Benefits of Smart Grid

Prepared for

Delegation from Saudi Arabia

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Duke SmartGrid Components

- Advanced Metering Infrastructure (AMI)
- Distribution Automation (DA)

Advanced Metering Infrastructure
- Electric -

- Advanced Digital Meters replace analog meters
- Reading usage every 15 minutes
- Sending data via power line carrier to node on a local pole or pad
- Backhaul to Meter Data Management System (MDMS) by wireless cellular common carrier

Distribution Automation

- Distribution line sensors feed circuit condition information to Distribution Management System (DMS)
- Sensors provide outage and voltage data
- Communications gear backhauls sensor data
- DMS controls switch gear, re-closers, and power conditioning equipment at substations
  - Sectionalize outages
  - Control voltage

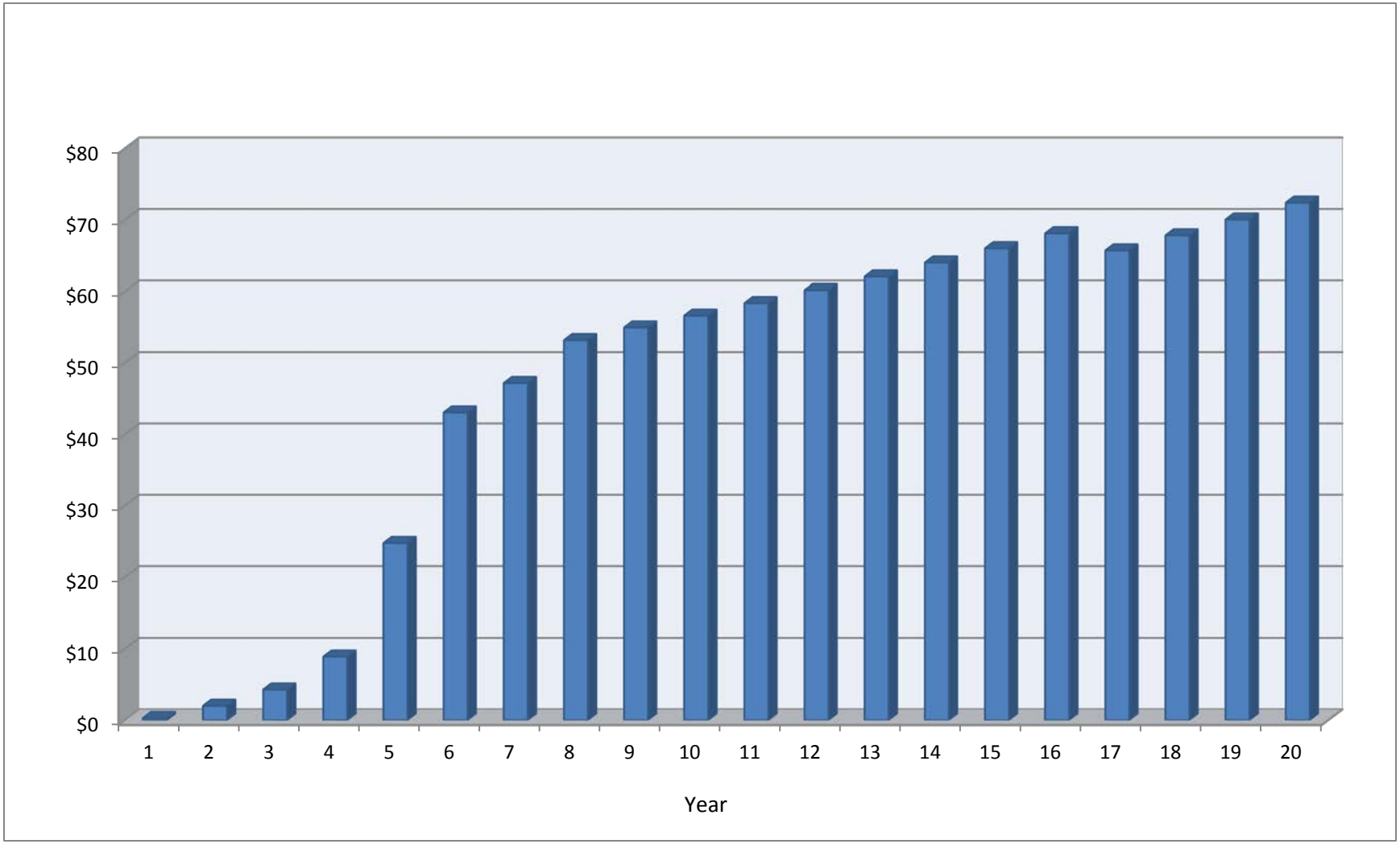
Benefits Assessment

- Benefits naturally accruing to the Company
  - Reductions in operating expense
  - Increases in revenues
    - Distribution (Duke Energy Ohio)
    - Generation (SSO Suppliers)
- Benefits naturally accruing to the Customer
  - Distribution efficiencies from IVVC
  - Fewer, smaller and shorter outages

Duke SmartGrid Deployment Costs

Millions of Nominal Dollars, 2009 - 2014	
Total Deployment CAPITAL Cost	$ 509.40
O&M Expenses 2009 - 2014	$ 63.10
Total	$ 572.50
USDOE SGIG Grant Offset	$ (110.00)
Source: Wyatt, p. 76, Table 38B - Revised	

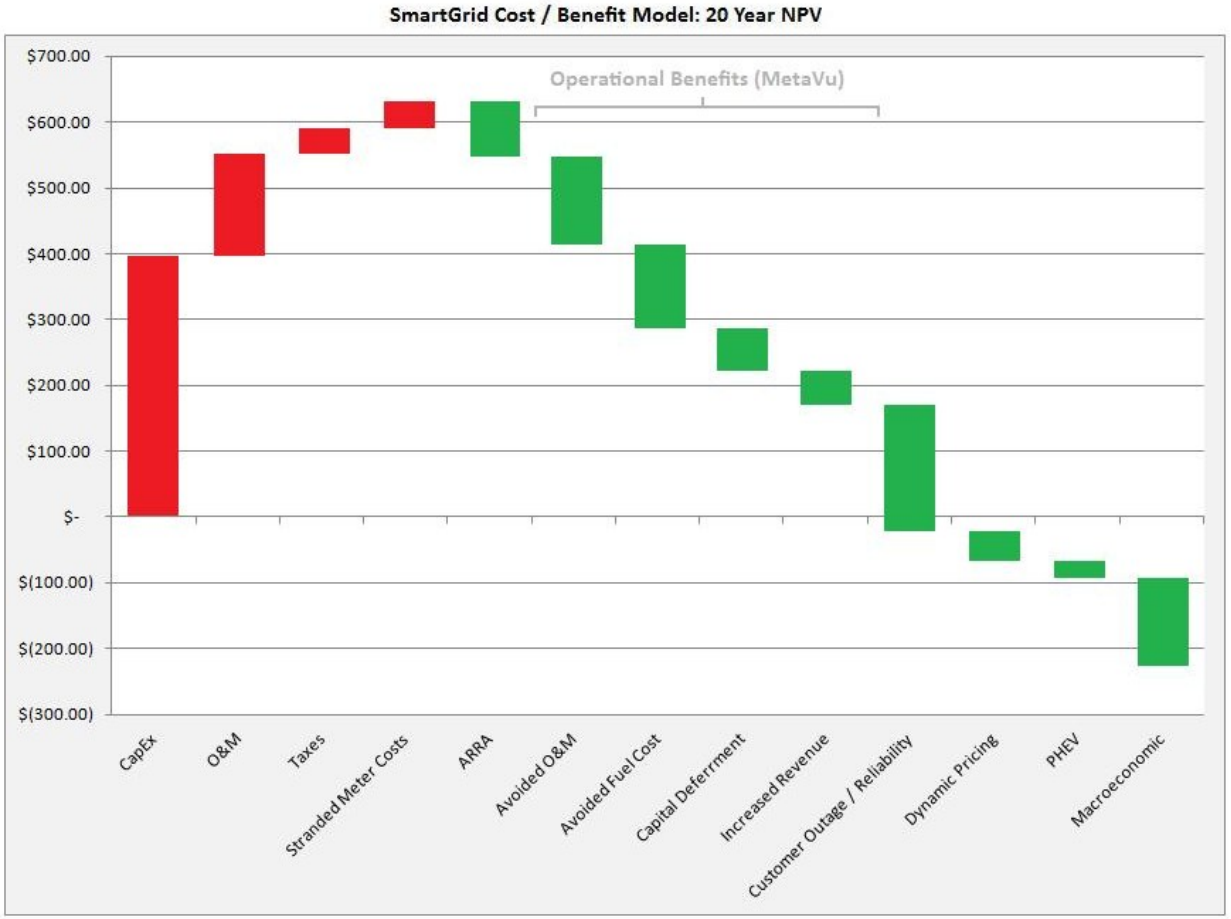
Total Annual Operational Benefits



Source: MetaVu

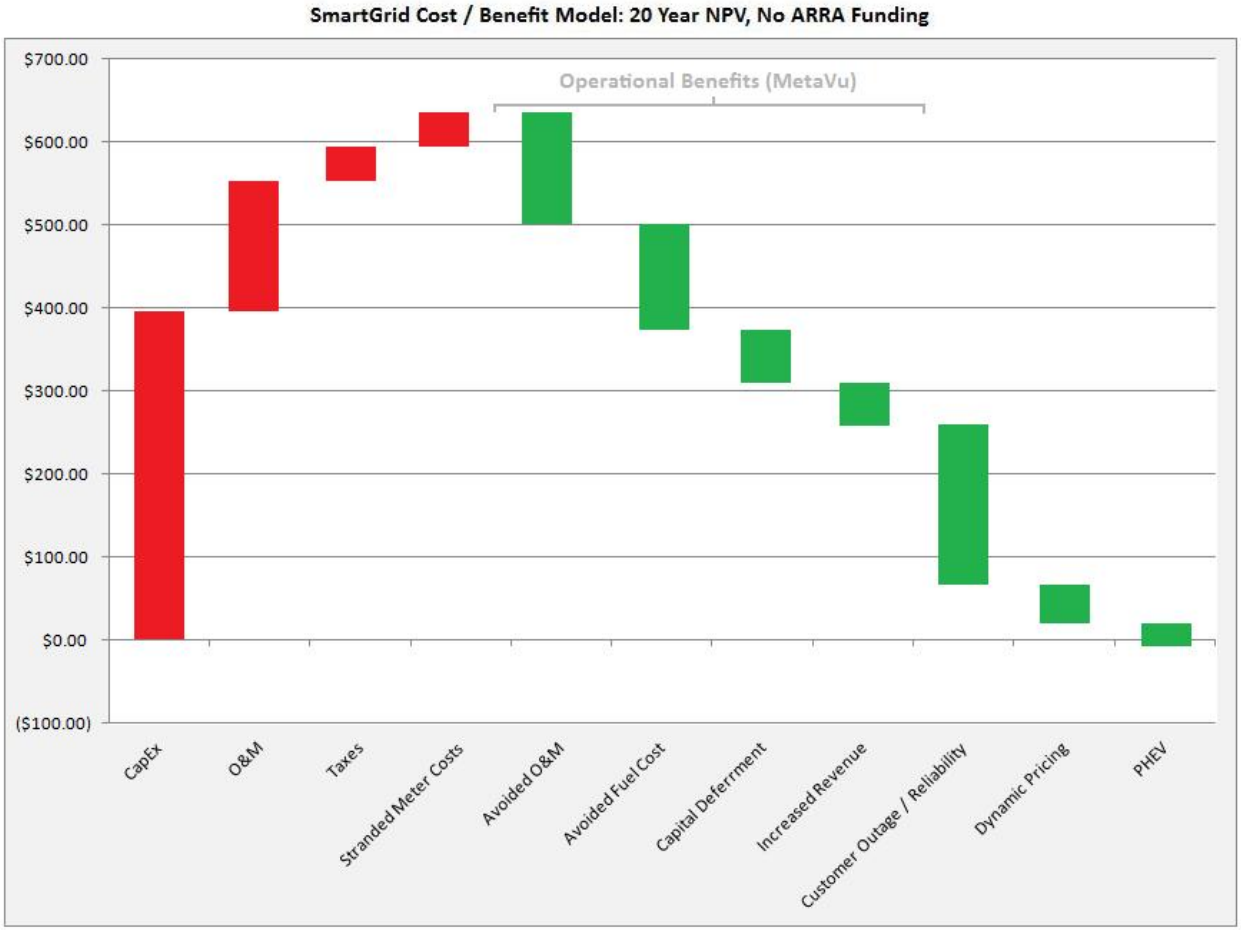
Business Case

Staff Analysis with SGIG Offset



Business Case

Staff Analysis – No Offset



Benefits Assessment

- 26 Buckets of Benefits estimated
  - SmartGrid costs are front loaded
  - Benefits are back loaded
- 20 year nominal value = $950 MM
- 20 year present value = $382 MM
- Some buckets not applicable due to SSO structure
  - Savings from Time Based Rates
  - Wholesale sales due to freed-up capacity

Figure 5.3.1 Summary of Base Case Estimate Data by Operational Benefit

Benefit Number	Infrastructure Category	Benefit	Savings Category	5-Year NPV BASE	20-Year Total BASE	20-Year NPV BASE
1	AMI	Regular meter reads	Avoided O&M Cost	$ 3.75	$ 125.28	$ 49.86
2	AMI	Off-cycle / off-season meter reads	Avoided O&M Cost	$ 8.33	$ 123.43	$ 53.96
3	AMI	Remote meter diagnostics	Avoided O&M Cost	$ 0.74	$ 16.07	$ 6.53
4 & 5[11]	AMI	Power theft (4) - Recovery Costs (5)	Increased Revenue	$ 0.92	$ 19.47	$ 7.94
6	AMI	Meter operations – Avoided capital costs	Capital Deferment	$ 2.03	$ 40.28	$ 16.58
7	AMI	Meter operations – Decreased annual expenses	Avoided O&M Cost	$ 0.29	$ 5.91	$ 2.43
8	AMI	Meter accuracy improvement	Increased Revenue	$ 0.98	$ 20.87	$ 8.51
9	AMI	Meter Salvage Value	Increased Revenue	$ 0.45	$ 0.93	$ 0.66
10	AMI	Outage Detection	Avoided O&M Cost	$ 0.07	$ 1.44	$ 0.59
11	AMI	Outage Verification	Avoided O&M Cost	$ 0.64	$ 12.68	$ 5.22
12	AMI	Outage – Incremental Revenue	Increased Revenue	$ 0.62	$ 14.96	$ 5.64
13	DA	24/7/365 System Voltage Reduction Strategy	Mostly Avoided Fuel Cost	$ 7.48	$ 389.92	$ 155.57
14	DA	Power Shortage Voltage Reduction	Capital Deferment	$ 0.07	$ 2.15	$ 0.86
15	DA	Continuous Voltage Monitoring	Avoided O&M Cost	$ 0.06	$ 4.37	$ 1.71
16	DA	VAR Management	Capital Deferment	$ 0.87	$ 22.54	$ 9.26
17	DA	Asset Management	Capital Deferment	$ -	$ 3.00	$ 1.89
18	DA	System Fine-tuning	Mostly Avoided Fuel Cost	$ 0.03	$ 18.74	$ 7.17
19	DA	Capacitor Inspections	Avoided O&M Cost	$ 0.05	$ 3.57	$ 1.39
20	DA	Circuit Breaker Inspections	Avoided O&M Cost	$ 0.10	$ 1.86	$ 0.77
21	AMI	Call center efficiency	Avoided O&M Cost	$ 0.14	$ 2.75	$ 1.13
22	AMI	Increase in safety	Avoided O&M Cost	$ 0.10	$ 2.28	$ 0.93
23	AMI	Billing savings – Shortened billing cycle	Avoided O&M Cost	$ 0.12	$ 1.78	$ 0.74
24	AMI	Vehicle Management	Avoided O&M Cost	$ 1.22	$ 24.83	$ 10.21
25	DA	Fuel Cost Reduction through VAR reduction	Avoided Fuel Cost	$ 0.18	$ 9.31	$ 3.73
26	DA	Wholesale sales due to freed-up capacity	Increased Revenue	$ 0.05	$ 81.54	$ 29.52
TOTAL				$ 29.29	$ 949.96	$ 382.79

[11] Benefits 4 & 5 have been combined as one benefit.

Figure 5.3.6 Operational Benefit Ranking by NPV Size

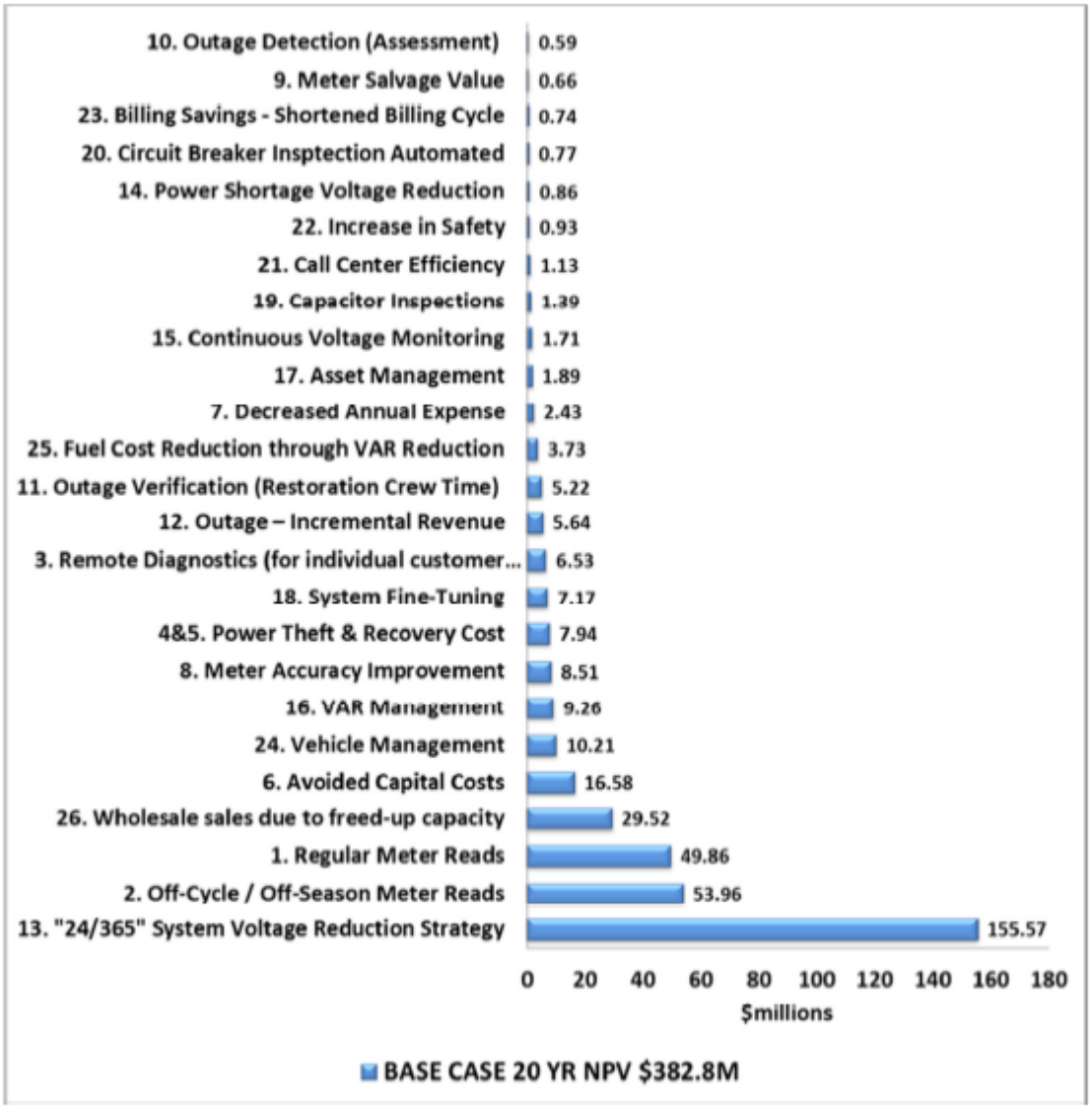


Figure 5.3.6 ranks Operational Benefits by base case 20-year NPV.

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Duke Energy of Ohio, Inc.

Operational Benefits of the Smart Grid (Case No. 10-2326-GE-RDR)

	Operational Benefits		20-yr NPV	20-Yr Total
1	Regular Meter Reads	Avoided O&M Cost	49.9	125.3
2	Off-Cycle/Off-Season Meter Reads	Avoided O&M Cost	54.0	123.4
3	Remote Meter Diagnostics	Avoided O&M Cost	6.5	16.0
7	Meter Operations Costs	Avoided O&M Cost	2.4	5.9
10	Outage Detection	Avoided O&M Cost	0.6	1.4
11	Outage Verification	Avoided O&M Cost	5.2	12.7
15	Continuous Voltage Monitoring	Avoided O&M Cost	1.7	4.4
19	Capacitor Inspection Costs	Avoided O&M Cost	1.4	3.6
20	Circuit Breaker Inspection Costs	Avoided O&M Cost	0.8	1.9
21	Call Center Efficiency	Avoided O&M Cost	1.1	2.8
22	Increase in Safety	Avoided O&M Cost	0.9	2.3
23	Billing Savings - Shortened Billing Cycle	Avoided O&M Cost	0.7	1.8
24	Vehicle Management Costs	Avoided O&M Cost	10.2	24.8
4/5	Power Theft/Theft Recovery Costs	Increased Revenue	7.9	19.5
8	Meter Accuracy Improvement	Increased Revenue	8.5	20.9
9	Meter Salvage Value	Increased Revenue	0.7	0.9
12	Outage Reductions	Increased Revenue	5.6	15.0
	TOTAL - Operational Benefits retained by Duke Ohio		**158.2**	**382.5**
	Benefits that offset Plant Investments			
16	VAR Management -- Acct. 36500	Deferred Capital	9.3	22.5
17	Asset Management -- Acct. 36200	Deferred Capital	1.9	3.0
6	Meter Operations Capital -- Acct. 39101	Deferred Capital	16.6	40.3
	Benefits not retained by Duke Ohio			
13	24-365 System Voltage Reduction Strategy	Avoided Fuel Cost	155.6	389.9
25	Fuel Cost Reduction through VAR improvement	Avoided Fuel Cost	3.7	9.3
14	Power Shortage Voltage Reduction	Capital Deferment	0.9	2.2
18	System Fine Tuning	Cap Defer & avoided fuel cost	7.2	18.7
26	Wholesale Energy Sale of Capacity Made Available	Increased Revenue	29.5	81.5
	TOTAL - 20-year Benefits (from MetaVu)		**382.8**	**950.0**

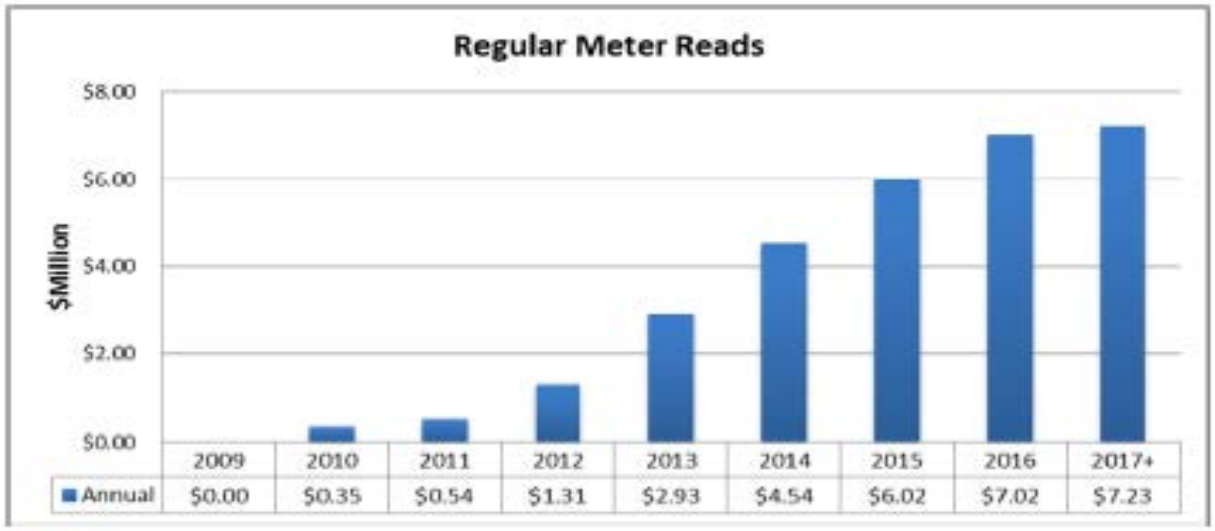
Regular Meter Reading
(Benefit 1)

- Metrics to measure the benefit:

- Number of meter readers
- Number of meter reading routes
- Certified Meters as % of Planned Total Deployment

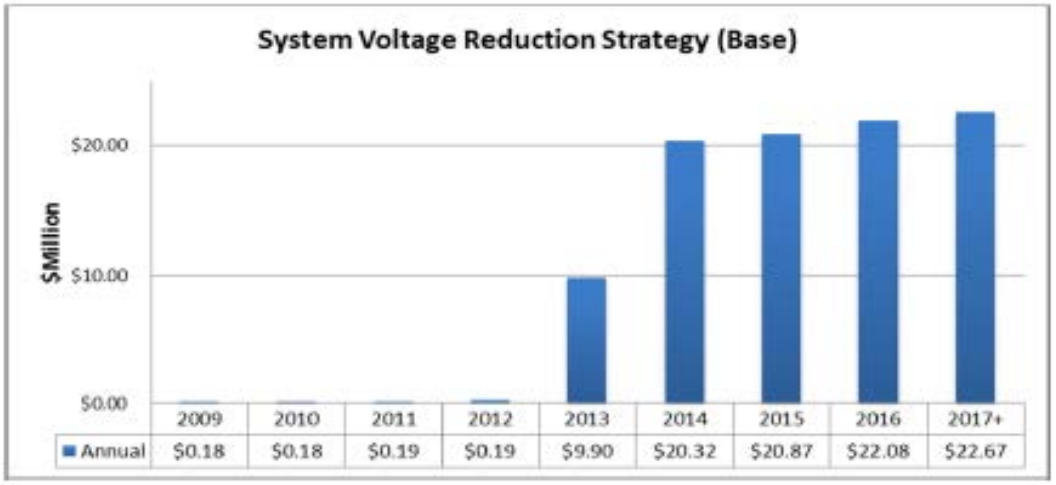
Regular Meter Reading
(Benefit 1)

- Majority of monthly manual meter reading will be eliminated
- Meter reading cost savings = Annual meter reading costs (labor & benefits) * percentage to be eliminated (80%)



24/365 System Voltage Reduction Strategy
(Benefit 13)

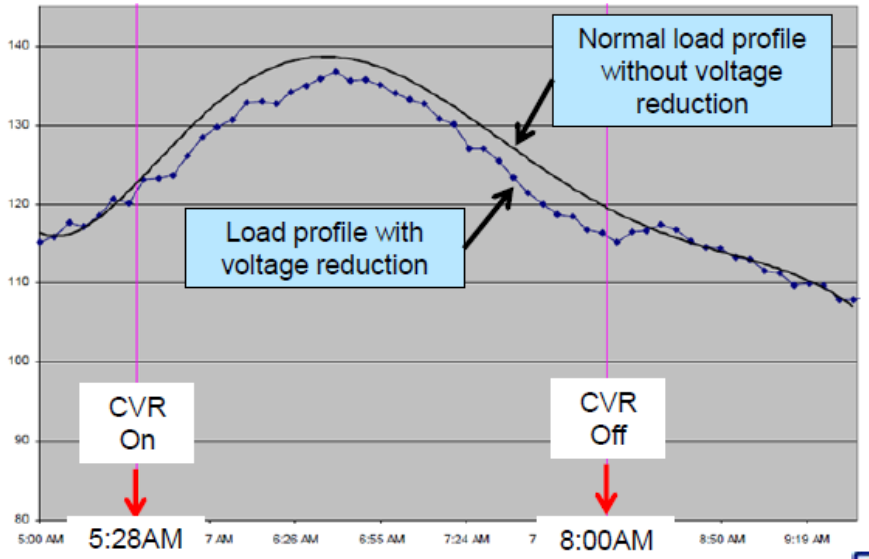
- Integrated Volt VAR Control (IVVC)
- Energy is saved due to overall reduction of the system voltage levels
- Benefit = Avoided costs due to system voltage reductions = fuel cost savings due to avoided production (Kwh) + avoided peak capacity charges + reduction to future costs of complying with EPA regulations (CO2)



Voltage Reduction Strategy

Peak Voltage Reduction for Peak Shaving

- Reduce voltage just prior to peak load occurrence
- Return to normal voltage following peak load period



1.0% to 3.0% demand reduction

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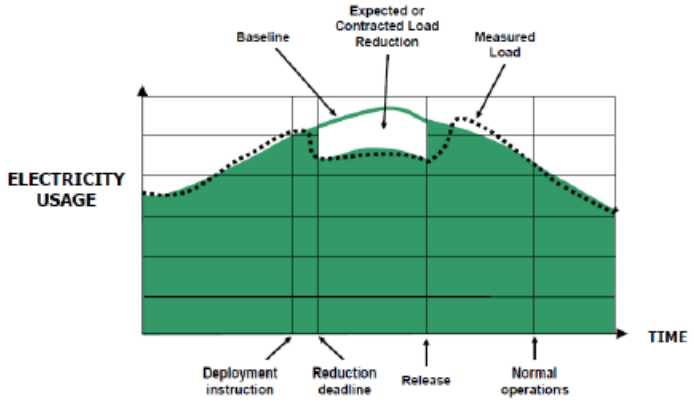
Peak Reduction via Voltage Control

Voltage Control Terminology

- **Voltage Reduction**
  - General practice of intentionally keeping the service delivery voltage as low as possible (within the acceptable range)
- **Peak Voltage Reduction**
  - practice of using Voltage reduction only during peak load conditions for peak shaving purposes



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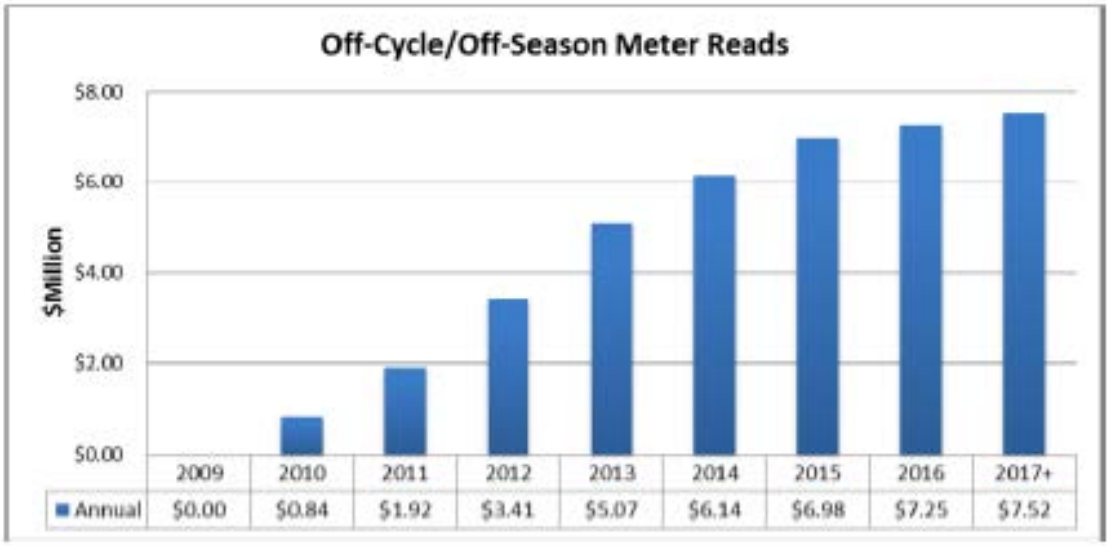
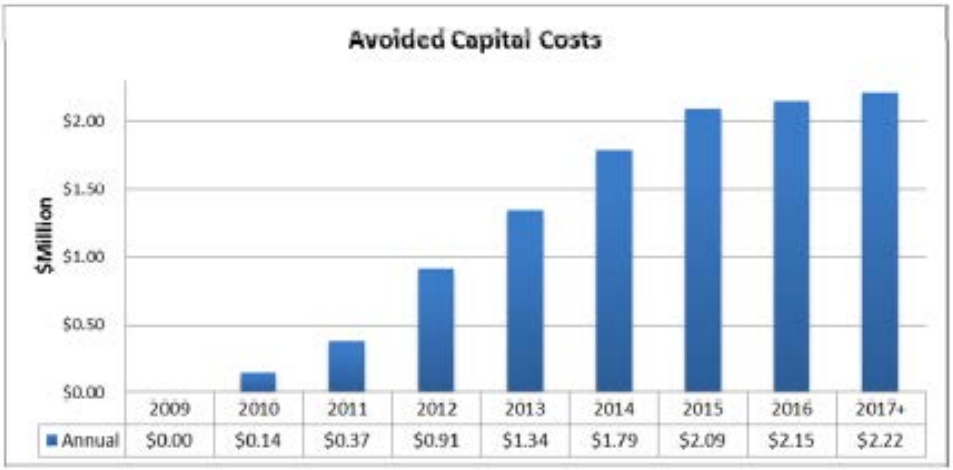
Off-Cycle/Off-Season Meter Readings
(Benefit 2)

- Reduction in the need for meter orders to be completed manually (move in/out, turn on/off)
- Off-Cycle/Off-Season Meter Reading Savings = Annual meter order costs (baseline) * estimated savings percentage (90%) * cumulative meter growth rate * cumulative labor inflation rate



Meter Operations – Avoided Capital Costs
(Benefit 6)

- Purchase and replacement of existing electromechanical meters, including associated labor, and handheld meter reading equipment would no longer be necessary
- Meter operations (avoided capital costs) = avoided replacement costs of 'old' meters + avoided labor + avoided replacement costs of handheld equipment



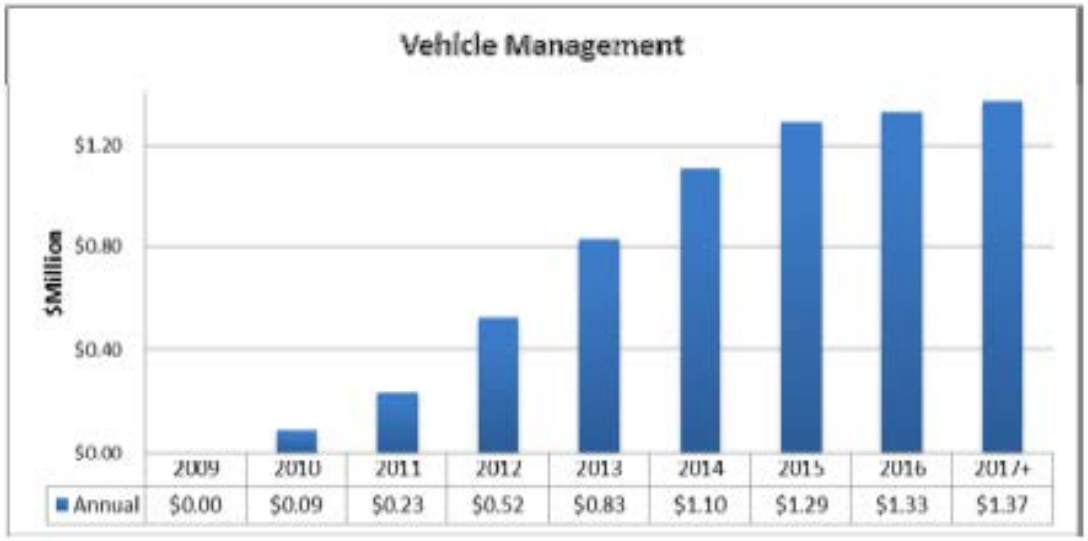
Meter Operations – Avoided Capital Costs
(Benefit 6)

- Metrics to measure the benefit:

- # of Handhelds repaired
- # of Handhelds purchased
- # of Non-AMI meters purchased
- # of Mechanical Meters repaired
- # of Smart meters that failed
- # of Gas modules that failed

Vehicle Management
(Benefit 24)

- Fewer meter readers means fewer meter reading vehicles, less mileage, and lower insurance costs
- Vehicle Management = auto insurance savings + (reduced number of vehicles * annual miles driven * operating costs per mile)



Vehicle Management
(Benefit 24)

- Metrics to measure the benefit:

- # of Meter reading vehicles
- Average miles per meter reading vehicle