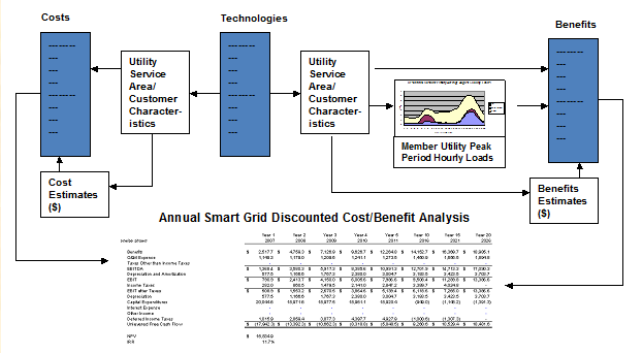
Smart Grid Investment Model™ and Application Summary



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Smart Grid Research Consortium

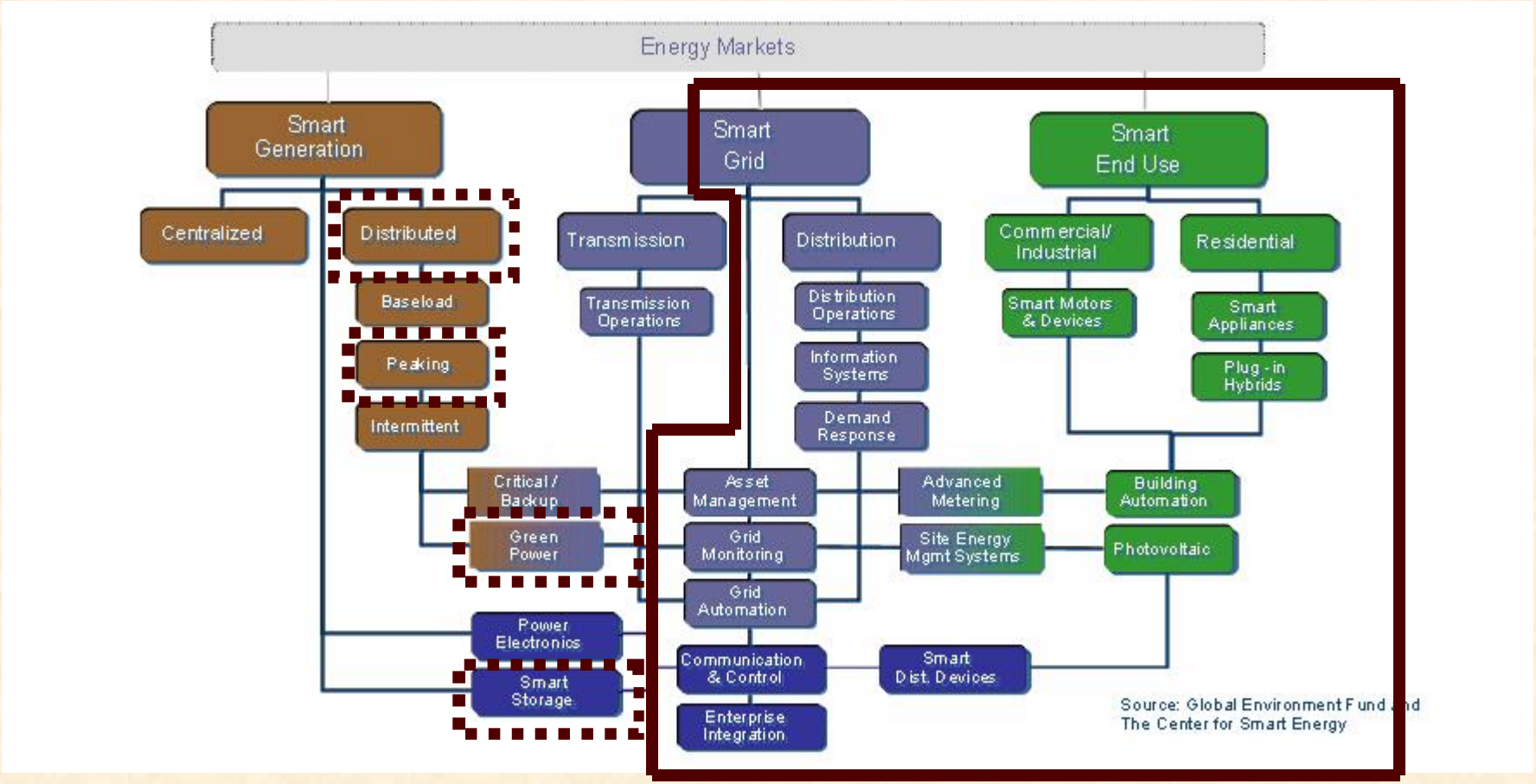
- Formed at Texas A&M University in early 2010
- Objective: Develop a utility-level quantitative smart grid business model tool
- Initially based on electric cooperative, municipal and public utility membership
- Established as an independent research organization in January 2011
- Completed Smart Grid Investment Model Development at the end of 2011
  - 15 utility applications through 2011
- Supports electric, water and natural gas applications
- 2012: unbundled model software and support services
  - Offer stand-alone Smart Grid Investment Model software provided with basic utility implementation
  - Offer comprehensive smart grid business case analysis applying the Smart Grid Investment model

Smart Grid Investment Model™ (SGIM)

- Comprehensive cost/benefit framework
  - AMI/smart meters - Distribution automation and reliability valuations - Volt/VAR control and conservation voltage regulation - Direct load control, programmable communicating thermostats, pricing programs, other demand response - IT and communications
- Incorporates utility-specific information
  - Infrastructure and customer information
  - Hourly load impact models
    - Load impacts of customer engagement programs (DR, pricing, etc.), conservation voltage regulation, avoided power and capital investment costs
- Intuitive, user-friendly Excel platform
- Provided as a $9,500 software package beginning 2012
  - Implemented for each utility using monthly customer-class sales data and 8760 system hourly loads data
  - Includes cost and benefit parameters, ranges and recommendations
  - Online training session and telephone consultations
  - Provides basic smart grid investment analysis from substations to customer programs

Smart Grid Investment Model Scope

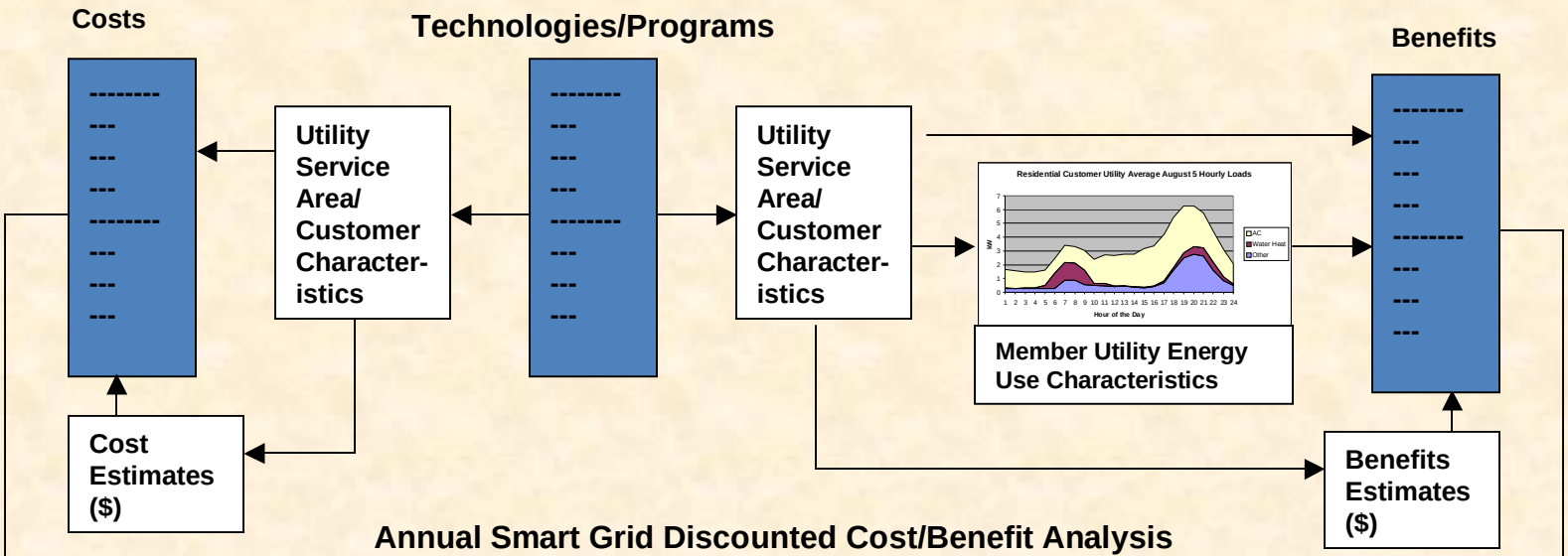
Back office → Substations → Feeders → Meters → In-Premise Programs



Smart Grid Investment Model Focus

Smart Grid Investment Model Impacts on Generation Functions

Model Applies Intuitive Utility-Perspective Smart Grid Investment Framework



Annual Smart Grid Discounted Cost/Benefit Analysis

erwise shown	Year 1 2007	Year 2 2008	Year 3 2009	Year 4 2010	Year 5 2011	Year 10 2016	Year 15 2021	Year 20 2026
Benefits	$ 2,517.7	$ 4,759.3	$ 7,126.9	$ 9,626.7	$ 12,264.8	$ 14,152.7	$ 16,369.7	$ 18,985.1
O&M Expense	1,149.3	1,179.0	1,209.6	1,241.1	1,273.5	1,450.9	1,656.5	1,894.8
Taxes Other than Income Taxes	-	-	-	-	-	-	-	-
EBITDA	$ 1,368.4	$ 3,580.3	$ 5,917.3	$ 8,385.6	$ 10,991.3	$ 12,701.9	$ 14,713.3	$ 17,090.3
Depreciation and Amortization	577.5	1,166.6	1,767.3	2,380.0	3,004.7	3,193.5	3,423.5	3,703.7
EBIT	$ 790.9	$ 2,413.7	$ 4,150.0	$ 6,005.6	$ 7,986.6	$ 9,508.4	$ 11,289.8	$ 13,386.6
Income Taxes	282.0	860.5	1,479.5	2,141.0	2,847.2	3,389.7	4,024.8	-
EBIT after Taxes	$ 508.9	$ 1,553.2	$ 2,670.5	$ 3,864.6	$ 5,139.4	$ 6,118.6	$ 7,265.0	$ 13,386.6
Depreciation	577.5	1,166.6	1,767.3	2,380.0	3,004.7	3,193.5	3,423.5	3,703.7
Capital Expenditures	20,044.6	18,971.6	18,977.5	18,961.1	18,920.4	(949.0)	(1,148.2)	(1,391.3)
Interest Expense	-	-	-	-	-	-	-	-
Other Income	-	-	-	-	-	-	-	-
Deferred Income Taxes	1,015.9	2,859.4	3,877.3	4,397.7	4,927.9	(1,000.6)	(1,307.3)	-
Unlevered Free Cash Flow	$ (17,942.3)	$ (13,392.3)	$ (10,662.3)	$ (8,318.8)	$ (5,848.5)	$ 9,260.6	$ 10,529.4	$ 18,481.6
NPV	$ 16,834.9							
IRR	11.7%							

Utility-Specific Hourly Load Models

Member Utility Data:

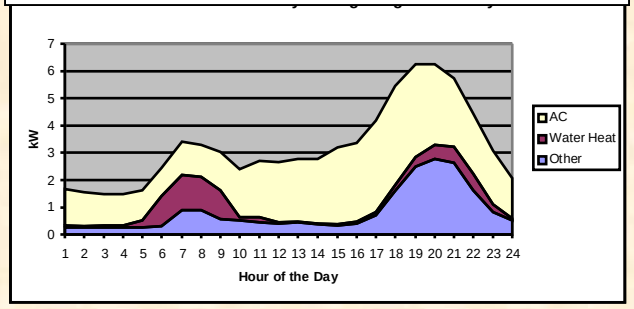
Historical Billing Data – Energy, Demand by Customer Class
Historical 8760 System Loads, Weather Data, …

Utility Customer Hourly Load Databases
(MAISY Customer Class/End-use)

Zip-detailed Service Area Customer Characteristics

Customer Class End-Use Hourly Load Model Estimation

Utility Energy and Hourly Load Models



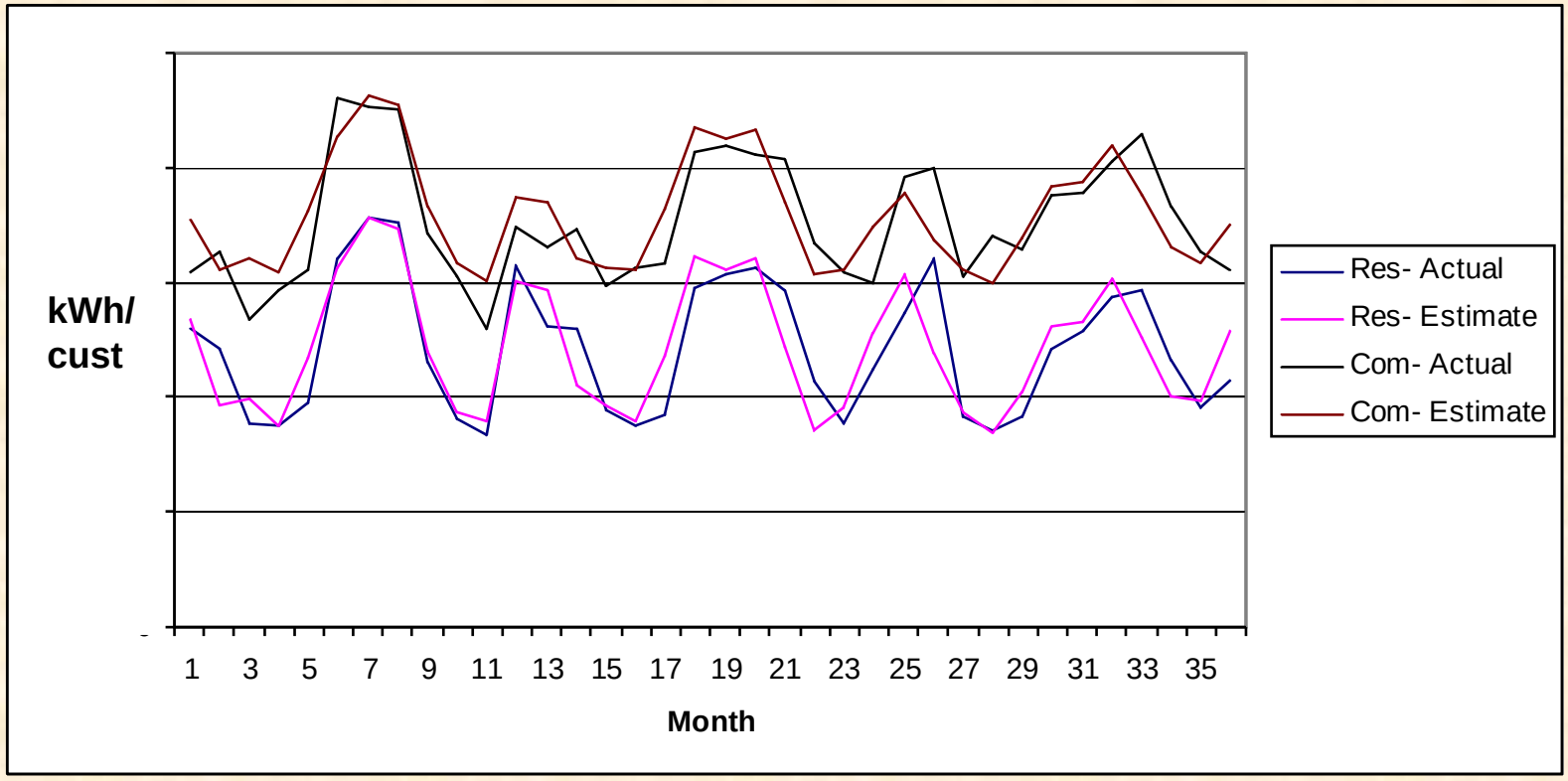
Hourly Load Forecasts

Monthly kWh and hourly loads

Customer class, end-use detail (space heat, central Ac, non-central AC, water heat, other)

20-year forecast horizon

Monthly Models Separate Baseload From Weather-Sensitive kWh Use



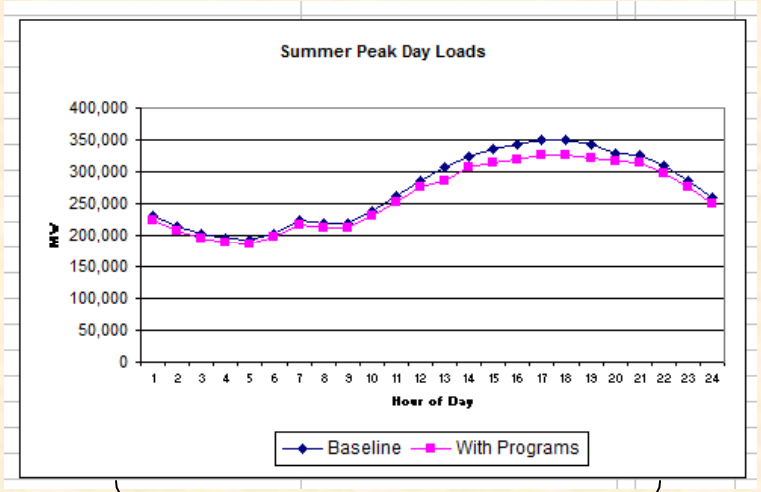
Technology, Program and Other Impacts Are Represented in Hourly Load Model Results

Technology impacts on customer hourly loads

Program impacts on customer hourly loads

Economic and utility impacts on customer hourly loads

Monthly Customer Class End-Use Hourly Load Models



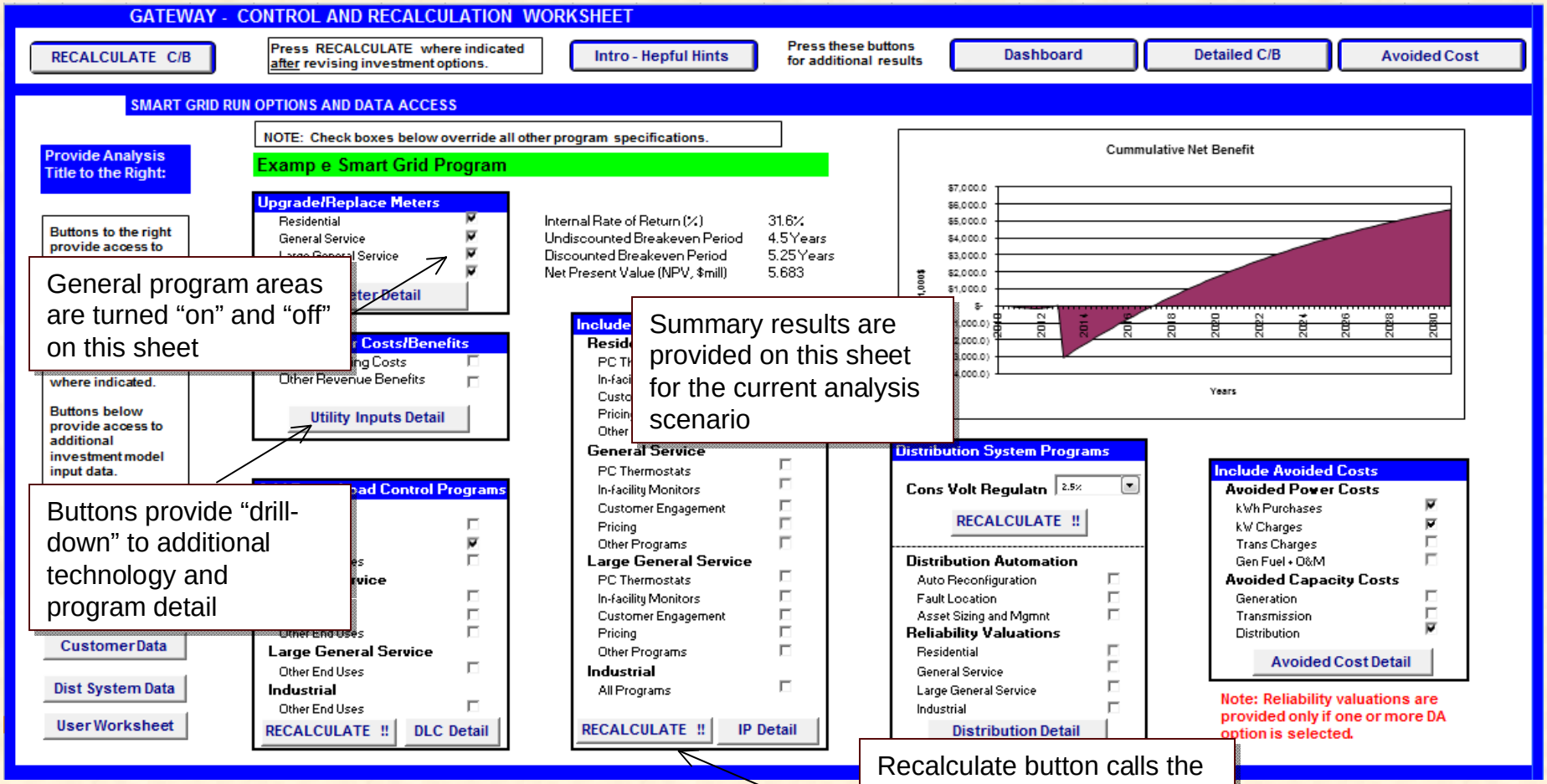
Cost/Benefit Calculations
(As Appropriate for Each Utility)

- **Avoided power purchase costs**
- **Avoided generation costs**
- **Avoided transmission costs**
- **Avoided G&T investment costs**
- **Avoided distribution investment costs**
- **Avoided equipment maintenance & capital costs**

Data Development, Implementation and Application Process

- Modest utility information requirements
  - Electricity use & related information
    - Monthly customer class billing data (customers, kWh, etc.)
    - Hourly system load data
  - Available utility infrastructure and customer information
- Utility Implementation
  - Estimate monthly customer class, end-use hourly load models
  - Implement/validate the SGIM model using utility and data
- Deliver the SGIM model
  - Provide training & support for in-house analysis
  - Optional turnkey Consortium application and analysis

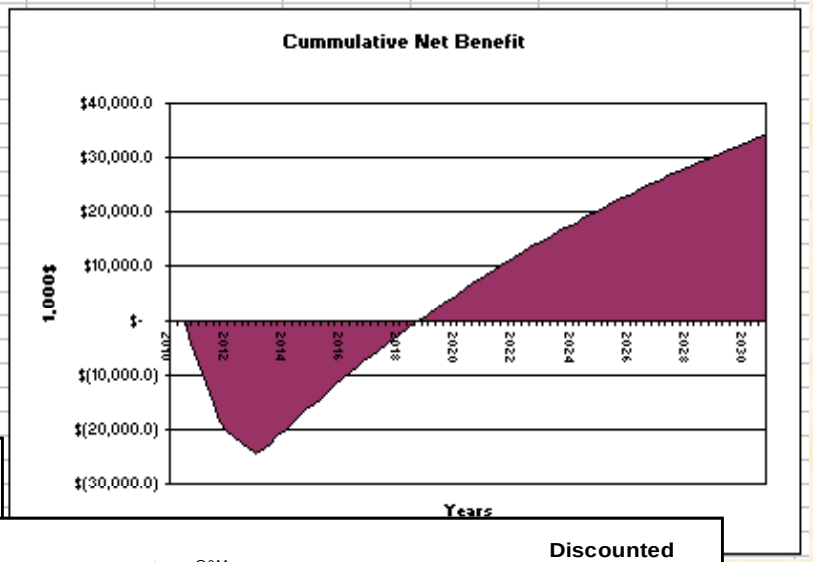
"GATEWAY" Worksheet Provides Access to all SG Programs, Model Parameters and Results

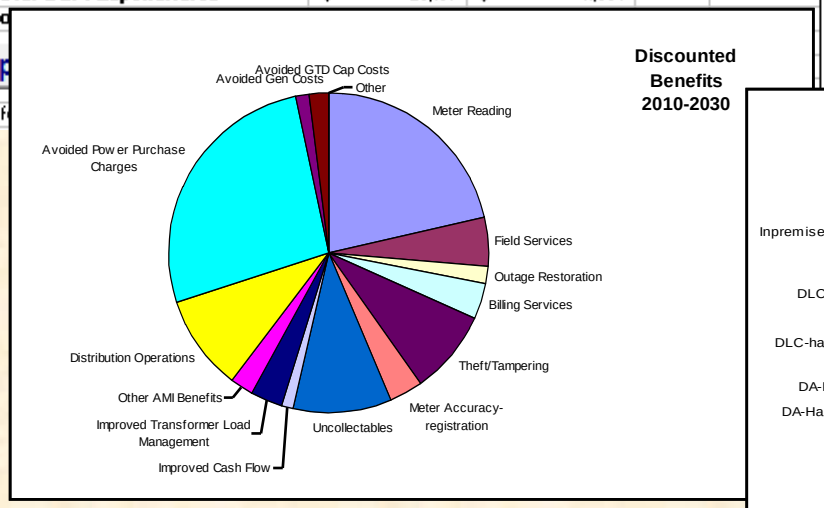


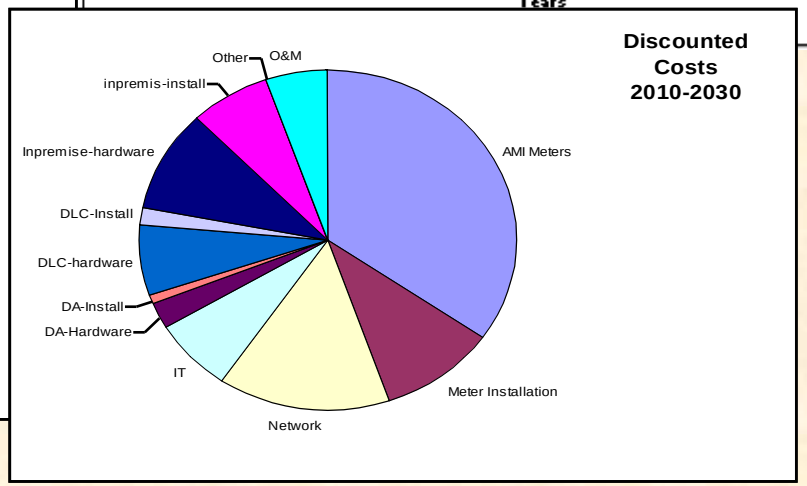
Model Provides Intuitive Summary Cost/Benefit Results for Technologies and Programs

SUMMARY RESULTS

Analysis Title:	Smart Grid Investment Model Baseline Forecast		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,000)	$ 34,081		
Internal Rate of Return (%)	17.1%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2010	4	
Undiscounted Breakeven Period	2017	4	**7.00**
Discounted Breakeven Period	2018	4	**8.00**
Expenditures and Benefits Over 20 Years ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 36,291	$ 32,410	
Total O&M Expenditures	$ 20,167	$ 11,084	







Example Analysis Requested by a Consortium Member

- Residential programmable thermostat/water heater program
  - Independent communications
  - $1,000 per customer (includes program costs)
- Specific results will vary by utility
  - AC & water heating load profiles
  - Avoided power cost parameters ($/kWh, peak kW charges, etc.)
  - Pricing program incentives
- Example results

SUMMARY RESULTS

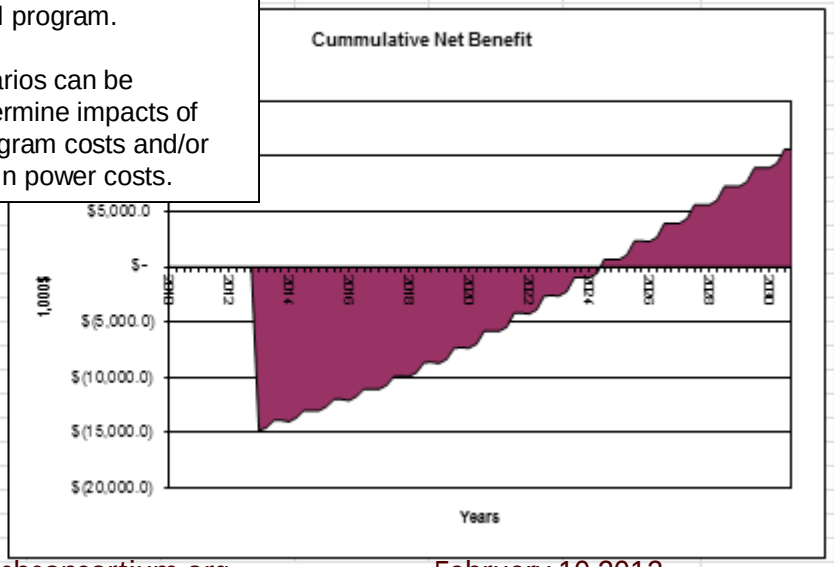
Analysis Title:	**Example SGIM Analysis**		
	Annual	Quarterly	
Discount Rate	5.00%	1.23%	
Project Financial Indicators			
Net Present Value (NPV, $1,00	$ 10,656		
Internal Rate of Return (%)	11.4%		
	Year	**Quarter**	**Payback (years)**
Smart Grid Initiation	2013	1	
Undiscounted Breakeven Peric	2022	3	**9.50**
Discounted Breakeven Period	2024	3	**11.50**
Expenditures and Benefits Over 20 Years ($1,000)			
	Nominal	**Discounted**	
Total Capital Expenditures	$ 38,643	$ 26,252	
Total O&M Expenditures	$ 4,644	$ 2,611	
Total Benefits	$ 75,756	$ 39,519	

Back to Run Options

Green-filled cells designate user input areas

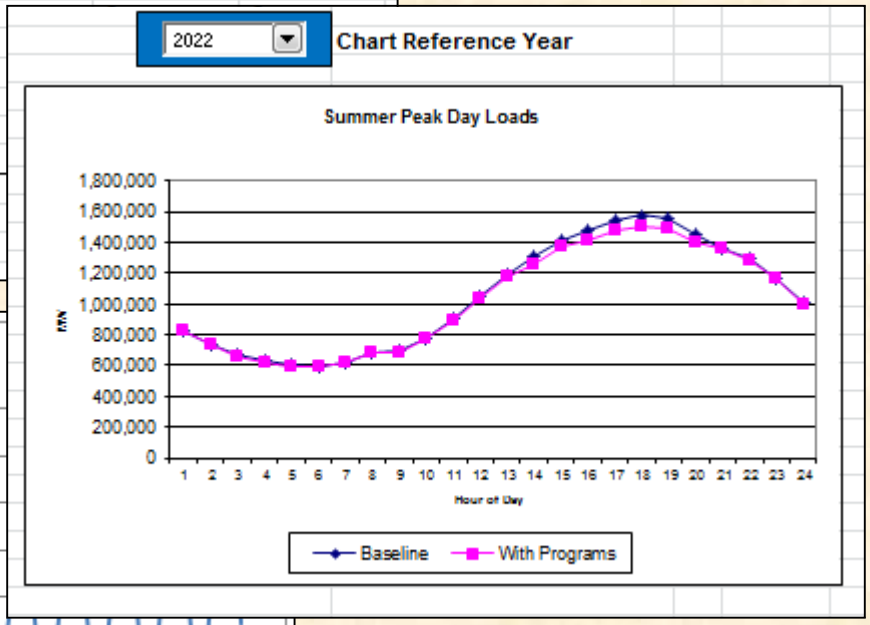
11.4% internal rate of return (IRR) and 11.5 year discounted payback reflect a marginal program.

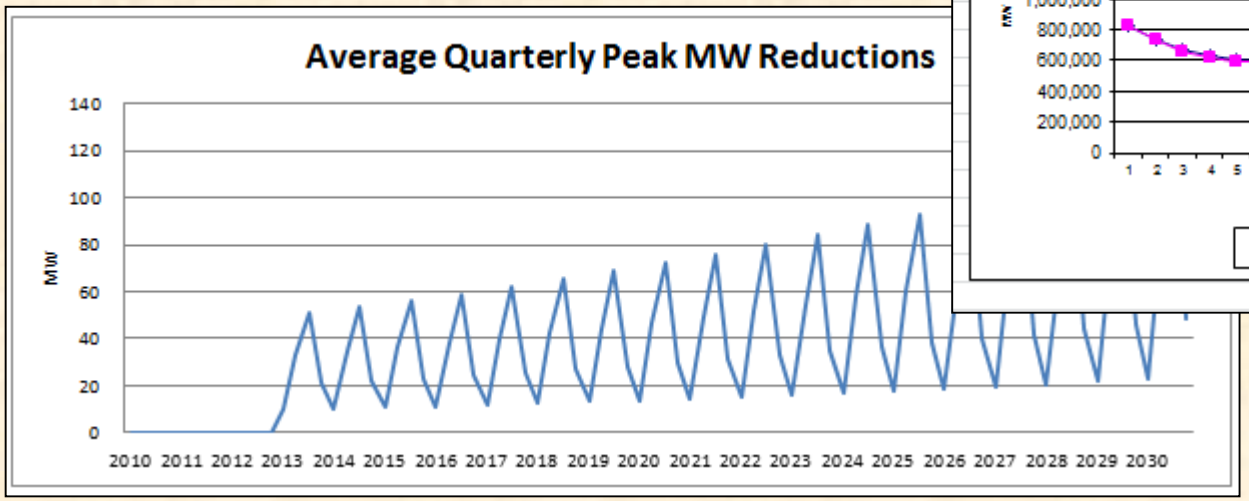
Alternative scenarios can be evaluated to determine impacts of reductions in program costs and/or future increases in power costs.



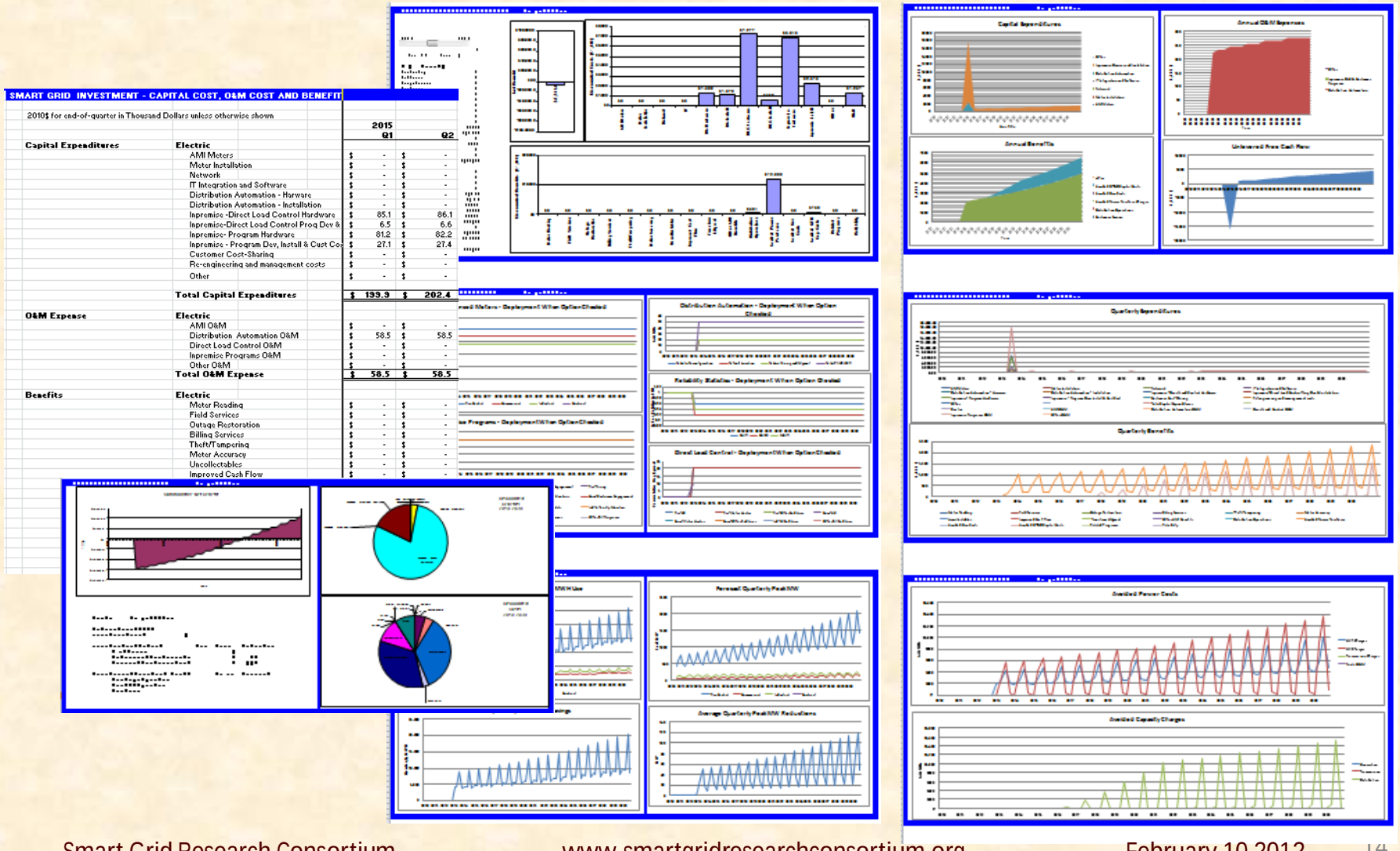
Air Conditioning and Water Heating Hourly Load and Avoided Cost Impacts are Calculated and Presented With Charts and Tables

COST SAVINGS						
			2017			
Avoided Power Costs (1000$)			Q1	Q2	Q3	Q4
Avoided Purchases	kWh Charges	$	309	$ 415	$ 682	$ 348
	kW Charges	$	7	$ 491	$ 736	$ 44
	Transmssion Charges	$	-	$		
Avoided Generation	Fuel + O&M	$	-	$		
			2017			
Avoided Capacity Investment Costs(1000$)			Q1			
	Generation	$	-	$		
	Transmission	$	-	$		
	Distribution	$	-	$		





Detailed Analysis Results are Available in the "DASHBOARD" AND "CB-Results" Worksheets



SMART GRID INVESTMENT - CAPITAL COST, O&M COST AND BENEFIT

2010$ for end-of-quarter in Thousand Dollars unless otherwise shown

		2015 Q1	Q2
Capital Expenditures	**Electric**		
	AMI Meters	$ -	$ -
	Meter Installation	$ -	$ -
	Network	$ -	$ -
	IT Integration and Software	$ -	$ -
	Distribution Automation - Hardware	$ -	$ -
	Distribution Automation - Installation	$ -	$ -
	Inpremise -Direct Load Control Hardware	$ 85.1	$ 86.1
	Inpremise-Direct Load Control Prog Dev &	$ 6.5	$ 6.6
	Inpremise- Program Hardware	$ 81.2	$ 82.2
	Inpremise - Program Dev, Install & Cust Co	$ 27.1	$ 27.4
	Customer Cost-Sharing	$ -	$ -
	Re-engineering and management costs	$ -	$ -
	Other	$ -	$ -
	Total Capital Expenditures	**$ 199.9**	**$ 202.4**
O&M Expense	**Electric**		
	AMI O&M	$ -	$ -
	Distribution Automation O&M	$ 58.5	$ 58.5
	Direct Load Control O&M	$ -	$ -
	Inpremise Programs O&M	$ -	$ -
	Other O&M	$ -	$ -
	Total O&M Expense	**$ 58.5**	**$ 58.5**
Benefits	**Electric**		
	Meter Reading	$ -	$ -
	Field Services	$ -	$ -
	Outage Restoration	$ -	$ -
	Billing Services	$ -	$ -
	Theft/Tampering	$ -	$ -
	Meter Accuracy	$ -	$ -
	Uncollectables	$ -	$ -
	Improved Cash Flow	$ -	$ -

SGIM Applications Areas

- AMI/Smart meters
- Distribution automation
  - Auto Reconfiguration
  - Fault Location
  - Asset Sizing and Management
  - Conservation Voltage Regulation
  - Customer Reliability Valuations
- Customer engagement (by customer class)
  - PC thermostats
  - In-facility monitors
  - Customer engagement
  - Pricing
  - Other programs
- Other technologies/programs

Smart Grid Research Consortium Products and Services

- $9,500 Smart Grid Investment Model implemented with your utility data
  - Customer class detail and monthly hourly load forecasting models
  - Cost/benefit parameters
  - Training workshops
  - Continuing telephone consultations to support in-house analysis
- Full-Service smart grid business case analysis applying the Smart Grid Investment Model
  - In-house meeting to develop utility infrastructure characteristics and key financial parameters
  - Full implementation of the Smart Grid Investment Model
    - Includes monthly customer class-end use hourly load impact models
    - Optionally includes substation, transformer, feeder detailed information to support least-cost distribution automation, Volt/VAR control and conservation voltage reduction strategy development
  - Comprehensive analysis of smart grid technologies, programs and strategies
  - Develop smart grid investment recommendations and present results
  - Provide continuing support

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