacted per outage
Make Before Break	Momentary Interruption 30-60 seconds	No Momentary Interruptions

SAIFI Improvements

Options	Cost
Traditional Approach Trim tree's, replace equipment	$6 - 12 M per loop
Smart Grid Technology Limit risk, add communications (fiber), and leverage technology	$2 - 4 M per loop

Both options produce similar SAIFI results for the first year

Enhancements to SAIFI assessment and asset management programs…

…will mitigate rising electric distribution SAIFI trends.

Poorest Performing Device Program

Targeting extended customers interrupted, a two part asset evaluation algorithm was developed, modeled after our current inside plant CMMS system structure.

I. Incident Evaluator Algorithm:

Device Health Score provides the basis for an initial prioritization of potential projects, subject to further field inspections and cost estimates as described below.

Customers Interrupted

60%

- Number of customer interruptions

Frequency

30%

- Number of occurrences

Remediation Complexity

10%

- Variance of cause codes

II. Field Inspection, SAIFI validation and Cost Estimates:

Scope of work assessment in field provides basis for cost estimate and validation of SAIFI benefit.

Benefits and costs form basis for ***SAIFI Investment Yield*** calculation and final prioritization of projects.

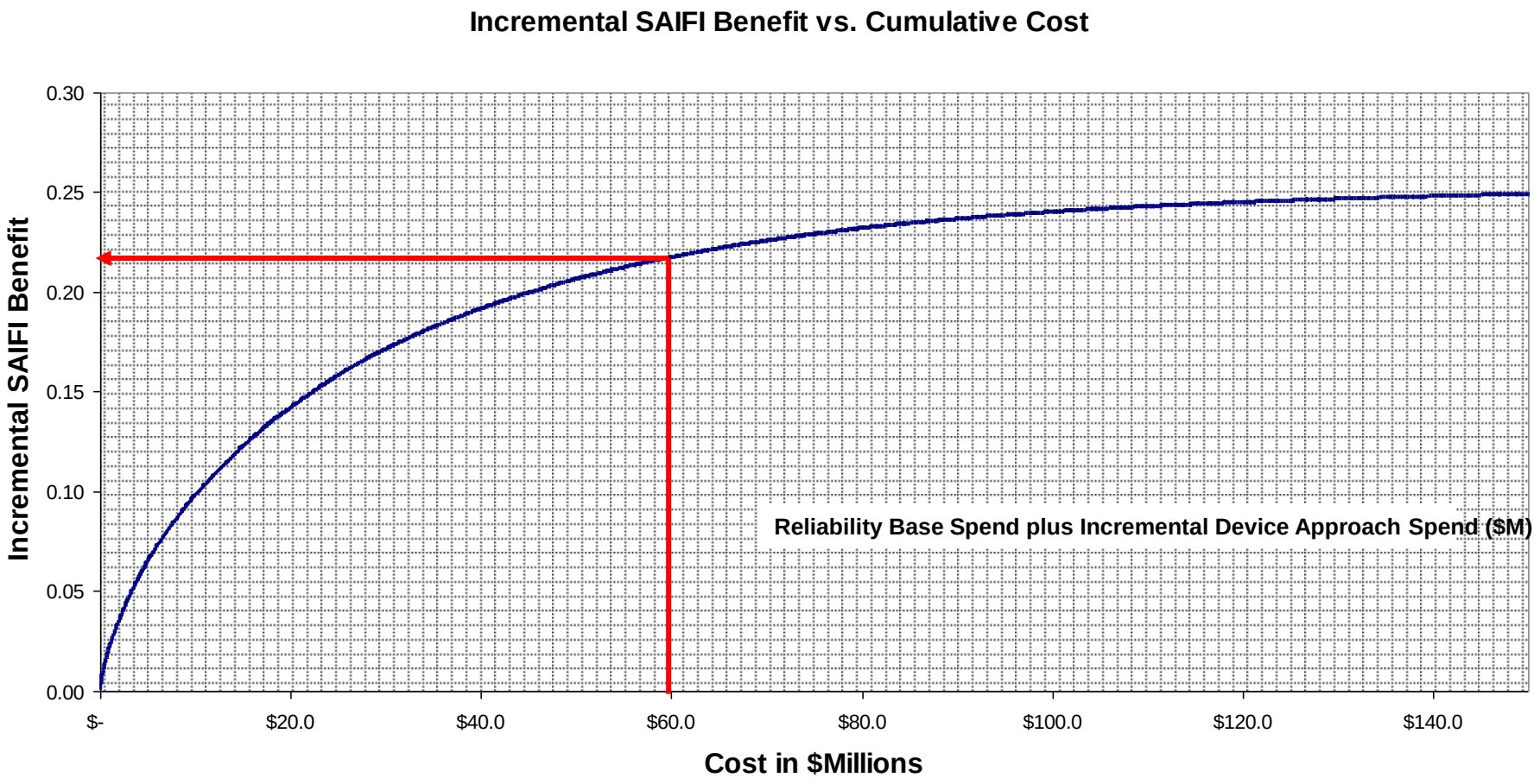
SAIFI Benefit Validation

Remediation Cost Estimate

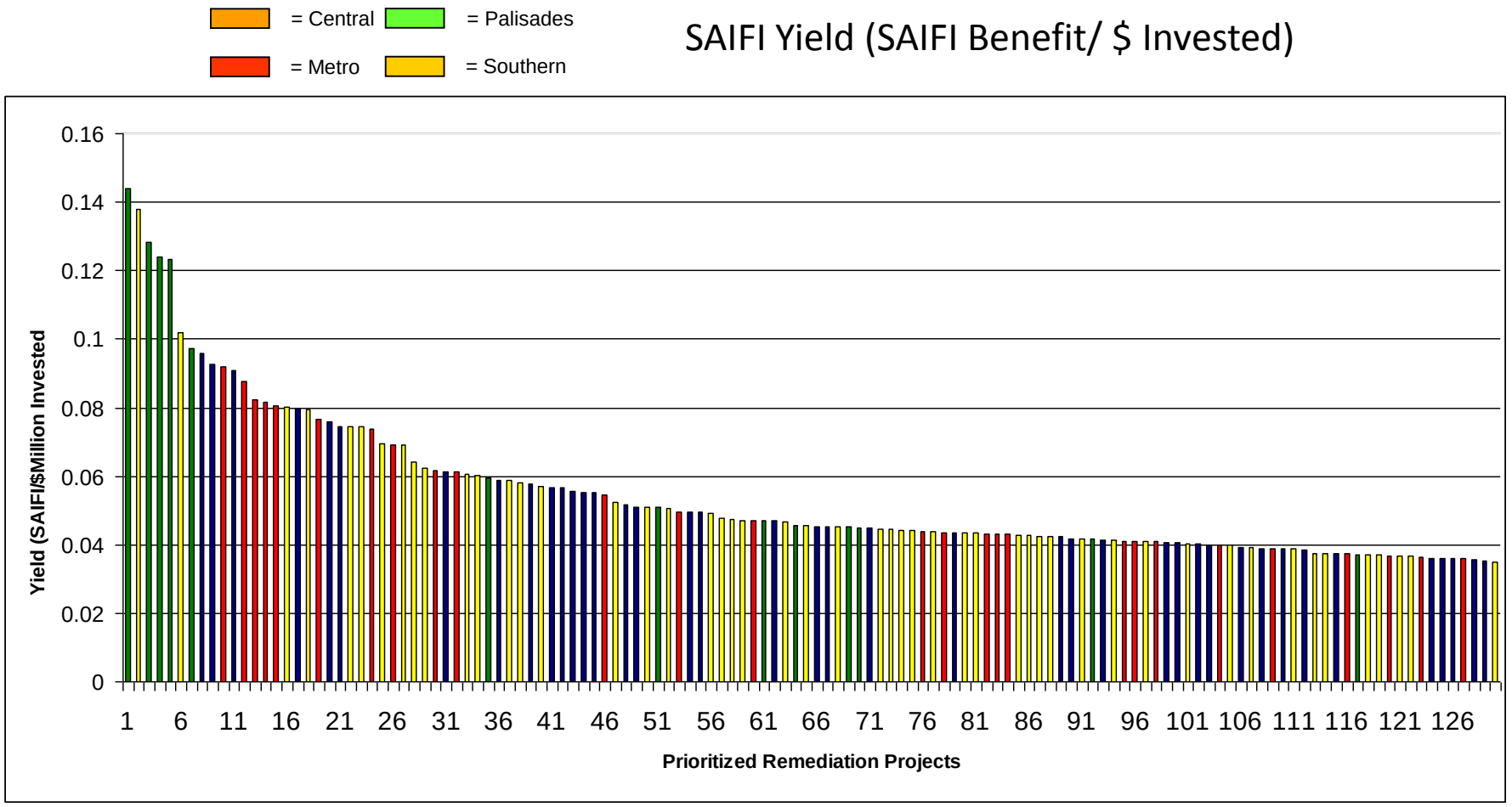
- Scope of work assessment by field engineering / asset management
  - SAIFI benefit validation
  - Remediation cost estimates

SAIFI Yield on Investment (Yield Score)

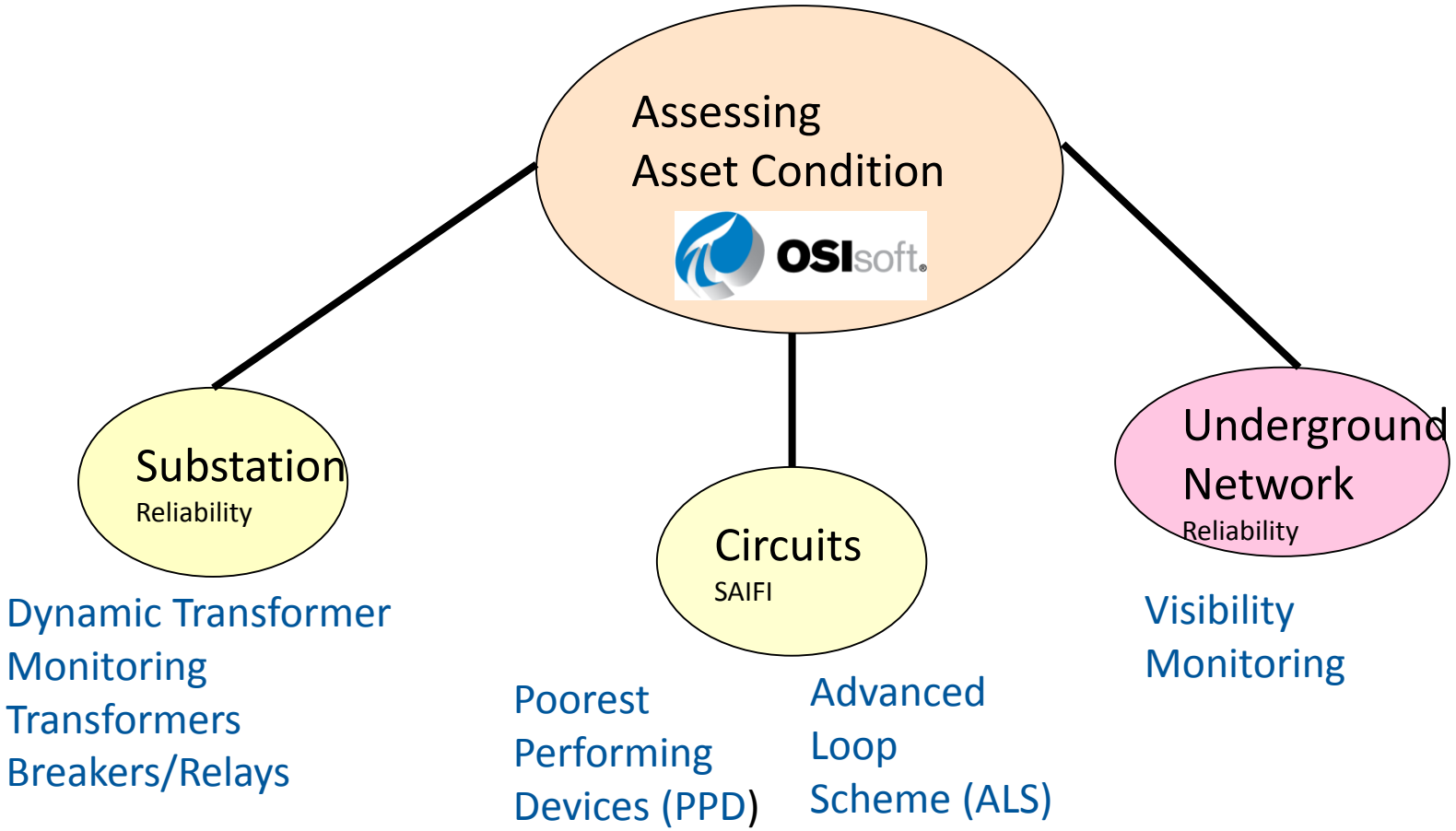
SAIFI Benefit attained from Incremental Spend



Remediation Options Prioritized by SAIFI Yield



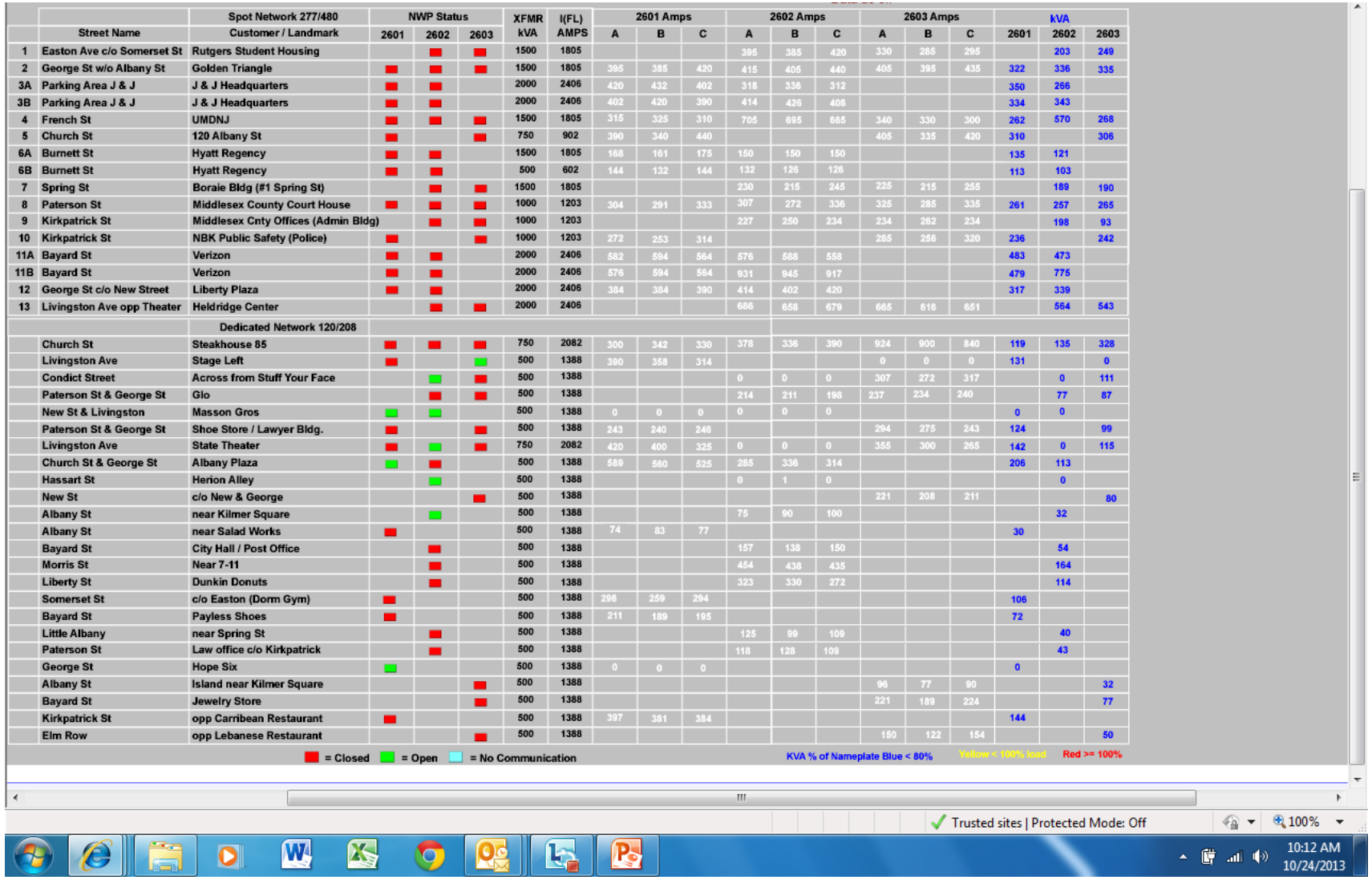
Assessing Asset Condition



Networking Monitoring System (NMS)

- Reduce restoration time for underground cables.
  (Sensor identify location of failures)
- Pattern recognition to determine type of fault.
- Visibility to all key underground network assets
- Consolidated asset inspection, test and maintenance data
- Consistent information base for comparative analysis

System Visualization



	Street Name	Spot Network 277/480 Customer / Landmark	NWP Status 2601	NWP Status 2602	NWP Status 2603	XFMR kVA	I(FL) AMPS	2601 Amps A	2601 Amps B	2601 Amps C	2602 Amps A	2602 Amps B	2602 Amps C	2603 Amps A	2603 Amps B	2603 Amps C	kVA 2601	kVA 2602	kVA 2603
1	Easton Ave c/o Somerset St	Rutgers Student Housing				1500	1805				395	385	420	330	285	295		203	249
2	George St w/o Albany St	Golden Triangle				1500	1805	395	385	420	415	405	440	405	395	435	322	336	335
3A	Parking Area J & J	J & J Headquarters				2000	2406	420	432	402	318	336	312				350	266	
3B	Parking Area J & J	J & J Headquarters				2000	2406	402	420	390	414	426	408				334	343	
4	French St	UMDNJ				1500	1805	315	325	310	705	695	685	340	330	300	262	570	268
5	Church St	120 Albany St				750	902	390	340	440				405	335	420	310		306
6A	Burnett St	Hyatt Regency				1500	1805	168	161	175	150	150	150				135	121	
6B	Burnett St	Hyatt Regency				500	602	144	132	144	132	126	126				113	103	
7	Spring St	Boraie Bldg (#1 Spring St)				1500	1805				230	215	245	225	215	255		189	190
8	Paterson St	Middlesex County Court House				1000	1203	304	291	333	307	272	336	325	285	335	261	257	265
9	Kirkpatrick St	Middlesex Cnty Offices (Admin Bldg)				1000	1203				227	250	234	234	262	234		198	93
10	Kirkpatrick St	NBK Public Safety (Police)				1000	1203	272	253	314				285	256	320	236		242
11A	Bayard St	Verizon				2000	2406	582	594	564	576	588	558				483	473	
11B	Bayard St	Verizon				2000	2406	576	594	564	931	945	917				479	775	
12	George St c/o New Street	Liberty Plaza				2000	2406	384	384	390	414	402	420				317	339	
13	Livingston Ave opp Theater	Heldridge Center				2000	2406				686	658	679	665	616	651		564	543
		Dedicated Network 120/208																	
	Church St	Steakhouse 85				750	2082	300	342	330	378	336	390	924	900	840	119	135	328
	Livingston Ave	Stage Left				500	1388	390	358	314				0	0	0	131		0
	Condict Street	Across from Stuff Your Face				500	1388				0	0	0	307	272	317		0	111
	Paterson St & George St	Glo				500	1388				214	211	198	237	234	240		77	87
	New St & Livingston	Masson Gros				500	1388	0	0	0	0	0	0				0	0	
	Paterson St & George St	Shoe Store / Lawyer Bldg.				500	1388	243	240	246				294	275	243	124		99
	Livingston Ave	State Theater				750	2082	420	400	325	0	0	0	355	300	265	142	0	115
	Church St & George St	Albany Plaza				500	1388	589	560	525	285	336	314				206	113	
	Hassart St	Herion Alley				500	1388				0	1	0					0	
	New St	c/o New & George				500	1388							221	208	211			80
	Albany St	near Kilmer Square				500	1388				75	90	100					32	
	Albany St	near Salad Works				500	1388	74	83	77							30		
	Bayard St	City Hall / Post Office				500	1388				157	138	150					54	
	Morris St	Near 7-11				500	1388				454	438	435					164	
	Liberty St	Dunkin Donuts				500	1388				323	330	272					114	
	Somerset St	c/o Easton (Dorm Gym)				500	1388	296	259	294							106		
	Bayard St	Payless Shoes				500	1388	211	189	195							72		
	Little Albany	near Spring St				500	1388				125	99	109					40	
	Paterson St	Law office c/o Kirkpatrick				500	1388				118	128	109					43	
	George St	Hope Six				500	1388	0	0	0							0		
	Albany St	Island near Kilmer Square				500	1388							96	77	90			32
	Bayard St	Jewelry Store				500	1388							221	189	224			77
	Kirkpatrick St	opp Carribean Restaurant				500	1388	397	381	384							144		
	Elm Row	opp Lebanese Restaurant				500	1388							150	122	154			50

= Closed = Open = No Communication

KVA % of Nameplate Blue < 80% Yellow < 100% load Red >= 100%

NMS Benefits

- Provides control and indication
- Provides Condition Assessment for transformers and network protector
- Remote access to network relays for settings and validation.
- O&M savings
  - OT savings (5% reduction in CM)
  - “Day priors” can be done via system rather than by field crew
  - Improved response & turnaround during faults

PSE&G Future Vision

- Cyber Security
- Asset Reliability
- Risk Management
- Storm Performance Improvements

  (Superstorm SANDY)

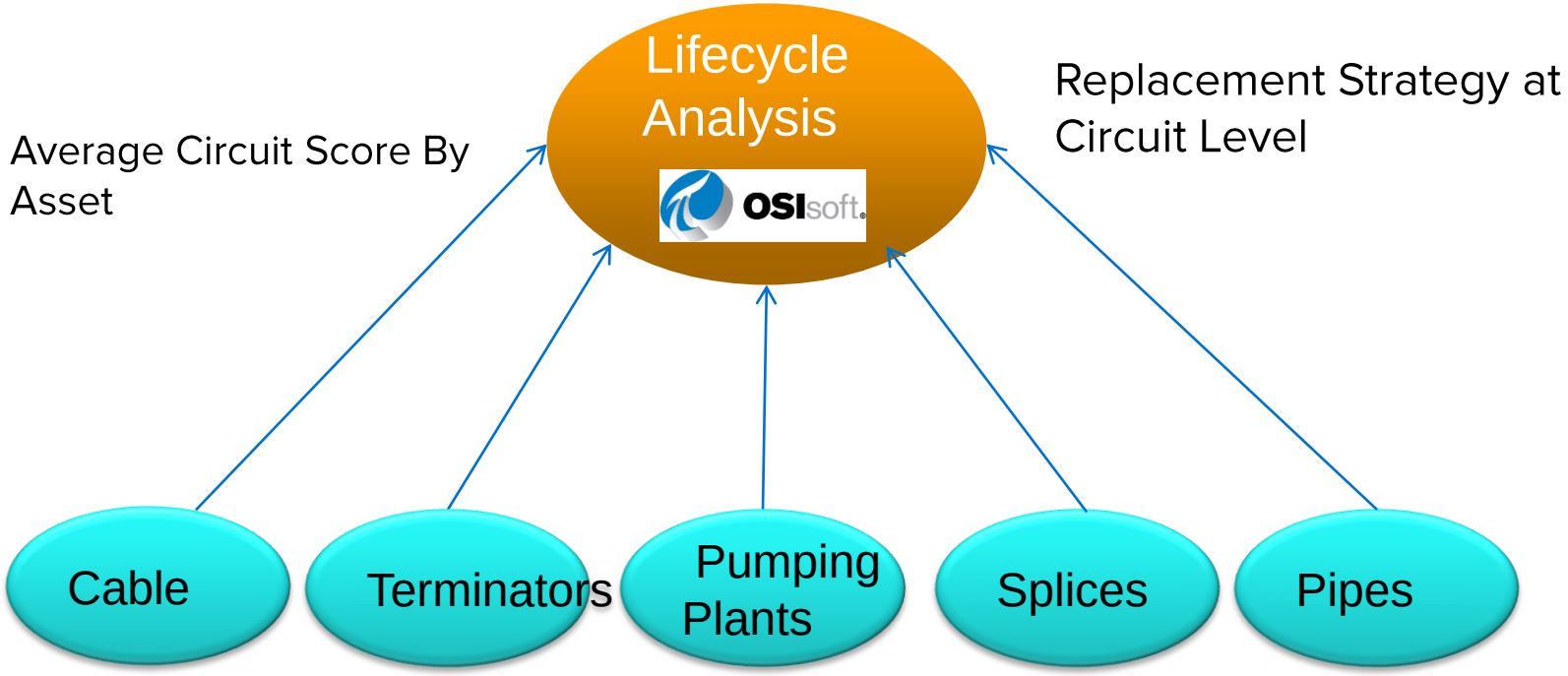
  - Outage Management (ADMS)
  - Graphic Information System
  - Mobile Data

Continously Expanding CMMS Condition Assessment Tools

CMMS has been enhanced to include condition assessment of:

- Transmission OH and UG
  - Enhance the Transmission OH and UG Condition Based Maintenance (CBM) program in order to minimize failures, increase equipment availability, redirect maintenance costs and prioritize capital expenditures.

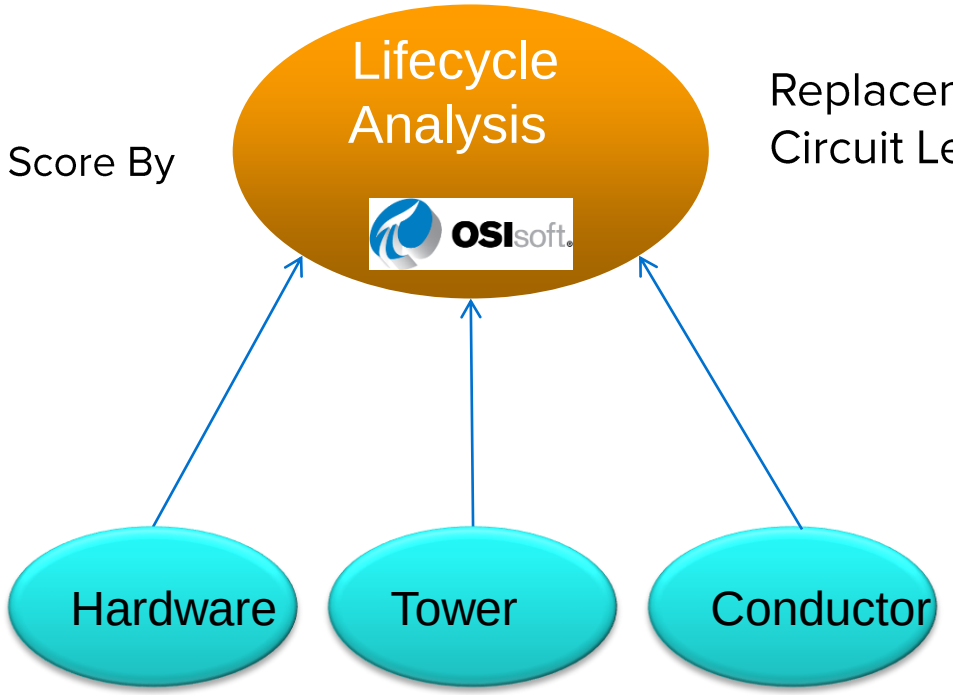
Transmission UG Asset Model & Strategy



CBM Algorithms at Asset Level to identify troubled assets

Transmission OH Asset Model & Strategy

Average Circuit Score By Asset



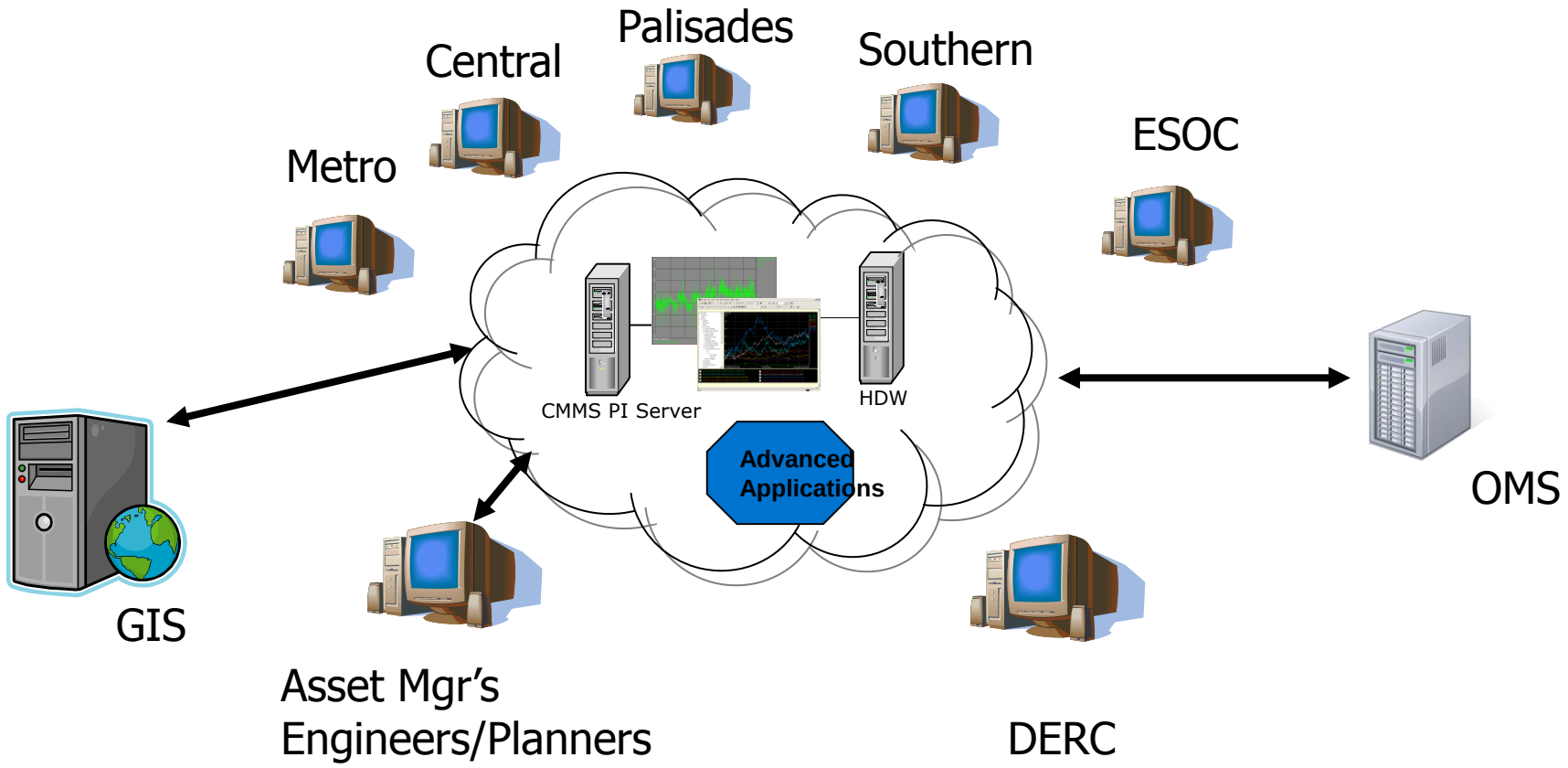
Replacement Strategy at Circuit Level

CBM Algorithms at Asset Level to identify troubled assets

Asset Reliability Management System

To Be Virtual Dispatch Center

The overall initiative focuses on utilizing, improving and augmenting the overall capabilities of the Transmission Operation System while incorporating new technology, methodology, recognizing and capitalizing on business drivers and opportunities along the way.



Predictive & Prescriptive Analytics

Identifying areas most impacted from a major storm before the storm happens

- Estimating the probability of significant wind/rain using new research for modeling turbulence by Princeton University
- Overlaying information on our GIS model with OMS historical data
- Positioning utility trucks in anticipation of outages to improve restoration time.

Identifying assets at risk of failure and consequence of failure

- Estimating the probability of an asset failure as a function of the asset age, condition assessment, failure history and loading history.
- Integrating historical data currently available in the PI system and Asset Registry.
- Use a hybrid strategy that combines historical data with priors derived from field experts

Predictive & Prescriptive Analytics

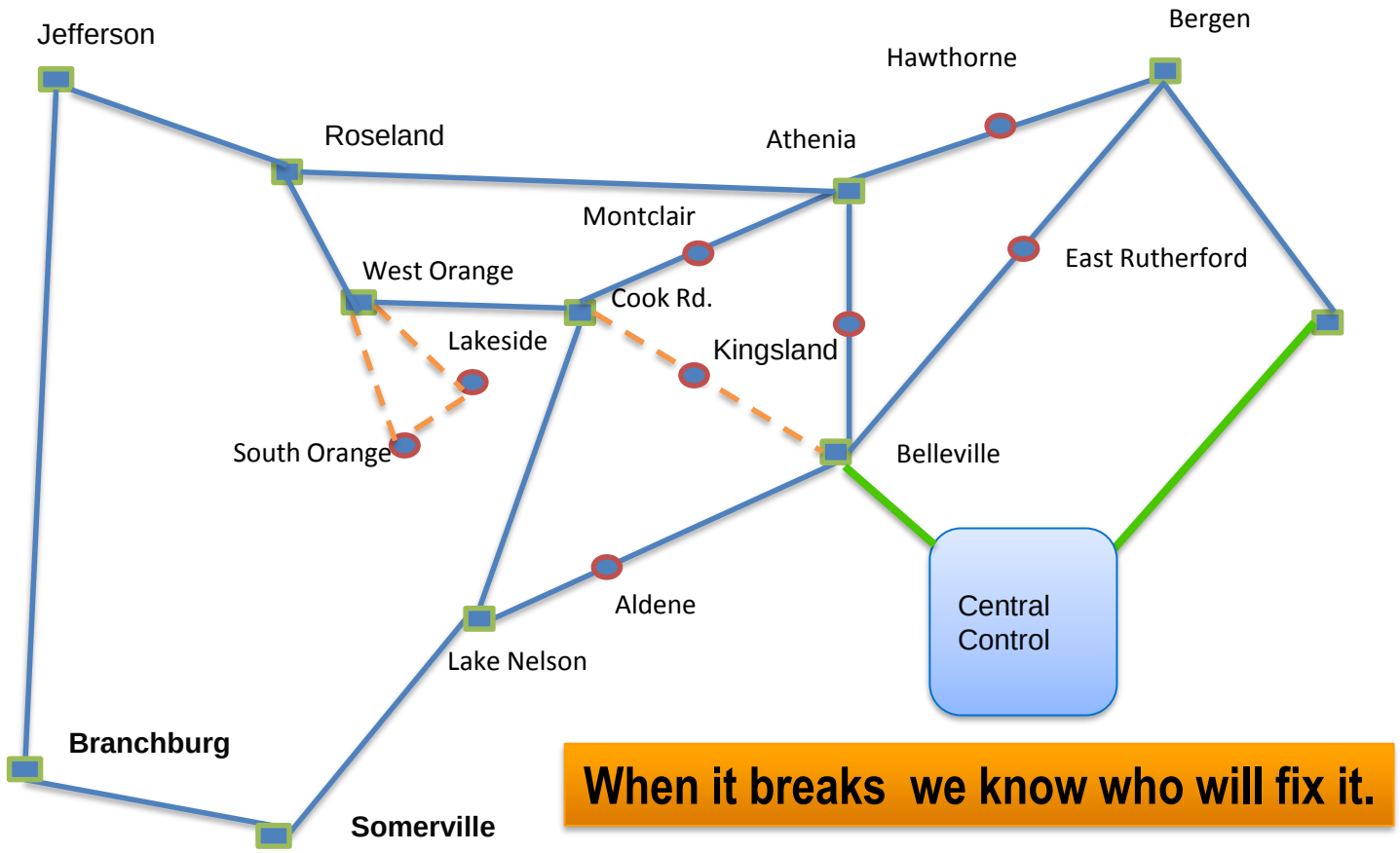
Designing a robust grid configuration

- Estimate the probability of branch (and bus) outages, where the primary risk is branch outages due to trees.
  (Joint effort with Princeton University)

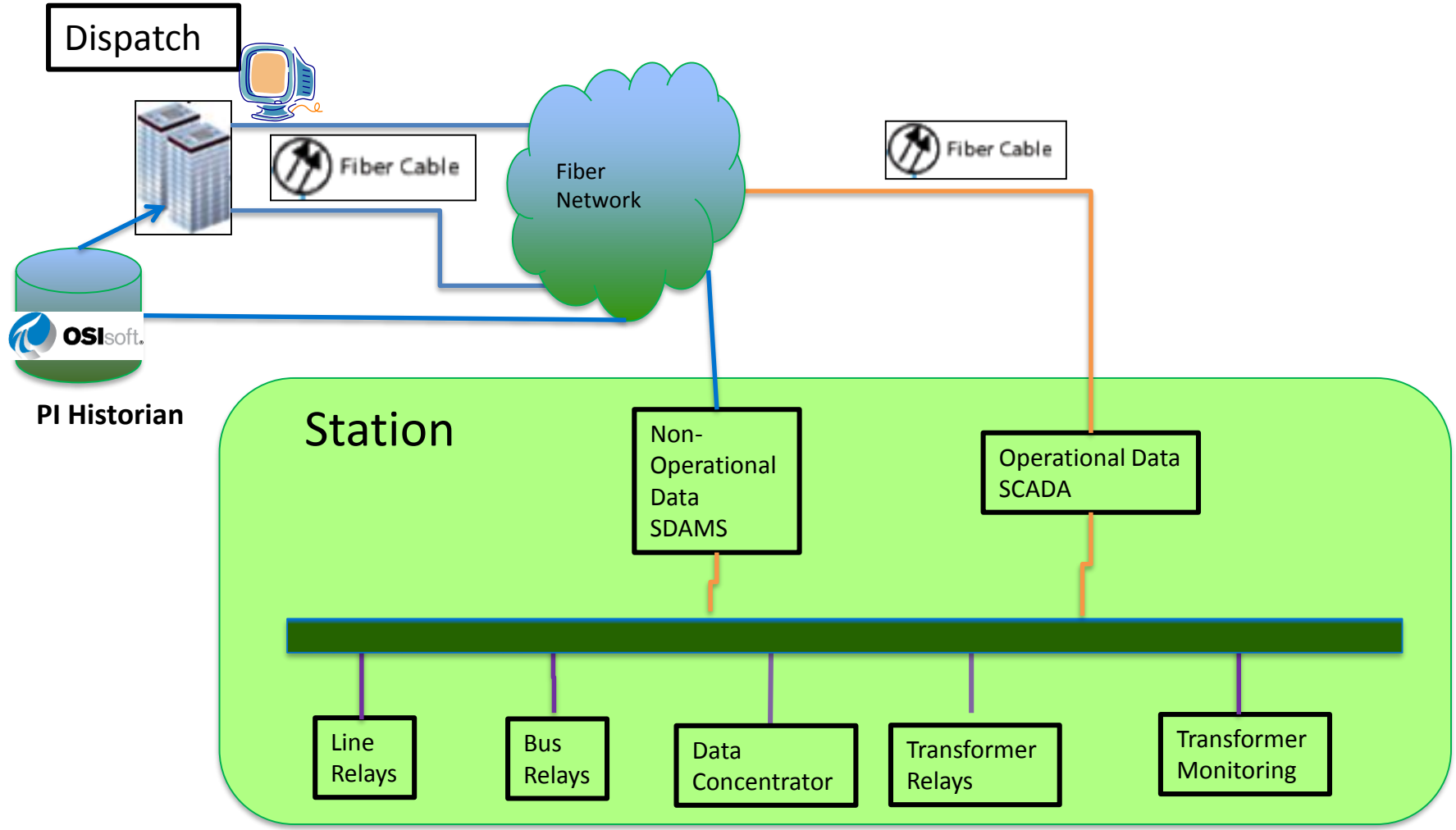
- Uses our GIS model as well as historical outage data from the PI & OMS databases and customer criticality of each location to create risk assessments and financial impacts of remediation

Build a Fiber Network

Reliable communications network



Smart Network Management needs data

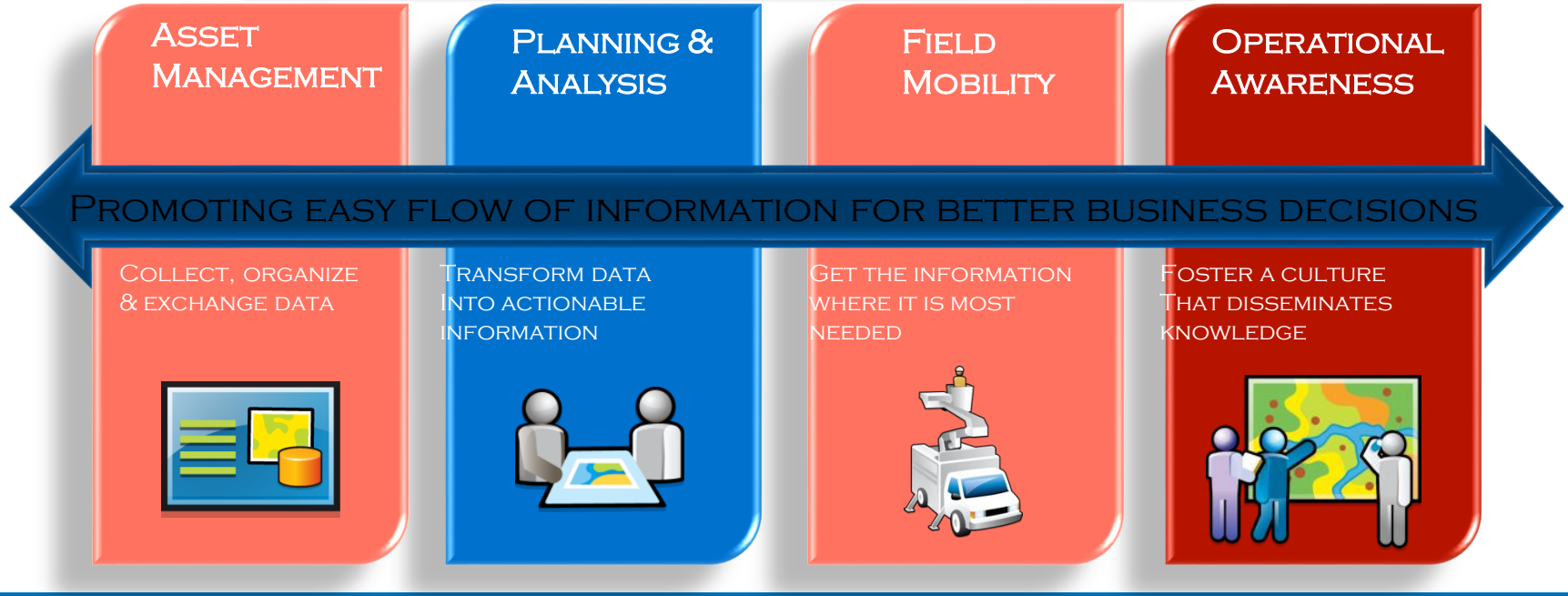


The Future is ….

Storm Damage Assessment – decision support systems

(GIS) Graphic Information System Upgrade
(OMS) Replace Outage Management System
(ADMS) Replace Distribution Management Systems

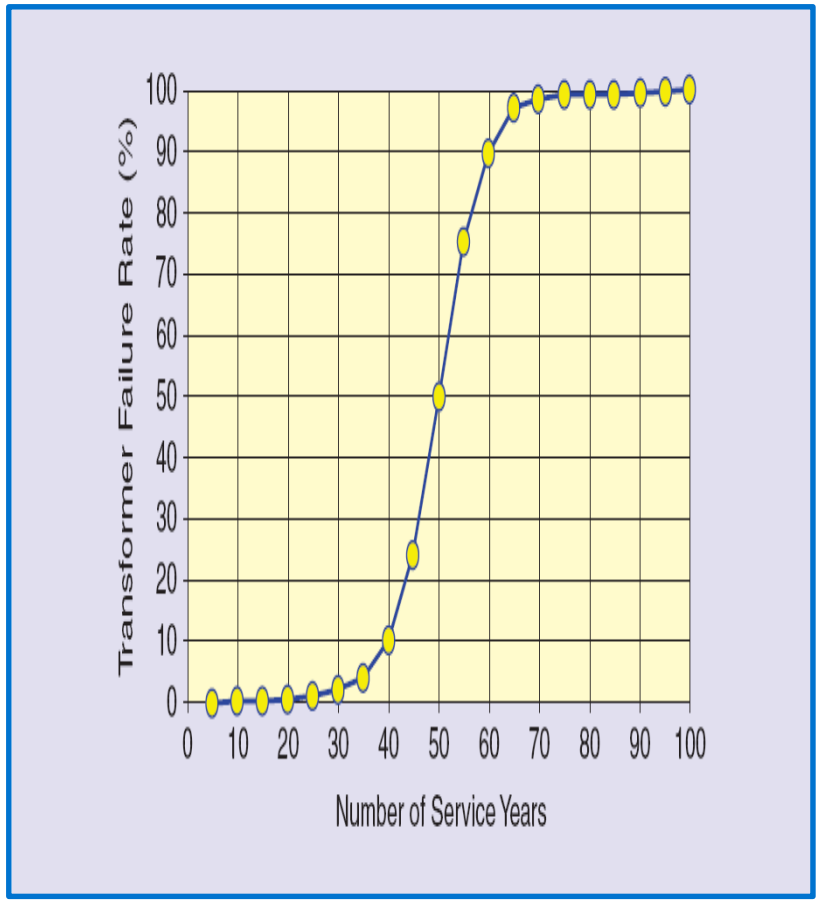
(EMS) Replace Energy Management System
Asset Risk Management (Operational Awareness)



Risk Management

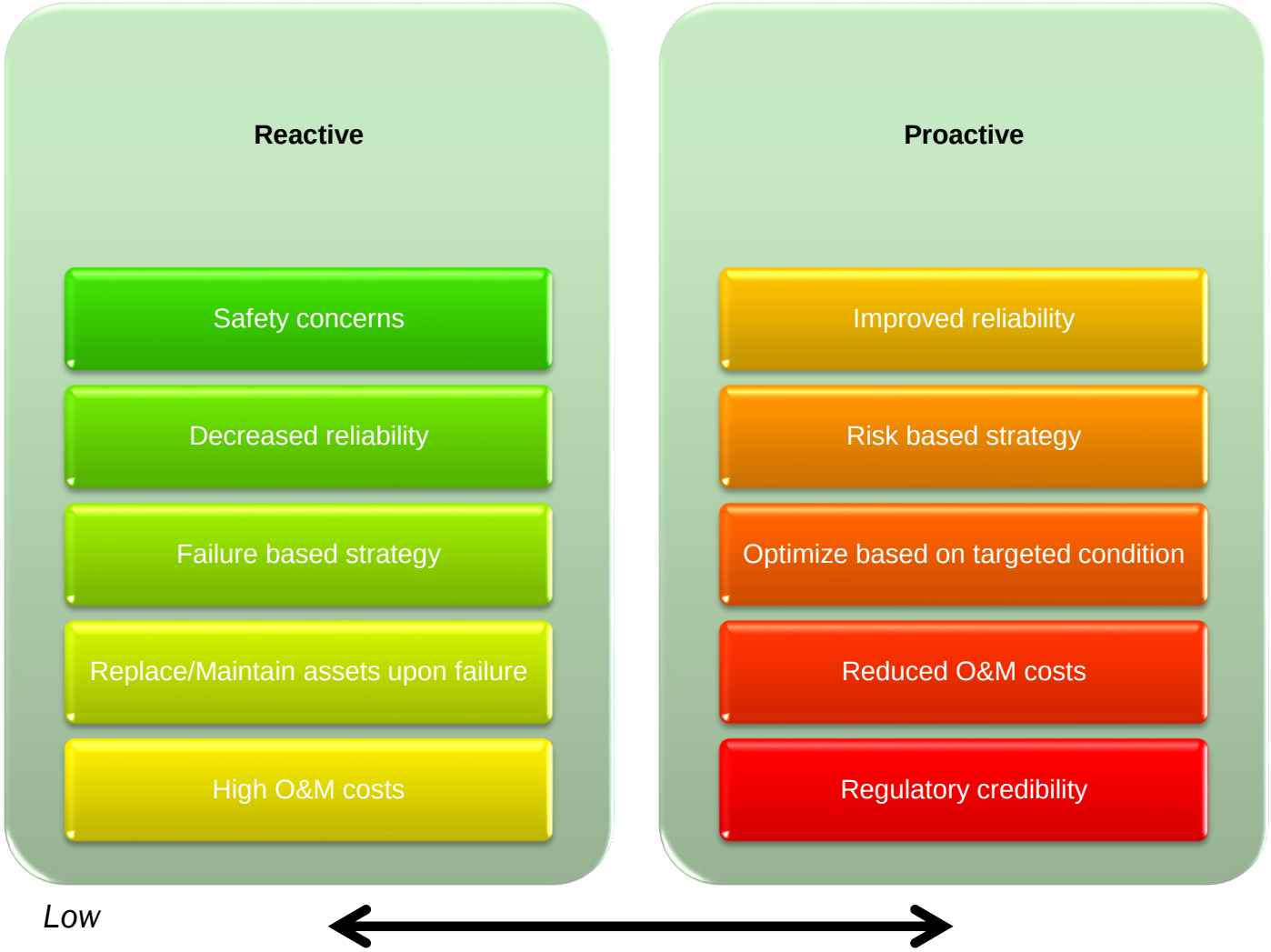
Our Future…

- Develop an '*Asset-Based Risk Register*' to document, track, and aid in communicating key system and component failure risks.
- Increased rigor in how Risk is defined, measured and reported (meaningful terms for decision making).
- Develop risk calculation framework and assessment methodologies including metrics and key risk indicators (KRIs)
- Timely, accurate and insightful data / information / recommendations



Life Cycle Analysis - A Shift in Strategy

Distribution Investments



A proactive risk based asset management strategy results in overall operational awareness.

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

ありがとう

Спасибо

Obrigado

OSIsoft®

Regional Conference

LATAM

June 7-8, Sao Paulo

#OSIsoftLATAM
#OSIsoftLRC

OSIsoft.

Regional Conference
LATAM
June 7-8, Sao Paulo

OSIsoft®

Regional Conference

LATAM

June 7-8, Sao Paulo