2012 Smart Grid Program
Peer Review Meeting

KCP&L Green Impact Zone
SmartGrid Demonstration Project

Edward T. Hedges, P.E.
Manager SmartGrid Technology Planning
Kansas City Power & Light Company

June 8, 2012

KCP&L Green Impact Zone SmartGrid Demonstration Project

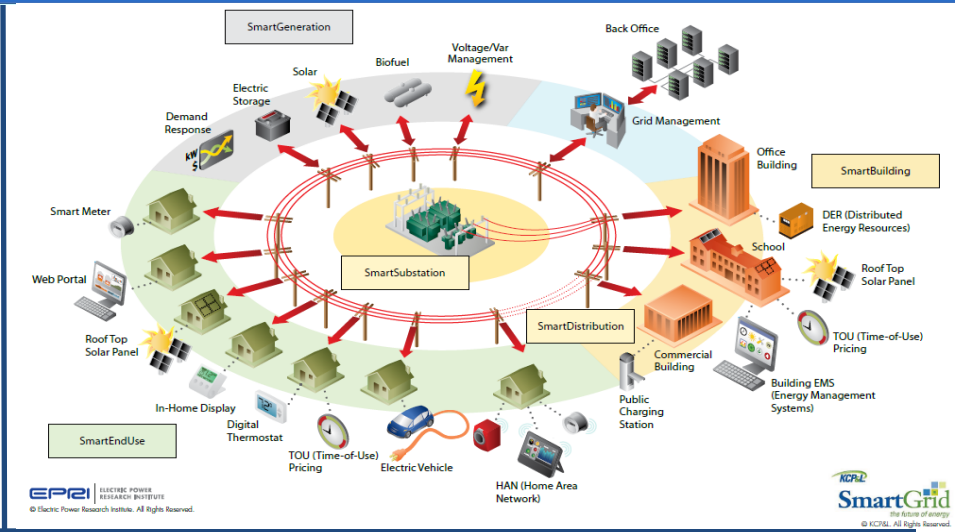
Objective

First, Create a complete, end-to-end Smart Grid

Second, Introduce new technologies, applications, protocols, communications and business models

Third, Incorporates a best-in-class approach to technology integration through use of Smart Grid interoperability standards

Finally, Support a targeted urban revitalization effort in Kansas City's Green Impact Zone



Life-cycle Funding ($K)

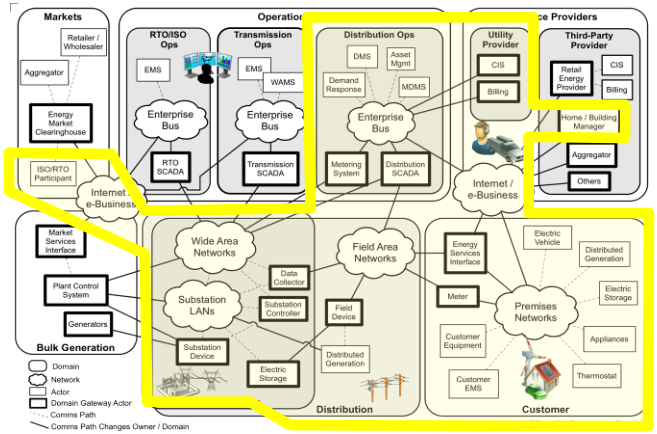
2010 – 2014
$23,940,112

Technical Scope

- SmartSubstation
- SmartDistribution
- SmartGeneration
- SmartDR/DER
- SmartMetering
- SmartEnd-Use
- Interoperable Standards Integration
- Cyber Security Profile Assessment

RD&D Needs and Project Targets

Align Systems w/NIST Ref Model



Interoperability

Incorporate NIST Interoperability Framework and Standards to accelerate industry adoption

- IEC 61850 (substation protection & automation)
- IEC 61850 (substation – control center)
- DNP/IP (field device to substation controller)
- IEC 61968 (AMI,MDM,OMS,DMS,DERM,HEMP)
- EPRI ESB Profile for IEC 61968
- OpenADR 2.0 (DERM – DR Control Auth)
- Smart Energy Profile 1.x and 2.0

Distribution Control Architecture

Demonstrate a fully integrated next generation 3 tier hierarchical control architecture (central-sub-device).

The SmartSubstation Distributed Control and Data Acquisition (DCADA) controller will incorporate a CIM based model of the local distribution network; perform decentralized sub and feeder device monitoring and assessment; and initiate automatic closed loop "1st Responder" control of individual field devices.

Cyber Security

Incorporate emerging Cyber Security framework and standards and evaluate for industry adoption

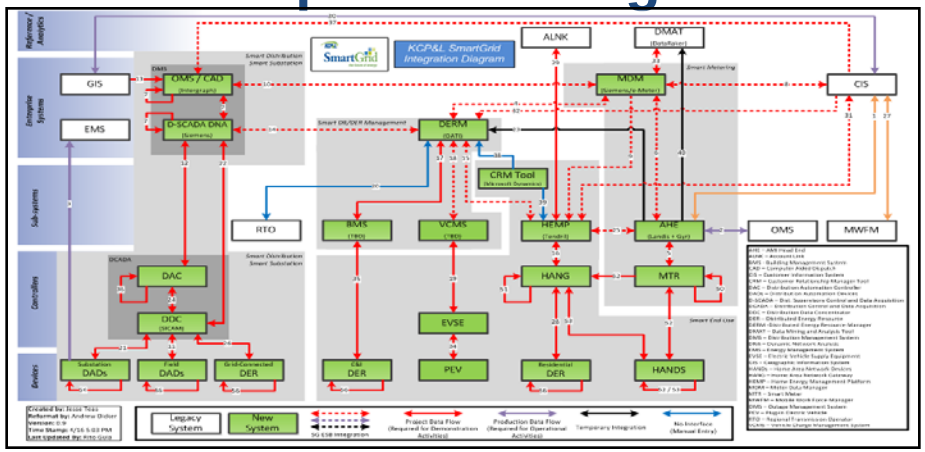
- NISTIR 7628-Guidelines for Smart Grid Cyber Security
- UCAIug -Security Profile for AMI
- UCAIug -Security Profile for Distribution Mgmt.
- UCAIug -Security Profile for 3rd Party Data Access

drafts

- UCAIug -Security Profile for Sub Automation
- UCAIug -Security Profile for OpenADR

Technical Approach

Interoperable Integration



The SmartGrid Back-Office

Is established by integrating these key systems

- AHE – AMI Head End
- MDM – Meter Data Management
- GIS – Geographic Information System
- OMS – Outage Management System)
- DMS – Distribution Management System
- D-SCADA – Distribution SCADA
- DERM – Dist. Energy Resource Mgmt.
- HEMP – Home Energy Mgmt Portal

SmartSubstation

Upgrade a major urban substation with legacy electromechanical relays and demonstrate a fully automated and secure, next-generation distribution SmartSubstation with a local distributed control system based on IEC 61850 protocols.

SmartDistribution

The DMS and DCADA controllers incorporate a CIM based model of the distribution network and provide the operational backbone of the system providing significant levels of feeder automation including Volt/Var management and complex automated feeder switching.

The DMS incorporates D-SCADA, DNA, and OMS components and serves as the primary point of integration for grid network management with the DERM, GIS and other systems.

Technical Approach

SmartDR/DER

Develop and demonstrate a next-generation, DERM system that coordinates with market and the DMS to economically schedule DR and DER events and resources in response to economic and reliability requests.

The DERM will schedule, issue, and manage DR events with the respective DR/DER Asset Control Authorities (HEMP, DMS, Commercial BMS, and VCMS)

SmartMetering

Demonstrate a state-of-the-art integrated AMI & meter data management (MDM) and analytics (MDA) capabilities to support two-way comms. with 14,000 SmartMeters in the demonstration area and provide integration with CIS, DMS, OMS, DERM, and HEMP.

The SmartMetering infrastructure will provide also provide advanced meter-to-HAN comms. to facilitate in-home display, home energy mgmt. systems, and other consumer-facing programs.

SmartGeneration

Implement DER technologies and DR programs sufficient in quantity and diversity to support the DERM development and demonstration.

- Distributed grid-connected solar systems (approx 180 kw)
- 1MWh grid-connected battery to provide grid support.
- AMI DR thermostats (approx 1600)
- Distribution Voltage Control (DVC)
- 10 PEV charging stations capable of DR response
- Potential integration with Commercial BMS
- Potential conversion of customer stand-by to parallel generation

SmartEndUse

Develop tools, products and enroll consumers in a variety of next-generation consumer-facing programs to support the DERM implementation and measure, analyze, and evaluate the impact that consumer education, enhanced energy usage information and other consumer-based programs have on end-use consumption.

- Energy Information Portals (Usage, EMS,DER)
- IHDs with daily bill estimation
- TOU Rates
- HAN DR devices (PCT, LCS, etc.)

2010-2011 Project Accomplishments

Task	Project Accomplishment	Completion
	Contract Definitization Complete	09/30/2010
8	Residential AMI Meter Deployment Initiated	10/20/2010
14	Deploy Premis Energy WEB Portal	10/20/2010
14	Deploy In-Home Display	10/27/2010
2	NEPA Compliance Obtained	10/28/2010
1	Revised PMP to DOE	10/29/2010
3	Interoperability and Cyber Security Plan Approved	11/18/2010
6	Education & Outreach Plan to DOE	12/30/2010
4	Benefits and Metrics Reporting Plan Approved	04/29/2011
8	Residential AMI Meter Deployment Completed	03/18/2011
14	SmartGrid Demo Home - Opening	04/30/2011
7	Cyber Security Rick Assessment Completed	11/10/2011
15	SmartGen – School Rooftop Solar – 100kw	11/28/2011

2012 Project Accomplishments

Task	Project Accomplishment	Completion
11	Meter Data Management PH1 Complete	03/24/2012
9	Baseline Data Collection Completed	03/31/2012
15	SmartGen–1MwHr Grid Battery (BESS) Delivery	04/28/2012
14	SmartEndUse-Launch EMS HAN Devices	04/30/2012
10	SmartSubstation-Protection Network FAT	05/04/2012
14	SmartEndUse-Launch TOU Tariff	05/22/2012
14	SmartEndUse-Launch Premise EMS WEB Portal	July 2012
15	SmartGen–BESS Commissioned under Local Control	July 2012
16	SmartDR/DER–DERM Implementation Unit Testing	July 2012
10	SmartSubstation-Commissioning	Sept 2012
12	SmartDistribution-DMS Commissioning	Sept 2012
13	SmartDistribution- IP Field Automation Network	Sept 2012
18	Begin 2 Yr Operational Testing Period	Oct 2012
13	SmartDistribution- 1st Responder Subsystem	Dec 2012
17	System – System Integration Testing	Dec 2012
5	Issue First Technology Performance Report	Dec 2012

2013-2014 Project Accomplishments

Task	Project Accomplishment	Completion
11	MDM Ph2 - Project Integration	Jan 2013
17	End-to-End Interoperability Testing Complete	May 2013
17	End-to-End Field Interoperability Demonstrations	June 2013
14	SmartEndUse-Deploy PEV Charging Stations	June 2013
15	SmartGen-Complete RoofTop Solar Installations	June 2013
10	SmartSubstation 61850 GOOSE Protection Schemes	June 2013
5	Issue Second Technology Performance Report	Dec 2013
10	SmartSubstation-Enhanced Asset Mgt. Functions	June 2014
14	SmartEndUse-HAN SEP2.0 Demonstration	June 2014
14	SmartEndUse-Launch Premise DER WEB Portal	June 2014
18	Complete 2 Yr Operational Testing Period	Sept 2014
19	Impact Metric Reporting	Oct 2014
20	Final Technology Performance Report	Dec 2014

Significance and Impact

Align Systems w/NIST Ref Model

Challenges, Hurdles & Realizations

- Adapting to legacy CIS processes & data req.
- Legacy structures persist in new systems
  - Meter ID vs ServDeliveryPoint
  - Register read vs interval usage data
  - Redundant duplicate data repositories

Adaptations & Adjustments

- ESB broker flows to transform data
- Augment legacy processes with manual processes

Interoperability

Challenges, Hurdles & Realizations

- Incompleteness of published standards (61968)
- Length of stds. adoption (SEP2.0)
- Getting NIST PAP output into vendor integration
- Standards not enough, need industry 'Profiles'

Adaptations & Adjustments

- Engaged in select 'profile' efforts (OpenADR2)
- Phased interoperability deployments

Distribution Control Architecture

Challenges, Hurdles & Realizations

- Conservative nature of oper. change mgmt.
- Need to deploy foundational elements first
- Unavailability of 61850 distribution controls
- Unavailability of IP based field device controls

Adaptations & Adjustments

- Phased deployment of technology & application
- Field devices using DNP/IP where available
- Integrating legacy DA comms. for serial devices

Cyber Security

Challenges, Hurdles & Realizations

- NISTIR and security profiles are evolving during course of demonstration
- Lack of IT and vendor partners resources involved in current industry initiatives
- Limitation of current industry products

Adaptations & Adjustments

- Using consultants to lead the cyber security effort and educate internal resources.

Interactions & Collaborations

Smart Distribution

- Smart Substation
- Distribution Management System (DMS)
- IP/RF 2-way Field Area Network (FAN)
- “First Responder” Distribution Automation

SIEMENS INTERGRAPH TROPOS networks

Smart End-Use

- Home Energy Management Portal (HEMP)
- In-home Display (IHD) with Interval Data
- Commercial Energy Management System (EMS)
- Demand Response Programs and TOU Rates
- Electric Vehicle (EV) Charging

TENDRIL The Power is Yours

Smart Metering

- Smart Meters
- Automated Metering Infrastructure (AMI)
- Meter Data Management (MDM)

Landis+Gyr eMeter

Smart Generation

- Distributed Energy Management System (DERM)
- Demand Response (DR) Programs and Time-of-Time-of-Use (TOU) Rates
- Residential / Commercial Rooftop Solar
- Utility-scale Battery Storage

Exergonix oati

Interoperability and Security

- State of the Art Integration and Security

IBM Structure Burns & McDonnell SINCE 1898

Program Advisory and Management Services Partners

EPRI ELECTRIC POWER RESEARCH INSTITUTE

Burns & McDonnell SINCE 1898

Structure™

Questions

Learn more at www.kcplsmartgrid.com

Edward T. Hedges, P.E.

Mgr. SmartGrid Technology Planning

Kansas City Power & Light Co.

816-245-3861

Ed.Hedges@kcpl.com

KCP&L

SmartGrid

the future of energy

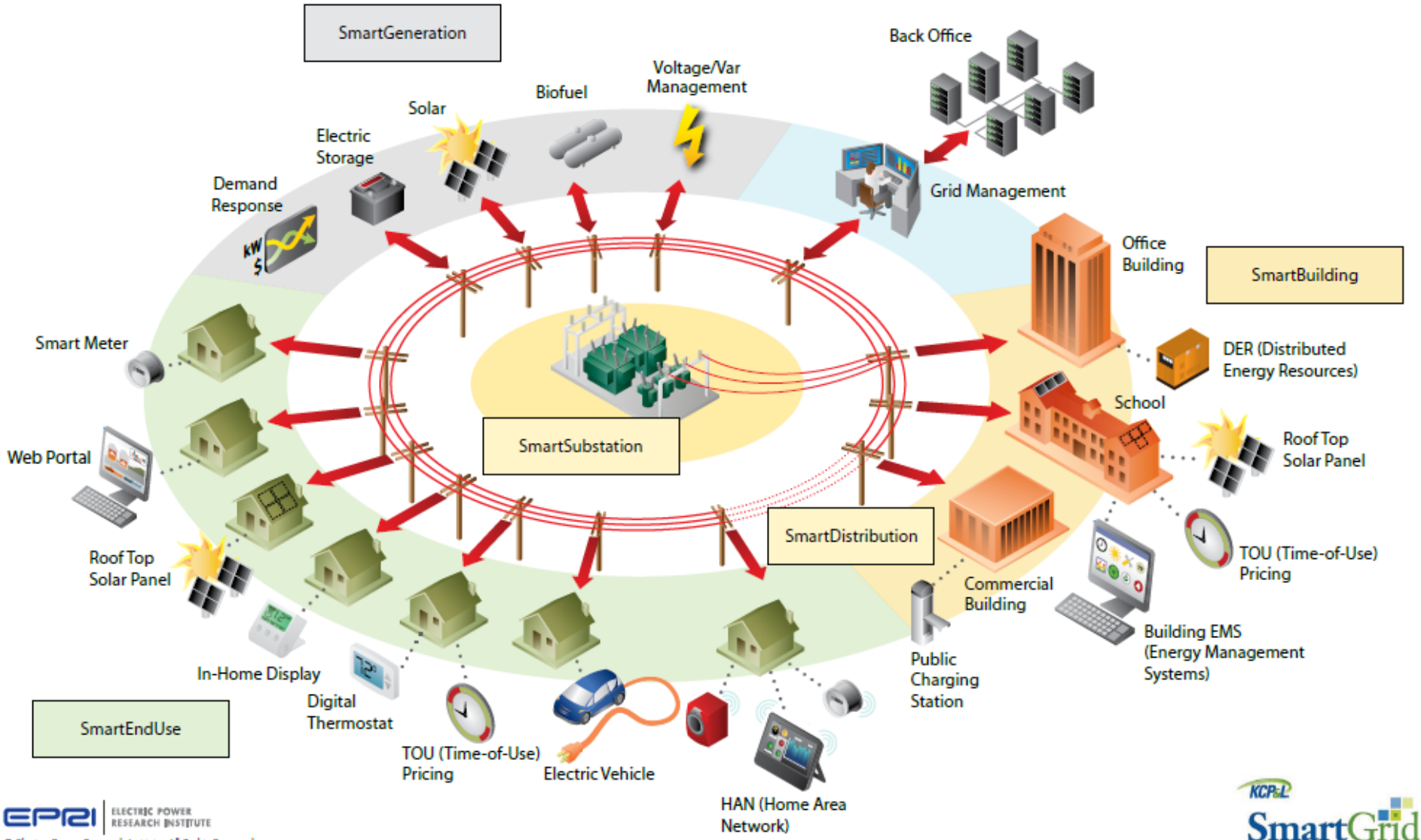
Back-up Slides

Project Objectives

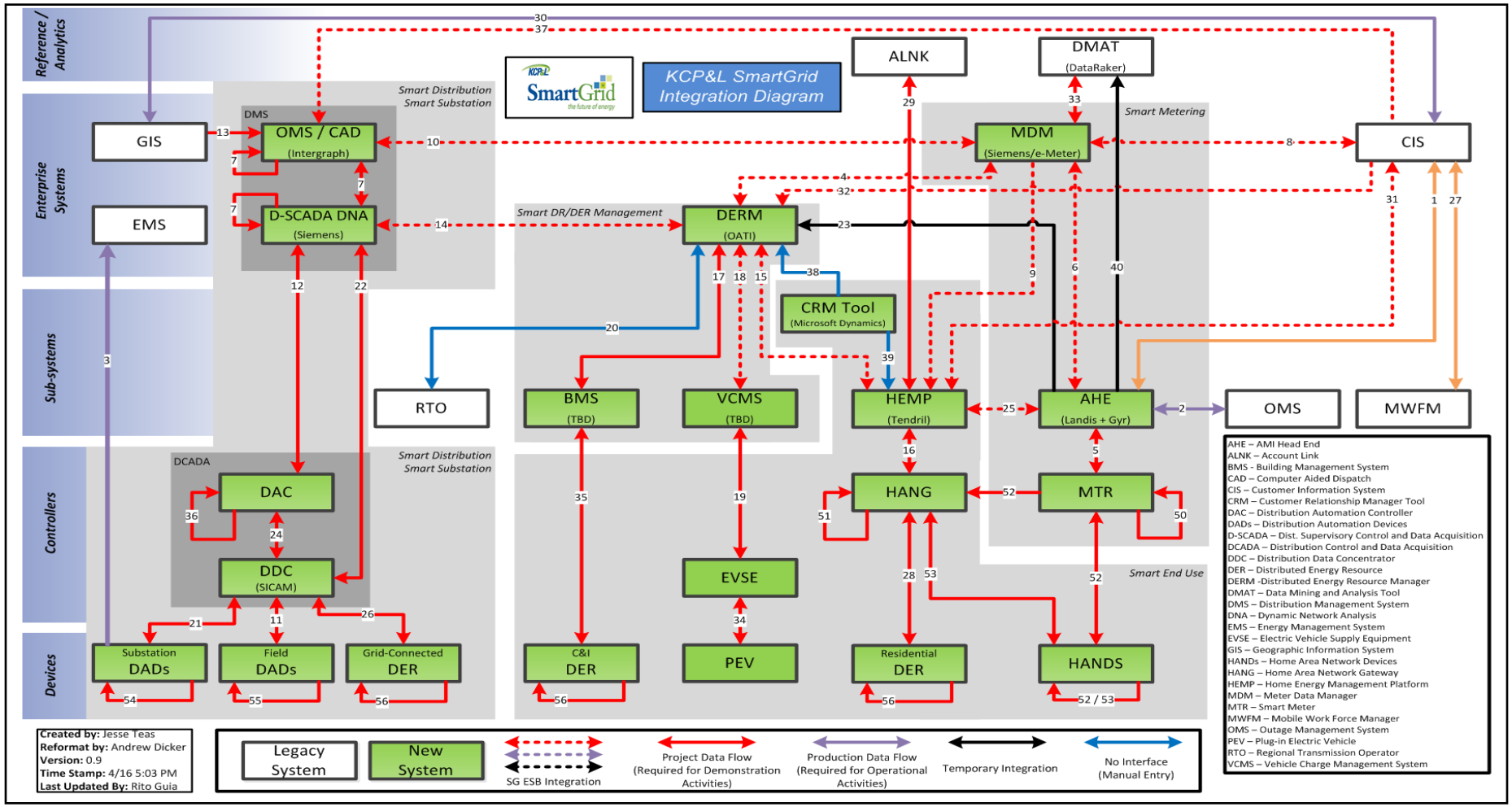
KCP&L's SmartGrid demonstration project complies with the Department of Energy's (DOE's) funding guidelines and combines commercial innovation with a unique approach to smart grid development and demonstration:

- First, **it creates a complete, end-to-end smart grid** — from smart generation to smart end-use — that will deliver improved performance focused on a major substation in an urban location.
- Second, **it introduces new technologies, applications, protocols**, communications and business models that will be evaluated, demonstrated and refined to achieve improved operations, increase energy efficiency, reduce energy delivery costs and improve environmental performance.
- Third, **it incorporates a best-in-class approach to technology integration**, application development and partnership collaboration, allowing KCP&L to advance the progression of complete smart grid solutions — with interoperability standards — rather than singular, packaged applications.
- Finally, KCP&L's demonstration project will provide the critical energy infrastructure required to **support a targeted urban revitalization effort** in Kansas City's Green Impact Zone.

KCP&L Demonstration
True End-to-End Smart Grid



Interoperability is the foundation of KCP&L's SmartGrid Program – *Far beyond traditional point-to-point interfaces.*

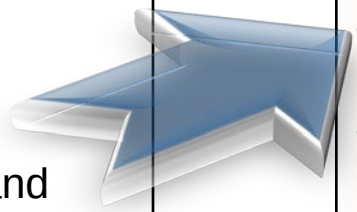


SmartMetering

Primary Objective: Develop and demonstrate state-of-the-art integrated AMI & meter data management (MDM) and analytics (MDA) capabilities to support two-way communication with 14,000 SmartMeters in the Demonstration Area and provide integration with CIS, DMS, OMS, DERM, HEMP

Capabilities

- Real-time, two-way RF Mesh enabled communication for…
  - Outage notification
  - Customer facing programs
  - Demand response programs
  - Periodic & On Demand meter reads
- Integrated connect and disconnect
- MDM provides the long-term storage and management of usage data



Benefits

- Improved meter read accuracy, frequency and scheduling flexibility
- Improved accuracy of meter inventory
- Remote service order completion
- Supports customer facing programs
- Supports implementation of variable pricing programs

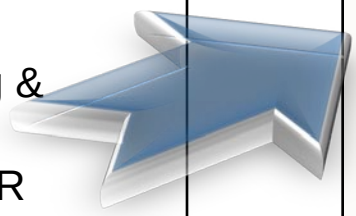
Technology: Smart Meters; Automated Metering Infrastructure (AMI) and AMI Head End; RF Mesh; Meter Data Management (MDM); Field Area Network; Integration to CIS, GIS, DERM, MDA

SmartDistribution

Primary Objective: Develop and demonstrate a fully automated and secure, next generation DCADA controller that incorporates a CIM based model of the local distribution network and performs local grid assessment and control of individual intelligent electronic device (IED) field controls

Capabilities

- Feeder Load profile metering at 15-min intervals
- Circuit outage and faulted section identification and isolation switching
- Distribution Sub & Feeders Integrated Voltage / VAR management
- Distribution Sub and Feeders Overload Management w/ Dynamic Voltage Control (DVC & CVR)
- Distributed Energy Resource (DER) Monitoring & Management
- Sub and Feeder Overload Management w/ DER
- Feeder Overload Management w/ Ambient & Duct Temperature
- Digital Fault Recording on Breaker Relays



Benefits

- Improved reliability by reducing sustained outages (frequency and duration)
- Reduced operational expenses
- Reduced maintenance expenses (through Predictive and proactive maintenance)
- Improved voltage management
- Accelerated event response capabilities

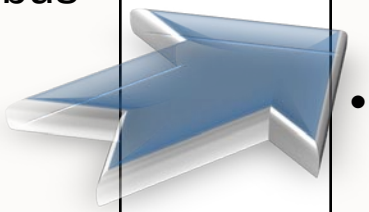
Technology: Integrated Distribution Management System (DMS) (includes: DSCADA, OMS, DNA) and Advanced Distribution Automation (ADA) components to control Substation DCADA and Intelligent Electronic Devices (IED); Integration to GIS, DERM, MDM

SmartSubstation

Primary Objective: Develop and demonstrate a fully automated and secure, next-generation distribution SmartSubstation with a local distributed control system based on IEC 61850 protocols

Capabilities

- Advanced Distribution Automation (ADA)
- Monitor and capture real-time transformer temperature & gas data
- Enablement of real-time equipment ratings
- Full substation automation with intelligent bus throw-over
- Peer-to-peer communication
- Fault recording
- Fault location
- Circuit Breaker Monitoring
- IP Network Communication



Benefits

- Improved real-time operating data on critical substation equipment
- Reduced O&M costs breaker and transformer maintenance
- Improved reliability by enabling distribution automation
- Business case validation

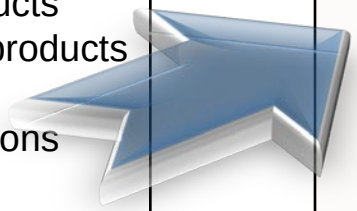
Technology: Intelligent electronic relays, Substation controllers, Communication Networks, Local DCADA and applications, DMS integration

Smart DR/DER Management

Primary Objective: Develop and demonstrate a next-generation, automated end-to-end DERM system that provides balancing of renewable and variable energy sources with controllable demand integrated in the utility grid, coordination with market systems, and provision of pricing signals

Capabilities

- Manage and control diverse types of Distributed Energy Resources (e.g. DVC, DG, bulk / mobile storage)
- Manage and control various DR programs, including dispatchable / direct load control programs
- Manage price-based and voluntary programs w/ market-based and dynamic tariffs
- Simulate power and transmission operation support products (e.g. mapping DR/DER capabilities to wholesale energy products and managing energy and ancillary services capabilities)
- Interoperability w/ DMS to monitor distribution grid conditions and manage distribution grid congestion
- Track and manage renewable portfolio standards (RPS) and greenhouse gas (GHG) reduction capabilities of distributed and demand-side resources



Benefits:

- Improved reliability through automated programmatic load shedding/shifting
- Creation of a Virtual Power Plant (VPP) for increased resource availability to DMS and trading operators

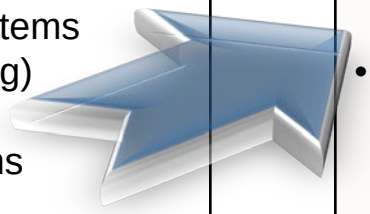
Technology: Intelligent Distributed Energy Resource Management (DERM) system and integration with DMS, HEMP, CIS, MDM, VEMS, BMS systems

SmartEnd-Use

Primary Objective: Develop and demonstrate how the next-generation SmartEnd-Use tools and programs available to our customers impact customer demand, energy consumption, and customer behavior

Capabilities

- Provide enhanced customer access to interval usage information, predictive billing, goal setting, energy savings tips, consumer generation and device management
- Enable 'real-time' monitoring of customer energy usage and alerts
- Ability to integrate and communicate with multiple systems allowing automated DR control (to include EV charging)
- Offer and manage price-based and TOU rate programs
- Provide 2-way communication and secure interactions between HAN devices, meter and the utility



Benefits

- Improved customer satisfaction through improved awareness and increased control over energy consumption
- Choice and flexibility in energy billing rates
- Improved understanding of customer behavior and usage patterns
- Reduce need for capacity expansion through improved load profile management

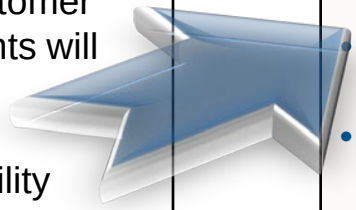
Technology: Home Energy Management Portal (HEMP), HAN, HANG, IHDs, Controllable Devises and integration with DERM, MDM, AMI, SmartMeter, CIS and Account Link

Outreach & Education

Primary Objective: Develop and execute Outreach and Education programs as part of the KCP&L SmartGrid Demonstration project to build awareness, educate and encourage participation among stakeholders on smart grid programs and its benefits

Community Engagement Goals & Objectives

- Educate and engage customers in the project area about how SmartGrid investments will ultimately impact and benefit them, and then influence behavior and encourage participation in energy use management
- Inform the remainder of KCP&L's customer base about how SmartGrid investments will ultimately impact and benefit them
- Share information with the broader utility industry on the progress and outcome of the project



High-Level Strategies

- Inform all SmartGrid Demonstration Area customers of project updates and milestones
- Provide training and encourage Demonstration Area customer participation of SmartGrid products
- Create SmartGrid product advocates
- Establish KCP&L as a thought leader and share information with the utility industry on the progress and outcomes of this project
- Utilize research to create greater understanding of customer demographics and behavioral drivers to inform engagement strategy